

No. 6.— *Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, in charge of ALEXANDER AGASSIZ, by the U. S. Fish Commission Steamer "Albatross," from October, 1904, to March, 1905, LIEUT. COMMANDER L. M. GARRETT, U. S. N., commanding.*

IX.

NEW SPECIES OF DINOFLAGELLATES. BY CHARLES
ATWOOD KOFOID.

THE pelagic collections of the Expedition made with the fine silk nets, especially those made at the depth of 300 fms. and brought to the surface in the open net, have contained a considerable number of species of Dinoflagellates which are as yet undescribed. Pending the publication of the final report with full illustrations, the following brief descriptions, accompanied by simple figures, are published of the new forms for which the plates are in preparation.

No attempt is made in these descriptions to discuss morphological or systematic problems, nor to indicate or discuss the distribution of the forms described. Nor is any list of the species found given herewith, since practically all known species of this group have occurred in the collections.

Noteworthy among the forms here described is the considerable number of new species of *Amphisolenia*, *Heterodinium*, *Ceratium*, and *Ocytoxum*. There is also included a new genus, *Acanthodinium*, which throws some light on the relationships of the problematical organism *Cladopyxis*, linking it with little doubt near to the Ceratiidae in the system. A unique new genus, *Centrodinium*, is represented by three species, and *Murrayella*, related to *Ocytoxum*, including four species, is also new. The plates of the obscure and puzzling genus *Protoceratium* are defined for the first time, and three species are added to the highly phosphorescent genus *Pyrocystis*. The discovery of a new representative of *Ptychodiscus*, a genus not reported since its description by Stein in 1883, is recorded.

In all three new genera, eighty-four new species, nine new "forms" are described. Unless otherwise stated they are all from collections

made by nets of No. 12 or 20 silk towed at depths of 300 fms., but open during both the descent and ascent. The types will be deposited in the United States National Museum, and co-types in the Museum of Comparative Zoölogy of Harvard College.

The species described are distributed as follows in the system: —

DINOFLAGELLIDIA.

ADINIDA.

Prorocentridae.

1. *Prorocentrum curvatum*.

DINIFERIDA.

Gymnodinina.

Pyrocystidae.

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| 2. <i>Pyrocystis acuta</i> . | 4. <i>Pyrocystis semicircularis</i> (Schröder.) |
| 3. <i>Pyrocystis fusiformis</i> forma
<i>biconica</i> . | 5. <i>Pyrocystis robusta</i> . |

Gymnodinidae.

6. *Pouchetia panamensis*.

Peridinina.

Ptychodiscidae.

7. *Ptychodiscus carinatus*.

Ceratiidae.

CERATIINAE.

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| 8. <i>Steiniella inflata</i> . | 21. <i>Ceratium schroeteri</i> Schröder. |
| 9. <i>Protoceratium areolatum</i> . | 22. <i>Ceratium scapiforme</i> . |
| 10. <i>Ceratium axiale</i> . | 23. <i>Ceratium tricarinatum</i> . |
| 11. <i>Ceratium bigelowi</i> . | 24. <i>Peridinium fatulipes</i> . |
| 12. <i>Ceratium claviger</i> . | 25. <i>Peridinium grande</i> . |
| 13. <i>Ceratium ehrenbergi</i> . | 26. <i>Peridinium latissimum</i> . |
| 14. <i>Ceratium pacificum</i> Schröder. | 27. <i>Peridinium longispinum</i> . |
| 15. <i>Ceratium dilatata</i> (Karsten). | 28. <i>Peridinium murrayi</i> . |
| 16. <i>Ceratium lanceolatum</i> . | 29. <i>Peridinium tenuissimum</i> . |
| 17. <i>Ceratium pennatum</i> . | 30. <i>Heterodinium agassizi</i> . |
| 18. <i>Ceratium pennatum</i> forma propria. | 31. <i>Heterodinium calvum</i> . |
| 19. <i>Ceratium pennatum</i> f. <i>inflata</i> . | 32. <i>Heterodinium curvatum</i> . |
| 20. <i>Ceratium pennatum</i> f. <i>falcata</i> . | 33. <i>Heterodinium expansum</i> . |

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| 34. <i>Heterodinium fenestratum</i> . | 41. <i>Heterodinium globosum</i> . |
| 35. <i>Heterodinium fides</i> . | 42. <i>Heterodinium hindmarchi</i> f. |
| 36. <i>Heterodinium gesticulatum</i> . | <i>maculata</i> . |
| 37. <i>Heterodinium gesticulatum</i> | 43. <i>Heterodinium laticinctum</i> . |
| <i>forma typica</i> . | 44. <i>Heterodinium longum</i> . |
| 38. <i>Heterodinium gesticulatum</i> f. | 45. <i>Heterodinium obesum</i> . |
| <i>extrema</i> . | 46. <i>Heterodinium praetextum</i> . |
| 39. <i>Heterodinium gesticulatum</i> f. | 47. <i>Heterodinium superbun</i> . |
| <i>mediocris</i> . | 48. <i>Centrodinium complanatum</i> (Cleve). |
| 40. <i>Heterodinium gesticulatum</i> f. | 49. <i>Centrodinium deflexum</i> . |
| <i>deformata</i> . | 50. <i>Centrodinium elongatum</i> . |

PODOLAMPINAE.

- 51.
- Podolampas reticulata*
- .

OXYTOXINAE.

- | | |
|---------------------------------------|---|
| 52. <i>Oxytoxum challengeroides</i> . | 58. <i>Oxytoxum turbo</i> . |
| 53. <i>Oxytoxum compressum</i> . | 59. <i>Murrayella globosa</i> . |
| 54. <i>Oxytoxum cristatum</i> . | 60. <i>Murrayella spinosa</i> . |
| 55. <i>Oxytoxum curvicaudatum</i> . | 61. <i>Murrayella punctata</i> (Cleve). |
| 56. <i>Oxytoxum gigas</i> . | 62. <i>Murrayella rotundata</i> . |
| 57. <i>Oxytoxum subulatum</i> . | |

Cladopyxidae.

- 63.
- Acanthodinium caryophyllum*
- . 64.
- Acanthodinium spinosum*
- .

Dinophysidae.

- | | |
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| 65. <i>Phalacroma lenticula</i> . | 82. <i>Amphisolenia quinquecauda</i> . |
| 66. <i>Phalacroma reticulata</i> . | 83. <i>Amphisolenia rectangulata</i> . |
| 67. <i>Phalacroma striata</i> . | 84. <i>Amphisolenia schroederi</i> . |
| 68. <i>Phalacroma ultima</i> . | 85. <i>Triposolenia longicornis</i> . |
| 69. <i>Dinophysis triacantha</i> . | 86. <i>Triposolenia fatula</i> . |
| 70. <i>Amphisolenia asymmetrica</i> . | 87. <i>Triposolenia ambulatrix</i> . |
| 71. <i>Amphisolenia bispinosa</i> . | 88. <i>Histioneis carinata</i> . |
| 72. <i>Amphisolenia brevicauda</i> . | 89. <i>Histioneis garretti</i> . |
| 73. <i>Amphisolenia clavipes</i> . | 90. <i>Histioneis josephinae</i> . |
| 74. <i>Amphisolenia curvata</i> . | 91. <i>Histioneis longicollis</i> . |
| 75. <i>Amphisolenia dolichocephalica</i> . | 92. <i>Histioneis navicula</i> . |
| 76. <i>Amphisolenia extensa</i> . | 93. <i>Histioneis paulseni</i> . |
| 77. <i>Amphisolenia laticincta</i> . | 94. <i>Histioneis pulchra</i> . |
| 78. <i>Amphisolenia lemmermanni</i> . | 95. <i>Histioneis reticulata</i> . |
| 79. <i>Amphisolenia palaeotheroides</i> . | 96. <i>Ornithocercus carolinae</i> . |
| 80. <i>Amphisolenia projecta</i> . | 97. <i>Ornithocercus heteroporus</i> . |
| 81. <i>Amphisolenia quadrispina</i> . | 98. <i>Ornithocercus serratus</i> . |

Amphilothidae.

- 99.
- Amphilothus quincuncialis*
- .

Prorocentrum curvatum, sp. nov.

Plate 1, Figs. 1, 2.

A small species with lanceolate curved body.

Body elongated, its length (dorso-ventral axis) 3 times the transdiameter and 5.5 times the antero-posterior one. Ventral end widest, truncate, bearing a short median flagellar collar which is anterior to the level of the suture. The body has nearly straight lateral margins for 0.5 of the length, then tapers to a blunt point. Seen from the side the body is curved posteriorly, the more distally, till the dorsal apex is almost at right angles to the ventral axis. The posterior valve is concave, and nearly flat, the anterior is convex both dorso-ventrally and transversely.

The thecal wall bears 6-7 longitudinal rows of close set pores on each valve.

Chromatophores small, irregular, dark yellow.

Length (dorso-ventral axis), 65 μ ; transdiameter, 22 μ .

Station, 4720.

Pyrocystis acuta, sp. nov.

Plate 1, Fig. 4.

A large species with slender, straight, or slightly concave, cylindrical body swollen at the centre and abruptly pointed at the tips. The length is 13-21 times the diameter of the swollen midregion. The shaft beyond the midbody is 0.35-0.6 of the greatest diameter. The taper to the acute point is confined within one transdiameter of the end. The ends and the midbody differentiate the species clearly from *P. lanceolata*.

Length, 675-1400 μ ; transdiameter, 45-95 μ .

Stations, 4728, 4732, 4740.

Pyrocystis fusiformis f. *biconica*, f. nov.

Plate 1, Fig. 3.

A small biconical form with broadly rounded apices and midregion. Apparently intermediate in form between *P. noctiluca* and *P. fusiformis* but not plainly intergrading with either. The length is 1.4-2.75 times the diameter. Differs from *P. fusiformis* in its relatively greater girth and in its straight rather than convex sides.

Length, 160-380 μ ; transdiameter, 60-215 μ .

Stations, 4728, 4732, 4740.

Pyrocystis semicircularis (SCHROEDER).¹

Plate 1, Fig. 6.

A medium-sized species with small ellipsoidal midbody and long slender cylindrical tapering incurved horns. Often yoked in pairs, as in *P. hamulus*.

¹ Schröder, B. Beiträge zur Kenntnis des Phytoplanktons warmer Meere. Viert. Nat. Ges. Zurich, 51, p. 319-377, 1906. Received while this paper was in press.

Outline of the complet and of long-horned single individuals nearly circular or elliptical. Midbody more convex on inner than on outer face of the arc, its length 1.7-2 times its transdiameter. The horns are tapering, sharp pointed, their distal ends sharply incurved, or with sigmoid flexure. Their length 4.5-10 transdiameters. The two horns are unequal in length, one being 1.1 times the length of the other. The long and the short horns are joined in the couplets.

Differs from *P. hamulus* in the larger size, less abrupt flexure of the arms, in the absence of the sharp double flexure at the midbody, and in the fact that the arms are more nearly equal in length.

Long axis of ellipse, of single or yoked individuals, 315-580 μ ; transdiameter of midbody, 40-62 μ .

Stations, 4691, 4728, 4740.

Pyrocystis robusta, sp. nov.

Plate 1, Fig. 5.

A small species of robust habit, deeply crescentic. Differs from *P. lunula* in its greater curvature, stouter body, and absence of central expansion.

Body fusiform but bent into a deep crescent whose tips nearly meet or even overlap. The convex margin is circular in outline, and the gap between the tips is less than 0.25 of the circumference. The diameter of the spherical or oval area enclosed by the crescent is 0.5, rarely 0.3-0.4, of the diameter of the larger circle. Greatest width at the middle of the body, tapering gradually to the tips. Width, 0.14-0.22 of the axial length.

Diameter of outer circle, 77-215 μ ; width of body at middle, 26-90 μ .

Stations, 4728, 4740.

Pouchetia panamensis, sp. nov.

Plate 1, Fig. 7.

A minute species with symmetrical ellipsoidal body and minute lens and melanosome.

Body elongated, ellipsoidal, its length 1.5 times its transdiameter. Epicone about equal to hypocone. Apex broadly rounded, antapex also rounded, flattened ventrally. Girdle very oblique, transverse furrow very wide, 0.2 of a transdiameter in width, deeply impressed, forming a descending right spiral, displaced 6.5 times its width, and with an overhang of 0.25 of the circumference. Longitudinal furrow, 0.25 of the width of the transverse furrow extending from near the apex to the antapex, where it widens and spreads in two lateral bifurcations, twisted 0.30 of the circumference around the body. Transverse flagellum arises at anterior junction and longitudinal at posterior junction of furrows. Ellipsoidal nucleus in hypocone, stout crescentic melanosome with minute spheroidal lens.

Length, 34 μ ; transdiameter, 21 μ .

Anchorage at Panama.

Ptychodiscus carinatus, sp. nov.

Plate 1, Figs. 8, 9.

A small disk-shaped species with concave anterior and posterior faces, wide furrow and ventro-posterior keel with the longitudinal furrow on its edge.

Body low, flat, disk-shaped, its length, including the keel, 0.33 of the transdiameter, which equals the dorso-ventral diameter. Excluding the keel the length is less than 0.25 of the diameter. The epitheca is a circular disk, notched ventrally, with concave anterior face, and broadly rounded edges which pass over into the large transverse furrow.

The hypotheca is also circular, disk-shaped, with somewhat concave posterior face. It is smaller than the epitheca, its diameter being about 0.9 of that of the epitheca. The hypotheca bears a thin ventral keel passing in a radial position from the centre of the posterior face to the flagellar pore. Its height is greatest about one third of the length from the centre, and is about 0.16 of the diameter. It bears the linear longitudinal furrow on its ventro-posterior edge.

The girdle is very wide with rounded edges, is deeper laterally than dorsally, is wider proximally than distally, so that a slight descending right spiral with little displacement is present. The longitudinal furrow lies in the ventral depression of the keel, is elliptical in outline on the epitheca, where it extends 0.6 of the distance to the centre.

Surface without sutures, pores, or reticulations. Figure sketched from life. Material in formalin is somewhat less depressed.

Length, 28 μ ; transdiameter, 90 μ .

Station, 4722.

Steiniella inflata, sp. nov.

Plate 2, Fig. 15.

A large hyaline species with robust body and with anterior end of longitudinal furrow bifurcated, very narrow girdle, and broad intercalary bands along sutures.

The body irregular and asymmetrical, its length 1.1 times the dorso-ventral and 1.2 times the transdiameter, its epitheca conical, deflected to the left, and rotund ventrally, the right side more rotund than the left. Its altitude 0.6 of the transdiameter. Apical pore in right margin of longitudinal furrow which passes beyond the apex.

Hypotheca larger than epitheca, its total altitude 0.7 of the total length and 0.8 of the transdiameter. Antapex asymmetrical, broadly rounded, longer upon the left side, with broad ventral excavation.

Girdle narrow, ribbed, slightly impressed, with prominent margins, forming a descending right spiral with displacement five times its own width. Both proximal and distal ends curved posteriorly, the latter more than the former. Longitudinal furrow passing nearly one fourth of the distance beyond the apex

toward the girdle, bifurcated near the apical pore, passing posteriorly 0.6 of the distance to the antapex.

Sutures marked by broad structureless intercalary bands. Epitheca with 5 precingulars, and 1 apical which is deeply cleft by the longitudinal furrow but appears to lack the dorsal median suture necessary to complete the division into two plates. A minute accessory plate in the precingular series at the left of the longitudinal furrow. Hypotheca with 5 posteingulars, 1 antapical, and an accessory near the longitudinal furrow. The right ventral precingular and left ventral posteingular are small plates.

Plates reticulate with characteristic reticulations similar to those of *S. fragilis*, with quite regular arrangement in places. Scattered nodal pores in the mesh and eccentric pores in each reticulation.

Length, 165 μ ; transdiameter, 115 μ .

Station, 4728.

PROTOCERATIUM (Bergh) KOFROID.

The thecal plates of this genus have not hitherto been determined, as the known species have lacked suture ridges and the density of the contents has interfered with the determination of the thecal structure. The following species has the plates clearly defined, and the definition of the genus may be accordingly emended.

Thecal wall definitely divided into plates, epitheca with one hexagonal apical plate and no apical pore, six nearly equal precingulars, the midventral one adjacent to, or containing the anterior end of the longitudinal furrow; hypotheca with six nearly equal posteingulars, the midventral one smaller and forming the posterior part of the longitudinal furrow plate, and one large antapical.

Protoceratium areolatum, sp. nov.

Plate 12, Fig. 71.

A minute species of ellipsoidal form. Thecal wall coarsely areolate, sutures marked by heavy ribs.

Body almost a perfect ellipsoid, the length 1.25 times the diameter *in* the furrow, and nearly equalling the diameter *on* the lists of the girdle. Epitheca less than the hypotheca by the width of the girdle, a low dome, abruptly flaring into the wide list, its altitude 0.33 of the diameter on the lists. Midventral plate slightly flattened, left side slightly wider than the right.

Hypotheca hemispherical, midventral plate somewhat excavated.

The girdle is wide, with wide, membranous, ribbed lists, furrow scarcely impressed, forming a descending right spiral with displacement equalling its width. Flagellar pore at proximal end of posterior list. Longitudinal furrow confined to girdle and hypotheca, running back to antapical plate on the ventral posteingular.

Plates normal, suture lines marked by ridges somewhat heavier than those

about the areoles. Suture lines with fins. Spines at the angles. Wall areolate with very large subequal polygons, 13-15 on the circumference at the girdle, 4-6 in each of the pre- and postcingular plates. No pores.

Length, 29 μ ; diameter, 22 μ .

Station, 4699.

Ceratium axiale, sp. nov.

Plate 4, Fig. 26.

A medium-sized species of the *C. tripos* group, with apical horn bent to the right, narrowly rounded shoulders and antapicals flexed close to the midbody and subparallel to the apical distally.

The midbody is rotund. The postmargin is a slightly asymmetrical arc whose radius equals the transdiameter. The antapicals are thus bent anteriorly very close to the midbody. The right horn is nearer to the midbody than the left, and bends laterally with more or less concavity on the outer face. It is longer than the left antapical, which is convex laterally and more removed from both the midbody and the apical horn. The distance between the antapicals distally is usually less than a transdiameter, while at the level of the girdle it is 1.25-1.75 transdiameters. The right antapical is sometimes bent beyond the apical, crossing it dorsally.

Length, 175-285 μ ; transdiameter, 45-60 μ ; left antapical, 110-160 μ ; right antapical, 115-200 μ .

Stations, 4638-4732.

Ceratium bigelowi, sp. nov.

Plate 3, Fig. 22.

An elongated species of the *C. furca* group, with inflated midbody, whose greatest transdiameter is over twice that at the girdle, long curved apical, and left antapical whose end is curved dorsally and to the left. Apical horn slightly curved to the left. The height of the midbody above the girdle to the base of the apical horn is about four transdiameters at the girdle. Antapex of left horn spinnulate. Ventral plate small, oblique, ellipsoidal. Right antapical very short, its end scarcely a transdiameter from the girdle. The hypotheca is relatively small, and the inflated part of the epitheca is in the region of the base of the apical plates.

Length, 900-1030 μ ; transdiameter at girdle, 40 μ ; greatest transdiameter of epitheca, 80-100 μ .

Stations, 4728-4730.

Ceratium claviger, sp. nov.

Plate 4, Fig. 27.

A small species related to *C. ranipes* with rounded shoulders and club-shaped, rarely bifurcated ends of the antapicals which are subparallel to the apical.

Apical horn straight, midbody as in *C. ranipes*. Postindentation slight, if

any, shoulders broadly rounded, the major curvature within about one transdiameter from the sides of the midbody at the level of the girdle. Antapicals often flexed outwardly distally. Their antapices swollen to 0.2-0.5 transdiameters in width or partially bifurcate in two subequal lobes, crowded with chromatophores and amyloid bodies. Thecal surface rugose, shoulders spinulate, a hyaline fin usually present on the postmargin.

Length, 210-350 μ ; distance between arms at girdle, 80-120 μ ; transdiameter of midbody, 35-40 μ ; length of antapicals, 115-260 μ .

Stations, 4594-4713.

Ceratium ehrenbergi, sp. nov.

Plate 2, Fig. 16.

A small species of the *C. lineatum* group with rotund midbody and short horns. Midbody with convex margins and very convex dorsal face, excavated ventrally. Girdle somewhat anteriorly placed, with prominent lists. Apical horn short. Antapicals short, pointed, slightly divergent. Surface with linear striae.

Length, 90-110 μ ; transdiameter, 50 μ .

Stations, 4711, 4719.

Ceratium pacificum, SCHROEDER.

Plate 3, Fig. 21.

A very elongated linear species of the *C. furca* group without expansion of a midbody. Total length, 20-30 transdiameters at the girdle. Epitheca with straight margins tapering evenly from girdle to apical pore. Hypotheca long, nearly two transdiameters in axial altitude. Left horn linear, in length from girdle to apex about 0.3 of the total length. Right horn parallel to left, straight, tapering, scarcely four transdiameters from girdle to its antapex. Postmargin narrow, girdle narrow and with feeble lists, ventral plate elongated, narrow. Chromatophores irregular, dark yellowish brown in color. Varies greatly in length.

Length, 400-775 μ ; transdiameter, 27-30 μ .

In Humboldt Current.

Ceratium dilatata (KARSTEN).

Plate 4, Fig. 25.

A small species resembling *C. platycorne*, but of smaller size, more arcuate postmargin, and more uniformly expanded blade-like antapicals.

The midbody is about the same size as in *C. platycorne*, and passes abruptly into the apical horn, rarely tapering into it as it frequently does in that species. The distinguishing features of the species are the antapicals, which continue from the symmetrically arcuate postmargin to the level of the base of the apical or beyond it, in a regular curve, to a position parallel to the apical or even incurved as in my figure. The ends of the antapicals are not continued in the

parallel direction any considerable distance, and are not so much incurved as they frequently are in *C. platycorne*. The antapicals are flattened, of uniform width, or expanded very slightly towards the antapex. The tips are rounded, squarish, or truncate, rarely asymmetrically pointed.

