Description: — The species differs from *Amphisolenia quadricauda* only in the following respects: — the antapical stem in front of the first branch is 5.8 times longer than the neck and 1.6 the total length of the anterior process and the midbody; however, this character is probably variable just as in *A. thrinax.* The most striking difference is that the antapical has four instead of three branches. Of these the second, third, and fourth are subequal and of about the same relative length and of the same shape and structure as the corresponding branches in *A. quadricauda.* The chromatophores are small, oblong, ellipsoidal, and numerous.

The proportions of one specimen, the type, were measured.

Dimensions: — Type specimen: Length of body, 840 μ. Length of head, 10 μ. Length of neck, 52 μ. Length of anterior process and midbody, 176 μ. Width of midbody, 44 μ. Length of antapical stem in front of first branch, 280 μ. Length of first branch, 316 μ. Length of second branch, 215 μ. Length of third branch, 187 μ. Length of fourth branch, 175 μ. Length of antapical stem behind fourth branch, 245 μ.

Comparisons: — The description given above is based on the type specimen. With regard to the relationships of the species, see the section on the comparisons of *Amphisolenia bifurcata* (p. 434).

Occurrence: — *Amphisolenia quinquecauda* is recorded at two of the 127 stations. These stations (4737, 4739) are on the fifth line of the Expedition and in the South Equatorial Drift. The samples are from 300–0 fathoms.

The surface temperatures of these stations were 81.5° and 70.0° respectively.

The frequency is less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4739 of the Expedition which thus is the type locality. The two record stations of this species are located in the area of distribution established for *Amphisolenia thrinax.*

Triposolenia Kofoid

Plate 14, 15, 27. Figure 60–74

Triposolenia Kofoid, 1906c, p. 93, 101; 1906d, p. 117; 1906e, p. 127; 1907a, p. 201.

Diagnosis: — Body seemingly tripartite, with three long and narrow extensions arising from midbody, one anterior, made up of head, neck, and anterior process, and two posterior, the antapicals, one of which is dorsal, the other ventral in origin. The three extensions are generally subequal and approximately balanced; their length is 1.0–3.4 the dorsoventral diameter of midbody measured between bases of antapicals.

TYPE.— *Triposolenia truncata.*

Organology: — The original *longitudinal axis of the body* in Triposolenia is no longer a straight or nearly straight line as in most other genera of Dinophysoidae owing to the obliquity of the neck and of the anterior process, and to the position and shape of the original antapical. For the sake of simplicity in quantitative determinations of structural features a new, more or less arbitrary, longitudinal axis of the body has therefore been utilized in this paper. In all species except one, *T. ambulatrix,* the axis utilized is that perpendicular to the line joining the midpoints of the bases of the two antapicals which is equidistant from these midpoints (Figure 60: 1, 2). In *T. ambulatrix,* unfortunately, another line had to

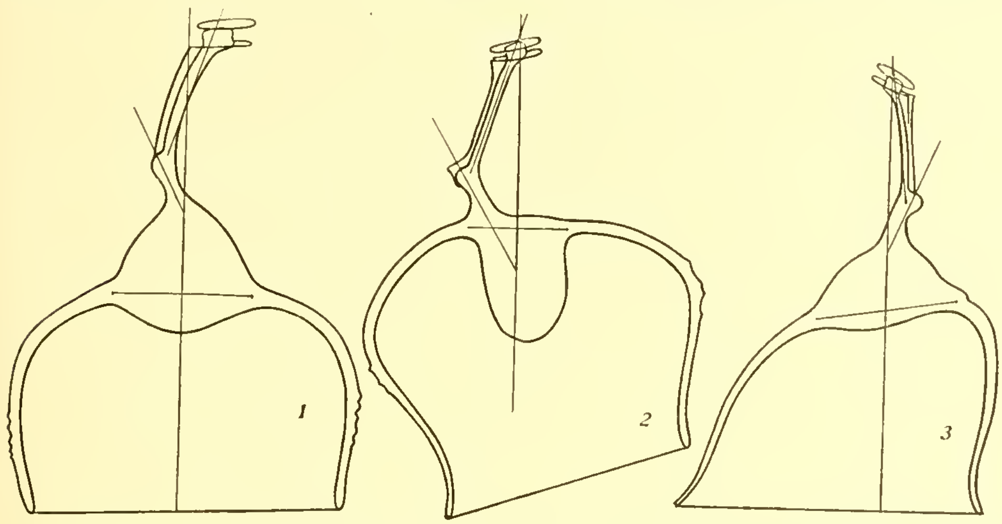

FIGURE 60.— Axes and angles utilized in our account of Triposolenia. In 1 and 2 the longitudinal axis of body is a perpendicular to line joining midpoints of bases of antapicals and equidistant from these midpoints; in 3 it is a perpendicular to line joining tips of antapicals and equidistant from midpoints of bases of these processes. The main axis of anterior process is drawn through midpoint of posterior end of process and through flagellar pore. The main axis of neck runs through midpoints of posterior and anterior ends of neck.

1, *Triposolenia intermedia,* sp. nov., left lateral view. × 360. Station 4613 (300–0 fathoms). This species is of the same type as *T. truncata, T. depressa, T. bicornis, T. longicornis,* and *T. fatula.* 2, *Triposolenia ramiciformis* Kofoid, left lateral view. × 360. Station 4613 (300–0 fathoms). This species has the same type as *T. exilis.* 3, *Triposolenia ambulatrix* Kofoid, right lateral view. × 360. Station 4713 (300–0 fathoms). This is the only species of this type.

be chosen. It is that perpendicular to the line joining the tips of the antapicals which is equidistant from the midpoints of the bases of these processes (Figure 60: 3).

These arbitrary longitudinal axes of the body have been chosen as bases of reference because of their relations to the plane of the girdle, to the longitudinal axis of the midbody, and to the antapicals. The plane of the girdle is nearly perpendicular to these arbitrary longitudinal axes, or at least more nearly so than to the main axis of the neck. Presumably the axis of rotation in locomotion is approximately perpendicular to the plane of the girdle and is therefore nearly coincident with or at least nearly parallel to the longitudinal axis used in this paper.

The body is seemingly tripartite. It has three long and narrow extensions arising from the midbody: one anterior, made up of the head, the neck, and the anterior process; and two posterior, the antapicals, one of which is dorsal, the other ventral in origin. The three extensions are generally subequal and approximately balanced; their length is 1.0–3.4 the dorsoventral diameter of the midbody measured between the bases of the antapicals.

Triposolenia is remarkable because of the combination of asymmetry, both bilateral and dorsoventral, with an approximately balanced relation of the three extensions of the midbody.

The *head* (*hd.*, Figure 61) is short, its axial length being only 0.14–0.45 the length of the neck. It is composed of the very short epitheca, the girdle region covering nearly two thirds of its axial length, and of a short, expanded region at the anterior end of the neck. It is bilaterally compressed; its transdiameter is not much greater than that of the neck. Its dorsoventral diameter (its "width," according to the terminology utilized in this paper) is somewhat variable, 0.6–2.0 its axial length. In lateral view the anterior face of the head, the epitheca, is more or less convex in most species; in a few species it is flat and in *Triposolenia truncata* even quite concave. Sometimes the head is subhorizontal; sometimes it is more or less inclined, about 1°–20°, anteriorly, that is, its dorsal end is elevated. Because of the narrowness of the head, the inclination is difficult to determine accurately, and so this characteristic has not been utilized in our descriptions of species. The head passes more or less abruptly into the neck.

The *neck* (*n.*, Figure 61) is an elongate, slender, almost cylindrical, and somewhat oblique extension of the anterior process. Its length, measured in a straight line from the posteroventral point of the head to the flagellar pore (Figure 61), is 0.14–0.28 the length of the body. The distance between the midpoints of the bases of the antapicals is about 0.8–2.3 the length of the neck. The neck is 3–17 times longer than wide, of nearly uniform caliber throughout, or somewhat constricted anteriorly, almost straight or somewhat concave dorsally, and generally more or less deflected, about 1°–25°, dorsally from the longitudinal axis of the body.

The *anterior process* (*ant. p.*, Figure 61) is an extension of the midbody in the anteroventral direction at an angle of about 12° to 41° from the longitudinal axis of the body. In the subgenus Triposolenia it arises from about the middle of the anterior side of the midbody. In the subgenus Ramiciformia its point of origin is so decidedly shifted ventrally that the anteroventral margin of the midbody is suppressed, and the ventral antapical and the anterior process bifurcate from a common, although but slightly developed projection of the midbody. The length of the anterior process, measured in a straight line from the midpoint of the flagellar pore to the midpoint of the posterior end of the process (Figure 61), is very hard or even impossible to establish with accuracy in many species. This is due to the fact that the process often merges gradually, sometimes even imperceptibly into the midbody, which, of course, prevents the establishment

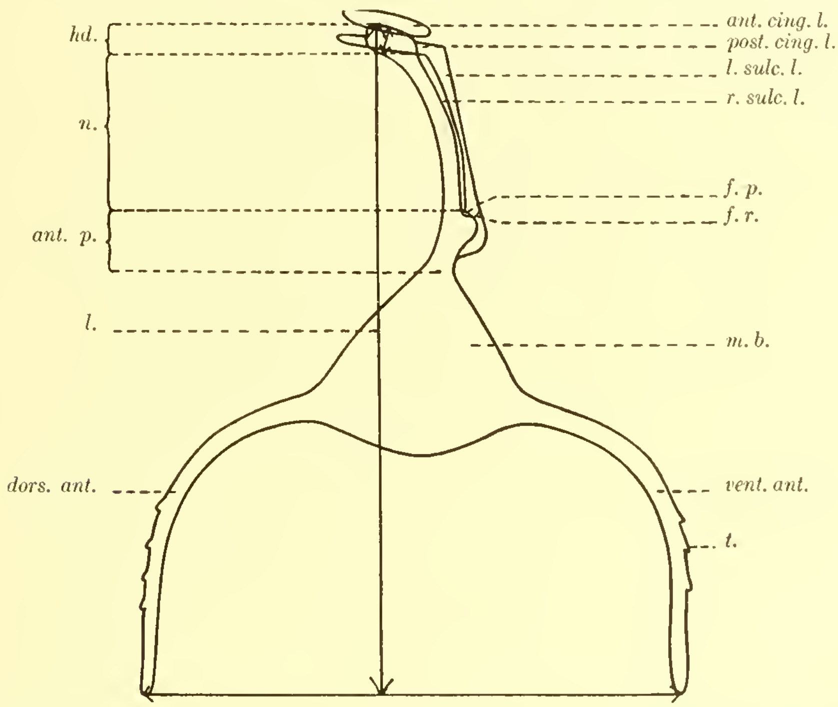

FIGURE 61.— *Triposolenia intermedia*, sp. nov., right lateral view. × 550. Station 4583 (300–0 fathoms). The length of body is measured from foremost point of head perpendicularly to line connecting tips of antapicals. Our method of measuring the (axial) length of head is indicated by bicapitate barbed line crossing the head. The length of neck is the distance in a straight line from posteroventral point of head to flagellar pore. The length of anterior process is the distance in a straight line from midpoint of flagellar pore to midpoint of posterior end of process. The dorsoventral diameter of midbody is the distance between midpoints of bases of antapicals. The lengths of antapicals are measured along curvatures from midpoints of bases to tips. The distance between tips of antapicals is measured between midpoints of tips.

Abbreviations:— *ant. cing. l.*, anterior cingular list; *ant. p.*, anterior process; *dors. ant.*, dorsal antapical; *f. p.*, flagellar pore; *f. r.*, fission rib; *hd.*, head; *l.*, length of body; *l. sulc. l.*, left sulcal list; *m. b.*, midbody; *n.*, neck; *post. cing. l.*, posterior cingular list; *r. sulc. l.*, right sulcal list; *t.*, tubercle; *vent. ant.*, ventral antapical.

of anything but an arbitrary posterior limit. However, it may be safe to say that the length does not exceed the axial length of the midbody; in most cases it evidently is decidedly less. The process is relatively stout, almost cylindrical or slightly compressed bilaterally, and anteriorly about twice as wide dorsoventrally as the neck. Anteriorly it expands around the *flagellar pore* (*f.p.*, Figure 61), forming a conspicuous, well-rounded *cytopharyngeal protuberance*.

The *midbody* (*m.b.*, Figure 61) is a centrally located enlargement of the body, strongly compressed bilaterally. Its axial length is about 0.15–0.33, its dorso-ventral diameter 0.12–0.40, and its transdiameter 0.04–0.10 the length of the body. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is from about 1.0 to nearly 3.0 the length of the neck. In the subgenus Triposolenia the midbody is in lateral view characterized by a subtriangular, subrotund or subellipsoidal shape. The corners of the triangle are marked by the anterior process and by the two antapicals. The three margins, the anterodorsal, anteroventral, and posterior margins, are more or less convex, almost straight or slightly concave. In most cases they are subequal in length; when differences in length do occur, the anteroventral margin generally is the shortest, due to the ventral dislocation of the anterior process, and the postmargin is the longest. In the subgenus Ramiciformia the anteroventral margin of the midbody is suppressed due to the ventral dislocation of the anterior process, the anterodorsal margin is straight or slightly convex or concave, and the postmargin is extended in a pendent, oblong, or rounded sack-shaped lobe.

The two *antapicals* (*dors. ant.* and *vent. ant.*, Figure 61) are sagittal extensions of the midbody, and are respectively ventral and dorsal in origin. They are prolongations of the thecal wall with protoplasmic core and are simple, long (1.8–3.4 times longer than the neck), narrow (6–50 times longer than wide), and approximately circular in cross-section. The dorsal antapical is in most species a trifle shorter than the ventral. Both antapicals stand, except in *Triposolenia ambulatrix*, in a balanced relation to the longitudinal axis of the body. In the species with balanced antapicals, the latter are always curved in the sagittal plane from a posterodorsal and a posteroventral direction, respectively, at their bases to a more or less posterior direction distally; sometimes they have a sigmoid curvature, being outwardly convex anteriorly and concave posteriorly. In some of these species the curvature is more or less localized in a major flexure or geniculation; in others, as in *T. truncata*, it is almost evenly distributed throughout the entire length. In *T. ambulatrix* the ventral antapical is abruptly deflected posterodorsally and has a more or less pronounced sigmoid curvature, its tip being deflected ventrally. The dorsal antapical of this species is deflected dorsally to such a degree that its balance with the ventral one is destroyed; it has a moderate dorsal convexity, and its tip is sometimes deflected dorsally which gives to the antapical a sigmoid shape. In addition to the curvature in the sagittal plane there is in all species a slight bilateral asymmetry, in that the antapicals do not lie in the sagittal plane of the midbody in their total extension but are slightly bent to the right in the middle or anterior regions and posteriorly to the left; the dorsal antapical exhibits generally more of the posterior curvature than the ventral. The tips of the antapicals are sometimes rounded and without *spinules* (*T. exilis*, Kofoid, 1906c, pl. 17, fig. 8); sometimes they are more or less truncate with dorsoventral spinules, as in *T. truncata*, or with lateral spinules, as in *T. depressa*. Except in *T. truncata* and in some specimens of *T. ambulatrix*, the outer margins of the major flexures or adjacent regions bear 2–5, rarely 1, 6, or 7, small elevations or *tubercles* (*t.*, Figure 61), each pierced by a pore. The tubercles lie close to the sagittal suture of the valves and are conical and often deflected posteriorly. In the subgenus Ramiciformia they are farther in front than in the subgenus Triposolenia.

The question is still open whether the ventral or the dorsal antapical is the original posterior part of the body. In Amphisolenia the branches of the antapical appear to be ventral in origin. In Dinophysis and Dinofurcula the accessory posterior process seems to be dorsal. The branching has undoubtedly originated independently in these three genera, as well as in Triposolenia. In attempting to find out which of the two antapicals in Triposolenia does correspond to the original posterior part of the body, we are therefore probably not justified in basing our conclusions on the conditions in the other known genera of this tribe.

The *transverse furrow* (Plate 14, fig. 1, 7, 14) forms a slightly oblique equatorial band around the small head, covering nearly two thirds of its axial length. Its distal part is not displaced posteriorly, *i.e.*, the furrow does not form a spiral about the head. Sometimes the furrow is nearly perpendicular to the arbitrary longitudinal axis of the body used in this paper, but in most cases it is somewhat inclined anteriorly, due to the anterior inclination of the head. Its anterior inclination is, as a rule, somewhat less than that of the head. Its floor is sometimes slightly convex, sometimes flattened or more or less concave; this character seems to vary even within the species.

The *longitudinal furrow* (Plate 14, fig. 1, 7, 14) is long and narrow. It is narrower than the neck and extends on the ventral side of the right valve of the neck in about a straight line from the transverse furrow to a little beyond the posterior end of the neck. It does not extend beyond the girdle, *i.e.*, into the epitheca. It is at most but slightly impressed.

The *lists of the furrows* are not excessively developed. They arise from low and narrow basal ridges (Plate 14, fig. 7, 14) and are hyaline, exceedingly delicate, and mostly furnished with simple, radial ribs. Frequently the basal ridges of the cingular lists are connected by a number of low and narrow ridges crossing the transverse furrow. The ventral ones of these cross-ridges are first and best developed.

The *anterior cingular list* (*ant. cing. l.*, Figure 61) is a flaring sheet, open ventrally, of moderate and almost uniform width throughout the greater part of its length, about as wide as or about two to three times wider than the transverse furrow. It has, on each valve, about five to twelve simple and nearly equidistant cross-ribs. Of these ribs two near the ventral suture of the valves are in many cases a little stronger than the others. On the dorsal side of the head the list flares anteriorly at an angle of about 10° to 40° from the transverse plane of the girdle, and it is frequently slightly concave ventrally.

The *posterior cingular list* (*post. cing. l.*, Figure 61) either has about the same width, inclination, and structure as the anterior, or else it is somewhat less inclined anteriorly, sometimes even subhorizontal, and has somewhat less-developed ribs.

The *sulcal lists* (*r. sulc. l.*, and *l. sulc. l.*), which form a direct continuation of the posterior cingular list, run about parallel to each other along the whole length of the neck. Posteriorly they diverge a little to enclose the flagellar pore. The left list approaches the median line just behind the pore, continues posteriorly for a short distance beyond the pore along the ventral side of the anterior process, and dies out within a short distance of the pore. The right list, which continues for but a very short distance beyond the flagellar pore, ends on the side of the cytopharyngeal protuberance. Both lists are of moderate width, generally somewhat narrower than the cingular lists; the right is slightly narrower than the left. The right decreases somewhat in width posteriorly; the same is true in the case of the left, except near the flagellar pore, where it increases somewhat in width. Their width and shape are somewhat variable even within the species. The ribs of the sulcal lists are different in the various species; they are of about the same type as, but, as a rule, somewhat less developed than, those of the cingular lists. Near the sagittal plane, just behind the flagellar pore, the left list in most cases has a fairly distinct rib (*f.r.*, Figure 61), supposed by us to be homologous with the *fission rib* of the left sulcal list in other genera of Dinophysoidae (see the section on the reproduction of the genus, p. 453).

The *flagellar pore* (*f.p.*, Figure 61) is a fairly large opening at the posteroventral end of the neck, or to express it in another way, at the anteroventral end of the anterior process, and leads into a narrow funnel, the *flagellar fundus*. It is ventrally surrounded by the cytopharyngeal protuberance, and its left lip is somewhat higher than the right. It is therefore directed anteriorly and somewhat to the right.

The *transverse flagellum* (*tr. fl.*, Kofoid, 1906c, pl. 16, fig. 6) arises in the flagellar pore and passes anteriorly between the sulcal lists and encircles the head from the left around to the right as in other girdled dinoflagellates.

The *longitudinal flagellum* has not been seen by us, nor is there any clear statement in the literature that this flagellum has been seen by any other investigator. Hjort (1911, pl. 12: 3) gives a reproduction of Kofoid's (1906c, pl. 15, fig. 1) drawing of the type specimen of *Triposolenia bicornis* to which a long trailing flagellum has been added. However, this addition probably is purely diagrammatical. The posterior displacement of the flagellar pore is suggestive of a possible reduction of this flagellum to a rudimentary state.

The *thecal wall* is of nearly uniform thickness except on the concave faces of the antapicals, where, as in Ceratium, it is somewhat thickened, especially in the more robust individuals. In most species it is hyaline and under low magnifications apparently structureless. When these species are examined under high magnifications, however, the wall is found to be very faintly and minutely spotted or flecked; sometimes it also is striate. In but a single species, *Triposolenia truncata*, are there plainly visible pits and reticulation; this is undoubtedly to be considered the more primitive condition. Pores are found only in the antapical tubercles and along the sagittal suture on the ventral side of the neck.

The *sagittal suture* is not structurally marked except by a faint line, or a few scattered pores along the ventral side of the neck or in the tubercles on the major flexures of the antapicals. The three *plates*, epithecal, cingular, and hypothecal, of each valve have never been found parted in the specimens thus far observed.

The *protoplasmic contents* (Plate 15, fig. 2) are very hyaline and coarsely granular. The *nucleus*, which is located in the midbody, is compressed and ellipsoidal, and has a moniliform chromatin reticulum. In the subgenus Ramiciformia, the nucleus and the greater part of the protoplasm are found in the pendent region of the midbody. Near the nucleus is found a *pusule*, which opens by a slender canal into the flagellar pore. One or more *accessory pusules*, also opening into the flagellar pore, may lie near it in the plasma. Occasionally the plasma is crowded with highly refractive ellipsoidal *metaplasmic bodies* of amyloid character. In many individuals it is possible to find small irregular, very pale yellowish-green, sometimes nearly colorless *chromatophores*. No species appears to possess the protoplasmic structures with a characteristic pattern in either form or distribution.

The *length of the body*, measured from the foremost point of the head perpendicularly to the line connecting the tips of the antapicals (Figure 61), is a fairly variable character even within the various species. The range of variation in length for the genus as a whole thus far established is 92 μ to 243 μ.

Reproduction: — Neither sexual reproduction nor binary fission has been observed as yet. Nor is there any evidence of a megacytic phase preceding binary fission.

The entire course of the line of fission is not known with certainty. Most probably it is as follows: — On the dorsal side of the body, along the middle of the head, neck, anterior process, midbody and antapicals. On the ventral side of the body, along the middle of the head, along the left side of the sulcus, to the left of the flagellar pore, crossing the left sulcal list just behind this pore, and along the middle of the anterior process, midbody, and antapicals. This assumption is supported by the conditions in Amphisolenia, as established in the present paper (Plate **13**, fig. 1–6, 8), and by the following facts which have been indicated in the section on the organology. The left sulcal list swings in toward the median line just behind the flagellar pore. Near the sagittal plane, just behind the pore, it has usually a fine rib, behind which it continues for a short distance along the ventral side of the anterior process. This rib is, according to our opinion, homologous with the fisson rib of the left sulcal list in other genera of this tribe, *e.g.*, Amphisolenia, Phalacroma, and Dinophysis (Plate **13**, fig. 6; Plate **1**, fig. 6; Plate **5**, fig. 3). Since no representative of Triposolenia has been observed in a stage of division, it cannot be stated positively that the left sulcal list is parted at this rib, and that its anterior and posterior parts are going to the left and to the right valve respectively, but the homologies here indicated make such a division probable. In any case, the continuation of the left sulcal list behind "the fission rib" in *Triposolenia* runs near the sagittal plane and may well belong to the right valve.

Distribution: — Our present knowledge of the general oceanic distribution of Triposolenia must be regarded as very incomplete. The distributional data available, given by Kofoid (1906c, 1907a) and Jörgensen (1923), are accompanied by drawings and thus can be checked.

The genus is marine and probably exclusively eupelagic. We have found it to be extensively distributed throughout the tropical, subtropical, and warm-temperate regions of the Eastern Pacific, and it has been recorded from the southwest coast of Portugal, from the Mediterranean, and from the Marmora Sea by Jörgensen (1923). It is therefore probably of world-wide distribution in tropical, subtropical, and warm-temperate waters. The fact that it has not been found as yet except in the regions mentioned above is presumably largely due to its very rare occurrence at the surface and the limitation of most plankton collections to surface levels.

The typical habitat of the genus appears to be the deeper levels of photosynthesis, predominantly between 200 and 100 meters (Jörgensen, 1923, p. 42, 43). Only one of the eight known species, *Triposolenia bicornis*, has been recorded as yet from surface waters (Kofoid, 1906c, p. 107). No closing-net data have been published as yet.

All the species seem to be rare. Even the most frequent members of the genus, *Triposolenia bicornis* and *T. ramiciformis*, have never been found up till the present time except in small numbers.

The most outstanding peculiarity of the distribution of Triposolenia according to the data of the Expedition is that the genus did not occur in any of the eighty-one surface catches nor in any of the twenty-four samples of Salpa stomachs from specimens taken in surface waters, although it is recorded from as many as fifty-nine (46.5%) out of the 127 stations of the Expedition at which Dinoflagellates were found. Most of the records are from vertical hauls from 300–0 fathoms, some from vertical hauls from 800, 400, 150, 100–0 fathoms. Vertical hauls were made at only sixty-eight out of the 127 stations. Representatives of the genus thus were found at no less than 86.8% of the stations at which vertical hauls were made.

Disregarding the stations at which surface catches only were made, the record stations of Triposolenia are distributed over the area covered by the Expedition in the following manner (Plate **27**): —

4 (100.0%) out of the 4 stations in the California Current
5 (100.0%) out of the 5 stations in the Mexican Current
6 (100.0%) out of the 6 stations in the Panamic Area
16 (76.2%) out of the 21 stations in the Peruvian Current
3 (60.0%) out of the 5 stations in the Easter Island Eddy
2 (100.0%) out of the 2 stations in the Galapagos Eddy
22 (95.7%) out of the 23 stations in the South Equatorial Drift
1 (100.0%) out of the 1 station in the South Equatorial Current

No vertical collections were made in the Equatorial Counter Current or in the North Equatorial Current.

The numbers of these fifty-nine stations are as follows: — 4571, 4574, 4580, 4583 (California Current); 4587, 4590, 4594, 4598, 4605 (Mexican Current); 4609, 4613, 4617, 4634, 4637, 4638 (Panamic Area); 4648, 4650, 4652, 4655, 4657, 4659, 4662, 4663, 4665, 4666, 4667, 4668, 4670, 4671, 4675, 4676 (Peruvian Current); 4691, 4697, 4699 (Easter Island Eddy); 4713, 4715 (Galapagos Eddy); 4679, 4681, 4683, 4685, 4687, 4701, 4705, 4707, 4709, 4711, 4717, 4719, 4721, 4722, 4724, 4728, 4730, 4732, 4734, 4737, 4739, 4740 (South Equatorial Drift); 4742 (South Equatorial Current).

The fifty-nine stations at which Triposolenia was found (Plate **27**) are scattered over the whole area covered by the Expedition and do not show any pronounced concentration in any of the regions into which this area has been divided. In the California Current, the Mexican Current, the Panamic Area, the Galapagos Eddy, and the South Equatorial Current the genus occurred at all the stations at which vertical hauls were made; in the South Equatorial Drift it was found at no less than twenty-two out of the twenty-three stations with vertical hauls. In the Peruvian Current it occurred at only sixteen out of the twenty-one stations with vertical hauls and in the Easter Island Eddy at only three out of the five stations with vertical hauls. If, on the other hand, the number of records of species, instead of the number of record stations, is considered, there appears to be a moderate concentration of the genus in the Peruvian Current and in the region of the South Equatorial Drift that is under the direct influence of this current, but in the Easter Island Eddy the genus is strikingly scarce. In the Easter Island Eddy the genus is recorded three times only; two of these three records are of *T. bicornis*, the remaining one of *T. ramiciformis*.

When the distribution of Triposolenia (Plate 27) in the region investigated by the Expedition is compared with that of the closely related Amphisolenia (Plate 26), we find the following outstanding similarities and differences. (*1*) Both genera have been found throughout the whole region investigated. (*2*) While in Triposolenia no species has been recorded from the surface, several species of Amphisolenia have been found in surface catches. However, most of the species of Amphisolenia appear also to be more or less limited to the deeper levels of photosynthesis. (*3*) While in Triposolenia there is a relatively large number of records of species in the Peruvian Current and in the portion of the South Equatorial Drift that is under the direct influence of this current, a moderate number of records of species in the western portion of the South Equatorial Drift, and a very small number of records of species in the Easter Island Eddy, there is in Amphisolenia a strikingly small number of records of species in the Peruvian Current and in the portion of the South Equatorial Drift that is under the direct influence of this current and a remarkably large number of records of species in the western and middle portions of the South Equatorial Drift and in the Easter Island Eddy.

In order to understand the differences between the horizontal distribution of Triposolenia and that of Amphisolenia in the area investigated by the Expedition, it is necessary to consider the horizontal distributions of the individual species of these two genera according to the data of the Expedition.

Disregarding the species of rare occurrence, the species of Triposolenia belong to any one of three main distributional types. Type 1: This type is characterized by an even distribution throughout the area investigated by the Expedition. It is represented by one species only, viz., *T. bicornis*, which according to available data is the most common representative of this genus (Figure 67). Type 2: This type is characterized by a distribution in waters of high average temperature. It is represented by one species only, viz., *T. truncata* (Figure 63). Most of the record stations of this species are in the Panamic Area and in the western portion of the South Equatorial Drift. In the relatively cool Peruvian Current and in the portion of the South Equatorial Drift that is under the direct influence of this current, this species appears to be either very rare or absent. Type 3: This type is characterized by a comparatively frequent occurrence in the relatively cool Peruvian Current and the portion of the South Equatorial Drift that is under the direct influence of this current. It comprises three of the most frequent species of this genus. Its most typical representative is *T. longicornis* (Figure 70). This species is recorded at a rather large number of stations in the Peruvian Current and the eastern portion of the South Equatorial Drift but has never been found in the Easter Island Eddy and in the western portion of the South Equatorial Drift. Another typical member of this group is *T. ramiciformis*, which next to *T. bicornis* is the most common species of this genus. *T. ramiciformis* (Figure 74) is recorded at forty of the 127 stations of the Expedition. Of these forty stations no less than twenty-six are in the Peruvian Current and in the portion of the South Equatorial Drift that is under the direct influence of this current, and two are in the Galapagos Eddy, which also is directly influenced by this current. In the western portion of the South Equatorial Drift and in the Easter Island Eddy, this species was found altogether at two stations only. *T. depressa* (Figure 65) also belongs to this group, but its distribution is somewhat atypical. It prevails in the Peruvian Current and in the eastern portion of the South Equatorial Drift and is absent in the Easter Island Eddy, but there are also some record stations in the western portion of the South Equatorial Drift.

The most frequent species of Amphisolenia belong to any one of three main distributional types. Type 1: This type is characterized by an almost even distribution throughout the area investigated by the Expedition. As examples *A. extensa* (Figure 52) and *A. globifera* (Figure 53) may be mentioned. Type 2: The species of this distributional type occur throughout the whole area investigated, but they are less frequent in the relatively cool Peruvian Current and in the eastern portion of the South Equatorial Drift, which is directly influenced by this current, than they are in the western portion of the South Equatorial Drift. This type includes *A. bidentata* (Figure 55) and *A. lemmermanni* (Figure 57). TYPE 3: The species of this type occur in waters of high average temperature. Their main habitat appears to be the western portion of the South Equatorial Drift and the Easter Island Eddy, and they have not been found as yet in the Peruvian Current and in the eastern portion of the South Equatorial Drift. This type includes *A. schauinslandi* (Figure 51), *A. thrinax* (Figure 59), and probably *A. rectangulata, A. bifurcata, A. quadricauda,* and *A. quinquecauda.*

The differences between the horizontal distribution of Triposolenia and that of Amphisolenia mentioned above are therefore due to the fact that in Triposolenia most of the species of relatively frequent occurrence prevail in the comparatively cool Peruvian Current and in the portion of the South Equatorial Drift that is directly influenced by this current, while in Amphisolenia most of the relatively common species are warm-water forms with their principal habitat in the middle and western portions of the South Equatorial Drift and in the Easter Island Eddy and are absent or of rare occurrence in the Peruvian Current and in the eastern portion of the South Equatorial Drift. The similarities in the horizontal distribution of Triposolenia and Amphisolenia are due to the fact that both genera include species of rather wide amplitude of thermal adaptation and therefore of more or less even distribution throughout the area investigated by the Expedition.

The prevalence of the most frequent species of Triposolenia in the Peruvian Current and in the eastern portion of the South Equatorial Drift indicates that these forms have their optimum habitat in relatively cool waters. This is presumably the explanation of the peculiar fact that this genus never was found in the surface catches of the Expedition, although it appears to be structurally well adapted to waters of low buoyancy. Its species are also less adapted by structure to vertical migration than are the slender, linear species of Amphisolenia.

There are 156 records of species of Triposolenia from vertical catches from 300 (800, 400, 150, 100)–0 fathoms. Out of these 156 records only three (1.9%; Stations 4571, 4648, 4663) showed a frequency of 2%; thirty-six (23.1%; Stations 4574, 4580, 4583, 4598 [3 records], 4605, 4613, 4617 [2 records], 4634, 4637, 4648, 4650 [2 records], 4652, 4655, 4657, 4659, 4662, 4666, 4668 [2 records], 4671 [2 records], 4675, 4701, 4713 [2 records], 4715 [2 records], 4724, 4730, 4739, 4742 [2 records]) showed a frequency of 1%; 117 (75.0%) showed a frequency of less than 1%.

Coincident occurrence of different species of Triposolenia is recorded at the following of the fifty-nine stations mentioned above: six species occurred coincidently at two stations (3.4%; Stations 4580, 4711); five species at five stations (8.5%; Stations 4583, 4598, 4613, 4709, 4713); four species at seven stations (11.9%; Stations 4650, 4652, 4659, 4667, 4721, 4724, 4742); three species at sixteen stations (27.1%; Stations 4587, 4617, 4637, 4662, 4668, 4671, 4676, 4681, 4683, 4701, 4705, 4715, 4717, 4730, 4732, 4740); and two species at fourteen stations (23.7%; Stations 4594, 4605, 4634, 4638, 4648, 4655, 4665, 4670, 4675, 4679, 4707, 4722, 4737, 4739).

Historical Discussion

The genus Triposolenia was established by Kofoid (1906c), who founded it on five new species, *T. truncata*, *T. depressa*, *T. bicornis*, *T. ramiciformis*, and *T. exilis*. In a later paper (1907a) the same author described three more species, *T. longicornis*, *T. fatula*, and *T. ambulatrix*. These eight species, besides a new one, *T. intermedia*, described in the present paper, are the only species of this genus known at the present time.

In Kofoid's works (1906c, d, e) an extensive description and discussion of the genus as a whole are given, and a subdivision of the genus in two subgenera, Posterocornia and Ramiciformia, is suggested. The only writer besides Kofoid, who has recorded the genus, is Jörgensen (1923). This author describes, figures, and gives the distribution of three of the species established by Kofoid but does not treat the genus as a whole.

Kofoid (1906c, p. 93) suggests that *Amphisolenia tripos* (*nomen nudum*) Schütt (1893) may refer to a species of Triposolenia. However, there is no information in the literature as to the structure of this species (see the section on the historical discussion of the genus Amphisolenia, p. 353).

Adaptive and Systematic Value of the Characters. Principles Used in the Descriptions of the Species

The genus Triposolenia, as previously mentioned, is confined to waters of tropical, subtropical, and warm-temperate nature or origin, in other words, to waters of comparatively low viscosity. Its peculiar organization is probably in part to be interpreted as an adaptation to the relatively low carrying capacity of these waters.

The asymmetry caused by the deflection to the left of the posterior parts of the antapicals has been analyzed by Kofoid (1906e) and shown to be adaptive. Its effect is to turn the organism upon its right face, as soon as it begins to descend while oriented with the anterior end of the body uppermost. In this sidewise position the body offers a maximal surface of resistance to the downward movement and thus facilitates the remaining of the organism on a level of optimum illumination. For further information on this interesting point, reference is made to the mentioned article by Kofoid (1906e). For further discussion of the adaptive significance of the organization of Triposolenia, see Kofoid (1906c, p. 95, 96; 1906d, p. 121; 1906e, p. 129).

The characters by which the species of this genus have been distinguished from each other are principally the shape of the head, the inclination, curvature, and relative length and width of the neck, the shape of the midbody, and the origin, relative length, curvature, spread, and structure of the antapicals. Pronounced structural differentiation of the thecal wall appears only in *Triposolenia truncata* among the species of this genus thus far known.

Although the size of the body is a character of rather great variability within the species, it is not without systematic value. In support of this statement, the following examples may be given: — *Triposolenia depressa* and *T. truncata*, 92–122 μ and 109–145 μ long respectively, are comparatively small species; while *T. longicornis* and *T. fatula* are relatively large, measuring 210–243 μ and 175 μ in length, respectively.

The structures least modified within the genus are the anterior process and the cingular and sulcal lists. Differences in the position, size, and shape of nucleus and pusules and in the number, form, and color of the chromatophores and metaplastic inclusions appear to have little significance in the matter of specific distinctions.

The individual species characters are all subject to variations of the fluctuating kind, in varying degrees of amplitude. Thus the relative length of the neck and the shape of the margins of the midbody, in lateral view, are rather variable. The greatest fluctuations are perhaps found in the antapicals, in their relative length and width, in their spread, in the degree and localization of their curvature, in the number and distribution of their tubercles, and in the form and structure of their tips. Fluctuations are least evident in the anterior process and in the head, but, on the other hand, these parts exhibit, generally speaking, rather slight differences in the various species.

A comparison between the list of the characters used in this paper for the differentiation of the species and the list of the characters subject to decided variations of the fluctuating kind shows that these lists are almost identical. From this follows that it is not possible, as a rule, to separate the species by single characters; the totality of the characters must be considered (*cf.* Kofoid, 1906d).

The great variability and the scarcity of the material available have rendered the establishment of the species very difficult. The division into species as presented in this paper should in some cases be regarded as tentative.

The following principles have been used in describing the species of this genus: —

(*1*) When not otherwise stated, all characteristics refer to specimens in lateral view.

(*2*) In describing the proportions of the body, the length of the neck, measured in a straight line from the posteroventral point of the head to the flagellar pore (Figure 61), has been used as a unit.

(*3*) The methods of measuring axes and angles used in this paper are shown in Figure 60.

(*4*) The methods used in measuring the length of the body and the proportions of the different parts of the body are shown in Figure 61.

(*5*) The thecal wall is without structure in all the species in whose diagnoses this character is not mentioned.

Subdivisions. Relationships between the Subgenera and among the Species

The genus Triposolenia may conveniently be divided into two subgenera, according to the position of the anterior process, the points of origin of the antapicals, and the shape of the midbody. These subgenera, Triposolenia and Ramiciformia, most probably represent natural systematic units and are, as far as our present knowledge goes, not connected by any transitional forms. They may be defined as follows: —

Subgenus 1. Triposolenia nobis, nom. subgen. nov.— Anterior process arises at or near the middle of anterior side of midbody. Midbody centrally located; in lateral view subtriangular, more or less rounded triangular, or subellipsoidal; with three distinct margins; postmargin not excessively developed. Antapicals arising from posterior part of midbody. Distance in a straight line from center of midbody to tip of ventral antapical always exceeds distance from center of midbody to apex of head.

Subgenus 2. Ramiciformia Kofoid.— Point of origin of anterior process shifted to near ventral margin of midbody. Midbody in lateral view ranging from oblong to rounded sack-shaped; with only two distinct margins, the anteroventral margin of the previous subgenus being suppressed; postmargin extended in a pendent lobe. Antapicals arising from anterior part of pendent midbody.

The subgenus Triposolenia corresponds to the subgenus Posterocornia Kofoid (1906c, p. 101), which thus becomes a synonym. It comprises seven of the nine species hitherto known, viz., *T. truncata*, *T. depressa*, *T. bicornis*, *T. longicornis*, *T. ambulatrix*, and *T. fatula*, all described by Kofoid in previous papers (1906c and 1907a), and *T. intermedia*, established in the present paper. The type of this subgenus (and thus of the genus) is *T. truncata*.

The subgenus Ramiciformia was established by Kofoid (1906c, p. 101) and comprises thus far only two species, viz., *Triposolenia ramiciformis*, which is the type of the subgenus, and *T. exilis*, both previously described by Kofoid (1906c). By a *lapsus calami* this subgenus was named Ramiciformis by Kofoid (1906c, p. 97); *cf.* Article 19 of the International Rules of Zoölogical Nomenclature.

If *Triposolenia truncata* be the most primitive species of this genus thus far known (p. 463), then the subgenus Triposolenia is more primitive than the subgenus Ramiciformia. The latter probably arose from a member of the former. However, as previously mentioned, no transitional forms between the two subgenera are known at the present time.

The present knowledge of the subgenus Triposolenia is too limited to allow any well-founded statements as to the relationships between the species. *T. depressa*, *T. bicornis*, *T. intermedia*, and *T. longicornis* appear to be very closely connected. *T. depressa* and *T. bicornis* intergrade; so probably do *T. bicornis* and *T. intermedia;* and *T. intermedia* appears to form a connecting link between *T. bicornis* and *T. longicornis*. Specimens are sometimes found which in the light of our present knowledge may be assigned to either *T. depressa* or *T. bicornis*. The sizes of these four species probably give a good indication of their mutual relationships. *T. depressa* is 92–122 μ long; *T. bicornis* is 120–153 μ long; *T. intermedia*, 165–177 μ; *T. longicornis*, 210–243 μ. *T. fatula* is probably rather closely related to *T. longicornis*. *T. truncata* and *T. ambulatrix*, especially the former, occupy rather isolated positions. As has previously been shown, *T. truncata* is probably the most primitive known member of its genus.

Key to the Species of Triposolenia

1. Midbody subtriangular; its postmargin not extended in a pendent lobe (subgenus Triposolenia) . . . . 2.
1. Postmargin of midbody extended in a pendent lobe (subgenus Ramiciformia) . . . . 8.
2. Epitheca quite concave; thecal wall profusely and strikingly pitted . . . . *truncata* Kofoid.
2. Epitheca convex or more or less flattened; thecal wall structureless or almost so . . . . 3.
3. Antapicals strikingly asymmetrical, both deflected dorsally, especially the dorsal . *ambulatrix* Kofoid.
3. Antapicals almost symmetrical or of moderate asymmetry, balanced or almost so . . . . 4.
4. Antapicals very long and slender, the ventral three times or more longer than neck . . . . 5.
4. Antapicals less than three times longer than neck . . . . 6.
5. Head 1.3–2.0 times longer than wide; margins of midbody subequal; antapicals subsymmetrical. *longicornis* Kofoid.

5. Head subspheroidal; anteroventral margin of midbody shorter than the two others; antapicals of moderate asymmetry . . . . *fatula* Kofoid.
6. Rather large, more than 160 μ; head wider than long . . . . *intermedia*, sp. nov.
6. Medium-sized or small, less that 160 μ; head subspheroidal . . . . 7.
7. Length almost always less than 120 μ; longitudinal axis of midbody in most cases foreshortened; geniculation scarcely evident in antapicals . . . . *depressa* Kofoid.
7. Length almost always more than 120 μ; longitudinal axis of midbody not foreshortened; antapicals generally geniculate . . . . *bicornis* Kofoid.
8. Distance between antapicals at level of tips 2.0 and at level of midbody 2.5 the length of midbody. *ramiciformis* Kofoid.
8. Distance between antapicals at level of tips as well as at level of midbody 1.6 the length of midbody. *exilis* Kofoid.

Subgenus 1. Triposolenia nobis, nom. subgen. nov.— All the seven species that belong to this subgenus have been found in the material of the Expedition. They have been treated in this paper in the following order indicative of relationships: — *Triposolenia truncata, T. depressa, T. bicornis, T. intermedia, T. longicornis, T. fatula*, and *T. ambulatrix*.

Triposolenia truncata Kofoid

Plate **14**, fig. 1–3. Figure 62, 63

Triposolenia truncata Kofoid, 1906c, p. 96, 98, 101, 102, 105, 106, 107, pl. 16, fig. 5; 1906d, p. 117, 118, 119, 120. Jörgensen, 1923, p. 43, fig. 64.

Diagnosis: — Head 1.5–2.0 times wider than long. Epitheca concave. Distance between bases of antapicals 1.8–2.3 the length of neck which is three to five times longer than wide and straight or slightly curved. Midbody subtriangular or subrotund; its three margins subequal and convex. Antapicals 2.7–3.4 times longer than neck, generally stout, subsymmetrical; geniculation scarcely evident; no tubercles; tips truncate and spinulate. Wall profusely pitted; neck reticulated. Length, 109–145 μ.

Tropical, subtropical, and warm-temperate regions of Eastern Pacific; Mediterranean; Marmora Sea.

Description: — The head is 0.37 (0.31–0.45) the length of the neck and 1.5–2.0 times wider than long. The anterior face of the epitheca is quite concave. The transverse furrow is flat or generally somewhat concave. The anterior cingular list is 1.5–2.0 times wider than the transverse furrow and has, on each valve, five to six generally slightly developed ribs.

The neck is comparatively short and thick. The distance between the midpoints of the bases of the antapicals is 2.1 (1.8–2.3) the length of the neck which is three to five times longer than wide. The neck is rather slightly curved dorsally, exceptionally almost straight, with a dorsal deflection of 5° (1°–14°) from the longitudinal axis of the body. The left sulcal list continues beyond the flagellar pore nearly to the midbody. It has, at least in some specimens, three ribs behind this pore; the anteriormost of these ribs is the fission rib.

The anterior process arises at or near the middle of the anterior margin of the midbody and is deflected ventrally 34° (28°–41°) from the longitudinal axis of the body. It measures 0.81 (0.74–0.86) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 2.6 (2.3–2.8) times longer than the neck.

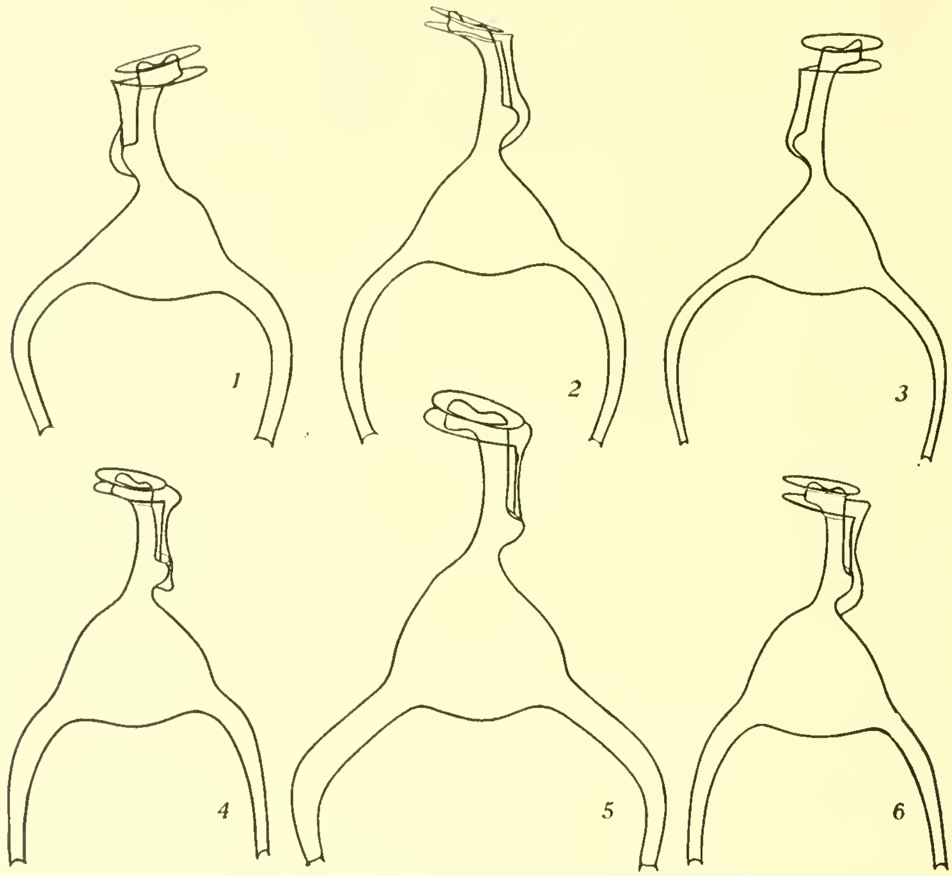

FIGURE 62.— *Triposolenia truncata* Kofoid, lateral view. 1, 3, from the left; the rest from the right. × 430. 1, 2, 3, 5, from Station 4742 (300–0 fathoms); 4, from Station 4637 (390–0 fathoms); 6, from Station 4634 (300–0 fathoms).

The midbody is subtriangular or subrotund (Jörgensen, 1923, fig. 64). Its three margins are subequal, and moderately, or rather boldly, and often nearly equally convex. The convexity of the anteroventral margin decreases toward the anterior process; sometimes this margin is almost straight. In some cases the posterior margin is somewhat longer than the anterodorsal one; and the latter is somewhat longer than the anteroventral.

The antapicals are of moderate length or comparatively short. In most cases the ventral is the longer, being 3.0 (2.7–3.4) times longer than the neck; the corresponding figures for the dorsal are 2.9 (2.7–3.2). Out of ten specimens two had subequal antapicals; and in the specimen with the greatest difference in this respect the ventral was 3.2 and the dorsal 2.9 times longer than the neck. The distance between the center of the midbody and the tip of the ventral antapical is subequal to the distance from the midpoint of the postmargin of the midbody to the anterior border of the neck. In most cases the antapicals are rather stout and taper gradually from the bases to the tips; sometimes they are widest at some distance from the bases. The ventral seems generally to be a little more slender than the dorsal; the former is, in the middle, 7–14, in most cases 8–11, the latter 6–13 (7–10) times longer than wide. The dorsoventral diameter of the tips is 0.4–0.7 that of the respective bases. The antapicals are almost symmetrical, the regions of major flexures and the tips being, respectively, approximately equidistant from the center of the midbody and in most cases also from the middle of the epitheca. The curvature is, as a rule, greatest in the middle third of the length; in this region it is, in most cases, nearly uniform, but sometimes more or less localized in a knee. In some specimens the antapicals are rather strongly curved proximally, and their distal halves are almost straight (Jörgensen, 1923, fig. 64). The distance between the tips is 3.7 (3.2–4.5) and between the outer margins at the place of greatest spread 4.3 (3.9–5.0) times longer than the neck. The distal fourth of the antapicals is deflected slightly to the left. The tips are truncate, and each tip has, on the dorsal and ventral angles, a pair of short, fine spinules. Sometimes the outer spinule alone is present and is larger than usual. No tubercles are developed.

The thecal wall is distinctly and profusely pitted (pores?), more sparingly so toward the base of the anterior process and toward the tips of the antapicals. On the neck the pits gradually widen to a rather coarse reticulum, 2–4 meshes wide on each valve.

The nucleus is small (in some cases observed) and is located posteriorly. There are a few irregular chromatophores, or numerous ellipsoidal ones gathered along the ventral margin of the midbody.

The proportions of ten specimens were measured. The length of these specimens was 130 (119–145) μ.

Dimensions: — Our specimens: Length of body, 113–145 μ (type, 131 μ). Distance from apex to midpoint of postmargin of midbody, 77–101 μ (average, 84 μ; type, 81 μ). Length of head, 6.5–10.0 μ (average, 7.7 μ; type, 7.2 μ). Length of neck, 19.0–23.5 μ (average, 21 μ; type, 21 μ). Length of anterior process, 14–19 μ (average, 17 μ; type, 17 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 49–65 μ (average, 54 μ; type, 51 μ). Distance between midpoints of bases of antapicals, 39–50 μ (average, 44 μ; type, 42 μ). Length of ventral antapical, 50–71 μ (average, 64 μ; type, 65 μ). Length of dorsal antapical, 50–69 μ (average, 61 μ; type, 61 μ). Distance between tips of antapicals, 67–105 μ (average, 78 μ; type, 67 μ). Distance between outer margins of antapicals at place of greatest spread, 78–117 μ (average, 91 μ; type, 82 μ). Jörgensen's (1923) specimens: Length of body of figured specimen, 109 μ. "Distance between points of the antapicals, 62–81 μ, midbody 34 μ high and 38–42 μ long; distance from apex to lowest (convex) boundary line of the midbody 68 μ."

Variations: — Judging by the specimens thus far observed, this species appears to be fairly uniform in proportions, except with regard to the antapicals. These vary considerably in thickness but less in length, thus giving to the organism different degrees of robustness. The spread and the shape of the antapicals and the size of the body are also subject to rather considerable variations.

Comparisons: — There can hardly be any doubt that the specimens assigned to *Triposolenia truncata* in the present paper belong to the same species as those from San Diego treated under this name by Kofoid (1906c, d). The type specimen (Kofoid, 1906c, pl. 16, fig. 5) falls within the range of variation of the specimens found in the material of the Expedition.

In the specimen figured by Jörgensen (1923, fig. 64) the midbody is more rounded and there are antapicals straighter than in our specimens. In spite of these differences, Jörgensen's determination of this form is probably correct.

Triposolenia truncata is probably the most primitive member of its genus and occupies a rather isolated position. It differs from all other species of the genus in its relatively stouter facies, the concave anterior side of its epitheca, and the very distinct structural differentiation of its thecal wall. It also is characterized by its small size, by its symmetrical and strikingly balanced antapicals, which, as a rule, have little or no geniculation, by the truncate tips of its antapicals, and by the absence of antapical tubercles. Its small size and relatively short and thick neck recall *T. depressa*. With regard to its relationship to *Amphisolenia inflata*, see the section on the subdivisions of the family (p. 336).

The rugose surface of the thecal wall of this species, which probably is a primitive character, may be interpreted as an adaptation to flotation. In other species of the genus increase in surface is acquired by a greater elongation of processes.

Synonymy: — The species was established by Kofoid (1906c) under the name of *Triposolenia truncata*. The only other writer to treat it, viz., Jörgensen (1923), used the same name. This is the type species of the genus.

Occurrence: — The species is recorded at nineteen of the 127 stations. There are 4, 5, 0, 2, 6, and 2 stations on the six lines of the Expedition. Of these nineteen stations, two (4580, 4583) are in the California Current; five (4613, 4617, 4634, 4637, 4638) are in the Panamic Area; two (4650, 4655) are in the Peruvian Current; one (4715) is in the Galapagos Eddy; eight (4711, 4717, 4724, 4730, 4732,

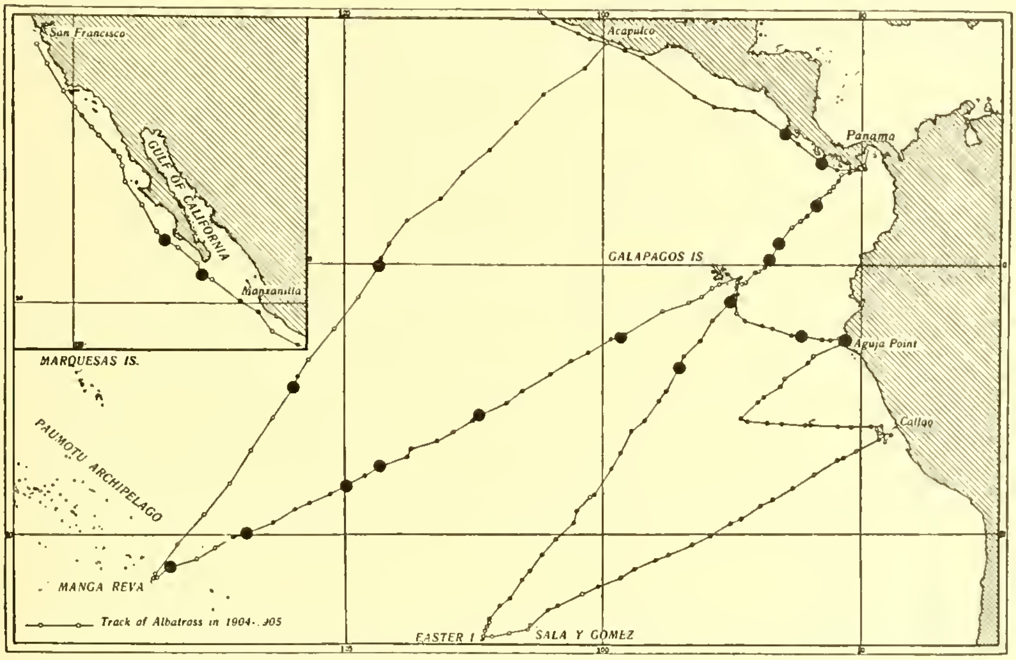

FIGURE 63.— Occurrence of *Triposolenia truncata* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

4737, 4739, 4740) are in the South Equatorial Drift; and one (4742) is in the South Equatorial Current. At one station (4655) the species is recorded from 400–0 fathoms. All the other records refer to catches from 300–0 fathoms.

The temperature range of these nineteen stations at the surface was 65°–83°; the average was 77.1°.

The frequency does not exceed 1%, which is recorded at three stations (4634, 4637, 4715).

The species was first recorded by Kofoid (1906c) from San Diego, California, the type locality, where it occurred sparingly in plankton from 180–0 fathoms during both winter and summer. Jörgensen (1923) found it in the Balearic Sea, east of Corsica, near Euboea, and in the Marmora Sea, "only in deeper water."

This is probably a eupelagic species of wide distribution in tropical, subtropical, and warm-temperate seas. In the Eastern Pacific it has, according to the records of the Expedition, a distribution that is more in accordance with the distribution of the genus Amphisolenia than that of any other species of the genus Triposolenia. This similarity in distribution is very interesting because this species is more closely related to Amphisolenia than any other known member of its genus. According to our records, it occurs in waters of high average temperature (77.1°). Most of the record stations are in the warm Panamic Area and in the South Equatorial Drift; only two record stations are in the relatively cool Peruvian Current. Its occurrence at San Diego and in the Mediterranean shows, however, that it has a rather wide amplitude of thermal adaptation in warm-water seas. Its absence from the very warm Mexican Current may be worth mentioning.

Triposolenia depressa Kofoid

Plate 14, fig. 4–9. Figure 64, 65

Triposolenia depressa Kofoid, 1906c, p. 98, 99, 101, 102, 104, pl. 16, fig. 3, 4; 1906d, p. 118, 119, 120; 1906e, p. 130, fig. A, B.
Triposolenia sp., Steuer, 1910, fig. 106; 1911, fig. 82.
Triposolenia ambulatrix Jörgensen, 1923, p. 42, 43, fig. 63.

Diagnosis: — Head small, subspheroidal or subcylindrical. Epitheca convex. Distance between bases of antapicals 1.3–1.6 the length of neck which is 6–11 times longer than wide and almost straight. Midbody subellipsoidal or subtriangular, its longitudinal axis often foreshortened; its margins convex, the anteroventral somewhat shorter than the others and sometimes straight or even concave. Antapicals 2.1–2.8 times longer than neck, slender, subsymmetrical or more or less asymmetrical; geniculation scarcely evident; tuberculate; tips rounded, sometimes truncate and spinulate. Length, 92–122 μ.

Tropical, subtropical, and warm-temperate regions of Eastern Pacific; Marmora Sea.

Description: — The head is 0.24 (0.21–0.33) the length of the neck, subspheroidal, in most cases about as long as wide, sometimes narrower, even subcylindrical. The anterior face of the epitheca is more or less convex. The transverse furrow is flat or slightly concave. The anterior cingular list is 2.0–2.5 times wider than the transverse furrow and has, on each valve, five to eight sometimes but slightly developed ribs.

The neck is comparatively short and of moderate width. The distance between the midpoints of the bases of the antapicals is 1.4 (1.3–1.6) the length of the neck which is 6–11 (in most cases 8–10) times longer than wide. The neck is almost straight or slightly curved dorsally, with a dorsal deflection of 21° (13°–25°) from the longitudinal axis of the body. The left sulcal list has a fission rib and, anteriorly, several other ribs.

The anterior process arises at a distance equaling or slightly exceeding half the dorsoventral width of the process, ventrally to the middle of the anterior margin of the midbody, and is deflected ventrally 28° (23°–33°) from the longitudinal axis of the body. It measures 0.52 (0.46–0.59) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.6 (1.5–1.8) the length of the neck.

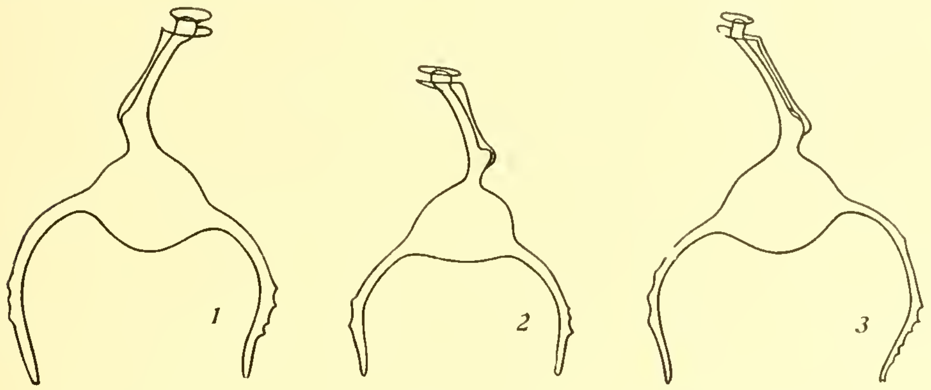

FIGURE 64.— *Triposolenia depressa* Kofoid, lateral view. 1, seen from the left; 2 and 3, from the right. × 430. 1, 2, from Station 4742 (300–0 fathoms); 3, from Station 4732 (300–0 fathoms).

The midbody is often characterized by the foreshortening of its longitudinal axis, which gives it a subellipsoidal shape with its major axis in the dorsoventral position. However, sometimes this foreshortening does not occur, and the midbody has a subtriangular shape. The three margins are more or less convex, sometimes, due to parasitic infection (?), even to such an extent as to give the midbody a subrotund shape; in a few cases the anteroventral margin is nearly straight or even slightly concave. The anteroventral margin is always somewhat shorter than the two others, due to the ventral dislocation of the anterior process; and the postmargin is always the longest.

The antapicals are of moderate lengths. In most cases the ventral is the longer, being 2.5 (2.2–2.8) times longer than the neck; the corresponding values for the dorsal are 2.2 (2.1–2.6); see the section on the comparisons of this species. Out of seven specimens two had subequal antapicals; and in the specimen with the greatest difference in this respect the ventral antapical was 2.5 and the dorsal 2.1 times longer than the neck. In three out of these seven specimens the distance between the center of the midbody and the tip of the ventral antapical was subequal to the distance from the midpoint of the postmargin of the midbody to the middle of the transverse furrow. The four other specimens deviated only slightly from this type. The antapicals are of almost the same width, in most cases slender, and nearly uniform in width throughout their entire lengths. The ventral is 15–29 times longer than its average width. The two processes are fairly strongly curved; sometimes they are curved to about the same extent, sometimes either one of them is more curved than the other. The curvature is sometimes almost evenly distributed, but in most cases it is more or less localized in the proximal half of the antapical; in the latter case geniculation is scarcely evident. Distally the antapicals exhibit in most specimens a slight sigmoid flexure. The distance between the tips is 2.6 (2.3–3.1) and between the outer margins at the place of greatest spread 3.2 (3.0–3.7) times longer than the neck. In dorsoventral view the antapicals are slightly curved; sometimes they are bent to the right proximally, and to the left distally, the dorsal having more distal curvature than the ventral; sometimes the distal curvature is hardly developed at all. The tips are mostly truncate in dorsoventral view, with minute terminal spinules. In lateral view the tips are more or less rounded in most specimens, sometimes truncate. There are two to seven scattered tubercles along the outer margins of the antapicals, all of them in most cases on the distal halves of the antapicals.

The thecal wall is hyaline, apparently without structure, and with a few pores along the midventral line of the neck and in the tubercles of the antapicals.

The nucleus is large. Besides the principal pusule there is an accessory pusule. The chromatophores are few, minute, and spheroidal.

The proportions of seven specimens were measured. The length of these specimens was 105 (92–114) μ.

Dimensions: — Our specimens: Length of body, 92–122 μ (type, 108 μ). Distance from apex to midpoint of postmargin of midbody, 57–71 μ (average, 66 μ; type, 67 μ). Length of head, 5.0–7.5 μ (average, 6.0 μ; type, 7.5 μ). Length of neck, 21–28 μ (average, 25 μ; type, 23 μ). Length of anterior process, 10–15 μ (average, 13 μ; type, 13 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 34–44 μ (average, 40 μ; type, 41 μ). Distance between midpoints of bases of antapicals, 31–39 μ (average, 35 μ; type, 36 μ). Length of ventral antapical, 47–74 μ (average, 62 μ; type, 63 μ). Length of dorsal antapical, 46–66 μ (average, 56 μ; type, 56 μ). Distance between tips of antapicals, 53–75 μ (average, 66 μ; type, 72 μ). Distance between outer margins of antapicals at place of greatest spread, 64–92 μ (average, 79 μ; type 77 μ). Jörgensen's (1923) specimen: Length of body, 96 μ. "Distance between points of posterior horns

89 μ, midbody 25 μ high and 38 broad, distance from apex to lower part of body 65 μ."

Variations: — The species exhibits a remarkable variability in several characters. The head is either about as long as wide, subrectangular or subrotund, or it is narrower than long, subcylindrical. In some specimens the midbody is foreshortened, its major axis being in the dorsoventral position, and its posterior margin is boldly convex and much longer than the anterior margins. In other specimens the midbody is either subrotund, or it is almost equilaterally subtriangular as in *Triposolenia bicornis* with only slightly convex posterior margin. The relative width of the neck, the curvature and spread of the antapicals, the deflection of the dorsal antapical, and the number of antapical tubercles are also rather strikingly variable characters.

Comparisons: — Some of the specimens, referred to *Triposolenia depressa* in this paper (Plate **14**, fig. 4, 5), are very similar to the type specimen of this species as drawn by Kofoid (1906c, pl. 16, fig. 3). Others (Figure 64) differ more or less strikingly from the type specimen, and their determination must be regarded as tentative. Some of these specimens (Figure 64: 2) are much smaller (about 92 μ) than *T. bicornis* (120–153 μ) and have relatively wide neck and antapicals without geniculation as in *T. depressa*. Their midbody, however, is subtriangular with only slightly convex posterior margin as in *T. bicornis*.

The specimen of this species found by Jörgensen (1923) and called *Triposolenia ambulatrix* by him differs from the type specimen especially in the shape, deflection, and relative length of the dorsal antapical. The ventral antapical is 2.4, the dorsal only 1.8 times longer than the neck. In the pronounced dorsal deflection of its dorsal antapical this specimen approaches *T. ambulatrix*.

Triposolenia depressa probably is closely related to *T. bicornis*. Jörgensen (1923, p. 42, fig. 63) even suggested that it might be but a "form" of this species. As conceived in this paper, it differs from *T. bicornis* especially in the smaller size of its body, the foreshortening of its midbody, the greater convexity of the postmargin of its midbody, the relative shortness and greater width of its neck, and the almost complete absence of geniculation in its antapicals. However, as is shown in the section on variability, the two species tend to intergrade in some of the distinctive characters.

Synonymy: — The species was established by Kofoid (1906c) under the name of *Triposolenia depressa*. The form treated by Jörgensen (1923, fig. 63) under the name *T. ambulatrix* is probably identical with *T. depressa*. Kofoid (1906c, fig. A, B) used this species to illustrate his discussion on the adaptive nature of the asymmetry in this genus. His figures were reproduced by Steuer (1910, fig. 106; 1911, fig. 82). Kofoid did not make any reference to species in his explanation of these figures; Steuer used the designation *Triposolenia* sp.

Occurrence: — The species is recorded at twenty-two of the 127 stations. There are 2, 7, 3, 5, 4, and 1 stations on the six lines of the Expedition. Of these twenty-two stations, one (4580) is in the California Current; one (4613) is in the Panamic Area; eight (4650, 4652, 4655, 4659, 4662, 4667, 4671, 4676) are in the Peruvian Current; ten (4681, 4683, 4701, 4705, 4709, 4711, 4721, 4724, 4730,

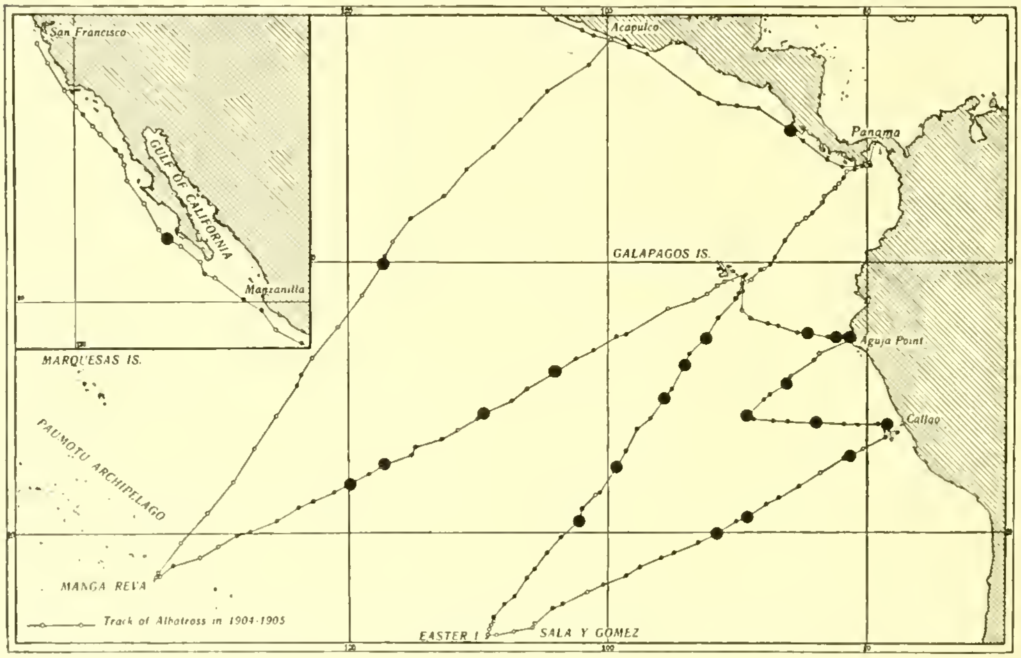

FIGURE 65.— Occurrence of *Triposolenia depressa* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

4732) are in the South Equatorial Drift; one (4713) is in the Galapagos Eddy; and one (4742) is in the South Equatorial Current. At one station (4652) the species is recorded from 100–0 fathoms; at two stations (4662, 4681) from 800–0 fathoms. All the other records refer to samples from 300–0 fathoms.

The temperature range of these twenty-two stations at the surface was 65°–80°; the average was 72.2°.

The frequency does not exceed 1%, which is recorded for two stations (4650, 4655).

Triposolenia depressa was first recorded by Kofoid (1906c) from San Diego, California, the type locality, where it was taken in a vertical haul from 95 fathoms.

Later it was recorded by Jörgensen (1923) from the Marmora Sea as *Triposolenia ambulatrix*.

The species probably is eupelagic and of subtropical and tropical nature, although it sometimes occurs in warm-temperate waters. In the material of the Expedition it is recorded mainly from the relatively cool Peruvian Current and from the part of the South Equatorial Drift that is under the influence of this current.

Triposolenia bicornis Kofoid

Figure 66, 67

Triposolenia bicornis Kofoid, 1906c, p. 96, 99, 101, 102, 104, 105, 107, pl. 15, fig. 1, 2, pl. 16, fig. 6; 1906d, p. 118, 119, 120. Hjort, 1911, p. 367, fig. 12: 3. Gran, 1912a, p. 935, fig. 9; 1912b, fig. 233. Jörgensen, 1923, p. 41, 42, 43, fig. 62.

Diagnosis: — Head subspheroidal. Epitheca convex. Distance between bases of antapicals 1.1–1.4 the length of neck which is 9–15 times longer than wide and almost straight. Midbody subtriangular; its margins subequal or almost so and convex. Antapicals 1.8–2.4 times longer than neck, rather slender, subsymmetrical, mostly geniculate, tuberculate; tips rounded, mostly without spinules. Length, 120–153 μ.

Tropical, subtropical, and warm-temperate regions of Eastern Pacific; Mediterranean and off west coast of Portugal.

Description: — The head is 0.18 (0.15–0.20) the length of the neck and as long as wide, in some cases slightly narrower, in others slightly wider. The anterior face of the epitheca and the transverse furrow are as in *Triposolenia depressa*. The anterior cingular list is two to three times wider than the transverse furrow and has, on each valve, ten to twelve delicate ribs.

The neck is rather long and narrow. The distance between the midpoints of the bases of the antapicals is 1.2 (1.1–1.4) the length of the neck which is 9–15 times longer than wide. The neck is almost straight or slightly curved dorsally, with a dorsal deflection of 20° (15°–25°) from the longitudinal axis of the body. The left sulcal list has a fission rib.

The anterior process arises at about or slightly ventrally to the middle of the anterior margin of the midbody. It is deflected ventrally 17° (12°–21°) from the longitudinal axis of the body. It measures 0.41 (0.36–0.48) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.4 (1.1–1.5) the length of the neck.

The midbody is subtriangular. Its margins are more or less convex, sometimes, due to parasitic infection (?), even to an extent so as to give the midbody a subrotund shape. In some cases they are almost subequal, in others the anteroventral margin is somewhat shorter than the anterodorsal, due to the ventral dislocation of the anterior process; the postmargin is always the longest.

The antapicals are of moderate length, rather slender, subsymmetrical, and in most cases with fairly distinct knees near or somewhat distally to the middle. The ventral antapical is 2.1 (1.9–2.4), the dorsal 2.0 (1.8–2.3) times longer than the neck. Out of eight specimens one had subequal antapicals; and in the specimen with the greatest difference in this respect the ventral was 2.1, the dorsal 1.8

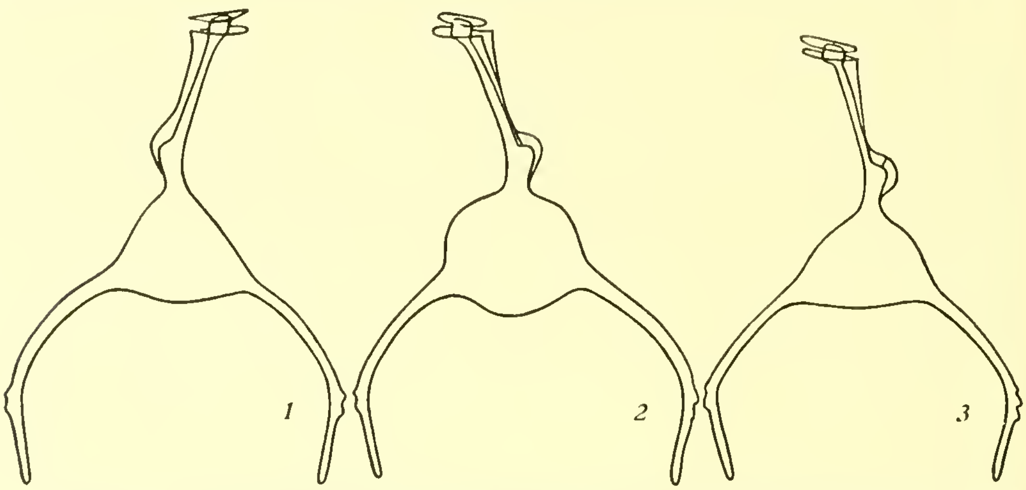

FIGURE 66.— *Triposolenia bicornis* Kofoid, lateral view. 1, seen from the left; 2 and 3, from the right. × 430. 1, from Station 4613 (300–0 fathoms); 2, from Station 4638 (300–0 fathoms); 3, from Station 4730 (300–0 fathoms).

times longer than the neck. The ventral is 16–26 times longer than its average width. The distance between the tips is 2.4 (1.9–2.9), and between the outer margins at the place of greatest spread 2.8 (2.5–3.1) times longer than the neck. The tips are rounded, mostly without spinules. For characteristics not mentioned above, see the description of the antapicals of *Triposolenia depressa* (p. 469).

The thecal wall is as in *T. depressa*.

The nucleus is large, ellipsoidal, and usually located near the posterior face of the midbody. A centrosome is found on the anterior face of the nucleus. One or two pusules are present along the ventral wall, each with efferent canal leading to the flagellar pore. The chromatophores are small, irregular, almost colorless, with superficial distribution.

The proportions of eight specimens were measured. The length of these specimens was 134 (126–141) μ.

Dimensions: — Our specimens: Length of body, 120–153 μ (type, 140 μ). In the original description (Kofoid, 1906c, p. 106) a maximum length of 185 μ is given. This high value is probably due to the fact that specimens of *Triposolenia intermedia* were included in *T. bicornis*. Distance from apex to midpoint of postmargin of midbody, 76–91 μ (average, 84 μ; type, 91 μ). Length of head, 5–7 μ (average, 6 μ; type, 7 μ). Length of neck, 30–37 μ (average, 34 μ; type, 35 μ). Length of anterior process, 12–16 μ (average, 14 μ; type, 16 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 40–52 μ (average, 46 μ; type, 52 μ). Distance between midpoints of bases of antapicals, 34–44 μ (average, 40 μ; type, 44 μ). Length of ventral antapical, 65–78 μ (average, 72 μ; type, 68 μ). Length of dorsal antapical, 65–71 μ (average, 69 μ; type, 68 μ). Distance between tips of antapicals, 71–89 μ (average, 83 μ; type, 89 μ). Distance between outer margins of antapicals at place of greatest spread, 89–101 μ (average, 95 μ; type, 95 μ). Jörgensen's (1923) specimens: Length of body of figured specimen, 136 μ. "Distance between points of horns almost constantly 102 μ, the midbody (32–) 34 μ high by (38–) 43–47 μ long, distance from upper end of cell to lowest boundary line of the midbody 80–85 μ."

Variations: — As conceived in this paper, *Triposolenia bicornis* is fairly constant in structure and proportions.

Comparisons: — Most of our specimens showed a very striking resemblance to the type specimen as drawn by Kofoid (1906c, pl. 15, fig. 1). The specimen figured under the name of *Triposolenia bicornis* by Jörgensen (1923, fig. 62), also agrees closely with the type and is certainly correctly determined.

With regard to the position of this species within its genus, see *Triposolenia depressa*, *T. intermedia*, and the section on the subdivisions of the genus (pp. 471, 461).

Synonymy: — The species was established by Kofoid (1906c) and later treated by Jörgensen (1923) under the name of *Triposolenia bicornis*. Reproductions of Kofoid's (1906c) drawing of the type specimen are to be found in Hjort (1911) and in Gran (1912a, b).

Occurrence: — The species is recorded at forty-five of the 127 stations. There are 9, 11, 4, 9, 10, and 2 stations on the six lines of the Expedition. Of these forty-five stations, four (4571, 4574, 4580, 4583) are in the California Current; two (4598, 4605) are in the Mexican Current; five (4609, 4613, 4617, 4637, 4638) are in the Panamic Area; nine (4648, 4650, 4652, 4657, 4659, 4667, 4668, 4670, 4671) are in the Peruvian Current; two (4697, 4699) are in the Easter Island Eddy; two (4713, 4715) are in the Galapagos Eddy; twenty (4679, 4681, 4683, 4687, 4701, 4705, 4707, 4709, 4711, 4717, 4721, 4722, 4724, 4728, 4730, 4732, 4734, 4737, 4739, 4740) are in the South Equatorial Drift; and one (4742) is in the South Equatorial Current. At one station (4652) the species is recorded from 100–0 fathoms; at one station (4713) from 150–0 fathoms; at one station (4670) from 800–0 fathoms; at four stations (4681, 4701, 4717, 4724) from 800–0 fathoms as well as from 300–0 fathoms. All other records refer to catches from 300–0 fathoms only.

The temperature range of these forty-five stations at the surface was 66°–85°; the average was 74.4°.

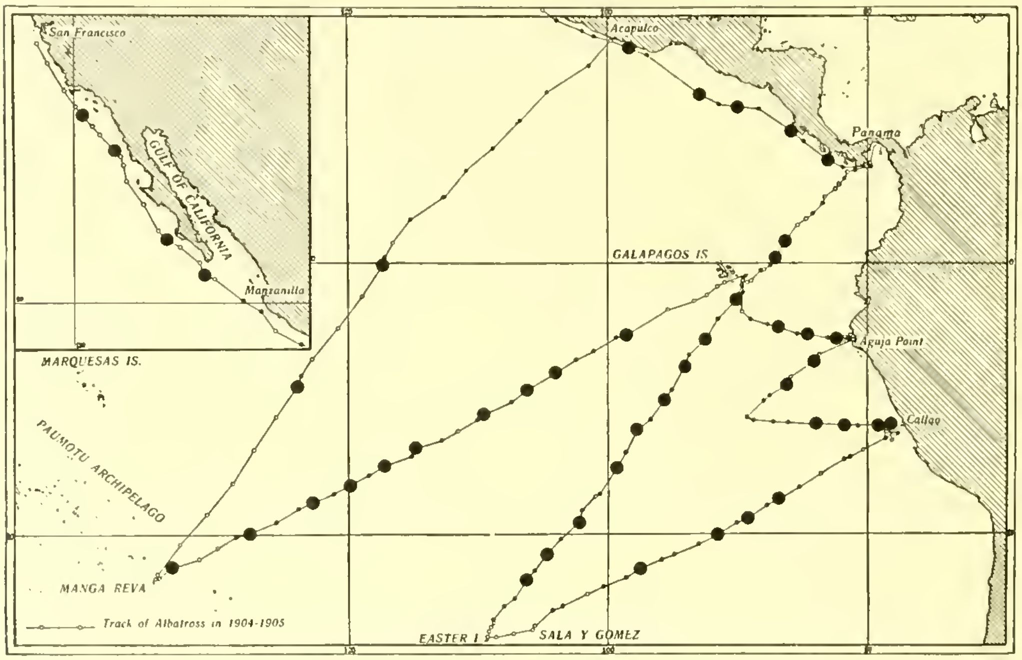

FIGURE 67.—Occurrence of *Triposolenia bicornis* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

At one station (4571) the frequency is 2%. At sixteen stations (4574, 4580, 4583, 4605, 4613, 4617, 4648, 4652, 4657, 4668, 4671, 4713, 4724, 4730, 4739, 4742) the frequency is 1%. At the remaining twenty-eight stations the frequency is less than 1%.

Previously the species has been taken by Kofoid (1906c) near San Diego, California, the type locality, where it frequently occurred in small numbers in vertical hauls from 135–0 fathoms, and rarely in surface catches. Jörgensen (1923) reported it as widely distributed in the Mediterranean, "especially, it would seem, between 100 and 200 m." He also found it off the southwest coast of Portugal.

This appears to be the most widely distributed and the most abundant species in the genus. It is probably eupelagic and of world-wide distribution in tropical, subtropical, and warm-temperate seas. According to the records, it is fairly evenly distributed throughout the region investigated by the Expedition.

Triposolenia intermedia, sp. nov.

Plate **14**, fig. 10. Figure 60: 1, 61, 68

Diagnosis: — Head 1.3–2.0 times wider than long. Epitheca convex or flat. Distance between bases of antapicals 1.3–1.4 the length of neck, which is 7–11 times longer than wide and gently curved. Midbody subtriangular; its margins almost subequal, more or less convex. Antapicals 2.1–2.5 times longer than neck, rather slender; strongest curvature in proximal half; not geniculate; tuberculate; tips rounded, not spinulate. Wall without structure or finely striated. Length, 165–177 μ.

Tropical, subtropical, and warm-temperate regions of Eastern Pacific.

Description: — The head is 0.18 (0.16–0.24) the length of the neck and 1.3–2.0 times wider than long. The anterior face of the epitheca is slightly convex or flat. The transverse furrow is flat or slightly concave. The anterior cingular list is about twice as wide as the transverse furrow and has five to eight ribs on each valve.

The neck is rather long and of moderate width. The distance between the midpoints of the bases of the antapicals is 1.3 (1.3–1.4) the length of the neck which is 7–11 times longer than wide. The neck is gently curved dorsally, with a dorsal deflection of 20° (15°–24°) from the longitudinal axis of the body. The left sulcal list has a fission rib and several other ribs.

The anterior process arises near or somewhat ventrally to the middle of the anterior margin of the midbody; in some cases it is displaced ventrally more than its own width. It is deflected ventrally 24° (21°–29°) from the longitudinal axis of the body. It measures 0.47 (0.44–0.50) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.6 (1.5–1.8) the length of the neck.

The midbody is subtriangular. Its three margins are convex, perhaps, on the average, slightly more so than in *Triposolenia bicornis*. The anteroventral and the anterodorsal margins are sometimes subequal, sometimes the former is somewhat shorter than the latter, due to the ventral displacement of the anterior process. The posterior margin is somewhat longer than the two others.

The antapicals are of moderate length, rather slender, almost symmetrical. The strongest curvature is, as a rule, in the proximal half of the antapical, sometimes in the middle, and not localized in a knee. There is no, or only very slight, indication of sigmoid curvature distally. The ventral antapical is 2.3 (2.2–2.5) times, and the dorsal 2.2 (2.1–2.4) times longer than the neck. Out of six specimens three had subequal antapicals; and in the specimen with the greatest difference in this respect the ventral was 2.5 times and the dorsal 2.2 times longer than the neck. In one of these specimens the distance between the center of the midbody and the tip of the ventral antapical was subequal to the distance from the midpoint of the postmargin of the midbody to the middle of the transverse furrow; in four cases the former, and in one case the latter distance was somewhat shorter than the other. The antapicals are of about the same width, and subuniform in width throughout their whole length. The ventral is 12–20 times longer than its average width. The distance between the tips is 2.9 (2.6–3.2) times, that between the outer margins at the place of greatest spread 3.1 (2.9–3.3) times longer than the neck. The tubercles and the tips of the antapicals are as in *Triposolenia bicornis*.

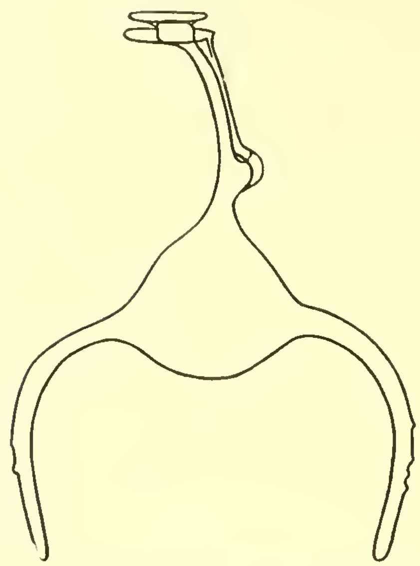

FIGURE 68.— *Triposolenia intermedia*, sp. nov., right lateral view. × 430. Station 4709 (300–0 fathoms).

The thecal wall is as in *Triposolenia depressa*, or it is characterized by a fine striation (see Plate 14, fig. 10).

The proportions of six specimens were measured.

Dimensions: — Length of body, 165–177 μ (average, 173 μ; type, 171 μ). Distance from apex to midpoint of postmargin of midbody, 105–124 μ (average, 113 μ; type, 105 μ). Length of head, 6.5–10.0 μ (average, 7.8 μ; type, 7.0 μ). Length of neck, 40–42 μ (average, 41 μ; type, 40 μ). Length of anterior process, 18–21 μ (average, 20 μ; type, 18 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 60–75 μ (average, 67 μ; type, 63 μ). Distance between midpoints of bases of antapicals, 50–56 μ (average, 54 μ; type, 50 μ). Length of ventral antapical, 92–99 μ (average, 95 μ; type, 99 μ). Length of dorsal antapical, 89–99 μ (average, 92 μ; type, 90 μ). Distance between tips of antapicals, 104–133 μ (average, 118 μ; type, 107 μ). Distance between outer margins of antapicals at place of greatest spread, 117–137 μ (average, 128 μ; type, 117 μ).

Variations: — As conceived in this paper, *Triposolenia intermedia* is fairly uniform in structure and proportions. The most variable characters are the shape of the antapicals and of the midbody. Some specimens are rather slender, others are more or less robust.

Comparisons: — The species is established on outline drawings of six specimens. It is in size and structure intermediate between *Triposolenia bicornis* and *T. longicornis.* In the shape and proportions of the midbody and in the relative length of the antapicals it is nearer to *T. bicornis;* in the shape and relative size of the head and in the curvature of the neck it resembles *T. longicornis.* Some of our specimens of *T. intermedia* are more robust than any of the recorded specimens of *T. bicornis* and *T. longicornis.* See also the section on the subdivisions of this genus (p. 461).

Synonymy: — See the section on the dimensions of *Triposolenia bicornis* (p. 475).

Occurrence:— *Triposolenia intermedia* is recorded at four of the 127 stations. There are 3, 0, 0, 1, 0, and 0 stations on the six lines of the Expedition. Of these four stations, two (4580, the type locality, 4583) are in the California Current; one (4613) is in the Panamic Area; one (4709) is in the South Equatorial Drift. The catches in which the species was found are from 300–0 fathoms.

The temperature range of these four stations at the surface was 72°–83°; the average was 77.7°.

The frequency is less than 1%.

This appears to be a rare species. However, it is possible that several of our records of *Triposolenia bicornis* refer to *T. intermedia.* In the material of the Expedition the species is limited to catches from tropical waters of very high average temperature (77.7°).

Triposolenia longicornis Kofoid

Plate 15, fig. 1–6. Figure 69, 70

Triposolenia longicornis Kofoid, 1907a, p. 201, pl. 17, fig. 101; 1906c, p. 102; 1906d, p. 118, 119, 124.

Diagnosis: — Head 1.3–2.0 times wider than long. Epitheca flattened or convex. Distance between bases of antapicals 1.0–1.2 the length of neck, which is 10–15 times longer than wide and moderately curved. Midbody subtriangular; its three margins almost subequal, the postmargin convex, the anterior concave or convex. Antapicals 2.6–3.3 times longer than neck, slender, subsymmetrical;

geniculation scarcely evident; tuberculate; tips truncate or rounded and spinulate. Length, 210–243 μ.

Tropical and subtropical regions of Eastern Pacific.

Description: — The head is 0.16 (0.14–0.17) the length of the neck and 1.3–2.0 times wider than long. The anterior face of the epitheca is flat, seldom convex. The transverse furrow is somewhat concave, seldom flat. The anterior

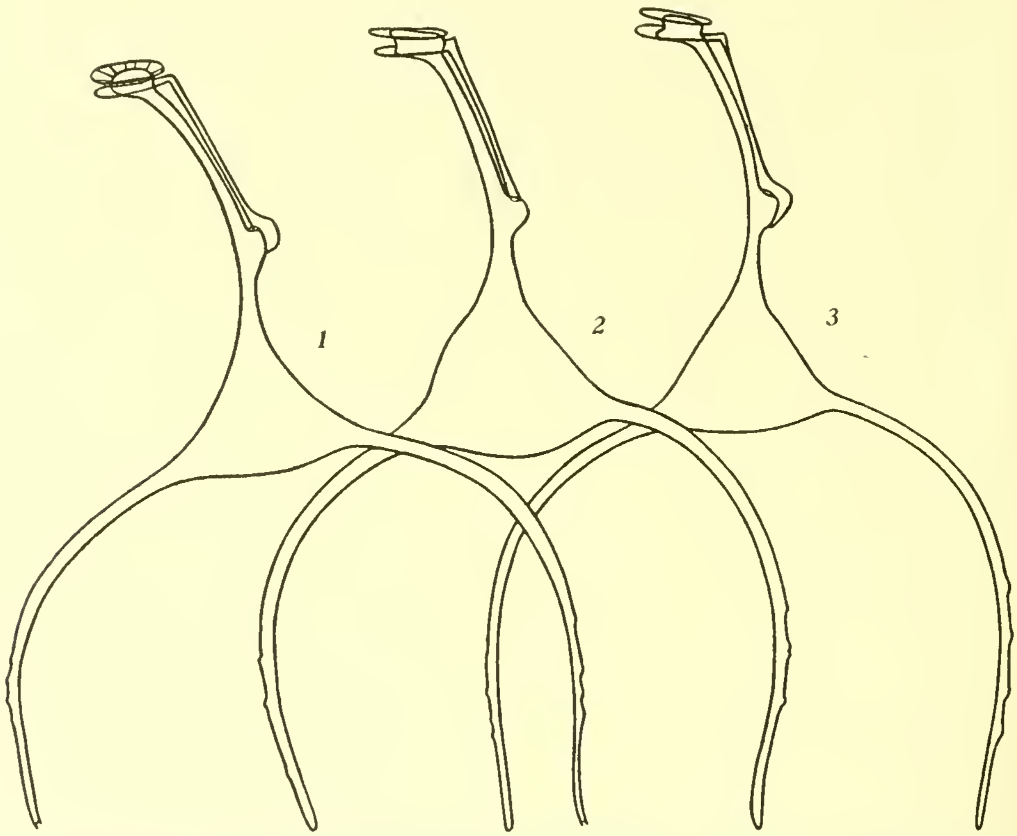

FIGURE 69.— *Triposolenia longicornis* Kofoid, right lateral view. × 430. 1, type specimen, from Station 4711 (300–0 fathoms); 2 and 3, from Station 4583 (300–0 fathoms).

cingular list is 1.5–2.0 times wider than the transverse furrow and has, on each valve, five to eight fairly well-developed ribs.

The neck is long and narrow. The distance between the midpoints of the bases of the antapicals is 1.0 (1.0–1.2) the length of the neck which is 10–15 times longer than wide. The neck is gently curved dorsally, with a dorsal deflection of 18° (14°–22°) from the longitudinal axis of the body. No fission rib has been seen, but the sulcal lists have several fine ribs anteriorly.

The anterior process arises at or near the middle of the anterior margin of the midbody and is deflected ventrally 15° (12°–19°) from the longitudinal axis of the body. It measures 0.68 (0.61–0.70) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.5 (1.4–1.6) the length of the neck.

The midbody is comparatively small and subtriangular. The postmargin is more or less convex and somewhat longer than the two anterior margins, which are subequal and slightly concave or convex.

The antapicals are long. In most cases the ventral is the longer, being 3.2 (3.1–3.3) times longer than the neck; the corresponding values for the dorsal are 3.0 (2.6–3.1). Out of five specimens one had subequal antapicals; and in the specimen with the greatest difference in this respect the ventral was 3.1 and the dorsal 2.6 times longer than the neck. The distance between the center of the midbody and the tip of the ventral antapical exceeds the distance from the midpoint of the postmargin of the midbody to the apex to an extent equaling the half or the whole length of the midbody. The antapicals are almost of the same width, slender, and subuniform in width throughout their entire lengths or (as in the type specimen) decidedly narrower distally than proximally. The ventral is 34–42 times longer than its average width. The antapicals are rather strongly curved, both to about the same extent. The curvature is sometimes almost evenly distributed, but in most cases it is more or less localized in the proximal half of the antapical. Only exceptionally the antapicals have a slight sigmoid flexure distally; in most cases their tips are incurved. The distance between the tips is 3.0 (2.7–3.3) and between the outer margins at the place of greatest spread 3.4 (3.2–3.5) times longer than the neck. In dorsoventral view the antapicals have a very slight sigmoid curvature, the tips being slightly curved to the left. The tips are truncate or rounded, and spinulate. There are two to five tubercles, sometimes but slightly developed, all of them on the distal halves of the antapicals.

The thecal wall, nucleus, and pusules are as in *Triposolenia depressa*.

The proportions of five specimens were measured. The length of these specimens was 232 (215–243) μ.

Dimensions: — Length of body, 210–243 μ (type, 225 μ; not 275 μ, as stated in the original description). Distance from apex to midpoint of postmargin of midbody, 118–132 μ (average, 125 μ; type, 127 μ). Length of head, 6–8 μ (average, 7.5 μ; type, 7.5 μ). Length of neck, 44–50 μ (average, 47 μ; type, 50 μ). Length of anterior process, 29–35 μ (average, 32 μ; type, 35 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 69–77 μ (average, 72 μ; type, 73 μ). Distance between midpoints of bases of antapicals, 44–57 μ (average, 49 μ; type, 50 μ). Length of ventral antapical, 135–157 μ (average, 151 μ; type, 155 μ). Length of dorsal antapical, 135–148 μ (average, 140 μ; type, 129 μ). Distance between tips of antapicals, 129–163 μ (average, 142 μ; type, 163 μ). Distance between outer margins of antapicals at place of greatest spread, 151–171 μ (average, 158 μ; type, 171 μ).

Variation: — Judging by the specimens thus far examined, this species is uniform in dimensions and proportions, but the shape of its midbody is somewhat variable. The anterior margins of the midbody are either almost straight or gently concave or convex.

Comparisons: — The description given above is based on the type material.

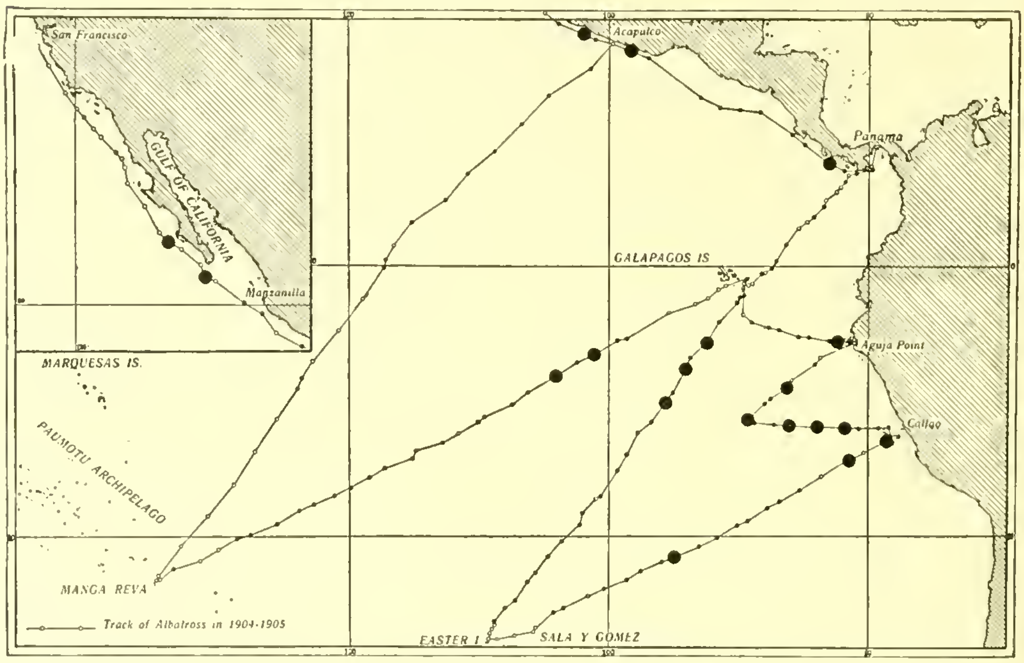

FIGURE 70.— Occurrence of *Triposolenia longicornis* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

Triposolenia longicornis probably is very closely related to *T. intermedia*, which in size and structure is intermediate between this species and *T. bicornis* (see *T. intermedia*, the section on comparisons, p. 479). Another close relative of this species probably is *T. fatula*, which it resembles in its long and narrow processes and in having a midbody with straight or but slightly concave or convex margins. It differs from this species especially in its relatively larger head, in the more pronounced dorsal deflection of its neck, and in not having the longitudinal axis of the midbody foreshortened. See also the section on the subdivisions of the genus (p. 461).

The species exhibits a very high degree of adaptation to flotation in its very long and slender processes and in the relatively small size of its midbody. Its processes are longer relatively than in any other species of this genus.

Occurrence: — The species is recorded at nineteen of the 127 stations. There are 5, 6, 3, 3, 2, and 0 stations on the six lines of the Expedition. Of these nineteen stations, two (4580, 4583) are in the California Current; two (4594, 4598) are in the Mexican Current; one (4617) is in the Panamic Area; eight (4652, 4659, 4662, 4665, 4667, 4668, 4675, 4676) are in the Peruvian Current; one (4713) is in the Galapagos Eddy; five (4685, 4709, 4711, 4719, 4721) are in the South Equatorial Drift. At one station (4652) the species is recorded from 100–0 fathoms and at one (4662) from 800–0 fathoms. All the other records refer to samples from 300–0 fathoms.

The temperature range of these nineteen stations at the surface was 66°–84°; the average was 72.2°.

The frequency never exceeds 1%, which is recorded at three stations (4617, 4675, 4713).

The species was first recorded by Kofoid (1907a) from Stations 4583 (not 4385 as originally stated) and 4711 of the Expedition. Of these two stations the last mentioned is the type locality.

The frequent occurrence of this species in the relatively cool Peruvian Current is remarkable. In this current the species is recorded at eight (30.8%) out of the twenty-six stations; in the South Equatorial Drift at only five (10.9%) out of the forty-six stations. Moreover, all the record stations in the South Equatorial Drift are in the eastern part of this region, which is under the influence of the Peruvian Current.

Triposolenia fatula Kofoid

Figure 71

Triposolenia fatula Kofoid, 1907a, p. 202, pl. 17, fig. 102; 1906c, p. 96, 102; 1906d, p. 119.

Diagnosis: — Head subspheroidal. Epitheca convex. Distance between bases of antapicals 1.4 the length of neck which is 14 times longer than wide and constricted anteriorly. Midbody subtriangular; its longitudinal axis foreshortened; its margins straight or very slightly convex or concave, the anteroventral one shortest. Antapicals 3.3–3.4 times longer than neck, slender; curvature as in *Triposolenia ambulatrix* but less asymmetrical; tuberculate; tips truncate and spinulate. Length, 175 μ.

Tropical and subtropical regions of Eastern Pacific.

Description: — The head is 0.20 the length of the neck, subspheroidal, about as long as wide. The anterior face of the epitheca is convex. The transverse furrow is flat or slightly concave. The anterior cingular list is 2.0–2.5 times wider than the transverse furrow and has, on each valve, five to eight well-developed ribs.

The neck is long, narrow, and suberect. The distance between the midpoints of the bases of the antapicals is 1.4 the length of the neck which is 14 times longer

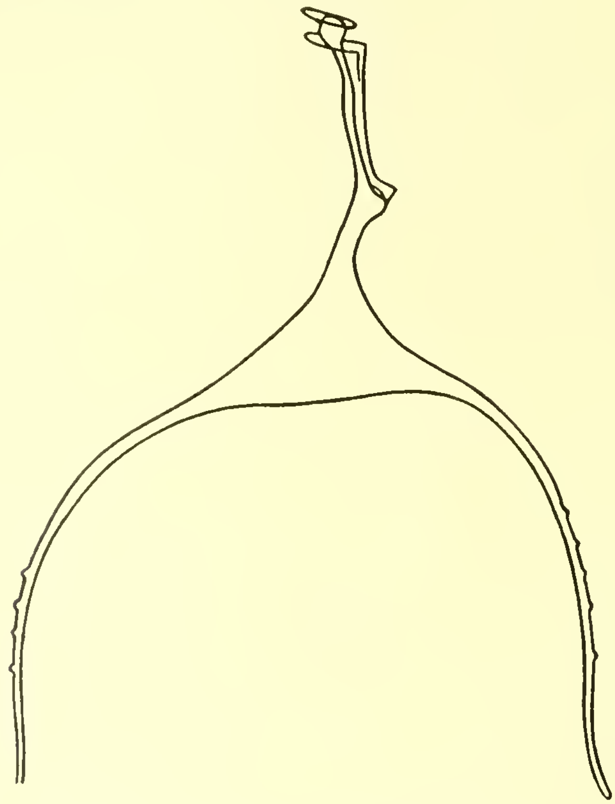

Figure 71.— *Triposolenia fatula* Kofoid, right lateral view of type specimen. × 430. Station 4587 (300–0 fathoms).

than wide. Anteriorly, near the head, the neck is constricted. It is almost straight, with a dorsal deflection of 7° from the longitudinal axis of the body. The left sulcal list has a fission rib and, anteriorly, several well-developed ribs.

The anterior process arises at a distance equaling half the dorsoventral width of the process, ventrally to the middle of the anterior margin of the midbody, and is deflected ventrally 27° from the longitudinal axis of the body. Its length almost equals that of the midbody and measures 0.73 the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.5 the length of the neck.

The midbody is subtriangular, with foreshortened longitudinal axis and with its major axis in the dorsoventral position. The three margins are almost straight. The postmargin is very slightly convex, the two anterior ones are straight or very slightly concave or convex. The posterior margin is longer and the anteroventral shorter than the anterodorsal. The shortness of the anteroventral margin is due to the ventral dislocation of the anterior process.

The antapicals are long; the ventral is 3.4 and the dorsal 3.3 times the length of the neck. The distance between the center of the midbody and the tip of the ventral antapical exceeds the distance from the midpoint of the postmargin of the midbody to the apex to an extent somewhat exceeding the length of the midbody. The antapicals are of about the same width, slender, subuniform in width throughout their entire length. The ventral is about 50 times longer than its average width. They are fairly strongly curved, somewhat asymmetrical; the dorsal does not converge or show a sigmoid flexure distally, as does the ventral; the curvature is not localized in a knee but fairly evenly distributed. The distance between the tips (*i.e.*, the distance between the outer margins at the place of greatest spread) is 4.0 times longer than the neck. In dorsoventral view, the dorsal antapical bends, distally, to the left; so does the ventral one but only very slightly and at the very end. The tips are truncate and minutely spinulate.

The thecal wall is as in *Triposolenia depressa*.

The cytoplasm contains a number of double-contoured plasmosomes. A large sack-shaped pusule is located in the anteroventral part of the midbody adjacent to the nucleus. From it a slender canal runs to the flagellar pore, expanding into a small vesicle near the pore. The nucleus is ellipsoidal and lies in a subcentral position.

The proportions of one specimen, the type, were measured.

Dimensions: — Length of body, 175 μ (not 190 μ, as stated in Kofoid, 1907a). Distance from apex to midpoint of postmargin of midbody, 87 μ. Length of head, 6.5 μ. Length of neck, 33 μ. Length of anterior process, 24 μ. Distance between flagellar pore and midpoint of postmargin of midbody, 49 μ. Distance between midpoints of bases of antapicals, 47 μ. Length of ventral antapical, 112 μ. Length of dorsal antapical, 110 μ. Distance between tips of antapicals (distance between outer margins of antapicals at place of greatest spread), 132 μ.

Comparisons: — The description given above is based on outline drawings of the type specimen.

Triposolenia fatula combines structural features of *T. longicornis* and *T. ambulatrix*. It resembles *T. longicornis* in its long and narrow processes and in having a midbody with straight or but slightly concave or convex margins. It differs from this species in its relatively smaller head, its more erect neck, and in the foreshortened longitudinal axis of its midbody. It resembles *T. ambulatrix* in the foreshortening of the longitudinal axis of its midbody and in the asymmetry of its antapicals. It differs from this species in the almost straight margins of its midbody, its relatively longer and more slender processes, and its less pronounced asymmetry.

Occurrence: — The species is recorded at only three of the 127 stations. These three stations (4587, 4594, 4598) are on the first line of the Expedition and in the Mexican Current. The catches in which the species was found are from 300–0 fathoms.

The temperature range of these three stations at the surface was 82°–84°; the average was 83.3°.

At Station 4598 the frequency is 1%, at the remaining stations less.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4587 of the Expedition, which thus is the type locality.

Judging by the available records, it appears to be one of the rarest of the species of the genus and restricted to waters of very high temperatures. Its adaptation to the low viscosity of its recorded habitat is suggested by the extreme elongation and marked slenderness of its processes, its relatively broad cingular lists, and its large pusule.

Triposolenia ambulatrix Kofoid

Plate **14**, fig. 11–14. Figure 60: 3, 72

Triposolenia ambulatrix Kofoid, 1907a, p. 203, pl. 4, fig. 24; 1906c, p. 96, 102; 1906d, p. 118, 119, 124.
non *Triposolenia ambulatrix* Jörgensen, 1923, p. 42, 43, fig. 63.

Diagnosis: — Head subspheroidal or subcylindrical. Epitheca convex. Distance between bases of antapicals 1.5–1.7 the length of neck which is 12–17 times longer than wide and almost straight or gently curved. Midbody subtriangular or subellipsoidal, its longitudinal axis foreshortened; with convex margins. Antapicals, 2.2–2.6 times longer than neck, slender, decidedly asymmetrical; deflected dorsally, more so than in other known species; not geniculate; with or without tubercles; tips rounded or truncate and spinulate. Length, 120–159 μ.

Tropical and subtropical regions of Eastern Pacific.

Description: — The head is 0.19 the length of the neck. Its structure is about the same as in *Triposolenia depressa*. The neck is rather long and narrow. The distance between the midpoints of the bases of the antapicals is 1.5 (1.5–1.7) the length of the neck which is 12–17 times longer than wide. The neck is almost straight or gently curved dorsally, with a dorsal deflection of 5° (0°–8°) from the longitudinal axis of the body. The ribs of the sulcal lists are very weak, scarcely noticeable; the fission rib was found in one specimen.

The anterior process arises ventrally to the middle of the anterior margin of the midbody; its distance from the middle equals or is somewhat greater or smaller than half its dorsoventral width. It is deflected ventrally 22° (17°–30°) from the longitudinal axis of the body. It measures 0.57 (0.56–0.58) the length of the neck. The distance from the flagellar pore to the midpoint of the postmargin of the midbody is 1.6 (1.4–1.7) the length of the neck.

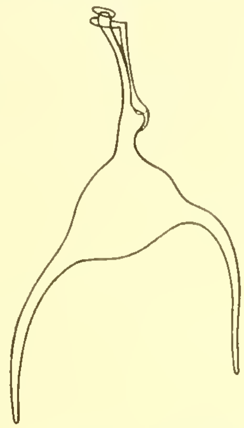

FIGURE 72.—*Triposolenia ambulatrix* Kofoid, right lateral view. × 430. Station 4598 (300–0 fathoms).

The midbody is subtriangular or subellipsoidal with foreshortened longitudinal axis and with its major axis in the dorsoventral position. Its three margins are more or less convex. The anteroventral margin is always somewhat shorter than the two others, due to the ventral dislocation of the anterior process; and the postmargin is always the longest.

The antapicals are pronouncedly asymmetrical and of moderate lengths. In one case the ventral was 2.6, the dorsal 2.3 times longer than the neck; in two other cases the corresponding figures were 2.4 and 2.5, and 2.3 and 2.2. In two out of three specimens the distance between the center of the midbody and the tip of the ventral antapical was subequal to the distance from the middle of the postmargin of the midbody to the apex; in the third case the latter distance was somewhat longer. The antapicals are of about the same width and taper gradually from the bases to the tips. The ventral is, in the middle, 19–22 times longer than wide. The dorsoventral diameter of the tips is 0.25–0.50 that of the bases. The ventral antapical is abruptly deflected posterodorsally, and has a more or less pronounced sigmoid curvature, its tip being deflected ventrally. The dorsal is not bent so as to form a balanced horn, in reversed symmetry, as in most of the other species of this genus, but is thrown posterodorsally with a moderate dorsal convexity; its tip is sometimes deflected dorsally, which gives it a sigmoid shape. The distance between the tips (*i. e.*, the distance between the outer margins at the place of greatest spread) is 3.2 (2.7–3.5) times longer than the neck. In dorsoventral view the antapicals are somewhat curved, the tip of the dorsal being deflected to the left, that of the ventral to the right. The tip of the ventral is rounded or more or less acute, that of the dorsal truncate and furnished with two minute spinules. The tubercles are very slightly developed and few in number; sometimes they are absent.

The thecal wall and the nucleus are as in *Triposolenia depressa*. The cytoplasm of the type specimen was crowded with numerous highly refractive double-contoured bodies.

The proportions of three specimens were measured. The length of these specimens was 146 (120–159) μ.

Dimensions: — Length of body, 120–159 μ (average, 146 μ; type, 158 μ). Distance from apex to midpoint of postmargin of midbody, 77–96 μ (average, 88 μ; type, 96 μ). Length of head, 5.0–6.5 μ (average, 6.0 μ; type, 6.5 μ). Length of neck, 26–35 μ (average, 32 μ; type, 34 μ). Length of anterior process, 15–20 μ (average, 18 μ; type, 19 μ). Distance between flagellar pore and midpoint of postmargin of midbody, 45–55 μ (average, 50 μ; type, 55 μ). Distance between midpoints of bases of antapicals, 39–58 μ (average, 49 μ; type, 58 μ). Length of ventral antapical, 59–90 μ (average, 77 μ; type, 90 μ). Length of dorsal antapical, 57–88 μ (average, 74 μ; type, 77 μ). Distance between tips of antapicals (distance between outer margins of the latter at place of greatest spread), 70–120 μ (average 101 μ; type, 120 μ).

Variations: — The species is rather constant in the few specimens thus far examined. The midbody varies in the degree of convexity of the anterior margins and in the degree of foreshortening. The decided convexity of the anterior margins of the midbody in the type specimen might be correlated with the fact that the midbody of this specimen was crowded with a great number of highly refractive double-contoured bodies. The degree of dorsal deflection of the antapicals is also variable.

Comparisons: — The description given above is based on the type material.

This is the most asymmetrical of the species of this genus. It has the most marked contrast between the dorsal and the ventral antapicals. The dorsal antapical is deflected dorsally to such a degree that its balance with the ventral one, so apparent in other species of this genus, is destroyed.

With regard to the relationships between this species and the other species of this genus, see *Triposolenia fatula* and the section on the subdivisions of this genus (p. 461).

Synonymy: — The species was established by Kofoid (1907a) under the name of *Triposolenia ambulatrix*. The form figured by Jörgensen (1923, fig. 63) as *T. ambulatrix* seems to be *T. depressa* Kofoid.

Occurrence: — The species is recorded at four only of the 127 stations. There are 2, 0, 0, 2, 0, and 0 stations on the six lines of the Expedition. Of these four stations, two (4587, 4598) are in the Mexican Current; one (4711) is in the South Equatorial Drift; one (4713) is in the Galapagos Eddy. All the samples in which the species was found are from 300–0 fathoms.

The temperature of these four stations at the surface was 73°–84°; the average was 78.5°.

The frequency is less than 1% except at Station 4598, where it is 1%.

The species was first recorded by Kofoid (1907a) from Station 4711 of the Expedition, which thus is the type locality.

It is eupelagic and appears to be one of the rarer species of the genus. In the material of the Expedition it is limited to catches from tropical waters.

Subgenus 2. RAMICIFORMIA Kofoid. — Of the two species that belong to this subgenus only one, *Triposolenia ramiciformis*, has been found in the material of the Expedition.

TRIPOSOLENIA RAMICIFORMIS Kofoid

Figure 60: 2, 73, 74

Triposolenia ramiciformis KOFOID, 1906c, p. 94, 99, 101, 102, 106, 107, 108, 109, 110, pl. 17, fig. 7; 1906d, p. 118, 119, 120.

Diagnosis: — Head small, capitate. Epitheca convex. Distance between bases of antapicals 0.77–0.97 the length of neck which is 11–17 times longer than wide and almost straight. Midbody pendent, subellipsoidal. Antapicals 2.6–3.4 times longer than neck, slender, subsymmetrical or more or less asymmetrical, geniculate, tuberculate; tips rounded. Length, 144–169 μ.

Tropical, subtropical, and warm-temperate regions of Eastern Pacific.

Description: — The head is 0.17 (0.15–0.19) the length of the neck, capitate, in most cases about as long as wide. The anterior face of the epitheca is more or less convex. The transverse furrow is flat or slightly concave or convex. The anterior cingular list is 1.5–2.5 times wider than the transverse furrow and has many fine ribs.

The neck is rather long and narrow. The distance between the midpoints of the bases of the antapicals is 0.89 (0.77–0.97) the length of the neck which is 11–17 times longer than wide. The neck is almost straight, with a dorsal deflection of 15° (5°–21°) from the longitudinal axis of the body. The left sulcal list has a fission rib.