Length, 95–135 μ ; greatest lateral extension, 65–90 μ .

Station, 4732.

Ceratium lanceolatum, sp. nov.

Plate 3, Fig. 17.

A small species related to *C. furca*, without differentiated apical horn.

The epitheca is not constricted to form an apical horn, but the midbody extends to the apical pore or nearly to it. The apical pore is oblique or strictly terminal. The sides of the epitheca are convex, or in some cases slightly concave distally on the left side, as in *C. scapiforme*.

The hypotheca is low, its axial altitude equalling or exceeding the transdiameter. Antapicals short, stout, and straight, the right about half the length of the left.

Length, 95–122 μ ; transdiameter, 19–22 μ .

Stations, 4717–4719.

Ceratium pennatum, sp. nov.

Plate 2, Figs. 12, 13, 14.

An elongated species of the *C. furca* group with elongated left antapical curved to the left and dorsally. Long apical, which is straight or curved evenly and but slightly to the left. Short right antapical usually present. An exceedingly variable species.

The midbody is quite variable in form, scarcely swollen in some cases, and merging gradually into the stout apical horn (*propria*, forma nov., Plate 2, Fig. 12) or more or less swollen, both hypotheca and epitheca being enlarged as they approach the girdle, and more or less sharply delimited from the horns in which they are continued (*inflata*, forma nov., Plate 2, Fig. 13). The species also varies in the curvature of the left antapical. This is gradual and distributed throughout most of the length in many individuals. In others it is limited to a short abrupt curve at the antapex (*falcata*, forma nov., Plate 2, Fig. 14). This form is, as a rule, about half the size of *f. propria*, and may prove to be a distinct species. The length of the right antapical is also subject to great variation, being usually fairly well developed, though rarely attaining to a length of 0.5 of a transdiameter.

The concave faces of the curved horns are often greatly thickened in both the apical and left antapical.

This species differs from *C. strictum* (Okamura and Nishikawa) in the curvature of its horns, and from *C. bigelovi*, sp. nov. in the fact that its greatest transdiameter is at the girdle or very close to it.

Length, 360–1225 μ ; transdiameter, 25–50 μ .

At many stations between 4574–4634.

Ceratium schroeteri, SCHROEDER.

Plate 3, Figs. 18, 19.

A small species resembling *C. digitatum*, but with less lateral expansion of the epitheca and less curvature of the antapicals than is found in that species.

Elongated, transdiameter at girdle 0.15 of the total length. Epitheca broad, tapering a short distance from the apex to a short, scarcely delimited apical horn, slightly scoop-shaped and twisted to the left. Antapical horns unequal, the end of the right 1.5 and of the left 2.4 transdiameters from the girdle at the lateral margin. The right horn is straight and tapering; the left is strongly curved dorsally and to the left, and the wall of its concave face is strongly thickened. Thecal wall, of the left antapical especially, scabrous with small spinules at the pores. Chromatophores numerous, irregular.

Length, 335 μ ; transdiameter at girdle, 50 μ .

Station, 4594.

Ceratium scapiforme, sp. nov.

Plate 3, Fig. 23.

A species of from small to medium size, of the *C. furca* group showing affinities to both *C. pennatum* and *C. schroeteri*. With long tapering blade-like epitheca not inflated beyond the transdiameter at the girdle, a short oblique scarcely differentiated apical horn, elongated left antapical, and submedian girdle.

The epitheca is 10-11 transdiameters in altitude and its wall is thickened in the region of curvature on the concave face. The apical pore is oblique, opening antero-dextrally. The hypotheca is short in altitude, scarcely more than a transdiameter to the middle of the postobliquity. The right antapical is short and straight, its antapex being about a transdiameter from the girdle. The left antapical is curved dorsally and to the left throughout its length, the curvature near its base being somewhat greater than it is distally. The concave faces of both apical and left antapical horns have thickened walls.

Length, 460-530 μ ; transdiameter, 25 μ .

Stations, 4719, 4740.

Ceratium tricarinatum, sp. nov.

Plate 3, Fig. 20.

A medium-sized species of the *C. furca* group with affinities to *C. bigelowi*, *C. digitatum*, and possibly *C. geniculatum*. Distinguished by the inflation of the epitheca into a tricarinate expansion which in its greatest transdiameter equals or exceeds that at the girdle.

One of the carinae is middorsal, and the other two latero-ventral, with sutures of the apical plates at two of the angles. The third suture is mid-ventral. The three faces of the midbody are concave, especially anteriorly. The expansion tapers more or less abruptly into the apical horn and bends somewhat to the left as it passes into the horn, which is straight but directed a little ventrally from the axis.

The hypotheca is very short, scarcely a transdiameter in axial length. The left antapical is long, nearly equalling the altitude of the epitheca in length. It is curved more or less evenly to the left and dorsally. The right antapical is short, straight, a little more than a transdiameter in length, subparallel to the left horn or divergent.

Length, 270–350 μ ; transdiameter at girdle, 35–40 μ .

Stations, 4709–4736.

Peridinium fatulipes, sp. nov.

Plate 5, Fig. 30.

A medium-sized species of the *P. divergens* group characterized by its widely divergent, heavily reticulate antapicals with wide postmarginal. It differs from *P. elegans* in its more divergent, widely set antapicals, and from *P. grande* in these same particulars, and also in its smaller size and in the peculiar distribution of its minute pores.

The body is elongated, its length 1.6 times the transdiameter and 2.5 times the dorso-ventral. Epitheca equals the hypotheca, both ventrally excavated. The epitheca resembles that of *P. grande* in proportion, having deeply concave lateral faces and long attenuate apical horn.

The hypotheca is contracted to 0.5 of the transdiameter, above the level of the base of the antapicals, which are slender, tapering, and widely divergent, their length 0.4 of a transdiameter, and the distance between their tips 0.8–0.9 of a transdiameter. The postindentation is 0.3 of a transdiameter in depth, forming a broad arc, notched by the longitudinal furrow, as seen ventrally.

The girdle is narrow, slightly impressed, with low membranous ribbed lists, with little displacement or forming a slight ascending right spiral. Longitudinal furrow with high lists not projecting posteriorly beyond the postmarginal.

Plates normal, three in middorsal series. Sutures with very broad bands of intercalary striae. Plates centrally reticulate with minute subequal irregular polygons, with minute pores irregularly distributed, not centrally located in the polygons, and not in the mesh itself.

Length, 147 μ ; transdiameter, 100 μ .

Station, 4732.

Peridinium grande, sp. nov.

Plate 5, Fig. 28.

A very large species of the *P. divergens* group with wide flaring girdle and long horns.

Body elongated, length 1.2–1.4 times the transdiameter and 2–2.3 times the dorso-ventral. Epitheca equals the hypotheca, girdle section very broadly reniform. Epitheca a very low cone with very flaring base, and dorsally set tapering apical horn, its altitude 0.6 of its transdiameter. Sides deeply concave.

Hypotheca less abruptly contracted than the epitheca, its transdiameter at base of the horns 0.33–0.4 of that at the girdle. Its altitude is 0.66–0.75 of

its transdiameter. The antapicals are slightly unequal, divergent, conical, acute, their length 0.35–0.45 of the transdiameter. The distance between the antapices is 0.38–0.45 of the transdiameter and is 1.3–1.5 times the depth of the postindentation which is subacute with nearly straight sides.

The antapicals diverge less than in *P. fatulipes*.

The girdle is narrow, median, nearly horizontal, furrow ribbed, scarcely impressed, not displaced, with low membranous ribbed lists. Longitudinal furrow with high membranous lists projecting posteriorly beyond the postmargin.

Plates normal, 3 in median dorsal series. Thecal wall faintly and minutely reticulate with small subequal polygons with very minute centrally located pores.

Length, 185–245 μ ; transdiameter, 150–195 μ .

Stations, 4732, 4740.

Peridinium latissimum, sp. nov.

Plate 5, Figs. 31, 32.

A small species with foreshortened, dorso-ventrally flattened body and widely separated very short or obsolete antapicals.

Body pentagonal in face view, anterior margins straight, postero-laterals convex, posterior concave. Its length, 0.8 of the transdiameter and 2.6 times the dorso-ventral. Epitheca, exceeding hypotheca, a low flattened cone, concave ventrally, convex dorsally, its altitude 0.4 of its transdiameter.

Hypotheca low, its altitude 0.45 of its transdiameter, equalling the distance between the low acute antapicals which in some individuals are almost obsolete.

Girdle narrow, almost horizontal, slightly postmedian, furrow deeply impressed, scarcely displaced.

Sutures marked by narrow bands, plates normal, 3 on dorsal side of epitheca. Surface minutely reticulate.

Length, 112 μ ; transdiameter, 89 μ ; dorso-ventral, 35 μ .

Stations, 4671, 4709.

Peridinium longispinum, sp. nov.

Plate 5, Fig. 33.

Syn. *P. michaelis* Ehrbg. in part, Stein ('83), Taf. IX, Figs. 9 and 11.

A small species of the *P. pellucidum* group with two intercalary middorsal plates, attenuate apical horn, and two long slender finned antapical spines.

Body elongated, flattened dorso-ventrally, its total length including spines 1.2–1.5 times the transdiameter. Epitheca exceeds the hypotheca, is compressed conical with concave lateral faces, and attenuate apical 0.15–0.4 of a transdiameter in length. The altitude is 0.6–0.8 of the transdiameter.

The hypotheca is low, subtruncate posteriorly, with slightly concave post-

margin. It is excavated ventrally, and its left lateral face is nearly straight while its right one is concave. Its altitude, excluding spines, is 1.2-1.35 transdiameters. Antapical horns are not developed, but from the postangles arise two subequal, solid, acicular, finned spines which are slightly divergent. Their length is 0.2-0.45 of a transdiameter.

The girdle is postmedian; the transverse furrow is not indented, and forms an ascending right spiral displaced distally less than its width. It has hyaline ribbed lists. The longitudinal furrow reaches the postmargin, is expanded distally, but its low lists do not as a rule project beyond the postmargin.

Sutures with striate intercalary bands, surface of plates sparingly porulate.

Length, 60-105 μ ; transdiameter, 50-85 μ .

Stations, 4613, 4711.

Peridinium murrayi, sp. nov.

Plate 5, Fig. 29.

Syn. *P. divergens*, Ehrbg. in Murray and Whitting ('99), Pl. 29, Fig. 4.

A large species resembling *P. oceanicum*, but differing from it in the much lower epitheca with more concave sides, longer apical horn, and longer and more divergent antapical horns.

Body compressed dorso-ventrally, dorso-ventral diameter 0.65 of the transdiameter, and about equal to the length of the apical, or either of the antapicals. Distance between the tips of the antapicals equals or exceeds the transdiameter.

Girdle nearly median, furrow not impressed, with high membranous ribbed lists, forming a descending right spiral displaced twice its width. Longitudinal furrow with high lists which project beyond the postmargin.

Chromatophores radiating, linear.

Length, 250 μ ; transdiameter, 135 μ .

Station, 4736.

Peridinium tenuissimum, sp. nov.

Plate 5, Fig. 34.

A minute hyaline species related to *P. pedunculatum*, but distinguished by its smaller size, more elongated body, and longer apical horn and antapical spines.

The length of the midbody excluding horn and spines exceeds the transdiameter. The midbody is broadly ovoid, passes abruptly into the cylindrical apical horn, whose length is but little less than a transdiameter. It flares slightly at the apical pore. The acicular divergent antapicals are nearly a transdiameter in length. The girdle is median on the midbody and is not displaced. The lists of the longitudinal furrow extend beyond the postmargin. The whole organism is exceedingly hyaline, plates and sutures not determinable.

Length, excluding antapical spines, 45-50 μ ; transdiameter, 25-28 μ .

Station, 4711.

Heterodinium agassizi, sp. nov.

Plate 6, Fig. 35.

A small species with very broadly rounded apex, scoop-shaped epitheca, and subequal antapicals. The bifurcation is deep and evenly rounded. The reticulations are of medium size and fairly regular.

The epitheca is broad, its apex almost a semicircle, with a slight constriction some distance in front of the girdle but not so deep as in *H. fides*. Ventral surface concave. Altitude of epitheca on ventral face 1.16 times the transdiameter at the girdle, on the dorsal 0.82 times. Ventral area elongated, pit at its anterior end.

Hypotheca about equal to the epitheca. Its lateral margins nearly straight, convergent, distance between the tips of the antapicals a little less than 0.5 of a transdiameter. Postindentation deep, axial depth about 0.5 of a transdiameter, evenly rounded. Antapicals subequal, acute, scarcely spreading. Ventral face deeply impressed about the longitudinal furrow. Girdle narrow, oblique, displaced its own width, coarsely reticulate; not deeply impressed, ridges low.

Thecal wall reticulate with polygons of medium size, which are subregular along the margins. Reticulations porulate. Marginal sutures very heavy. Below the girdle on the dorsal side there are 34 contiguous reticulations and about 130 in the dorsal apical plate. Plates normal, obscure on ventral face of hypotheca.

Chromatophores bright cadmium yellow.

Length, 155 μ ; transdiameter, 78 μ .

Station, 4699.

Heterodinium calvum, sp. nov.

Plate 7, Fig. 43.

A large spheroidal species with wide girdle and smooth wall.

Body spheroidal, flattened a little on the ventral face. Epitheca hemispheroidal, with rounded apex, flaring a little at the girdle. The ventral pit is median, in a quadrangular ventral area. The hypotheca is also hemispheroidal, with flattened antapex, with angular outline. It is excavated ventrally. The girdle is median, is very wide, especially in the distal half. The transverse furrow is impressed and the anterior ridge has considerable overhang. It forms a descending right spiral displaced its own width. The longitudinal furrow is slender, narrow, and extends but little beyond the posterior list of the distal end of the girdle.

The thecal wall is smooth, suture lines faintly marked, or with low ridges spinous in places, on the ventral face of the hypotheca. Porulate, but without other surface modification.

Length, 75 μ ; transdiameter, 75 μ .

Station, 4739.

Heterodinium curvatum, sp. nov.

Plate 8, Fig. 48.

A large species with tapering epitheca deflected to the right, salient girdle, widely separated spreading antapicals with slightly incurved tips.

Body elongated, length nearly twice the transdiameter at the girdle, and nearly three times the greatest dorso-ventral extension. Epitheca contracted regularly from the base to the apical pore. Right margin somewhat concave, the left nearly straight, a feebly developed apical horn inclined to the right. Altitude about equals the transdiameter. Ventral area squarish, pit nearly central.

Hypotheca shorter than epitheca on ventral face, equal to it on the dorsal. Its altitude less than a transdiameter. More abruptly contracted than the epitheca to the base of the antapicals, which diverge but have incurved tips. Distance between the tips 0.6 of a transdiameter. Postindentation moderate, axial depth 0.4 of a transdiameter, the postmargin a very broad curve. Antapicals subequal, elongated, tapering, acute.

Girdle oblique, displaced its own width, obsolete distally, its posterior list decurrent on the right antapical. Furrow deeply impressed, with salient ridges partially reticulate.

Thecal plates normal; sutures marked by smooth bands, or bands of minute polygons. Lateral sutures with high lists. Reticulations somewhat deficient on tips of apical and antapical horns and midcentral region of hypotheca. Reticulations relatively small, porulate, subequal, elongated and subregular along the lateral margins. About 150 reticulations on the dorsal apical plate and 34 contiguous to the girdle on the dorsal side.

Length, 235 μ ; transdiameter, 127 μ .

Station, 4699.

Heterodinium expansum, sp. nov.

Plate 6, Fig. 36.

A small species with short, stout, widely separated antapicals, nearly straight postmargin, and very oblique girdle.

The body is stout, its length being 1.3 transdiameters. It is strongly flattened dorso-ventrally, its greatest dorso-ventral extension being only 0.28 of a transdiameter. The girdle is very oblique, its antero-posterior extension being 0.3 of the total length. It is nearly median in position.

The epitheca is broadly rounded anteriorly in ventral view and passes abruptly into the short apical horn, which is deflected a little to the right and ventrally. Its altitude is 0.6 of a transdiameter and its ventral face flattened. The ventral area forms an elongated tract in the centre of the ventral face, and the ventral pit is located anteriorly in this area.

The hypotheca is convex laterally, excavated ventrally, with short, stout, acute, subequal antapical horns 0.18 of a transdiameter in length. The post-

margin is straight or nearly so, horizontal, and equals the axial altitude of the hypotheca in length.

The transverse furrow is not impressed, its posterior list is absent, and it forms a descending right spiral displaced distally its own width. The longitudinal furrow extends but half-way to the postmargin and is very narrow.

The left intercalary plate is large. Suture lines are marked by ridges. Thecal wall reticulate, with coarse, irregular, unequal polygons.

Length, 105 μ ; transdiameter, 80 μ .

Station, 4637.

Heterodinium fenestratum, sp. nov.

Plate 8, Fig. 47.

A small species of robust habit, rotund body, short incurved antapicals, very coarse reticulations, and deficient posterior list to the girdle.

The body is very robust, the length being 1.36 times the transdiameter and 1.6 times the dorso-ventral diameter. The epitheca is abruptly contracted from the spreading girdle to a tapering apical horn which terminates in a large oblique or squarely truncate apical pore. Its altitude is 0.70-0.75 of a transdiameter. Its margins are in all views deeply concave. The ventral excavation is not marked. The ventral area is squarish with central pit.

The hypotheca is a little smaller than the epitheca, its altitude being about 0.45 of the total length. It is contracted less abruptly than the epitheca, having a width of 0.55 of a transdiameter at the level of the postindentation. The sides of the antapicals are nearly parallel to the main axis. The antapicals are short, stout, acute. The postindentation is very shallow, being 0.2-0.26 of a transdiameter in depth. The postmargin is a broad, quite regular curve.

The girdle is wide, is displaced 1.5-2 times its own width, slightly impressed, if at all, and bears a regular series of large reticulations. Its anterior ridge is heavy and ribbed, and the posterior one is obsolete or scarcely developed.

The plates are normal. The left intercalary is very small, embracing but one or two reticulations. The marked characteristic of the species is the very coarse reticulations each of which has 1-10 pores. There are 17 reticulations on the dorsal apical plate and 8 contiguous to the posterior margin of the girdle on the dorsal side. Suture lines are marked by very wide bands.

Length, 95-105 μ ; transdiameter, 70-77 μ .

Stations, 4730, 4742.

Heterodinium fides, sp. nov.

Plate 7, Fig. 45.

A small species with constricted scoop-shaped epitheca, wide salient girdle, and short, divergent, subequal antapicals.

Body stout, its length 1.5 times the transdiameter and 2 times the greatest

dorso-ventral extension. Epithea scoop-shaped, excavated ventrally, flaring at the girdle. Its altitude 0.75 of a transdiameter. Apex with broadly sloping slightly convex margins, which turn abruptly posteriorly to a broad, deep constriction just below the level of the ventral area, below which it abruptly expands to the girdle, thus giving to the epithea a form which suggests the body of a violin. The ventral area is ellipsoidal, with the pit at its anterior end.

The hypotheca is somewhat shorter than the epithea, its ventral altitude being less than 0.75 of a transdiameter. It is constricted somewhat rapidly, reaching 0.5 of a transdiameter at the level of the base of the antapicals. The antapicals are short, stout, acute, and divergent, their tips being less than 0.5 of a transdiameter apart. The postindentation is less than 0.25 of a transdiameter in depth and is broadly rounded.

The girdle is but slightly oblique, is displaced its own width, and is obsolete distally, its posterior ridge being decurrent on the right antapical. The furrow is deeply impressal, has very prominent ridges and coarse reticulations.

The thecal plates are normal. The left intercalary plate of the epithea is unusually large. The reticulations are porulate, relatively large, and somewhat irregular.

Length, 123 μ ; transdiameter, 83 μ .

Station, 4228.

Heterodinium gesticulatum, sp. nov.

Plate 6, Figs. 37, 38, 39, 40.

A medium-sized species with rounded apex, right antapical deflected strongly to the right and the posterior angle of the postcingular plates on the left margin of the hypotheca strongly protuberant.

Body moderately elongated, the length 1.6 to 2.3 times the transdiameter (measured on the anterior ridge of the girdle). The epithea is shorter and distinctly wider than the hypotheca. Its apex is broadly rounded, almost semicircular in face view, but the ventral face is not deeply excavated or scoop-shaped. It is often wider anteriorly than it is at the girdle, and may have a slight constriction just anterior to the girdle. The ventral area is irregularly squarish with central pit.

The hypotheca is narrower than the epithea, its transdiameter at the girdle being 0.9 to 0.75 of that of the epithea. Its ventral surface is flattened, the dorsal one rotund. The posterior part of the hypotheca beyond the suture between the postcingular¹ and antapical plates is deflected to the right, in extreme cases as much as 40°. The right antapical is deflected more than the left, attaining even 45° to the main axis, while the left is only 5°-10° or subparallel to the axis. The right margin of the epithea is deeply concave, while the left is carried out in a more or less prominent, often decurved angle at the point just anterior to the suture between the left postcingular and the left ant-

¹ These plates were called postmedians in my earlier paper (:05), On *Heterodinium*, etc., Univ. of Calif. Pubs. Zoöl., 2, p. 345.

apical plates. This salient angle is the most striking feature of the species. The antapicals are short or more or less elongated, acute, and divergent. The postindentation is deep or shallow, being 0.2-0.8 of a transdiameter (of hypotheca) in depth. The postmargin forms a broadly rounded or subacute bay, with a hyaline irregularly toothed fin along most of the margin.

Girdle slightly oblique, displaced a little less than its width, obsolete distally. Anterior ridge very heavy, posterior one scarcely developed.

The plates are normal, the left intercalary being relatively large. The sutures are marked by prominent ridges, or by broad bands with or without fine reticulations. Thecal wall porulate, covered with reticulations of medium size. About 20 contiguous to the posterior side of the girdle on the dorsal side in the dorsal apical. Reticulation often lacking on some of the plates.

Chromatophores few, centrally located, spheroidal. Sometimes massed in chromospheres.