The anterior process arises from the midbody at the base of the ventral antapical. It is deflected ventrally 29° (22°–38°) from the longitudinal axis of the body. It measures 0.47 (0.41–0.54) the length of the neck. The distance from the flagellar pore to the hindmost point of the postmargin of the midbody is 1.7 (1.6–1.9) the length of the neck.

The midbody is pendent, sack-shaped, and generally broadly rounded posteriorly; usually it tapers but little near its posterior end, but several specimens have been seen in which it tapers gradually from the bases of the antapicals to a

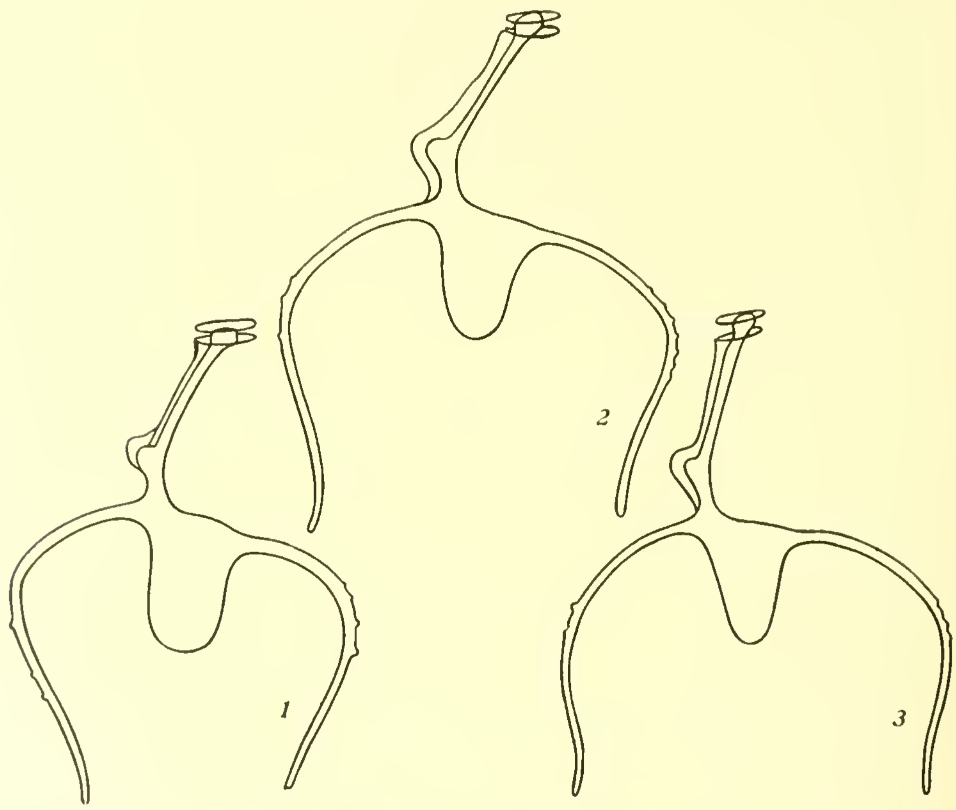

FIGURE 73.— *Triposolenia ramiciformis* Kofoid, left lateral view. × 430. 1, from Station 4681 (300–0 fathoms); 2, 3, from Station 4613 (300–0 fathoms).

rather narrowly rounded posterior end. The ventral antapical and the anterior process arise together from the anteroventral angle of the midbody and the dorsal antapical from the anterodorsal angle. The anterior edge of the midbody, between the anterior process and the dorsal antapical, is almost straight or slightly convex or concave.

The antapicals are rather long. In most cases the ventral is the longer, being 3.2 (2.7–3.4) times longer than the neck; the corresponding figures for the dorsal are 2.9 (2.6–3.1). Out of twelve specimens one had the ventral shorter than the dorsal, the former being 2.7, the latter 2.9 times longer than the neck. In the specimen with the greatest difference in this respect the ventral was 3.3, the dorsal 2.8 times longer than the neck. The antapicals are of almost the same width, slender, and subuniform in width throughout their entire lengths. The ventral is 30–40 times longer than its average width. They are strongly curved. Sometimes they are curved to about the same extent, sometimes either one of them is more curved than the other. The curvature is sometimes almost evenly distributed, but in most cases there is a distinct knee near or somewhat proximally to the middle of the antapical. Distally the antapicals exhibit in most cases a more or less developed sigmoid flexure. The distance between the tips is 2.3 (1.8–2.8) and between the outer margins at the place of greatest spread 3.1 (2.9–3.2) times longer than the neck. In the region of the major flexure and behind it, each antapical has, on its outer surface, two to six tubercles. The tips are rounded or more or less bluntly pointed.

The thecal wall is as in *Triposolenia depressa*.

The nucleus is lenticular in shape, bilaterally compressed, and lies in the posterior part of the midbody. The chromatophores are few, irregular in form, and yellowish green.

The proportions of twelve specimens were measured. The length of these specimens was 154 (144–169) μ.

Dimensions: — Length of body, 144–169 μ (average, 154 μ; type, 152 μ). Distance from apex to hindmost point of postmargin of midbody, 100–111 μ (average, 105 μ; type, 107 μ). Length of head, 6–7 μ (average, 6.5 μ; type, 6.0 μ). Length of neck, 35–42 μ (average, 38 μ; type, 40 μ). Length of anterior process, 15–22 μ (average, 18 μ; type, 17 μ). Distance from flagellar pore to hindmost point of postmargin of midbody, 61–70 μ (average, 65 μ; type, 65 μ). Distance between midpoints of bases of antapicals, 30–36 μ (average, 34 μ; type, 36 μ). Length of ventral antapical, 106–133 μ (average, 121 μ; type, 119 μ). Length of dorsal antapical, 103–126 μ (average, 110 μ; type, 108 μ). Distance between tips of antapicals, 64–114 μ (average, 89 μ; type, 96 μ). Distance between outer margins of antapicals at place of greatest spread, 110–130 μ (average, 119 μ; type, 117 μ).

Variations: — The species is strikingly variable with regard to the shape of the midbody. In some specimens the midbody tapers uniformly to a blunt posterior tip, while in others its dorsal and ventral margins are subparallel, and its posterior end is broadly rounded. The antapicals vary in degree of sigmoid flexure, in the distance between the tips, and in the amount of tuberculation. There are some differences in the amount of lateral displacement of the origin of the anterior process and in the obliquity of the neck.

Comparisons: — Most of the specimens assigned to *Triposolenia ramiciformis* in this paper agree very closely with the type specimen of this species as drawn by Kofoid (1906c, pl. 17, fig. 7).

The species differs from *Triposolenia exilis,* the only other species of this subgenus, in the greater obliquity of the neck, in the greater width of the anterior part of the midbody, and in the less immediate posterior deflection of the ant-

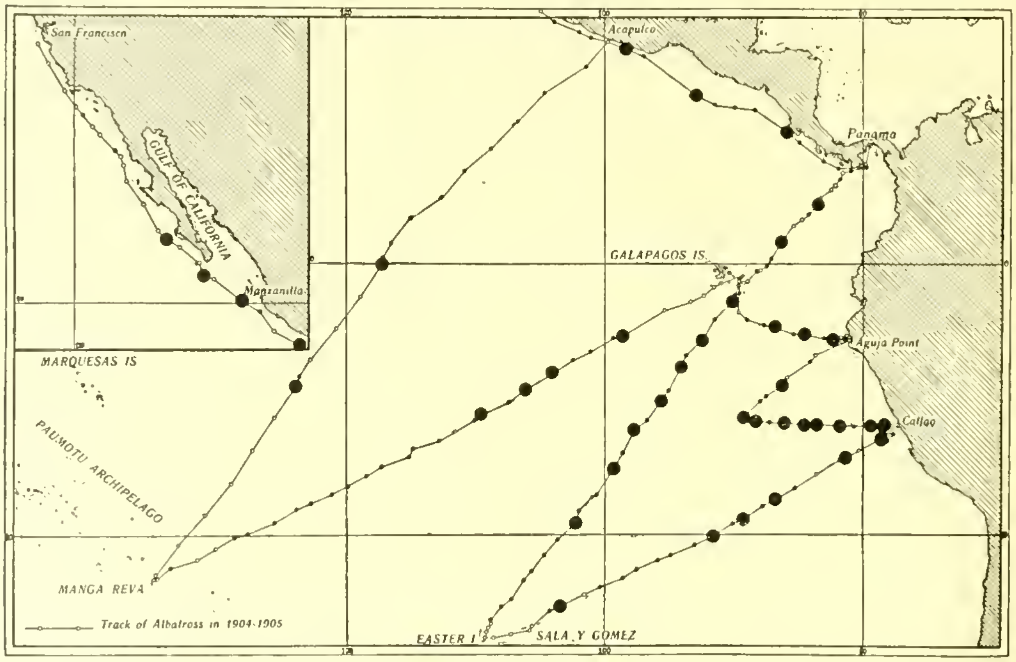

FIGURE 74.— Occurrence of *Triposolenia ramiciformis* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

apicals. It is probably better adapted to flotation than *T. exilis.* The tuberculations on the antapicals are farther in front in the subgenus Ramiciformia than in the subgenus Triposolenia.

Occurrence: — The species is recorded at forty of the 127 stations. There are 7, 14, 6, 7, 4, and 2 stations on the six lines of the Expedition. Of these forty stations, two (4580, 4583) are in the California Current; four (4587, 4590, 4598, 4605) are in the Mexican Current; three (4613, 4634, 4637) are in the Panamic Area; fourteen (4648, 4650, 4652, 4659, 4662, 4663, 4665, 4666, 4667, 4668, 4670, 4671, 4675, 4676) are in the Peruvian Current; one (4691) is in the Easter Island Eddy; two (4713, 4715) are in the Galapagos Eddy; thirteen (4679, 4681, 4683, 4701, 4705, 4707, 4709, 4711, 4717, 4721, 4722, 4724, 4740) are in the South Equatorial Drift; one (4742) is in the South Equatorial Current. At one station (4652) the species is recorded from 100–0 fathoms, at three stations (4662, 4670, 4715) from 800–0 fathoms, and at one station (4681) from both 800–0 fathoms and 300–0 fathoms. All the other records refer to catches from 300–0 fathoms only.

The temperature range of these forty stations at the surface was 66°–85°; the average was 73.4°.

At two stations (4648, 4663) a frequency of 2% is recorded. At ten stations (4598, 4650, 4659, 4552, 4666, 4668, 4671, 4701, 4715, 4742) a frequency of 1% was found. At the remaining stations the frequency is less than 1%.

Previously the species has been taken by Kofoid (1906c) off San Diego, California, the type locality, where it occurred in catches from 100 fathoms.

This is one of the two most widely distributed and abundant species of the genus in the region investigated by the Expedition, standing second to *Triposolenia bicornis* with forty-five record stations. It appears to be more concentrated than any other species of this genus in the Peruvian Current and in the eastern part of the South Equatorial Drift, which is under the influence of this current.

3. ORNITHOCERCIDAE, fam. nov.

Diagnosis: — Body of diverse shapes, usually about as long as deep or more or less decidedly deeper than long. Epitheca low, more or less disk-like; its depth 0.07–0.88 the depth of hypotheca. Transverse furrow, as a rule, wide and decidedly wider dorsally than ventrally; its dorsal width 0.33–0.77 the greatest depth of body. Cingular lists large, inclined anteriorly, funnel-shaped; dorsal width, 0.30–2.00 the depth of body. Usually with phaeosomes in girdle. Length of body, 13.3–88.7 μ.

Marine and eupelagic, widely distributed in tropical, subtropical, and warm-temperate waters.

Subdivisions. Relationships among the Genera

The species of the family Ornithocercidae have in the present paper been assigned to one of three genera, viz., Ornithocercus, Parahistioneis, and Histioneis. Of these genera, Ornithocercus and Histioneis were established by Stein (1883), while Parahistioneis is new. Following the suggestion of Murray and Whitting (1899), a fairly great number of investigators rejected Stein's (1883) genus Ornithocercus and referred all the known species, among which were representatives of all the three genera mentioned above, to one single genus, Histioneis (see the historical section of Ornithocercus, p. 509). We are not able to accept this decision, which was caused by the discovery of *Histioneis* (= *Parahistioneis*) *francescae* and *H.* (= *Parahistioneis*) *para*, since Ornithocercus and Histioneis are structurally very distinct and evidently represent two evolutionary lines embodying very different structural developments. For instance, in Ornithocercus (*1*) the anterior cingular list does not become stalked; (*2*) the posterior cingular list has no submarginal cross-rib but a great number of radial ribs; and (*3*) the left sulcal list has usually more than one main rib behind the fission rib. In Histioneis, on the other hand, (*1*) the anterior cingular list is stalked in all but one of the twenty-eight known species; (*2*) the posterior cingular list has a submarginal cross-rib but only two pairs of radial ribs, viz., those next to the sagittal suture; and (*3*) the left sulcal list has never more than one main rib behind the fission rib. Parahistioneis occupies in several respects a position intermediate between Ornithocercus and Histioneis. For example, it agrees with Ornithocercus in not having any submarginal cross-rib in the posterior cingular list, and all but one of its species resemble Histioneis in having a single main rib in the left sulcal list behind the fission rib. In regard to the stalking of the anterior cingular list and to the radial ribs of the posterior cingular list, some of the members of Parahistioneis exhibit tendencies inherent in Histioneis, while others approach Ornithocercus. A further generic subdivision of this family will probably be desirable and feasible after a thorough reëxamination of the right sulcal list which is now unknown in most of the species. Parahistioneis includes quite heterogeneous elements, and at least one member of Ornithocercus, viz., *O. formosus*, is likely to have its generic allocation changed.

Lindemann (1924, p. 7) suggested that Ornithocercus, "die Krone aller Peridineen," evolved from Histioneis. This, however, can hardly be the case for the following reasons: — (*1*) the primitive species of Ornithocercus (*O. splendidus*) have a deeper epitheca than Histioneis and the width of their transverse furrow is subuniform throughout; (*2*) even the most primitive members of Histioneis, viz., *H. costata* and *H. paulseni*, have the posterior cingular list of a much more advanced type than the one characteristic of Ornithocercus. In other words, in these *three* fundamental respects Ornithocercus is more primitive than Histioneis. Neither can we derive Histioneis from Ornithocercus. The former genus is in some respects, especially in the structure of the left sulcal list, more primitive than the latter. In considering the relationship between these two genera, the structure of the right sulcal list should also be taken into account.

It seems to be most in conformity with known facts to assume that the three genera of this family evolved independently from a common ancestor approaching the Dinophysis type and embodying the following characteristics: — (*1*) the body was subrotund in lateral outline; (*2*) the transverse furrow was located anteriorly and of subuniform width throughout; (*3*) the anterior cingular list was wide and funnel-shaped but not stalked and furnished with a great number of radial ribs; (*4*) the posterior cingular list was fairly wide, inclined anteriorly, open ventrally, and had a rather great number of radial ribs but no submarginal rib; (*5*) the right sulcal list was fairly small and its ventral edge free; (*6*) the left sulcal list ended on the posteroventral side of the body, was angular posteroventrally, and had but one main rib behind the fission rib; (*7*) the thecal wall was areolate or finely reticulate. From this ancestral type the present genera evolved partly by progressive, partly by retrogressive evolutionary processes.

Distribution: — The three genera of Ornithocercidae are exclusively marine, eupelagic, and widely distributed in tropical, subtropical, and warm-temperate waters. Most of the species have been found only in the warmest regions of the seas. While some of the species of Ornithocercus occasionally may be found in large numbers, most members appear to be exceedingly rare. The optimum habitat of most species is the deeper levels of photosynthesis, but some species of Ornithocercus are rather frequent in surface waters.

Key to the Genera

1. Posterior cingular list with submarginal cross-rib .... *Histioneis* Stein (1883).
1. Posterior cingular list without submarginal rib .... 2.
2. Posterior cingular list with less than six radial ribs .... *Parahistioneis*, gen. nov.
2. Posterior cingular list with six or more radial ribs .... *Ornithocercus* Stein (1883).

Ornithocercus Stein

Ornithocercus Stein, 1883, p. 25. Bütschli, 1885, p. 944, 1011. Schütt, 1896, p. 28. Delage & Hérouard, 1896, p. 386.
Parelion Schmidt, 1888, pl. 144, fig. 59–61.
Ornithocerus Schütt, 1893, fig. 83 (*lapsus pennae*).
Ornithoceras Gräf, 1909, p. 139 (*lapsus pennae*).

Diagnosis: — Body subcircular, subellipsoidal, subobovate, rounded subtriangular, or subtrapeziform in lateral outline, usually about as deep as long (length: depth, 0.76–1.24: 1), compressed bilaterally. Epitheca low, disk-like, its depth usually 0.37–0.67, seldom as little as 0.28 or as much as 0.88 the depth of body. Transverse furrow, as a rule, wide dorsally and wider dorsally than ventrally; dorsal width, 0.33–0.55 the depth of body; ventral width, 0.31–0.70 the dorsal width (exception *Ornithocercus splendidus*). Cingular lists large, anterior not stalked, posterior usually slightly narrower than anterior; width, 0.37–1.46 the depth of body; anterior with 4–24 radial ribs, inclined anteriorly at 25°–50°; posterior with 6–24 usually simple ribs, no cross-rib, inclined anteriorly at 30°–85°; besides ribs sometimes reticulation. Right sulcal list small, its ventral margin free (except in *O. formosus*). Left sulcal list large, extending at least to near antapex, sometimes to posterior cingular list; two- to five-lobed, rounded, or squarish; width at lobes 0.27–1.92 the depth of body; behind fission rib 4–15 strong radial ribs (except in *O. formosus*, that has only one) and often reticulation.

Type. — *Ornithocercus magnificus* Stein.

Organology: — The *body* (*theca*) in Ornithocercus is simple and more uniform in shape than in any of the other large genera of this tribe. Usually it is somewhat asymmetrical in lateral view, due largely to the shape of the transverse furrow and to the inclination of the longitudinal axis, but symmetrical or subsymmetrical specimens may be found in a few species, for instance, in *O. splendidus* (Figure 77: 4; 85: 3) and in *O. quadratus* (Figure 87: 1–4). In dorsoventral view it appears always to be symmetrical. Sometimes the longitudinal axis is perpendicular to the girdle (see the figures just mentioned), but usually it is slightly (1°–10°) deflected posterodorsally; the maximum deflection as yet recorded is about 20° (*O. heteroporus*).

When seen in lateral view, the body usually is about as deep as long, the typical ratio between the length and the depth being 0.90–1.10 : 1. In exceptionally deep specimens (*cf. Ornithocercus splendidus*) this ratio may be 0.76 : 1; and in the specimen with the most elongated body found in the material of the Expedition (belonging to *O. splendidus*) it was as high as 1.24 : 1. As a rule, the body is deepest in or near the middle, and only in exceptional cases (some specimens of *O. splendidus*) the greatest depth is located at the girdle. In most species it is subcircular in lateral outline, but it may be subellipsoidal, subobovate, rounded subtriangular, or subtrapeziform (*O. heteroporus, O. splendidus*). In dorsoventral view the body usually is subellipsoidal, widest in the middle, 1.4–1.7 times longer than wide, well rounded posteriorly and narrowly rounded conical anteriorly (Plate **17**, fig. 4, 6); but it may be broadly ellipsoidal, with broadly rounded apices, and about 1.14 times longer than wide (*O. heteroporus*, Plate **18**, fig. 1), or again its outline may be obovate (*O. splendidus*, Figure 77 : 7).

The *epitheca* forms an ellipsoidal, gently vaulted to flat disk, the dorsoventral diameter of which decidedly exceeds the transdiameter (Schütt, 1895, pl. 5, fig. 22). In lateral view it usually is somewhere between 0.37 and 0.67 as deep as the hypotheca, gently convex to flat, highest in or dorsally to the center (only seldom ventrally to the center), and inclined ventroposteriorly at 5°–15°. Sometimes (*Ornithocercus heteroporus*) its depth may be only 0.28, sometimes (*O. splendidus*) as much as 0.88 the greatest depth of the hypotheca; and it may be horizontal (*O. heteroporus* and *O. splendidus*).

Due to the small height of the epitheca, the *transverse furrow* is situated near the anterior end of the body. Its distal portion is not displaced posteriorly, in other words, it does not form a spiral about the body; and its postmargin is always straight or nearly so. In the relatively primitive species, *Ornithocercus splendidus*, it is of subuniform or nearly subuniform width throughout, and its width is 0.11–0.28 the greatest depth of the body. In the remaining species it is more or less strikingly wider dorsally than ventrally; the dorsal width is 0.33–0.55 the greatest depth of the body, and the ventral width is 0.31–0.70 the dorsal width. Usually it is gently or moderately concave dorsally, but it may be flat or even slightly convex. Ventrally it is, as a rule, gently convex to flat.

The *longitudinal furrow* is about half as long as the hypotheca or slightly more and at most but slightly impressed.

While in Phalacroma, Dinophysis, and most of the other genera of this tribe, the *lists of the furrow* are comparatively narrow and simple, they are characterized in Ornithocercus by their very large size and high structural differentiation. They arise from low and narrow basal ridges (Plate 17), and in spite of their large size they are hyaline and very delicate.

Of the *cingular lists* the anterior usually is slightly wider than the posterior; and the posterior is, as a rule, somewhat more inclined anteriorly than the anterior. In most specimens the width of these lists is somewhere between 0.37 and 0.90 the greatest depth of the body, and the anterior inclination somewhere between 25° and 50° in the case of the anterior list and between 30° and 85° in the case of the posterior. *Ornithocercus splendidus,* which is unique in the excessive width of these lists (0.77–1.46 the greatest depth of the body), is also characterized by the fact that the two lists have about the same anterior inclination (30°–50°). The dorsal and ventral inclination are sometimes about equal; sometimes the ventral is slightly steeper. The anterior cingular list has on each valve between four and twenty-four, often between five and ten, complete, subequidistant radial ribs. These ribs may be simple or more or less anastomosing, and sometimes (Plate 16, fig. 1) they have distally candelabra-like branches. In *O. formosus* (Plate 17, fig. 4) the dorsal of these ribs is branched in the same manner as in many of the species of Histioneis. Besides these complete ribs, there is frequently a varying number of short, marginal radial ribs, which may be simple or anastomosing. The tips of the ribs may extend slightly beyond the margin of the list (Plate 17, fig. 1). The posterior cingular list is on each valve furnished with between six and twenty-four, as a rule between eight and nineteen, complete, subequidistant radial ribs. These ribs usually are simple or one or a few of them are branched proximally. In exceptional cases (*Ornithocercus splendidus,* Plate 17, fig. 3) they anastomose, or (Plate 17, fig. 1, 5) the dorsal and ventral of them are connected by reticulation. In a few specimens (Plate 16, fig. 3) this list has besides the complete ribs some short, marginal radial ribs. The anterior cingular list is always closed ventrally. On the other hand, we are not able to decide as to whether or not the posterior is always open ventrally.

The *sulcal lists* form a direct continuation of the posterior cingular list and run parallel to each other on either side of the longitudinal furrow. The entire right sulcal list and the portion of the left sulcal list which is behind the fission rib belong to the right valve; and the portion of the left sulcal list in front of the fission rib belongs to the left valve.

The *right sulcal list,* which always is strikingly smaller than the left, exhibits fairly decided variations in size and shape. In most species its ventral margin is free, but in *Ornithocercus formosus* this margin appears to be attached to the left sulcal list, just as in Histioneis, so that these two lists thus form a canal open posteriorly and presumably also anteriorly (Plate 17, fig. 5). In some species (*e.g.*, *Ornithocercus magnificus*) this list is very small, ending at or near the fission rib of the left sulcal list, and subtriangular or rounded triangular, decreasing gradually in width posteriorly. In other species (Figure 85: 5; Plate 16, fig. 1; Plate 17, fig. 1, 7) it is comparatively large and extends far beyond the fission rib of the left sulcal list (but never quite as far as to the midline of the body). In these species it either is of subuniform width throughout the greater portion of its length and gently (Plate 17, fig. 1) or strongly (Plate 16, fig. 1) convex posteriorly, or (Plate 17, fig. 7) it decreases strikingly in width in its posterior half and has an irregularly sigmoid ventral margin. Its maximum width does not, as a rule, exceed the dorsal width of the transverse furrow. In some species this list appears to lack structural differentiation; in others it has one or more regular or irregular ribs (Plate 16, fig. 4, 1), or it may be reticulated (Plate 17, fig. 1, 5). Its size, shape, and structure are frequently quite variable within the species.

The *left sulcal list*, which is very large, has undergone in this genus more striking modifications than any other structure; and the species hitherto established are based largely on the differences in this list. As a rule, it is decidedly variable even within the species. In the most primitive members of this genus (*Ornithocercus heteroporus* and *O. splendidus*, Figure 75, 77) this list is two-lobed and ends at or near the antapex of the body; the lobes are subequal or nearly so, and narrowly rounded or subacute. In the remaining species this list extends to the dorsal side of the body and sometimes (Plate 16, fig. 1; Plate 17, fig. 7) it encircles the hypotheca, ending at the posterior cingular list. Among these species one, *O. formosus* (Plate 17, fig. 5), is characterized by having this list strongly two-lobed, the lobes being narrowly rounded or subacute; the others have it three-lobed (*O. magnificus*, *O. thurni*, and *O. carolinae*, Figure 79, 81, 89), four- or even five-lobed (*O. steini*, Figure 83), rounded (*O. orbiculatus*, Plate 17, fig. 7), or squarish (*O. quadratus*, Figure 86). When it is three-lobed, the lobes usually are narrowly rounded and either subequal, as in *O. magnificus* and *O. thurni*, or the middle (antapical) one of them is strikingly larger than the others, as in *O. carolinae*. The lobes either are well marked, as in Figure 81: 6 of *O. thurni*, or nearly indistinguishable, as in Figure 83: 10, 11, of *O. steini*. The width of this list, measured at the tips of the lobes, is usually somewhere between 0.50 and 1.92 the greatest depth of the body; in *O. carolinae* the width at the dorsal lobe may amount to only 0.27 the greatest depth of the body. The fission rib, which is made up of two members, one belonging to the left, the other to the right valve, and which arises at or near the middle of the body, usually is straight or nearly so, and is subhorizontal or somewhat inclined posteriorly. As a rule, its inclination lies between 1° and 25°; its maximum inclination is about 55° (see *O. carolinae* and *O. formosus*, Plate 17, fig. 1, 5). In exceptional cases (*O. quadratus* f. *intermedia*, Figure 87: 15–20) its posterior member is recurved posteriorly. In front of the fission rib this list usually has, besides the anterior main rib, *i.e.*, the rib at the junction of this list and the posterior cingular list, one or a few regular or irregular radial ribs and frequently a more or less developed reticulation (Plate 17, fig. 1, 3, 5, 7, 9). Behind the fission rib it sometimes (*O. formosus*, Plate 17, fig. 5) has only one strong radial rib, but usually (*e.g., O. magnificus, O. thurni, O. steini*, Figure 79, 81, 83) there are from four to seven ribs of this kind; and in one species (*O. carolinae*, Plate 17, fig. 1) the number of these ribs is 13–15. These ribs, which afford very important taxonomic characters, and which in the present paper have been named the *a*-, *b*-, *c*-, etc., ribs, the *a*-rib being the one situated most dorsally, either are simple and nearly straight (*e.g.*, in *O. quadratus* f. *schütti*, Figure 86: 7–14), or they are more or less branched and irregular (*e.g.*, in *O. quadratus* f. *assimilis*, Figure 87: 1–8). The tips of these ribs are in several species connected by a submarginal rib, which may be fairly heavy (*e.g.*, in *O. magnificus*, Figure 79) or very fine (*O. steini*, Figure 83), and which may be present or absent in the same species. Besides the radial and submarginal ribs a more or less developed reticulation frequently characterizes this portion of the list; reticulation is especially found in the tips of the lobes and dorsally to the dorsal radial rib (Plate 17, fig. 1, of *O. carolinae*). The great variations observed by us in the structural differentiations of this list seem to be due largely to age, to irregularities in the regeneration of local injuries, and to processes of resorption and growth in adjustment to the requirements of flotation. Generally speaking, the older a specimen is, the more complicated is the structure of this list (see Schütt, 1900a).

Parasagittal lists have not been recorded in this genus.

The *flagellar pore* is a rounded or somewhat elongated opening of moderate size, located in the transverse furrow, in other words, on the right valve, at or just behind the posterior cingular list. Its largest diameter usually does not exceed half the ventral width of the transverse furrow. No counterparts have been found to the pores recorded in Phalacroma (Plate 3, fig. 1, 2, of *Phalacroma pulchrum* and *P. giganteum*) on the ventral side of the left valve, near the sagittal suture, and just in front of the anterior cingular list. It is, however, not impossible that such pores do exist in Ornithocercus.

The *longitudinal flagellum* has been figured only in *Ornithocercus magnificus* (by Schütt, 1895, pl. 5, fig. 21: 1). In this species it originates in the flagellar pore and has a length about 1.5 the greatest depth of the body. The *transverse flagellum* has not been observed as yet; presumably it is well developed, lies in the girdle, and encircles the body from the left around to the right.

The structure of the *thecal wall* is subject to but slight variations in this genus. In all the species the entire theca has a fairly great number of scattered pores. The most primitive species (*Ornithocercus heteroporus* and *O. splendidus*) may have no other structural differentiation, but in all the higher members the hypotheca is areolate. The areoles are rounded or angular, of moderate and often subuniform size, and each of them has a pore in the middle; sometimes (Plate 17, fig. 5, 7) they are close-set, sometimes (Plate 17, fig. 1) more or less spaced. In some species (*e.g., O. magnificus*, Plate 16, fig. 3) the (10–20) areoles that border the girdle posteriorly are larger than the others. Sometimes (Plate 16, fig. 1) the areoles are developed only on the central portion of the hypotheca.

The *protoplasmic contents* have been figured in one species only, viz., in *Ornithocercus magnificus* (Schütt, 1895, pl. 5, fig. 21: 2). In this species the *nucleus* is large, ovoidal, is located posterodorsally, and has a moniliform chromatin reticulum. Two fairly large *pusules* open at the flagellar pore by a slender canal. *Chromatophores* are not present (Schütt, 1895, p. 64). *Metaplasmic inclusions* of various kinds, such as globules of fats and oils, have been found. See also Schütt (1895) and Bütschli (1885). *Phaeosomes*, ovoidal or spheroidal, small or of medium size, are often found in the girdle. Their color is green or yellowish green.

The *length of the body* ranges within the genus from about 27 μ (*Ornithocercus heteroporus*) to about 68 μ (*O. thurni*), according to our own measurements made on the material of the Expedition. Measurements made on previously published figures give a maximum length of more than 80 μ.

Reproduction: — Just as in Phalacroma and Dinophysis and in the other genera of this tribe, binary fission is the only known mode of reproduction in Ornithocercus. The details of this procedure are not known, but in all probability they are about the same as in Phalacroma (see the corresponding section of this genus, p. 51).

At least in some species (see, for instance, Plate 18, fig. 4–6 of *Ornithocercus thurni*) the two schizonts remain attached to each other for some time by means of an accessory ridge along the anterior or middle portions of the dorsal margin of the hypotheca. No data are available as to the length of this period of attachment, but presumably it is comparatively short. Since very few free specimens with traces of this ridge have been found, it appears plausible that this structure is resorbed shortly after the separation of the schizonts. Usually this ridge is fairly wide; its width may even be subequal to half the greatest depth of the body. Its shape is squarish, and its dorsal margin is deeply serrated in most specimens. It may be nearly without structural differentiation, but usually it is reticulated; sometimes (Plate 18, fig. 2) the reticulation is fine, sometimes (Plate 18, fig. 6) the meshes are large and regular in arrangement. While in *Dinophysis miles* as many as eight adhering specimens have been found (Weber-van Bosse, 1901, pl. 17, fig. 3), in Ornithocercus never more than two specimens have been recorded attached to each other. The adaptive significance of this phenomenon possibly is that it facilitates the remaining of the schizonts in the horizontal position during the period when their lists are relatively undeveloped. In the horizontal position these organisms offer the maximum surface of resistance.

As a rule, the schizonts are of about the same size, shape, and structure as their parent. Sometimes, however, there is a more or less pronounced difference in the size or in the shape as well as in the structure. This phenomenon, which is illustrated by Plate 18, figure 2, 7–9, appears to be due to an increase in the rate of division beyond the rate of growth of the cytoplasm. Indeed, sometimes (Plate 18, fig. 9) the fission takes place so rapidly that parts of the theca of the grandparent still remain unabsorbed. A striking feature of this mode of fission is that the ventral side of the body remains unchanged and that the reduction in size takes place largely dorsally, or dorsally and posteriorly (Plate 18, fig. 9, 2). In some specimens the length as well as the depth of the body are reduced, the schizonts being more or less strikingly smaller but of about the same shape as the mother. In other cases only the depth is reduced, and the schizonts become more or less oblong. Plate 18, figure 9, shows a specimen about as long as its grandparent but only about half as deep. In this manner specimens may originate which are so strikingly different from their ancestral type that a specific allocation is impossible or at least conjectural.

The significance and causes of the phenomenon described in the last paragraph are unknown. It is probably not an abnormality brought about by unfavorable factors in the surrounding medium, since most of the recorded specimens of this kind were found not in turbulent or relatively cold regions but in the South Equatorial Drift, *i. e.*, in the area characterized by hydrographic conditions more stable and presumably more favorable to this genus than any of the remaining areas investigated by the Expedition. Hensen (1911, p. 152) probably refers to small specimens originated in this manner when he speaks of "Schwärmlinge . . . wie solches von Ornithocercus bekannt geworden ist." What happens to these small individuals? Do they succumb after they have reached a minimum size, or do they regain the size of their ancestors by the process of ecdysis or regulatory enlargement during growth? Or, again, do they form a stage preparatory to sexual reproductions? No data bearing on these interesting and important questions are available at the present writing.

Megacytic specimens have been found in some species, for instance, in *Ornithocercus magnificus s. str.*, but the intercalary zone appears never to attain any considerable width.

It may finally be mentioned in this connection that we are unable to furnish data on the mode of reproduction in the closely related genera Parahistioneis and Histioneis, and that no information on this point is published at present. However, in all probability these genera resemble Phalacroma in this respect.

Distribution: — Ornithocercus is marine, eupelagic, of circumequatorial distribution, and all its species are true warm-water forms, being restricted to tropical, subtropical, and warm-temperate seas. The genus is a characteristic element of the group of beautiful and luxuriant plankton organisms that has aroused the admiration and been the source of the enthusiastic descriptions of the life of tropical waters by many investigators. It is one of the groups of organisms causing the striking contrast between the plankton of the equatorial and the polar regions. In the Atlantic Ocean, Ornithocercus has been recorded between lat. 45° N. and lat. 42° S.; in the Pacific Ocean its northern limit appears to be at about lat. 35° N. Some species, as *O. splendidus,* seem to be restricted to tropical and subtropical seas; others, as *O. thurni*, are predominantly tropical and subtropical but occur also in small numbers in warm-temperate waters; still others, as *O. magnificus*, are almost as frequent in warm-temperate as in tropical and subtropical seas. The distribution of the genus as a whole appears to be fairly well established. The general distribution of several of the species, on the other hand, must be regarded as rather uncertain, due to the broad concept of species held by several investigators (see, for instance, *O. magnificus*, the section on synonymy, p. 534), to the great difficulties of specific determinations, and to the fact that but few of the distributional data are accompanied by figures or descriptions by means of which the determinations of species by planktonologists may be checked and compared.

Although Ornithocercus appears always to lack chromatophores (Schütt, 1895, p. 64), it is found more commonly in surface waters than any other genus of Dinophysoidae. Most of the records of this genus published at the present writing are from surface hauls. It should be emphasized, however, that our knowledge of its vertical distribution is still very fragmentary. The only records based on catches made with closing nets available as yet are those of the VALDIVIA Expedition (see *O. splendidus, O. magnificus*, and *O. quadratus*, the sections on distribution, p. 526, 536, 570).

Most of the species seem to be rare. Some of them, however, as *Ornithocercus magnificus*, *O. thurni*, and *O. quadratus*, when compared with species of other genera of this tribe, are relatively common, and a sudden appearance in great numbers of *O. magnificus* has been recorded (Schiller, 1914, p. 14).

Representatives of Ornithocercus were found at 100 (78.7%) out of the 127 stations of the Expedition from which dinoflagellates were recorded. These 100 stations are distributed over the whole area covered by the Expedition in the following manner (Plate 28): —

2 (50.0%) out of the 4 stations in the California Current
13 (100.0%) out of the 13 stations in the Mexican Current
17 (100.0%) out of the 17 stations in the Panamic Area
8 (29.6%) out of the 27 stations in the Peruvian Current
9 (90.0%) out of the 10 stations in the Easter Island Eddy
4 (100.0%) out of the 4 stations in the Galapagos Eddy
40 (89.0%) out of the 45 stations in the South Equatorial Drift
3 (100.0%) out of the 3 stations in the South Equatorial Current
2 (100.0%) out of the 2 stations in the Equatorial Counter Current
2 (100.0%) out of the 2 stations in the North Equatorial Current

The numbers of these 100 stations are as follows:—4580, 4583 (California Current); 4587, 4588, 4590, 4592, 4594, 4596, 4598, 4600, 4604, 4605, 4607, 4545, 4546 (Mexican Current); 4609, 4611, 4613, 4615, 4617, 4619, 4623, 4624, 4627, 4631, 4634, 4635, 4637, 4638, 4639, 4640, 4644 (Panamic Area); 4646, 4647, 4648, 4650, 4659, 4664, 4671, 4676 (Peruvian Current); 4689, 4691, 4692, 4695, 4696, 4697, 4698, 4699, 4700 (Easter Island Eddy); 4713, 4714, 4715, 4716 (Galapagos Eddy); 4679, 4680, 4681, 4682, 4683, 4684, 4685, 4686, 4687, 4701, 4702, 4704, 4705, 4707, 4709, 4711, 4712, 4717, 4718, 4719, 4720, 4721, 4722, 4723, 4724, 4725, 4727, 4728, 4729, 4730, 4731, 4732, 4733, 4734, 4735, 4736, 4737, 4739, 4740, 4741 (South Equatorial Drift); 4742, 4743, 4540 (South Equatorial Current); 4541, 4542 (Equatorial Counter Current); 4543, 4544 (North Equatorial Current).

At fifty-one out of these 100 stations Ornithocercus was taken in vertical hauls and at fifty-seven in surface hauls. Most of the vertical hauls are from

300–0 fathoms, some are from 800, 150, 100–0 fathoms. Vertical hauls were made at only sixty-eight out of the 127 stations. The genus was thus found at 75.0% of the stations at which vertical hauls were made.

Disregarding the stations at which surface catches only were made, the record stations are distributed over the area covered by the Expedition in the following manner: —

2 (50.0%) out of the 4 stations in the California Current
5 (100.0%) out of the 5 stations in the Mexican Current
6 (100.0%) out of the 6 stations in the Panamic Area
7 (31.8%) out of the 22 stations in the Peruvian Current
5 (100.0%) out of the 5 stations in the Easter Island Eddy
2 (100.0%) out of the 2 stations in the Galapagos Eddy
23 (100.0%) out of the 23 stations in the South Equatorial Drift
1 (100.0%) out of the 1 station in the South Equatorial Current

There were no vertical hauls made in the Equatorial Counter Current or in the North Equatorial Current.

The numbers of these fifty-one vertical stations are as follows: — 4580, 4583 (California Current); 4587, 4590, 4594, 4598, 4605 (Mexican Current); 4609, 4613, 4617, 4634, 4637, 4638 (Panamic Area); 4646, 4647, 4648, 4650, 4659, 4671, 4676 (Peruvian Current); 4689, 4691, 4695, 4697, 4699 (Easter Island Eddy); 4713, 4715 (Galapagos Eddy); 4679, 4681, 4683, 4685, 4687, 4701, 4705, 4707, 4709, 4711, 4717, 4719, 4721, 4722, 4724, 4728, 4730, 4732, 4734, 4736, 4737, 4739, 4740 (South Equatorial Drift); 4742 (South Equatorial Current).

Surface catches and stomachs of Salpa taken in surface waters (eighty-one surface catches and twenty-four samples of Salpa stomachs) were examined from eighty-two stations. As previously mentioned, the genus was taken at fifty-seven, *i. e.*, at 69.5% of all the surface stations. Taking into consideration the surface stations only, these fifty-seven record stations are distributed in the following manner: —

1 (25.0%) out of the 4 stations in the California Current
9 (100.0%) out of the 9 stations in the Mexican Current
13 (100.0%) out of the 13 stations in the Panamic Area
3 (15.0%) out of the 20 stations in the Peruvian Current
4 (80.0%) out of the 5 stations in the Easter Island Eddy
2 (100.0%) out of the 2 stations in the Galapagos Eddy
19 (82.6%) out of the 23 stations in the South Equatorial Drift
2 (100.0%) out of the 2 stations in the South Equatorial Current
2 (100.0%) out of the 2 stations in the Equatorial Counter Current
2 (100.0%) out of the 2 stations in the North Equatorial Current

The numbers of these fifty-seven surface stations are as follows: — 4583 (California Current); 4588, 4590, 4592, 4596, 4600, 4604, 4607, 4545, 4546 (Mexican Current); 4611, 4615, 4617, 4619, 4623, 4624, 4627, 4631, 4635, 4638, 4639, 4640, 4644 (Panamic Area); 4646, 4648, 4664 (Peruvian Current); 4692, 4696, 4698, 4700 (Easter Island Eddy); 4714, 4716 (Galapagos Eddy); 4680, 4682, 4684, 4686, 4702, 4704, 4709, 4712, 4718, 4720, 4723, 4725, 4727, 4729, 4731, 4733, 4735, 4740, 4741 (South Equatorial Drift); 4743, 4540 (South Equatorial Current); 4541, 4542 (Equatorial Counter Current); 4543, 4544 (North Equatorial Current).

Thus if we use either the records from vertical hauls or the records from surface hauls as indicators of the distribution of Ornithocercus, our data show that this genus is about evenly distributed throughout the area examined by the Expedition except in the California Current and in the Peruvian Current, for the genus is relatively rare in waters entering the tropics from temperate regions. The genus occurred at all the vertical as well as at all the surface stations in the Mexican Current, Panamic Area, Galapagos Eddy, South Equatorial Current, Equatorial Counter Current, and North Equatorial Current. In the Easter Island Eddy and in the South Equatorial Drift it occurred at all the vertical stations and at 80.0% and 82.6%, respectively, of the surface stations. In the California Current it was absent from the northern stations; and in the Peruvian Current it occurred at only 31.8% of the vertical stations and at 15.0% of the surface stations. The scarcity of the genus in the Peruvian Current is also evident if the number of species found at each record station is considered. At not less than three out of the eight record stations, only one species was found, while in other regions, as a rule, several species were found at each station (Plate 28).

The rare occurrence of Ornithocercus in the Peruvian Current is probably due to the fact that this current is relatively cool while the species of this genus are distinctly warm-water forms. The cause of its absence from the northern stations in the California Current is probably that this current comes from the north and has not been warm for a sufficient length of time until it reaches the middle of Lower California. Our temperature records for the stations of this current, viz., Stations 4571, 4574, 4576, 4580, and 4583, the last located near Point Lucas, the southernmost point of Lower California, are as follows: — 71°, 69°, 69°, 76°, and 83°. It should be observed, however, that the genus occurs, although rarely, as far to the north as at San Diego, California, where it has been taken repeatedly by the senior author in the autumn when other tropical elements appear in the plankton.

According to their distribution within the area investigated by the Expedition, the species of this genus can be divided into two groups, viz., those relatively frequent in the Mexican Current and the Panamic Area, and those absent from or very rarely occurring in these regions. *Ornithocercus magnificus* (Figure 80), *O. thurni* (Figure 82), *O. steini* (Figure 84), and *O. quadratus* (Figure 88) belong to the first of these two groups; while *O. heteroporus* (Figure 76), *O. splendidus* (Figure 78), and *O. carolinae* (Figure 90) belong to the second. The reasons why the last three species avoid the Mexican Current and the Panamic Area are obscure. It cannot be due to too low temperature, since this is about the same as in the South Equatorial Drift where these species are relatively frequent. It may be that the unusually turbulent current conditions in these regions are responsible for this phenomenon.

There are 236 records of species of Ornithocercus from vertical catches. Out of these 236 records, one (0.4%; Station 4613) showed a frequency of 16%; one (0.4%; Station 4598) showed 15%; one (0.4%; Station 4613) showed 12%; one (0.4%; Station 4721) showed 11%; three (1.3%; Stations 4713, 4740, 4742) showed 10%; two (0.8%; Stations 4695, 4699) showed 9%; four (1.7%; Stations 4605, 4609, 4617, 4728) showed 8%; six (2.5%; Stations 4634, 4638 [2 records], 4715, 4721, 4722) showed 7%; three (1.3%; Stations 4637, 4638, 4689) showed 6%; five (2.1%; Stations 4613, 4617, 4691, 4724, 4736) showed 5%; twelve (5.1%; Stations 4590 [2 records], 4598, 4605, 4609, 4638, 4683, 4697, 4722, 4724, 4730, 4740) showed 4%; ten (4.2%; Stations 4598, 4634 [2 records], 4637, 4681 [2 records], 4732, 4734, 4737, 4739) showed 3%; thirty (12.7%; Stations 4580, 4583, 4587, 4605, 4617, 4634, 4646, 4650, 4681, 4687, 4689 [2 records], 4691, 4695, 4697, 4701 [2 records], 4709, 4715, 4717, 4719, 4728, 4730, 4734, 4737 [2 records], 4739, 4740 [2 records], 4742) showed 2%; forty-four (18.6%; Stations 4583, 4594, 4617, 4637, 4647, 4648, 4679, 4683, 4685 [2 records], 4687, 4689, 4691, 4695 [2 records], 4697, 4699 [2 records], 4701 [2 records], 4705 [2 records], 4707, 4711, 4715, 4717, 4722, 4724, 4728 [2 records], 4732 [4 records], 4734, 4736 [3 records], 4737 [3 records], 4739 [2 records], 4742) showed 1%; 113 (47.8%) showed a frequency of less than 1%.

There are 156 records of species of this genus from surface catches. Out of these 156 records, one (0.6%; Station 4619) showed a frequency of 37%; one (0.6%; Station 4546) showed 21%; one (0.6%; Station 4607) showed 15%; one (0.6%; Station 4607) showed 14%; two (1.3%; Stations 4604, 4543) showed 13%; three (1.9%; Stations 4607, 4615, 4545) showed 10%; two (1.3%; Stations 4635, 4696) showed 9%; one (0.6%; Station 4543) showed 8%; two (1.3%; Stations 4590, 4604) showed 7%; four (2.6%; Stations 4600, 4604, 4619, 4546) showed 6%; six (3.8%; Stations 4596, 4600, 4617, 4692, 4696, 4545) showed 5%; eight (5.1%; Stations 4607, 4615, 4619, 4635, 4638, 4714, 4720, 4741) showed 4%; eight (5.1%;

Stations 4588, 4600, 4615, 4640, 4733, 4542, 4545, 4546) showed 3%; 26 (16.7%; Stations 4592 [2 records], 4596, 4600, 4615, 4617, 4619, 4624, 4627, 4631 [2 records], 4638 [2 records], 4639, 4648, 4682, 4692, 4712, 4714, 4716, 4720, 4731, 4733, 4741, 4540, 4543) showed 2%; 29 (18.6%; Stations 4590 [2 records], 4596, 4604, 4617, 4638, 4639, 4640 [3 records], 4644, 4702, 4712, 4716 [2 records], 4720, 4725, 4729, 4731 [2 records], 4733 [3 records], 4735, 4541 [3 records], 4542 [2 records]) showed 1%; 61 (39.1%) showed less than 1% or did not have the frequency established.

As will be seen from a comparison between the last two paragraphs and the corresponding paragraphs in the sections on the distribution of the other genera of Dinophysoidae, the average frequency of the individual species of Ornithocercus is higher than in any other genus of this family. Furthermore, the relative number of surface records is decidedly higher than in other genera, as will be seen from the following values:

Triposolenia	vertical records,		156	surface records,		0	ratio,	∞ : 1
Histioneis	"	"	94	"	"	17	"	5.5 : 1
Amphisolenia	"	"	210	"	"	42	"	5.0 : 1
Phalacroma	"	"	309	"	"	74	"	4.2 : 1
Dinophysis	"	"	170	"	"	44	"	3.9 : 1
Ornithocercus	"	"	236	"	"	156	"	1.5 : 1

The genus Parahistioneis is not considered in this connection since most of its surface records refer to specimens found in Salpa stomachs.

Coincident occurrence of different species of Ornithocercus in catches from 300 (800, 150, 100)–0 fathoms is recorded at the following of the fifty-one stations mentioned above:—eight species occurred coincidently at four stations (7.8%; Stations 4701, 4722, 4724, 4737); seven species at four stations (7.8%; Stations 4730, 4732, 4734, 4742); six species at eight stations (15.7%; Stations 4590, 4691, 4699, 4705, 4721, 4728, 4739, 4740); five species at nine stations (17.7%; Stations 4583, 4587, 4613, 4681, 4695, 4697, 4709, 4717, 4736); four species at fourteen stations (27.4%; Stations 4598, 4605, 4609, 4617, 4634, 4637, 4638, 4646, 4647, 4683, 4685, 4689, 4713, 4719); three species at seven stations (13.7%; Stations 4594, 4650, 4671, 4679, 4687, 4707, 4715); two species at one station (2.0%; Station 4711).

Coincident occurrence of different species of this genus in surface hauls is recorded at the following of the fifty-seven surface stations mentioned above: five species occurred coincidently at three stations (5.3%; Stations 4617, 4733, 4743); four species at fourteen stations (24.6%; Stations 4588, 4592, 4600, 4604, 4607, 4615, 4619, 4638, 4640, 4731, 4741, 4540, 4541, 4542); three species at sixteen stations (28.1%; Stations 4583, 4590, 4596, 4631, 4635, 4639, 4644, 4692, 4712, 4716, 4720, 4727, 4729, 4543, 4545, 4546); two species at thirteen stations (22.8%; Stations 4611, 4623, 4646, 4682, 4686, 4696, 4700, 4702, 4714, 4718, 4723, 4725, 4735).

Of the nine species of this genus found in the material of the Expedition not less than eight were recorded from surface hauls. The number of surface records of each of these eight species is as follows:—*Ornithocercus magnificus*, 42 records, *i.e.*, at 55.3% of all the record stations of this species; *O. steini*, 37 records (54.4%); *O. thurni*, 36 records (48.6%); *O. quadratus*, 33 records (43.4%); *O. splendidus*, 4 records (11.5%); *O. heteroporus*, 2 records (13.5%); *O. carolinae*, 1 record (4.2%); *O. orbiculatus*, 1 record (100.0%); *O. formosus*, no record (0.0%). A fact worth emphasizing in this connection is that *O. splendidus* is comparatively rare in surface waters in spite of the fact that it appears to be more highly adapted to flotation than any other species of this genus.

The distribution of Ornithocercus within the area investigated by the Expedition is such that we may expect to find that this genus is rather evenly distributed in all tropical and subtropical seas.

Historical Discussion and Systematics

Ornithocercus was established by Stein (1883, p. 25), who did not give any diagnosis but limited himself to a few remarks on the general organization and the systematic position of this genus and to the presentation of figures of five specimens, all, according to him, members of a single species, *O. magnificus*. Diagnoses of this genus were published later by Bütschli (1885, p. 1011), Delage and Hérouard (1896, p. 386), and Schütt (1896, p. 28). All these diagnoses are fairly satisfactory; the one by Schütt (1896) is by far the most nearly complete and displays the best evaluation of the systematic importance of the individual characteristics. No extensive description and discussion of the morphology of this genus have been published at the present writing, and the amount of original observations presented is relatively small. The last fact is due to the limitation of most of the species to tropical and subtropical seas and to the complete absence of this genus from the northern European waters, which are the only areas that have been submitted as yet to intensive investigations.

Besides *magnificus* the following specific names of Ornithocercus are to be found in the literature:—*O. splendidus* Schütt (1893); *O. splendens* Schütt (1896); *O. quadratus* and *O. steini* Schütt (1900a); *O. carolinae*, *O. heteroporus*, and *O.*

serratus Kofoid (1907a); *O. formosus* and *O. orbiculatus* Kofoid and Michener (1911); *O. compactus, O. horridus,* and *O. papillosus* Hensen (1911); *O. assimilis* and *O. minor* Jörgensen (1923). Representatives of this genus were figured also by Pouchet (1883) under the name of *Dinophysis galea* and by Schmidt (1888) as *Parelion thurnii* (Schmidt considered his species a diatom). In the present paper the following new names have been established: *Ornithocercus quadratus* f. *schütti, O. quadratus* f. *simplex,* and *O. quadratus* f. *intermedia.*

Of the species mentioned in the last paragraph, *Ornithocercus compactus, O. horridus,* and *O. papillosus* were introduced by Hensen (1911) as *nomina nuda,* and there is no information published as yet as to their organization. *O. splendens* Schütt (1896) is a *lapsus pennae* for *O. splendidus. O. minor,* a name used by Jörgensen (1923) in his manuscript, is a synonym of *O. magnificus s. str.* The specimens represented by Pouchet (1883, fig. G: 1, 4) as *Dinophysis galea* cannot be assigned with certainty to species, due to the sketchy nature of the figures.

Ornithocercus magnificus Stein (1883) is not a homogeneous systematic unit. Schütt (1900a), who was the first to point out this fact, applied the name *magnificus* to the specimen represented by Stein's (1883) Plate 23, figure 1, and made the specimen represented by Stein's (1883) Plate 23, figure 3, the type of a new species, which he called *O. steini.* However, since specimens of the last species had been figured previously as *Parelion thurnii* by Schmidt (1888) in a manner leaving no doubt as to their specific allocation, *steini* must be replaced by *thurni* as the name of this species. The specific name *steini* thus should have been discarded as a synonym, had it not been for the fact that out of the three specimens figured by Schütt (1900a) as *Ornithocercus steini,* only one, his figure 7, is referable to this species as conceived in the present paper. The two other specimens, his figures 5 and 6, are, according to our opinion, fairly young and undifferentiated members of a species later described and figured by Kofoid (1907a) as *O. serratus.* Under these circumstances the name *O. steini s. str.* has to be maintained for these two specimens of Schütt (1900a), and *O. serratus* Kofoid must be discarded as a synonym. *O. orbiculatus* Kofoid and Michener (1911) may be based on an abnormal specimen of *O. steini s. str.* and thus its specific status must be regarded as uncertain. *O. assimilis* Jörgensen (1923) has in the present paper been referred to *O. quadratus* under the designation *O. quadratus* f. *assimilis.* However, it should be emphasized that there are fairly strong reasons suggesting the specific independence not only of this *forma* but also of the remaining four *formae* included by us in this species, viz., f. *quadrata,* f. *schütti,* f. *simplex,* and f. *intermedia.* With regard to the specific differentiation between *Ornithocercus carolinae* and

Histioneis [*Parahistioneis*] *francescae*, see the first of these two species, the section on comparisons (p. 575). Some of the specimens of *Ornithocercus carolinae* are transitional to *Histioneis francescae*. Jörgensen (1923, p. 38), who accepted *Ornithocercus carolinae* as a valid species, even suggested that these two forms "may perhaps be identical." We consider it necessary to treat them tentatively as specifically distinct.

Thus out of the species of Ornithocercus established as yet, only eight have been regarded in the present paper as valid, viz., *O. carolinae* Kofoid (1907a), *O. formosus* Kofoid and Michener (1911), *O. heteroporus* Kofoid (1907a), *O. magnificus* Stein (1883) *s. str.*, *O. quadratus* Schütt (1900a), *O. splendidus* Schütt (1893), *O. steini* Schütt (1900a) *s. str.*, and *O. thurni* (Schmidt, 1888); and of *O. quadratus* there are five *formae*, which *may* be specifically independent.

All the descriptions of species published up to the present writing are very incomplete and include no or but few data of variation. The descriptions published by Kofoid (1907a) and Kofoid and Michener (1911) are preliminary and based on the same material as those of the present paper. The extraordinary variability, partly due to regulatory processes, and the uncertainty of specific delimitations have rendered the taxonomy of this genus very difficult, and the synonymies of some of the common species, viz., *Ornithocercus magnificus s. str.* and *O. thurni* are tangled almost beyond the possibility of unravelling.

No subdivision of this genus has been attempted as yet, with the exception of the establishment by Murray and Whitting (1899, p. 332) of the subgenus Paraschüttia, which was based on a single species, *Ornithocercus splendidus*.

A few contributions to the morphology of this genus were made by Bütschli (1885, p. 944) and Schütt (1895, p. 19, 23, 54, 64, 112, 114, 116, 130, 131, 136, 138). Schütt (1899, 1900a) submitted the growth and differentiation of the thecal wall and of the lists to a quite detailed analysis. A few remarks as to the adaptiveness of the lists in flotation were made by Carisso (1911), Gran (1912a, 1912b), Schütt (1893), and Steuer (1910, 1911). Some suggestions as to the functions of the furrows and lists were made by Francé (1923). Hensen (1911, p. 152) mentions the formation in this genus of small specimens, "Schwärmlinge," the results of rapid binary fission.