This is the most abundant species of the genus in tropical waters. It is exceedingly variable, but the diverse forms are so well connected by intermediates that they must be regarded as one species. The following forms may be recognized:—

Forma *typica* (Plate 6, Fig. 37). With little constriction of epitheca, moderate marginal projection of the left posteingulars and postindentation.

Forma *extrema* (Plate 6, Fig. 38). With constricted epitheca and relatively narrow hypotheca, excessive marginal projection and deep postindentation, and considerable obliquity of the hypotheca.

Forma *mediocris* (Plate 6, Fig. 39). With little deflection of hypotheca and antapicals, less inequality in transdiameters, slight marginal projection, and often with moderate subacute postindentation.

Forma *deformata* (Plate 6, Fig. 40). With right or left antapical undeveloped.

Length, 118 to 170 μ ; transdiameter of epitheca, 67 to 100 μ ; of hypotheca, 48 to 91 μ .

At various stations between 4594 and 4724.

This species (forma *extrema*) is figured in Capt. R. F. Scott's "Voyage of the Discovery," Vol. 2, on the plate facing p. 192 under the legend "Peridineans caught on the voyage out."

Heterodinium globosum, sp. nov.

Plate 8, Fig. 51.

A small species with rotund body, short apical horn, and small spine-like antapicals, deficient list, and sparse reticulations.

The body is spheroidal, the length (excluding apical and antapical horns) about equals the transverse and dorso-ventral diameter. The total length is 1.3 times the transdiameter and 1.5 times the dorso-ventral. The epitheca is dome-shaped, flaring at the girdle, and constricted apically to a short, stout horn

with oblique apical pore deflected to the right. The ventral area is poorly defined and the pit is located far anteriorly.

The hypotheca is low dome-shaped with two short, acute, unequal, widely separated divergent antapicals. The left is 2-3 times the length of the right, and the distance between their tips is 0.45 of a transdiameter. The postindentation is very shallow and the postmargin a broad, irregular curve.

The girdle is slightly oblique, is displaced less than its own width, lacks the posterior list entirely. The furrow is not impressed, and is marked by sparsely distributed reticulations.

The plates are normal. The left intercalary is of medium size. The wall is porulate in the central areas of the plates, which are imperfectly reticulate or bounded by ridges. The suture lines are bounded by broad, structureless bands.

Length, 117 μ ; transdiameter, 82 μ .

Stations, 4691, 4692, 4699.

Heterodinium hindmarchi, forma maculata, f. nov.

Plate 7, Fig. 42.

Distinguished from the typical *H. hindmarchi* by the character of the reticulations. The form, proportions, and dimensions resemble those of the species named, but the reticulations are entirely different. In the type they are coarse and subregular. In f. *maculata* they are exceedingly diverse in size. Distally on the apical and antapicals, the minute reticulations predominate. In the pre- and postcingular plates they are predominately marginal in the plates or intercalated in more or less complete horizontal series. They are also found in isolated and irregular groupings. Possibly such differences here constitute a specific distinction.

Length, 140 μ ; transdiameter, 80 μ .

Station, 4691.

Heterodinium laticinctum, sp. nov.

Plate 7, Fig. 46.

A moderately large species with very oblique, very wide girdle, broadly rounded apex, angular hypotheca, and incurved unequal antapicals.

The body is robust, ovate in ventral view, its length 1.4 times the transdiameter and 1.8 times the dorso-ventral. The apex is semicircular in outline.

The epitheca is low scoop-shaped with slight excavation, foreshortened dorsally so that the dorsal precingulars are scarcely as wide as the girdle. The apical pore is displaced to the right. The ventral area is displaced to the left, is subcircular with eccentric pit.

The hypotheca is a little longer than the epitheca. Its sides are slightly convex, and the antapicals are incurved and very acute. The left is twice the length of the right. They arise toward the ventral face and make a sharp offset dorsally to meet the postcingular suture.

The postindentation is shallow, about 0.25 transdiameter in depth, and the postmargin is squarish, with serrate fin.

The girdle is very oblique, displaced its own width, has low anterior and posterior lists, the latter decurrent on the left antapical. The furrow is slightly impressed and bears a few transverse ribs.

The plates are normal, the left intercalary being very small. The sutures are marked by ribs which locally bear hyaline serrated lists. Plates porulate. Reticulation lacking on specimen seen.

Length, 148 μ ; transdiameter, 105 μ .

Station, 4724.

Heterodinium longum, sp. nov.

Plate 7, Fig. 44.

A medium-sized species resembling *H. rigdenae* but more elongated, with deeper postindentation and higher epitheca. It also resembles *H. hindmarchi*, but can be distinguished from it by its wider epitheca with straighter sides and the absence of convergence in the antapicals.

The body is elongated, its length 1.5 times its transdiameter, compressed dorso-ventrally. The epitheca exceeds the hypotheca, its length being about 0.6 of the total length. It is compressed conical, with straight margins and apical but little deflected to the right. The ventral area is squarish and deflected to the left with eccentric pit.

The hypotheca is contracted more than the epitheca, is convex anteriorly and concave posteriorly at the margins. The antapicals are pointed, stout, divergent, and subequal, the left often larger. The postindentation is deep, exceeding 0.5 of the altitude of the hypotheca. The postmargin is broadly rounded, and the tips 0.5 of a transdiameter apart.

The girdle is slightly oblique, displaced its own width, with slight anterior ridge and deficient posterior list obsolete distally. The furrow is not impressed and is more or less ribbed.

The plates are normal, suture lines well defined. Plates porulate, with coarse regular reticulations.

Length, 93-125 μ ; transdiameter, 65-90 μ .

Stations, 4732, 4734, 4742.

Heterodinium obesum, sp. nov.

Plate 8, Fig. 50.

A minute species with spheroidal body, prominent apical horn, large hypotheca, and very unequal antapicals.

The body is robust; excluding all of the horns it is almost a sphere. The total length is 1.3 times the transverse or the dorso-ventral diameter. The epitheca is a low cone with slightly flaring base, nearly straight sides, and apex displaced ventrally. The total altitude is 0.6 of its transdiameter,

and the distance to the base of the horn 0.35 of the transdiameter. The apical pore is inclined a little to the right.

The ventral area is not strongly defined and the pit is not far removed from the girdle.

The hypotheca is very rotund, its greatest diameter being slightly below the girdle. Its total altitude is 0.8 of its transdiameter at the girdle, and its axial altitude 0.6. The left antapical is longer than the right and is formed by a blunt protuberant lobe whose width is half its height, bearing on its broadly rounded antapex a one or two-ribbed fin strongly deflected to the right. The right antapical is nothing but a finned spinule arising from the body, also deflected to the right.

The girdle is not oblique save in the distal third, where it is so deflected posteriorly that its displacement is twice its width. The anterior ridge is heavy, the posterior obsolete. The furrow is not impressed and is faintly ribbed.

The plates are normal, the left intercalary large, subtriangular. The suture lines are faint, marked by structureless bands. The plates are porulate with or without faint reticulations of relatively large size.

Length, 50 μ ; transdiameter, 37 μ .

Station, 4734.

Heterodinium praetextum, sp. nov.

Plate 7, Fig. 41.

A very large species of the subgenus *Euheterodinium* with slender, tapering, apical horn developed to a degree unusual in the genus.

The body is elongated, its length 1.3 times the transdiameter and 1.7 times the dorso-ventral. Epithea exceeds the hypotheca in ventral view, and equals it dorsally. Its altitude is 0.8 of its transdiameter at the base, its ventral face is excavated, its laterals convex in the median region and concave distally, and the dorsal nearly straight. The apical horn is deflected to the right, and its length is 0.25 of the altitude. The midventral suture is strongly deflected to the left basally, and the ventral area is elongated, oblique, with eccentric pit.

The hypotheca is broadly excavated ventrally, abruptly contracted dorsally, and with feeble double curves laterally. The postindentation is shallow, forming an asymmetrical arc, its depth 0.3 of the altitude of the hypotheca. The antapicals are short, stout, bluntish.

The girdle is slightly oblique and postmedian, forming a descending right spiral displaced distally its own width. The furrow is scarcely impressed, with deflected posterior list obsolete distally and decurrent on left antapex.

The longitudinal furrow is short with low lists.

The thecal plates are normal, and the walls reticulate with subequal, subregular polygons which become smaller distally on the horns. The suture lines are marked by broad bands with imperfectly developed areas of minute reticulations.

Length, 240 μ ; transdiameter, 180 μ .

Station, 4740.

Heterodinium superbum, sp. nov.

Plate 8, Fig. 49.

A very small species of robust habit, spheroidal body, and short spine-like antapicals. Reticulations rather coarse.

The body is elongated spheroidal, its length 1.28 times the transdiameter and 1.35 times the dorso-ventral diameter. The body is very rotund at the girdle. The epitheca and hypotheca are equal in length, but the latter is more rotund. The epitheca is subconical, its altitude is 0.56 of its transdiameter. It flares slightly at the girdle and its lateral margins have but little convexity. There is a partially developed apical horn, deflected to the right and set somewhat to the ventral side of the axis.

The hypotheca is very rotund, low dome-shaped, its altitude between the horns being a little less than 0.5 of its transdiameter. The antapicals are set to the ventral side in line with the apical, causing an abrupt shelf where the dorsal antapical plate joins the postcingulars. The right is 1.15 times the length of the left, which is 0.2 of a transdiameter in length. They are tapering, spine-like, with 0.3 of a transdiameter between tips. The postindentation is very shallow and the postmargin a broad curve.

The girdle is not oblique, is displaced its own width. The anterior list is very heavy, the posterior light and obsolete distally. The furrow is scarcely impressed and is heavily ribbed.

The plates are normal, the left intercalary triangular in form. The thecal wall is coarsely reticulate and porulate. There are about 30 reticulations in the dorsal apical and 15 contiguous to the girdle on the dorsal side. Suture lines with narrow ridges, minor reticulations or serrations.

Length, 74 μ ; transdiameter, 59 μ .

Station, 4699.

CENTRODINIUM, gen. nov.*Steiniella* (?) Cleve.

Ceratiinae with laterally compressed midbody contracted to an apical horn with pore and a single median antapical, median girdle on midbody, transverse furrow impressed, forming a descending right spiral. Longitudinal furrow mainly confined to hypotheca. Theca fully divided in discrete plates. Suture lines faint. Epitheca composed of apical and precingular series, 2 plates (possibly 4) in the former, and 6 in the latter. Girdle not distinctly divided into constituent plates. Hypotheca composed of 5 precingulars, 4 antapicals, and one dorsal intercalary. Thecal wall hyaline, structureless, porulate. Small ventral pore above the flagellar pore. Chromatophores present.

In warm temperate and tropical seas.

Centrodinium complanatum (CLEVE).*Steiniella* (?) *complanata*, Cleve.

Length 4-5 times dorso-ventral diameter. Midbody not abruptly set off from apical or antapical. Antapex not deflected to the left, bearing three short spinules. Apex and antapex coarsely porulate, the former not abruptly truncate.

Length, 300-400 μ ; dorso-ventral diameter, 75-80 μ .

Station, 4719.

Centrodinium deflexum, sp. nov.

Plate 9, Figs. 53, 54.

A medium-sized species with narrow apical, and antapical abruptly deflected to the left at an angle of 45°.

Body not greatly elongated, length 1.3 times the dorso-ventral diameter and 7 times the transdiameter. Epitheca and hypotheca nearly equal. Midbody laterally compressed, not flaring at the girdle laterally, dorsal and ventral margins both convex, epitheca abruptly contracted to the slender apical horn whose length is 0.5-0.12 of the transdiameter in length and broadly rounded at the end. This horn is directed obliquely dorsally in line with the trend of the ventral margin.

The hypotheca resembles the epitheca in proportions in lateral view, but the antapical horn is directed ventrally subparallel to the direction of the apical. In side view this is seen to be bent abruptly to the left as it leaves the midbody, at an angle of about 45°. The antapex bears 3 short spinules, 1 on the left and 2 on the right side.

Thecal wall hyaline, porulate, structureless, sutures faintly marked, apical and antapical regions coarsely porulate.

Length, 145-200 μ ; dorso-ventral diameter, 66-75 μ .

Stations, 4730, 4732.

Centrodinium elongatum, sp. nov.

Plate 9, Fig. 52.

A large species with truncate apex, epitheca shorter than hypotheca and long antapical horn.

Body elongated, length 3-4 times the dorso-ventral diameter and 7 times the transverse. Epitheca 0.3 of the total length, laterally compressed, flaring abruptly laterally to the girdle, ventral margin nearly straight, dorsal convex. Apical horn stout, short, abruptly truncate, its length equal to or exceeding its dorso-ventral width, and 0.35 of the dorso-ventral diameter in width.

Hypotheca greatly elongated, tapering within a transdiameter of the apex into the stout elongated antapical horn, its length 1.7-3 times its dorso-ventral diameter. Antapical horn cylindrical, curved to the left in a slight gradual curve, apparently twisted, terminating in three acute spinules.

Girdle narrow, median in the midbody, impressed, without salient ridges, forming a descending right spiral, displaced its own width. Longitudinal furrow extending a short distance on the epitheca where it contains an accessory ventral pore and is continued posteriorly on the midbody as a diminishing groove nearly to the base of the antapical.

Thecal wall hyaline, finely porulate, larger pores on apex and antapex. Dorsal wall of apical greatly thickened.

Length, 275 μ ; dorso-ventral diameter, 67 μ .

Station, 4722.

This is the type species of *Centrodinium*.

Podolampas reticulata, sp. nov.

Plate 2, Fig. 11.

A large species with the form of *P. biceps*, but with reticulate fins on the antapical spines. Their fins are very large and broadly rounded, with irregularly serrate margins and distal reticulations spreading from the spines. The fins are more decurrent laterally and less pointed than in *P. biceps*, and the spines 0.5–0.7 as long. The body is a trifle shorter and somewhat more round anteriorly and less squarish posteriorly.

Length of body, 80–92 μ ; transdiameter, 70–75 μ .

Stations, 4638, 4732.

Oxytoxum challengeroides, sp. nov.

Plate 10, Fig. 65.

A medium-sized species resembling *O. milneri*, but shorter, with fine regular polygonal reticulations resembling those of the *Challengeridae*.

Body elongated, its length 3.7 times the transdiameter, which equals the dorso-ventral at the girdle. Epitheca 0.4 of the length of the hypotheca, low conical, flaring at the base, its altitude 1.17 times the transdiameter, tapering quickly into the short straight apical horn, which is displaced ventrally and has an asymmetrically pointed apex, the terminal spinule being on the left margin of the horn.

Hypotheca conical, with slightly convex sides, tapering without constriction into the pointed antapical, which is also somewhat displaced ventrally.

Girdle wide, 0.33 of the length from the apex, furrow deeply impressed, with well-defined margins, forming a descending right spiral displaced nearly its own width. Small accessory pore in its posterior margin in the midventral line behind the large flagellar pore. Longitudinal furrow not extended upon the hypotheca, with a tapering lanceolate extension 0.6 of the distance to the apex on the epitheca.

Plates normal, 5 apicals, pre- and postcingulars, one apical spine. Sutures with narrow bands, thecal wall minutely and subregularly reticulate with small hexagonal polygons, porulate.

Length, 80 μ ; dorso-ventral diameter, 23 μ .

Station, 4732.

***Oxytoxum compressum*, sp. nov.**

Plate 10, Fig. 63.

A medium-sized species resembling *O. cristatum*, but lacking the galeate apex, and having the antapical horn strongly deflected to the ventral side.

Body elongated, laterally compressed. Total length 2 times the transdiameter and 1.6 times the dorso-ventral. Epitheca 0.25 the total length, low campanulate or dome-shaped, flaring at the girdle, apex blunt, broadly rounded. Altitude of epitheca 0.5 of the transdiameter and 0.35 of the dorso-ventral diameter.

Hypotheca elongated, its length 1-1.4 times the dorso-ventral and 1.5 the transdiameter. Dorsal and ventral margins somewhat convex, gradually rounded posteriorly to the hook-like ventrally recurved antapical spine. Lateral margin but slightly convex, abruptly contracted to the antapical.

Girdle narrow, horizontal, ribbed, furrow deeply impressed with salient ridges, forming a descending right spiral displaced its own width, without overhang. Longitudinal furrow short, its length 0.3-0.4 of the total length, equally extended on both sides of girdle, both ends expanded.

Pre- and postcingular plates normal, apicals and antapicals not resolved into separate parts. Postcingulars with marginal and median striae, which are faintly outlined on epitheca also. Wall porulate.

Length, 100 μ ; dorso-ventral diameter, 62 μ .

Stations, 4699, 4724.

***Oxytoxum cristatum*, sp. nov.**

Plate 10, Fig. 64.

A medium-sized species with elongated laterally compressed body, galeate epitheca, and long antapical spine.

Total length 2.5 times the transverse and 1.85 times the dorso-ventral diameter. Epitheca 0.4 of the total length, helmet-shaped, with flaring base abruptly compressed laterally to a thin dorsally recurved apex. Apex a sharp horizontal, or even posteriorly deflected spine. Transverse diameter of the base 0.75 of the dorso-ventral and 0.9 of the altitude.

Hypotheca tapering obliquely to the ventral side, laterally compressed, lateral margins slightly convex, dorsal broadly rounded, ventral concave, abruptly contracted to a long, tapering, ventrally deflected, antapical spine, 0.4-0.6 of the transdiameter in length.

Girdle narrow, with salient margins, furrow impressed, forming a descending right spiral displaced its own width, no overhang, and with numerous stout ribs. Longitudinal furrow short, length 0.3 of the total length, nearly 0.6 of its course on the epitheca, elongated elliptical in form.

Neither apical nor antapical region resolvable into separate plates. Pre- and

postcingular plates, each with marginal and median rib, sometimes porulate, sometimes with very fine transverse tessellations.

Length, 100 μ ; transdiameter, 38 μ ; dorso-ventral, 50 μ .

Stations, 4730, 4732.

Oxytoxum curvicaudatum, sp. nov.

Plate 10, Fig. 61.

A minute species of robust habit. Body ellipsoidal, transverse and dorso-ventral diameter equal. Length 1.2 times the transdiameter. Altitude of epitheca scarcely 0.5 of the total length and 0.4 of its transdiameter, in the form of a low dome with blunt apex and convex sides.

Hypotheca over 2.5 times as high as the epitheca, the diameter of its base 1.25 times its altitude. Anteriorly the sides are slightly, if at all, convex. Ant-apex very broadly rounded, terminating in an acute, minute, antapical spur which is deflected ventrally to a horizontal position.

Girdle about 0.3 of the total length from the apex. Transverse furrow compressed, without lists or salient ridges forming a descending right spiral with displacement twice its width, with slight overhang.

Longitudinal furrow broad and shallow, its length 0.35 of the total length of the body, wider and longer on epitheca than on hypotheca.

Pre- and postcingular plates marked with eleven longitudinal striae, fainter upon the epitheca. Interstrial areas finely reticulated.

Girdle ribbed and areolated.

Length, 41 μ ; diameter, 30 μ .

Station, 4711.

Oxytoxum gigas, sp. nov.

Plate 10, Fig. 59.

A very large species of slender habit, attenuate epitheca and hypotheca, galeate apex, and regularly tapering antapex, greatly displaced girdle, and minute pores in longitudinal striae.

The body is nearly biconical, the epitheca about 0.4 of the total length. Total length 4 times the dorso-ventral and 4.8 times the transdiameter. Epitheca subconical with concave sides, very little flare at the base, slight lateral compression, and somewhat elongated slightly galeate apex, broadly rounded and deflected dorsally. Its total altitude 2.2 times its transdiameter at the base.

Hypotheca a regularly tapering cone, slightly compressed laterally. Its total altitude 3.5 times its transdiameter at the base. Antapex not differentiated in form from the postcingular section, forming 0.22 of the total length of the hypotheca.

Girdle very narrow and very oblique; furrow deep, with prominent but not salient margins, forming a descending right spiral displaced 7 times its own width, with numerous faint ribs and a few pores. Longitudinal furrow narrow,

of uniform width, its length 0.15 of the total length of the body. It extends from the proximal end of the transverse furrow posteriorly to a girdle width beyond its distal end. The flagellar pore lies near the proximal end.

Pre- and postcingular plates normal, sutures indistinct in apex and antapex, but each composed of several plates.

Thecal wall marked by equidistant striae containing regularly spaced pores. The striae along sutures somewhat heavier than the 2-3 intermediate ones on each plate. Striae are interrupted at the transverse sutures between the cingular and the terminal plates.

Length, 267 μ ; transdiameter, 55 μ .

Station, 4732.

Probably *Steiniella mitra* Schütt¹ belongs in *Oxytoxum*.

Oxytoxum subulatum, sp. nov.

Plate 10, Fig. 62.

A large species of slender habit, elongated form, with abruptly contracted epitheca and long subulate apex.

The body is greatly elongated, its length 5-6 times the transdiameter and 4.5-5 times the dorso-ventral. There is little lateral compression. The epitheca is 0.9 of the length of the hypotheca. The epitheca is trumpet shaped with low abruptly contracted basal part and slender linear apical horn with sharp asymmetrical apex shaped like the point of a cannula with the excavation upon the right side, the relative length of the three parts, flaring base, horn and point, are respectively 0.18, 0.58, and 0.24 of the altitude of the epitheca, which is 2.3 times its transdiameter. The horn is set somewhat to the ventral side of the epitheca.

The hypotheca is almost conical, slightly gibbous just below the girdle, more on the ventral than on the dorsal side, contracted as it passes into the slender attenuate antapex. Its altitude is 2.8-3.2 times its transdiameter at the girdle. The antapical horn is slender, straight, its length a little less than 0.5 transdiameters.

The girdle is nearly horizontal, the furrow very deeply impressed with thin, slightly salient ridges, forming a descending right spiral displaced 0.5 of its width.

Apical region formed of 4 slender plates, antapical fused. Thecal wall with 10-12 longitudinal striae. Surface with minute areoles.

Length, 124-142 μ ; transdiameter, 21-27 μ .

Stations, 4698, 4699.

Oxytoxum turbo, sp. nov.

Plate 10, Fig. 60.

A minute elongated top-shaped species with capitate epitheca.

Body elongated, its length 2.3 times the greatest transverse diameter, which

¹ Schütt, F. Die Peridineen der Plankton Expedition. Taf. 7, Fig. 27, 1895.

equals the dorso-ventral. The greatest diameter is a short distance posterior to the girdle. The epitheca is a small hemisphere with a short, stout, apical horn with blunt apex. The apical horn emerges very abruptly from the dome of the epitheca. The altitude of the epitheca above the girdle is 0.5 of its transdiameter, which in turn is 0.5 of the greatest transdiameter of the hypotheca, and about 0.16 of the total length.

The hypotheca is top-shaped, abruptly rounded to the girdle, tapering regularly posteriorly to an acute point.

The girdle is peculiar, very wide, its width 0.12 of the total length, and slightly exceeding the altitude of the epitheca. It is constricted to an acute-angled furrow at its middle, and extends anteriorly on the capitate epitheca and posteriorly upon the expanding hypotheca. Its margins are marked by faint lines with a prominent line of pores, especially in the hypotheca, where a low hyaline list also occurs. The list on the hypotheca is very low.

Plates normal, scarcely defined on epitheca, apical horn not separable, antapical also apparently fused. The surface faintly marked with punctate longitudinal striae.

Length, 50 μ ; transdiameter, 22 μ .

Station, 4734.

MURRAYELLA, gen. nov.

Oxytoxinae with spheroidal body and medium girdle, epitheca and hypotheca nearly equal. Transverse furrow impressed, forming a descending right spiral with more or less displacement. Longitudinal furrow on both epitheca and hypotheca but not reaching the apex or antapex. Theca composed of discrete plates. Epitheca with 6 precingulars and 2-4 apicals and a small mid-ventral intercalary next to the longitudinal furrow. No apical pore. Hypotheca composed of 5 postcingulars one of which is the longitudinal furrow plate, and an antapical apparently of one spine-like plate. Plates ribbed and reticulate. Chromatophores yellowish.

Ceratium biconicum Murr. et Whitt. and *Steiniella* (?) *punctata* Cleve belong in this genus.

Murrayella globosa, sp. nov.

Plate 9, Fig. 56.

A small globose species with epitheca equalling the hypotheca. Epitheca conical, its altitude 0.6 of a transdiameter. Apex rounded or with small acute point. Hypotheca hemispherical with short acute terminal spine deflected to the right. Left side somewhat more convex than the right. Girdle median, displaced distally its own width. Furrow deeply impressed, without lists or salient ridge, sparingly ribbed. Longitudinal furrow greatly widened on the epitheca, reaching 0.4 of the diameter to the apex and its width nearly equaling its height. Posteriorly the longitudinal furrow is narrow and not so expanded at the end as on the epitheca.

The sutures are marked by ridges with cross striae or by broad intercalary bands. The longitudinal furrow plate of the hypotheca is long and narrow. The postcingulars have a median rib. The surface of the plates is minutely and regularly reticulate. No pores.

Chromatophores small, spheroidal. Large central yellowish chromosome.

Length, 68 μ ; transdiameter, 59 μ .

Station, 4732.

This is the type of *Murrayella*.

Murrayella spinosa, sp. nov.

Plate 9, Fig. 57.

A small species of biconical form with antapical spine resembling *Amphidoma*.

Body biconical, epitheca longer than hypotheca, total length 1.4 times the transdiameter. Epitheca conical, its altitude 0.5 of its transdiameter, sides slightly convex. Antapex with short spine with a transverse fin.

Girdle postmedian, 0.55 of the length from the apex, impressed, without salient ridges, forming a descending right spiral displaced less than 0.5 of its own width, most of the displacement occurring in the *proximal* part of the furrow. Longitudinal furrow on the epitheca only a narrow groove terminating in a pit, on hypotheca two girdle widths in length with marginal lists.

Plates normal. Suture lines with broad reticulated bands and central seam. Plates finely reticulate with irregular polygons. Four apical plates. A mid-ventral accessory strip in the precingular row.

Length, 45 μ ; transdiameter, 32 μ .

Station, 4732.

Murrayella punctata (CLEVE).

Steiniella (?) *punctata* Cleve.

Plate 9, Fig. 58.

A small species, variable in size and proportions, biconical in form with median girdle and axis shifted ventrally.

Body elongated, length 1.55 times the dorso-ventral and 1.7 times the transdiameter. Epitheca and hypotheca subequal. Epitheca conical, its altitude 1.8 of its transdiameter, right and left margins straight or concave, base occasionally somewhat flaring, dorsal margin convex, more so than the ventral, apex displaced ventrally, broadly rounded.

Hypotheca resembling the epitheca, but its ventral face is concave, and the ventrally displaced antapex is more or less acute.

Girdle relatively wide in small individuals, and narrower in large ones, furrow deeply impressed with slightly salient margins, forming a descending right spiral displaced its own width. The longitudinal furrow is very long, 0.75 of the total length of the body. It runs from the girdle to the apex, narrowing gradually till at a point half-way to the apex it is continued as a linear channel. Near the middle of the epitheca it is deflected to the right. On the

hypotheca it turns to the right distally and forms a broad channel with high membranous lists on either side.

The post- and precingular plates are normal. There are four apicals and two antapicals. Suture lines are marked by bands, and the plates are finely reticulate with small subequal irregular polygons. The transverse and longitudinal furrows are partially reticulated. An exceedingly variable species.

Length, 65–155 μ ; dorso-ventral diameter, 40–73 μ .

Stations, 4691, 4730, 4732.

Murrayella rotundata, sp. nov.

Plate 9, Fig. 55.

A minute spheroidal species without apical or antapical horns.

Body rotund, spheroidal, its length 1.05 times the dorso-ventral diameter. Epitheca less than the hypotheca, its altitude 0.42 of the total length and 0.44 of the dorso-ventral diameter, low dome-shaped, slightly flaring at girdle.

The hypotheca is symmetrical, less rotund than the epitheca, and less flaring at the girdle, almost hemispherical, with a minute antapical elevation a little to the ventral side of the antapical pole.

Girdle horizontal, slightly impressed, with salient ridges, forming a descending right spiral displaced its own width. Longitudinal furrow narrower than the girdle, extending one girdle width on the hypotheca and two on the epitheca.

Length, 45 μ ; dorso-ventral diameter, 43 μ .

Station, 4701.

ACANTHODINIUM, gen. nov.

(?) *Cladopyxis* Stein ('83) in part.

Body spheroidal with premedian girdle. Epitheca with apical pore, four apical and eight precingular plates. Hypotheca with two antapical, six postcingular plates, and a longitudinal furrow plate of two moieties. The pre- and postcingular plates and the antapicals usually bear a centrally located spine, which is simple or branched distally. Thecal wall porulate.

Acanthodinium caryophyllum, sp. nov.

Plate 11, Fig. 67.

Similar to *A. spinosum*, but with ends of spines quadripartite with hyaline films connecting the divisions. Spines with one axial pore canal, occasionally with two or three connecting or independent ones at the base. This axial canal branches peripherally in the processes, which are usually four, occasionally two or three. The thecal plates are similar in number and general arrangement to those of *A. spinosum*, and the spines show a similar distribution on the plates and are subject to similar irregularities in distribution. The spines are longer (0.7–0.9 transdiameters at girdle) than in *A. spinosum*, but in other respects the dimensions are nearly the same.

Possibly an older form of *A. spinosum*. Intermediate stages not, however, observed. Transdiameter of midbody, 40 μ ; length of spines, 35 μ . Station, 4722.

Acanthodinium spinosum, sp. nov.

Plate 11, Fig. 66.

Axial length of body (without spines) 1.1–1.2 transdiameters of girdle. Dorso-ventral and transverse diameters equal. Epitheca less than hypotheca. Altitude of epitheca 0.3–0.4 of the axial length from the apex. Transverse furrow very lightly indented, its proximal and distal ends not displaced. Longitudinal furrow short with low lists. Epitheca with small circular area about apical pore. Apical plates without spines. Dorsal and ventral apicals narrow, laterals very wide. Of the eight precingular plates the two midventrals are small, and the remaining six are large, subequal, and bear centrally located spines. The two laterals are often without spines.

In the hypotheca the plates are less regular. The two antapicals are unequal in size and may bear spines. The six postcingulars are also unequal, the left midventral being smaller and the others increasing in size to the right. The longitudinal furrow plate consists of a larger posterior and smaller anterior moiety. Spines have been found on all plates of the hypotheca excepting only the furrow plates and the left midventral postcingular. Spines 0.4–0.6 transdiameters at girdle in length, slightly curved conical, tapering evenly, to a sharp point, with one central pore canal. Suture lines marked by single, rarely doubled, ridges. Thecal wall porulate. Plates usually bordered by a peripheral pore-free band.

Length, 45 μ ; diameter at girdle, 40 μ ; length of spines 16–25 μ .

Stations, 4707, 4722.

This is the type of *Acanthodinium*.

Phalacroma lenticula, sp. nov.

Plate 12, Fig. 69.

A medium-sized species with lenticular body, very high epitheca, and finely reticulate wall.

Body lens-shaped, much compressed laterally, its transdiameter less than 0.25 of the dorso-ventral, nearly circular in lateral view, the dorso-ventral width of the body exclusive of the fin, 1.06 times the length, the longest antero-posterior axis being slightly oblique (10° antero-dorsally) to the girdle. The epitheca is unusually high, nearly equalling the hypotheca in length. The girdle is narrow, furrow not impressed, with low fins. Left ventral fin with two ribs, the right low, reticulate at the base.

Thecal wall finely reticulate, about 16 mesh on the radius at the girdle, minutely porulate.

Length, 81 μ ; dorso-ventral diameter, 86 μ .

Station, 4749.

Phalacroma reticulata, sp. nov.

Plate 12, Fig. 72.

A small species of biconical form, laterally compressed, with very coarse reticulations.

The length is 1.6 times the transdiameter, and 1.25 times the dorso-ventral. The epitheca is a low symmetrical cone, laterally compressed, its altitude 0.48 of its dorso-ventral diameter and 0.57 of its transdiameter. Its sides are straight and the apex is broadly rounded.

The hypotheca is a high cone, its altitude a trifle less than its transdiameter and 0.8 of its dorso-ventral. Its ventral margin is convex in the middle, the dorsal nearly straight and the laterals a little concave. The antapex is rounded.

The girdle is 0.4 of the length from the apex and has low hyaline lists. The left ventral list is high, with a single prominent rib and several secondary ones. It is decurrent posteriorly and is continued around the hypotheca on the right side of the suture to the dorsal girdle, as a low list.

The surface is coarsely reticulate, with 24 polygons on the epithecal valve and 36 on the hypothecal.

Length, 100 μ ; transdiameter, 64 μ .

Station, 4740.

Phalacroma striata, sp. nov.

Plate 12, Fig. 73.

A large species resembling *P. cuneus*, but differing in the form of antapex. In *P. cuneus* this is symmetrically contracted to a rounded antapex. In *P. striata* the hypotheca is relatively larger, is broadly rounded at the antapex and more expanded ventrally. The ventral margin is nearly straight, and forms a right angle with the girdle. The left ventral fin follows the outline of the body or even exaggerates the ventral expansion, and reaches the level of the antapex. It is faintly radially striate. Girdle with wide membranous lists.

Thecal wall reticulate, with coarse polygons each with central pore.

Length, 120 μ ; dorso-ventral diameter in girdle, 120 μ .

Stations, 4638, 4719.

Phalacroma ultima, sp. nov.

Plate 12, Fig. 68.

A bizarre species of small size with bifurcated antapex and longitudinal furrow displaced to the right.

The length of the body is 1.6 times the greatest dorso-ventral extension, and 4 times the transdiameter (excluding the collars). The epitheca is low, its greatest altitude above the furrow is 0.35 of its dorso-ventral diameter. It is highest in the ventral third and declines rapidly dorsally.

The hypotheca is deeply and broadly bifurcated by a wide arc which reaches the posterior end of the longitudinal furrow. The depth of the bifurcation is but little less than the dorso-ventral diameter of the body in the girdle. As a result of the bifurcation there are two slender tapering acute horns, a shorter ventral and longer dorsal. Their length is about 0.75 of the distance between their tips.

The girdle is wide, with flaring sub-horizontal lists. The longitudinal furrow is turned abruptly to the right and runs on the right face of the organism to the dorsal side of base of the ventral horn. The suture between the valves follows this course and then turns abruptly toward the ventral margin of the horn.

There is a low ridge on the right side of the furrow which continues as a short spine beyond the posterior margin of the body.

Length, 60 μ ; dorso-ventral diameter, 38 μ .

Station, 4711.

Dinophysis triacantha, sp. nov.

Plate 12, Fig. 74.

Related to *D. schütti* Murr. et Whitt. and *D. uracantha* Stein. Resembles *D. uracantha* in having marginal ribs to the postero-dorsal spine. Differs from both of these species in the presence of a third spine in the ventral fin, located at its dorso-posterior margin and formed as in the case of the postero-dorsal spine by marginal thickenings.

Body broadly ovate in lateral view, anterior collar unevenly ribbed, ventral fin feebly reticulated. Thecal wall with fine irregular reticulations, a few of which contain pores. The three spines subequal, in length about 0.5 of the dorso-ventral diameter of the body.

Length of body without spines or collar, 50 μ ; greatest dorso-ventral diameter, 50 μ ; spines, 20-25 μ .

Station, 4722.

Amphisolenia asymmetrica, sp. nov.

Plate 13, Fig. 76.

An elongated species resembling *A. dolichocephalica*. Total length nearly twenty-five times that of the neck and nearly fifty times the dorso-ventral diameter of the midbody. Head long, narrow, oblique, its long axis slightly exceeding the neck in length, with low spreading sparingly ribbed lists. Antapical stem curved ventrally and distally deflected abruptly to the right, bearing a short spine in the left face at the point of deflection and three equidistant terminal spinules on the slightly swollen end. Walls thickened distally along sutures which do not follow the median plane of symmetry through the apparently twisted antapex but divide it into two asymmetrical valves, the right with two terminal spinules and the left with one terminal and the lateral.

Nucleus elongated, chromatophores few, large, ellipsoidal.

Length, 1200 μ ; dorso-ventral diameter of the midbody 60 μ ; length of head, 190 μ .

Station, 4732.

Amphisolenia bispinosa, sp. nov.

Plate 14, Fig. 85.

A moderately large species of robust proportions, midbody but little expanded and tapering very gradually into the antapical stem, which is slightly curved ventrally and bears two very long attenuate spines, one upon each side. The antapex is porulate, and several sinuous ridge-like markings are found on the short neck. The head is elongated, oblique, with spreading lists with few ribs.

Nucleus much elongated. Chromatophores numerous, ellipsoidal.

Length, 670 μ ; dorso-ventral diameter of midbody, 20 μ .

Station, 4605.

Amphisolenia brevicauda, sp. nov.

Plate 13, Fig. 79.

A very small species with elongated midbody and very short, straight, simple antapical.

The head is oblique, elongated, its length 2.5 times its dorso-ventral thickness. The neck is long and slender, its length 0.25 of the total length. The midbody is greatly elongated, slightly enlarged posteriorly, its length 0.5 of the total length, contracting abruptly to a short antapical extension whose length is less than that of the neck. The antapex is acute, without spines or modifications.

Length, 200 μ ; transdiameter of midbody, 12 μ .

Station, 4740.

Amphisolenia clavipes, sp. nov.

Plate 14, Fig. 90.

A small but robustly proportioned species with small capitate head, long neck, tapering fusiform midbody not sharply delimited posteriorly. The antapex is bent abruptly to the right for a distance about equalling the greatest transdiameter of the midbody and terminates in a slight knob-like expansion with a dorsal and a ventral spinule.

Nucleus much elongated, chromatophores elongated, cylindrical.

Length, 235 μ ; dorso-ventral diameter of midbody, 13 μ .

Station, 4736.

Amphisolenia curvata, sp. nov.

Plate 14, Fig. 87.

A stout species of medium size, with cushion-shaped head, fusiform body, and an antapical stem ventrally curved throughout, without terminal expansion.

A single small terminal spinule occurred on the left valve of individual drawn. Transverse lists low, spreading with few stout ribs, one of which passes down upon the side of the neck. The antapex is porulate and bears a few irregular reticulations on the thecal wall.

Nucleus small, broadly ellipsoidal. Chromatophores numerous, spheroidal.

Length, 460 μ ; dorso-ventral diameter of midbody, 35 μ .

Station, 4605.

Amphisolenia dolichocephalica, sp. nov.

Plate 13, Fig. 82.

A large species with long very slender body with slight dorsal convexity. Head oblique, greatly elongated, its length nearly seven times its transverse and ten times its dorso-ventral diameter. Lists nearly horizontal, with numerous fine ribs. Neck about as long as the head, midbody tapering, fusiform. Antapex curved somewhat ventrally and to the right, with subcapitate termination bearing two straight spinules at the suture and decurrent hyaline ridges which pass quickly from the knob-like end to the slender cylindrical stem.

Nucleus greatly elongated.

Length, 1050 μ ; dorso-ventral diameter of midbody, 22 μ ; length of head, 82 μ .

Station, 4728.

Amphisolenia extensa, sp. nov.

Plate 13, Fig. 78.

A very large species with flattened very oblique head, relatively short neck, stout fusiform midbody and an enormously elongated antapical stem which is six times the length of the rest of the organism. The head is flattened ellipsoidal, with low spreading lightly ribbed transverse lists, a ribbed furrow, and coarsely ribbed longitudinal lists. The antapical stem is slightly convex dorsally and terminates in a slightly swollen subtruncate antapex without spines.

Nucleus elongated, chromatophores numerous, subspheroidal.

Length, 1380 μ ; dorso-ventral diameter, 25 μ .

Station, 4699.

Amphisolenia laticincta, sp. nov.

Plate 13, Fig. 80.

A minute species with straight fusiform body. Head obliquely rounded, transverse furrow very wide, equalling the long axis of the head in width. Transverse lists low, spreading, with few faint ribs. Neck short, slightly exceeding the dorso-ventral diameter of the midbody in length. Midbody fusiform, forming nearly half of the total length. Antapical stem straight, with a single terminal spinule.

Nucleus elongated, chromatophores small, irregular.

Length, 112 μ ; dorso-ventral diameter of midbody 9 μ ; width of transverse furrow, 6 μ .

Station, 4740.

***Amphisolenia lemmermanni*, sp. nov.**

Plate 14, Figs. 88, 89.

A species of medium size with broadly fusiform midbody, elongated, straight antapical stem with terminal expansion deflected to the right. The head is oblique, the neck about 1.4 times the dorso-ventral diameter of the midbody in length, and the terminal expansion of the antapex with three acute spines, one on the left side a short distance above the end at the point of deflection of the spreading antapex which is carried out on its dorsal and ventral angles in the other two spines. A slight knob-like expansion at the end of the straight section is connected by lists with the terminal spinules.

Length, 565 μ ; dorso-ventral diameter of the midbody, 40 μ .

Station, 4730.

***Amphisolenia palaeotheroides*, sp. nov.**

Plate 14, Fig. 84.

Body stout, its length 20-36 times the greatest dorso-ventral diameter, elongated fusiform with central swelling scarcely differentiated. Flagellar pore removed from the apex 0.12 of the total length. Antapex twisted slightly, terminating in an oblique asymmetrical enlargement with three large, stout, terminal spines. A similar stout spine at the beginning of the obliquity a short distance above the antapex. Collars with few ribs, transverse furrow ribbed and porolate.

Length, 426-605 μ ; dorso-ventral diameter of body, 12-24 μ .

Station, 4732.

***Amphisolenia projecta*, sp. nov.**

Plate 13, Fig. 77.

A small species of the *A. thrinax* group with bifurcated antapex whose ventral limb resembles that of *A. bifurcata* while the dorsal one is a knob-like prominence without spinules or lateral asymmetry. Body elongated with fusiform midbody. Total length 17 times the dorso-ventral diameter. Flagellar pore to apex 0.16 of the total length. Bifurcation to antapex 0.2 of the total length. Ventral limb of antapex fusiform, with four spinules, one lateral, and three terminal, limb deflected to the right at level of the lateral spinule. Dorsal limb equal to dorso-ventral diameter of midbody in length; clavate, its length twice its width.

Length, 185 μ ; dorso-ventral diameter, 11 μ .

Station, 4701.

Amphisolenia quadrispina*, sp. nov.*Plate 14, Fig. 86.**

Body very long and slender, its length about 45 times the greatest dorso-ventral diameter, attenuate, fusiform, expanding posteriorly to a knob-like termination with four equidistant short incurved terminal spinules. Body constricted immediately anterior to the knob. Midbody not sharply delimited, about one third of the total length in length. Length of neck (girdle to flagellar pore) 0.13 of the total length, or four to five dorso-ventral diameters of the head without lists. Head capitate, transverse lists spreading, subhorizontal with few fine ribs, width of lists equals the transdiameter of the head. Terminal knob porulate.

Nucleus elongated, many small spheroidal chromatophores.

Length, 635-689 μ ; dorso-ventral diameter of midbody, 14-17 μ .

Stations, 4613, 4722.

Amphisolenia quinquecauda*, sp. nov.*Plate 13, Fig. 75.**

This is a large species resembling *A. thrinax* but having five instead of three antapical ends. The neck and midbody form the apical third of the body, and the branches begin with the antapical third. The neck is short, but little longer than the dorso-ventral diameter of the midbody, which is stout, fusiform, its dorso-ventral diameter but slightly exceeding its transverse diameter.

The head is elongated, oblique, with spreading transverse lists heavily ribbed with about 20 ribs. The axis in the posterior third bends ventrally in a double curve and ends in a triangular antapex with short spinules on the angles. There is a dorsal spine a short distance from the antapex. The four branches are arranged in one plane in a single dorsal series and are all without enlargements, slightly curved, with the convex side dorsal. The first branch has an end similar to that of the axis, but the three slightly shorter ones of the middle group have but two small terminal spinules.

Nucleus elongated. Chromatophores small, elongated, very numerous.