Contributions to our knowledge of the distribution of Ornithocercus are to be found in the following papers, not specifying those previously mentioned in this section:— Cleve (1897a, 1900b, 1901a, 1901c, 1902b, 1903b), Cleve, Ekman, and Pettersson (1901), Daday (1888), Entz (1902b, 1905), Faria and Cunha (1917), Forti (1922), Gräf (1909), Hensen (1895), Issel (1921), Jörgensen (1911), Karsten (1906, 1907), Kofoid (1911), Lemmermann (1899a, 1901a, 1904, 1905), Lindemann (1924, 1925), Lohmann (1902, 1908, 1920), Mangin (1906), Murray and Whitting (1899), Okamura (1907, 1912), Ostenfeld (1898a, 1915), Ostenfeld and Schmidt (1901), Pavillard (1905, 1916), Schiller (1912, 1912a, 1914), Schmidt (1901), Schröder (1900a, 1906a, 1906b, 1909, 1911), Stüwe (1909), Whitelegge (1891), and Zacharias (1906). Of these investigators only Murray and Whitting (1899), Okamura (1907), and Schröder (1900a) give original figures by means of which the correctness of the determinations may be checked. Forti (1922) gives reproductions of previously published figures of the species recorded. Many, perhaps even most, of the data on the distribution of this genus should be accepted tentatively on account of the great difficulties implied in the determination of the species and to the broad concept of species held by several of the investigators.

References to Ornithocercus or minor contributions to our knowledge of this genus are found also in Balbiani (1884c), Bergh (1884), Calkins (1902), Chun (1886, 1903), Doflein (1909, 1911, 1916), Effenberger (1911), Entz (1902a), Fricke (1902), Gadeceau (1909), Goldschmidt (1909), Hensen (1891), Hjort (1911), Klebs (1912), Meunier (1910), Nathansohn (1910b), Oltmanns (1922), Schütt (1900b), Stiasny (1913), Théel (1909), Wallengren and Hennig (1911), Walther (1893), Willey and Hickson (1909), and Zacharias (1906a, 1907, 1911).

Accepting the decision of Murray and Whitting (1899), the following investigators use Histioneis instead of Ornithocercus as the generic name of the species of this genus: — Cleve (1900b, 1901a, 1901c, 1902b, 1903b), Cleve, Ekman, and Pettersson (1901), Entz (1902b, 1905), Forti (1922), Gadeceau (1909), Issel (1921), Lemmermann (1899a, 1901a, 1904, 1905a), Pavillard (1905, 1916), and Schröder (1900a, 1906a). With regard to this usage, see our treatment of the family Ornithocercidae, the section on the subdivisions (p. 494).

The following misspellings of the name Ornithocercus have been found by us: Ornithocerus Schütt (1893, fig. 83), Fricke (1902, p. 55), Théel (1909); Ornithoceras Gräf (1909, p. 139).

Adaptive and Systematic Value of the Characters. Principles used in the Description of the Species

Among all the genera of Dinophysoidae, Ornithocercus is the one that occurs most frequently in the surface waters of the tropical and subtropical seas. Since these waters are characterized by a lower buoyancy than the deeper strata in the same regions and the waters nearer to the poles, it appears reasonable to expect this genus to be more highly differentiated for flotation than any other genus of this tribe. This expectation, however, is hardly borne out by a comparative morphological study. Ornithocercus undoubtedly is well adapted to flotation, but at the same time it has remained relatively primitive in many respects. The most striking examples of adaptations to flotation are not found within this genus but in the closely related genus Histioneis, in which the evolutionary processes have been carried to the extreme, resulting in a multitude of bizarre species, in most respects profoundly different from what might be called the basic type of this family. In regard to the shape of the theca, comparisons should also be made with the extreme genera Triposolenia and Amphisolenia.

Perhaps the most outstanding feature in the evolution of Ornithocercus is the fact that the theca has remained largely undifferentiated. Indeed, in none of the other large genera of this tribe has the theca been subject to so little change. It is, generally speaking, still subcircular in lateral outline, somewhat compressed bilaterally, and relatively large when compared with the whole organism. In other words, while in some of the other genera, *e.g.*, Triposolenia and Amphisolenia, the shape of the theca has been modified in response to the needs of flotation, Ornithocercus has remained nearly unchanged in this respect. Furthermore, while the members of Phalacroma and Dinophysis and of the other more or less primitive genera are fairly active swimmers, the organization of Ornithocercus indicates that the species of this genus are relatively slow. How, then, do these species keep themselves within their optimum habitat?

We suggest the following answer to this question. (*1*) The specific gravity is comparatively low, approaching that of the surrounding medium. This has been brought about in a twofold manner: first, the protoplasm contains fairly large pusules and inclusions of low specific gravity, such as fats and oils (Schütt, 1895, pl. 5, fig. 21 : 2); second, the transverse furrow and the thin cingular lists have been strikingly widened and include a large space filled principally with water. Thus the volume of the organism has been increased decidedly without a corresponding increase in the absolute weight. (*2*) In all the species the cingular lists are very large and undoubtedly act as parachutes, when the organism is in an upright position. In *Ornithocercus splendidus* these lists appear to be the principal means of flotation; they have an excessive development and a very wide spread (Figure 77 : 7). (*3*) The left sulcal list, which is very large and in most species extends nearly around the entire hypotheca, has at least two main functions: first, it increases very greatly the surface of resistance whenever the organism is turned upon one of its lateral faces, and the asymmetry and the lobes of this list probably cause the organism in this position to descend in a spiral or zigzag line; second, it acts as a keel and a rudder, thus stabilizing the progressive movement. (*4*) The body is fairly small. In the largest specimens of this genus found in the material of the Expedition it was only 67.6 μ long, while of Phalacroma specimens were found by us measuring nearly 150 μ in length (*P. giganteum*). (*5*) In most species the surface friction is increased by structural differentiations in the theca and by the ribs and reticulation of the lists.

These five points are arranged according to their probable relative importance, the first being the most important. The investigators who previously have touched upon the phenomena of adaptation to flotation in Ornithocercus (see the historical discussion of this genus, p. 509) have mentioned only the second of these points.

The small size of the right sulcal list and the oblique position of the left sulcal list (the anterior portion of this list belongs to the left valve, the posterior portion to the right) should be correlated with the spiral mode of swimming. Francé (1923, p. 31), who interprets these organisms as miniature turbines, emphasizes the fact that the transverse furrow is narrower ventrally than dorsally and that the longitudinal furrow is narrowest posteriorly. "By this the instreaming water is retarded slightly in its course, producing a back-pressure, an economical over-pressure which can be observed in the accelerated motion of the cell."

It may also be mentioned in this connection that besides decreasing the specific gravity of the organism, the large chamber enclosed by the girdle also functions as a container for the phaeosomes. However, this appears to be a secondary function, since most specimens have very few (or no) phaeosomes, occupying only a small portion of the enclosed space.

All the external characters have been utilized in our descriptions and separations of the species of this genus. However, since the size of the body varies greatly within the species, due to the mode of fission illustrated by Plate 18, figure 2, 7–9, and since most of these species agree fairly closely in the shape and structure of the body and in the size and shape of the cingular list, the most important distinguishing characteristics have been taken from the left sulcal list. Indeed, most of the species, *e.g., Ornithocercus magnificus, O. thurni, O. steini, O. orbiculatus, O. quadratus*, and *O. formosus*, are based almost exclusively on differences in the size, shape, and structure of this list.

Unfortunately, the characters that are most profoundly modified within the genus as a whole also are subject to the most extreme fluctuations. These fluctuations, which are due to regulatory processes following binary fission, to adjustments to flotation, and to irregularities in the regeneration following local injuries, render the establishment and characterization of the species exceedingly difficult. For instance, in the case of *O. quadratus* (Figure 86, 87) we have had to establish five *formae*, but these may possibly represent five different species. Furthermore, we found some specimens in the material of the Expedition that were too aberrant for certainty of specific assignment (Figure 92).

The following principles have been used by us in describing the species of this genus: — (*1*) When not otherwise stated, all characteristics refer to specimens in lateral view. (*2*) The terminology and the methods of measurement are largely the same as in Phalacroma and Dinophysis; see Figure 29. The angles are measured as in Figure 94 of Histioneis. It should be mentioned that the length of the fission rib and of the dorsal main rib (the *a*-rib) of the left sulcal list is measured from the base of the rib to the margin of the list; while the lengths of the remaining main ribs of this list behind the fission rib (the *b*-, *c*-, *d*-, and *e*-ribs) are measured from the bases of the ribs to the submarginal rib. (*3*) The terms length and depth of body refer to theca exclusive of lists. (*4*) The number of ribs in the cingular lists given in the diagnoses is the number on each valve.

Subdivisions. Relationships among the Species

No attempt at subdividing Ornithocercus has been carried out hitherto, with the exception of the establishment by Murray and Whitting (1899, p. 332) of the subgenus Paraschüttia, which was based on a single species, *Ornithocercus splendidus*. According to our opinion, this genus may be divided into three groups as follows.

1. Splendidus group: — *O. heteroporus* and *O. splendidus* (Figure 75, 77).

2. Magnificus group: — *O. magnificus s. str.*, *O. thurni*, *O. steini s. str.*, *O. orbiculatus*, *O. quadratus*, and *O. carolinae* (Figure 79, 81, 83; Plate 17, fig. 7; Figure 86, 87, 89).

3. Formosus group: — *O. formosus* (Figure 91).

1. Splendidus group (syn. Paraschüttia). Epitheca subhorizontal. Theca porulate and but seldom areolate. Width of transverse furrow and inclination of cingular lists variable. Left sulcal list two-lobed and ends at or near antapex of body. Ventral margin of right sulcal list free.

Of the two species of this group, *Ornithocercus heteroporus* is the more primitive in the size of the body and in the size and structure of the cingular lists. On the other hand, it is slightly more advanced in the width of the transverse furrow and in the inclination of the lists. This species may be considered, on the whole, as the most primitive member of this genus.

2. Magnificus group. Transverse furrow decidedly wider dorsally than ventrally, and epitheca thus somewhat inclined ventroposteriorly. Theca areolate as well as porulate. Posterior cingular list somewhat more inclined anteriorly than the anterior. Left sulcal list three- to five-lobed, squarish, seldom two-lobed, and ends on dorsal side of body. Ventral margin of right sulcal list free.

Within this group, which comprises the typical members of this genus, *Ornithocercus carolinae* occupies structurally a somewhat isolated position, being characterized especially by the very large antapical lobe and the numerous radial ribs of the left sulcal list. The remaining species of this group are fairly closely related and have reached about the same evolutionary level. We are unable to decide which of them, all characters considered, is structurally closest to the ancestral type. *O. orbiculatus* may be found to be an aberrant specimen of *O. steini s. str.*

3. Formosus group. Transverse furrow decidedly wider dorsally than ventrally; epitheca somewhat inclined ventroposteriorly. Theca areolate and porulate. Posterior cingular list inclined anteriorly somewhat more than the anterior. Left sulcal list two-lobed and ends on dorsal side of body. Ventral margin of right sulcal list attached to left sulcal list.

Of these three groups the Splendidus group appears to be the most primitive. The obovate shape of the body in lateral as well as in dorsoventral view characteristic of most specimens of *Ornithocercus splendidus*, the subuniform width of the transverse furrow and the subequal inclination of the two cingular lists also found in this species, the subhorizontal position of the epitheca, and the ending of the left sulcal list at or near the antapex of the body are relatively primitive features suggestive of this assumption. On the other hand, it must be remembered that *O. splendidus* is more advanced than the other species of this genus in the excessive width of the cingular lists.

The Formosus group is somewhat isolated and occupies structurally in some respects a position intermediate between Ornithocercus and Histioneis (see *Ornithocercus formosus*, the section on comparisons, p. 579).

Key to the Species of Ornithocercus

1. Left sulcal list biangular .... 2.
1. Left sulcal list not biangular .... 5.
2. Left sulcal list ends at or near antapex .... 3.
2. Left sulcal list ends on dorsal side of body .... 4.
3. Length of body 34 μ or less; anterior cingular list 0.48–0.68 the depth of body ... *O. heteroporus* Kofoid.
3. Length of body more than 34 μ; anterior cingular list 0.77–1.46 the depth of body. *O. splendidus* Schütt.

4. With only one strong rib in left sulcal list behind fission rib....... *O. formosus* Kofoid and Michener.
4. With more than one strong rib in left sulcal list behind fission rib.............. *O. quadratus* Schütt.
5. Left sulcal list with three lobes; *a*-rib ends in dorsal lobe.......................................6.
5. Left sulcal list not with three lobes; *a*-rib does not end in dorsal lobe..........................8.
6. Left sulcal list with more than eight radial ribs behind fission rib; its antapical lobe decidedly larger than the two other lobes.. *O. carolinae* Kofoid.
6. Left sulcal list with less than eight radial ribs behind fission rib; its three lobes subequal or nearly so.7.
7. *c*- and *e*-ribs of left sulcal list end at vertices of antapical and posteroventral lobes. . *O. thurni* (Schmidt).
7. *c*- and *e*-ribs of left sulcal list do not end at vertices of antapical and posteroventral lobes. *O. magnificus* Stein *s. str.*
8. Left sulcal list with four or more usually distinct lobes behind fission rib; ribs usually regular. *O. steini* Schütt *s. str.*
8. Left sulcal list with rounded margin behind fission rib; its ribs irregular and partly incomplete. *O. orbiculatus* Kofoid and Michener.

1. Splendidus Group. Both the species belonging to this group, viz., *Ornithocercus heteroporus* and *O. splendidus*, were found in the material of the Expedition.

Ornithocercus heteroporus Kofoid

Plate 18, fig. 1, 3. Figure 75, 76

Ornithocercus heteroporus Kofoid, 1907a, p. 206, pl. 12, fig. 70. Jörgensen, 1923, p. 37, 38, fig. 54.

Diagnosis: — Lateral outline obliquely subellipsoidal or subcircular. Cingular lists: anterior 0.48–0.68, posterior 0.37–0.60 the greatest depth of body; anterior with five to seven radial ribs, the bases of which may be connected by reticulation; posterior with nine to ten usually simple ribs. Left sulcal list usually ends at or somewhat ventrally to antapex but may extend somewhat farther; with *two* lobes, one of which is posteroventral, the other posterior; width at posteroventral lobe 0.56–1.06, at posterior lobe 0.54–1.06 the greatest depth of body; lobes narrowly rounded to subacute, large to fairly small; distance between their tips 0.81–1.41 the greatest depth of body; dorsal margin straight, or gently convex or concave; with three to six radial ribs and submarginal rib behind fission rib. Length, 27.4–34.0 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This is a small species, obliquely subellipsoidal or subrotund in lateral outline, widest near the middle. The ratio between the length and the depth of the body is 1.04 (0.99–1.08) : 1. The longitudinal axis is deflected posterodorsally at 10° (5°–20°).

The epitheca is 0.37 (0.28–0.45) as deep as the hypotheca, gently convex, highest in or near the center, and subhorizontal or but slightly tilted ventroposteriorly. The transverse furrow is gently convex or flat; its dorsal width is 0.38 (0.36–0.42) the greatest depth of the body; its ventral width is 0.57 (0.50–

0.66) its dorsal width. The posterior cingular list is 0.23 (0.19–0.26) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are well rounded and confluent; or any of them may be slightly flattened. When seen in dorsoventral view, the body is broadly ellipsoidal and widest near the middle; the anterior end is almost as broadly rounded as the posterior; the ratio between the length and the width is 1.14: 1.

The anterior cingular list is 0.56 (0.48–0.68) the greatest depth of the body and has an anterior inclination of 30° (25°–40°); it has on each valve five to seven complete radial ribs, the bases of which may be connected by reticulation. The posterior cingular list is 0.48 (0.37–0.60) the greatest depth of the body and is inclined anteriorly at 60° (55°–75°); it has on each valve nine to ten complete, subequidistant radial ribs, which usually are simple, but some of which may be proximally branched or connected by reticulation. The right sulcal list is of moderate size and ends near the fission rib of the left sulcal list; it either is subtriangular, decreasing gradually in width posteriorly, or it is of subuniform width throughout the greater portion of its length and gently rounded posteriorly. The left sulcal list usually ends at or somewhat ventrally to the antapex of the body, but it may extend somewhat farther (Jörgensen, 1923, fig. 54). It has *two* narrowly rounded to subacute lobes, one posteroventral, the other posterior, and these usually are of moderate size but may be fairly small to quite large. The width of this list at the anterior main rib is 0.49 (0.36–0.60), at the fission rib 0.46 (0.32–0.54), at the posteroventral lobe 0.80 (0.56–1.06), at the narrowest place between the lobes 0.46 (0.24–0.61), and at the posterior lobe 0.76 (0.54–1.06) the greatest depth of the body. The distance between the tips of the lobes is 1.13 (0.81–1.41) the greatest depth of the body. The margin of this list between the anterior main rib and the tip of the posteroventral lobe may be nearly straight, but usually it is gently concave. Between the tips of the lobes the margin is moderately concave in most specimens, but it may be slightly or strikingly concave. The dorsal margin of this list is straight, or gently convex or concave. In front of the fission rib this list generally has one or two ribs; when two ribs are present, they may either be simple, or they may anastomose, and their bases may be connected by reticulation. Behind the fission rib there are three to six simple radial ribs, the tips of which are connected by a submarginal rib. The submarginal rib extends to the fission rib, which it joins at any point between the tip and the base (Figure 75: 1, 2, 4). The radial ribs may be furnished with very short branches (Figure 75: 1); and some of them may not quite reach the submarginal rib. Reticulations have not been found behind the fission rib.

The thecal wall is porulate with evenly distributed pores; these may either be all alike, or one in six or eight may be darker than the others. Sometimes areolation is developed of about the same type as in *Ornithocercus carolinae*. Fairly large phaeosomes have been observed in the transverse furrow.

The dimensions of seven of our specimens, including the type, and of the specimen figured by Jörgensen (1923, fig. 54) were measured.

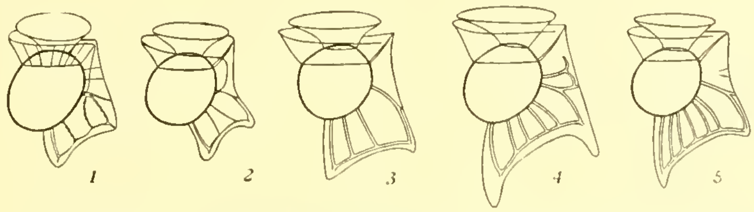

FIGURE 75.— *Ornithocercus heteroporus* Kofoid, right lateral view, illustrating variations in the shape and structure of left sulcal list. × 340. 1, from Station 4681 (300–0 fathoms); 2, from Station 4732 (300–0 fathoms); 3, from Station 4722 (300–0 fathoms); 4, from Station 4734 (300–0 fathoms); 5, from Station 4737 (300–0 fathoms).

Dimensions: — Our specimens: Length of body, 27.4–34.0 μ (average, 30.2 μ; type, 27.7 μ). Greatest depth of body, 25.7–31.4 μ (average, 28.9 μ; type, 25.7 μ). Jörgensen's (1923) specimens were 32–34 μ long and 31–32 μ deep.

Variations: — While the size of the body and the size and shape of the cingular lists are quite constant, the shape and structure of the left sulcal list are subject to considerable variations. The two lobes of the left sulcal list sometimes (Figure 75: 4) are very large, sometimes of moderate size (Figure 75: 1). The number of radial ribs in this list behind the fission rib ranges from three (Figure 75: 1–3) to six (Figure 75: 5). The shape of the body also exhibits some variability; usually it is obliquely subellipsoidal, but it may be subrotund (Figure 75: 3).

Comparisons: — Our description and figures are based on the type material. The specimen figured by Jörgensen (1923, fig. 54) agrees so closely with some of our typical representatives of this species (Figure 75: 3) that its allocation may be considered as certain. This species, as conceived in the present paper, includes specimens of quite different habitus, and its systematic unity may appear somewhat questionable. That these specimens have been lumped together is due to the fact that their variation seems to be continuous.

The small size, the shape of the body, and the fact that the left sulcal list usually ends at or somewhat ventrally to the antapex of the body indicate that this species is fairly low in the evolutionary scale of this genus. Its closest relative possibly is *Ornithocercus splendidus*, which it resembles in the shape of the body and in having a two-lobed left sulcal list usually ending at or somewhat ventrally to the antapex. These two species are easily distinguished from each other by the width of the cingular lists and by the structure of the left sulcal list. *O. splendidus* has much more highly elaborated and expanded lists, though of the same fundamental type.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Ornithocercus heteroporus*, a name also used by Jörgensen (1923).

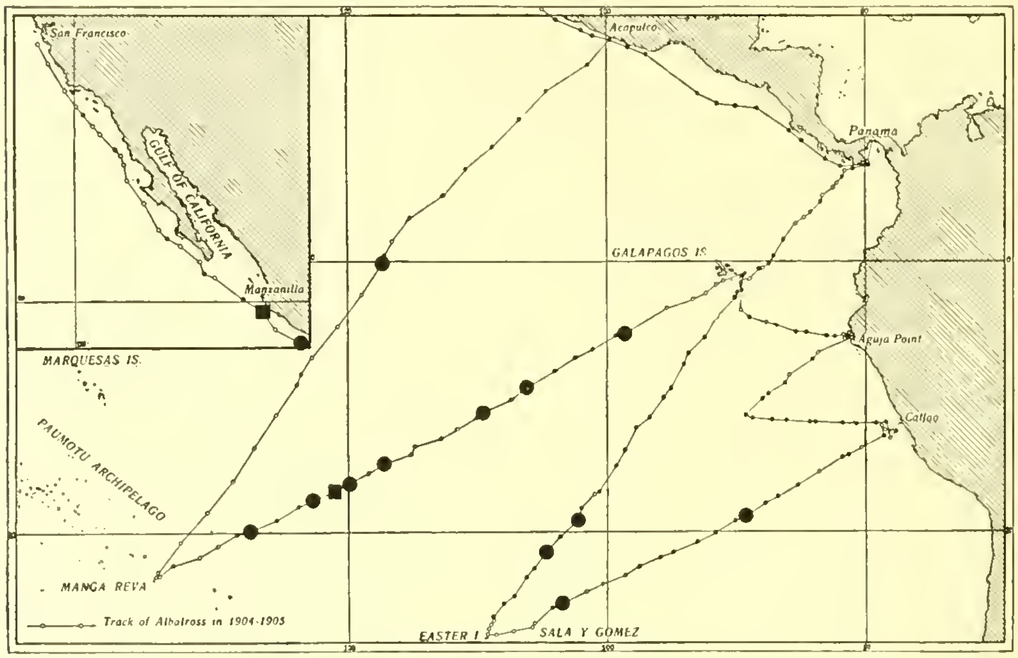

FIGURE 76.— Occurrence of *Ornithocercus heteroporus* Kofoid. Large, solid circles indicate records from vertical hauls; squares, records from surface hauls (Salpa); small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

Occurrence: — *Ornithocercus heteroporus* is recorded at fifteen of the 127 stations. There are 2, 0, 2, 2, 8, and 1 stations on the six lines of the Expedition. Of these fifteen stations, two (4588, 4590) are in the Mexican Current; two (4691, 4699) are in the Easter Island Eddy; ten (4681, 4701, 4717, 4722, 4724, 4730, 4732, 4733, 4734, 4737) are in the South Equatorial Drift; and one (4742) is in the South Equatorial Current. At two stations (4588, 4733), the species was found in stomachs of Salpa taken in surface waters; all the other records refer to hauls from 300–0 fathoms.

The temperature range of these fifteen stations at the surface was 68°–83°; the average was 77.3°.

The frequency is in all cases less than 1%.

This species was first recorded by Kofoid (1907a) from Station 4699 of the Expedition, which thus is the type locality. Later Jörgensen (1923) found it to be widely spread in the Mediterranean and he also recorded it from the Bay of Cadiz, from a station "south-southeast of St. Helena," from the Guinea Current, and from off the southeast coast of Arabia.

This is probably a eupelagic, stenothermal, and warm-water species, widely distributed but rare in tropical, subtropical, and warm-temperate seas. Its absence from the California Current, Panamic Area, and Peruvian Current as well as its rare occurrence in the Mexican Current, according to our data, are noteworthy. Its prevalence in deeper waters should also be observed.

Ornithocercus splendidus Schütt

Plate **16**, fig. 2, 4; Plate **17**, fig. 3. Figure 77, 85: 3, 78

Ornithocercus splendidus Schütt, 1893, p. 272, fig. 82 (as *Ornithocerus splendidus* in fig. 83); 1895, p. 19, 130, 131, 150, pl. 5, fig. 22; 1899, p. 14, 16, 50, pl. 6, fig. 11; 1900a, p. 9, 20, fig. 11. Hensen, 1895, p. 189; 1911, tab. 15. Karsten, 1906, pl. 187; 1907, p. 240, 247, 248, 249, 253, 256, 268, 272, 273, 274, 276, 287, 292, 294, 295, 296, 298, 299, 301, 303, 304, 305, 306, 309, 310, 311, 312, 316, 318, 319, 336, 338, 340, 347, 348, 351, 353, 354, 355, 356, 357, 427, 471, 473. Doflein, 1909, p. 457, fig. 404A; 1911, p. 522, fig. 463A; 1916, p. 423, fig. 375A. Stüwe, 1909, p. 236, 237, 254, 288. Steuer, 1910, p. 197, fig. 107; 1911, p. 103, fig. 83. Nathansohn, 1910b, p. 60, 62, fig. 30. Carisso, 1911, p. 89. Effenberger, 1911, fig. 27: B. Hjort, 1911, pl. 367, fig. 11: 5. Gran, 1912a, p. 935, fig. 7a; 1912b, p. 328, 329, fig. 234a. Stiasny, 1913, p. 46, 77, fig. 12. Francé, 1923, fig. 11: 5. Lindemann, 1924, p. 10; 1925, p. 96.

Ornithocercus splendens Schütt, 1896, pl. 29, fig. 41B. Gräf, 1909, p. 138, 149, 165, 173, 176, 179, 184, 186, 188.

Histioneis splendida Murray & Whitting, 1899, p. 332, tab. 3, 68, pl. 32, fig. 1a–c. Lemmermann, 1899a, p. 320, 374; 1901a, p. 377. Schröder, 1906a, p. 329. Gadeceau, 1909, pl. 9, fig. "2 en haut."

Histioneis splendidus Cleve, 1901c, p. 252; 1902b, p. 32.

Ornithocercus magnificus, Doflein, 1909, p. 465, fig. 417: 8; 1911, p. 531, fig. 478: 8; 1916, p. 436, fig. 396: 8. Oltmanns, 1922, fig. 38: 8.

Ornithocerus splendidus Théel, 1909, p. 239, fig. 39.

Diagnosis: — Lateral outline subobovate, subellipsoidal, subcircular, subtriangular, or subtrapeziform. Cingular lists are huge: anterior 0.77–1.46, posterior 0.81–1.41 the greatest depth of body; both with 6–24 complete, sometimes irregular ribs, connected by more or less developed anastomoses. Left sulcal list ends at or somewhat ventrally to antapex; with two lobes, one of which is posteroventral, the other posterior; width at posteroventral lobe 0.96–1.92, at posterior lobe 0.80–1.53 the greatest depth of body; lobes narrowly rounded distally, and sometimes long and narrow, sometimes small; distance between their tips 0.82–2.07 the greatest depth of body; dorsal margin straight, moderately convex or concave, or sigmoid; with two to five, often incomplete, ribs behind fission rib; reticulations in lobes and often at tip of fission rib and between lobes. Submarginal rib usually absent. Length of body, 37.7–114.0 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This species is usually medium-sized but may be fairly small or very large. The shape of the body in lateral outline is quite variable: sometimes it is subsymmetrically or obliquely subobovate, sometimes subrotund or obliquely subellipsoidal, sometimes rounded subtriangular or rounded subtrapeziform; and these various shapes are connected by transitions. The greatest depth is located at or somewhat behind the posterior cingular list, or near the middle of the body. The ratio between the length and the depth of the body is 1.05 (0.76–1.24): 1. In our material two groups can be distinguished: one in which the body is deep (ratio 0.76–0.85: 1), the other with the body of moderate depth (ratio 1.04–1.24: 1). The longitudinal axis may be perpendicular to the posterior cingular list, but usually it is somewhat deflected posterodorsally; the maximum deflection as yet observed is about 20°; the average deflection is 10°.

The epitheca is 0.68 (0.50–0.88) as deep as the hypotheca, usually gently convex, but sometimes flat or strongly convex, highest in, or dorsally or ventrally to, the center, and subhorizontal. The transverse furrow is flat or gently convex; its dorsal width is subequal to or but slightly greater than the ventral, and 0.22 (0.11–0.28) the greatest depth of the body. The posterior cingular list is 0.30 (0.17–0.40) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are confluent, and any one of them may be somewhat flattened. When seen in dorsoventral view, the body is regularly obovate, widest at or somewhat behind the posterior cingular list; the ratio between the length and the width is 1.4–1.7: 1.

The cingular lists are wider relatively than in any other known species and resemble a pair of everted parachutes. The anterior of them is 1.17 (0.77–1.46), the posterior 1.15 (0.81–1.41) the greatest depth of the body; both have an anterior inclination of 30°–50°, and both are furnished with 6–24 complete radial ribs, which are connected by more or less developed anastomoses, and which may be quite irregular. The right sulcal list, which is small, ends somewhere between the fission rib of the left sulcal list and the second rib behind the fission rib. It either is subtriangular, decreasing gradually in width posteriorly; or it is of subuniform width throughout the greater portion of its length and strongly rounded or rounded subrectangular (Plate 17, fig. 3) posteriorly. Its width in the middle is 0.14–0.20 the greatest depth of the body; and it may be furnished with one to several, regular or more or less irregular ribs. The left sulcal list, which ends at or somewhat ventrally to the antapex of the body, has two lobes, one of which is posteroventral, the other posterior in position. At the posteroventral lobe the width of this list is 1.40 (0.96–1.92), at the posterior lobe 1.23 (0.80–1.53) the greatest depth of the body; at the anterior main rib and between these two lobes the corresponding values are 0.75 (0.67–1.00) and 0.74 (0.48–0.93), respectively. The two lobes are narrowly rounded distally, and sometimes long and narrow, sometimes small. The distance between their tips is 1.38 (0.82–2.07) the greatest depth of the body. The margin between the anterior main rib and the tip of the posteroventral lobe may be almost straight, but usually it has a more or less pronounced concavity. The concavity between the two lobes sometimes is rather shallow, sometimes it is very deep. The dorsal margin of this list is nearly straight in some specimens, in others it is gently concave, moderately convex, or strikingly sigmoid. There are two to five radial ribs behind the fission rib. These ribs usually are simple, straight or gently curved, and the posterior ends either in or somewhat ventrally to the posterior lobe. Some may extend to the margin of the list, but most of them usually end before the margin is reached. The posterior one may have a dorsal branch near its base (Murray and Whitting, 1899, pl. 32, fig. 1a). A submarginal rib may be present between the two lobes (Figure 85: 3). More or less developed reticulation is to be found in the two lobes, at the end of the fission rib, and sometimes at the end of one of the ribs ending between the lobes. In front of the fission rib this list has one to three ribs.

The thecal wall has numerous pores; on the hypotheca each of these sometimes is surrounded by a small areole. Near the middle of the body there are about 10–15 pores across the face of each valve. We have no record of the presence of phaeosomes.

The dimensions of twenty of our specimens and of the specimen figured by Murray and Whitting (1899, pl. 32, fig. 1) were measured.

Dimensions: — Our specimens: Length of body, 37.7–49.8 μ (average, 43.2 μ). Greatest depth of body, 32.9–62.2 μ (average, 43.3 μ). In our large specimens the greatest depth is 43.0–62.2 μ (average, 57.5 μ); in our small specimens it is 32.9–39.2 μ (average, 35.6 μ). The type specimen, according to Schütt (1893, fig. 83), was about 114 μ long. The specimen figured by Murray and Whitting (1899, pl. 32, fig. 1a) was 87.2 μ long and 84.0 μ deep.

Variations: — This species shows a pronounced variability in most of its characters. The length of the body varies from 37.7 to 114.0 μ. In our material two very distinct size-groups can be distinguished; in one of these the body is very deep (43.0–62.2 μ; average, 57.5 μ), in the other it is of moderate depth (32.9–39.2 μ; average, 35.6 μ). The shape of the body is also subject to striking variations; sometimes it is subsymmetrically (Plate 16, fig. 4) or obliquely (Figure

77: 8) subobovoidal, sometimes subrotund (Figure 77: 4), sometimes obliquely subellipsoidal (Figure 77: 3), sometimes rounded subtriangular (Figure 77: 11), sometimes rounded subtrapeziform (Figure 77: 9, 10), and these various forms are

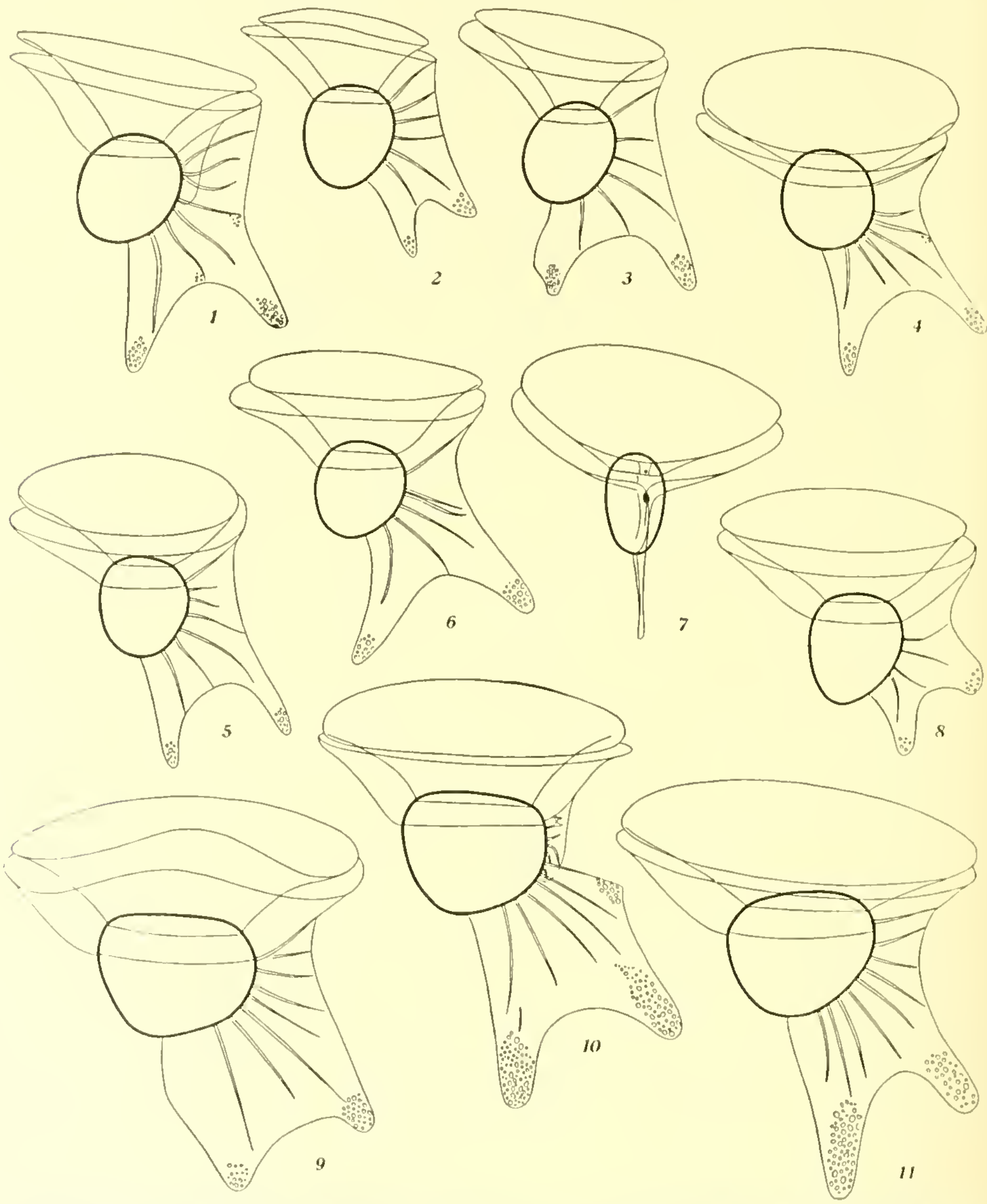

FIGURE 77.—*Ornithocercus splendidus* Schütt. 1–6, 8–11, in right lateral view; 7, in ventral view, illustrating variations in size of body and in shape and structure of left sulcal list. × 340. 1, 2, 3, 5, 6, 7, from Station 4737 (300–0 fathoms); 4, from Station 4737 (100–0 fathoms); 8, from Station 4730 (300–0 fathoms); 9, 11, from Station 4740 (300–0 fathoms); 10, from Station 4695 (300–0 fathoms).

connected by transitions. Both the cingular lists may have relatively few (Plate **16**, fig. 2) or numerous (Schütt, 1893, fig. 82) radial ribs. The development of the anastomoses connecting these ribs also varies; compare our Plate **17**, figure 3, and Schütt's (1893) figure 82. The left sulcal list, which sometimes ends at, sometimes ventrally to the antapex of the body, varies in size, shape, and structure. In some specimens it is comparatively narrow (Figure 77: 8), in others wide (Figure 77: 10, 11). Its two lobes may be short (Figure 77: 8, 9), or long and narrow (Figure 77: 5, 11). The concavity between these lobes may be relatively shallow (Figure 77: 9) or deep (Figure 77: 5), narrow (Figure 77: 2) or wide (Figure 77: 6). The dorsal margin of this list is nearly straight in some specimens (Figure 77: 1), but it may be gently concave (Figure 77: 6), moderately convex (Plate **17**, fig. 3), or strikingly sigmoid (Figure 77: 3). The number of the radial ribs behind the fission rib ranges from two to five (Figure 77: 2, 10), and their shapes also vary. A submarginal rib may be present between the two lobes (Figure 85: 3); and the reticulation in these lobes shows various degrees of development. The eleven specimens represented by Figure 77, Figure 85: 3, Plate **16**, figure 2, 4, and Plate **17**, figure 3, illustrate the range of variation exhibited by this species in the material of the Expedition. Unfortunately, we are not able to give the relative frequency of these various forms, since only twenty of our specimens were subjected to a careful study.

Comparisons: — In spite of the fact that Schütt (1893) figures the type specimen of *Ornithocercus splendidus* from the ventral and posterior sides only and our knowledge of its structure thus is quite incomplete; and in spite of the apparent striking difference in size (114.0 μ as compared to 37.7–49.8 μ) between this specimen and the specimens from the material of the Expedition assigned in the present paper to this species, this allocation of ours may be regarded as fairly certain. The dimensions of Schütt's (1893) specimens are from a single specimen, and are based on his stated magnification (250 diameters). If we utilize another magnification (650 diameters) based on his figures, the dimensions of his specimen will fall within ours. The specimen figured by Murray and Whitting (1899, pl. 32, fig. 1) agrees closely with some of our specimens except in size (the length of its body being 87.2 μ as compared to 37.7–49.8 μ) and in the fact that the posterior rib of its left sulcal list has a short, reticulated branch near the base. A similar shift in the magnification cited by Murray and Whitting (1899) from 310 to 620 brings his specimen within our dimensions.

The species, as conceived in the present paper, is strikingly variable. We have considered it most advisable to treat these various forms as belonging to a single systematic unit for the following reasons. (*1*) Striking differences in size, if such exist, are characteristic of several species of this genus, and small specimens are known sometimes to arise from large by rapidly succeeding fissions (Plate **18**, fig. 2, 7). Our large specimens evidently were in the megacytic stage. (*2*) The structure of the cingular lists, and the size, shape, and structure of the left sulcal list are subject to pronounced variations in other species of this genus, *e.g.*, in *Ornithocercus steini* and *O. thurni*. Furthermore, these variations evidently are partly due to differences in age and to adaptive regulation. (*3*) The variations are apparently continuous, with the exception of those in size.

Ornithocercus splendidus occupies a rather isolated position; indeed, Murray and Whitting (1899, p. 332) established it as the sole member of a new subgenus, Paraschüttia. We do not know which of the other known species of this genus is its closest relative. It may be mentioned, however, that *O. heteroporus* resembles it in having a two-lobed left sulcal list usually ending at or somewhat ventrally to the antapex of the body. *O. splendidus* differs strikingly from *O. heteroporus* in its larger size and in having the cingular list very wide and structurally highly differentiated. The similarity between *O. splendidus* and *O. quadratus* f. *intermedia* should also be observed.

Synonymy: — This species was established by Schütt (1893) under the name of *Ornithocercus splendidus*, a specific name also used by most of the other investigators who have treated this form. Schütt's (1896) name *O. splendens*, evidently due to a slip of the pen, was applied to this species by Gräf (1909). In Doflein (1909, 1911, 1916) and Oltmanns (1922) this form is figured as *O. magnificus*, a typographical error. Murray and Whitting (1899), Lemmermann (1899a, 1901a), Cleve (1901c, 1902b), Schröder (1906a), and Gadeceau (1909) use Histioneis as the generic name of this species. Reproductions of Schütt's (1893) figures of the type specimen are found in Schütt (1896), Doflein (1909, 1911, 1916), Théel (1909), Nathansohn (1910b), Steuer (1910, 1911), Effenberger (1911), Stiasny (1913), Oltmanns (1922), and Francé (1923). Reproductions of Murray and Whitting's (1899) figures are given by Gadeceau (1909), Hjort (1911), and Gran (1912a, b).

Occurrence: — *Ornithocercus splendidus* is recorded at thirty-five of the 127 stations. There are 2, 1, 8, 8, 11, and 5 stations on the six lines of the Expedition. Of these thirty-five stations, one (4583) is in the California Current; one (4587) is in the Mexican Current; one (4613) is in the Panamic Area; one (4676) is in the Peruvian Current; five (4689, 4691, 4695, 4697, 4699) are in Easter Island Eddy; twenty-two (4679, 4681, 4683, 4685, 4687, 4701, 4702, 4705, 4707, 4709, 4717, 4721, 4722, 4724, 4728, 4730, 4732, 4734, 4736, 4737, 4739, 4740) are in the South Equatorial Drift; three (4742, 4743, 4540) are in the South Equatorial Current; and one (4541) is in the Equatorial Counter Current. At four stations (4702, 4743, 4540, 4541) the species was taken in surface waters only; at one station (4737) in a haul from 100–0 fathoms as well as in a haul from 300–0 fathoms; at eight stations (4681, 4689, 4701, 4721, 4724, 4728, 4732, 4740) in hauls from both 800–0 fathoms and 300–0 fathoms. All the remaining records refer to hauls from 300–0 fathoms only.

The temperature range of these thirty-five stations at the surface was 68°–83°; the average was 75.8°. At the four stations in the surface catches of which this species was found, the surface temperature ranged from 73° to 80°; the average was 77.5°.

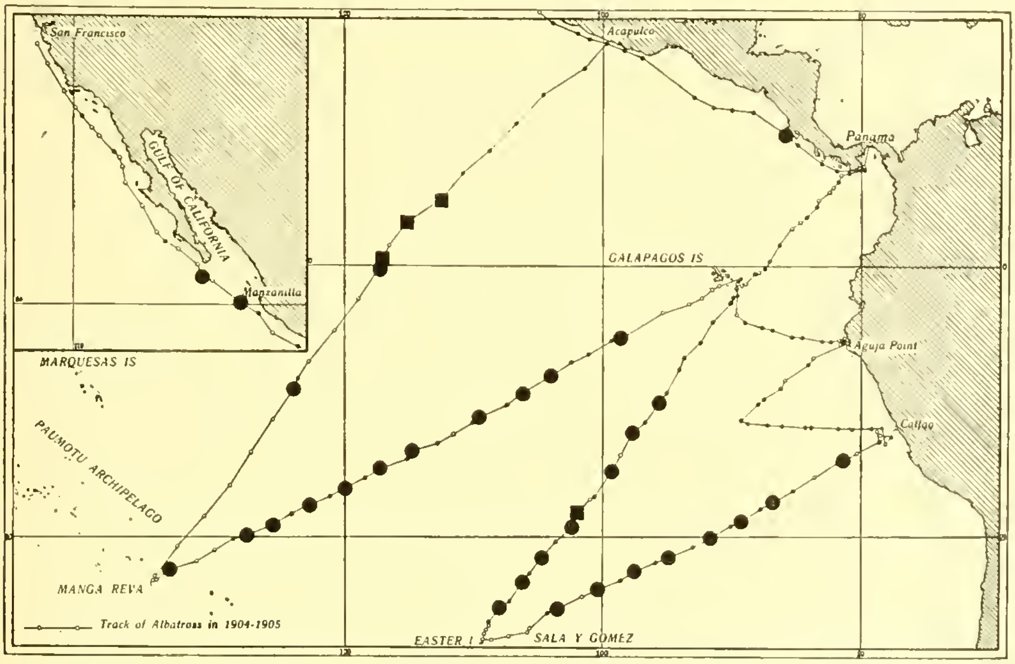

FIGURE 78.— Occurrence of *Ornithocercus splendidus* Schütt. Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

At one of the surface stations (4541) the frequency was 1%; at the remaining surface stations it was less. For the catches from 100, 300, or 800 fathoms to the surface the records of frequency are as follows: 4% at one station (4724); 3% at two stations (4681, 4739); 2% at five stations (4689, 4697, 4737, 4740, 4742); 1% at eight stations (4683, 4685, 4687, 4695, 4701, 4722, 4728, 4732); at the remaining stations the frequency is less than 1%.

The type specimen of this species (Schütt, 1893) was probably taken in the tropical or in the subtropical region of the Atlantic Ocean. Later investigators have shown it to be widely distributed. The following authors have found it in the Atlantic, between lat. 41° N. and lat. 21° S. : — Hensen (1895, 1911), Murray and Whitting (1899), Lemmermann (1899a), Cleve (1901c, 1902b), Karsten (1906), Stüwe (1909), and Gräf (1909). It has been recorded from the Gulf of Naples by Lindemann (1924, 1925). In the Red Sea and the Gulf of Aden it was found by Karsten (1907); in the Indian Ocean, by Schröder (1906a), Karsten (1907), and Gräf (1909).

Most of the records referred to in the last paragraph were from surface hauls. The only records of closing-net hauls published as yet are the following by Karsten (1907): — Station 182, lat. 10° 8′ S., long. 97° 14′ E., 200–100 m., dead; Station 229, lat. 2° 38′ S., long. 63° 37′ E., 600–400 m. and 200–20 m., no statement as to condition of specimens; Station 268, lat. 9° 6′ N., long. 53° 41′ E., 80–67 m., living; 105–88 m., dead.

According to the authors mentioned in the next but last paragraph, this species occurs in waters of the following temperatures and salinities.

	Temperature	Range	Number and Mean of Observations		Salinity Range	Number and Mean of Observations	
Murray and Whitting (1899)		64°–84°	11	73.6°			
Cleve (1901c)		62.2°–81.0°	24	70.7°	33.88–37.21	16	36.24
Cleve (1902b)	65.3°					4	35.37
Stüwe (1909)	68.6°						
Gräf (1909)		81.5°–84.2°					

Of the investigators who have contributed to our knowledge of the distribution of this species only Schütt (1893) and Murray and Whitting (1899) give figures by means of which their determinations may be checked.

Ornithocercus splendidus is eupelagic and widely distributed in tropical and subtropical seas. In most cases it is rare, but sometimes (Gräf, 1909, p. 173) it is fairly common. In the Eastern Pacific it occurs in the whole area investigated by the Expedition, but it is strikingly rare in the Mexican Current, Panamic Area, and Peruvian Current, and is not recorded from the northern portion of the California Current; however, it occurs occasionally as far to the north as at San Diego. Another striking feature about the distribution of this species, according to our data, is its rare occurrence in surface waters (four stations out of 35).

2. Magnificus Group. All the species belonging to this group were found in the material of the Expedition. They have been treated in this paper in the following order, indicative of relationships: — *Ornithocercus magnificus s. str., O. thurni, O. steini s. str., O. orbiculatus, O. quadratus,* and *O. carolinae.*

Ornithocercus magnificus Stein, *s. str.* Schütt

Plate 16, fig. 3. Figure 79, 80

Ornithocercus magnificus Stein, 1883, *partim*, pl. 23, fig. 1, 2. Chun, 1886, p. 58. Daday, 1888, p. 99. Schütt, 1895, p. 112, 136, 138, pl. 4, fig. 21: 9, pl. 5, fig. 21: 1, 3–8; 1895, pl. 5, fig. 21: 2(?); 1896, p. 29, fig. 41A; 1899, p. 14, 16, pl. 6, fig. 7, 12(?); 1900a, p. 9, 16, 18, fig. 8–10. Hensen, 1895, p. 189; 1911, p. 137, 138, 163, 393, tab. 15. Cleve, 1897a, *partim*, p. 26, tab. 1. Ostenfeld, 1898a, p. 428; 1915, p. 7. Ostenfeld & Schmidt, 1901, p. 173. Schmidt, 1901, p. 138. Lohmann, 1902, p. 53; 1908a, p. 168, 169; 1920, p. 484, 492, 539, 545, 547, 565. Entz, 1902a, p. 122. Zacharias, 1906, p. 509, 518, 530, 531, 532, 534, 536, 552, 557, 566, 569; *non* 1906a, p. 274, fig. 7; *non* 1907, fig. 14; *non* 1911, fig. 51. Karsten, 1906, p. 180, 181, 182, 183, 187, 189, 190, 191, 200, 201, 202, 204, 205, 207; 1907, p. 236, 238, 240, 241, 243, 245, 246, 247, 248, 249, 250, 253, 254, 255, 256, 258, 259, 260, 263, 265, 267, 268, 269, 270, 271, 274, 275, 276, 277, 279, 283, 289, 290, 291, 292, 295, 297, 298, 300, 304, 305, 308, 311, 313, 314, 315, 316, 317, 321, 322, 323, 324, 325, 330, 331, 332, 333, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 352, 353, 354, 355, 356, 357, 358, 427, 440, 445, 450, 471. Schröder, 1906a, p. 321, 322, 323, 325, 326, 329, 335; 1911, p. 15, 18. Kofoid, 1907a, p. 205, 206; 1911, p. 237. Okamura, 1907, p. 132, *partim*(?); 1912, p. 20. Doflein, 1909, p. 465, fig. 417: 7 (*non* 417: 8); 1911, p. 531, fig. 478: 7 (*non* 478: 8); 1916, p. 436, fig. 396: 7 (*non* 396: 8). Gräf, 1909, p. 173. Schiller, 1912, p. 27; 1912a; 1914, p. 14. Gran, 1912b, p. 328, 330, fig. 235. Faria & Cunha, 1917, *partim*, p. 79. Oltmanns, 1922, fig. 38: 7 (*non* fig. 38: 8). Jörgensen, 1923, p. 35, 36, 37, 44, fig. 48. Lindemann, 1924, p. 7 (*non* p. 5).

non *Ornithocercus magnificus* Bütschli, 1885, pl. 55, fig. 7. Chun, 1903, p. 75, fig. b. Whitelegge, 1891, p. 185. Fricke, 1902, p. 55. Willey & Hickson, 1909, p. 184, fig. 8. Hjort, 1911, p. 367, fig. 12: 4. Francé, 1923, fig. 11: 2.

Histioneis magnifica Murray & Whitting, 1899, *partim*, p. 332, 333, tab. 1–9. Entz, 1902b, p. 94; 1905, p. 112. Pavillard, 1905, *partim*, p. 60, 81, 102; 1916, *partim*, p. 61. Meunier, 1910, p. 59. Issel, 1921, p. 17. Forti, 1922, *partim* (?), p. 113, 192, 209, 213, pl. 7, fig. 124.

Histioneis magnificus Lemmermann, 1899a, *partim*, p. 319, 320, 323, 330, 331, 332, 374; 1901a, *partim*, 376; 1905a, p. 37 (as *H. magnifica*). Cleve, 1900b, *partim*, p. 1031; 1901a, p. 16; 1901c, p. 250 (as *H. magnifica*); 1902b, p. 32 (as *H. magnifica*); 1903b, p. 345 (as *H. magnifica*). Cleve, Ekman, & Pettersson, 1901, *partim*, p. 16, tab. 2.

non *Histioneis magnificus* Lemmermann, 1899a, p. 317, 323, 327.

non *Histioneis magnifica* Schröder, 1900a, p. 20, pl. 1, fig. 15.

Ornithoceras magnificus Gräf, 1909, p. 139.

Ornithocercus magnificus, var. *a*, Stüwe, 1909, p. 237, 243, 244, 254, 275, 288, pl. 2, fig. 21.

Ornithocercus minor Jörgensen, 1923, p. 35.

Diagnosis: — Subcircular in lateral outline. Cingular lists: anterior 0.51–0.92, posterior 0.48–0.68 the greatest depth of body; anterior with four to nine simple, complete, and some incomplete ribs; posterior with twelve to seventeen simple, complete, and some incomplete ribs. Left sulcal list ends on dorsal side of body at 0.33–0.60 the greatest depth of body from posterior cingular list; with three narrowly rounded lobes, one of which is posteroventral, one antapical, and one posterodorsal; width at posteroventral lobe, 0.72–1.33, at antapical lobe 0.64–1.19, and at posterodorsal lobe 0.66–1.19 the greatest depth of body; typically with five ribs behind fission rib; distal ends of these ribs and fission rib connected by submarginal rib; with reticulum in each of the three lobes; *a*-rib extends into posterodorsal lobe; *b*- and *c*-ribs usually end dorsally to vertex of midlobe, *d*- and *e*-ribs dorsally to posteroventral lobe. Length of body, 31.9–46.6 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This species is fairly small or medium-sized, subcircular in lateral outline, and deepest in or near the middle. The ratio between the length and the depth of the body is 0.94–1.13: 1; in our specimens this ratio is 1.01 (0.94–1.12): 1. The longitudinal axis may be perpendicular to the posterior cingular list, but usually it is deflected posterodorsally at 7° (1°–10°).

The epitheca is 0.47 (0.37–0.56) as deep as the hypotheca, slightly convex or flat, highest in or somewhat dorsally to the center, and somewhat tilted ventro-posteriorly. The transverse furrow usually is somewhat concave but may be almost flat; its dorsal width is 0.38 (0.34–0.42) the greatest depth of the body; its ventral width is 0.52 (0.44–0.62) its dorsal width. The posterior cingular list is 0.26 (0.20–0.30) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are confluent; the dorsal may be somewhat flattened (Figure 79: 4).

The anterior cingular list is 0.51–0.92 the greatest depth of the body and has an anterior inclination of 40° (35°–45°); in our specimens its width is 0.63 (0.51–0.79); it has on each valve four to nine simple and complete ribs and between these a varying number of incomplete ribs; and it may be reticulated basally (Stein, 1883, pl. 23, fig. 1). The posterior cingular list is 0.56 (0.48–0.68) the greatest depth of the body and is inclined anteriorly at 60° (45°–80°); it has on each valve 12–17 complete, simple, and subequidistant ribs and may have the same number of incomplete ribs (Plate 16, fig. 3). The right sulcal list is relatively small and subtriangular or rounded triangular, decreasing gradually in width posteriorly; it usually extends to or somewhat beyond the fission rib of the left sulcal list but may be somewhat shorter (Plate 16, fig. 3). The left sulcal list ends on the dorsal side of the body at a distance from the posterior cingular list equaling 0.50 (0.33–0.60) the greatest depth of the body and is characterized by three narrowly rounded posterior lobes, one of which is posteroventral, one antapical (the middle one), and one posterodorsal. In our specimens the width of this list at the anterior main rib is 0.53 (0.42–0.64), at the fission rib 0.55 (0.40–0.64), at the posteroventral lobe 0.88 (0.72–1.21), at the antapical lobe 0.79 (0.64–1.04), and at the posterodorsal lobe 0.83 (0.66–1.13) the greatest depth of the body. In the specimens figured by Stein (1883, pl. 23, fig. 1, 2), which have this list somewhat wider than any other figured specimens, the corresponding values are: — 0.51–0.65, 0.62–0.65, 1.33, 1.15–1.19, and 1.15–1.19. The ventral margin of this list is almost straight, gently concave or convex, gently sigmoid, being concave anteriorly and convex posteriorly, or slightly irregular. Between the tips of the antapical lobe and the tips of the posteroventral and posterodorsal lobes, the posterior margin is gently or more or less strikingly concave (Figure 79: 5; Plate 16, fig. 3). The dorsal margin is gently convex. Between the anterior main rib and the fission rib this list may have one or a few ribs (Stein, 1883, pl. 23, fig. 2). Behind the fission rib this list typically (Figure 79:3) has five radial ribs connected distally by a submarginal rib. The submarginal rib extends along the whole posterior margin of the list and from the posteroventral lobe to the fission rib with which it is connected; in the tip of each of the three posterior lobes it usually forms a reticulum (Plate 16, fig. 3); sometimes (Stein, 1883, pl. 23, fig. 2) it is incomplete. Of the five radial ribs the *a*-rib (the dorsal rib) extends into the posterodorsal lobe; the *b*- and *c*-ribs usually end dorsally to the vertex of the antapical (middle) lobe, but the *c*-rib may join the submarginal rib just in front of this point (Jörgensen, 1923, fig. 48); the *d*- and the *e*-ribs always join the submarginal rib dorsally to the posteroventral lobe. In our specimens the lengths of the main radial ribs, measured to the points where these ribs join the submarginal rib, are as follows:— the *a*-rib is 0.65 (0.49–0.78), the *b*-rib 0.43 (0.33–0.51), the *c*-rib 0.50 (0.40–0.68), the *d*-rib 0.50 (0.37–0.63), and the *e*-rib 0.48 (0.34–0.58) the greatest depth of the body. Sometimes less than five main radial ribs are developed; sometimes one or a few accessory ribs are interpolated (Figure 79: 2, 5). These variations probably are due to age; the *a*- and the *d*-ribs usually are developed before the remaining ribs; the next to appear usually is the *c*-rib (Figure 79: 8, 7). Generally the radial ribs are simple; but in old specimens they may have short projections or be more or less branched, the branches in most cases anastomosing (Figure 79: 1, 2).

The whole thecal wall is porulate, that of the hypotheca is areolate. The areoles are of moderate and subuniform size (Plate 16, fig. 3) or relatively small (Jörgensen, 1923, fig. 48), and each of them has a pore in the middle. Near the middle of the body there are on the average 13–20 areoles across the face of each valve. A row of 11–13 polygons, somewhat larger than the areoles, borders the girdle posteriorly. Phaeosomes are to be found in the transverse furrow.