Length, 835 μ ; dorso-ventral diameter of midbody, 42 μ ; length of first dorsal process about 300 μ .

Station, 4739.

Amphisolenia rectangulata*, sp. nov.*Plate 14, Fig. 83.**

A large species with short fusiform midbody, elongated oblique head, and much elongated antapical stem with very slight ventral curvature. The antapex terminates with very slight enlargement in rectangular form with the major axis dorso-ventral, and an acute spinule on each corner.

Nucleus much elongated; chromatophores spheroidal, numerous.

Differs from *A. quadrispina* in the more broadly fusiform midbody and in the form of the antapex, having no spheroidal enlargement.

Length, 735 μ ; dorso-ventral diameter of midbody, 24 μ .

Station, 4740.

***Amphisolenia schroederi*, sp. nov.**

Plate 13, Fig. 81.

A medium-sized species with capitate head, elongated fusiform midbody, and antapex with two spinules.

The body is elongated, its length 25 times the dorso-ventral diameter. The head is small, spheroidal, its diameter less than that of the midbody. The neck is about 0.16 of the total length and the midbody is not differentiated. The antapex is not enlarged, is truncate, and deflected to the right. It bears on the angles two stout terminal spines both of which are on the right valve.

This species differs from *A. bispinosa* in the location of the terminal spines and in the form of the head.

Length, 510 μ ; dorso-ventral diameter of the midbody, 20 μ .

Station, 4737.

TRIPOSOLENIA, KOFOID.¹

Dinophysidae with equal or unequal valves. With three subequal processes from a laterally compressed central midbody, one anterior and two posterior. The anterior process consists of the head, neck, protuberant cytopharyngeal region, and a short process from the midbody. The posterior processes are two symmetrically placed curved antapical horns, respectively dorsal and ventral in origin, with or without marginal tubercles or terminal spinules. The head and neck resemble those of *Amphisolenia*. The essential difference between *Amphisolenia* and *Triposolenia* lies in the presence in the latter of balanced antapicals arising from a midbody containing the greater mass of protoplasm and the nucleus. In all known forms of *Amphisolenia* the midbody is fusiform and bears no dorsal horn, the dorsal horn, if present, arising from the antapical process.

The thecal wall is structureless, pitted, or rarely locally reticulate.

The nucleus is located in the midbody. Chromatophores lacking (?) or of pale greenish-yellow color.

Sparingly distributed in warm temperate and tropical waters, but rarely taken at the surface.

***Triposolenia longicornis*, sp. nov.**

Plate 17, Fig. 101.

A very large species with long process and long antapical horns, small triangular midbody, and flattened head.

¹ Kofoid, C. A. Dinoflagellata of San Diego Region II. On *Triposolenia*, a new genus of the Dinophysidae. Univ. of Calif. Pubs. Zool., 3, p. 99-133, plates 15-19. 1906.

The midbody is laterally compressed, triangular in lateral view with the anterior margins subequal and both concave. The postmargin is but slightly convex. The anterior process is long, its length equalling that of an anterior margin. The cytopharyngeal margin is expanded ventrally to twice the dorso-ventral diameter of the neck, which is slender, its length being nearly one and one half times that of the process. It is curved dorsally in a regular arc, which continues the curvature of the dorso-ventral margin of the midbody. The head is flattened and the transverse furrow is slightly constricted.

The antapicals arise from the postero-lateral angle of the midbody and spread latero-posteriorly in a broad curve. The tips are somewhat incurved, but there is no sigmoid flexure as in *T. fatula*. The greatest distance between the antapicals is 0.63, and that between the tips 0.5 (of the total length). The antapicals are truncate in dorsal or ventral view, with short lateral terminal spinules. In lateral view they are somewhat rounded. Both horns are deflected to the left distally, the dorsal somewhat more than the ventral.

The lists are heavily and sparingly ribbed and the thecal wall shows no structural differentiation.

Length to postmargin of midbody, 125 μ ; to tip of ventral antapical, 275 μ .
Stations, 4385, 4711.

Its long process and horn are evidently adaptive to the higher temperatures of its habitat.

Triposolenia fatula, sp. nov.

Plate 17, Fig. 102.

A large species resembling *T. ambulatrix* with less asymmetry of the spreading antapicals and a constricted region in the anterior part of the neck.

The midbody is low triangular in lateral view with nearly straight margins, the posterior longer, and the antero-ventral shorter than the antero-dorsal. The anterior process is long, its length exceeding the altitude of the midbody. The neck is very long and slender and its distal fifth is reduced in dorso-ventral diameter and bent dorsally to a slight extent. Its length is about 0.2 of the total length. The head is spheroidal and relatively small.

The antapicals are very long, their length being 4.5 times the altitude of the midbody. They are slightly asymmetrical, the dorsal is slender, does not converge or show a sigmoid flexure distally, as does the ventral. The distance between the tips is five times the altitude of the midbody. Distally the dorsal antapical bends to the left, and the ventral one only slightly at the very end. The tips are truncate and minutely spinulate.

The thecal wall is hyaline, structureless, and the collars and lists are heavily but sparingly ribbed.

Length to postmargin of midbody, 90 μ ; to tip of ventral antapical, 190 μ .
Station, 4587.

***Triposolenia ambulatrix*, sp. nov.**

Plate 4, Fig. 24.

A medium-sized species of the *T. bicornis* type with both antapical horns deflected dorsally, especially the dorsal one.

The midbody is laterally compressed, subtriangular in lateral view with anterior process and antapicals arising from the angles as in *T. bicornis*. Its sides are all convex and the anterior process arises abruptly from somewhat squarish shoulders. The head is spheroidal, and the neck long, slender, and convex ventrally. There is a large ventral protuberance about the flagellar pore.

The ventral antapical is abruptly deflected postero-dorsally and forms a slight sigmoid curve which is less pronounced distally. Its tip is acute and it is deflected to the *right* distally. The dorsal antapical is not bent to form a balanced horn, in reverse, as in *T. bicornis*, but is thrown dorso-posteriorly with a slight anterior convexity. Its tip is truncate and bears two minute spinules. It is deflected to the *left* distally. There are a few distally located tubercles on the dorsal and ventral margins of the antapicals.

Length to postmargin of midbody, 95 μ ; to tip of ventral antapical, 165 μ .
Station, 4711.

***Histioneis carinata*, sp. nov.**

Plate 16, Fig. 98.

Somewhat resembling *H. biremis* Stein as figured by Murray and Whitting¹ in its bird-shaped body, and in the absence of a postero-dorsal prolongation. The anterior collar is less abundantly ribbed, and both it and the posterior one are asymmetrical, being lower at the right end. There is no fin dorsal to the posterior rib. The areoles on the midbody are more numerous, being 11 by 20 to 8 by 15 in *H. biremis*. There is no ventro-marginal rib in the posterior wing.

Length, 90 μ ; dorso-ventral diameter of midbody, 50 μ .
Station, 4724.

***Histioneis garretti*, sp. nov.**

Plate 16, Fig. 97.

A small species resembling *H. para* Murr. et Whitt. but differing from it in the presence of a fin on the dorsal side of the posterior rib. There are reticulations in the basal part of the anterior collar, and along the dorsal ribs of the posterior collar. The ventral and posterior fins are also more or less reticulate. Both collars closed ventrally and dorsally.

Length, 63 μ ; dorso-ventral diameter, 38 μ .
Station, 4732.

¹ New Peridiniaceae from the Atlantic. Trans. Linn. Soc. Lond. Bot., 32, Plate 32, Fig. 6.

Histioneis josephinae, sp. nov.

Plate 15, Fig. 91.

A large species with deeply concave midbody and broad, subcylindrical, posterior collar as in *H. helenae*. This species is especially marked by the enormous development of the various wings and by the presence in their peripheral portions of arborescent thickenings which resemble a coral necklace in form. In addition to an enormously developed posterior dorso-ventral wing there is also present a pair of transverse wings arising from the posterior rib, and a great accessory lateral on the left side, the latter as well as the ventral wing being provided with an excessively hyaline outer segment. Each of these wings bears one or several coral-like thickenings at the termination of ribs or in peripheral regions. The most striking development of organs of flotation among the Dinoflagellidia.

Length, 115 μ ; dorso-ventral diameter, including wings, 80 μ .
Station, 4699.

Histioneis longicollis, sp. nov.

Plate 16, Fig. 100.

A small species resembling immature stages of *H. cymbalaria* but differs from it in having a more rotund body, a postero-ventral fin deflected ventrally from the axis and without ventral marginal rib. The posterior collar bears a hyaline list on its anterior margin outside of the rib. Both collars are closed both dorsally and ventrally by hyaline membranes. The body wall is not pitted or reticulated.

Length, 70 μ ; dorso-ventral diameter of body, 24 μ .
Station, 4711.

Histioneis navicula, sp. nov.

Plate 16, Fig. 96.

A medium-sized species with boat-shaped body resembling that of *H. cymbalaria* but longer and more slender. The posterior collar resembles that of *H. biremis*, but both it and the anterior are complete both dorsally and ventrally, there being no gap in the suture line. The anterior collar is asymmetrical, being shorter along the right margin. This collar is somewhat reticulated and ribbed. The ventral fin has a single ventral and one posterior rib, the latter branching at the tip. Phaeosomes in the anterior chamber.

Length, 86 μ ; dorso-ventral axis of body, 62 μ .
Station, 4734.

Histioneis paulseni, sp. nov.

Plate 15, Fig. 94.

A small species related to *H. remora*. It differs from it in having the body more elongated in the dorso-ventral direction, a wider and relatively shorter

postero-ventral fin, in the absence of reticulations on the fins, and in the presence of a hyaline border on the anterior margin of the posterior collar. Both dorsal and ventral collar clefts in both collars are closed by delicate hyaline membranes.

Length, 64 μ ; dorso-ventral diameter of body, 33 μ .

Station, 4711.

Histioneis pulchra, sp. nov.

Plate 16, Fig. 99.

A medium-sized species of the general form of *H. mitchellana* but differing from it in the character of the reticulations of the wings and collars. In *H. pulchra* the reticulations are coarse, irregular, and more or less incomplete. They are found on the anterior parts of the two collars, on the posterior part of the ventral, and on the posterior wings. In *H. mitchellana* the reticulations are fine, delicate, and more or less regular.

Length, 135 μ ; dorso-ventral diameter, 60 μ .

Station, 4730, 4734, 4742.

Histioneis reticulata, sp. nov.

Plate 15, Fig. 95.

A small species resembling *H. crateriformis* Stein but differing from it in the much lower anterior collar, a higher, more recurved anterior process from the body, in the presence of a subregular polygonal reticulum on parts of the posterior collar and on the ventral fins, and in its straight posterior rib.

Both ventral fins are relatively low. The left has two ribs, both of which are straight. The middorsal and midventral clefts of the posterior collar are both closed by membranes, the former with five equidistant transverse ribs running across the closing membrane.

Length, 115 μ ; dorso-ventral diameter, 85 μ .

Stations, 4699.

Ornithocercus carolinae, sp. nov.

Plate 15, Fig. 92.

A medium-sized species resembling *O. magnificus* but differing from it in the following particulars: the posterior wing has 12-14, rarely 9-15, light ribs of uniform size evenly distributed without prominent midribs to the marginal and median projections. These ribs are more slender and more numerous than those in *O. magnificus*. The anterior collar has numerous (twenty or more) primary ribs, with intercalated secondary and tertiary ones. The right and left ventral wings are in old (?) individuals reticulated. Reticulations may also be found in the middorsal region of the posterior collar, at the base of the anterior one, and on the dorsal margin of the posterior wing.

Length, 100 μ ; dorso-ventral diameter, 65 μ .

Stations, 4719, 4721, 4722, 4724, 4740.

Ornithocercus heteroporus, sp. nov.

Plate 12, Fig. 70.

A minute species with slightly oblique axis, relatively few ribs in the collar, posterior wing confined to the ventral side of the midbody, with marginal ribs. Pores heterotypical.

Midbody rotund, laterally compressed, its length 1.16 times the dorso-ventral and 1.3 times the transverse diameter. Anterior collar flaring with few ribs, reticulated basally. Posterior collar with 8 ribs, a row of coarse reticulations at its base and along the base of the right ventral wing (obsolete in individual figured). Left ventral reticulate at base. Posterior wing confined to ventral side with marginal ribs and peripheral seam. Thecal wall porulate with evenly distributed pores, one in 6 or 8 darker than the others.

Length, 50 μ ; dorso-ventral diameter, including fin, 37 μ .

Station, 4699.

Ornithocercus serratus, sp. nov.

Plate 15, Fig. 93.

A large species with rounded posterior wing with 4-5 equidistant rounded or acute apices.

This species differs from all others in the large number and the regularity of the marginal prominences of the posterior wing, each of which is the termination of a single rib. There is as a rule no marginal connecting rib as often in *O. magnificus*, *steini*, and *quadratus*. The dorsal margin of the posterior wing is more rounded, not angular or squarish as in other species. The ribs are also more regularly spaced, freer from branching and other irregularities, and the posterior wing has less intercostal reticulation. Terminal reticular brushes appear on some individuals at the ends of the ribs.

Length, 110-145 μ ; dorso-ventral diameter, 95-130 μ .

Stations, 4613, 4742.

Amphilothus quincuncialis, sp. nov.

Plate 1, Fig. 10.

A minute species of ellipsoidal form, median girdle, with skeletal elements with quincuncial arrangement in the hypotheca.

Body broadly ellipsoidal, its length 1.6 times the transverse diameter. Epithea and hypotheca subequal. Epithea a low cone with very constricted blunt apex, its altitude 0.8 of its transdiameter.

Hypotheca a low dome with very broadly rounded antapex, its altitude 0.8 times its transdiameter.

Girdle 0.1 of the total length in width, nearly median in position, deeply impressed, without lists, horizontal, without displacement. Longitudinal furrow straight, a wide shallow furrow, 0.8 of the length of the body in length, equally extended on the two sides of the girdle.

Skeletal elements superficial, diamond-shaped in hypotheca, 5-6 rows, with primary nodal tubercles and smaller internodal beads and openings in each area, with irregular mesh between pores and margins. In the epitheca there are about 16 subregular meridional ridges with pores between.

Length, 33 μ ; diameter, 20 μ .

Anchorage at Panama, surface.

EXPLANATION OF PLATES.

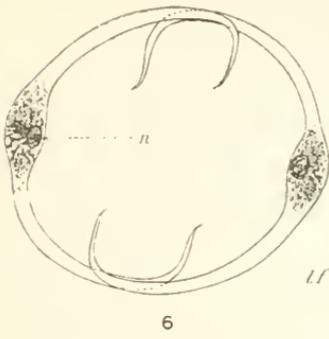
All figures have been drawn with camera lucida. They have been drawn in ink for reproduction by Mr. A. B. Streedain from pencil sketches made by Miss E. J. Rigden, with few exceptions, those designated in the explanations as drawn from life being made by the author.

ABBREVIATIONS.

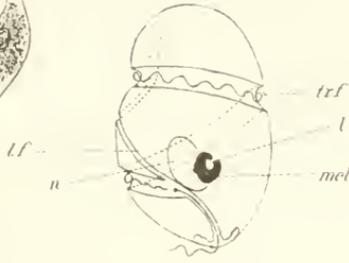
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|---|---|
| <i>a. c.</i> , anterior collar. | <i>p.</i> , pore. |
| <i>a. l. f.</i> , accessory lateral fin. | <i>p. c.</i> , posterior collar. |
| <i>ant.</i> , antapex. | <i>p. can.</i> , pore canals. |
| <i>ap. p.</i> , apical pore. | <i>p. f.</i> , posterior fin. |
| <i>arb.</i> , arborescent thickening. | <i>ph.</i> , phaeosomes. |
| <i>a. v.</i> , anterior valve. | <i>p. v.</i> , posterior valve. |
| <i>car.</i> , carina. | <i>R.</i> , right side. |
| <i>D.</i> , dorsal side. | <i>r. l. f.</i> , right lateral fin. |
| <i>d. ant.</i> , dorsal antapical horn. | <i>r. v. f.</i> , right ventral fin. |
| <i>f. p.</i> , flagellar pore. | <i>s.</i> , suture. |
| <i>h.</i> , head. | <i>sk. el.</i> , skeleton elements. |
| <i>L.</i> , left side. | <i>sp.</i> , spine. |
| <i>l.</i> , lens. | <i>th. w.</i> , thickened wall. |
| <i>l. f.</i> , longitudinal furrow. | <i>tr. f.</i> , transverse furrow. |
| <i>l. i. p.</i> , left intercalary plate. | <i>v.</i> , ventral side. |
| <i>l. v. f.</i> , left ventral fin. | <i>v. a.</i> , ventral area. |
| <i>mb.</i> , midbody. | <i>v. ant.</i> , ventral anterior horn. |
| <i>mel.</i> , melanosome. | <i>v. f.</i> , ventral fin. |
| <i>n.</i> , nucleus. | <i>v. p.</i> , ventral pore. |
| <i>nk.</i> , neck. | <i>v. pl.</i> , ventral plate. |
| <i>o. s.</i> , outer segment. | |

PLATE 1.

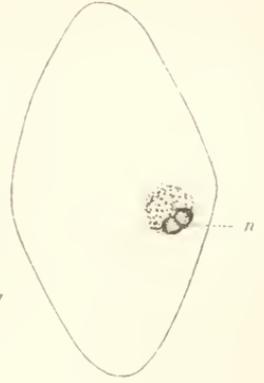
- Fig. 1. *Prorocentrum curvatum*, sp. nov., lateral view. $\times 565$. From life.
Fig. 2. The same, anterior face. $\times 565$.
Fig. 3. *Pyrocystis fusiformis*, forma *biconica*, f. nov. $\times 100$.
Fig. 4. *Pyrocystis acuta*, sp. nov. $\times 62$.
Fig. 5. *Pyrocystis robusta*, sp. nov. $\times 320$.
Fig. 6. *Pyrocystis semicircularis* (Schröder), lateral view of yoked pair. $\times 100$.
Fig. 7. *Pouchetia panamensis*, sp. nov., ventral view. $\times 895$. From life.
Fig. 8. *Ptychodiscus carinatus*, sp. nov., ventral view. $\times 450$. From life.
Fig. 9. Lateral view of the same. $\times 450$.
Fig. 10. *Amphilothus quincuncialis*, sp. nov. Oblique view of right face. $\times 895$.
From life.



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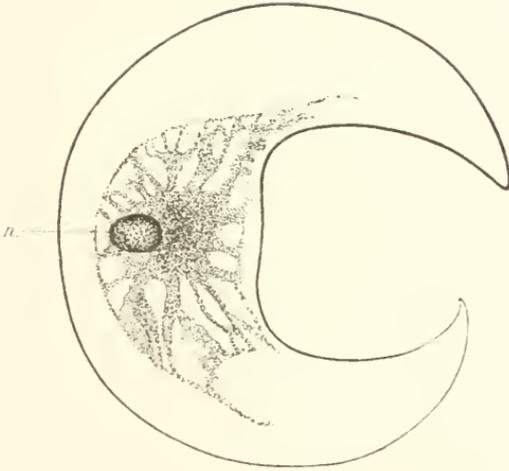
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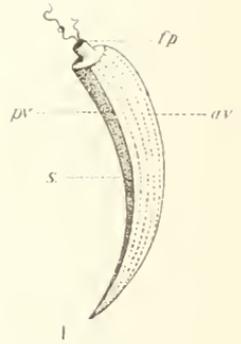
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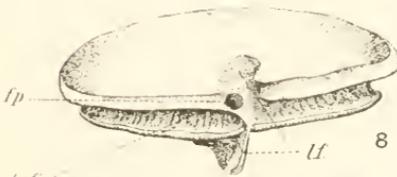
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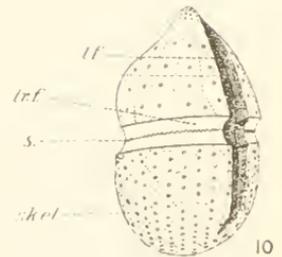
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PLATE 2.

- Fig. 11. *Podolampas reticulata*, sp. nov., ventral face. $\times 935$.
Fig. 12. *Ceratium pennatum*, sp. nov., forma *propria*, f. nov., ventral face. $\times 100$.
Fig. 13. *Ceratium pennatum* forma *inflata*, f. nov., ventral face. $\times 100$.
Fig. 14. *Ceratium pennatum* forma *falcata*, f. nov., ventral face. $\times 100$.
Fig. 15. *Steiniella inflata*, sp. nov., ventral face. $\times 450$.
Fig. 16. *Ceratium ehrenbergi*, sp. nov., ventral face. $\times 450$.