The proportions of thirteen of our specimens and of the specimens figured by Stein (1883, pl. 23, fig. 1, 2), Schütt (1895, pl. 5, fig. 21: 4), and Jörgensen (1923, fig. 48) were measured.

Dimensions: — Our specimens: Length of body, 31.9–46.6 μ (average, 38.4 μ). Greatest depth of body, 33.4–47.4 μ (average, 38.5 μ). We do not know the size of the two specimens of this species figured by Stein (1883, pl. 23, fig. 1, 2), one of which is the type. According to Stein's (1883) information about the magnifications of his figures given in an introductory remark to the explanations of the plates, these specimens were somewhere between 37.3 and 60.7 μ long; the type specimen (Stein, 1883, pl. 23, fig. 1) was somewhere between 39.5 and 60.7 μ. The specimen represented by Schütt's (1895) Plate 5, figure 21:4, was 42.6 μ long and 40.6 μ deep; the one figured by Jörgensen (1923, fig. 48) was 40.0 μ long and 40.0 μ deep. According to Zacharias (1906, p. 518) the length of the body is 40 μ.

Variations: — As conceived in the present paper, *Ornithocercus magnificus s. str.* is comparatively constant, except in the size of the body and in the size, shape, and structure of the left sulcal list. The first eight specimens of Figure 79

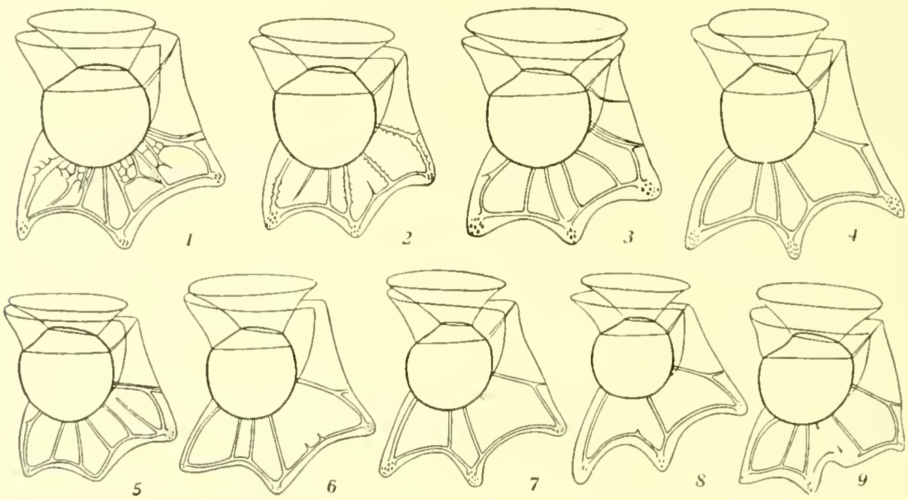

FIGURE 79.— *Ornithocercus magnificus* Stein, *s. str.*, right lateral view, illustrating variations in shape and structure of left sulcal list. × 340. 1, from Station 4742 (300–0 fathoms); 2, 5, from Station 4638 (300–0 fathoms); 3, from Station 4715 (300–0 fathoms); 4, from Station 4681 (300–0 fathoms); 6, from Station 4701 (300–0 fathoms); 7, from Station 4697 (300–0 fathoms); 8, from Station 4737 (300–0 fathoms); 9, from Station 4607 (300–0 fathoms).

cover fairly completely its range of variation as established from the material of the Expedition. The chief variations occur in the number and development of the radial ribs of the left sulcal list. In most of our specimens (186, *i.e.*, 62.0%, out of 300) these ribs agreed very closely with those of the specimen represented by Figure 79: 3; seventy-three specimens (24.3%) agreed with Figure 79: 4; twenty-two (7.3%) with Figure 79:.7; thirteen (4.3%) with Figure 79: 5; two (0.7%) with Figure 79: 8; each of the types shown in Figure 79: 1,2,6, was represented by only one specimen (0.3%). The specimens represented by Figure 79: 1, 2, probably were old, while Figure 79: 8 appears to represent a fairly young specimen, in which the structures of the right valve are still in a relatively undifferentiated condition following binary fission (compare Schütt, 1900a, fig. 8–10). The specimen represented by Figure 79: 9 should be considered as aberrant with regard to the portion of the left sulcal list posteroventrally to the antapex of the body; probably this portion is in a condition of regeneration following a local injury. As an example of an old specimen in which the radial ribs of the left sulcal list are very heavy and furnished with anastomosing branches and numerous short projections, reference is made to Schütt (1900a, fig. 10). The *c*-rib of this list usually ends somewhat dorsally to the vertex of the middle lobe of this list (Figure 79; Schütt, 1900a, fig. 8–10), but it may join the submarginal rib just in front of this point (Stein, 1883, pl. 23, fig. 2; Jörgensen, 1923, fig. 48). The submarginal rib usually is well developed along the whole posterior margin of this list, but it may be partly absent (Schütt, 1900a, fig. 9). With regard to the specimen represented by Schütt (1895, pl. 5, fig. 21: 2), see the next section. The variations observed thus seem largely to be due to age, to irregularities in the regeneration of local injuries, or to resorption in adjustment to the requirements of flotation.

Comparisons: — Observations on a large number of specimens collected by the Expedition confirm the opinion of Schütt (1900a) that *Ornithocercus magnificus*, as conceived by Stein (1883), is heterogeneous (see the next section) and enable us to form a fairly good picture of *O. magnificus s. str.* Our specimens agree quite closely with those figured by Stein (1883, pl. 23, fig. 1, 2), Schütt (1895, pl. 5, fig. 21: 1, 4; 1900a, fig. 8–10), and Jörgensen (1923, fig. 48), and their specific unity appears to be beyond doubt. It should be observed in this connection that in the type specimen (Stein, 1883, pl. 23, fig. 1) the portion of the left sulcal list outside the submarginal rib has been omitted. The specimen represented by Schütt's (1895) Plate 5, figure 21 : 2, differs strikingly from the typical specimens in the shape of the posterior margin of the left sulcal list and in the structure of this list between rib *a* and the fission rib. In spite of this, it has not been excluded from this species since the same radial ribs can be distinguished as in the typical specimens; we regard its aberrant structure as due to the same causes as in the case of the specimen represented by our Figure 79: 9.

No specimens have been found as yet which are distinctly intermediate between *Ornithocercus magnificus s. str.* and any of the other known species of this genus. Indeed, this species appears to occupy a somewhat isolated position. It is characterized especially by *(1)* its relatively small size; *(2)* its fairly small right sulcal list; *(3)* its three-lobed left sulcal list, which is furnished with five radial ribs behind the fission rib and with a submarginal rib, and *(4)* by the fact that in this list the *a*-rib extends into the dorsal lobe, the *b*-rib ends ventrally to the dorsal lobe, the *c*-rib somewhat dorsally to the vertex of the middle lobe, and the *e*-rib usually somewhat dorsally to the vertex of the ventral lobe. Its closest-known relative probably is *O. thurni,* which also has a three-lobed left sulcal list furnished with five radial ribs behind the fission rib and with a submarginal rib. *O. thurni* is easily distinguished from this species by its larger size, its relatively large right sulcal list, and by the fact that the *c*- and *e*-ribs of the left sulcal list end at the vertices of the middle and ventral lobes. *O. magnificus* also resembles *O. carolinae* in possessing a three-lobed left sulcal list. The last species is readily recognized from the first by the dominating size of the middle of these three lobes and by having a greater number of radial ribs in the left sulcal list; it is probably not very closely related to *O. magnificus.*

Synonymy: — The synonymy of this species is so tangled that it probably will prove to be almost impossible to unravel. Under the name of *Ornithocercus magnificus,* Stein (1883, pl. 23, fig. 1–6) figured five specimens, belonging to three different species. Schütt (1900a, p. 16, 18), who was the first to point out the heterogeneity of this species as conceived by Stein, applied the name *magnificus* to the specimen represented by Stein's (1883) Plate 23, figure 1, which thus should be regarded as the type. We conclude that figure 2 of this plate also is referable to *O. magnificus s. str.* The specimen represented by Stein's (1883) Plate 23, figure 3, Schütt (1900a) made the type of a new species, *O. steini* [= *O. thurni*], to which also should be referred Stein's (1883) Plate 23, figure 5. Finally, Stein's (1883) Plate 23, figure 3, represents a specimen of *O. steini s. str.,* in which the lists have not yet attained their complete differentiation.

In spite of this heterogeneity a fairly great number of the authors who have treated *Ornithocercus magnificus* show neither by figures, references to figures, nor otherwise how they conceive this species. These investigators are as follows: — Chun (1886), Daday (1888), Hensen (1895, 1911), Ostenfeld (1898a), Lemmermann (1899a), Cleve (1900b, 1901a, 1901c, 1902b), Cleve, Ekman, and Pettersson (1901), Entz (1902a), Zacharias (1906), Karsten (1906, 1907), Schröder (1906a, 1911), Gräf (1909), Meunier (1910), Okamura (1912), Schiller (1912, 1912a, 1914), Issel (1921), and Lindemann (1924, p. 7). All these references should therefore rightly be furnished with question marks to indicate the uncertainty of their allocation. Lemmermann (1904, p. 643) points out that *Histioneis magnificus* Lemmermann (1899a, p. 317, 323, 327) refers to *Ornithocercus steini* [= *thurni*] only. Cleve (1897a), Pavillard (1905, 1916), and Faria and Cunha (1917) refer to all of Stein's (1883) figures and are thus marked with *partim* in our bibliographical list. Okamura (1907), who also refers to all of Stein's (1883) figures, represents as *O. magnificus* two specimens of *O. thurni;* whether or not he found any *O. magnificus s. str.* cannot be decided from his published data. Stüwe (1909), who has a very broad concept of this species, including *O. magnificus s. str., O. thurni, O. steini s. str.*, and *O. quadratus,* distinguishes his records of *O. magnificus s. str.* under the designation *O. magnificus* var. *a.* Entz (1902b, 1905) distinguishes two "varieties" of *O. magnificus,* viz., var. *steini* [= *thurni*] and var. *quadrata,* but it cannot be established from his data whether he found *O. magnificus s. str.* The specimen figured by Murray and Whitting (1899) under the name of *Histioneis magnifica* (Stein) belongs to *Ornithocercus thurni,* but the distributional data of these investigators probably refer to *O. magnificus s. str.* as well; the species was found to vary "greatly in size and in the character of the markings on the sail and funnel"; with regard to the use of Histioneis for Ornithocercus, see below. Bütschli (1885), Chun (1903), Zacharias (1906a, 1907, 1911), Willey and Hickson (1909), and Francé (1923) reproduce under the name of *O. magnificus* either of Stein's (1883) figures 4 and 5, Plate 23 [= *O. thurni*]. In recording *O. magnificus,* Whitelegge (1891) refers only to Bütschli's (1885) reproduction of Stein's (1883) Plate 23, figure 4 [= *O. thurni*]. Hjort (1911) reproduces Murray and Whitting's (1899, pl. 32, fig. 2) figure of *Histioneis magnifica* [= *Ornithocercus thurni*] under the name of *O. magnificus. Histioneis* (= *Ornithocercus*) *magnifica* Schröder (1900a) is a synonym of *Ornithocercus quadratus;* and the last name is considered a synonym of *O. magnificus* by Cleve (1903b). *Ornithocercus magnificus* Lindemann (1924, p. 5) refers to *Histioneis magnifica* Schröder (1900a). *O. magnificus* Fricke (1902) refers to *O. thurni.* Although Forti (1922) reproduced only Stein's (1883) Plate 23, figure 1 and 2, in other words only figures of *O. magnificus s. str.*, he evidently held a very broad concept of this species, since he was inclined to believe that *O. magnificus s. str., O. steini* [= *thurni*], and *O. quadratus* were but stages in the life cycle of a single species; his material included possibly more than *O. magnificus s. str.*

Ornithocercus magnificus s. str. was established, as mentioned previously, by Schütt (1900a); the three specimens figured by Schütt (1900a) all belong to this species as conceived in the present paper. Two of the specimens previously figured by Schütt (1895, pl. 5, fig. 21: 1, 4) as *O. magnificus* are typical representatives of *O. magnificus s. str.;* a third specimen (1895, pl. 5, fig. 21: 2) is aberrant but may also be referable to this species. Two of these figures, figures 21: 1 and 21: 2, were later reproduced by Schütt (1896, 1899) in a somewhat modified form. Schmidt (1901), Ostenfeld and Schmidt (1901), Lohmann (1902, 1908a, 1920), Kofoid (1907a, 1911), and Ostenfeld (1915) have the same concept of this species as Schütt (1900a). The same is true with regard to Effenberger (1911) and Gran

(1912b), who reproduce Schütt's (1895) Plate 5, fig. 21: 1; to Jörgensen (1923), who gives an original figure of this species; and to Doflein (1909, 1911, 1916) and Oltmanns (1922) who reproduce under the name of *O. magnificus* not only Schütt's (1895) Plate 5, figure 21: 1, but also, evidently through an editorial error, one of Schütt's (1893, fig. 82) figures of *O. splendidus.*

Jörgensen (1923) mentions that in his manuscript he used the name *Ornithocercus minor* for *O. magnificus s. str.*

The following investigators use Histioneis as the generic name of this species: — Murray and Whitting (1899), Lemmermann (1899a, 1901a, 1905), Schröder (1900a), Cleve (1901c, 1902b, 1903b), Cleve, Ekman, and Pettersson (1901), Entz (1902b, 1905), Pavillard (1905, 1916), Meunier (1910), Issel (1921), and Forti (1922). With regard to this usage, see our treatment of the family Ornithocercidae, the section on the subdivisions (p. 494).

Occurrence: — *Ornithocercus magnificus* is recorded at seventy-six of the 127 stations. There are 20, 13, 6, 12, 17, and 8 stations on the six lines of the Expedition. Of these seventy-six stations, one (4583) is in the California Current; thirteen (4587, 4588, 4590, 4592, 4594, 4596, 4598, 4600, 4604, 4605, 4607, 4545, 4546) are in the Mexican Current; sixteen (4609, 4611, 4613, 4615, 4617, 4619, 4624, 4627, 4631, 4634, 4635, 4637, 4638, 4639, 4640, 4644) are in the Panamic Area; five (4646, 4647, 4648, 4650, 4671) are in the Peruvian Current; nine (4689, 4691, 4692, 4695, 4696, 4697, 4698, 4699, 4700) are in the Easter Island Eddy; two (4613, 4616) are in the Galapagos Eddy; twenty-six (4685, 4686, 4687, 4701, 4702, 4705, 4712, 4720, 4721, 4722, 4724, 4725, 4727, 4728, 4729, 4730, 4731, 4732, 4733, 4734, 4735, 4736, 4737, 4739, 4740, 4741) are in the South Equatorial Drift; one (4742) is in the South Equatorial Current; one (4542) is in the Equatorial Counter Current; two (4543, 4544) are in the North Equatorial Current. There are forty-two records from the surface (Stations 4583, 4588, 4590, 4592, 4596, 4600, 4604, 4607, 4611, 4615, 4617, 4619, 4624, 4627, 4631, 4635, 4638, 4639, 4640, 4644, 4686, 4692, 4696, 4698, 4700, 4702, 4712, 4716, 4720, 4725, 4727, 4729, 4731, 4733, 4735, 4740 [Salpa], 4741, 4542, 4543, 4544 [Salpa], 4545, 4546). At thirty-seven of these forty-two stations the species was taken in surface waters only; at five stations (4583, 4590, 4617, 4638, 4740), in hauls from 300–0 fathoms as well as at the surface; at Stations 4588 and 4619, in Salpa stomachs as well as in surface hauls. At one station (4737) it is recorded from 100–0 fathoms and 300–0 fathoms; at four stations (4689, 4728, 4732, 4736) from 800–0 fathoms and 300–0 fathoms; at two stations (4647, 4721) from 800–0 fathoms only. All the remaining records refer to hauls from 300–0 fathoms only.

The species was taken also in surface waters in Acapulco Harbor, adjacent to the Mexican Current. This station is not included in the 127 stations mentioned above.

The temperature range of these seventy-six stations at the surface was 66°–85°; the average was 77.5°. At the forty-two stations in the surface catches of which this species was found, the surface temperature ranged from 71° to 84°; the average was 78.5°. At Acapulco it was 83°.

For the surface catches the following frequencies are recorded: — 21% at one station (4546); 13% at one station (4604); 9% at two stations (4635, 4696);

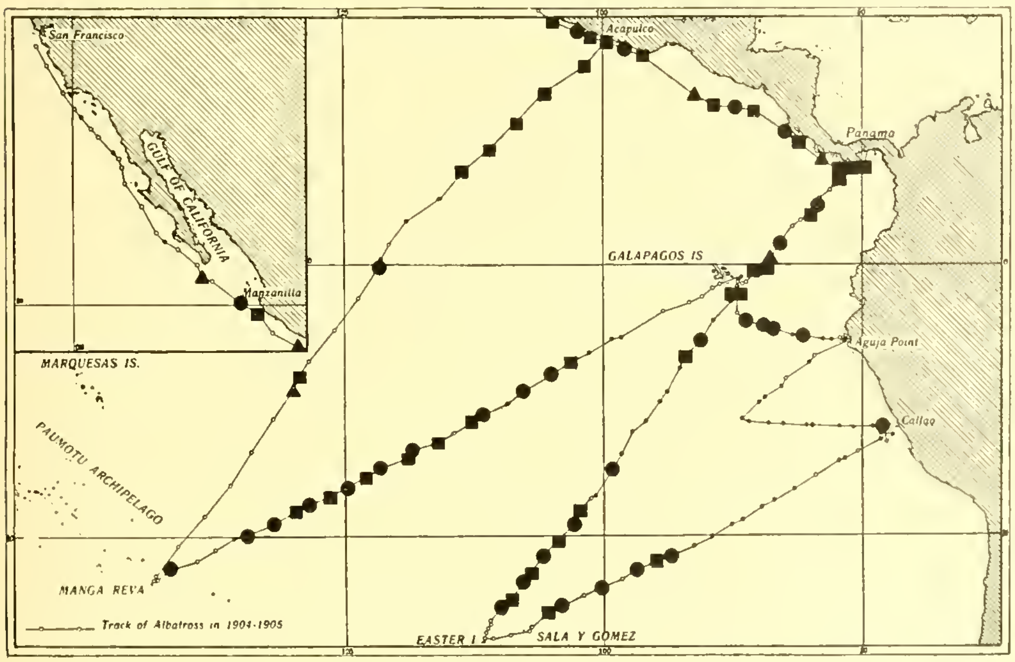

FIGURE 80.— Occurrence of *Ornithocercus magnificus* Stein, *s. str.* Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; triangles, records from both vertical and surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

7% at one station (4590); 6% at one station (4619); 5% at four stations (4596, 4600, 4692, 4545); 4% at one station (4607); 3% at three stations (4588, 4733, 4542); 2% at eleven stations (4592, 4615, 4617, 4624, 4627, 4631, 4638, 4639, 4720, 4731, 4543); 1% at seven stations (4640, 4644, 4702, 4712, 4716, 4725, 4735); in the remaining cases the frequency is less than 1%. For the catches from 100, 300, or 800 fathoms to the surface the records of frequency are as follows: 9% at two stations (4695, 4699); 8% at one station (4609); 7% at one station (4634); 6% at two stations (4637, 4689); 5% at four stations (4613, 4617, 4691, 4736); 4% at three stations (4590, 4638, 4697); 3% at four stations (4598, 4732, 4734, 4737); 2% at eight stations (4583, 4605, 4646, 4650, 4687, 4728, 4739, 4740); 1% at three stations (4648, 4685, 4701); at the remaining stations the frequency is less than 1%. For the catch made in Acapulco Harbor a frequency of less than 1% is recorded.

The species was first recorded by Stein (1883) "aus dem Atlantischen Meer." Later investigators have shown it to be widely distributed. The following authors have found it in the Atlantic between lat. 45° N. and lat. 42° S.: — Hensen (1895, 1911), Cleve (1897a, 1901c, 1902b, 1903b), Ostenfeld (1898a), Murray and Whitting (1899), Lemmermann (1899a), Karsten (1906), Zacharias (1906), Lohmann (1908), Gräf (1909), Stüwe (1909), Faria and Cunha (1917), and Jörgensen (1923). In the Caribbean Sea it was found by Murray and Whitting (1899) and Cleve (1901c). Of these authors Hensen (1911), Cleve (1901c), Murray and Whitting (1899), and Karsten (1906) found it at a great number of localities. Jörgensen (1923) recorded this species from a great number of stations throughout the Mediterranean. Other investigators who have found it in the Mediterranean are as follows: — Cleve (1903b) at lat. 37° N., long. 4° E., and lat. 33° N., long. 30° E.; Pavillard (1905, 1916) in the Gulf of Lyons; Forti (1922) in the Ligurian Sea; Daday (1888) and Zacharias (1906) in the Gulf of Naples; Entz (1902b, 1905), Zacharias (1906), Schröder (1906a, 1911), Schiller (1912, 1912a, 1914), and Issel (1921), in the Adriatic Sea; Schröder (1906a) in the Ionian Sea. In the Red Sea it has been found by Cleve (1900b, 1903b), Ostenfeld and Schmidt (1901), and Schröder (1906a); in the Gulf of Aden, by Ostenfeld and Schmidt (1901) and Schröder (1906a); in the Arabian Sea, by Cleve (1901a, 1903b), Ostenfeld and Schmidt (1901), and Schröder (1906a); in the Indian Ocean, by Cleve (1901a), Schröder (1906a), Karsten (1907), and Gräf (1909); in the Malay Archipelago, by Cleve (1901a) and Ostenfeld (1915); in the Gulf of Siam, by Schmidt (1901); in the South China Sea, by Schröder (1906a); in Japanese waters, by Okamura (1907, 1912); in the Pacific, at lat. 6° N., long. 111° W., by Lemmermann (1899a); at San Diego, California, by Kofoid (1911); in the Peruvian Current, at lat. 33° S., long. 82° W., and at lat. 23° S., long. 74° W., respectively, by Lemmermann (1899a) and by Zacharias (1906). Of the writers mentioned in the last sentence, Karsten (1907) found it at a great number of localities.

Most of the records referred to in the last paragraph were from surface hauls. The only records of closing-net hauls published as yet are the following by Karsten (1906, 1907): — Station 27, lat. 29° 20′ N., long. 15° 57′ W., 2500–2200 m., no statement as to condition of specimens; Station 65, lat. 1° 56′ S., long. 7° 48′ E., 300–200 m., living; Station 170, lat. 32° 53′ S., long. 83° 1′ E., 200–100 m., living; Station 181, lat. 12° 6′ S., long. 96° 44′ E., 500-300 m., dead, 200–100 m., dead; Station 182, lat. 10° 8′ S., long. 97° 14′ E., 200–100 m., dead; Station 191, west coast of Sumatra, 200–180 m., dead, 100–60 m., dead; Station 218, lat. 2° 29′ N., long. 76° 47′ E., 100–80 m., living; Station 221, lat. 4° 5′ S., long. 73° 24′ E., 200–160 m., living, 160–120 m., dead; Station 227, lat. 2° 56′ S., long. 67° 59′ E., 600–400 m., cells with protoplasmic contents; Station 228, lat. 2° 38′ S., long. 65° 59′ E., 300–200 m., living, 200–100 m., living; Station 229, lat. 2° 38′ S., long. 63° 37′ E., 1000–800 m., dead, 200–20 m., condition unknown; Station 236, lat. 4° 38′ S., long. 51° 16′ E., 180–130 m., dead, 100–80 m., living; Station 239, lat. 5° 42′ S., long. 43° 36′ E., 103–85 m., living, 120–105 m., dead; 80–65 m., living; 60–45 m., living; 40–25 m. and 20–15 m., condition unknown; Station 268, lat. 9° 6′ N., long. 53° 41′ E., 105–88 m., dead; 63–46 m., living; 42–25 m., living; 42–15 m., living.

According to the authors mentioned in the next to the last paragraph, this species occurs in waters of the following temperatures and salinities.

	Temperature Range	Number and Mean of Observations		Salinity Range	Number and Mean of Observations	
Murray and Whitting (1899)	57.0°–86.0°	125	75.5°			
Cleve (1901a)	77.4°–88.2°	5	80.9°	32.12–36.20	5	34.72
	78.1°–82.9°	5	77.9° *	33.06–33.80	5	33.59
Cleve (1901c)	62.6°–82.4°	150	73.0°	33.20–37.63	120	36.12
Cleve (1902b)		45	73.8°		45	36.11
Cleve (1903b)	60.2°–87.3°	20	76.5°	35.52–39.92	20	36.90
Ostenfeld and Schmidt (1901)	79.0°–84.5°					
Stüwe (1909)	68.5°–80.2°					
Issel (1921) (minimum)	54°					

*Lower than minimum temp.

Usually this species is fairly rare, or it occurs in moderate numbers. However, Schiller (1914, p. 14) records a sudden mass appearance ("gewaltige Mengen") in the Gulf of Trieste during September, 1909. The phenomenon lasted four days and affected the entire gulf.

Cleve, Ekman, and Pettersson (1901) give a chart of the distribution of this species in the Atlantic.

Of the investigators who have contributed to our knowledge of the distribution of this species, Schmidt (1901), Ostenfeld and Schmidt (1901), Lohmann (1908), Kofoid (1911), Ostenfeld (1915), and Jörgensen (1923) show by figures, references to figures, or otherwise that they conceive this species in the restricted sense established by Schütt (1900a). Cleve (1897a), Murray and Whitting (1899), Pavillard (1905, 1916), Okamura (1907), and Faria and Cunha (1917), on the other hand, show that they have the same broad conception as Stein (1883), and their data of distribution thus may refer either to any or to all of the three species *Ornithocercus magnificus s. str., O. thurni,* and *O. steini s. str.* Cleve (1903b) includes *O. quadratus* in *O. magnificus,* and his data therefore should be accepted with reservation. Stüwe (1909), who also has a very broad concept of the last species, distinguishes *O. magnificus s. str.* as *O. magnificus* var. *a,* and only his records of this "variety" have been included in the account given above. Forti's (1922) records may partly refer to *O. thurni* and *O. quadratus.* The remaining authors do not give any information by means of which their concept of *O. magnificus* may be judged, and so their distributional data should be accepted with reservation.

Ornithocercus magnificus is eupelagic and widely distributed in tropical, subtropical, and warm-temperate waters. It appears to be one of the most common representatives of this genus and occasionally may occur in enormous quantities causing the discoloration of the water. In the Eastern Pacific it occurs in the whole area investigated by the Expedition, but it is strikingly rare in the Peruvian Current. It is not recorded from the northern portion of the California Current, but it occurs occasionally as far to the north as at San Diego, California. Like most of the remaining species of this genus, it is relatively frequent in surface waters; and the highest records of frequency are from surface catches.

Ornithocercus thurni (Schmidt)

Plate 18, fig. 4–6. Figure 81, 82

? *Dinophysis galea* Pouchet, 1883, *partim,* p. 426, fig. G: 4.

Ornithocercus magnificus Stein, 1883, *partim,* pl. 23, fig. 4, 5. Bütschli, 1885, pl. 55, fig. 7. Whitelegge, 1891, p. 185. Cleve, 1897a, *partim,* p. 26, tab. 1. Chun, 1903, p. 75, fig. b. Zacharias, 1906a, p. 274, fig. 7; 1907, fig. 14; 1911, fig. 51. Okamura, 1907, *partim* (?), p. 132, pl. 4, fig. 27. Willey & Hickson, 1909, p. 184, fig. 8. Hjort, 1911, p. 367, fig. 4. Faria & Cunha, 1917, *partim,* p. 79. Francé, 1923, fig. 11: 2.

Parelion thurnii Schmidt, 1888, pl. 144, fig. 59–61; 1890, p. 22.

Histioneis magnifica Murray & Whitting, 1899, *partim,* p. 332, 333, tab. 1–9, pl. 32, fig. 2. Lemmermann, 1899a, p. 317, 323, 327. Pavillard, 1905, *partim,* p. 60, 81, 102; 1916, *partim,* p. 61.

Ornithocercus steinii Schütt, 1900a, *partim,* p. 5, 16, 17, fig. 7. Gran, 1912a, p. 935, fig. 7b; 1912b, p. 328, 329, fig. 234b. Ostenfeld, 1915, p. 7.

Histioneis steinii Lemmermann, 1901a, *partim,* p. 377; 1904, p. 317, 323, 327; 1905a, p. 37.

Ornithocerus magnificus Fricke, 1902, p. 55.

Histioneis magnificus var. *steinii* Entz, 1902b, p. 94; 1905, p. 112 (as *magnifica* var. *steinii*).

Ornithocercus steini Kofoid, 1907a, p. 206. Jörgensen, 1923, p. 36, 37, 38, fig. 49.

Ornithocercus magnificus var. *c* and *d* Stüwe, 1909, p. 235, 254, 275, 288.

Histioneis magnifica var. *steinii* Forti, 1922, p. 114.

Diagnosis: — Lateral outline subcircular. Cingular lists: anterior 0.46–0.80, posterior 0.47–0.74 the greatest depth of body; anterior with five to nine complete ribs, often branched distally, and numerous short, marginal ribs; posterior with 11–16 complete and often simple ribs. Left sulcal list ends on dorsal side of body 0.10–0.40 the greatest depth of body from posterior cingular list; with three narrowly to fairly broadly rounded lobes, one of which is posteroventral, one antapical, and one posterodorsal; width at posteroventral lobe 0.65–1.16, at antapical lobe 0.54–1.10, and at posterodorsal lobe 0.51–1.02 the greatest depth of body; typically with five ribs behind fission rib and with submarginal rib connecting these ribs; with reticulum in each lobe; *a*-rib extends into posterodorsal lobe; *b*-rib ends ventrally to this lobe, and *c*- and *e*-ribs at vertices of antapical and posteroventral lobes. Length of body, 43.7–81.5 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This is a fairly large or medium-sized species, with subcircular outline in lateral view, deepest in or near the middle. The ratio between the length and the depth of the body is 0.87–1.05: 1; in our specimens this ratio is 0.98 (0.91–1.05): 1. The longitudinal axis is deflected posterodorsally at 10° (5°–15°).

The epitheca is 0.53 (0.42–0.67) as deep as the hypotheca, slightly convex or almost flat, highest in the center or dorsally, and tilted ventroposteriorly at 5°–15°. The transverse furrow often is rather strikingly concave, but may be almost flat (Figure 81: 7); its dorsal width is 0.42 (0.37–0.55) the greatest depth of the body; its ventral width is 0.48 (0.32–0.62) its dorsal width. The posterior cingular list is 0.35 (0.28–0.48) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are well rounded and confluent; or any one of them may be slightly flattened (Figure 81: 3).

The anterior cingular list is 0.46–0.80 the greatest depth of the body and has an anterior inclination of 40° (35°–50°); in our specimens its width is 0.62 (0.46–0.75). It has on each valve five to nine complete radial ribs which, when fully developed, usually are furnished distally with candelabra-like branches (Stein, 1883, pl. 23, fig. 4, 5); between these main ribs there are numerous short, marginal radial ribs, which sometimes are connected by anastomoses. The posterior cingular list is 0.60 (0.47–0.74) the greatest depth of the body and is inclined anteriorly at 65° (50°–80°); it has on each valve 11–16 complete, subequidistant ribs, which usually are simple but some of which may be branched proximally; between the main ribs a few short ribs may be found (Okamura, 1907, pl. 4, fig. 27a). The right sulcal list is comparatively large, of subuniform width throughout the greater portion of its length and rounded posteriorly; sometimes it ends at the *e*-rib of the left sulcal list, sometimes it extends to the *d*-rib; its average width is 0.17–0.23 the greatest depth of the body; at least in some specimens it has a few ribs (Figure 81:6). The left sulcal list ends on the dorsal side of the body at a distance from the posterior cingular list equaling 0.25 (0.10–0.40) the greatest depth of the body and is characterized by three narrowly to fairly broadly rounded posterior lobes, one of which is posteroventral, one antapical, and one posterodorsal. In our specimens the width of this list at the anterior main rib is 0.50 (0.41–0.66), at the fission rib 0.55 (0.46–0.72), at the posteroventral lobe 0.81 (0.65–1.16), at the antapical lobe 0.75 (0.54–0.91), and at the posterodorsal lobe 0.67 (0.51–0.96) the greatest depth of the body. In one of the specimens figured by Stein (1883, pl. 23, fig. 4), which has this list somewhat wider than any other figured specimen, the corresponding values are 0.67, 0.73, 1.03, 1.10, and 1.02. The ventral margin of this list sometimes (Figure 81:1) is almost straight, sometimes it is gently convex (Figure 81:2) or sigmoid (Figure 81:11), or it may form a broadly rounded lobe near the fission rib (Figure 81:3–7). Between the tip of the antapical lobe and the tips of the posteroventral and posterodorsal lobes, the posterior margin usually (Figure 81:1, 2) is gently concave, but it may be almost straight (Jörgensen, 1923, fig. 49), strikingly and evenly concave (Figure 81:6), or it may have a small (Figure 81:4) or a large (Figure 81:11) lobe between the antapical and posteroventral lobes. The dorsal margin of this list is gently convex or nearly straight. Between the anterior main rib and the fission rib this list may have one or a few usually irregular ribs (Figure 81:2, 4, 5). Behind the fission rib it typically (Figure 81:1) has five radial ribs connected distally by a submarginal rib. The submarginal rib extends along the entire posterior margin of the list and may in some specimens be traced up to the fission rib (Figure 81:5, 6); in each of the three posterior lobes it usually forms a more or less developed reticulum; sometimes (Figure 81:3) it is incomplete, sometimes (Figure 81:4) it is marginal, and in young specimens (Figure 81:7–10) it is entirely absent. Of the five radial ribs behind the fission rib, the *a*-rib (*i.e.*, the dorsal rib) extends into the posterodorsal lobe; the *b*-rib ends about midway between the posterodorsal and antapical lobes; the *c*-rib ends at the vertex of the antapical lobe; the *d*-rib, about midway between the antapical and posteroventral lobes; and the *e*-rib at the vertex of the posteroventral lobe. In our specimens the lengths of these five ribs, measured in straight lines to the points where these ribs join the submarginal rib, are as follows: — the *a*-rib is 0.57 (0.48–0.66), the *b*-rib 0.44 (0.35–0.51), the *c*-rib 0.65 (0.44–0.78), the *d*-rib 0.53 (0.45–0.67), and the *e*-rib 0.70 (0.57–1.00) the greatest depth of the body. Sometimes (Figure 81: 3, 4) two *d*-ribs are present, sometimes less than five ribs are developed. In the latter case the differences presumably are due to age; the *a*- and *c*-ribs appear to develop before the remaining ribs: the next to appear is the *e*-rib, then comes the *b*-rib, and finally the *d*-rib. In young specimens these ribs are simple, but soon they develop short branches, which probably increase in number with age. Dorsally to the *a*-rib as well as at the distal end of the anterior fission rib, reticulation sometimes is to be found.

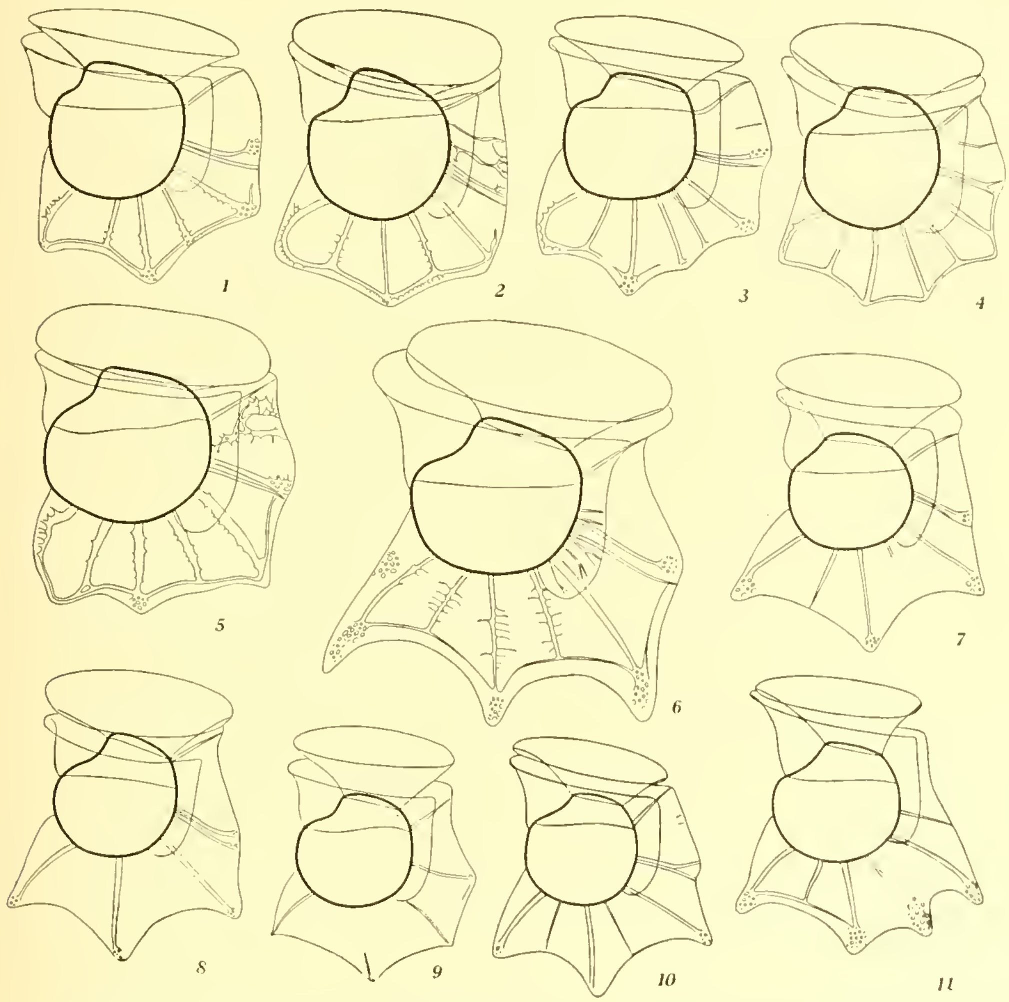

FIGURE 81.—*Ornithocercus thurni* (Schmidt), right lateral view, illustrating variations in size of body, and in shape and structure of left sulcal list. × 340. 1, 3, from Station 4607 (surface); 2, from Station 4613 (300–0 fathoms); 4, from Station 4617 (300–0 fathoms); from 5, Station 4638 (300–0 fathoms); 6, from Station 4737 (150–0 fathoms); 7, 8, 9, 11, from Station 4697 (300–0 fathoms); 10, from Station 4691 (300–0 fathoms).

The whole thecal wall is porulate, that of the hypotheca is areolate. The areoles are of moderate and subuniform size (Jörgensen, 1923, fig. 49), and each of them has a pore in the middle. Near the middle of the body there are about ten to twenty areoles across the face of each valve. Phaeosomes, sometimes in very large numbers, are to be found in the transverse furrow.

The proportions of twenty of our specimens and of the specimens figured by Stein (1883, pl. 23, fig. 4, 5), Murray and Whitting (1899, pl. 32, fig. 2), Schütt (1900a, fig. 7), Okamura (1907, pl. 4, fig. 27), and Jörgensen (1923, fig. 49) were measured.

Dimensions: — Our specimens: Length of body, 43.7–61.4 μ (average, 51.4 μ). Greatest depth of body, 44.4–66.6 μ (average, 52.4 μ). We do not know the size of the type specimen (Schmidt, 1883, pl. 144, fig. 61), nor that of the two specimens figured by Stein (1883, pl. 23, fig. 4, 5). According to Stein's (1883) information about the magnifications of his figures given in an introductory remark to the explanations of the plates, these specimens were somewhere between 62.4 and 97.8 μ long. The specimen represented by Murray and Whitting's (1899) Plate 32, figure 2, was 58.8 μ long and 68.0 μ deep; the one figured by Schütt (1900a, fig. 7) was 81.5 μ long and about as deep as long; Okamura's (1907, pl. 4, fig. 27b) specimen was about 54.5 μ long and 47.8 μ deep; Jörgensen's (1923, fig. 49), 63.5 μ long and 65.0 μ deep.

Variations: — The shape of the body, and the shape of the cingular lists and of the right sulcal list are rather constant. The size of the body and the shape and structure of the left sulcal list, on the other hand, are strikingly variable. The length of the body varies from 43.7 μ to 81.5 μ. The variations in size should be correlated with the peculiar mode of reproduction illustrated by Plate 18, figure 2, 7, 9. In the case of the left sulcal list the most variable features are the number and the shape of the ribs and the shape of the margin between the *a*- and *c*-ribs and between the *c*- and *e*-ribs. The normal number of ribs in the portion of this list that belongs to the right valve is six, viz., the *a*-, *b*-, *c*-, *d*-, and *e*-ribs, and the fission rib. Sometimes seven ribs are found, in which case two *d*-ribs are developed (Figure 81: 3, 4); sometimes the number is more or less reduced. In the latter case, the *d*-rib usually is the first to be absent (Figure 81: 7); next in order comes the *b*-rib (Figure 81: 8), then the *c*-rib (Figure 81: 9). The submarginal rib is well developed in most specimens but may be partly (Figure 81: 3, 11) or entirely (Figure 81: 7, 8, 9, 10) absent. Sometimes the ribs are simple but usually at least some of them are furnished with short branches. Any of the *a*-, *b*-, *c*-, *d*-, and *e*-ribs may be branched proximally (as in Figure 83: 8, of *Ornithocercus steini*). The lobes of this list at the tips of the *a*-, *c*-, and *e*-ribs generally are more or less reticulated, and reticulation also may be found dorsally to the *a*-rib, but sometimes these structures are lacking (Figure 81: 9). The variations in the number and shape of the ribs and in the reticulation seem largely to be due to age; the older a specimen is the more complex is its structure. As to the shape of the margin of this list between the *a*- and *c*-ribs and between the *c*- and *e*-ribs, the following variations have been observed: — sometimes the margin between these ribs is almost straight (Jörgensen, 1923, fig. 49); sometimes it is gently concave (Figure 81:2), sometimes strikingly but evenly concave (Figure 81:6); sometimes a small (Figure 81:4) or a large (Figure 81:11) lobe is formed between the *c*- and the *e*-ribs. It should finally be pointed out that the various forms of this species figured and described in the present paper are connected by a fairly complete series of intermediate forms. The eleven specimens of Figure 81 illustrate the range of variation exhibited by this species in the material of the Expedition. Most of our specimens (111, *i.e.*, 50.9% out of the 218 that were carefully examined) agreed with the specimen represented by Figure 81:1; fifty-three specimens (24.3%) agreed with Figure 81:7; thirteen specimens (6.0%) with Figure 81:8; twelve (5.5%) with Figure 81:7, but they lacked the *d*-rib and had but a slight indication of the *b*-rib; eleven (5.0%) with Figure 81:10, but they had the *b*- and *d*-ribs less distinctly developed; three (1.4%) with Figure 81:2; three (1.4%) with Figure 81:10; three (1.4%) with Figure 81:7, but they lacked the *d*-rib; two (0.9%) with Figure 81:3, but they lacked the submarginal rib; two (0.9%) with Figure 81:11; and of each of the forms represented by Figure 81:3, 4, 5, 6, 9, only one specimen was found.

Comparisons: — The type specimen as figured by Schmidt (1888, pl. 144, fig. 59–61), as well as the specimens figured by Murray and Whitting (1899, pl. 32, fig. 2) and by Okamura (1907, pl. 4, fig. 27a, b), especially one of those figured by the last author (fig. 27a), show a striking resemblance to the majority of our specimens. On the other hand, none of our specimens agrees completely with the specimen represented by Stein's (1883) Plate 23, figure 4, but the differences exhibited by the latter specimen lie within the range of variation found in the material of the Expedition, with the exception of the size of the body and the relative size of the left sulcal list. The specimen figured by Schütt (1900a, fig. 7) resembles fairly closely the one represented by Stein (1883, pl. 23, fig. 4). Jörgensen's (1923, fig. 49) specimen approaches our Figure 81:1, but it lacks the submarginal rib, a difference of no systematic consequence.

In spite of the striking variability characteristic of this species as conceived in the present paper, we are forced to assume that we are dealing with a single systematic unit by the following facts: — (*1*) the size varies very decidedly within the species of this genus, due to the peculiar mode of division illustrated by Plate

18; (*2*) the structure of the left sulcal list is subject to similar and about equally striking variations also within other species of this genus, *e.g.*, *Ornithocercus magnificus*, and these variations appear to be due to differences in age (Schütt, 1900a); (*3*) the various forms recorded are connected by fairly complete series of intermediate specimens.

No specimens have been found as yet which are distinctly intermediate between *Ornithocercus thurni* and any of the other known species of this genus. The specimen represented by Figure 81: 11, resembles *O. steini* in so far as the lobe between the *c*- and the *e*-ribs of the left sulcal list is concerned, but its *a*- and *b*-ribs are typical of *O. thurni*. The species is characterized especially by its left sulcal list, which is three-lobed and furnished with a submarginal rib and five radial ribs behind the fission rib; the *a*-rib extends into the dorsal lobe, the *b*-rib ends ventrally to the dorsal lobe, the *c*-rib at the vertex of the middle or antapical lobe, and the *e*-rib at the vertex of the ventral lobe. Its closest relatives probably are *O. magnificus* and *O. steini*. From the former species it differs strikingly in size and in the fact that the *c*- and *e*-ribs end at the vertices of the middle and ventral lobes, respectively. From *O. steini* it differs in having the *b*-rib end distinctly ventrally to the dorsal lobe and in the relative shortness of the *b*- and *d*-ribs when compared to the *c*-rib. From *O. carolinae*, which also has a three-lobed left sulcal list, it is easily recognized by the relatively smaller size of the middle lobe and by the smaller number of radial ribs in this list (see also *O. quadratus*).

Synonymy: — This species was first established by Schmidt (1888), who made it the type of a new genus of diatoms under the name of *Parelion thurnii*. Schütt (1896, p. 28) wrote Parelion as a synonym of Ornithocercus but did not mention the specific name *thurnii*. Fricke (1902) in his list of the species of Schmidt's Atlas der Diatomaceenkunde, substituted the name of *Ornithocercus magnificus* for *Parelion thurnii*. Other investigators have completely disregarded the last name. However, although this procedure is likely to bring about some confusion, we are forced to revive the specific name of *thurni*, since Schmidt figured his specimen so well that its specific allocation is beyond all doubt.

Later this species was established under the name of *Ornithocercus steinii* by Schütt (1900a), who subdivided Stein's (1883) *O. magnificus* into two species, *O. magnificus s. str.* and *O. steinii*. To the last species Schütt (1900a) refers only Stein's (1883) Plate 23, figure 4, but figure 5 of this plate also belongs to it. Of the three specimens figured by Schütt (1900a) as *O. steini*, only one, his figure 7, is referable to this species as conceived in the present paper. The two others, his figures 5 and 6, are, according to our opinion, fairly young and undifferentiated representatives of a species later on described and figured in a late stage by Kofoid (1907a) as *O. serratus*. For this last species we retain the name *O. steini s. str.*

Under the name of *Ornithocercus magnificus* reproductions of either one or the other of Stein's (1883) figures 4 and 5, Plate 23 [= *O. thurni*] are given by Bütschli (1885), Chun (1903), Zacharias (1906a, 1907, 1911), Willey and Hickson (1909), and Francé (1923). Whitelegge (1891) refers under the same name only to Bütschli's (1885) reproduction of Stein's (1883) Plate 23, figure 4 [= *O. thurni*]. The specimen figured by Murray and Whitting (1899) as *Histioneis magnifica* (Stein) belongs to *Ornithocercus thurni*, but the distributional data of these investigators probably refer to *O. magnificus s. str.* as well; the species was found to be very variable (as to the use of Histioneis for Ornithocercus, see below). Reproductions of Murray and Whitting's (1899) figure of *Histioneis magnifica* [= *O. thurni*] were given by Hjort (1911) and by Gran (1912a, 1912b); Hjort (1911) used the name *O. magnificus,* while Gran (1912a, 1912b) used *O. steinii*. In recording *O. magnificus*, Okamura (1907) referred to all the five figures given by Stein (1883) under this name, but he represented only two specimens of *O. thurni*. Whether he found only the last species or *O. magnificus s. str.* as well, cannot be decided from his published data. Cleve (1897a), Pavillard (1905, 1916), and Faria and Cunha (1917) also refer to all of Stein's (1883) figures of *O. magnificus*, but do not give any figures. It should also be mentioned in this connection that *O. thurni* might be included in the records of the several authors who have reported *O. magnificus* without showing by figures, references to figures, or otherwise how they conceive this species (see *O. magnificus*, the section on synonymy, p. 534). Stüwe (1909), too, had a very broad concept of *O. magnificus*, including in this species *O. magnificus s. str.*, *O. thurni*, *O. steini s. str.*, and *O. quadratus*, but he distinguished *O.thurni* as *O. magnificus* var. *c* and var. *d*. Entz (1902b, 1905) recorded *Ornithocercus thurni* as *Histioneis magnificus* var. *steinii* and *H. magnifica* var. *steinii;* and Forti (1922) was inclined to regard this species and *Ornithocercus magnificus* as stages in the life cycle of a single species. Lemmermann (1904), who held the same concept of *Ornithocercus steini* [= *thurni*] as did Schütt (1900a), pointed out that *Histioneis magnifica* Lemmermann (1899a, p. 317, 323, 327) is a synonym of *Ornithocercus steini* [= *thurni*]. Kofoid (1907a), Ostenfeld (1915), and Jörgensen (1923) also have the same concept of *O. steini* [= *thurni*] as Schütt (1900a); Jörgensen (1923) figures this species. Goldschmidt (1907) and Wallengren and Hennig (1911) give a fanciful reproduction of Stein's (1883) Plate 23, figure 4 [= *O. thurni*], taken from Haeckel ("Kunstformen") that does not correspond to any known species; no name was applied by these authors to this reproduction.

Pouchet (1883, fig. G: 1) figured under the name of *Dinophysis galea* a specimen that cannot certainly be referred to *Ornithocercus thurni*. His figure must be regarded as too sketchy for specific identification.

The following investigators use Histioneis as a generic name of this species:—Murray and Whitting (1899), Lemmermann (1899a, 1901a, 1904, 1905a), Entz (1902b, 1905), Pavillard (1905, 1916), and Forti (1922). With regard to this usage, see our treatment of the family Ornithocercidae, the section on the subdivisions (p. 494).

Occurrence: — *Ornithocercus thurni* is recorded at seventy-four of the 127 stations. There are 18, 10, 11, 12, 16, and 7 stations on the six lines of the Expedition. Of these seventy-four stations, one (4583) is in the California Current; eleven (4587, 4588, 4590, 4592, 4594, 4596, 4598, 4600, 4604, 4605, 4607) are in the Mexican Current; twelve (4609, 4613, 4615, 4617, 4619, 4623, 4631, 4634, 4637, 4638, 4640, 4644) are in the Panamic Area; four (4646, 4647, 4664, 4671) are in the Peruvian Current; eight (4689, 4691, 4692, 4695, 4696, 4697, 4699, 4700) are in the Easter Island Eddy; four (4713, 4714, 4715, 4716) are in the Galapagos Eddy; twenty-nine (4679, 4680, 4681, 4682, 4683, 4684, 4685, 4686, 4701, 4705, 4709, 4717, 4719, 4721, 4722, 4724, 4727, 4728, 4730, 4731, 4732, 4733, 4734, 4735, 4736, 4737, 4739, 4740, 4741) are in the South Equatorial Drift; three (4742, 4743, 4540) are in the South Equatorial Current; and two (4541, 4542) are in the Equatorial Counter Current. There are thirty-six records from the surface (Stations 4583, 4588 [Salpa], 4590, 4592, 4596, 4600, 4604, 4607, 4615, 4617, 4619, 4623, 4631, 4638, 4640, 4644, 4646, 4664 [Salpa], 4680, 4682, 4684, 4686, 4692, 4696, 4700, 4714, 4716, 4727, 4731, 4733, 4735, 4741, 4743, 4540, 4541, 4542). At thirty-one of these thirty-six stations the species was taken in surface waters only; at five stations (4583, 4590, 4617, 4638, 4646) in hauls from 300–0 fathoms as well as at the surface; at Stations 4619 and 4646 in Salpa stomachs as well as in surface hauls. At one station (4737) it is recorded from 100–0 fathoms and 300–0 fathoms; at one station (4713) from 150–0 fathoms and 300–0 fathoms; at four stations (4681, 4701, 4715, 4724) from 800–0 fathoms and 300–0 fathoms; at two stations (4647, 4728) from 800–0 fathoms only. All the remaining records refer to hauls from 300–0 fathoms only.

The species was taken also in surface waters in Acapulco Harbor, off the Mexican Current. This station is not included in the 127 stations mentioned above.

The temperature range of these seventy-four stations at the surface was 66°–85°; the average was 76.8°. At the thirty-six stations in the surface catches of which the species was found, the surface temperature ranged from 68° to 84°; the average was 77.4°. At Acapulco it was 83°.

For the surface catches the following frequencies are recorded: — 37% at one station (4619, Salpa); 23% at one station (4619); 10% at two stations (4607, 4615); 7% at one station (4604); 5% at two stations (4617, 4696); 2% at nine stations (4592, 4596, 4600, 4631, 4638, 4682, 4714, 4716, 4540); 1% at three stations (4590, 4640, 4733); in the remaining cases the frequency is less than 1%.

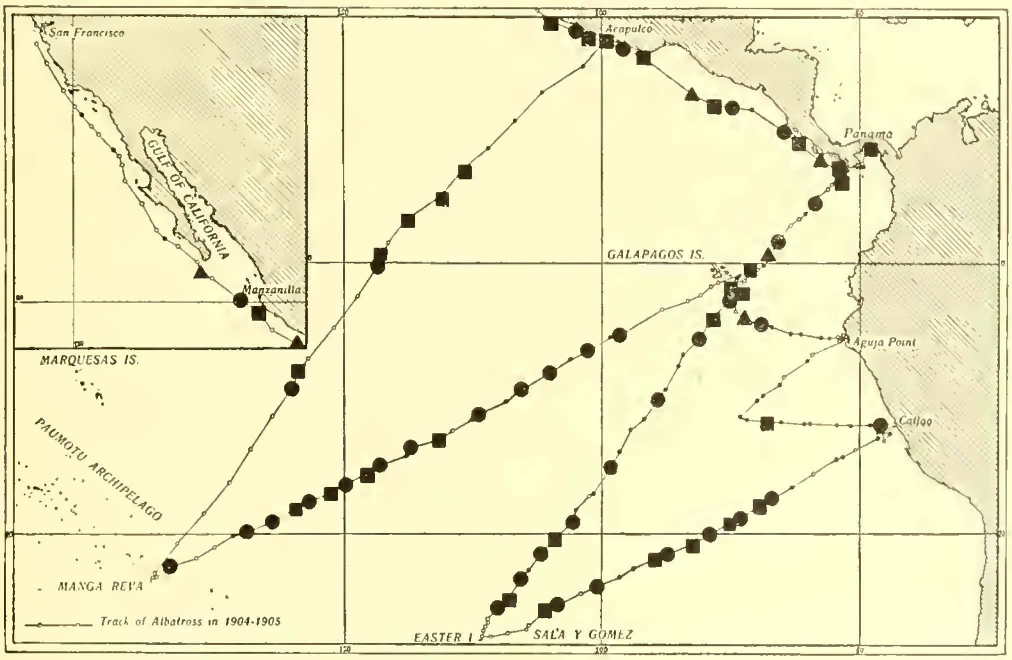

FIGURE 82.— Occurrence of *Ornithocercus thurni* (Schmidt). Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; triangles, records from both vertical and surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

For the catches from 100, 150, 300, or 800 fathoms to the surface the records of frequency are as follows: — 16% at one station (4613); 10% at one station (4713); 7% at one station (4715); 6% at one station (4638); 4% at five stations (4598, 4609, 4683, 4730, 4740); 2% at eight stations (4617, 4634, 4681, 4695, 4701, 4717, 4734, 4737); 1% at eleven stations (4647, 4679, 4689, 4691, 4699, 4705, 4728, 4732, 4736, 4739, 4742); at the remaining stations the frequency is less than 1%. For the catch made in Acapulco Harbor a frequency of less than 1% is recorded.

Schütt (1900a) does not give any information as to the type locality. The following investigators have found this species in the Atlantic between lat. 45° N.

and lat. 30° S: — Cleve (1897a), Murray and Whitting (1899), Stüwe (1909), Faria and Cunha (1917), and Jörgensen (1923). In the Caribbean Sea it was found by Murray and Whitting (1899). Jörgensen (1923) found it at a few stations in the eastern as well as in the western Mediterranean. Other investigators who have found it in the Mediterranean are as follows: — Pouchet (1883) and Pavillard (1905, 1916) in the Gulf of Lyons; and Entz (1902b, 1905) in the Adriatic Sea. Ostenfeld (1915) recorded it from the Malay archipelago; Whitelegge (1891) from Sydney, Australia; Stein (1883) "aus der Südsee"; Lemmermann (1899a) between the island of Laysan and Hawaii.

Most of the records referred to in the last paragraph were from surface hauls. No records of closing-net hauls have been published as yet. According to Murray and Whitting (1899), the species occurs in temperatures ranging from 57.0° to 86.0°; mean of 125 observations, 75.5°.

Of the investigators who have contributed to our knowledge of the distribution of this species, Stein (1883), Whitelegge (1891), Lemmermann (1899a), Entz (1902b, 1905), Stüwe (1909), Ostenfeld (1915), and Jörgensen (1923) show by figures, references to figures, or otherwise that their data refer to *Ornithocercus thurni* as conceived in the present paper. Cleve (1897a), Murray and Whitting (1899), Pavillard (1905, 1916), Okamura (1907), and Faria and Cunha (1917), on the other hand, show that they have the same broad conception of *O. magnificus* as Stein (1883), and their data of distribution thus may refer either to any or to all of the three species *O. magnificus*, *O. thurni*, and *O. steini s. str.* With regard to the data of distribution of Pouchet (1883), see the section on synonymy (p. 548); compare also the account of *O. magnificus* (p. 534).