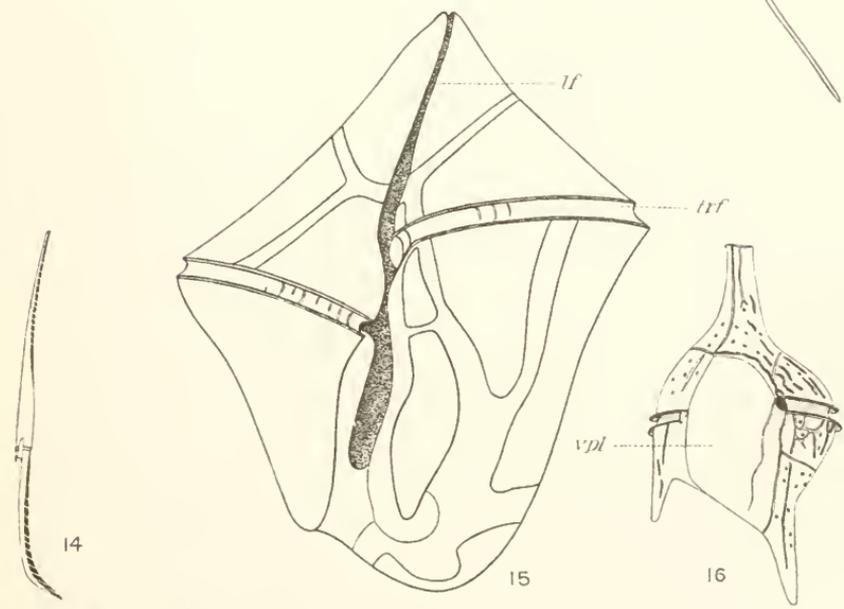
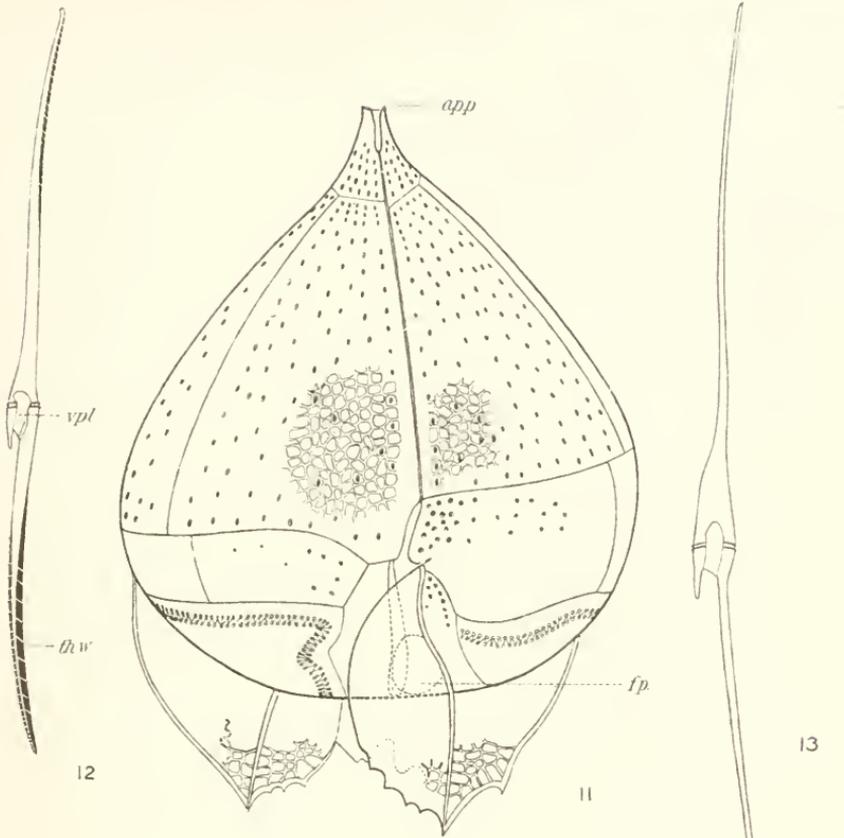
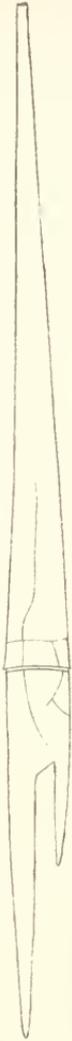


PLATE 3.

- Fig. 17. *Ceratium lanceolatum*, sp. nov., ventral view. $\times 935$.
Fig. 18. *Ceratium schröteri* Schröder, view of dextral face. $\times 315$.
Fig. 19. Ventral view of the same. $\times 315$.
Fig. 20. *Ceratium tricarinatum*, sp. nov., dorsal view. $\times 210$.
Fig. 21. *Ceratium pacificum* Schröder, dorsal view. $\times 285$.
Fig. 22. *Ceratium bigelowi*, sp. nov., dorsal view. $\times 100$.
Fig. 23. *Ceratium scapiforme*, sp. nov., dorsal view. $\times 205$.



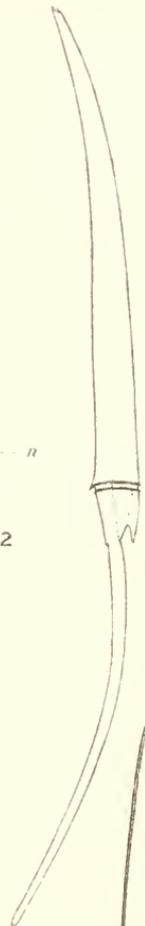
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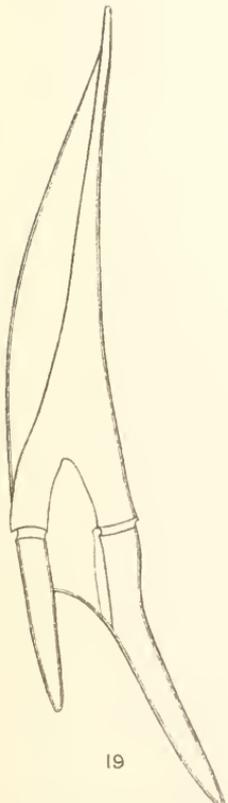
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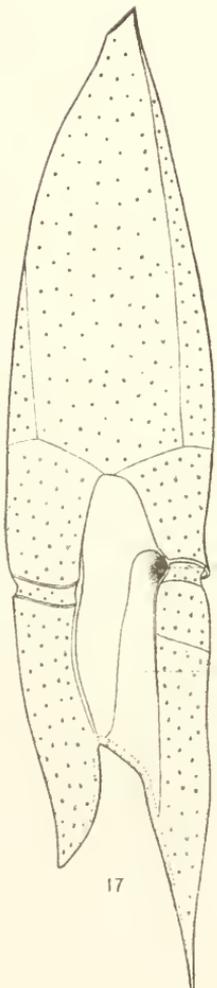
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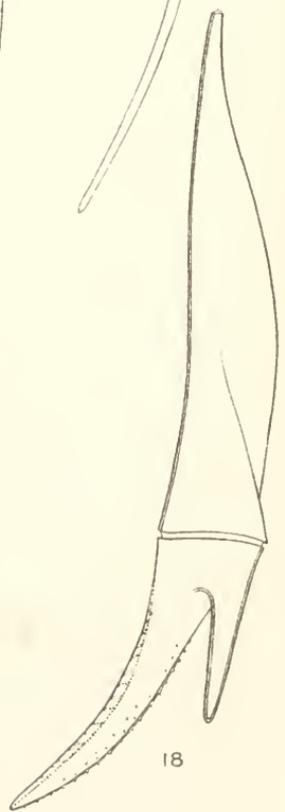
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PLATE 4.

- Fig. 24. *Triposolenia ambulatrix*, sp. nov., dextral face. $\times 450$.
Fig. 25. *Ceratium dilatata* (Karsten), ventral face. $\times 450$.
Fig. 26. *Ceratium axiale*, sp. nov., ventral face. $\times 450$.
Fig. 27. *Ceratium claviger*, sp. nov., ventral face. $\times 285$. From life.

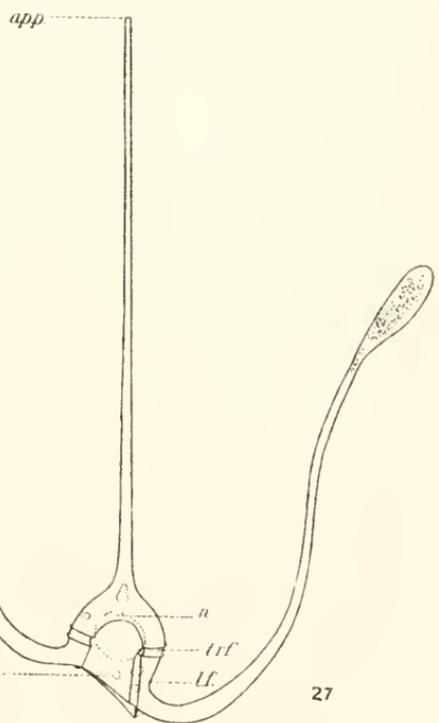
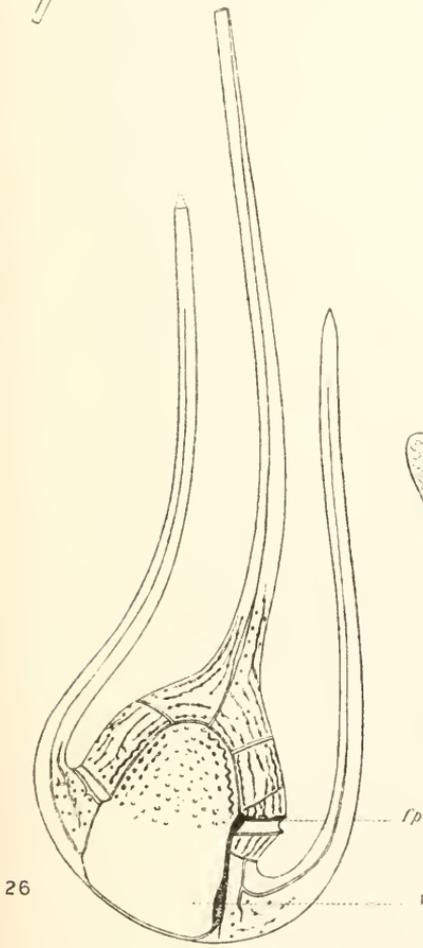
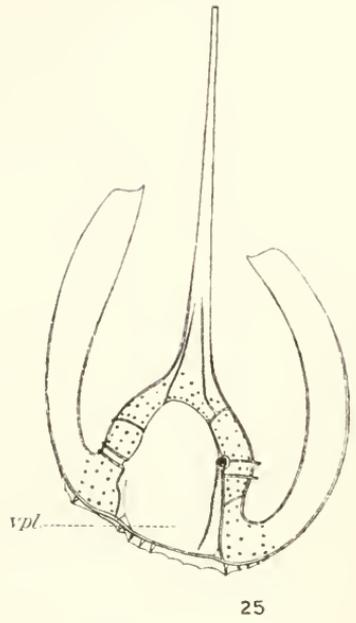
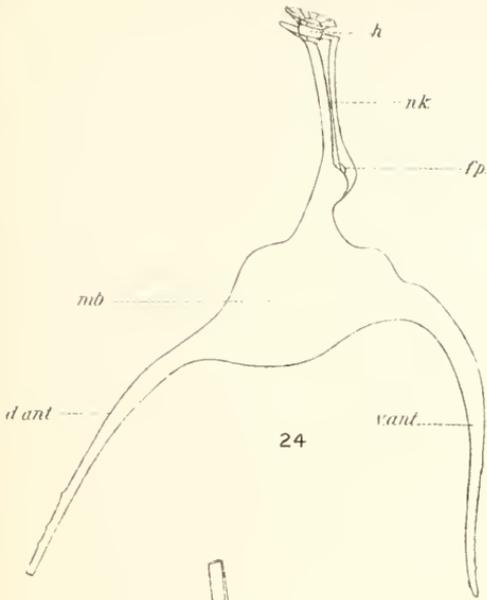
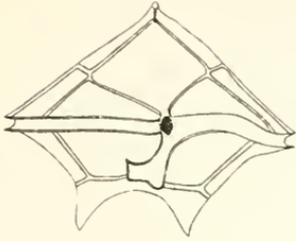
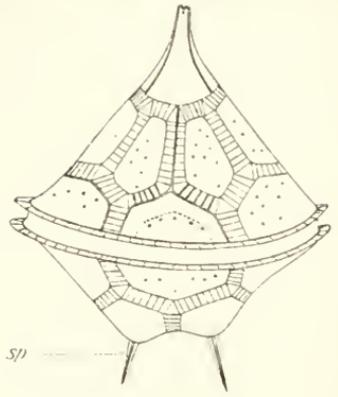


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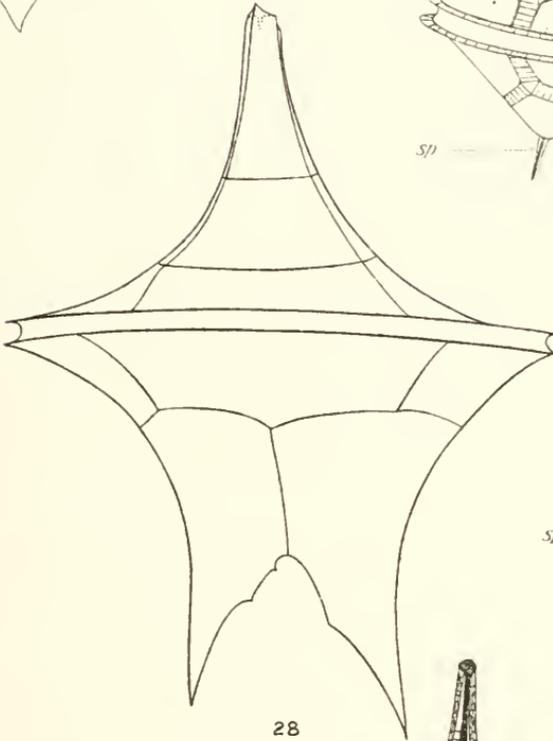
- Fig. 28. *Peridinium grande*, sp. nov., dorsal face. × 450.
Fig. 29. *Peridinium murrayi*, sp. nov., ventral face. × 295. From life.
Fig. 30. *Peridinium fatulipes*, sp. nov., ventral face. × 565.
Fig. 31. *Peridinium latissimum*, sp. nov., ventral face. × 295. From life.
Fig. 32. Same, diagrammatic apical view. × 295.
Fig. 33. *Peridinium longispinum*, sp. nov., dorsal face. × 450.
Fig. 34. *Peridinium tenuissimum*, sp. nov., ventral face. × 450.



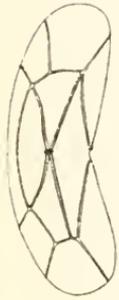
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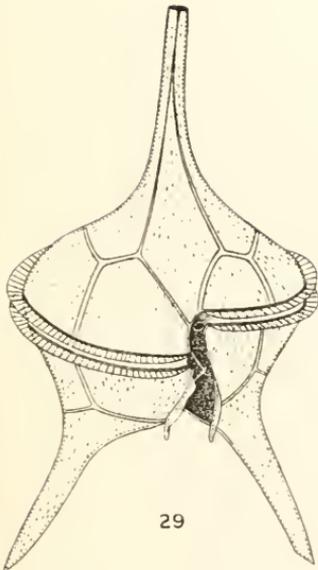
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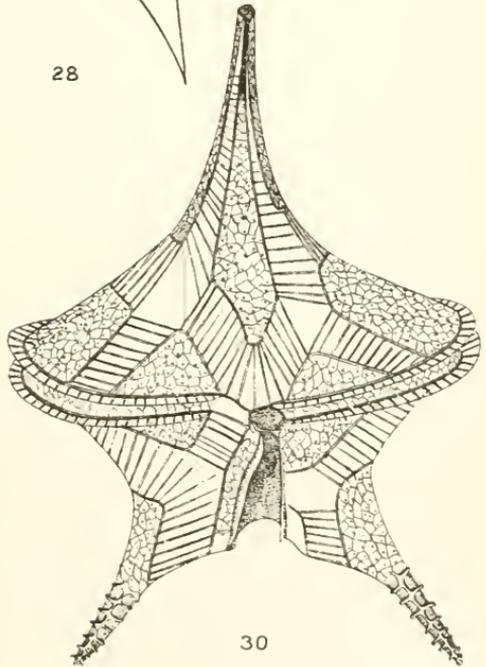
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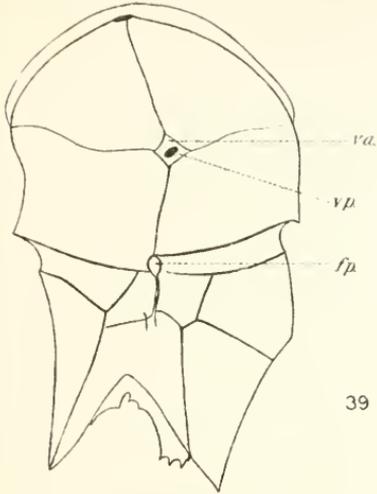
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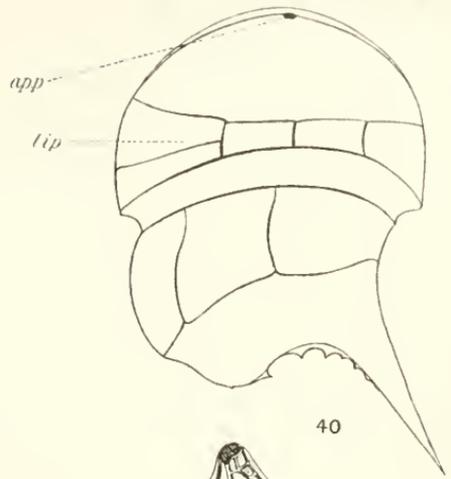
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PLATE 6.

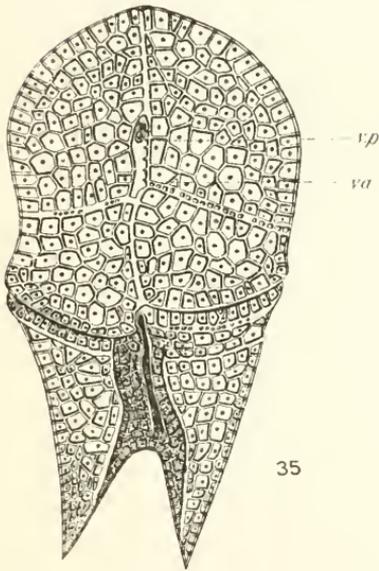
- Fig. 35. *Heterodinium agassizi*, sp. nov., ventral face. $\times 450$.
Fig. 36. *Heterodinium expansum*, sp. nov., ventral face. $\times 565$
Fig. 37. *Heterodinium gesticulatum*, sp. nov., forma *typica*, f. nov., ventral face.
 $\times 440$.
Fig. 38. *Heterodinium gesticulatum*, sp. nov., forma *extrema*, f. nov., ventral face.
 $\times 450$.
Fig. 39. *Heterodinium gesticulatum*, sp. nov., forma *mediocris*, f. nov., ventral face.
 $\times 450$.
Fig. 40. *Heterodinium gesticulatum*, sp. nov., forma *deformata*, f. nov., dorsal face.
 $\times 450$.



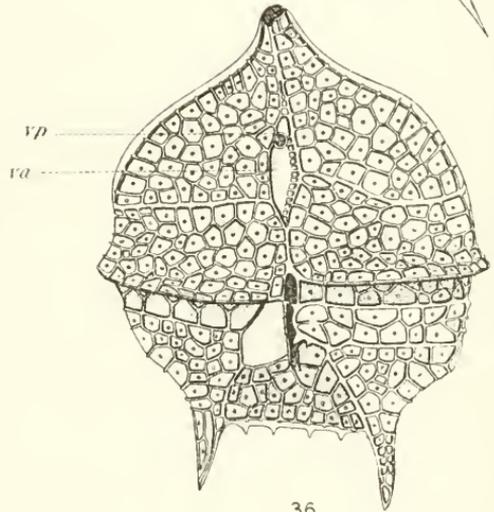
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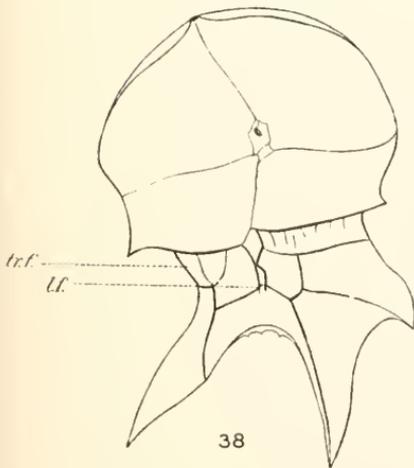
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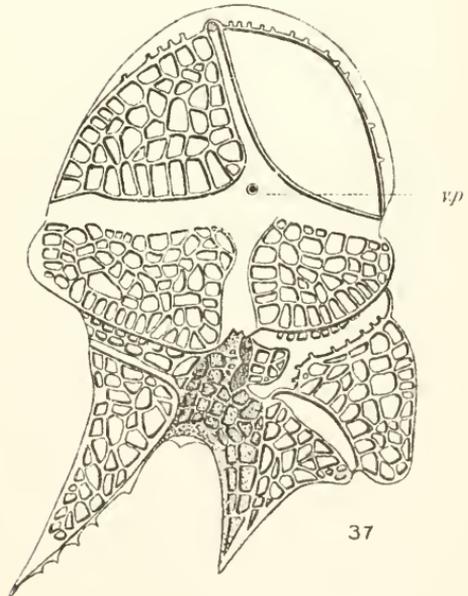
35



36



38



37

PLATE 7.

- Fig. 41. *Heterodinium praetextum*, sp. nov., dorsal face. × 405.
Fig. 42. *Heterodinium hindmarchi* forma *maculata*, f. nov., ventral face. × 405.
Fig. 43. *Heterodinium calvum*, sp. nov., ventral face. × 405.
Fig. 44. *Heterodinium longum*, sp. nov., ventral face. × 405.
Fig. 45. *Heterodinium fides*, sp. nov., dorsal face. × 405.
Fig. 46. *Heterodinium laticinctum*, sp. nov., view of right side. × 405.