Ornithocercus thurni is eupelagic and widely distributed in tropical, subtropical, and warm-temperate waters. While in tropical seas this species is about as common as *O. magnificus*, it is rare in warm-temperate and subtropical waters (*e.g.*, in the Mediterranean), when compared with that species. In the Eastern Pacific it occurs in the whole area investigated by the Expedition, but it is strikingly rare in the Peruvian Current and is not recorded from the northern portion of the California Current; however, it occurs occasionally as far to the north as at San Diego, California. Most of the record stations of high frequencies are in or near the Panamic Area, in the Galapagos Eddy, and in the Easter Island Eddy. This species is relatively frequent in surface waters; it should be observed that the highest records of frequency are from surface catches.

Ornithocercus steini Schütt, *s. str.*

Plate 16, fig. 1. Figure 83, 84

Ornithocercus magnificus Stein, 1883, *partim*, pl. 23, fig. 3.
Ornithocercus steini Schütt, 1900a, *partim*, fig. 5, 6.
Ornithocercus serratus Kofoid, 1907a, p. 206, pl. 15, fig. 93. Kofoid & Michener, 1911, p. 300. Faria & Cunha, 1917, p. 79. Jörgensen, 1923, p. 38, 43, 44, fig. 52.
Ornithocercus magnificus var. *b* Stüwe, 1909, p. 254, 275, 288.

Diagnosis: — Subcircular in lateral outline. Cingular lists: anterior, 0.49–0.73, posterior 0.45–0.72 the greatest depth of body; anterior with seven to nine complete ribs, sometimes branched distally, and with some short, marginal ribs; posterior with ten to nineteen complete and often simple ribs. Left sulcal list ends on dorsal side of body, at or near posterior cingular list; with four nearly equidistant, narrowly to fairly broadly rounded posterior lobes, viz., the posteroventral, midventral, middorsal, and posterodorsal lobes; width at posteroventral lobe 0.53–1.12, at midventral lobe 0.51–1.04, at middorsal lobe 0.50–1.00, at posterodorsal lobe 0.48–0.97 the greatest depth of body; typically with five ribs behind fission rib and with reticulum in each lobe; submarginal rib may be present; *a*-rib ends near middle of dorsal margin of list; each of the *b*- to *e*-ribs ends at the vertex of one of the four lobes. Length of body, 54.8–67.6 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This is a fairly large species, subcircular in lateral view, deepest in or near the middle. The ratio between the length and the depth of the body is 0.92 (0.82–1.00) : 1. The longitudinal axis may be perpendicular to the posterior cingular list, but usually it is deflected posterodorsally at 7° (1°–15°).

The epitheca is 0.61 (0.54–0.67) as deep as the hypotheca, slightly convex or nearly flat, highest in or near the center or dorsally, and tilted ventroposteriorly at 5°–15°. The transverse furrow is moderately or but slightly concave; its dorsal width is 0.40 (0.34–0.53) the greatest depth of the body; its ventral width is 0.47 (0.31–0.62) its dorsal width. The posterior cingular list is 0.36 (0.29–0.46) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are well rounded and confluent; or any of them may be slightly flattened.

The anterior cingular list is 0.49–0.73 the greatest depth of the body and has an anterior inclination of 40° (30°–50°); in our specimens its width is 0.57 (0.49–0.67); it has on each valve seven to nine complete, radial ribs, which, when fully developed, may be furnished distally with candelabra-like branches (Kofoid, 1907a, pl. 15, fig. 93); between these main ribs there is a varying number of short, marginal radial ribs, which sometimes are connected by anastomoses. The posterior cingular list is 0.56 (0.45–0.72) the greatest depth of the body and is inclined anteriorly at 65° (50°–85°); it has on each valve ten to nineteen complete, subequidistant ribs, some of which may be branched proximally. The right sulcal list is comparatively large, of subuniform width throughout the greater portion of its length and rounded posteriorly; it appears always to end near the *d*-rib of the left sulcal list; its average width is 0.16–0.20 the greatest depth of the body; at least in some specimens it has a few ribs (Figure 83: 5; Plate **16**, fig. 1). The left sulcal list ends on the dorsal side of the body, at or near the posterior cingular list; the maximum length of this distance is about 0.33 the greatest depth of the body. The list is characterized by four (in exceptional cases by five, Figure 83: 7) nearly equidistant, narrowly to fairly broadly rounded posterior lobes, which we designate, according to their positions, the posteroventral, the midventral, the middorsal, and the posterodorsal lobes. In most specimens these four lobes are well marked, but they may be but slightly indicated (Figure 83: 10) or almost absent (Figure 83: 11). In our specimens the width of this list at the anterior main rib is 0.48 (0.42–0.57), at the fission rib 0.54 (0.45–0.67), at the posteroventral lobe 0.69 (0.53–0.88), at the midventral lobe 0.67 (0.51–0.85), at the middorsal lobe 0.65 (0.50–0.83), and at the posterodorsal lobe 0.62 (0.48–0.79) the greatest depth of the body. In the specimen figured by Jörgensen (1923, fig. 52), which has this list somewhat wider than in any other figured specimen, the corresponding values are: 0.55, 0.81, 1.12, 1.04, 1.00, and 0.97. The ventral margin of this list usually forms a fairly distinct lobe at the fission rib (Figure 83: 2), but it may be almost straight, gently convex (Figure 83: 10, 11), or somewhat irregular (Figure 83: 5). The dorsal margin is gently convex in most specimens, but it may be somewhat angular at the end of the *a*-rib (Figure 83: 10, 12). Between the anterior main rib and the fission rib this list often has one to three ribs or an irregular reticulum (Figure 83: 11). Behind the fission rib it typically (Figure 83: 2) has five complete radial ribs, the distal ends of which may or may not be connected by a very weak submarginal rib, reticulations in the four lobes as well as dorsally to the *a*-rib and at the distal end of the fission rib, and in some cases it may have a few short, irregular ribs between the bases of the main ribs (Figure 83: 1; Kofoid, 1907a, pl. 15, fig. 93). Of the five main radial ribs behind the fission rib, the *a*-rib (*i.e.*, the dorsal rib) ends near the middle of the dorsal margin of this list, the *b*-rib ends at the vertex of the posterodorsal lobe, the *c*-rib at the vertex of the middorsal lobe, the *d*-rib at the vertex of the midventral lobe, and the *e*-rib at the vertex of the posteroventral lobe. In our specimens the lengths of these ribs are

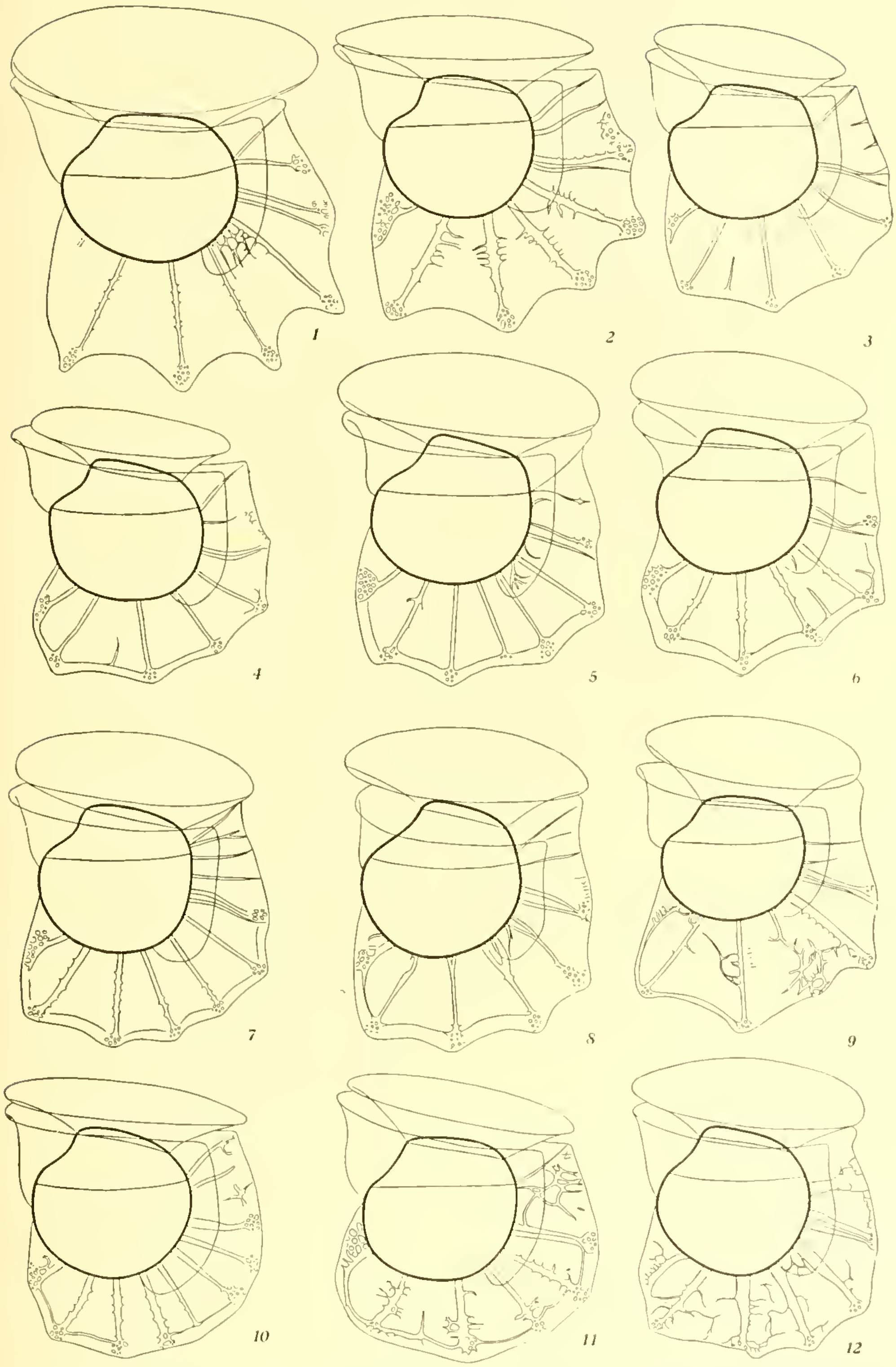

FIGURE 83.— *Ornithocercus steini* Schütt, *s. str.*, right lateral view, illustrating variations in shape and structure of left sulcal list. × 340. 1, from Station 4742 (300–0 fathoms); 2, from Station 4722 (300–0 fathoms); 3, from Station 4607 (300–0 fathoms); 4, 5, 6, 8, from Station 4607 (surface); 7, from Station 4619 (surface); 9, from Station 4721 (300–0 fathoms); 10, from Station 4605 (300–0 fathoms); 11, from Station 4638 (300–0 fathoms); 12, from Station 4637 (300–0 fathoms).

as follows, if the *a*-rib is measured in a straight line to the margin of the list, and the *b*- to *e*-ribs are measured in straight lines to the points where they join the submarginal rib or, in the case of the absence of the last rib, to the beginning of the reticulations of the lobes: — the *a*-rib is 0.37 (0.28–0.53), the *b*-rib 0.52 (0.39–0.66), the *c*-rib 0.56 (0.41–0.74), the *d*-rib 0.57 (0.45–0.78), and the *e*-rib 0.59 (0.45–0.77) the greatest depth of the body. In the specimen figured by Jörgensen (1923, fig. 52), these ribs are somewhat longer; compare the measurements of the width of this list given above. In no case have less than five main radial ribs been found; but in a few specimens six or seven of them have been recorded; two *d*-ribs may be present, and in one specimen (Figure 83: 10) a further rib was developed next to the *e*-rib. An incomplete rib may be present between the *b*- and *c*-ribs, between the *c*- and *d*-ribs, and between the *d*- and *e*-ribs. In young specimens the radial ribs are simple, but soon they develop short branches, which probably increase in number and complexity with age.

The central portion of the hypotheca is areolate and porulate; the rest of the theca is porulate (Plate 16, fig. 1; Kofoid, 1907a, pl. 15, fig. 93). There is one pore in each areole. The areoles are of moderate and subuniform size. Phaeosomes of a rich greenish-yellow or olive-yellow color are often found in the transverse furrow; sometimes a few of these bodies are found attached to the left sagittal list. Specimens of normal and healthy appearance have been found completely lacking phaeosomes. The cytoplasm is of a reddish or geranium-pink tint and lacks every trace of chromatophores.

The dimensions of seventeen of our specimens and of the specimens figured by Stein (1883, pl. 23, fig. 3), Schütt (1900a, fig. 6), and Jörgensen (1923, fig. 52) were measured.

Dimensions: — Our specimens: Length of body, 54.8–67.6 μ (average, 62.4 μ). Greatest depth of body, 62.4–77.8 μ (average, 67.8 μ). The size of the type specimen (Schütt, 1900a, fig. 5) is unknown. The length of the specimen figured by Stein (1883, pl. 23, fig. 3) is also unknown. However, according to Stein's (1883) information about the magnifications of his figures given in an introductory remark to the explanations of the plates, it was somewhere between 42.0 and 64.5 μ. Schütt's (1900a, fig. 6) specimen was 65.0 μ long and 66.6 μ deep; Jörgensen's (1923, fig. 52), 64.5 μ long and 67.6 μ deep.

Variations: — The great majority of the recorded specimens show a fairly pronounced constancy in all characters. A few are subject to rather striking variations in the shape and structure of the left sulcal list. In some specimens the number of radial ribs in this list is six (Figure 83: 5, 7) or seven (Figure 83: 10), or there may be, besides the normal number of five complete radial ribs, one more or less incomplete rib (Figure 83: 3, 4, 6, 11). Sometimes (Figure 83: 3, 4) the radial ribs are simple, but usually they are furnished with short, more or less developed branches. At least the *c*- and *d*-ribs may be branched proximally (Figure 83: 8). In one of our specimens (Figure 83: 9) the *d*-rib was very aberrant, its distal portion forming an irregular reticulum (due to regeneration following local injury?). The submarginal rib may be absent (Figure 83: 1–3) or present (Figure 83: 4–11); when present, it usually, but not always (Figure 83: 11), is exceedingly weak. Sometimes (Figure 83: 1; Jörgensen, 1923, fig. 52) the four lobes of this list are very pronounced; sometimes (Figure 83: 2) they are moderately developed; or they may be but slightly indicated (Figure 83: 10) or almost absent (Figure 83: 11). The variations in the development of the branches of the radial ribs are presumably due to age. The same appears to be true in regard to the submarginal rib. On the other hand, we do not know whether or not the established variations in the number of the ribs and in the development of the marginal lobes are due wholly to this cause, to resorption in adaptation to flotation, or to regulation following fission. It should be mentioned in this connection that in some recently divided specimens, probably belonging to this species, the left sulcal list had five well-developed and simple radial ribs behind the fission rib, and its posterior margin was almost evenly rounded, *i.e.*, without lobes. The twelve specimens of Figure 83, and the two represented by Plate 16, figure 1, and by Kofoid (1907a, fig. 93) illustrate the range of variation exhibited by this species in the material of the Expedition. The great majority of our specimens (125, *i.e.* 74.0% out of the 169 that were carefully examined) agreed with the specimen represented by Figure 83: 2; sixteen specimens (9.5%) agreed with Figure 83: 4; seven (4.1%) with Figure 83: 3; five (3.0%) with Figure 83: 7; two (1.2%) with Figure 83: 5; two (1.2%) with Figure 83: 6; two (1.2%) with Figure 83: 2, but they had somewhat narrower left sulcal lists with slightly less marked lobes; one (0.6%) with Figure 83: 3, but without the short rib between the *b*- and *c*-ribs; one (0.6%) with Figure 83: 3, but with a short rib between the *c*- and *d*-ribs instead of between the *b*- and *c*-ribs; and of each of the forms represented by Figure 83: 1, 8, 9, 10, 11, 12, by Plate 16, figure 1, and by Kofoid's (1907a) Plate 15, figure 93, only one specimen was found.

Comparisons: — The type specimen as figured by Schütt (1900a, fig. 5), as well as the specimen represented by Stein's (1883) Plate 23, figure 3, although young and thus not fully differentiated, are typical members of this species as conceived in the present paper. Schütt's (1900a) figure 6 is somewhat less representative, having but slightly indicated lobes in the sulcal list, but its present allocation may be considered as fairly certain. Jörgensen's (1923, fig. 52) specimen is an unusually well-developed example of this species.

The typical members of this species (Figure 83: 2) are characterized especially by their left sulcal list, which is four-lobed, with or without an exceedingly fine submarginal rib, and with five complete radial ribs behind the fission rib. Of these five radial ribs the dorsal one, the *a*-rib, ends near the middle of the dorsal margin of this list, while each of the remaining four ends at the vertex of one of the four lobes. Besides these typical specimens several more or less aberrant ones have been assigned by us to this species. Our reasons for including these aberrant forms are the relatively great variability in several of the other species of this genus and the fact that the extremes appear to be connected with the typical ones by fairly complete series of intermediate specimens.

No specimens have been recorded as yet which are distinctly intermediate between *Ornithocercus steini* and any of the other species of this genus. Regarding the specimen represented by Figure 81: 11, of *O. thurni*, see the last species, the section on comparisons. The closest relative of *O. steini* appears to be *O. thurni*. The former species is easily distinguished from the latter by having four, instead of three lobes in the left sulcal list, by having the *a*-rib end at about the middle of the dorsal side of this list, and by having the *b*-rib end at the vertex of the dorsal lobe.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Ornithocercus serratus* but had been figured previously by Stein (1883, pl. 23, fig. 3) and by Schütt (1900a, fig. 5, 6). Stein (1883, pl. 23, fig. 1–6) figured under the name of *O. magnificus* three different species. Schütt (1900a), who was the first to subdivide *O. magnificus* Stein, applied the name *O. magnificus s. str.* to Stein's (1883) Plate 23, figure 1, and the new name *O. steini* to Stein's (1883) Plate 23, figure 4. The species to which the last figure belongs had, however, previously been established by Schmidt (1888, pl. 144, fig. 59–61) as *Parelion thurnii*. The name *Ornithocercus steini* Schütt should therefore have been discarded as a synonym of *O. thurni* (Schmidt), had it not been for the fact that out of the three specimens figured by Schütt (1900a, fig. 5–7) as *O. steini* two are not referable to this species but to one later established by Kofoid (1907a) as *O. serratus*. Under these circumstances the name *O. steini s. str.* has to be maintained for these two specimens of Schütt (1900a) and *O. serratus* Kofoid must be rejected as a synonym. Stüwe (1909) recorded *O. steini s. str.* as *O. magnificus* var. *b*. Later this species was figured by Jörgensen (1923, fig. 52) as *O. serratus*.

Occurrence: — *Ornithocercus steini* is recorded at sixty-eight of the 127 stations. There are 16, 12, 1, 10, 19, and 10 stations on the six lines of the Expedition. Of these sixty-eight stations, one (4583) is in the California Current; ten (4587, 4590, 4592, 4598, 4600, 4604, 4605, 4607, 4545, 4546) are in the Mexican Current; fourteen (4609, 4611, 4613, 4615, 4617, 4619, 4623, 4634, 4635, 4637, 4638, 4639, 4640, 4644) are in the Panamic Area; five (4646, 4647, 4648, 4650, 4659) are in the Peruvian Current; one (4692) is in the Easter Island Eddy; four (4713, 4714, 4715, 4716) are in the Galapagos Eddy; twenty-seven (4701, 4704, 4705, 4709, 4711, 4712, 4717, 4718, 4719, 4720, 4721, 4722, 4723, 4724, 4727, 4728, 4729, 4730, 4731, 4732, 4733, 4734, 4736, 4737, 4739, 4740, 4741) are in the South Equatorial Drift; three (4742, 4743, 4540) are in the South Equatorial Current; two (4541, 4542) are in the Equatorial Counter Current; and one (4543) is in the North Equatorial Current. There are thirty-seven records from the surface (Stations 4590, 4592, 4600, 4604, 4607, 4611, 4615, 4617, 4619, 4623, 4635, 4638, 4639, 4640, 4644, 4646, 4648, 4692, 4704, 4712, 4714, 4716, 4718, 4720 [Salpa], 4723 [Salpa], 4727, 4729, 4731, 4733, 4741, 4743, 4540, 4541, 4542, 4543, 4545, 4546). At thirty-three of these thirty-seven stations the species was taken in surface waters only; at four stations (4590, 4617, 4638, 4646), in hauls from 300–0 fathoms as well as at the surface; at Stations 4619, 4712, and 4741, in Salpa stomachs as well as in surface hauls. At one station (4737) it is recorded from 100–0 fathoms and 300–0 fathoms; at one station (4713), from 150–0 fathoms and 300–0 fathoms; at five stations (4715, 4721, 4724, 4728, 4732), from 800–0 fathoms and 300–0 fathoms; at two stations (4647, 4717), from 800–0 fathoms only. All the remaining records refer to hauls from 300–0 fathoms only.

The temperature range of these sixty-eight stations at the surface was 69°–85°; the average was 77.5°. At the thirty-seven stations in the surface catches of which this species was found, the surface temperature ranged from 71° to 84°; the average was 77.8°.

For the surface catches the following frequencies are recorded: — 14% at one station (4607); 13% at one station (4543); 10% at one station (4545); 6% at one station (4600); 4% at four stations (4615, 4635, 4714, 4741); 3% at two stations (4640, 4546); 2% at five stations (4619, 4648, 4692, 4712, 4733); 1% at eleven stations (4590, 4604, 4617, 4638, 4639, 4716, 4720, 4729, 4731, 4541, 4542); in the remaining cases the frequency is less than 1%. For the catches from 100, 150, 300, or 800 fathoms to the surface the records of frequency are as follows: — 15% at one station (4598); 12% at one station (4613); 11% at one station (4721); 8% at two stations (4605, 4617); 7% at two stations (4638, 4722); 3% at two stations

(4634, 4637); 2% at two stations (4715, 4719); 1% at five stations (4711, 4724, 4732, 4736, 4737); at the remaining stations the frequency is less than 1%.

The type locality is unknown, but probably somewhere in the Atlantic Ocean. Stein (1883) figured one specimen "aus der Südsee" under the name of *Ornithocercus magnificus.* Stüwe (1909) found this species at two stations in the Atlantic, viz., at lat. 33° 29′ N., long. 21° 43′ W., and at lat. 4° 3′ N. and long. 26° 0′ W., in surface waters of 68.5°–82.8°. Faria and Cunha (1917) found it off Rio de Janeiro. Jörgensen (1923) recorded it from the Bay of Cadiz and from the eastern

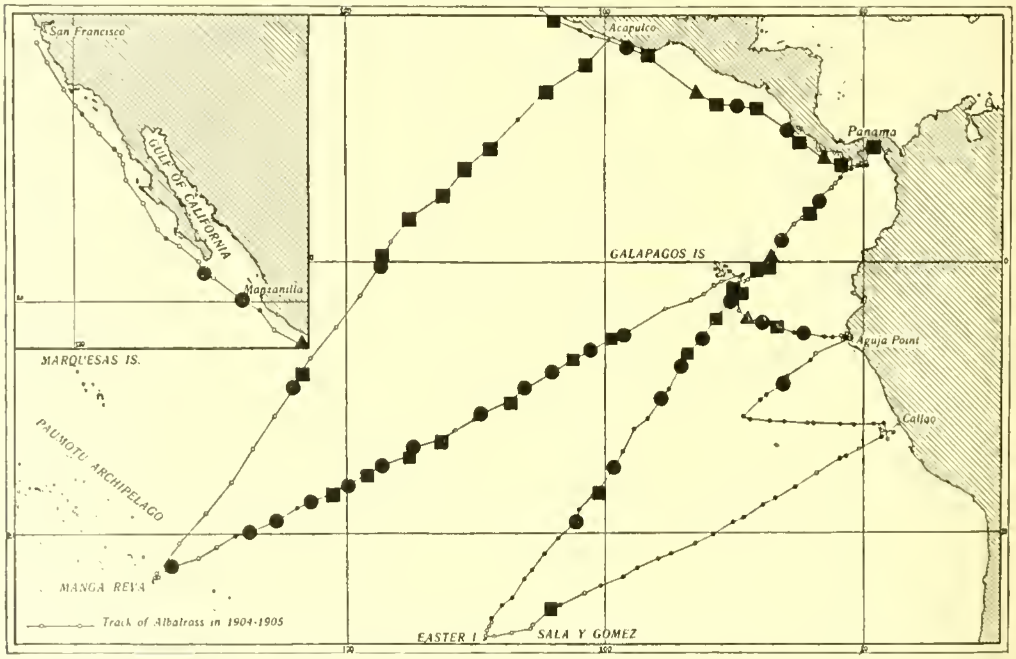

FIGURE 84.— Occurrence of *Ornithocercus steini* Schütt, *s. str.* Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; triangles, records from both vertical and surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

portion of the Mediterranean (the THOR Expedition) and stated that "it has been found, rarely, in the Florida Current, (30°–32° N., coast of America, May, 1910), far west of the Straits of Gibraltar (14° W., 29/8 1901) and in the Guinea Current 1/10 1903 (German South Pole Exped.) and fairly common in the southern Atlantic between South Africa and South America 11° W. to 38° W., 31° N. to 17° N. June to August 1911 ('Fram')." Kofoid (1907a) recorded this species from the Eastern Pacific, viz., from Stations 4613 and 4742 of the Expedition. See also the account of *Ornithocercus magnificus.*

Of the investigators who have contributed to our knowledge of the distribution of this species, Stein (1883), Kofoid (1907a), and Jörgensen (1923) give figures by means of which the determinations may be judged.

Ornithocercus steini is eupelagic and widely distributed in tropical, subtropical, and warm-temperate seas. In the Eastern Pacific it occurs in the whole area investigated by the Expedition but is strikingly rare in the Peruvian Current and in the Easter Island Eddy and is not recorded from the northern portion of the California Current; however, it occurs occasionally as far to the north as San Diego. Like most of the remaining species it is relatively frequent in surface waters, and the frequency percentages are on the average somewhat higher in the surface catches than in the vertical catches.

Ornithocercus orbiculatus Kofoid and Michener

Plate 17, fig. 7

Ornithocercus orbiculatus Kofoid & Michener, 1911, p. 300.

Diagnosis: — Lateral outline subcircular. Anterior cingular list 0.52, posterior 0.51 the greatest depth of body; anterior either with about twelve complete ribs and numerous short marginal ribs, or with a number of irregular ribs; posterior with about fifteen complete, simple ribs. Left sulcal list ends on dorsal side of body at posterior cingular list; margin subcircular, with small lobe dorsally; with five ribs, corresponding to *a*-, *b*-, *c*-, *d*-, and *e*-ribs in related species; *a*-rib reticulated distally, the remaining ribs irregular; width of list at *a*-rib 0.34, at *b*-rib 0.46, at *c*-rib 0.50, at *d*-rib 0.52, and at *e*-rib 0.49 the greatest depth of body; submarginal rib absent. Length of body, 66.6 μ.

Eastern tropical Pacific.

Description: — On account of the uncertain status of this species, we refrain from giving the usual elaborate specific description.

Dimensions: — Length of body, 66.6 μ. Greatest depth of body, 70.4 μ.

Comparisons: — Our diagnosis is based on the type specimen. This species undoubtedly is very closely related to *Ornithocercus steini*. Indeed, the only specimen observed as yet may even be an abnormal member of the mentioned species. We maintain *O. orbiculatus* tentatively, until further evidence is available. Kofoid and Michener (1911, p. 301) considered the type as "possibly a phase in thecal reconstruction."

Occurrence: — *Ornithocercus orbiculatus* has been recorded at only one of the 127 stations (4617), on the first line of the Expedition, in the Panamic Area, in surface waters of 78°, with a frequency of less than 1% (one specimen).

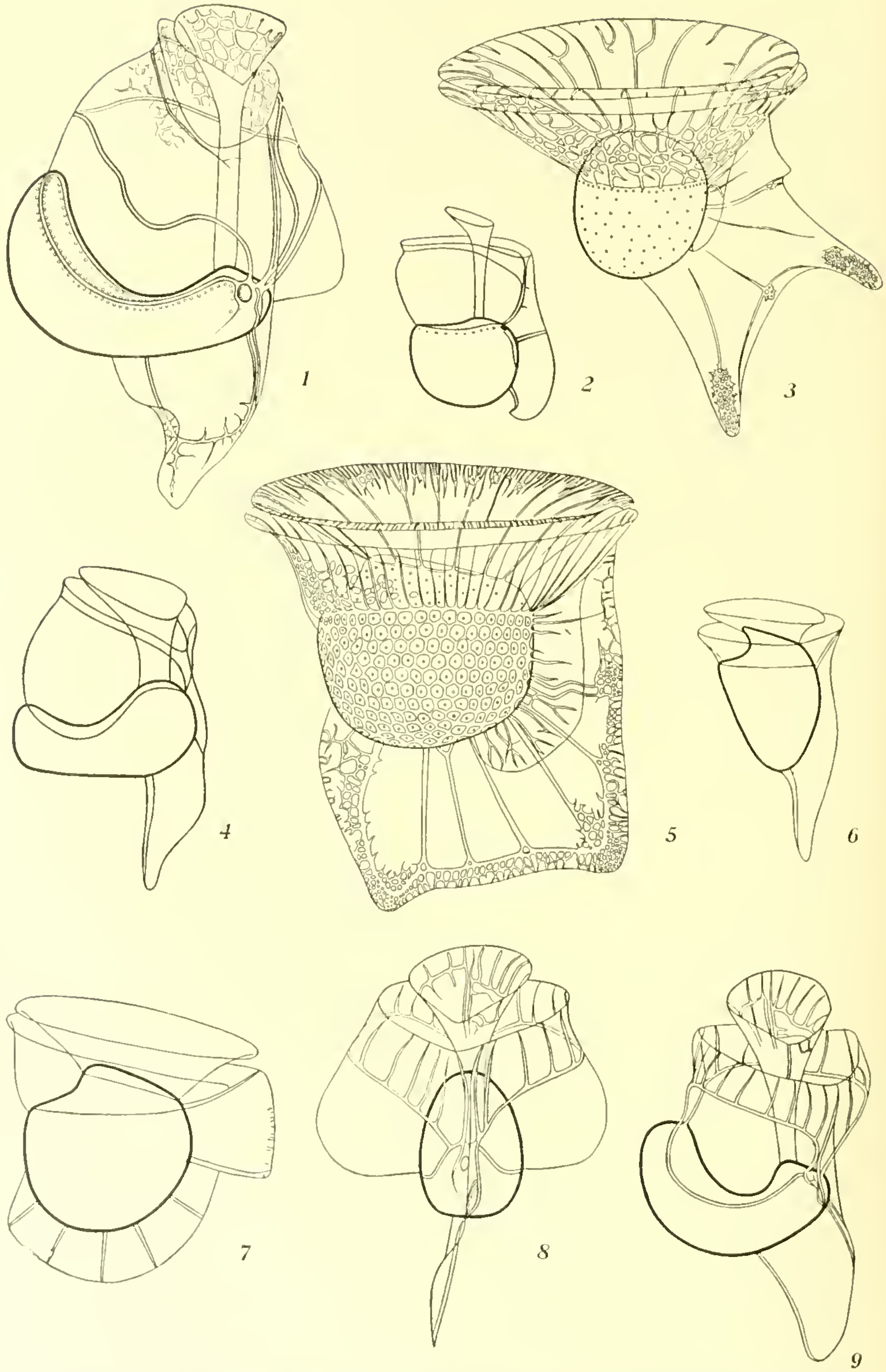

FIGURE 85.— 1, *Histioneis panda* Kofoid and Michener, oblique right lateral view of type specimen. × 935. Station 4724 (300–0 fathoms). 2, *Histioneis inornata* Kofoid and Michener, right lateral view of type specimen. × 935. Station 4720 (Salpa). 3, *Ornithocercus splendidus* Schütt, right lateral

Ornithocercus quadratus Schütt

Plate 17, fig. 2, 8. Figure 85: 5, 86, 87, 88

? *Dinophysis galea* Pouchet, 1883, *partim*, p. 426, fig. G: 4.
Ornithocercus quadratus Schütt, 1900a, p. 5, 10, 17, 26, 27, fig. 1–4, 12, 13. Ostenfeld & Schmidt, 1901, p. 173. Karsten, 1906, p. 185, 186, 190, 193, 194, 195, 197, 198, 199, 200, 202, 203, 205, 206; 1907, p. 235, 237, 238, 240, 241, 249, 286, 288, 299, 302, 306, 307, 309, 312, 315, 318, 338, 341, 344, 346, 427, 447. Schröder, 1906a, p. 321, 326, 329, 333, 335, 339; 1909, p. 211; 1911, p. 12. Kofoid, 1907a, p. 206. Schiller, 1912, p. 27; 1912a. Gran, 1912b, p. 328. Jörgensen, 1923, p. 37, 38, fig. 50.
Histioneis magnifica Schröder, 1900a, p. 20, pl. 1, fig. 15.
Histioneis quadrata Lemmermann, 1901a, p. 376; 1904, p. 611, 643; 1905a, p. 37.
Histioneis magnificus var. *quadratus* Entz, 1902b, p. 94; 1905, p. 112 (as *magnifica* var. *quadrata*).
Ornithocercus magnificus var. *c* Stüwe, 1909, p. 235, 238, 239, 240, 242, 254, 275, 288.
Histioneis magnifica var. *quadrata* Forti, 1922, p. 114.
Ornithocercus assimilis Jörgensen, 1923, p. 37, fig. 51.

Diagnosis: — Lateral outline subcircular. Anterior cingular list 0.50–1.00, posterior cingular list 0.45–0.86 the greatest depth of body; inclination of these lists about the same as in *Ornithocercus steini*. Left sulcal list ends on dorsal side of body at a distance from the posterior cingular list equaling 0.37 (0.05–0.65) the greatest depth of body; either squarish or with two lobes, one of which is posteroventral, the other posterodorsal in position; width at posteroventral corner 0.58–1.10, at posterodorsal corner 0.53–0.88 the greatest depth of body; with three to eight ribs behind fission rib, and usually with submarginal rib; ribs very variable, sometimes with, sometimes without, branches. Length of body, 37.8–73.4 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — On account of the uncertain specific unity of this form, we have refrained from giving the usual elaborate specific description.

Dimensions: — Our specimens: Length of body, 64.0–37.8 μ. Greatest depth of body, 78.5–37.1 μ. In forma *quadrata* the corresponding values were 64.0–55.3 μ and 78.5–68.1 μ; in forma *schütti* they were 54.0–44.3 μ and 58.5–46.0 μ; in forma *assimilis*, 52.8–46.7 μ and 55.0–46.5 μ; in forma *simplex*, 45.2–43.0 μ and 43.4–42.0 μ; in forma *intermedia*, 45.0–37.8 μ and 42.9–37.1 μ. The type specimen (Schütt, 1900a, fig. 4) was 73.4 μ long and 82.7 μ deep. The specimens figured by Schröder (1900a, pl. 1, fig. 15) were only about 36.0 μ long and 40.1 μ

view. × 450. Station 4740 (300–0 fathoms). 4, *Histioneis carinata* Kofoid (?), right lateral view. × 450. Station 4681 (300–0 fathoms). 5, *Ornithocercus quadratus* Schütt f. *quadrata*, right lateral view. × 450. Station 4740 (300–0 fathoms). 6, *Parahistioneis para* (Murray and Whitting), right lateral view. × 450. Station 4699 (300–0 fathoms). 7, *Ornithocercus* sp., right lateral view of division stage, in which the left sulcal list of the right valve is in a state of development, and which shows that the lists of the old valve are not resorbed. × 450. Station 4619 (surface). 8, *Histioneis panaria*, sp. nov., ventral view of type specimen. × 935. Station 4724 (300–0 fathoms). 9, *Histioneis panaria*, sp. nov., oblique right lateral view of type specimen. × 935. Station 4724 (300–0 fathoms).

deep. Whether these specimens actually were so small or whether there is a mistake in the magnifications cannot be decided. It should be observed that according to the shape and structure these specimens appear to belong to forma *quadrata*. The specimen represented by Jörgensen's (1923) figure 50 (forma *quadrata*) was about 59.9 μ long and 60.5 μ deep; the one represented by Jörgensen's (1923) figure 51 (forma *assimilis*) was 44.4 μ long and 42.5 μ deep.

Variations: — *Ornithocercus quadratus*, as conceived in the present paper, is characterized by an extraordinary variability. It is indeed an eloquent example of Schütt's (1893, p. 269, 270) statement that in tropical waters "selbst die einzelnen Individuen desselben Typus weichen so weit von einander ab, dass es aussicht, als wollte jedes von ihnen sich als eigene Varietät etabliren." Almost every one of the characteristics used in distinguishing the species of this genus appears to be in a plastic, ever-changing condition in *O. quadratus*. Whether or not our decision to treat this multitude of forms as a single species is correct cannot be decided at the present time. We wish to emphasize, however, that our solution is regarded as tentative and that it is the result of many futile efforts at a usable and defensible subdivision. In Figures 86 and 87 the specimens have been arranged according to certain degrees of similarity. In the following discussion of these figures we shall first present the results of our attempts to classify our specimens and then give the reasons why the groups established have not been treated as independent species.

O. quadratus f. *quadrata:* — The specimens represented by Figure 86: 1–6, and by Figure 85: 5, form a distinct group, the specific unity of which appears to be beyond doubt in spite of the rather pronounced variations in the structure and shape of the left sulcal list. This group, which comprises also the type specimen (Schütt, 1900a, fig. 4) and the specimens represented by Schütt's (1900a) figure 3 and Jörgensen's (1923) figure 50, is characterized especially by the large size, by the gently concave or flat transverse furrow, and by the highly reticulated margin of the left sulcal list; it should also be mentioned that the radial ribs of this list often are furnished with short, more or less developed branches. The number of radial ribs in this list behind the fission rib ranges from five (Figure 86: 6) to eight (Figure 86: 2), six being the typical. The arrangement of these ribs is rather variable. The shape of the left sulcal list is also variable; sometimes, *e.g.*, in the type specimen (Schütt, 1900a, fig. 4), in Jörgensen's (1923) figure 50, and in our Figure 86: 1, this list is squarish and comparatively broad; sometimes (Figure 86: 4) its posterior margin is characterized by a fairly well-developed antapical lobe, in other words, its posterior portion is rather distinctly three-lobed; sometimes (Figure 86: 3) it is relatively narrow and has two pronounced posterior lobes, its postmargin being strikingly concave. To this group belonged fifty-seven (*i.e.*, 18.7%) out of the 305 specimens of this species that were carefully examined by us. Out of these fifty-seven specimens not less than thirty-seven (64.9%) agreed with Figure 86: 5; eight (14.0%) also resembled Figure 86: 5, but their left sulcal list had the postmargin somewhat straighter, an extra rib was developed between the fission rib and the rib ending near the posteroventral corner (as in Figure 86: 4), and in some of these specimens the margin outside the submarginal rib was very narrow; 4 (7.0%) agreed with Figure 86: 3, but their left sulcal list had the postmargin shaped as in Figure 86: 2, and its submarginal rib was marginal; one (1.8%) agreed with Figure 86: 3, but all the ribs of the left sulcal list were complete; one (1.8%) agreed with Figure 86: 4, but its left sulcal list had the ribs ending near the antapical and posteroventral lobes incomplete, and its antapical lobe was slightly less developed; of each of the forms represented by Figure 86: 1, 2, 3, 4, 6, and by Figure 85: 5, only one specimen was found.

O. quadratus f. *schütti:* — A second, fairly distinct group is formed by the specimens represented by Figure 86:7–14, and by Plate **17**, figure 8. In the case of these specimens, too, the unity appears to be certain, although striking variations occur. This group, which also includes Schütt's (1900a) figure 2, is characterized mainly by the intermediate size, by the gently or moderately concave transverse furrow, and by the shape and structure of the left sulcal list. This list is squarish; the margin outside its submarginal rib is comparatively narrow, and either plain or furnished with but slightly developed structural differentiations; and its ribs are nearly always simple, in other words, without branches. The number of radial ribs in this list behind the fission rib ranges from three (Figure 86: 14) to seven (Figure 86: 7), six being the normal, and it evidently increases with age as in the case of *Ornithocercus magnificus* and *O. thurni*. The arrangement of these ribs is variable; *e.g.*, in some specimens (Figure 86: 12) one of these ribs ends at the posteroventral corner of this list, while in others (Plate **17**, fig. 8) this corner lacks ribs. The posterior margin of this list sometimes (Figure 86: 11) is nearly straight, sometimes moderately convex (Figure 86: 7) or concave (Figure 86: 12); a slight indication of an antapical lobe may also be present. To this group belonged 145 (47.6%) out of the 305 specimens of this species that were carefully examined by us. Out of these 145 specimens seventy-eight (53.8%) agreed with Figure 86: 8; twenty-three (15.9%) agreed with Figure 86: 10; twenty-two (15.2%) with Figure 86: 7; eight (5.5%) with Figure 86: 14; five (3.4%) with Figure 86: 8, but their left sulcal list had an extra, incomplete rib between the

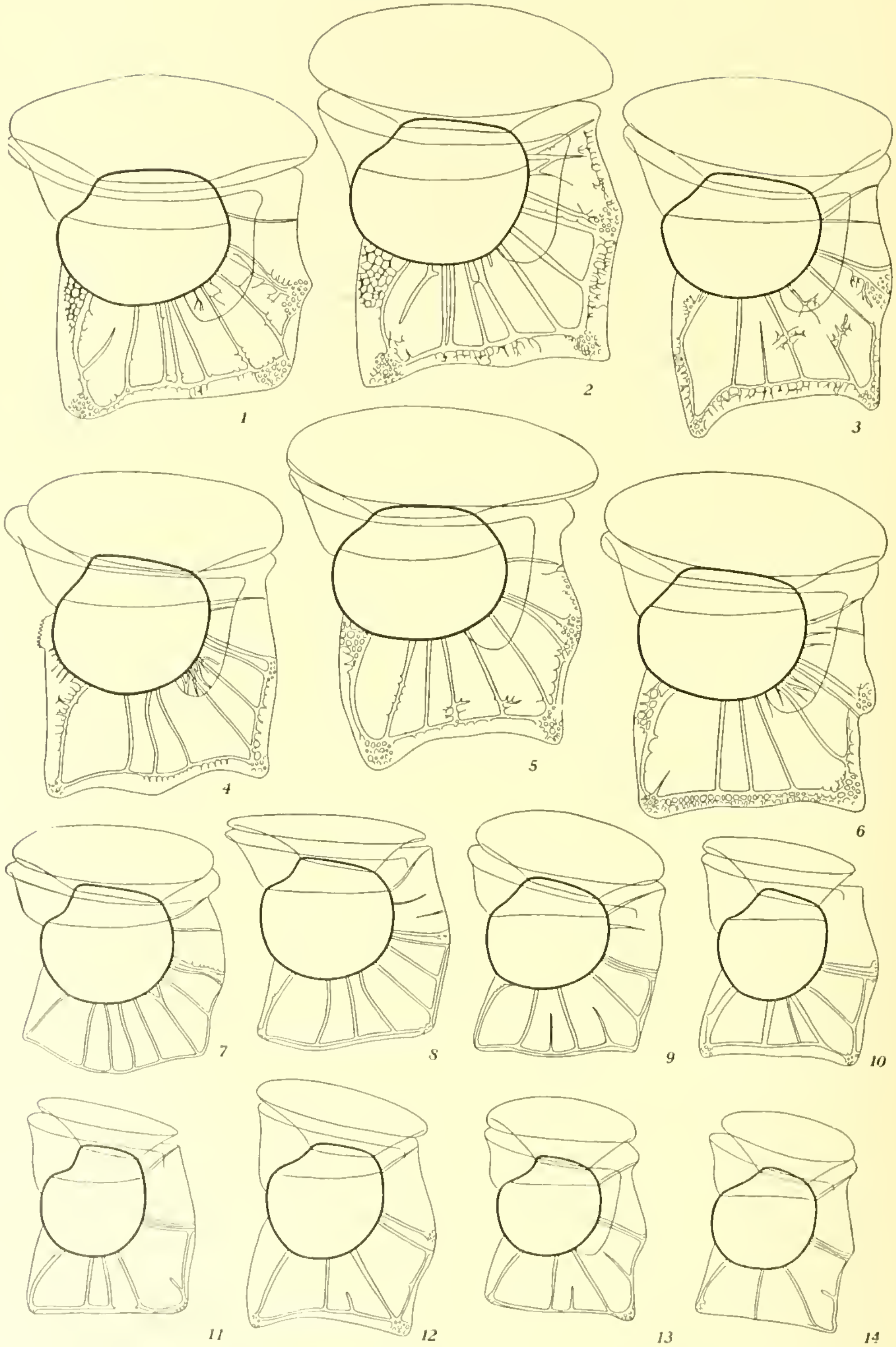

FIGURE 86.—*Ornithocercus quadratus* Schütt, right lateral view, illustrating variations in size of body and in shape and structure of left sulcal list. × 340. 1–6 belong to forma *quadrata*; 7–14, to f. *schütti*, f. nov. 1, 5, from Station 4687 (300–0 fathoms); 2, from Station 4742 (300–0 fathoms); 3, 13, from Station 4737 (100–0 fathoms); 4, 7, 8, from Station 4722 (300–0 fathoms); 6, 9, from Station 4740 (300–0 fathoms); 10, 14, from Station 4732 (300–0 fathoms); 11, from Station 4701 (300–0 fathoms); 12, from Station 4730 (300–0 fathoms).

dorsal rib and the three antapical ribs, the margin outside its submarginal rib was somewhat broader and had a slight reticulation, and its postmargin was more lobed in the middle; two (1.4%) agreed with Figure 86: 9; one (0.7%), with Figure 86: 8, but it lacked the submarginal rib in the left sulcal list; one (0.7%), with Figure 86: 8, but it lacked the submarginal rib and the radial rib to the posteroventral corner of the left sulcal list; one (0.7%) agreed with Figure 86: 9, but its left sulcal list lacked the submarginal rib, and its radial ribs were complete; there was only one specimen of each of the forms represented by Figure 86: 11, 12, 13, and by Plate **17**, figure 8.

O. quadratus f. *assimilis* (Jörgensen): — A third group, the unity of which is equally probable, is formed by the specimens represented by Figure 87: 1–8. This group, which includes also Jörgensen's (1923, fig. 51) *Ornithocercus assimilis*, may be characterized as follows. The size is intermediate. The transverse furrow is flat or gently convex. The left sulcal list is squarish and nearly as wide dorso-ventrally as in the second group. The margin of this list outside the submarginal rib is of a moderate width and as a rule not structurally differentiated except dorsally to the dorsal rib and at the corners where it often is reticulated. The radial ribs behind the fission rib, the number of which varies (with age?) from five (Figure 87: 7) to eight (Figure 87: 1), usually are furnished with short, more or less developed branches, or their proximal ends may be connected by reticular anastomoses (Figure 87: 1, 2). Their arrangement is variable; for instance, sometimes (Figure 87: 2) one of them ends at the posteroventral corner of this list, while in other cases (Figure 87: 6) this corner lacks ribs. The distal end of the posterior fission rib generally is bent posteriorly, joining the submarginal rib (Figure 87: 5, 6; Jörgensen, 1923, fig. 51). The posterior margin of this list sometimes (Figure 87: 3) is nearly straight, sometimes (Figure 87: 1) gently convex, and sometimes (Figure 87: 5, 6) it has an indication of an antapical lobe. To this group belonged only twenty-nine (9.5%) out of the 305 specimens of this species that were carefully examined by us. Out of these twenty-nine specimens twelve (41.4%) agreed with Figure 87: 7; ten (34.4%) agreed with Figure 87: 8; two (6.9%) with Figure 87: 2; and of each of the forms represented by Figure 87: 1, 3, 4, 5, 6, there was only one specimen.

O. quadratus f. *simplex*, nov.: — A fourth and quite distinct group is formed by the specimens represented by Figure 87: 11–13 and by Plate **17**, figure 2. This group is characterized especially by the relatively small size, by the gently convex transverse furrow, and by the shape and the structure of the left sulcal list. This list is squarish and relatively narrow when compared to this structure in the previ-

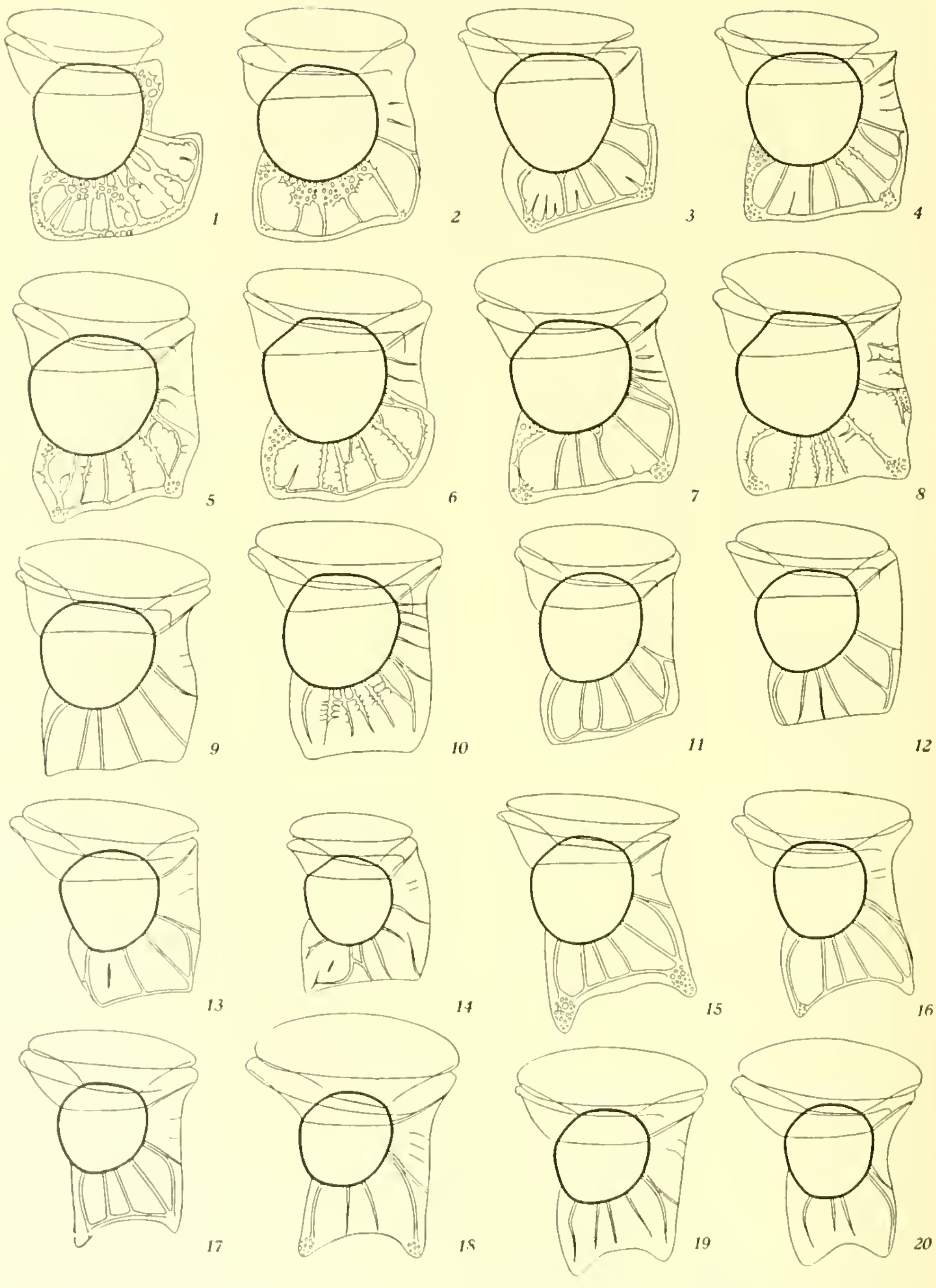

FIGURE 87.—*Ornithocercus quadratus* Schütt, right lateral view, illustrating variations in size of body and in shape and structure of left sulcal list. × 340. 1–8 belong to forma *assimilis* (Jörgensen); 11–13, to f. *simplex*, f. nov.; 15–20, to f. *intermedia*, f. nov.; 9, 10, 14 are of uncertain allocation. 1, 3, 6, from Station 4638 (300–0 fathoms); 2, from Station 4605 (300–0 fathoms); 4, 7, 8, from Station 4607 (surface); 5, 14, from Station 4619 (surface); 9, from Station 4713 (300–0 fathoms); 10, 11, 12, from Station 4681 (300–0 fathoms); 13, from Station 4722 (300–0 fathoms); 15, from Station 4732 (300–0 fathoms); 16, 18, from Station 4737 (300–0 fathoms); 17, 19, 20, from Station 4730 (300–0 fathoms).

ous groups. The margin outside its submarginal rib, when this is present, is fairly narrow and lacks structural differentiation. Its ribs appear always to be simple, in other words, to lack branches. The number of the radial ribs behind the fission rib ranges from three (Figure 87: 13) to five (Figure 87: 11, 12); presumably these ribs increase in number with age. At least in some specimens (Figure 87: 13) the distal portion of the fission rib is bent backward. The postmargin of this list is nearly straight. To this group belonged sixty-one (20.0%) out of the 305 specimens of this species carefully examined by us. Out of these sixty-one specimens not less than fifty-one (83.5%) agreed with Figure 87: 12; seven (11.5%) resembled Figure 87: 13, fairly closely; two (3.3%) agreed with Figure 87: 11; and one (1.6%) with Plate 17, figure 2.

O. quadratus f. *intermedia*, nov.: — A fifth, and last, group is made up of the specimens represented by Figure 87: 15–20. Although quite pronounced variations occur within this group, it forms a fair unit. It is characterized chiefly by the relatively small size, by the gently convex or flat transverse furrow, and by the shape and structure of the left sulcal list. This list is strikingly bilobed, its postmargin being of pronounced concavity and relatively narrow dorsoventrally. The margin outside the submarginal rib, when this is present, is of moderate width (Figure 87: 15) or narrow (Figure 87: 16, 17), and it lacks structural differentiation except in the two lobes, which sometimes are reticulated (Figure 87: 15). Its ribs are always simple, *i.e.*, lack branches. The number of radial ribs behind the fission rib is from three (Figure 87: 18, 20) to five (Figure 87: 15, 16). The distal portion of the fission rib is curved backward. To this group belonged only eight (2.6%) of the 305 specimens of this species that we examined carefully. Two of these eight specimens agreed with Figure 87: 19; one more resembled this figure, but the postmargin of the left sulcal list was but slightly concave; and of each of the forms represented by Figure 87: 15, 16, 17, 18, 20, only one specimen was found.

The specimens represented by Figure 87: 9, 10, 14, are of uncertain allocation. The form represented by Figure 87: 9, of which three specimens are recorded, resembles the specimens of the third group in the shape of the body and in the shape of the left sulcal list; in the simplicity of the radial ribs of this list, on the other hand, it agrees with the specimens of the second group. The specimen of Figure 87: 10, embodies characteristics of the third, fourth, and fifth groups. It resembles the specimens of the third group in having the radial ribs of the left sulcal list furnished with short branches; the shape of this list recalls the fourth group; and the shape of the posterior fission rib suggests relationship to the fifth group. The specimen of Figure 87: 14 presumably is abnormal. It approaches most closely the fourth group, but the radial ribs of the left sulcal list behind the fission rib are very irregular (possibly due to regeneration following damage).

Unfortunately, we are not able to give a complete account of the distribution of these five forms in the area investigated by the Expedition, since a fairly great number of our specimens were not identified to forma. However, since the distribution of the 305 specimens of this species that were carefully examined by us shows certain interesting and possibly indicative features, it will be presented. The fifty-seven specimens of forma *quadrata* were restricted to the South Equatorial Drift and the South Equatorial Current. Two of them occurred at Station 4687, the remaining ones were taken at Stations 4709, 4721, 4722, 4724, 4730, 4732, 4736, 4737, 4740, and 4742; most of them (36) were found at Station 4740. The 145 specimens of forma *schütti* were found at the following stations: 4605, 4607, 4638, 4679, 4697, 4701, 4709, 4713, 4721, 4722, 4730, 4732, 4736, 4737, 4740, and 4742. In other words, most of them were recorded from the South Equatorial Drift, but some were taken in the Mexican Current, Panamic Area, Easter Island Eddy, Galapagos Eddy, and South Equatorial Current. This form was most common at Stations 4701, 4707, 4709, 4721, 4722, and 4740. The twenty-nine specimens of forma *assimilis* occurred at Stations 4605, 4607, 4619, 4638, 4713, and 4737; in other words, in the Mexican Current, Panamic Area, Galapagos Eddy, and South Equatorial Drift. Most of these specimens were found in the Mexican Current and the Panamic Area. The sixty-one specimens of forma *simplex* were taken at Stations 4605, 4607, 4638, 4681, 4691, 4695, 4697, 4701, 4713, 4722, 4724, 4730, 4732, 4737, 4740, and 4742; *i.e.*, they were fairly evenly distributed in the area occupied by forma *schütti*. The eight specimens of forma *intermedia* were restricted to three stations in the eastern portion of the South Equatorial Drift, viz., to Stations 4730, 4732, and 4737. According to these data, therefore, two of these five forms, viz., forma *schütti* and forma *simplex*, appear to be fairly uniformly distributed over the area occupied by the species; two, viz., forma *quadrata* and forma *intermedia*, appear to have their center of distribution in the eastern portion of the South Equatorial Drift; and one, forma *assimilis*, appears to predominate in the Mexican Current and the Panamic Area.