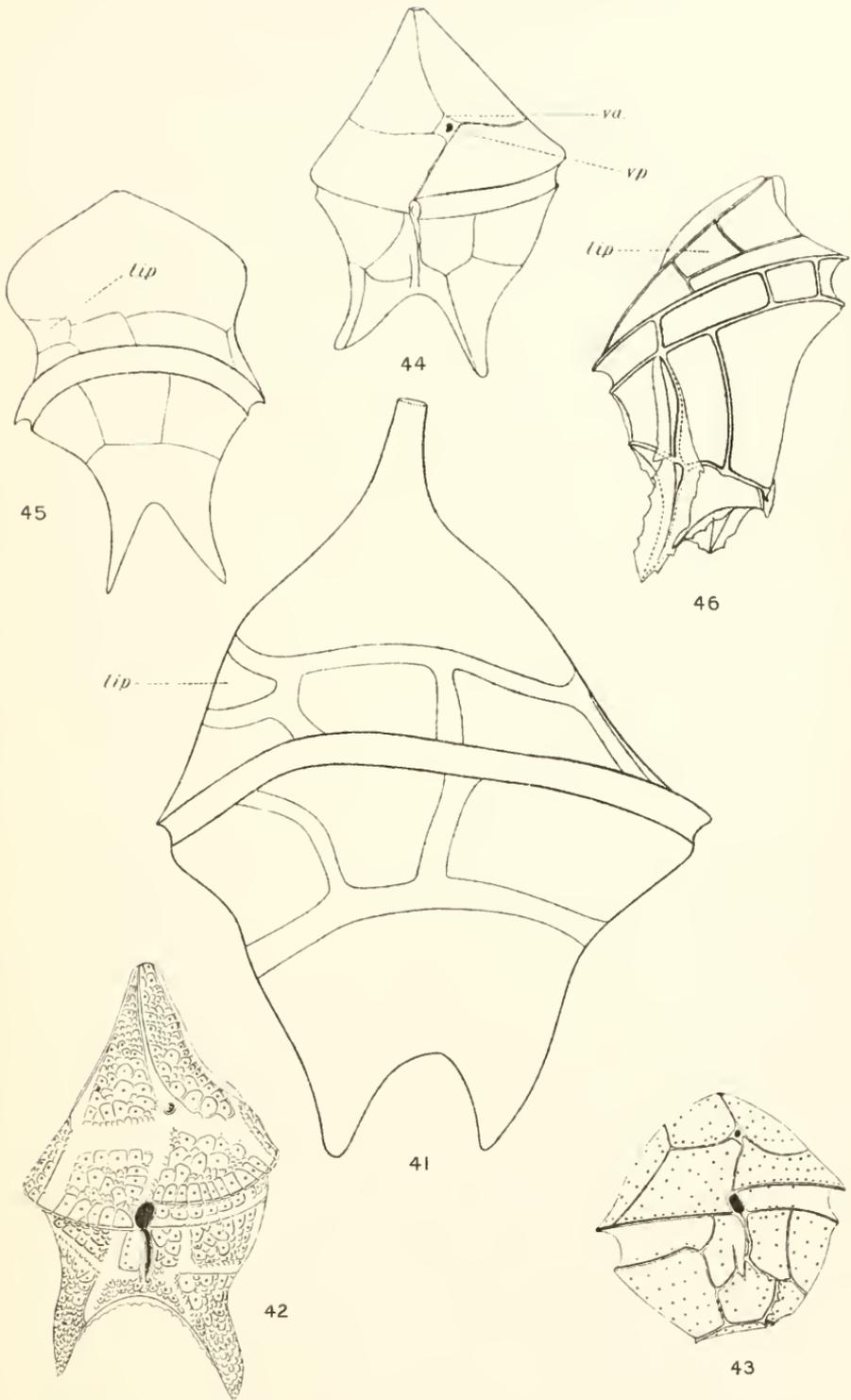
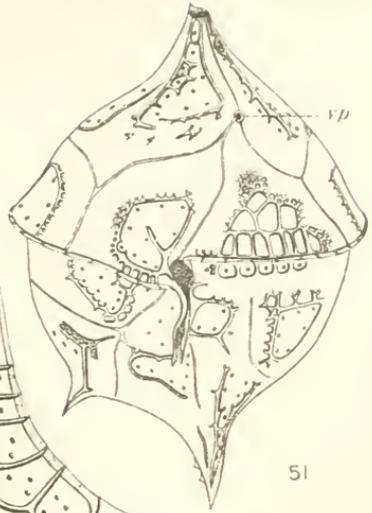


PLATE 8.

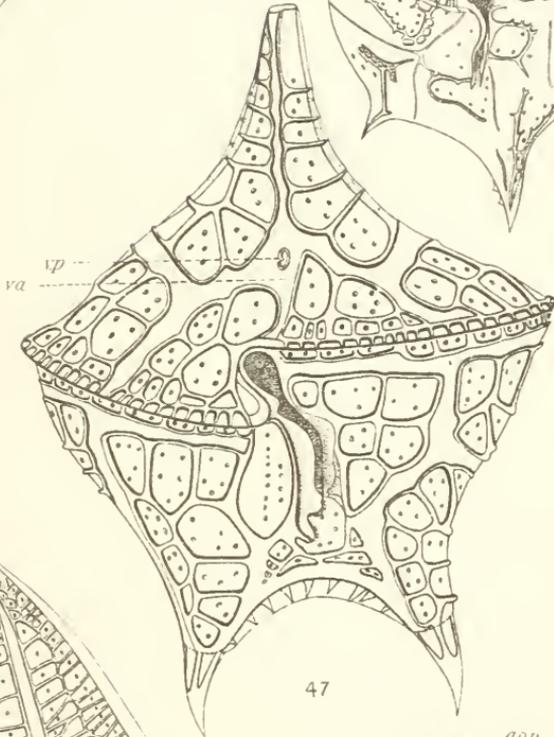
- Fig. 47. *Heterodinium fenestratum*, sp. nov., ventral face. × 840.
Fig. 48. *Heterodinium curvatum*, sp. nov., ventral face. × 840.
Fig. 49. *Heterodinium superbum*, sp. nov., ventral face. × 840.
Fig. 50. *Heterodinium obesum*, sp. nov., ventral face. × 840.
Fig. 51. *Heterodinium globosum*, sp. nov., ventral face. × 840.



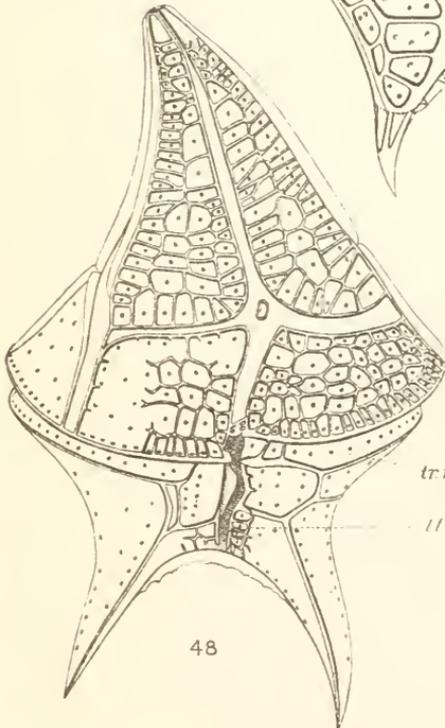
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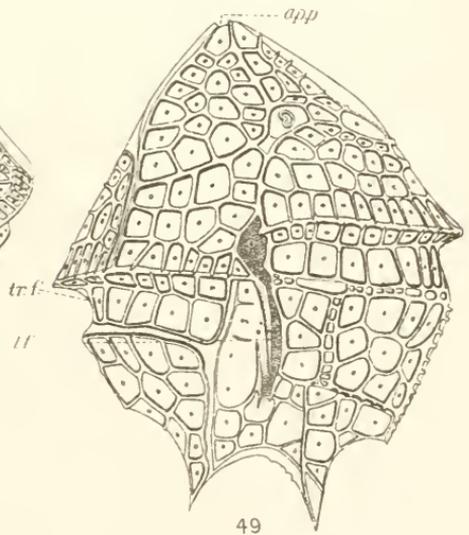
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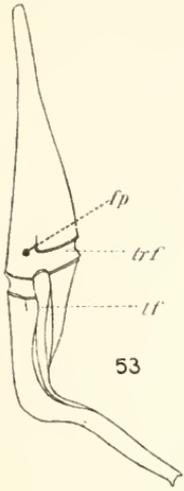
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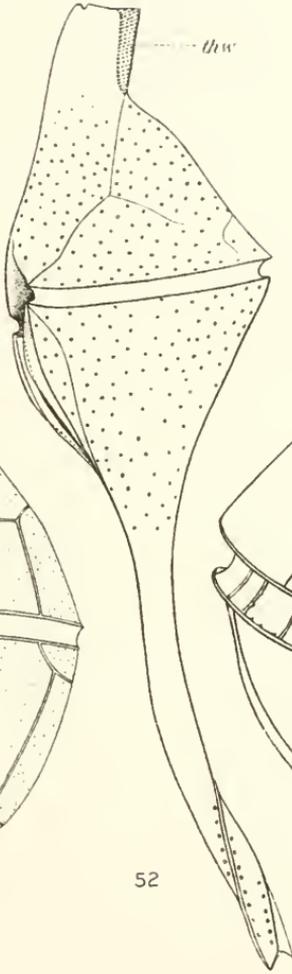
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PLATE 9.

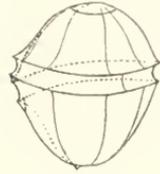
- Fig. 52. *Centrodinium elongatum*, sp. nov., left face. × 450.
Fig. 53. *Centrodinium deflexum*, sp. nov., ventral view. × 450.
Fig. 54. Same, left face. × 450.
Fig. 55. *Murrayella rotundata*, sp. nov., view of right face. × 442.
Fig. 56. *Murrayella globosa*, sp. nov., ventral face. × 935.
Fig. 57. *Murrayella spinosa*, sp. nov., ventral face. × 935.
Fig. 58. *Murrayella punctata* (Cleve), ventral face. × 935.



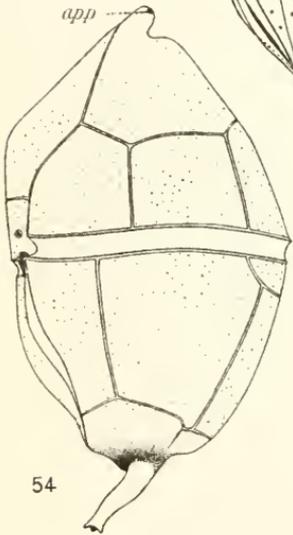
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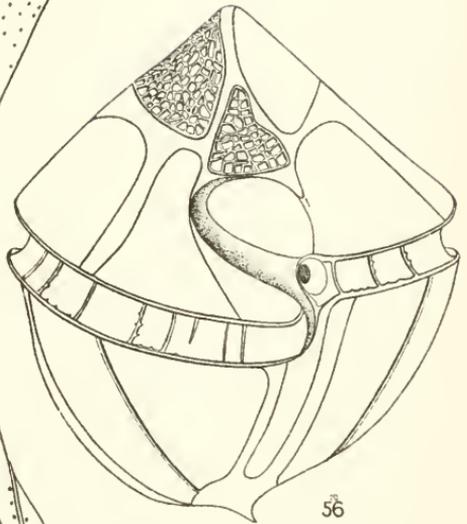
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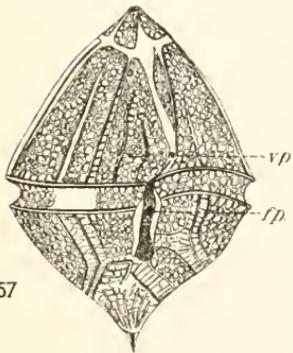
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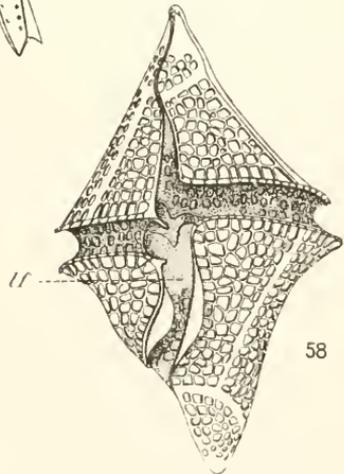
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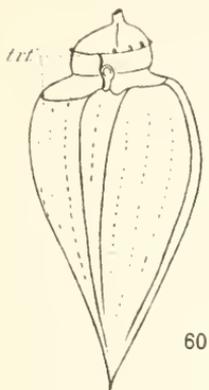
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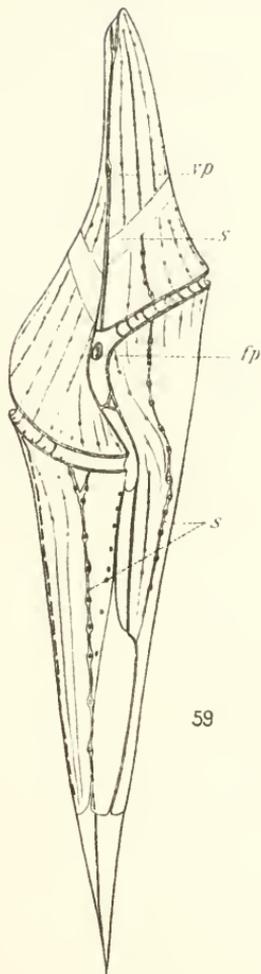
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PLATE 10.

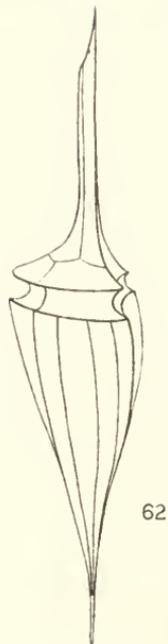
- Fig. 59. *Oxytoxum gigas*, sp. nov., ventral face. $\times 450$.
Fig. 60. *Oxytoxum turbo*, sp. nov., ventral face. $\times 935$.
Fig. 61. *Oxytoxum curvicaudatum*, sp. nov., sinistral face. $\times 442$. From life.
Fig. 62. *Oxytoxum subulatum*, sp. nov., dextral face. $\times 565$.
Fig. 63. *Oxytoxum compressum*, sp. nov., oblique view of sinistral face. $\times 442$.
From life.
Fig. 64. *Oxytoxum cristatum*, sp. nov., sinistral face. $\times 442$. From life.
Fig. 65. *Oxytoxum challengeroides*, sp. nov., ventral view, reticulations shown
only on midventral postcingular plate. $\times 935$.



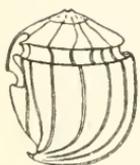
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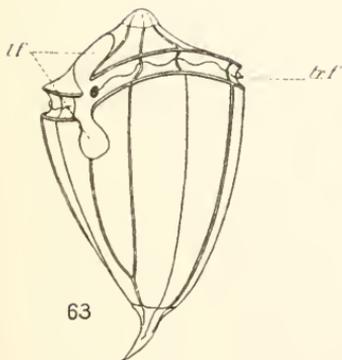
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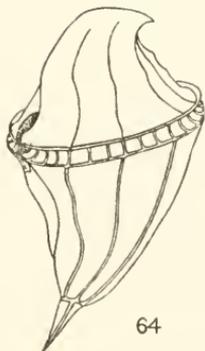
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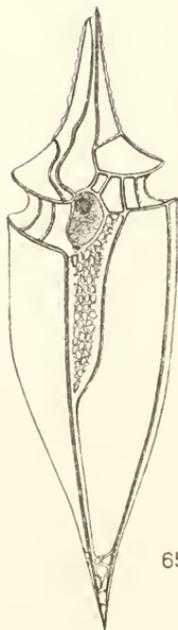
61



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64



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PLATE 11.

Fig. 66. *Acanthodinium spinosum*, sp. nov., ventral view. $\times 935$.

Fig. 67. *Acanthodinium caryophyllum*, sp. nov., ventral view. $\times 935$.

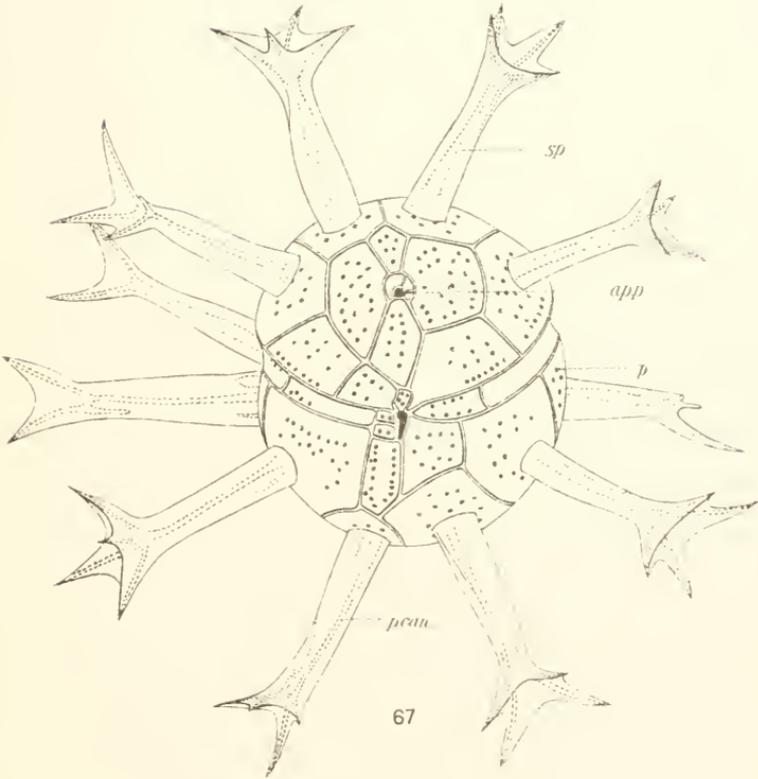
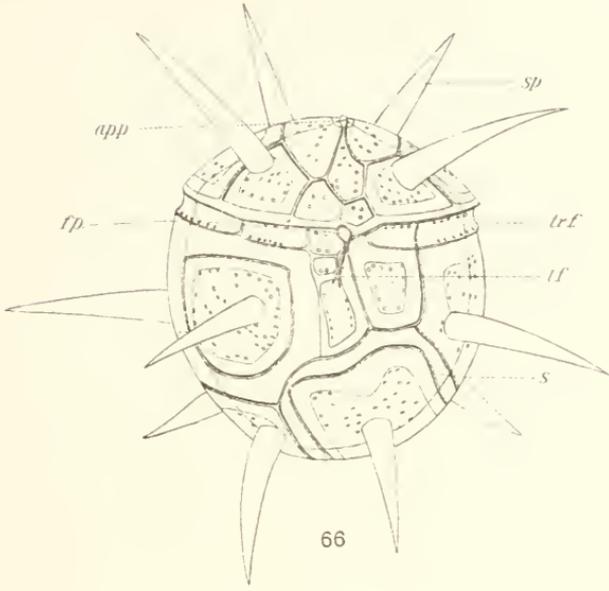
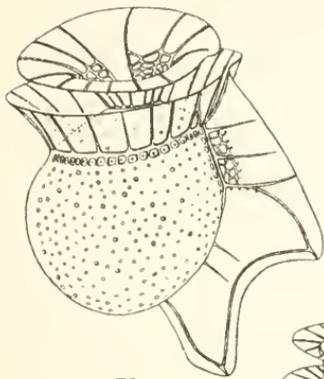
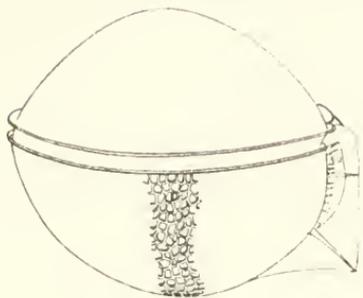


PLATE 12.

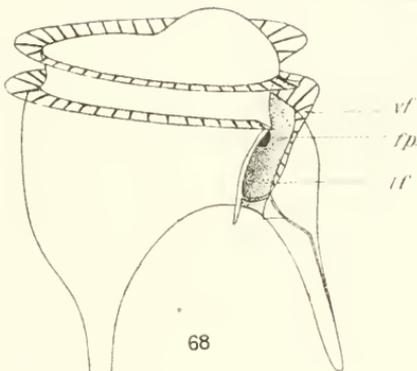
- Fig. 68. *Phalacroma ultima*, sp. nov., dextral view. $\times 935$.
Fig. 69. *Phalacroma lenticula*, sp. nov., dextral face. $\times 450$. Reticulations only partially shown.
Fig. 70. *Ornithocercus heteroporus*, sp. nov., dextral face. $\times 935$.
Fig. 71. *Protoceratium areolatum*, sp. nov., sinistro-ventral view. $\times 935$.
Fig. 72. *Phalacroma reticulata*, sp. nov., dextral face. $\times 450$.
Fig. 73. *Phalacroma striata*, sp. nov., sinistral face. $\times 337$.
Fig. 74. *Dinophysis triacantha*, sp. nov., dextral face. $\times 700$.



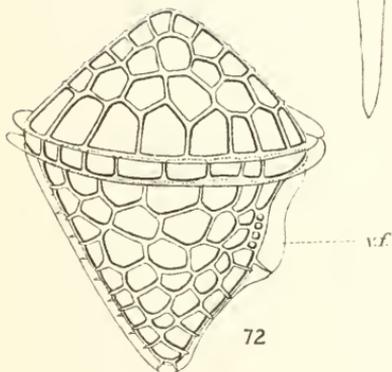
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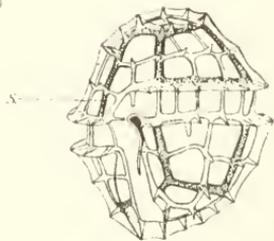
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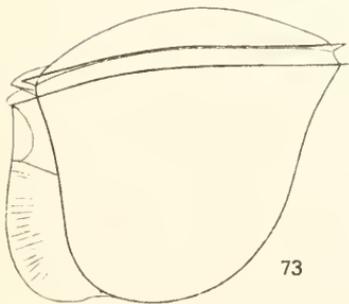
68



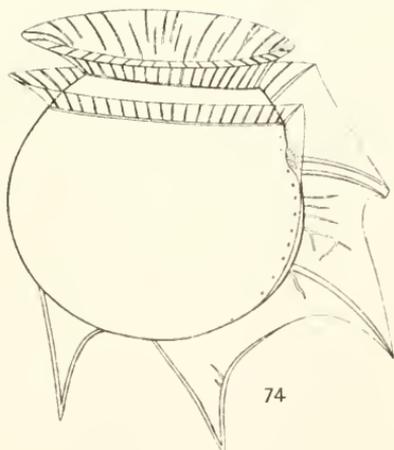
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73



74

PLATE 13.

- Fig. 75. *Amphisolenia quinquecauda*, sp. nov., dextral face. $\times 100$.
Fig. 76. *Amphisolenia asymmetrica*, sp. nov., dextral face. $\times 100$.
Fig. 77. *Amphisolenia projecta*, sp. nov., dextral face. $\times 450$. From life.
Fig. 78. *Amphisolenia extensa*, sp. nov., dextral face. $\times 100$.
Fig. 79. *Amphisolenia brevicauda*, sp. nov., dextral face. $\times 450$.
Fig. 80. *Amphisolenia laticincta*, sp. nov., dextral face. $\times 450$.
Fig. 81. *Amphisolenia schroederi*, sp. nov., dextral face. $\times 300$.
Fig. 82. *Amphisolenia dolichocephalica*, sp. nov., dextral face. $\times 100$.