Our reasons for treating these five forms as formae and not as distinct species are as follows: — (*1*) Differences in size appear to be of little consequence in this genus, due to the peculiar mode of division illustrated by Plate **18**. (*2*) The structure and shape of the left sulcal list are strikingly variable also within other species of this genus. This list appears to change quite readily in response to changes in the surrounding medium; and the area investigated by the Expedition is very large, includes regions of quite different physical conditions, and some of these regions are very turbulent. (*3*) Forma *schütti*, f. *assimilis*, f. *simplex*, and f. *intermedia* are not clear-cut units, but all their characteristics show overlapping variations. Intermediate specimens sometimes are found, the allocation of which is uncertain.

On the other hand, it cannot be too strongly emphasized that there are fairly good reasons in favor of the systematic independence of these forms. First, the variations exhibit distinct modes corresponding to these formae. For instance, out of the fifty-seven specimens of f. *quadrata* not less than thirty-seven (64.9%) agreed quite well with Figure 86: 5; and out of the 145 specimens of f. *schütti* seventy-eight (53.8%) agreed with Figure 86: 8. Second, the distribution of these forms also appears to support the assumption of systematic differentiation. It is far from impossible that we are concerned here with the incipient stages of speciation.

Comparisons: — The type specimen as figured by Schütt (1900a, fig. 4), as well as the specimens represented by Schröder's (1900a) Plate 1, figure 15, and by Jörgensen's (1923) figure 50, resemble our Figure 85: 5; Schütt's (1900a) figures 2 and 3 agree fairly well with our Figure 86: 8 and Figure 86: 4, respectively; and Jörgensen's (1923, fig. 51) figure of *Ornithocercus assimilis* approaches rather closely our Figure 87: 7. On the other hand, we have not found any specimens with the posteroventral corner of the left sulcal list as well rounded as in Schütt's (1900a) figure 1.

The closest-known relative of *Ornithocercus quadratus* appears to be *O. thurni*. The former species is easily distinguished from the latter by its squarish or two-lobed left sulcal list, although this list may have a fairly well-developed middle (antapical) lobe (Figure 86: 4). It also should be mentioned that *O. quadratus* f. *intermedia* is almost intermediate between this species and *O. splendidus* in the shape of the left sulcal list. This list of this forma also recalls *O. heteroporus*.

Synonymy: — This species was established by Schütt (1900a) under the name of *Ornithocercus quadratus*. In the same year it was figured by Schröder (1900a) as *Histioneis magnifica*. Ostenfeld and Schmidt (1901), Karsten (1906, 1907), Schröder (1906a, 1909, 1911), Kofoid (1907a), Schiller (1912, 1912a), Gran (1912b), and Jörgensen (1923) either record or mention this species under the name applied by Schütt (1900a); of these investigators only Jörgensen (1923) gives any figure. Lemmermann (1901a, 1904, 1905a) uses the name *Histioneis* *quadrata;* Entz (1902b) uses *H. magnificus* var. *quadratus;* Entz (1905) and Forti (1922) use *H. magnifica* var. *quadrata;* Stüwe (1909) uses *Ornithocercus magnificus* var. *e;* none of these investigators gives any figures. Under the name of *Dinophysis galea* Pouchet (1883, p. 426) figures four specimens, one of which (fig. G: 4) resembles this species but is not so figured as to permit positive identification. *Ornithocercus assimilis* Jörgensen (1923, p. 37, fig. 51), which by its author was considered as possibly a "form" of *O. quadratus,* has in the present paper been included in this species.

Occurrence: — *Ornithocercus quadratus* is recorded at seventy-six of the 127 stations. There are 17, 11, 8, 11, 19, and 10 stations on the six lines of the Expedition. Of these seventy-six stations, two (4580, 4583) are in the California Current; thirteen (4587, 4588, 4590, 4592, 4594, 4596, 4598, 4600, 4604, 4605, 4607, 4545, 4546) are in the Mexican Current; eleven (4609, 4615, 4617, 4619, 4631, 4634, 4635, 4637, 4638, 4639, 4640) are in the Panamic Area; four (4646, 4647, 4650, 4671) are in the Peruvian Current; five (4689, 4691, 4695, 4697, 4699) are in the Easter Island Eddy; two (4713, 4715) are in the Galapagos Eddy; thirty-three (4679, 4681, 4682, 4683, 4685, 4687, 4701, 4705, 4707, 4709, 4711, 4712, 4717, 4718, 4719, 4720, 4721, 4722, 4723, 4724, 4725, 4728, 4729, 4730, 4731, 4732, 4733, 4734, 4736, 4737, 4739, 4740, 4741) are in the South Equatorial Drift; three (4742, 4743, 4540) are in the South Equatorial Current; two (4541, 4542) are in the Equatorial Counter Current; and one (4543) is in the North Equatorial Current. There are thirty-three records from the surface (Stations 4583, 4588, 4592, 4596, 4600, 4604, 4607, 4615, 4617, 4619, 4631, 4635, 4638, 4639, 4640, 4682, 4709 [Salpa], 4712, 4718, 4720 [Salpa], 4723 [Salpa], 4725, 4729, 4731, 4733, 4741, 4743, 4540, 4541, 4542, 4543, 4545, 4546). At twenty-nine of these thirty-three stations the species was taken in surface waters only; at three stations (4583, 4617, 4638), in hauls from 300–0 fathoms as well as at the surface; at one station (4709), in a haul from 300–0 fathoms as well as from a Salpa; at Stations 4619 and 4725, in Salpa stomachs as well as in surface hauls. At one station (4737) it is recorded from 100–0 fathoms and 300–0 fathoms; at eight stations (4681, 4701, 4715, 4717, 4721, 4724, 4728, 4732) from 800–0 fathoms and 300–0 fathoms; at one station (4647) from 800–0 fathoms only. All the remaining records refer to hauls from 300–0 fathoms only.

The species was taken also in surface waters in Acapulco Harbor, off the Mexican Current. This station is not included in the 127 stations mentioned above.

The temperature range of these seventy-six stations at the surface was 66°–

85°; the average was 77.0°. At the thirty-three stations in the surface catches of which this species was found, the surface temperature ranged from 69° to 84°; the average was 78.8°. At Acapulco it was 83°.

For the surface catches the following frequencies are recorded: — 15% at one station (4607); 8% at one station (4543); 6% at two stations (4604, 4546); 4% at three stations (4619, 4638, 4720); 3% at three stations (4600, 4615, 4545); 2% at one station (4741); 1% at six stations (4596, 4640, 4731, 4733, 4541, 4542); in the remaining cases the frequency is less than 1%. For the catches from 100, 300, or 800 fathoms to the surface the records of frequency are as follows: — 10% at two stations (4740, 4742); 8% at one station (4728); 7% at two stations (4638, 4721); 5% at one station (4724); 4% at three stations (4590, 4605, 4722); 3% at two stations (4634, 4681); 2% at seven stations (4580, 4587, 4689, 4691, 4701, 4709, 4730); 1% at sixteen stations (4583, 4594, 4617, 4637, 4695, 4697, 4699, 4705, 4707, 4715, 4717, 4732, 4734, 4736, 4737, 4739); at the remaining stations the frequency is less than 1%. For the catch made in Acapulco Harbor a frequency of less than 1% is recorded.

The type locality of this species is unknown. Karsten (1906) found the species at sixteen stations in the Atlantic, between lat. 8° 58′ N. and lat. 5° 47′ S., and between long. 16° 27′ W. and long. 8° 4′ E.; Stüwe (1909) at fifteen stations in the Atlantic, between lat. 34° 53′ N. and lat. 3° 50′ N., and between long. 20° 22′ W. and long. 40° 16′ W.; Schröder (1909) in the West Indies; Jörgensen (1923) off the east coast of America, between lat. 30° N. and lat. 36° N., at lat. 30° S., long. 13° W., and on the southwest coast of Portugal. In the Mediterranean it has been found by the following investigators: — Pouchet (1883) [?] in the Gulf of Lyons; Schröder (1900a) in the Gulf of Naples; Entz (1902b, 1905), Schröder (1906a), and Schiller (1912, 1912a) in the Adriatic Sea; Jörgensen (1923) at several stations, nearly all of which were located in the eastern portion of the Mediterranean. In the Red Sea and in the Gulf of Aden it has been found by Ostenfeld and Schmidt (1901); in the Arabian Sea by Schröder (1906a) and Jörgensen (1923); in the Indian Ocean by Schröder (1906a), and by Karsten (1907) who recorded it from nineteen stations, between lat. 32° 53′ S. and lat. 9° 6′ N. and between long. 45° 29′ E. and long. 98° 21′ E.; in the East Indies, in the South China Sea, and in Japanese waters by Schröder (1906a); and between Laysan Island and Hawaii by Lemmermann (1904).

Most of the records referred to in the last paragraph were from surface hauls. Only one closing-net record has been published as yet, viz., from Station 229 of the Valdivia Expedition, lat. 2° 38′ S., long. 63° 37′ E., 200–20 m., dead (Karsten, 1907).

Stüwe (1909) found this species in waters ranging from 65.5° to 82.7°.

Of the investigators who have contributed to our knowledge of the distribution of this species, only Pouchet (1883), Schröder (1900a), and Jörgensen (1923) give figures by means of which their determinations may be checked.

Ornithocercus quadratus is eupelagic and widely distributed in tropical, subtropical, and warm-temperate waters. In the Eastern Pacific it occurs in the

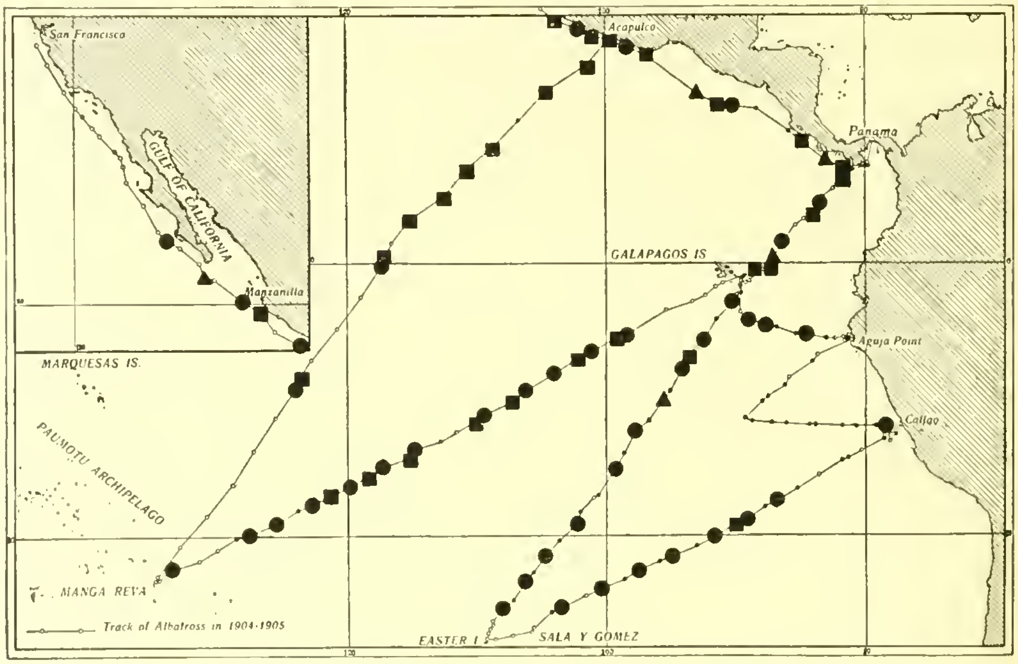

FIGURE 88.— Occurrence of *Ornithocercus quadratus* Schütt. Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; triangles, records from both vertical and surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

whole area investigated by the Expedition, but it is strikingly rare in the Peruvian Current. It is not recorded from the northern portion of the California Current but occurs occasionally as far to the north as San Diego, California. It is one of the most common species of Dinophysoidae. See also the section on variations.

ORNITHOCERCUS CAROLINAE Kofoid

Plate **17**, fig. 1, 6. Figure 89, 90

Ornithocercus carolinae KOFOID, 1907a, p. 205, pl. 15, fig. 92. JÖRGENSEN, 1923, pl. 38, fig. 53.

Diagnosis: — Lateral outline subcircular. Cingular lists: anterior 0.46–0.67, posterior 0.43–0.58 the greatest depth of body; anterior with 12–19 complete ribs, sometimes with basal and distal anastomoses, and a number of short, marginal ribs; posterior with 14–19 complete, simple ribs, some of which may be connected by anastomoses. Left sulcal list ends on dorsal side of body, 0.37–0.71 the greatest depth of body from posterior cingular list; with three lobes, one of which is posteroventral, one posterior, and one posterodorsal; the posterior larger than the others and usually narrowly rounded; width at posteroventral lobe (= fission rib) 0.34–0.73, at posterior lobe 0.65–1.11, at posterodorsal lobe 0.27–0.59 the greatest depth of body; with 11–15 radial ribs behind fission rib and usually with reticulation in posterodorsal and posterior lobes. Submarginal rib may be present. Length, 30.5–52.0 μ.

Widely distributed in tropical, subtropical, and warm-temperate seas.

Description: — This is a medium-sized or small species, subrotund in lateral outline, deepest at or near the middle. The ratio between the length and the depth of the body is 0.98 (0.91–1.07): 1. The longitudinal axis may be perpendicular to the posterior cingular list, but usually it is deflected posterodorsally at 1°–10°.

The epitheca is 0.49 (0.38–0.64) as deep as the hypotheca, slightly convex or almost flat, highest in the center or dorsally, and sometimes subhorizontal but usually tilted ventroposteriorly at 5°–12°. The transverse furrow is gently concave or nearly flat; its dorsal width is 0.42 (0.36–0.46) the greatest depth of the body; its ventral width is 0.56 (0.45–0.70) its dorsal width. The posterior cingular list is 0.29 (0.22–0.36) the length of the body from the apex. The dorsal, posterior, and ventral margins of the hypotheca are well rounded and confluent; or any of them may be slightly flattened. In dorsoventral view the body is subellipsoidal, well rounded posteriorly, subacute anteriorly, widest in the middle, and 1.6 times longer than wide.

The anterior cingular list is 0.59 (0.46–0.67) the greatest depth of the body and has an anterior inclination of 35° (25°–45°); it has on each valve 12–19 complete ribs, which may be connected by anastomoses basally as well as distally, and a varying number of short, marginal radial ribs. The posterior cingular list is 0.53 (0.43–0.58) the greatest depth of the body and is inclined anteriorly at 65° (50°–85°); it has on each valve 14–19 complete, simple radial ribs, some of which may be connected by anastomoses (Jörgensen, 1923, fig. 53). The right sulcal list is fairly large, ending at about the third or fourth rib behind the fission rib of the left sulcal list; its anterior half is of subuniform width; posteriorly its width decreases gradually; in the middle its width is about 0.17–0.20 the greatest depth of the body; it may be furnished with some ribs that may anastomose. The left sulcal list ends on the dorsal side of the body at a distance from the posterior cingular list equaling 0.51 (0.37–0.71) the greatest depth of the body and is characterized by three usually well-developed lobes, one of which is posteroventral, one posterior, and one posterodorsal in position. The posterior of these lobes, which always is larger than the others, usually is narrowly rounded. The posteroventral and posterodorsal lobes also are narrowly rounded in most specimens, but the former may be but slightly indicated and the latter may be subrectangular. In our specimens the width of this list at the anterior main rib is 0.46 (0.37–0.56), at the posteroventral lobe (*i.e.*, at the fission rib) 0.53 (0.34–0.73), at the posterior lobe 0.80 (0.65–1.03), and at the posterodorsal lobe 0.43 (0.27–0.59) the greatest depth of the body. In the specimen figured by Jörgensen (1923, fig. 53), which had the posterior lobe better developed than in any of our specimens, the width at this lobe was 1.11 the greatest depth of the body. The margin between the anterior main rib and the fission rib may be nearly straight, but usually it is gently concave. Between the tip of the posterior lobe and the tips of the posteroventral and posterodorsal lobes, the posterior margin usually is moderately or rather strongly concave, but the margin between the posteroventral and posterior lobes may be nearly straight or even gently convex. The dorsal margin of this list is gently convex or nearly straight. In front of the fission rib this list has a varying number of ribs which may be partly connected by anastomoses. The fission rib ends in the posteroventral lobe. Behind the fission rib there are 11–15 radial ribs, some of which may be branched proximally. The dorsal one of these ribs is somewhat stronger than the others and ends in the posterodorsal lobe. Sometimes the bases of these ribs are connected by reticulation. In the posterodorsal and posterior lobes and dorsally to the dorsal radial rib reticulation is usually present. Reticulation may also be developed in the posteroventral lobe. A submarginal rib may be present along the posterior margin.

The thecal wall has numerous pores; on the hypotheca each of these is surrounded by a small areole. Near the middle of the body there are about 10–17 areoles across the face of each valve. The areoles bordering the transverse furrow posteriorly are somewhat larger than the rest. Small, ellipsoidal or ovate, greenish-yellow phaeosomes may be present in the transverse furrow; sometimes their number is very large. The cytoplasm is pink.

The dimensions of fourteen of our specimens, including the type, and of the specimen figured by Jörgensen (1923, fig. 53) were measured.

Dimensions: — Our specimens: Length of body, 30.5–52.0 μ (average, 41.9 μ; type, 44.9 μ). Greatest depth of body, 31.9–57.0 μ (average, 42.9 μ; type, 49.4 μ). The specimen figured by Jörgensen (1923, fig. 53) was 47.5 μ long and 49.0 μ deep.

Variations: — Most of the members of this species (Figure 89: 1–4), although exhibiting a remarkable variability in size, are structurally rather constant. However, since we have been forced to include some specimens deviating very considerably from these typical ones, the range of variation of the species as a whole is quite pronounced. Next to the size of the body, the most variable characters are the shape and structure of the left sulcal list. The posterior lobe of this list is usually rather narrowly rounded, but it may be subrectangular (Figure 89: 7). The posteroventral lobe is in most cases very well developed, due to the pro-

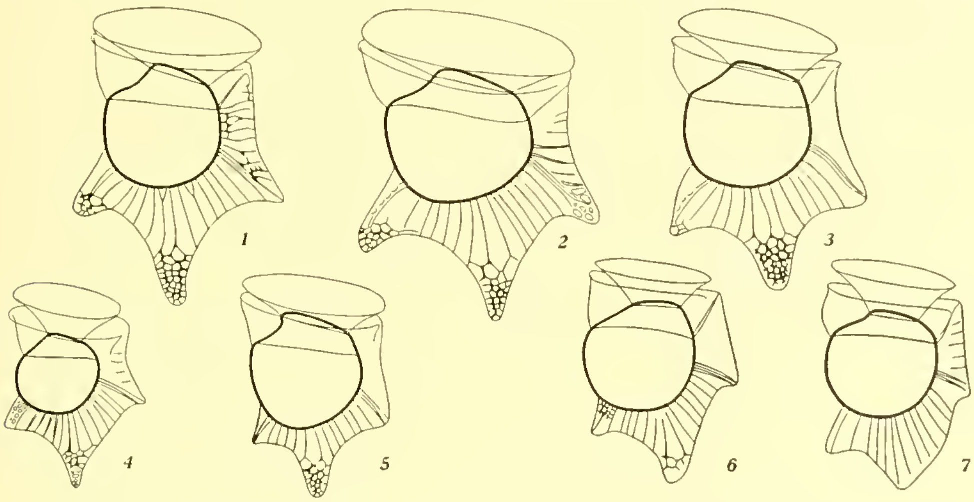

FIGURE 89.— *Ornithocercus carolinae* Kofoid, right lateral view, illustrating variations in size and in shape and structure of the left sulcal list. × 340. 1, 2, from Station 4740 (300–0 fathoms); 3, from Station 4719 (300–0 fathoms); 4, from Station 4691 (300–0 fathoms); 5, 7, from Station 4722 (300–0 fathoms); 6, from Station 4732 (300–0 fathoms).

nounced concavity of the margin between this lobe and the posterior one; sometimes, however, this margin may be nearly straight, in which case the posteroventral lobe is but slightly marked (Figure 89: 7). The posterodorsal and posterior lobes are reticulated in most specimens, but this reticulation may be absent (Figure 89: 5, 7). A submarginal rib may be present or absent. The bases of the radial ribs are usually free but may be connected by a fine reticulation. The fission rib is either subhorizontal or inclined posteriorly at 1°–40°. The depth and inclination of the epitheca and the shape of the hypotheca also exhibit variations.

Comparisons: — Our description and figures are based on the type material. The specimen figured by Jörgensen (1923, fig. 53) agrees so closely with the type that there can be no doubt as to the correctness of its allocation.

The systematic unity of this species is somewhat uncertain. Some of our specimens (Figure 89: 1–4), although varying in size, are quite uniform in structure and resemble the type (Kofoid, 1907a, fig. 92). Their specific unity appears unquestionable. Others (Figure 89: 7) are very different from the type and approach in a striking manner *Histioneis francescae* Murray and Whitting (1899, pl. 32, fig. 3); in some of them the radial ribs of the left sulcal list were even connected by fine reticulation just as in the type of this last species. Our assignment of these aberrant specimens to *Ornithocercus carolinae* is due to the fact that transitional forms have been found (Figure 89: 5, 6).

Ornithocercus carolinae is characterized especially by the three lobes of the left sulcal list, the middle (posterior) one of which is the largest; and by the

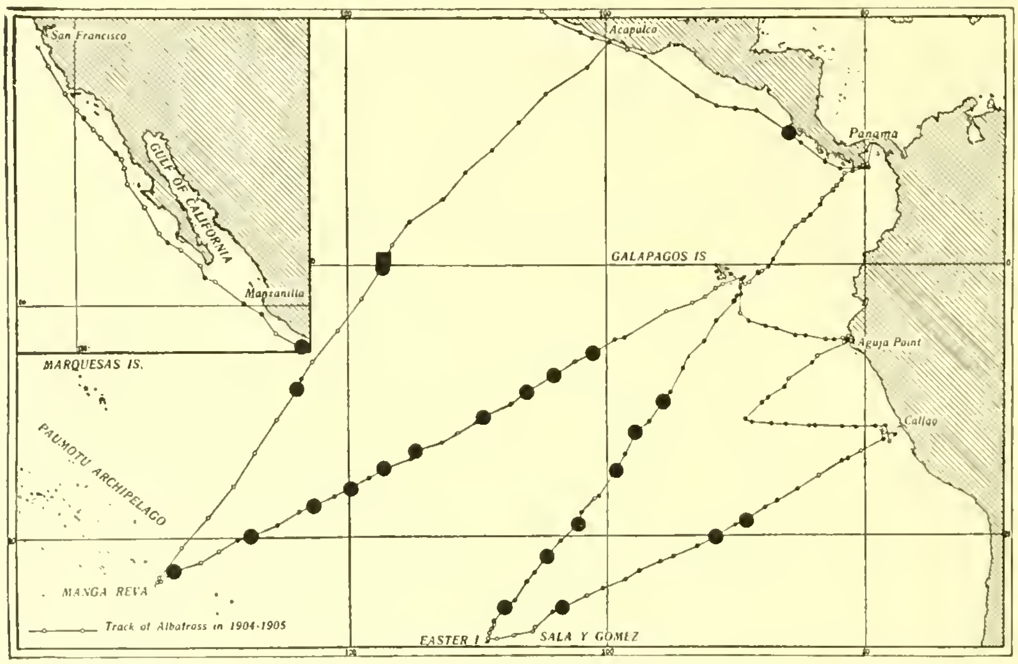

FIGURE 90.— Occurrence of *Ornithocercus carolinae* Kofoid. Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

numerous radial ribs in this list behind the fission rib. Its closest-known relative is *Histioneis* [*Parahistioneis*] *francescae,* into which it even may merge (Jörgensen, 1923, p. 38). According to Murray and Whitting's (1899, pl. 32, fig. 3) figure, the type of *Histioneis francescae* differs from our atypical members of *Ornithocercus carolinae* mainly in having the entire posterior cingular list finely and evenly reticulated, while in our specimens this list is ribbed. A reinvestigation of the relationship between these two species is necessary. Within Ornithocercus the present species occupies a somewhat isolated position; and there is no clear indication as to which of the members of this genus is its closest relative.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Ornithocercus carolinae*, and this specific name was used also by Jörgensen (1923), who is the only investigator besides Kofoid to record this form.

Occurrence: — *Ornithocercus carolinae* is recorded at twenty-four of the 127 stations. There are 2, 0, 3, 6, 10, and 3 stations on the six lines of the Expedition. Of these twenty-four stations, one (4590) is in the Mexican Current; one (4613) is in the Panamic Area; three (4691, 4695, 4699) are in the Easter Island Eddy; seventeen (4681, 4683, 4701, 4705, 4707, 4709, 4719, 4721, 4722, 4724, 4728, 4730, 4732, 4734, 4737, 4739, 4740) are in the South Equatorial Drift; and two (4742, 4743) are in the South Equatorial Current. At one station (4743) the species was taken in a surface haul; at one station (4737) in a haul from 100–0 fathoms as well as in a haul from 300–0 fathoms; at two stations (4681, 4728) in hauls from both 800–0 fathoms and 300–0 fathoms. All the other records refer to hauls from 300–0 fathoms only.

The temperature range of these twenty-four stations at the surface was 68°–83°; the average was 76.1°. At Station 4743 the surface temperature was 78°.

The frequency is less than 1% at all stations except at Station 4737 where it is 1%.

The species was first recorded by Kofoid (1907a) from Stations 4719, 4721, 4722, 4724, and 4740 of the Expedition. The type specimen is from Station 4730 of the Expedition. Later Jörgensen (1923) reported it from the Bay of Cadiz, from a few localities in the central and eastern Mediterranean, and from the coast of Brazil.

This is a eupelagic, stenothermal, and warm-water species, widely distributed but rare in tropical, subtropical, and warm-temperate regions. Its absence from the California and Peruvian Currents, according to our data, as well as its rare occurrence in surface waters are noteworthy.

3. Formosus Group. The only member of this group, *Ornithocercus formosus*, was recorded from the material of the Expedition.

Ornithocercus formosus Kofoid and Michener

Plate **17**, fig. 4, 5. Figure 91

Ornithocercus formosus Kofoid & Michener, 1911, p. 300.

Diagnosis: — Lateral outline subcircular. Cingular lists: anterior 0.53–0.62, posterior 0.48–0.53 the greatest depth of body; anterior with 14–17 complete radial ribs, of which some of the dorsals originate from a common stem, a few incomplete ribs, and basal reticulation; posterior with 12–15 complete ribs, some of which may anastomose. Left sulcal list ends on dorsal side of body, 0.54–0.64 the greatest depth of body from posterior cingular list; with two narrowly rounded or subacute lobes, one of which is posterodorsal, the other posteroventral; width at former lobe 0.82–0.86, at latter lobe 0.75–0.90 the greatest depth of body; behind fission rib only one big rib, which ends at tip of posterodorsal lobe; with submarginal rib along postmargin and from posteroventral lobe to fission rib, and with fine reticulation in lobes and dorsally to big rib; between big rib and fission rib there are 10–12 weak, irregular, anastomosing or incomplete ribs. Length, 41.1–43.8 μ.

Eastern tropical Pacific.

Description: — This is a medium-sized species, subrotund in lateral outline, widest at or near the middle. The ratio between the length and the depth of the body is 0.99 (0.97–1.01): 1. The longitudinal axis is deflected posterodorsally at about 15°.

The epitheca is 0.44 (0.41–0.48) as deep as the hypotheca, slightly convex or flat, highest in or near the center, and has a slight ventroposterior tilting. The transverse furrow is flat or gently convex; its dorsal width is 0.41 (0.33–0.47) the greatest depth of the body; and its ventral width is 0.57 (0.50–0.67) its dorsal width. The posterior cingular list is 0.24 (0.21–0.27) the length of the body from the apex. The hypotheca may be somewhat flattened dorsally and posteroventrally; its dorsal, posterior, and ventral margins are confluent. In dorsoventral view the body is subellipsoidal, broadly rounded posteriorly, subacute anteriorly, widest in the middle, and about 1.4 times longer than wide.

The anterior cingular list is 0.58 (0.53–0.62) the greatest depth of the body and has an anterior inclination of 40°–45°; on each valve it has 14–17 simple, complete radial ribs, some of the dorsal of which originate from a common stem, a few incomplete ribs, and basal reticulation. The posterior cingular list is 0.51 (0.48–0.53) the greatest depth of the body and inclined anteriorly at 70° (65°–80°); on each valve it has 12–15 complete, subequidistant radial ribs, some of the dorsal and ventral ones of which anastomose into a reticulum. The right sulcal list has been observed in one specimen only; in this specimen, the type, it was subrectangular and reticulate, ended at the fission rib, had a maximum width about 0.12 the greatest depth of the body, and its ventral margin appeared to be attached to the left sulcal list as in Histioneis (Plate 17, fig. 5). The left sulcal list ends on the dorsal side of the body at a distance from the posterior cingular list equaling 0.59 (0.54–0.64) the greatest depth of the body and is characterized by two narrowly rounded or subacute posterior lobes, one of which is posteroventral, the other posterodorsal. The width of this list at the anterior main rib is 0.55 (0.52–0.58), at the fission rib 0.48 (0.36–0.58), at the posteroventral lobe 0.84 (0.82–0.86), and at the posterodorsal lobe 0.84 (0.75–0.90) the greatest depth of the body. The ventral margin of this list usually is almost straight and subparallel to the midline of the body, but it may bulge out into a low and broad lobe at the fission rib. Between the posterior lobes the margin is deeply concave, the minimum width of the list in this region being 0.31–0.37 the greatest depth of the body. Dorsally the margin is gently convex. Between the anterior main rib and the fission rib this list is heavily reticulated. Behind the fission rib it has only one big rib, which ends at the tip of the posterodorsal lobe. A feeble submarginal rib extends along the posterior margin, between the tips of the posterior lobes, and along the ventral margin, from the tip of the posteroventral lobe to the fission rib. Both lobes as well as the portion of the list dorsally to the big rib are finely and heavily reticulated; and between the big rib and the fission rib there are about 10–12 weak, irregular radial ribs, most of which anastomose.

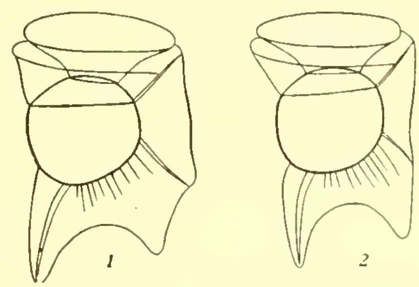

Figure 91. — *Ornithocercus formosus* Kofoid and Michener, right lateral view. × 340. 1, from Station 4722 (300–0 fathoms); 2, from Station 4737 (100–0 fathoms).

The thecal wall of the hypotheca is reticulate; the meshes are rounded or subangular, subuniform, of medium size, and each of them has a pore in the middle. Near the middle of the body there are about 20–25 meshes across the face of each valve. The meshes bordering the girdle posteriorly are not different in size from the others. The transverse furrow is porulate but lacks reticulation. Phaeosomes have not been observed.

The dimensions of three specimens were measured.

Dimensions: — Length of body, 41.1–43.8 μ (average, 42.9 μ; type, 41.1 μ). Greatest depth of body, 40.6–45.2 μ (average, 42.9 μ; type, 40.6 μ).

Variations: — The five specimens of this species examined as yet, were remarkably constant in size, shape, and structure. The most striking variation was found in the shape of the ventral margin of the left sulcal list. Usually this margin is almost straight, but in one specimen (Figure 91: 1) it bulged out into a low and broad lobe at the fission rib.

Comparisons: — The description and figures given in the present paper are based on the type material.

This species occupies a rather isolated position and is in several respects intermediate between Ornithocercus and Histioneis. The shape and structure of its body, the size and shape of its cingular lists, the structure of its posterior cingular list, and the ending of its left sulcal list on the dorsal side of the body are characteristics typical of Ornithocercus. It resembles Histioneis in the following respects: — (*1*) the dorsal radial ribs of the anterior cingular list originate from a common stem; (*2*) the ventral margin of the right sulcal list appears to be attached to the face of the left sulcal list; (*3*) there is only one strong and complete radial rib in the left sulcal list behind the fission rib, and this strong rib runs somewhat inside the dorsal margin of this list. We do not know which of the described members of Ornithocercus is the closest-known relative of this species (see also *Histioneis costata*, the section on comparisons).

Occurrence: — *Ornithocercus formosus* is recorded at five of the 127 stations. There are 0, 0, 0, 2, 3, and 0 stations on the six lines of the Expedition. Of these five stations, one (4697) is in the Easter Island Eddy, and four (4701, 4722, 4724, 4737) are in the South Equatorial Drift. At one station (4737) the species was taken in a haul from 100–0 fathoms; the remaining records refer to hauls from 300–0 fathoms.

The temperature range of these five stations at the surface was 72.0°–81.5°; the average was 76.5°.

The frequency is in all cases less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4697 of the Expedition, which thus is the type locality. Its absence from the coastal currents and from the surface waters is noteworthy.

Specimens of Ornithocercus of Questionable Specific Allocation

A few of the specimens of this genus found in the material of the Expedition are of questionable specific allocation (Figure 92). These specimens appear to be abnormal, and their aberrant structure is probably, at least in most cases, due to irregularities in the regenerative processes following local injuries or to disturbances in regulatory adaptations to flotation. Instead of assigning them more or less arbitrarily to one or the other of the known species, or establishing them as types of new species, we have deemed it most advisable to treat them separately and to restrict ourselves to pointing out in which respects they approach certain known species. Future investigators may be able to solve the question of the specific allocation in a more definite manner by the application of experimental methods to form-regulation.

Figure 92: 1. This specimen resembles *Ornithocercus thurni*, but it differs from that species in having two antapical ribs in the left sulcal list, each ending in a separate (antapical) lobe. This list thus has four lobes instead of three.

Figure 92: 2. The squarish shape of the left sulcal list is suggestive of *Ornithocercus quadratus*. On the other hand, the ribs of this list behind the fission rib form an irregular reticulum and show no resemblance to those of this species.

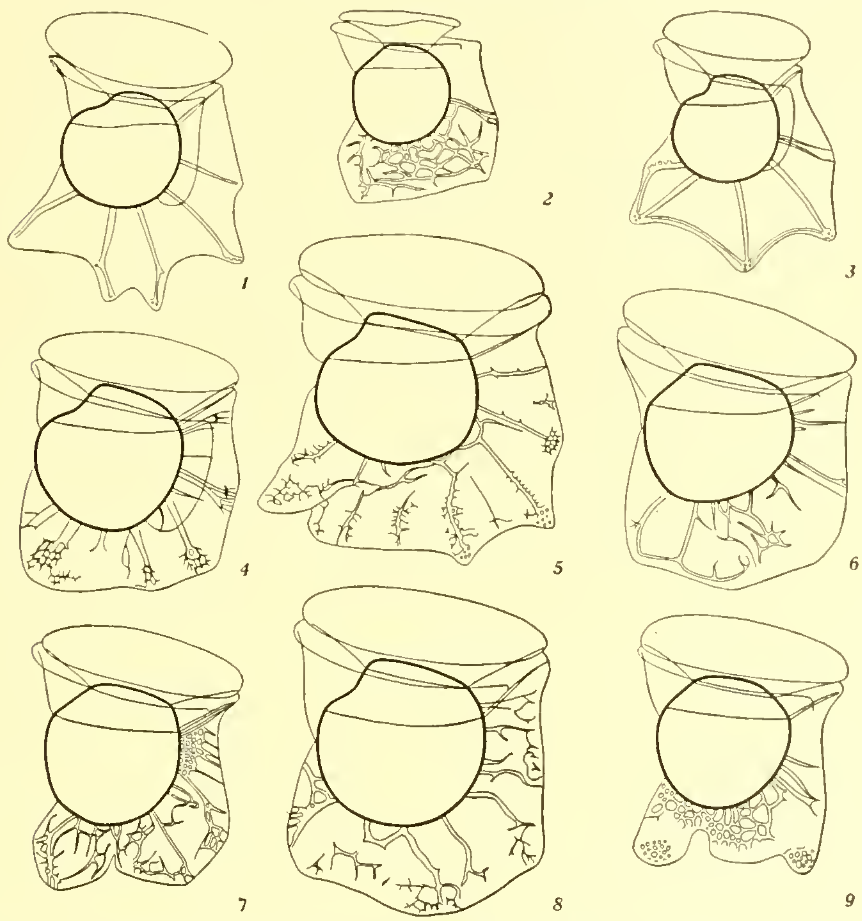

FIGURE 92.— *Ornithocercus* spp. Specimens of questionable specific allocation, right lateral view. × 340. 1, from Station 4691 (300–0 fathoms); 2, 7, from Station 4638 (300–0 fathoms); 3, from Station 4732 (300–0 fathoms); 4, from Station 4619 (surface); 5, from Station 4722 (300–0 fathoms); 6, from Station 4742 (300–0 fathoms); 8, from Station 4637 (300–0 fathoms); 9, from Station 4605 (300–0 fathoms).

Figure 92: 3. The *a*- and *b*-ribs of the left sulcal list are of about the same type as in *Ornithocercus steini*, but in other respects this specimen resembles some of our representatives of *O. thurni*.

Figure 92: 4. The squarish shape of the left sulcal list reminds us of *Ornithocercus quadratus*, but the radial ribs of this list, although quite irregular and partly incomplete, indicate relationship to *O. steini*.

Figure 92: 5. The shape of the posteroventral portion of the left sulcal list, as well as the *a*-rib of this list indicate that this is a specimen of *Ornithocercus steini*, but the irregularities in the shape of the posterodorsal portion of this list and in its *b*- and *c*-ribs prevent a definite specific allocation.

Figure 92: 6. Judging by the shape of the left sulcal list and by the *a*- and *b*-ribs of this list, this specimen belongs to *Ornithocercus thurni.* The *c*-, *d*-, and *e*-ribs of this list, however, are too irregular and incomplete to permit the assignment of this specimen to this or to any other known species.

Figure 92: 7, 9. We must refrain from attempting any specific assignment of these two specimens on account of the pronounced irregularities in the shape and structure of the left sulcal list.

Figure 92: 8. This specimen probably belongs to either *Ornithocercus steini* or *O. thurni*, but the radial ribs of the left sulcal list are too irregular and incomplete to permit even a tentative choice between these two species. The shape of this list suggests relationship to *O. thurni.*

The rounding-off of the angles of the left sulcal list and the irregularities in the ribs seen in *O. orbiculatus* are suggested in the individuals shown in Figure 92: 4, 6, and 8.

Another group of specimens cannot be determined specifically, either on account of the fact that they are not sufficiently differentiated following fission (Figure 85: 7), or due to the profound structural changes attending fission (Plate **18**, fig. 2, 7–10).

Parahistioneis, gen. nov.

Plate **19**, **29**. Figure 93: 2–7, 85: 6

Histioneis Auctorum *partim.*

Diagnosis: — Body subrotund, subobovate, rounded squarish, carafe- or gourd-like in lateral outline, usually slightly longer than deep (ratio between length and depth, 0.86–1.44: 1), and more or less compressed bilaterally. Epitheca small, nearly flat to rather strongly vaulted; its depth 0.14–0.48 the depth of hypotheca. Transverse furrow wide, and, as a rule, decidedly wider dorsally than ventrally; dorsal width 0.37–0.63 the depth of body. Cingular lists large; anterior funnel-shaped but usually not stalked, with 1–14 complete radial ribs and a dorsal height 0.30–0.72 the depth of body; posterior usually forms a closed, cylindrical, upright collar, with less than six radial ribs and without a submarginal cross-rib, and with a dorsal height of 0.34–0.57 the depth of body. Right sulcal list small; its ventral margin probably in most species attached to the left (exception, *Parahistioneis rotundata*). Left sulcal list usually large; with but one posterior lobe and one complete radial rib behind the fission rib (exception, *P. franceseae*, which has two posterior lobes and several complete radial ribs behind the fission rib); its greatest width 0.27–0.97 the depth of body.

TYPE.— *Parahistioneis diomedeae*.

Organology: — The *body* (*theca*) of Parahistioneis, when seen laterally, is always more or less asymmetrical, due especially to the shape of the transverse furrow; the hypotheca usually is subsymmetrical. In dorsoventral view, on the other hand, it appears always to be symmetrical. The longitudinal axis is perpendicular or nearly so, except in *Parahistioneis franceseae* and *P. crateriformis* (Murray and Whitting, 1899, pl. 32, fig. 3; Stein, 1883, pl. 22, fig. 5, 6), in which it has a posterodorsal inclination of about 15°. The ratio between the length and the depth ranges from 0.86: 1 to 1.44: 1; usually it is somewhere between 1.08: 1 and 1.15: 1; in only one species does the depth exceed the length. In other words, the body is usually slightly longer than deep. The shape of the body in lateral view ranges from subrotund (*P. rotundata*, Figure 93: 3), subovate (*P. garretti*, Figure 93: 5), and rounded squarish (*P. paraformis*, Figure 93: 4) to carafe- (*P. karsteni*, Figure 93: 2) and gourd-like (*P. diomedeae*, Figure 93: 6). The outline in dorsoventral view is unknown in most species. When known, it sometimes is subrotund (*P. rotundata*, Plate **19**, fig. 9) or urn-shaped, widest at the posterior cingular list, well and evenly rounded posteriorly, and constricted anteriorly (*P. paraformis*, Plate **19**, fig. 6); or it is widest and strongly convex in the middle, gently concave anteriorly and posteriorly, and its apices are narrowly rounded (*P. diomedeae*, Plate **19**, fig. 4). The ratio between the length and the width ranges from 1.10: 1 to 1.58: 1.

The *epitheca* is small, and nearly flat to rather strongly vaulted. Sometimes (*Parahistioneis reticulata*, Figure 93: 7) its curvature is subsymmetrical, sometimes (*P. diomedeae*, Figure 93: 6) it is more curved dorsally than ventrally. Its depth ranges from 0.14 to 0.48 the greatest depth of the hypotheca (*P. crateriformis*, Stein, 1883, pl. 22, fig. 5, 6; *P. franceseae*, Murray and Whitting, 1899, pl. 32, fig. 3). In some species (*e.g.*, *P. reticulata*, Figure 93: 7) it is subhorizontal; in others it is more or less inclined ventroposteriorly, its maximum inclination being about 20° (*P. diomedeae*, Figure 93: 6).

Due to the small size of the epitheca, the *transverse furrow* is always situated near the anterior end of the body. Its distal portion is not displaced posteriorly; in other words, it does not form a spiral about the body. Its postmargin sometimes is straight (*Parahistioneis rotundata*, Figure 93: 3), sometimes concave anteriorly (*P. karsteni*, Figure 93: 2), and sometimes more or less undulating (*P. diomedeae*, Figure 93: 6). It is always very wide; its dorsal width (measured in a straight line between the dorsal points of the epitheca and the hypotheca) ranges from 0.37 to 0.63 the greatest depth of the body (*P. para*, Murray and Whitting, 1899, pl. 32, fig. 4a; *P. crateriformis*, Stein, 1883, pl. 22, fig. 5, 6); and the typical range is from 0.43 to 0.54. In *P. paraformis* (Figure 93: 4) the dorsal and ventral widths are subequal, but usually the dorsal is somewhere between 1.3 and 2.5 times wider than the ventral (measured along the curvatures). Dorsally it has a dorsoposterior inclination of somewhere between 20° and 55° and is either gently convex (*P. francescae*, Murray and Whitting, 1899, pl. 32, fig. 3), or gently, moderately, to strongly concave (*P. garretti*, *P. karsteni*, *P. diomedeae;* Figure 93: 5, 2, 6). Ventrally it is gently convex, flat, or gently concave. Just as in Histioneis, the concavity and great width of this furrow are correlated with the tendency to increase the size of the girdle. This increase has two purposes: it decreases the specific weight of the organism and increases the capacity of the girdle as a container of the phaeosomes. The distance from the apex to the posterior cingular list is somewhere between 0.23 and 0.50 the length of the body.

The length of the *longitudinal furrow* usually is subequal to or somewhat less than half the length of the hypotheca. Anteriorly this list does not extend beyond the girdle and it is at most but slightly impressed.

The *lists of the furrows* are large but delicate and arise from low and narrow basal ridges (Plate 19).

The *anterior cingular list* is closed, funnel-shaped, and never notched ventrally. On the dorsal side its anterior inclination ranges from 15° to 60° (usually between 20° and 40°); on the ventral side this inclination either is subequal to that of the dorsal side, or it is somewhat steeper (*Parahistioneis reticulata* and *P. karsteni;* Figure 93: 7, 2). In most species (*e.g.*, *P. diomedeae*, Figure 93: 6) this list is sessile; in others (*P. karsteni* and *P. rotundata;* Figure 93: 2, 3) it either has an incipient or a short stalk. It always is characterized by a distal flare, which either is symmetrical (*P. paraformis*, Figure 93: 4) or more pronounced dorsally than ventrally (*P. rotundata*, Figure 93: 3). Distally this list is from two to six times wider than proximally. Its dorsal height ranges from 0.30 to 0.72 (usually from 0.50 to 0.65) the greatest depth of the body; and its right and left sides are of about equal height. Its anterior margin is even, except in *P. dentata* (Murray and Whitting, 1899, pl. 33, fig. 4), in which it is deeply serrated, the teeth, according to the figure, being scale-like and overlapping. When sessile, this list has a fairly great number of radial ribs (about eight to fourteen), most of which are complete, and all of which are simple except the dorsal which has one to many branches (Plate 19, fig. 1, 10, 4). When stalked, it is characterized by a more or less reduced number of well-developed radial ribs, the dorsal of which are branched (*P. karsteni* and *P. rotundata;* Plate 19, fig. 2, 8). Besides the complete ribs, this list may have some incomplete, simple, marginal, radial ribs (*P. diomedeae*, Plate 19, fig. 5) and a basal reticulation (*P. garretti* and *P. paraformis;* Plate 19, fig. 1, 3). The tips of the ribs may project slightly beyond the free edge of the list.

The *posterior cingular list* is closed except posteroventrally, where it probably opens into the canal formed by the right sulcal list. *Parahistioneis rotundata* (Plate 19, fig. 8) is presumably an exception to this rule; in this species this list appears to be open ventrally. (This character is not known in *P. franceseae.*) In most species this list forms a cylindrical, upright collar of moderate height and about as high dorsally as ventrally; sometimes, however, its anterior inclination does not amount to more than about 65° (*P. paraformis* and *P. garretti;* Figure 93: 4, 5). It may flare anteriorly (*P. reticulata* and *P. diomedeae;* Plate 19, fig. 7, 10, 4), but it never forms lateral pouches. Its dorsal height ranges from 0.34 to 0.57 the greatest depth of the body. The structural differentiation of this list usually is very simple. In some species (*P. crateriformis*, Stein, 1883, pl. 22, fig. 5, 6) this list has only a pair of simple, dorsal ribs, one rib on either side of the sagittal suture, and a similar pair ventrally; others (*P. paraformis* and *P. rotundata;* Plate 19, fig. 3, 8) have besides the sagittal ribs only one to four simple, radial ribs and sometimes a slight reticulation dorsally and ventrally; others, again, have no radial ribs except the sagittal ribs, but a more or less developed, fine reticulation (*P. diomedeae* and *P. reticulata;* Plate 19, fig. 5, 7). The number of radial ribs in this list is thus always small. In contradistinction to Histioneis, a submarginal cross-rib is never present, but in one species (*P. dentata*, Murray and Whitting, 1899, pl. 33, fig. 4) the anterior margin is thickened.

In *Parahistioneis rotundata* (Plate 19, fig. 8) the *right sulcal list* is fairly large and ends at the fission rib of the left sulcal list; its ventral margin is sigmoid and probably free, and it lacks structural differentiation. On the other hand, in *P. diomedeae* and *P. dentata* (Plate 19, fig. 5; Murray and Whitting, 1899, pl. 33, fig. 4a) this list is relatively very small, finely reticulated, and its ventral margin is attached to the left sulcal list, thus forming a canal, which opens posteriorly near the fission rib of the left sulcal list and presumably also into the girdle. Just as in Histioneis, the water caused by the movement of the transverse flagellum to enter the girdle probably passes out by this canal. The condition of this list in the last two species may be similar to that of the remaining members of this genus, in which this structure is unknown. This assumption is made probable by the fact that in these species the posterior cingular list is closed; furthermore, the small size and the attachment of the ventral margin make this list very difficult to detect, which would explain why it has not been recorded.

The *left sulcal list* usually is rather large. In some species (*Parahistioneis paraformis* and *P. reticulata;* Figure 93: 4, 7) it ends at or just ventrally to the antapex of the body; in others it extends more or less beyond this point and may end on the dorsal side of the body at a distance from the posterior cingular list equaling only about 0.47 the greatest depth of the body (*P. diomedeae*, Figure 93: 6). The shape and structure of this list are quite diverse within this genus and afford important taxonomic characteristics. The most aberrant type is found in *P. francescae* (Murray and Whitting, 1899, pl. 32, fig. 3). In this species this list ends on the dorsal side of the body, at a distance from the posterior cingular list equaling about 0.55 the greatest depth of the body, and is characterized by two well-developed lobes, one of which is posterodorsal, the other antapical. At the latter lobe, which is by far the larger, the list reaches its greatest width, viz., about 0.67 the greatest depth of the body. The ventral margin (to the tip of the antapical lobe) is moderately convex; and the margin between the vertices of the lobes is rather strongly concave, subrectangular. The fission rib, which arises a fairly short distance behind the girdle, is about 0.43 the greatest depth of the body, nearly straight, and slightly deflected posteriorly. A strong rib, the posterior main rib, ends in the posterodorsal lobe. Dorsally to the latter rib and anteriorly to the fission rib, this list is reticulate. Between these ribs there are fifteen weak radial ribs partly connected by reticulations and with their tips joined by a submarginal rib. This is the only species of this genus in which this list has two posterior lobes and more than one complete radial rib behind the fission rib. In the remaining ones this list has one posterior lobe and two complete radial ribs, viz., the fission rib and the posterior main rib, and it is always widest at the tip of the posterior lobe. The fission rib, which arises at or near the posterior end of the longitudinal furrow, is double, straight or nearly so, and subhorizontal (*P. rotundata*, Figure 93: 3) or deflected posteriorly at 1°–45°; its length ranges from 0.12 to 0.35 the greatest depth of the body. The posterior main rib, which arises at or somewhat ventrally to the antapex of the body and ends at or near the vertex of the posterior lobe, either is marginal (*P. para*, Figure 85: 6) or it arises at some distance from the dorsal end of the list; this distance may be as long as 0.54 the greatest depth of the body (*P. diomedeae*, Figure 93: 6). This rib is directed posteriorly or deflected ventrally at 1°–30° from the longitudinal axis of the body, and its length ranges from 0.27 to 0.97 the greatest depth of the body; it may be of moderate strength or strong; usually it is simple and tapers distally, but its distal end may be reticulate or club-shaped (*P. paraformis* and *P. diomedeae;* Figure 93: 4, 6); and it is straight, gently concave dorsally, or gently sigmoid. In one species (*P. diomedeae,* Figure 93: 6) the ventral margin of this list forms a rounded rectangular lobe at the fission rib; in the others this margin (from the anterior edge of the posterior cingular list to the tip of the posterior lobe) does not form any distinct lobe but is gently to moderately convex (*P. paraformis,* Figure 93: 4; *P. crateriformis,* Stein, 1883, pl. 22, fig. 5, 6), moderately to strongly sigmoid (*P. rotundata,* Figure 93: 3; *P. dentata,* Murray and Whitting, 1899, pl. 33, fig. 4a), or strongly undulating (*P. karsteni,* Figure 93: 2). At the tip of the posterior main rib the margin is narrowly rounded or acute, and dorsally to this rib it is gently concave, straight, gently convex, or gently to strongly sigmoid. In front of the fission rib this list usually is reticulate, but it may have but a few short radial marginal ribs (*P. rotundata,* Figure 93: 3) or be without structural differentiation (*P. crateriformis,* Stein, 1883, pl. 22, fig. 5, 6). Between the two main ribs it may be entirely or partly reticulate (*P. reticulata* and *P. garretti;* Plate 19, fig. 7, 1), or it may have a few short radial basal ribs (*P. crateriformis,* Stein, 1883, pl. 22, fig. 5) or a submarginal rib as well as short radial basal ribs (*P. rotundata,* Figure 93: 3). Dorsally to the posterior main rib this list may be reticulate or it may lack structural differentiation.

Parasagittal lists have thus far not been found in this genus.

The *flagellar pore,* which is located to the right in the transverse furrow at or just behind the posterior cingular list, is rounded or slightly elongated and has a maximum diameter of about 4 μ. There are no records of pores of the kind found in Phalacroma (Plate 3, fig. 1, 2, of *P. pulchrum* and *P. giganteum*) on the ventral side of the left valve, near the sagittal suture, and just in front of the anterior cingular list. The *flagella,* which have not been observed as yet, presumably are similar to those in Dinophysis and Phalacroma.

The *thecal wall* exhibits but slight variations in structure. It is always porulate, and in all species, except *Parahistioneis rotundata,* it is strongly areolate or reticulate. There is either one pore in each mesh and areole, or there is a smaller number of pores than areoles and meshes. In *P. rotundata* (Plate 19, fig. 8) the wall of the hypotheca is finely and very faintly reticulate and has but eleven pores on the right face, six of which are located along the girdle.

The *protoplasmic contents* have thus far not been observed. Large, rounded and small, ovoidal *phaeosomes* have been found in the girdle (Plate **19**, fig. 5, 7).

The *length of the body* ranges within this genus from 17.7 μ (*Parahistioneis rotundata*) to 53.5 μ (*P. diomedeae*).

The methods of measurement are largely the same as in Histioneis.

Distribution: — Parahistioneis belongs to the same distributional group as Histioneis; in other words, it is marine, presumably of circumequatorial distribution, avoids coastal waters, is limited to tropical and subtropical seas, and all its species are very rare. In the Atlantic as well as in the Pacific Ocean its northern limit seems to be near lat. 35° N.; its southern extension is unknown. It has not been found as yet in the Mediterranean. The distribution of the genus as a whole and of the individual species is very uncertain due to the scarcity of distributional data.

The vertical distribution of this genus must be regarded as unknown. All the records published as yet are from surface hauls.

Representatives of Parahistioneis were found at sixteen (12.6%) out of the 127 stations of the Expedition from which dinoflagellates were recorded. These sixteen stations were distributed in the following manner (Plate **29**):—

0 (0.0%) out of the four stations in the California Current; 2 (15.4%) out of the thirteen stations in the Mexican Current; 1 (5.9%) out of the seventeen stations in the Panamic Area; 0 (0.0%) out of the twenty-seven stations in the Peruvian Current; 2 (20.0%) out of the ten stations in the Easter Island Eddy; 0 (0.0%) out of the four stations in the Galapagos Eddy; 11 (24.4%) out of the forty-five stations in the South Equatorial Drift; 0 (0.0%) out of the three stations in the South Equatorial Current; 0 (0.0%) out of the two stations in the Equatorial Counter Current; 0 (0.0%) out of the two stations in the North Equatorial Current.

The numbers of these sixteen stations are as follows: — 4598, 4604 (Mexican Current); 4619 (Panamic Area); 4697, 4699 (Easter Island Eddy); 4701, 4709, 4711, 4720, 4722, 4724, 4725, 4732, 4733, 4734, 4741 (South Equatorial Drift).

At nine out of these sixteen stations the genus was taken in hauls from 300–0 fathoms or from 800–0 fathoms. One (4598) of these nine stations is located in the Mexican Current; two (4697, 4699) are in the Easter Island Eddy; and six (4701, 4711, 4722, 4724, 4732, 4734) in the South Equatorial Drift. At seven stations the genus was found in surface waters. These stations are as follows: — 4604 (Mexican Current); 4619 (Panamic Area); 4709, 4720, 4725, 4733, 4741 (South Equatorial Drift).

These data show that Parahistioneis was not found by the Expedition in the California and Peruvian Currents, both of which are of temperate origin, in the Galapagos Eddy, which is directly influenced by the Peruvian Current, or in the South Equatorial Current, Equatorial Counter Current, and the North Equatorial Current. Most (eleven out of sixteen) of the record stations are in the South Equatorial Drift. The species of this genus evidently are stenothermal, warm-water forms limited to high salinities.

There are seventeen records of species of Parahistioneis from vertical catches. Out of these seventeen records, three (17.7%; Stations 4598, 4699, 4722) showed a frequency of 1%; the remaining fourteen (82.3%) showed a frequency of less than 1%. There are eleven records of species from surface catches. Out of these eleven records, one (9.1%; Station 4619) showed a frequency of 2%; one (9.1%; Station 4720) showed 1%; the remaining nine (81.8%) showed less than 1% or did not have the frequency established. The average frequency of the individual species is about as low as in the genus Histioneis.

Coincident occurrence of different species of Parahistioneis in catches from 300 (800)–0 fathoms is recorded at the following of the nine stations mentioned above: — three species occurred coincidently at one station (11.1%; Station 4699); two species at six stations (66.7%; Stations 4697, 4701, 4722, 4724, 4732, 4734). Coincident occurrence of different species of this genus in surface catches is recorded at the following of the seven stations mentioned above: — three species occurred coincidently at one station (14.3%; Station 4733); two species at two stations (28.6%; Stations 4619, 4720).

It should be mentioned that during the Expedition only two, *Parahistioneis diomedeae* and *P. reticulata*, out of the six species were found free-living in surface waters. The remaining surface records refer to specimens found in the stomachs of Salpa taken near the surface. The following species were found in Salpa stomachs: — *P. diomedeae*, *P. karsteni*, *P. paraformis*, *P. reticulata*, and *P. rotundata*.

Out of our seven species only two have been found outside the area investigated by the Expedition, a fact undoubtedly due to the incompleteness of our knowledge of the distribution of this genus.