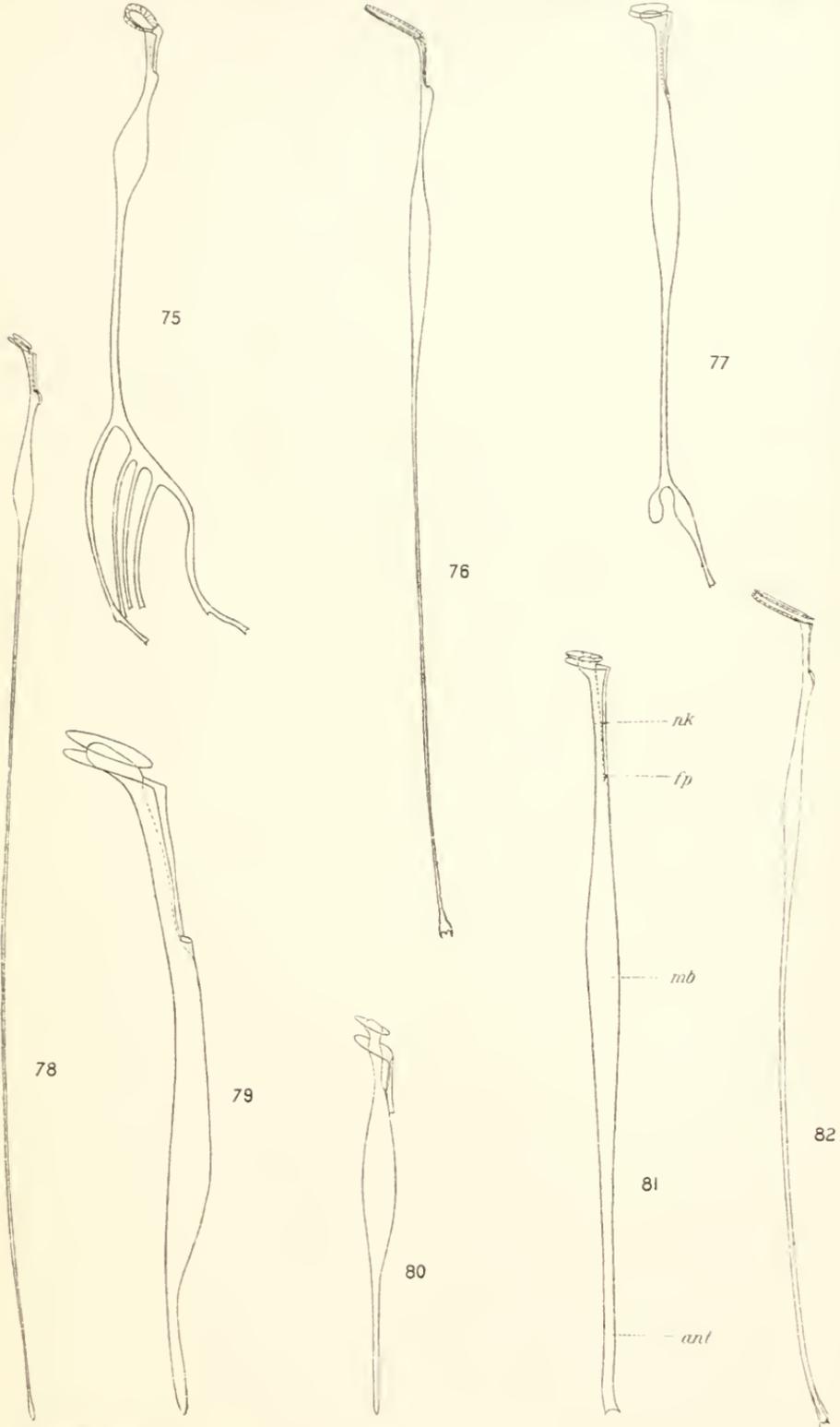
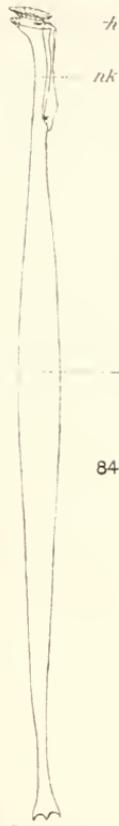


PLATE 14.

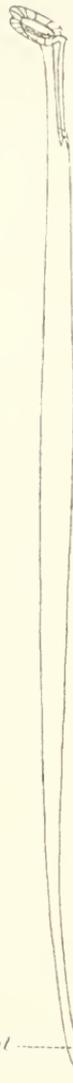
- Fig. 83. *Amphisolenia rectangulata*, sp. nov., dextral face. $\times 200$.
Fig. 84. *Amphisolenia palaeotheroides*, sp. nov., dextral face. $\times 208$.
Fig. 85. *Amphisolenia bispinosa*, sp. nov., dextral face. $\times 200$.
Fig. 86. *Amphisolenia quadrispina*, sp. nov., dextral face. $\times 200$.
Fig. 87. *Amphisolenia curvata*, sp. nov., dextral face. $\times 200$.
Fig. 88. *Amphisolenia lemmermanni*, sp. nov., dextral face. $\times 200$.
Fig. 89. Same, ventral view of antapex. $\times 200$.
Fig. 90. *Amphisolenia clavipes*, sp. nov., ventral view. $\times 450$.



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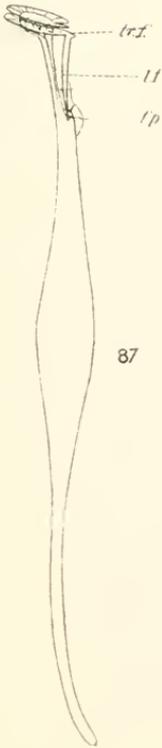
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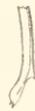
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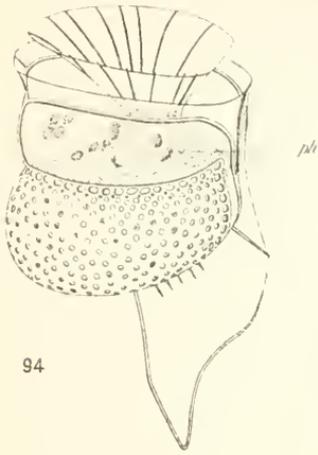
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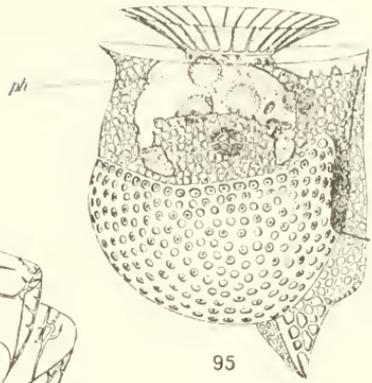
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PLATE 15.

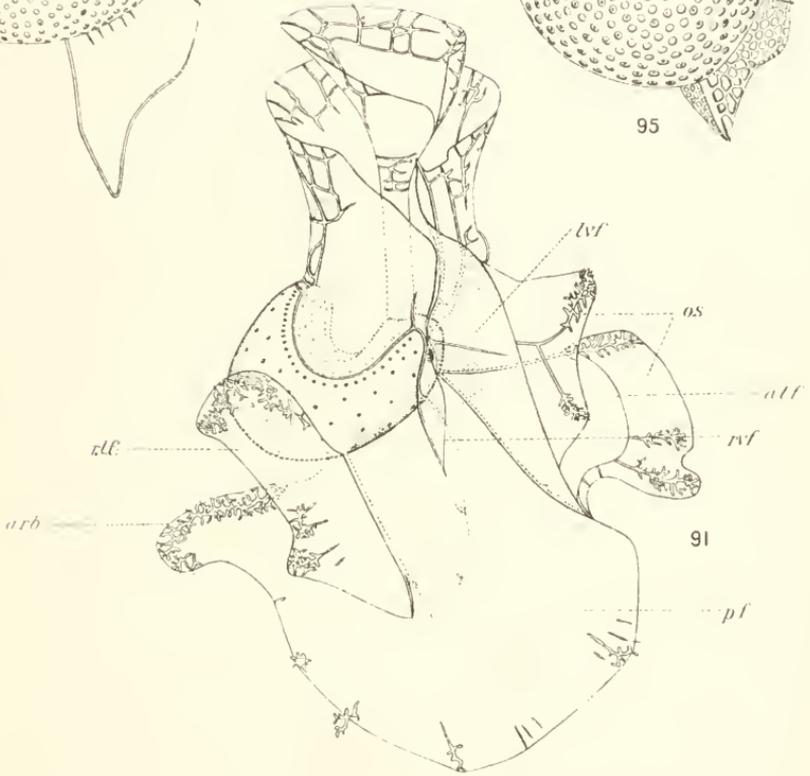
- Fig. 91. *Histioneis josephinae*, sp. nov., dextral face. × 840.
Fig. 92. *Ornithocercus carolinae*, sp. nov., dextral face. × 535.
Fig. 93. *Ornithocercus serratus*, sp. nov., dextral face. × 450.
Fig. 94. *Histioneis paulseni*, sp. nov., dextral face. × 840.
Fig. 95. *Histioneis reticulata*, sp. nov., dextral face. × 840.



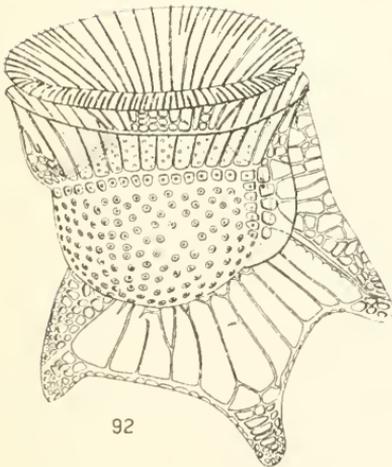
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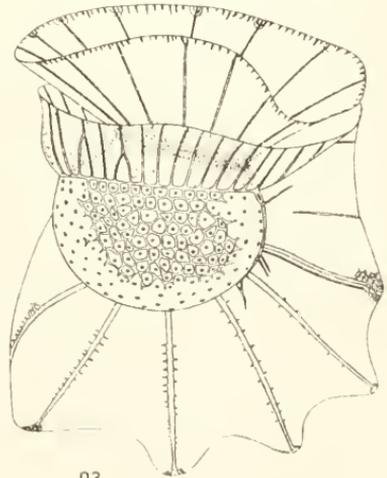
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91



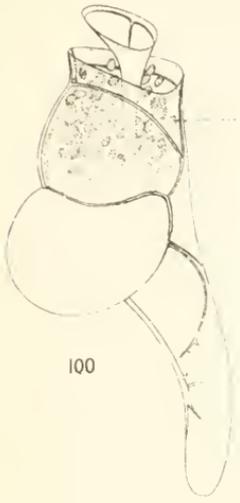
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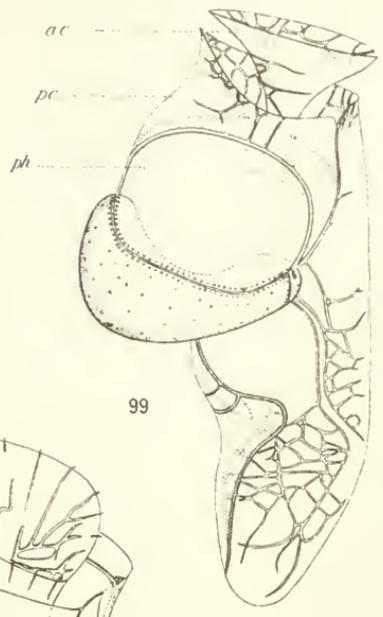
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PLATE 16.

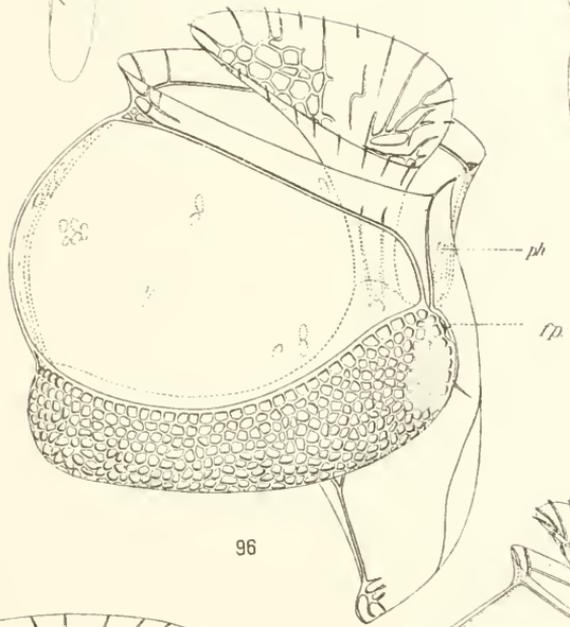
- Fig. 96. *Histioneis navicula*, sp. nov., dextral face. × 840.
Fig. 97. *Histioneis garretti*, sp. nov., dextral face. × 840.
Fig. 98. *Histioneis carinata*, sp. nov., dextral face. × 840.
Fig. 99. *Histioneis pulchra*, sp. nov., dextral face. × 840.
Fig. 100. *Histioneis longicollis*, sp. nov., dextral face. × 840.



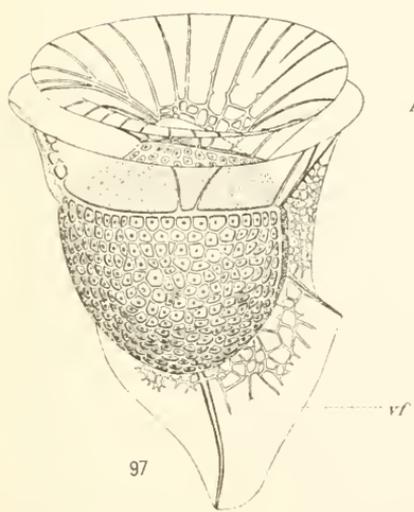
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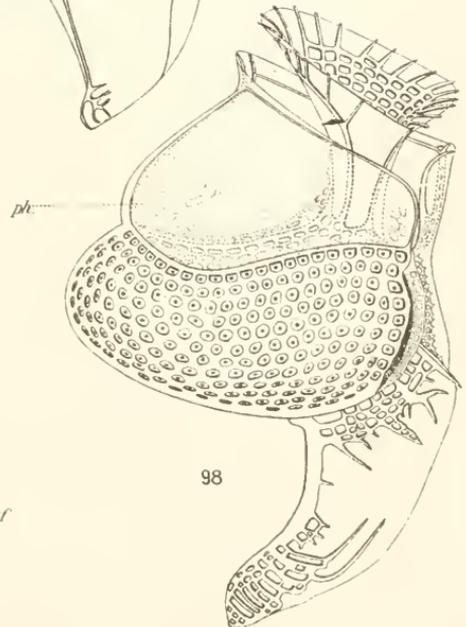
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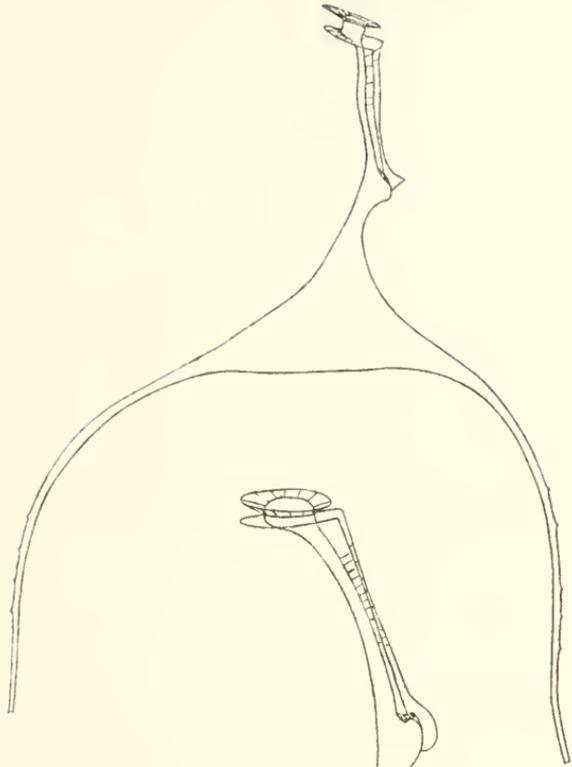
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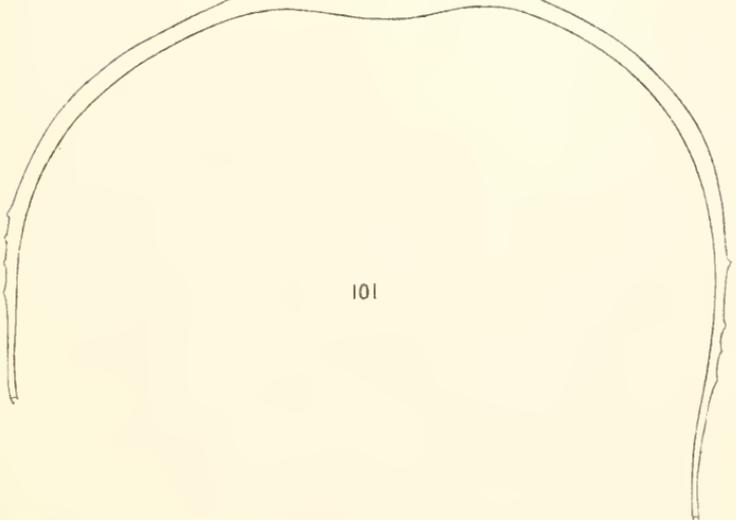
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PLATE 17.

- Fig. 101. *Tripodosolenia longicornis*, sp. nov., view of right face. $\times 505$.
Fig. 102. *Tripodosolenia fatula*, sp. nov., view of right face. $\times 505$.



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PLATE 18.

Map showing position of the stations occupied by the "Albatross" during the cruise in the Eastern Pacific in 1904-1905.

Bulletin of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
VOL. L. NO. 7.

MYLOSTOMID DENTITION.

BY C. R. EASTMAN.

WITH ONE PLATE.

CAMBRIDGE, MASS., U. S. A. :
PRINTED FOR THE MUSEUM.
FEBRUARY, 1907.

No. 7. — *Mylostomid Dentition*. BY C. R. EASTMAN.

THE reconstruction of the Mylostomid type of dentition acquires significance through its relevancy to the larger question of the affinities of Arthrodires. Nature has not disclosed to us by direct evidence the manner in which upper and lower dental plates of Mylostomids functioned against one another during life. The disposition of the various parts must therefore be determined by indirect means, such as by observing evidence of co-adaptation, mutual contact and wear, and, so far as may be, through analogy with related forms. In reality the problem is a simple one, devoid of mystery and intricacy, and requiring little mechanical ingenuity for its solution and complete verification. Of trivial intrinsic importance, its solution promises enlightenment as to the relations of the perplexing group of Arthrodires. A matter of minor interest in itself, it determines consequences of real magnitude, and hence is worthy of thoughtful consideration. It is proposed in the following pages to examine into the general nature of the problem, the different solutions that have been proposed for it, and some of the consequences depending thereon.

The limiting conditions of the problem may be stated first. Mylostomids are known upon the evidence of two fairly well-preserved skeletons to be Arthrodiran fishes essentially like *Dinichthys*, except that their dentition is adapted for crushing instead of cutting. The two specimens referred to are the only ones thus far discovered which present us with the disarranged but nearly complete dentition of single individuals. The fact that in each case the dental elements are known positively to have belonged to a single individual not only facilitates their reconstruction, but furnishes a scale of relative proportions which may be presumed to hold constant throughout the species. Thus provided with a standard of comparison, we may select from a sufficiently large assortment of detached plates the necessary components of a complete dentition, all of whose parts shall be proportionate with respect to one another, and shall have precisely the same conformation as those known to have been associated in a single mouth. Or, given a detached mandible of the same configuration as those found in natural assemblage with other parts,

the size of the upper dental plates which must have accompanied it during life can be predicted with entire accuracy.

Experience having shown that all of the dissociated dental elements now known, upper and lower, exhibit among themselves practically uniform dimensions and uniform conformation, one is entitled to conclude therefrom that they represent average-sized individuals, and that the elements were arranged after an invariable pattern. For, supposing their disposition to have been inconstant, we should be at a loss to account for their marked regularity of form and proportion, and similar indications of wear. Hence any theoretical reconstruction of the dentition, whether based upon detached specimens or upon the evidence of naturally associated parts, must satisfy the test of totality. It must apply universally, not only to such plates as are known to have belonged to a single individual, but to all those that have been found in the detached condition as well; it must be compatible with all their essential features, and be negatived by none of them.

It may be that only one, or more than one theoretical reconstruction of the dentition is competent to explain all the observed facts. As between two rival hypotheses, that one may be regarded as the more plausible which is mechanically simple, free from anomalous suppositions, and in harmony with analogy. An hypothesis which is mechanically complicated, presupposes anomalous conditions, and violates analogy, is less worthy of credence. For in so far as it depends upon the assumption of the unique, of something for which nature affords no parallel, it becomes improbable; and the improbable is always to be distrusted. Speaking broadly, any hypothesis whatsoever has the elements of trustworthiness, provided it can be shown to agree with a number of diverse facts. The greater number of diverse facts with which it agrees, the more completely can it be verified. When many circumstances point toward a single conclusion, the chances of that conclusion being correct are enormously increased with each additional favoring circumstance. They might even be supposed to increase in geometrical rather than in arithmetical ratio. Finally, an hypothesis that is found to agree entirely with observed facts cannot but be believed to be true. It will be instructive to inquire how far either of the two extant interpretations of Mylostomid dentition are in accordance with observed facts.

NEWBERRY'S VIEWS. — Our earliest information regarding the Mylostomid type of dentition is due to the zeal and acumen of Professor J. S. Newberry, who described the constituent elements of the type species,