Historical Discussion

Of the nine species referred by us to the genus Parahistioneis, one, *P. paraformis*, is proposed in the present paper, and the remaining ones were previously described and figured in the genus Histioneis. These species are as follows: —

Histioneis crateriformis Stein (1883), *H. dentata* Murray and Whitting (1899), *H. diomedeae* Kofoid and Michener (1911), *H. francescae* Murray and Whitting (1899), *H. garretti* Kofoid (1907a), *H. karsteni* Kofoid and Michener (1911), *H. para* Murray and Whitting (1899), *H. reticulata* Kofoid (1907a), and *H. rotundata* Kofoid and Michener (1911).

The following investigators have contributed to our knowledge of the distribution of this genus, not specifying those mentioned above: — Cleve (1901a, 1901c), Daday (1888), Lemmermann (1899a, 1901a), Lohmann (1908), Ostenfeld and Schmidt (1901), and Schröder (1900a). None of these writers gives figures by means of which the determinations may be checked. Minor contributions are found in Bütschli (1885) and Jörgensen (1923). The cytological aspect of the morphology of this genus has not been treated as yet.

Subdivisions. Relationships among the Species

The ten species referred to Parahistioneis in the present paper may be divided as follows:

1. Species of uncertain generic allocation: — *P. francescae, P. crateriformis,* and *P. rotundata* (Figure 93: 3; Murray and Whitting, 1899, pl. 32, fig. 3; Stein, 1883, pl. 22, fig. 5, 6).

2. Garretti group: — *P. garretti, P. paraformis,* and *P. para* (Figure 93: 5, 4; 85: 6).

3. Reticulata group: — *P. karsteni, P. reticulata, P. diomedeae,* and *P. dentata* (Figure 93: 2, 7, 6; Murray and Whitting, 1899, pl. 33, fig. 4).

1. Species of uncertain generic allocation. *Parahistioneis francescae* (Murray and Whitting, 1899, pl. 32, fig. 3): — The structurally closest-known relative of this species is *Ornithocercus carolinae* (Figure 89). Indeed, these two forms approach each other so closely that even their specific separation has been questioned (Jörgensen, 1923, p. 38), and our material indicates that their ranges of variation overlap. The only reason for the present (tentative) generic assignment is that the posterior cingular list of *P. francescae* is finely and evenly reticulated, instead of ribbed, according to Murray and Whitting's (1899) figure. It is possible, however, that this peculiarity of the type specimen is due to advanced ontogenetic differentiation; in other words, that the reticulation is preceded by ribbing, the ribs later being connected by numerous fine anastomoses (see *Ornithocercus carolinae*, the section on comparisons). If this is the case, then *Parahistioneis francescae* should be referred to Ornithocercus. Murray and Whitting

(1899), who did not separate Ornithocercus from Histioneis, referred it to the latter genus.

Parahistioneis crateriformis (Stein, 1883, pl. 22, fig. 5, 6): — This species is structurally fairly close to some of the primitive members of Histioneis, and the only character that prevents its assignment to this genus is the lack of a cross-rib in its posterior cingular list. If this rib is absent, in other words, if Stein (1883) did not overlook it, then this species should be assigned to the Reticulata group and be placed near *Parahistioneis karsteni*. Stein (1883) assigned it to Histioneis.

Parahistioneis rotundata (Figure 93: 3): — This species, which was referred to Histioneis by Kofoid and Michener (1911), occupies a somewhat isolated position and embodies characteristics of Ornithocercus and Histioneis, as well as of Parahistioneis. It is characterized especially by the following features: — its body is subrotund and lacks an anterior process; its anterior cingular list is stalked and has but few (five or less) ribs on each valve; its posterior cingular list appears to be open ventrally and has about five radial ribs on each valve; its right sulcal list is comparatively large, and its ventral edge appears to be free, *i.e.*, not attached to the left sulcal list. If by future investigations it is shown: (*1*) that the posterior cingular list of this species is open ventrally, (*2*) that the ventral edge of its right sulcal list is not attached to the left sulcal list, and (*3*) that these peculiarities are not found in the Garretti and Reticulata groups, then this species should be removed from Parahistioneis and made the type of a new genus. We thus regard its present generic allocation as tentative.

The three members of this group thus may be representatives of three different genera.

2. Garretti group (Figure 93: 5, 4; 85: 6). Body subovate to rounded squarish in lateral outline, without a well-developed anterior process. Anterior cingular list sessile, with eight or more radial ribs on each valve. Posterior cingular list appears always to be closed ventrally and has two to four radial ribs on each valve besides the dorsal and ventral pairs next to the sagittal suture. Right sulcal list small; its ventral edge attached to left sulcal list (?).

The three members of this group are structurally very uniform and have reached about the same evolutionary level.

3. Reticulata group (Figure 93: 2, 7, 6; Murray and Whitting, 1899, pl. 33, fig. 4). Body carafe- or gourd-shaped in lateral outline with well-developed anterior process. Anterior cingular list may have an incipient stalk but is usually sessile; with five or more radial ribs on each valve. Posterior cingular list appears always to be closed ventrally and has no radial ribs except the dorsal and ventral pairs next to the sagittal suture. Right sulcal list small; its ventral edge attached to left sulcal list (?).

Of the four species assigned to this group, *Parahistioneis reticulata*, *P. diomedeae*, and *P. dentata* are structurally very close to each other and have reached about the same evolutionary level. *P. dentata* is somewhat aberrant in having the anterior edge of the anterior cingular list deeply serrated and the anterior edge of the posterior cingular list supported by a marginal rib. (These features are unique and need to be verified.) *P. karsteni* is somewhat more primitive than these three species in being smaller and in having the anterior process of the body somewhat less developed. On the other hand, it is more advanced in having the anterior cingular list characterized by an incipient stalk and by a small number of radial ribs.

The Reticulata group, which is quite primitive in the shape and structure of the anterior cingular list, is more advanced than the Garretti group in the shape of the body and in the structure of the posterior cingular list; the body has developed a large anterior process, and in the posterior cingular list the primitive ribbing has disappeared.

Key to the Species of Parahistioneis

1. Posterior cingular list with no radial ribs besides the dorsal and ventral pairs....................2.
1. Posterior cingular list with radial ribs besides the dorsal and ventral pairs......................7.
2. Left sulcal list with two distinct posterior lobes, one of which is dorsoposterior, the other antapical; R_3 ends in dorsoposterior lobe..........................*P. francescae* (Murray and Whitting).
2. Left sulcal list not of this type..3.
3. Anterior edge of anterior cingular list deeply serrated..........*P. dentata* (Murray and Whitting).
3. Anterior edge of anterior cingular list smooth..4.
4. Left sulcal list angular at R_2............................*P. diomedeae* (Kofoid and Michener).
4. Left sulcal list not angular at R_2..5.
5. Left sulcal list wide; R_3 0.67 the depth of body.............*P. karsteni* (Kofoid and Michener).
5. Left sulcal list fairly narrow; R_3 less than 0.45 the depth of body..........................6.
6. Anterior cingular list sessile, its dorsal height 0.32–0.40 the depth of body..*P. reticulata* (Kofoid).
6. Anterior cingular list stalked, its dorsal height 0.70–0.75 the depth of body..*P. crateriformis* (Stein).
7. R_3 of left sulcal list arises about 0.50 the depth of body from dorsal end of list..*P. garretti* (Kofoid).
7. R_3 of left sulcal list submarginal..8.
8. R_3 of left sulcal list with heavy posterior reticulation...................*P. paraformis*, sp. nov.
8. R_3 of left sulcal list not with heavy posterior reticulation.................................9.
9. Anterior cingular list stalked, with five ribs or less on each valve..*P. rotundata* (Kofoid and Michener).
9. Anterior cingular list not stalked, with ten ribs or more on each valve. *P. para* (Murray and Whitting).

1. Species of Uncertain Generic Allocation. Of the three species of this group, viz., *Parahistioneis franceseae*, *P. crateriformis*, and *P. rotundata*, only the last was found in the material of the Expedition.

PARAHISTIONEIS ROTUNDATA (Kofoid and Michener)

Plate 19, fig. 8, 9. Figure 93: 3

Histioneis rotundata KOFOID & MICHENER, 1911, p. 299.

Diagnosis: — Body subcircular in lateral outline; length: depth, 1.13:1. Dorsally the transverse furrow is gently concave, 0.48 the depth of body, 1.3 times wider than ventrally, and inclined dorsoposteriorly at 20°. Distance from apex to posterior cingular list 0.23 the length of body. Anterior cingular list with short stalk, flaring in its distal 0.66 with straight sides to an asymmetrical funnel 1.5 wider dorsally than ventrally; its height 0.64 the depth of body. Posterior cingular list appears to be open ventrally; with five to six simple, complete ribs; dorsal height 0.39 the depth of body. Left sulcal list ends somewhat ventrally to antapex; narrowly rounded at R_3; margin rather strongly convex just behind R_2; dorsal margin gently concave; R_2 0.32 the depth of body; R_3 submarginal, of moderate strength, 0.78 the depth of body; from near the middle of R_2 a rib runs posteriorly, subparallel to margin of list; between R_2 and R_3 there are four incomplete ribs. Length, 17.7 μ.

Eastern tropical Pacific.

Description: — This is a minute species, the body of which is subcircular in lateral outline, and deepest near the middle. The ratio between the length and the depth of the body is about 1.13:1. The longitudinal axis is perpendicular.

The epitheca is about 0.17 as deep as the hypotheca, convex, highest somewhat dorsally to the center, and subhorizontal. Dorsally the transverse furrow is gently concave, about 0.48 the greatest depth of the body, about 1.3 times wider than ventrally, and inclined dorsoposteriorly at about 20°; ventrally it is gently convex. The distance from the apex to the posterior cingular list is about 0.23 the length of the body. The anterior margin of the hypotheca is nearly straight and horizontal. The dorsal, posterior, and ventral margins are confluent and subcircular. Seen in dorsoventral view, the body is regularly and broadly obovoidal, widest near the middle, and about 1.10 times longer than wide.

The anterior cingular list has a short but distinct stalk, is inclined anteriorly at 35°–40°, and is about 5.5 times wider distally than proximally; it flares in its distal 0.66 abruptly with straight sides to an asymmetrical funnel 1.5 times wider dorsally than ventrally, inclined slightly dextrally with no ventral notch; its height is about 0.64 the greatest depth of the body; and it has on each valve two radial ribs, the ventral of which is simple, the dorsal furnished with three branches. The posterior cingular list appears to be open ventrally, and its dorsal margin is inclined anteriorly at 80°–85°; the dorsal height is about 0.39, the ventral 0.48 the greatest depth of the body; it has on each valve five to six simple, complete radial ribs and no reticulation. The right sulcal list ends at the fission rib of the left sulcal list, and its ventral margin, which appears to be free, is strikingly sigmoid, concave in the middle, and convex posteriorly. The left sulcal list ends somewhat ventrally to the antapex, the ventral margin is nearly straight in front of the fission rib, between the fission rib and the posterior main rib the margin is rather strongly convex anteriorly and nearly straight posteriorly, at the posterior main rib the list is narrowly rounded, and the dorsal margin is gently concave. The fission rib is straight, subhorizontal, and about 0.32 the greatest depth of the body. The posterior main rib is submarginal, of moderate strength, gently concave dorsally, deflected 5°–10° posteroventrally, and about 0.78 the greatest depth of the body; on the ventral side it has about six knob-like processes. In front of the fission rib there are about four short, marginal radial ribs. From near the middle of the fission rib, a rib runs posteriorly and about parallel to the ventral margin, ending near the posterior main rib. Between the fission rib and the posterior main rib there are four incomplete basal ribs, the anterior of which is fairly long, bent posteriorly, and branched distally.

The thecal wall of the hypotheca is finely and very faintly reticulated and has eleven pores on the right face, six of which are located along the girdle. There are no records of phaeosomes.

The dimensions of one specimen only, the type, were measured.

Dimensions: — Length of body, 17.7 μ. Greatest depth of body, 15.7 μ. Total length, 37.1 μ.

Comparisons: — Our description and figures are based on the type specimen.

This species occupies a somewhat isolated position. It embodies characteristics of Ornithocercus, Histioneis, and Parahistioneis, and hence even its generic assignment should be regarded as tentative. The subcircular outline of the body in lateral view, the ribbing of the posterior cingular list, and the development of the right sulcal list indicate relationships to Ornithocercus. It differs from this genus in having comparatively few ribs in the posterior cingular list, in the shape and structure of the anterior cingular list, and in having only two main ribs in the left sulcal list. The shape and structure of the anterior cingular list remind us of Histioneis and the shape of the left sulcal list of *Parahistioneis karsteni*. There is no certain indication as to which of the known members of these three genera is the closest relative of the present species. The minute size, the subspheroidal shape of the body, the size of the right sulcal list, and the fact that the left sulcal list ends on the ventral side of the body, place it fairly low in the evolutionary scale.

Occurrence: — *Parahistioneis rotundata* is recorded at five of the 127 stations. One station (4709) is on the fourth, three (4720, 4725, 4733) are on the fifth, and one (4741) is on the sixth line of the Expedition, and all of them are in the South Equatorial Drift. Five specimens were found, all occurring in Salpa taken in

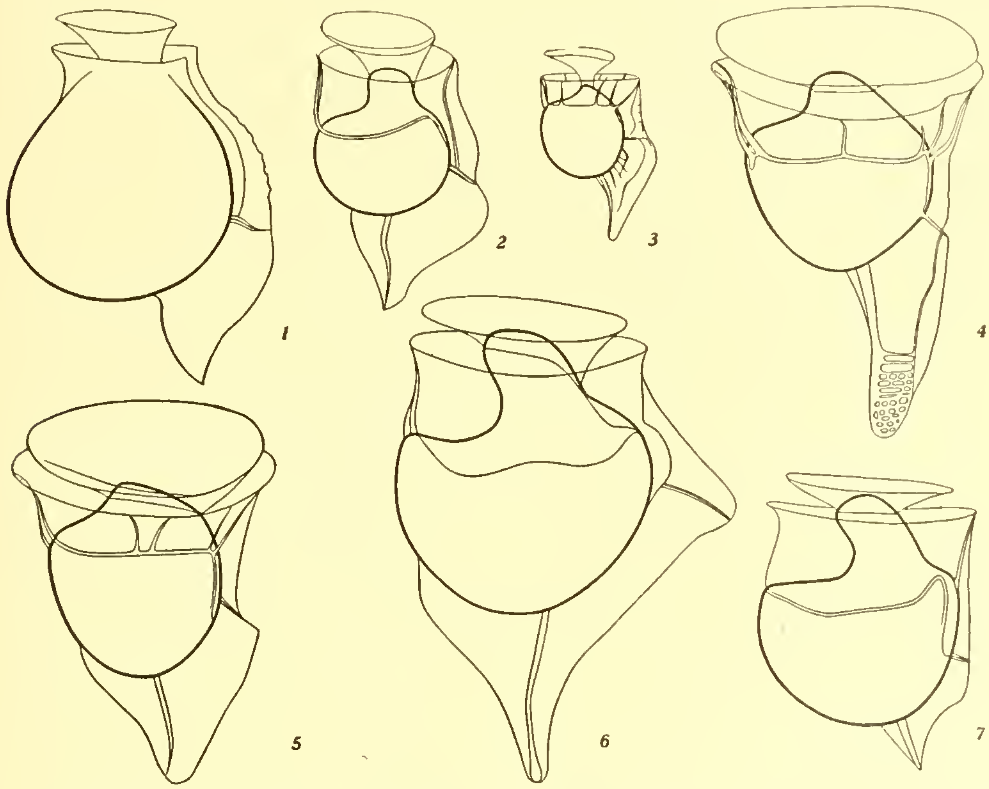

FIGURE 93.— Histiophysis and Parahistioneis, right lateral view. × 340. 1, *Histiophysis rugosa* (Kofoid) from Station 4705 (300–0 fathoms); 2, *Parahistioneis karsteni* (Kofoid and Michener) from Station 4619 (Salpa); 3, *P. rotundata* (Kofoid and Michener) from Station 4720 (Salpa); 4, *P. paraformis*, sp. nov., from Station 4724 (300–0 fathoms); 5, *P. garretti* (Kofoid) from Station 4732 (300–0 fathoms); 6, *P. diomedeae* (Kofoid and Michener) from Station 4699 (300–0 fathoms); 7, *P. reticulata* (Kofoid) from Station 4699 (300–0 fathoms).

surface waters. The temperature of these five stations at the surface ranged from 72° to 80°; the average was 77.0°.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720 of the Expedition, which thus is the type locality. The restriction of all the record stations to the South Equatorial Drift is noteworthy.

2. Garretti Group. All the three members of this group were found by us in the material of the Expedition. They have been treated in the following order: — *Parahistioneis garretti*, *P. paraformis*, and *P. para*.

Parahistioneis garretti (Kofoid)

Plate **19**, fig. 1. Figure 93: 5

Histioneis garretti Kofoid, 1907a, p. 203, pl. 16, fig. 97.

Diagnosis: — Body broadly subobovoidal in lateral outline; length: depth, 1.15: 1. Dorsally the transverse furrow is gently concave, 0.52 the depth of body, 2.3 times wider than ventrally, and inclined dorsoposteriorly at 35°–40°. Distance from apex to posterior cingular list 0.36 the length of body. Anterior cingular list sessile, subequal dorsally and ventrally; its height 0.60 the depth of body. Posterior cingular list closed; with two simple ribs in the middle and one ventrally; dorsal height 0.52 the depth of body. Left sulcal list ends on dorsal side of body, 0.59 the depth of body from posterior cingular list; narrowly rounded at R_3; dorsal margin and margin between R_2 and R_3 gently sigmoid; R_2 0.31 the depth of body; R_3 arises 0.50 the depth of body from dorsal end of list, fairly weak, 0.60 the depth of body; reticulated in front of R_2; behind R_2 reticulations are restricted to basal portion. Length, 37.3 μ.

Eastern tropical Pacific.

Description: — This is a medium-sized species, with body broadly subobovoidal in lateral outline, deepest just behind the transverse furrow. The ratio between the length and the depth of the body is about 1.15: 1. The longitudinal axis is about perpendicular.

The epitheca is about 0.55 as deep as the hypotheca, convex, highest dorsally, and tilted ventroposteriorly at about 10°. Dorsally the transverse furrow is gently concave, about 0.52 the greatest depth of the body, about 2.3 times wider than ventrally, and inclined dorsoposteriorly at 35°–40°; ventrally it is gently convex. The distance from the apex to the posterior cingular list is about 0.36 the length of the body. The anterior margin of the hypotheca is nearly straight and subhorizontal. The dorsal, posterior, and ventral margins are confluent; the posterior is somewhat more convex than the others.

The anterior cingular list is sessile, inclined at the base anteriorly at 15°–25°, and about 2.5 times wider distally than proximally; it flares into a broad funnel with nearly equal dorsal and ventral extent, straight sides, and with the ventral arising farther posterior than the dorsal and therefore steeper. Its top, somewhat flattened in Figure 93: 5, is nearly horizontal, its height is about 0.60 the greatest depth of the body, and it has on each valve 11 or 12 subequidistant radial ribs, most of which are complete, and all of which are simple except the dorsal one, which has two branches; proximally these ribs are connected by reticulation. The posterior cingular list is closed, somewhat flaring distally, and its dorsal and ventral margins are inclined anteriorly at 50°–70°; the dorsal height is about 0.52, the ventral 0.57 the greatest depth of the body; besides the ribs at the sagittal suture, this list has on each valve three simple, straight radial ribs, two of which are near the middle and one ventrally; dorsally a slight reticulation is present. The left sulcal list is of medium size and ends on the dorsal side of the body at a distance from the posterior cingular list equaling about 0.59 the greatest depth of the body. It is narrowly rounded at the posterior main rib; and the dorsal margin and the margin between the fission rib and the posterior main rib are gently sigmoid. The portion of this list in front of the fission rib is finely reticulated; in the type specimen it is but slightly developed (following fission?), its ventral margin is gently concave, and its posterior width is but slightly more than half the length of the fission rib. The fission rib is straight, about 0.31 the greatest depth of the body, and deflected posteriorly at about 25°. The posterior main rib arises near the antapex of the body and about 0.50 the greatest depth of the body from the dorsal end of the list, is fairly weak, gently concave dorsally, and deflected posteroventrally at 5°–10°; its length is about 0.60 the greatest depth of the body. Behind the fission rib the basal portion of this list is reticulated, the meshes being rather small to medium-sized.

The thecal wall is porulate and reticulated, the meshes being subuniform and medium-sized, and each of them having one pore in the middle. On each valve about eighteen meshes border the girdle posteriorly. There is no record of phaeosomes.

The dimensions of one specimen only, the type, were measured.

Dimensions: — Length of body, 37.3 μ. Greatest depth of body, 32.3 μ. Total length, 72.5 μ.

Comparisons: — Our description and figure are based on the type specimen.

Judging by the size, shape, and structure of the body, of the cingular lists, and of the left sulcal list in front of the fission rib, this species is most closely related to *Parahistioneis paraformis*. These two species are readily distinguished from each other by the shape and structure of the left sulcal list behind the fission rib. Another close relative evidently is *P. para*. This relationship is indicated by pronounced similarities in the shape and structure of the body and of the cingular lists. *P. garretti* differs strikingly from *P. para* in having the left sulcal list end on the dorsal side of the body and in having the posterior main rib of this list arise at a distance from the dorsal end of the list equaling 0.50 the greatest depth of the body.

Occurrence: — *Parahistioneis garretti* is recorded at only one of the 127 stations, 4732, on the fifth line of the Expedition in the South Equatorial Drift, from a haul from 300–0 fathoms, a surface temperature of 79°. The frequency is less than 1% (one specimen).

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4732 of the Expedition, which thus is the type locality.

Parahistioneis paraformis, sp. nov.

Plate 19, fig. 3, 6. Figure 93: 4

? *Histioneis para* Murray & Whitting, 1899, *partim*, pl. 32, fig. 4c.
Histioneis para Okamura, 1912, p. 20, pl. 3, fig. 55.

Diagnosis: — Body rounded, squarish in lateral outline; length: depth, 1.08–1.11 : 1. Dorsally the transverse furrow is moderately concave, 0.48 the depth of body, but slightly wider than ventrally, and inclined dorsoposteriorly at 40°–45°. Distance from apex to posterior cingular list 0.43 the length of body. Anterior cingular list sessile, low, subequal, broadly flaring; its height 0.61 the depth of body. Posterior cingular list closed, with one simple rib in the middle and one ventrally; dorsal height 0.53 the depth of body; line of attachment subhorizontal. Left sulcal list ends at antapex; narrowly rounded posteriorly, gently convex between R_2 and R_3, gently concave dorsally; R_2 0.35 the depth of body; R_3 submarginal, strong, heavily reticulated distally, 0.95 the depth of body; Length, 38.0–39.0 μ.

Tropical and subtropical Pacific.

Description: — This is a medium-sized species, with body rounded squarish in lateral outline, deepest in the middle. The ratio between the length and the depth of the body is 1.08–1.11 : 1. The longitudinal axis is perpendicular.

The epitheca is about 0.35 as deep as the hypotheca, rather strongly convex, somewhat higher dorsally than ventrally, and subhorizontal. Dorsally the transverse furrow is moderately concave, about 0.48 the greatest depth of the body, but slightly wider than ventrally, and inclined dorsoposteriorly at 40°–45°; ventrally it is gently convex, nearly flat. The distance from the apex to the posterior cingular list is about 0.43 the length of the body. The anterior margin of the hypotheca is gently undulating and subhorizontal. The dorsal, posterior, and ventral margins of the hypotheca are confluent and well convex; or the hypotheca may be somewhat flattened posterodorsally and posteroventrally. In dorsoventral view the body is urn-shaped, widest at the posterior cingular list; narrowly rounded anteriorly, due to the pronounced concavity of the transverse furrow; and the hypotheca is fairly broadly rounded posteriorly, with evenly convex lateral outlines; the ratio between the length and the width is about 1.34: 1.

The anterior cingular list is sessile, widely flaring, inclined anteriorly at 20°–25°, and about four times wider distally than proximally; its dorsal and ventral extent are subequal, sides concave, equal dorsally and ventrally, and arising at the same level, with horizontal top; its height is about 0.61 the greatest depth of the body, and it has on each valve 8–13 subequidistant, complete radial ribs, all of which are simple except the dorsal one which may have three branches; proximally these ribs are connected by reticulation. The posterior cingular list is closed, somewhat flaring distally, and its dorsal and ventral margins are inclined anteriorly at about 70°; the dorsal and ventral heights are about 0.53 the greatest depth of the body; besides the ribs at the sagittal suture, this list has on each valve two usually simple, straight radial ribs, one of which is in the middle and one ventrally; no reticulation is present. The left sulcal list is of narrow tongue-shape and ends at or near the antapex of the body; it is narrowly rounded posteriorly, the ventral margin between the fission rib and the posterior main rib is gently convex, and the dorsal margin is gently concave. The portion of this list in front of the fission rib is finely reticulated; in the type specimen it is but slightly developed (following fission?), its ventral margin is gently concave, nearly straight, and its posterior width is but slightly more than half the length of the fission rib (Plate **19**, fig. 6). The fission rib is straight, about 0.35 the greatest width of the body, and deflected posteriorly at 25°–30°. The posterior main rib is submarginal, very strong, gently concave dorsally, about 0.95 the depth of the body, and deflected posteroventrally at 5°–10°; its distal end is heavily reticulated and fills the posterior portion of the list. Between the fission rib and the posterior main rib this list is faintly reticulated, the meshes being rather large.

The thecal wall is porulate and reticulated, the meshes subuniform and medium-sized, and each of them has one pore in the middle. On each valve about 16 meshes border the girdle posteriorly. There is no record of phacosomes. Large, round chromatophores (?) are present.

All the dimensions were measured in only one specimen, the type. The length and depth of the body and the total length were measured in three more specimens.

Dimensions: — Length of body, 38.0–39.0 μ (type, 38.0 μ). Greatest depth of body, 35.0–36.0 μ (type, 35.0 μ). Total length, 82–95 μ (type, 83 μ).

Comparisons: — The specimen represented by Okamura (1912, pl. 3, fig. 55) is figured in a very sketchy manner but nevertheless agrees quite closely with the type except in the ventral margin of the left sulcal list, which is strikingly concave just behind the fission rib (due to recent binary fission?). The specimen figured by Murray and Whitting (1899, pl. 32, fig. 4c) as *Histioneis para* may possibly belong to this species, but it differs in the relative depth of the epitheca, in the ribbing of the posterior cingular list, and in having a well-developed rib in the left sulcal list just behind the fission rib.

The closest-known relatives of this species presumably are *Parahistioneis garretti* and *P. para* (regarding the relationship to *P. garretti,* see this species, the section on comparisons). *P. paraformis* recalls *P. para* in having but two ribs in the posterior cingular list, in the narrowly tongue-shaped and reticulated left sulcal list, and in the urn-shape of the body in dorsoventral view. It is easily distinguished from this species by the broader shape of the body seen laterally and by the fact that the strong posterior main rib of the left sulcal list is heavily reticulated distally.

Synonymy: — This species has been recorded and figured previously by Okamura (1912, p. 20, pl. 3, fig. 55) under the name of *Histioneis para.* One of the two specimens represented by Murray and Whitting (1899, pl. 32, fig. 4c) under this name may also be referable to the present species, but this allocation is somewhat uncertain, as mentioned in the last section.

Occurrence: — *Parahistioneis paraformis* is recorded at seven of the 127 stations. There are 0, 0, 0, 2, 5, and 0 stations on the six lines of the Expedition. Of these seven stations one (4697) is in the Easter Island Eddy; and six (4701, 4722, 4724, 4732, 4733, 4734) are in the South Equatorial Drift. At one station (4733) the species was found in the stomach of a Salpa taken in surface waters. All the other records refer to hauls from 300–0 fathoms.

The temperature range of these seven stations at the surface was 75°–81°; the average was 77.7°. At Station 4733 the surface temperature was 80°.

The frequency is in each case less than 1%. The species has previously been recorded from Japanese waters by Okamura (1912) and is presumably widely distributed in tropical and subtropical seas.

Parahistioneis para (Murray and Whitting)

Figure 85: 6

Histioneis para Murray & Whitting, 1899, *partim*, p. 333, pl. 32, fig. 4a, b, tab. 3, 4, 5, 6, 8, 9. Lemmermann, 1899a, *partim*, p. 374; 1901a, p. 376. Cleve, 1901c, p. 252. Kofoid & Michener, 1911, p. 298, 299. non *Histioneis para* Okamura, 1912, p. 20, pl. 3, fig. 55.

Diagnosis: — Body subobovoidal in lateral outline, obliquely truncate anteriorly; length: depth, 1.13–1.44: 1. Dorsally the transverse furrow is moderately to rather strongly concave, 0.37–0.43 the greatest depth of body, 1.5–2.0 times wider than ventrally, and inclined dorsoposteriorly at 35°–40°. Distance from apex to posterior cingular list 0.24–0.27 the length of body. Anterior cingular list sessile, subequal in dorsal and ventral extension, with unequal concave sides; its height 0.50 the depth of body. Posterior cingular list closed, with two simple ribs, one on either side of the middle; its dorsal height 0.39–0.45 the depth of body, with sinuous line of attachment. Left sulcal list narrowly tongue-shaped, ends at antapex, reticulated; R_3 marginal, directed posteriorly, straight or gently sigmoid, of moderate strength, and 0.76–0.97 the depth of body. Length, 43.7–47.0 μ.

Widely distributed in tropical and subtropical seas.

Description: — This is a medium-sized species, with body subobovoidal in lateral outline, obliquely truncate anteriorly, and deepest at the posterior cingular list. The ratio between the length and the depth of the body is 1.13–1.44: 1. The longitudinal axis is perpendicular.

The epitheca is 0.46–0.55 as deep as the hypotheca, flat except dorsally where it is angular or subangular in lateral outline, and tilted ventroposteriorly at 10°–15°. Dorsally the transverse furrow is moderately to rather strongly concave, 0.37–0.43 the greatest depth of the body, 1.5–2.0 times wider than ventrally, and inclined dorsoposteriorly at 35°–40°; ventrally it is flat or gently convex. The distance from the apex to the posterior cingular list is 0.24–0.27 the length of the body. The anterior margin of the hypotheca is nearly straight and subhorizontal. Posteriorly the hypotheca tapers quite decidedly, its posterior end being rather narrowly rounded. The dorsal margin of the hypotheca is gently convex or flattened, the ventral margin gently convex. In dorsoventral view the body is urn-shaped, widest somewhat behind the girdle; narrowly rounded anteriorly, due to the pronounced concavity of the transverse furrow; the hypotheca tapers posteriorly, with evenly and gently convex lateral outlines, and rather narrowly rounded posterior end; the ratio between the length and the width is about 1.66: 1.

The anterior cingular list is sessile and flaring, inclined anteriorly at 20°–25°, and 2.3–2.8 times wider distally than proximally; its dorsal extension is 1.3 the ventral, sides concave, the ventral steeper than the dorsal; posteriorly its line of attachment declines abruptly, and top horizontal; its height is about 0.50 the depth of the body; and it has on each valve about 10–12 subequidistant, complete radial ribs, all of which are simple (except possibly the dorsal one, which may be branched as in *Parahistioneis paraformis*). The posterior cingular list is closed, slightly flaring distally, and its dorsal and ventral margins are inclined anteriorly at 55°–65°; the dorsal and ventral heights are 0.39–0.45 and 0.43–0.52 the greatest depth of the body; besides the ribs at the sagittal suture, this list has on each valve two simple, straight radial ribs, one on either side of the middle; no reticulation is present. The left sulcal list is of narrow tongue-shape, ends at or near the antapex of the body, and is entirely covered by reticulation. Its ventral margin is gently convex or sigmoid, its dorsal margin is nearly straight or gently sigmoid, and it is narrowly rounded or subacute posteriorly. The posterior main rib is marginal, directed posteriorly, of moderate strength, and 0.76–0.97 the depth of the body.

The thecal wall is reticulate; about 13 meshes border the girdle posteriorly. There is no record of phaeosomes.

The dimensions of one specimen from the material of the Expedition and of the type specimen (Murray and Whitting, 1899, pl. 32, fig. 4a) were measured.

Dimensions: — Our specimen: Length of body, 47.0 μ. Greatest depth of body, 32.6 μ. Total length, 85.2 μ. Type specimen, according to Murray and Whitting (1899, Plate 32, figure 4a): Length of body, 43.7 μ. Greatest depth of body, 38.6 μ. Total length, 87.0 μ.

Comparisons: — *Histioneis* [*Parahistioneis*] *para*, as conceived by Murray and Whitting (1899), evidently includes two species, the one represented by their Plate 32, figure 4a and b, the other by their Plate 32, figure 4c. The specimen represented by the first two (fig. 4a, b) of these figures should be regarded as the type of this species. It is characterized especially by the fact that the hypotheca tapers posteriorly and that the entire left sulcal list is reticulated. The specimen represented by the last (fig. 4c) of these three figures may be referable to *Parahistioneis paraformis*, sp. nov., and is characterized by having the hypotheca subsemicircular in lateral outline and by lacking reticulation in the left sulcal list except at the distal end of the posterior main rib. The specimen of *P. para* found in the material of the Expedition agrees quite closely with the type, except in the smaller relative depth of the body and in the smaller relative width of the cingular lists. We have no records of the structure of the cingular and sulcal lists except what is shown in Figure 85: 6.

The closest-known relatives of *Parahistioneis para* presumably are *P. paraformis* and *P. garretti* (see these two species, the sections on comparisons).

Synonymy: — This species was established by Murray and Whitting (1899, pl. 32, fig. 4a–c) under the name of *Histioneis para*. This specific name should, according to our opinion, be applied to the specimen represented only by their Plate 32, figure 4a and 4b. Their Plate 32, figure 4c, appears to be referable to *Parahistioneis paraformis* (see the last section). Cleve (1901c) does not state whether he found both these forms or only one of them in his material. The specimen figured by Okamura (1912) as *Histioneis para* belongs to *Parahistioneis paraformis*.

Occurrence: — *Parahistioneis para* is recorded at only one (4699) of the 127 stations, on the fourth line of the Expedition in the Easter Island Eddy, from 300–0 fathoms, at a surface temperature of 75°. The frequency is 1%.

Murray and Whitting (1899), who were the first to record this species, found it at sixteen stations in the Atlantic Ocean and in the Caribbean Sea, between lat. 33° 40′ N. and lat. 13° 6′ N. and between long. 31° 20′ W. and long. 78° 44′ W., in surface waters of 75° (62°–82°). Cleve (1901c) found it in the Atlantic, between lat. 33° N. and lat. 24° N. and between long. 31° W. and long. 51° W.; temperature, 70.7°; salinity, 37.22. It should be remembered that this species, as conceived by Murray and Whitting (1899), appears to be heterogeneous (see the section on synonymy). Cleve (1901c) does not give any figures, and so his determinations cannot be checked.

3. Reticulata Group. Of the four members of this group, *Parahistioneis dentata* was not recorded from the material of the Expedition. The remaining ones have been treated in the following order: — *P. karsteni*, *P. reticulata*, and *P. diomedeae*.

Parahistioneis karsteni (Kofoid and Michener)

Plate 19, fig. 2. Figure 93: 2

Histioneis karsteni Kofoid & Michener, 1911, p. 298.

Diagnosis: — Body rounded carafe-shape in lateral outline; with fairly long, nearly erect anterior process; hypotheca semicircular; length : depth, 1.09 : 1. Dorsally the transverse furrow is rather strongly concave, 0.52 the depth of body, 2.5 times wider than ventrally, and inclined dorsoposteriorly at 40°–45°. Distance from apex to posterior cingular list 0.41 the length of body. Anterior cingular list with incipient stalk, flaring asymmetrically with twice as much dorsal as ventral flare and more posterior origin ventrally; its height 0.54 the depth of body. Posterior cingular list closed, lacks structural differentiation; dorsal height, 0.57 the depth of body. Left sulcal list ends on dorsal side of body, 0.64 the depth of body from posterior cingular list; rather strongly convex just behind R_2, acute at R_3; R_2 0.25 the depth of body; R_3 arises 0.27 the depth of body from dorsal end of list, fairly weak, 0.67 the depth of body; reticulated, reticulation weak behind R_2. Length, 28.2 μ.

Eastern tropical Pacific.

Description: — This is a fairly small species, with body of rounded carafe-shape in lateral outline; with a rather long, slightly oblique anterior process, broadly rounded posteriorly and deepest in the middle. The anterior process is slightly deeper than long and has an anterodorsal inclination of about 5°. The ratio between the length and the depth of the body is about 1.09: 1. The longitudinal axis is about perpendicular.

The epitheca is about 0.35 as deep as the hypotheca, well convex, highest near the center, and tilted ventroposteriorly at 15°–20°. Dorsally the transverse furrow is rather strongly concave, about 0.52 the greatest depth of the body, 2.5 times wider than ventrally, and inclined dorsoposteriorly at 40°–45°; ventrally it is gently concave. The distance from the apex to the posterior cingular list is about 0.41 the length of body. The anterior margin of the hypotheca is gently concave and inclined dorsoposteriorly at 5°–10°. The dorsal, posterior, and ventral margins of the hypotheca are confluent and semicircular.

The anterior cingular list has an incipient stalk, is inclined anteriorly at about 40° and is approximately 2.5 times wider distally than proximally; it flares asymmetrically, arising farther posterior ventrally than dorsally, with straight ventral and concave dorsal side, twice as much dorsal as ventral extension, and top with slight posteroventral slope; its height is about 0.54 the greatest depth of the body; and it has on each valve five to six complete, subequidistant radial ribs, all of which are simple except the dorsal one, which has three branches. The posterior cingular list is closed, and its dorsal and ventral margins are subparallel to the longitudinal axis; its dorsal height is about 0.57 the greatest depth of the body; it has no ribs except the dorsal and ventral ones, and it lacks structural differentiation with the exception of a slight ventral reticulation. The left sulcal list is of medium size and ends on the dorsal side of the body at a distance from the posterior cingular list equaling about 0.64 the greatest depth of the body. The ventral margin is gently sigmoid in front of the fission rib; between this rib and the posterior main rib the margin is rather strongly convex anteriorly and gently sigmoid posteriorly; at the tip of the posterior main rib it is acute, forming an angle of about 85°; the dorsal margin is gently sigmoid, convex anteriorly and concave posteriorly. The fission rib is straight, about 0.25 the greatest depth of the body, and deflected posteriorly at about 25°. The posterior main rib arises at the antapex of the body and about 0.27 the greatest depth of the body from the dorsal end of the list, is fairly weak, gently sigmoid, and directed posteriorly; its length is about 0.67 the greatest depth of the body. Almost the entire list is reticulated, the meshes being of medium size to rather small; behind the fission rib the reticulation is very faint; in front of this rib it is rather pronounced.

The thecal wall is porulate and deeply reticulated, the meshes being subuniform and medium-sized. The pores are located in the meshes, but by far the greater number of the meshes lack pores. On each valve about 15 meshes border the girdle posteriorly. There is no record of phaeosomes.

The dimensions of the type specimen only were measured.

Dimensions: — Type specimen: Length of body, 28.2 μ. Greatest depth of body, 25.8 μ. Total length, 56.6 μ.

Comparisons: — Our description and figure are based on the type specimen.

The shape of the body and the structure of the left sulcal list indicate that this species is rather closely related to *Parahistioneis diomedeae* and *P. reticulata*, two species from which it differs strikingly in being markedly smaller, in having the anterior cingular list characterized by an incipient stalk, and in the shape of the left sulcal list.

Synonymy: — This species was established by Kofoid and Michener (1911) as *Histioneis karsteni*.

Occurrence: — *Parahistioneis karsteni* is recorded at only one of the 127 stations (4619) on the first line of the Expedition in the Panamic Area. Only one specimen was found in a Salpa taken in surface waters of 79°.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4619 of the Expedition, which thus is the type locality.

Parahistioneis reticulata (Kofoid)

Plate 19, fig. 7, 10. Figure 93: 7

Histioneis reticulata Kofoid, 1907a, p. 205, pl. 15, fig. 95. Okamura, 1912, p. 21, pl. 3, fig. 56a, b.

Diagnosis: — Body gourd-shaped in lateral outline; with long oblique anterior process; hypotheca semicircular; length: depth, 1.15–1.35: 1. Dorsally the transverse furrow is very strongly concave, 0.48–0.54 the depth of body, 1.5

as wide as ventrally, and inclined dorsoposteriorly at 50°. Distance from apex to posterior cingular list 0.50 the length of body. Anterior cingular list sessile; its height 0.32–0.40 the depth of body. Posterior cingular list closed, a large part of it finely reticulated; dorsal height 0.34–0.43 the depth of body. Left sulcal list narrow; ends at or somewhat ventrally to antapex; strikingly sigmoid between R_2 and R_3; R_2 0.12 the depth of body; R_3 arises 0.09–0.20 the depth of body from dorsal end of list, strong but not club-shaped, 0.27–0.37 the depth of body; reticulated. Length, 35.9–44.0 μ.

Tropical and subtropical Pacific.

Description: — The body of this medium-sized species is gourd-shaped in lateral outline; with long, oblique anterior process, broadly rounded posteriorly and deepest in the middle. The anterior process is about 1.30 times longer than deep, and has an anterodorsal inclination of about 25°–30°. The ratio between the length and the depth of the body is 1.15–1.35: 1. The longitudinal axis is perpendicular.

The epitheca is about 0.31 as deep as the hypotheca, well convex, highest in or near the center, and subhorizontal. Dorsally the transverse furrow is very strongly concave, 0.48–0.54 the greatest depth of the body, about 1.5 times wider than ventrally, and inclined dorsoposteriorly at about 50°; ventrally it is gently concave. The distance from the apex to the posterior cingular list is about 0.50 the length of the body. The anterior margin of the hypotheca is moderately and somewhat irregularly concave, and inclined dorsoposteriorly at 5°–10°. The dorsal, posterior, and ventral margins of the hypotheca are confluent and semicircular. When seen in dorsoventral view, the body is carafe-shaped, widest in the middle, and strikingly angular at the junction of the transverse furrow and the hypotheca; the transverse furrow is fairly strongly concave; the antapex is rather narrowly rounded; the outlines of the hypotheca are moderately convex, and flattened or even slightly concave posteriorly; length: width, 1.42: 1.

The anterior cingular list is sessile, of equal width and flare ventrally and dorsally, and with no posterior extension ventrally, inclined anteriorly at about 25°, and about 2.7 times wider distally than proximally; its height is 0.32–0.40 the greatest depth of the body; and it has on each valve about 11–14 subequidistant, complete radial ribs, all of which are simple except the dorsal one which has two branches. The posterior cingular list is closed; the membrane that closes the midventral cleft has five equidistant transverse ribs; the dorsal and ventral margins are subparallel to the longitudinal axis, except anteriorly, where the list is flaring; the dorsal height is 0.34–0.43 the greatest depth of the body, the ventral height is slightly less; it has no ribs except the dorsal and ventral ones, but the larger portion of it is finely reticulated. The left sulcal list is relatively narrow and ends at or somewhat ventrally to the antapex of the body. Its ventral margin is nearly straight in front of the fission rib; between this rib and the posterior main rib the margin is strongly sigmoid; at the tip of the posterior main rib it forms an angle of 40°–50°; the dorsal margin is gently convex, nearly straight. The fission rib is nearly straight, about 0.12 the greatest depth of the body, and deflected posteriorly at about 10°. The posterior main rib arises 0.09–0.20 the greatest depth of the body from the dorsal end of the list, is strong but not club-shaped distally, deflected about 30° from the longitudinal axis, and 0.27–0.37 the greatest depth of the body. The entire list is strikingly reticulated, with the meshes of medium to rather small size.

The thecal wall is porulate and areolate, the areoles being medium-sized. The pores are located in the areoles, but not all the areoles have pores. On each valve 20–25 areoles border the girdle posteriorly. Phaeosomes, some small and ellipsoidal, some large and globular, are found in the transverse furrow.

The dimensions of the type only were measured.

Dimensions: — Type specimen: Length of body, 44.0 μ. Greatest depth of body, 38.2 μ. Total length, 55.5 μ (not 115 μ, as stated in the original description). The two specimens figured by Okamura (1912, pl. 3, fig. 56a, b) were 35.9–39.7 μ long and 27.0–29.5 μ deep.

Comparisons: — Our description and figures are based on the type material. The two specimens represented by Okamura (1912, pl. 3, fig. 56a, b) as *Histioneis reticulata* (?) are figured in a very sketchy manner but nevertheless sufficiently detailed for certainty of specific assignment. Although they are somewhat smaller (35.9–39.7 μ, as compared with 44.0 μ) and narrower (ratio between length and depth, 1.33–1.35: 1, as compared with 1.15: 1) than the type specimen, their allocation undoubtedly is correct.

With regard to the position of *Parahistioneis reticulata* within its genus, see *P. diomedeae*, which is the closest-known relative of this species.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Histioneis reticulata*, and this name was used also by Okamura (1912).

Occurrence: — *Parahistioneis reticulata* is recorded at nine of the 127 stations. There are 2, 0, 0, 4, 3, and 0 stations on the six lines of the Expedition. Of these nine stations, two (4598, 4604) are in the Mexican Current; two (4697, 4699) are in the Easter Island Eddy; and five (4701, 4711, 4722, 4733, 4734) are in the South Equatorial Drift. At one station (4604) the species was taken in a surface haul;

at one station (4733) it occurred in a Salpa taken in surface waters; the remaining records refer to hauls from 300–0 fathoms.

The temperature range of these nine stations at the surface was 72°–84°; the average was 77.9°. At the two stations in the surface waters of which this species was found, the surface temperatures were 84° and 80°.

The frequency is less than 1% except at two stations (4598, 4722), where it is 1%.

The species was first recorded by Kofoid (1907a) from Station 4699 of the Expedition which thus is the type locality. Later it was found by Okamura (1912) in Japanese waters. Its absence from the California and Peruvian Currents is noteworthy.

PARAHISTIONEIS DIOMEDEAE (Kofoid and Michener)

Plate 19, fig. 4, 5. Figure 93: 6

Histioneis diomedeae KOFOID & MICHENER, 1911, p. 294.

Diagnosis: — Body asymmetrically gourd-shaped in lateral outline, with long, oblique, dorsally deflected anterior process; hypotheca semicircular; length: depth, 1.11 : 1. Dorsally the transverse furrow is very strongly concave, 0.43 the depth of body, twice as wide as ventrally, and inclined dorsoposteriorly at 55°. Distance from apex to posterior cingular list 0.47 the length of body. Anterior cingular list sessile, of equal length and flare dorsally and ventrally; its height 0.30 the depth of body. Posterior cingular list closed, in part finely reticulated; dorsal height 0.36 the depth of body. Left sulcal list ends on dorsal side of body, 0.47 the depth of body from posterior cingular list; with two lobes, one rounded, subrectangular at R_2, one narrowly rounded at R_3; R_2 0.33 the depth of body; R_3 arises 0.54 the depth of body from dorsal end of list, club-shaped distally, 0.68 the depth of body; reticulated. Length, 53.5 μ.

Eastern tropical Pacific.

Description: — This is a large species with the body asymmetrically gourd-shaped in lateral outline, with long, oblique anterior process, broadly rounded posteriorly, and deepest in the middle. The anterior process is about 1.25 times longer than deep and has an anterodorsal inclination of about 20°–25°. The ratio between the length and the depth of the body is about 1.11 : 1. The longitudinal axis is perpendicular.

The epitheca is about 0.40 as deep as the hypotheca, well convex, somewhat higher dorsally than ventrally, and tilted ventroposteriorly at 15°–20°. Dorsally the transverse furrow is very strongly concave, 0.43 the greatest depth of the body, about twice as wide as ventrally, and inclined dorsoposteriorly at about 55°; ventrally it is gently concave. The distance from the apex to the posterior cingular list is about 0.47 the length of the body. The anterior margin of the hypotheca is rather strikingly undulating and is inclined dorsoposteriorly at 5°–10°. The dorsal, posterior, and ventral margins of the hypotheca are confluent and semicircular. When seen in dorsoventral view, the body is widest and strongly convex in the middle and has narrowly rounded apices, the outline being gently concave anteriorly and posteriorly; the ratio between the length and the width is 1.58: 1.

The anterior cingular list is sessile, of equal length and flare dorsally and ventrally, inclined anteriorly at about 20°, and about twice as wide distally as proximally; its height is 0.30 the greatest depth of the body; and it has on each valve about 12–14 subequidistant, complete, radial ribs and a number of incomplete, radial marginal ribs; of the complete ribs all are simple except the dorsal one, which has about six branches (Plate **19**, fig. 4). The posterior cingular list is closed, and its dorsal and ventral margins are subparallel to the longitudinal axis; its dorsal height is about 0.36 the greatest depth of the body; it has no ribs except the dorsal and ventral ones, and is finely reticulated dorsally and ventrally. The right sulcal list is crescent-shaped and extends to a point somewhat beyond the fission rib of the left sulcal list; its greatest width is about 0.09 the greatest depth of the body, and it is finely reticulated. The left sulcal list ends on the dorsal side of the body at a distance from the posterior cingular list equaling about 0.47 the depth of the body. It is characterized by having two lobes, one rounded, subrectangular at the fission rib, the other narrowly rounded at the tip of the posterior main rib. The ventral margin of this list in front of the fission rib is almost straight throughout; between the fission rib and the posterior main rib the margin is moderately concave; and the dorsal margin is gently sigmoid, convex anteriorly, and concave posteriorly. The fission rib is nearly straight, about 0.33 the greatest depth of the body, and deflected posteriorly at about 15°–20°. The posterior main rib arises somewhat ventrally to the antapex and about 0.54 the greatest depth of the body from the dorsal end of the list, is club-shaped distally, directed posteriorly, and measures about 0.68 the greatest depth of the body. Dorsally to the posterior main rib this list is finely reticulated; its remaining portion is characterized by a somewhat coarser reticulation except anteriorly, and ventrally to the posterior main rib where no structural differentiation is to be found.

The thecal wall has numerous pores, each of which is surrounded by an areole of moderate and subuniform size. On each valve about 30–35 areoles border the girdle posteriorly. Phaeosomes, some small and ellipsoidal, some large and globular, are found in the transverse furrow.

The dimensions of the type only were measured.

Dimensions: — Type specimen: Length of body, 53.5 μ. Greatest depth of body, 48.2 μ. Total length, 91 μ.

Comparisons: — Our description and figures are based on type material.

The closest-known relative of this species undoubtedly is *Parahistioneis reticulata*, which it resembles in the peculiar gourd-like shape of the outline of the body in lateral view and in the shape and structure of the cingular lists. It is very easily distinguished from this species by its larger size, and by its large, two-lobed left sulcal list, the posterior main rib of which is very long and club-shaped distally. Another close relative is *Histioneis* [*Parahistioneis*] *dentata* Murray and Whitting (1899, pl. 33, fig. 4a, b), which it resembles especially in the shape of the body in lateral as well as in dorsoventral view, and to a less degree in the shape of the posterior portion of the left sulcal list. *Parahistioneis dentata* differs strikingly from the present species in the peculiarly serrated anterior edge of the anterior cingular list and in having the anterior margin of the left sulcal list thickened. The shape of its body and the structure of its left sulcal list also suggest comparatively close relationship to *P. karsteni*, a very small species lacking a lobe in the left sulcal list at the fission rib and having a slightly stalked anterior cingular list.

Occurrence: — *Parahistioneis diomedeae* is recorded at four of the 127 stations. There are 1, 0, 0, 1, 2, and 0 stations on the six lines of the Expedition. Of these four stations, one (4619) is in the Panamic Area; one (4699) is in the Easter Island Eddy; and two (4720, 4724) are in the South Equatorial Drift. At one station (4720) the species was taken in a surface haul; at one station (4619) it occurred in a Salpa taken in surface waters; the two remaining records refer to hauls from 300-0 fathoms.

The temperature range of these four stations at the surface was 75°–79°; the average was 77.3°. At Stations 4619 and 4720 the temperature was 79° and 76°, respectively.

The frequency is less than 1% except at Station 4619 where it is 2%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720. The type specimen is from Station 4699.

Histioneis Stein

Histioneis Stein, 1883, p. 25. Bütschli, 1885, p. 943, 1010. Schütt, 1896, p. 29. Delage & Hérouard, 1896, p. 386.
Histoneis Ostenfeld & Schmidt (*lapsus pennae*), 1901, p. 173.

Diagnosis: — Body of diverse shapes, usually deeper than long; ratio between length and depth, 0.32–1.33: 1. Epitheca small, low, disk-like; its depth 0.07–0.24 the depth of body. Transverse furrow wide dorsally and decidedly wider dorsally than ventrally; dorsal width 0.37–0.77 the depth of body; ventral width 0.09–0.50 the dorsal width. Cingular lists large, closed; anterior funnel-like and stalked (except in *Histioneis paulseni*), its dorsal height 0.57–2.00 the depth of body, its structure variable; posterior usually subcylindrical, its dorsal height 0.47–1.10 the depth of body, and always with one dorsal and one ventral pair of ribs and one cross-rib. Left sulcal list usually large, of diverse shapes, in most species narrowly to broadly tongue-shaped, its greatest width varying from 0.30 to 2.14 the depth of body, and never with more than one main rib behind fission rib.

Type: — We designate as the type species of the genus, *Histioneis remora* Stein (1883, explanation of his pl. 22, fig. 11).

Organology: — The *body* (*theca*) in Histioneis is more diverse in shape than in any of the other large genera of Dinophysoidae, ranging from quite simple to very aberrant types. When seen laterally, it always is more or less asymmetrical, due largely to the shape of the transverse furrow and to the posterodorsal inclination of the longitudinal axis. The hypotheca, however, is symmetrical or subsymmetrical in some of the primitive species. In dorsoventral view the body appears always to be symmetrical just as in the other genera of this tribe. The minimum posterodorsal inclination of the longitudinal axis (*l.a.*, Figure 94) is about 5°–10° (*H. inornata* and *H. inclinata;* Figure 95: 10, 13); the maximum inclination is 50°–60° (*H. josephinae*, Figure 96: 7). The inclination, which is somewhat variable even within the species, is difficult to determine with accuracy, since the antapex is not clearly marked in most species. The information given on this point in our descriptions of species should thus be regarded as approximative.

When seen laterally, the *body* sometimes (*e.g.*, *Histioneis inclinata*, Figure 95: 13; *H. remora*, Stein, 1883, pl. 22, fig. 11) is about as long as deep, but usually it is deeper than long. In the species with the most pronounced dorsoventral elongation (*H. mitchellana*, Figure 96: 4), the ratio between the length and the depth of the body is 0.32–0.53: 1. *H. panda*, in which this ratio is about 0.36: 1, has a curved, sausage-shaped body with an average height only about 0.23 the depth, measured along the curvature of the body (Figure 95: 9). In only two of the known species (*H. biremis* and *H. highleyi;* Figure 95: 11, 14) the body is longer than deep; in the latter species the ratio between the length and the depth may be as high as 1.33: 1.

There is no shape of *body* that can be said to be typical of this genus. In most of the more or less primitive and in some of the highly differentiated species,

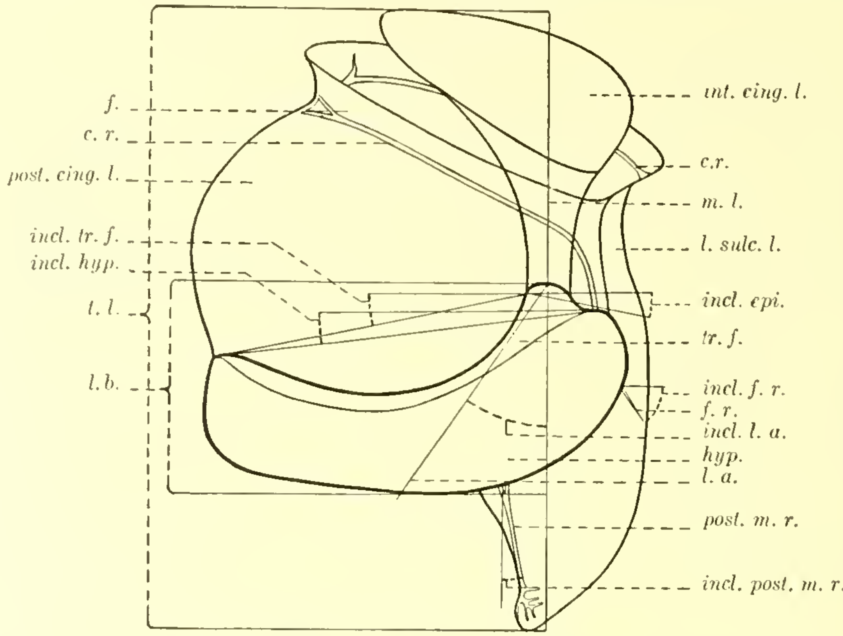

FIGURE 94.— Terminology and methods of measurement in Histioneis.

Terminology: — The midline is the line drawn through the center of the epitheca and the central axis of the proximal portion of the anterior cingular list. If the longitudinal axis of the body were not inclined, it would coincide with the midline. In the specimen represented by this figure the longitudinal axis of body is inclined *posterodorsally*, the transverse furrow *dorsoposteriorly*, and the epitheca *ventroposteriorly*. The fission rib (R_2) is the rib of left sulcal list at place where this list is divided in binary fission. The posterior main rib (R_3) is the rib of left sulcal list near posterior end of this list, or, in the case that more than one rib is present in this region, the best developed of these. The frill is the portion of posterior cingular list in front of cross-rib, *i.e.*, the rib that in the more or less primitive species runs about parallel to anterior margin of this list.

Methods of Measurement: — Measurements are made in straight lines, if not otherwise stated. Proportions of theca measured as if all parts were in the same plane, *i.e.*, as they appear in drawings. The length of body is distance between the two perpendiculars to midline that pass through the apices of body. The depth of body is measured perpendicularly to midline. The inclination of longitudinal axis of body is the angle between this line and midline. The depth of epitheca is measured along base of anterior cingular list. The dorsal width of transverse furrow is measured in a straight line between dorsal points of epitheca and hypotheca when it is compared with the depth of body, and along curvature of furrow between these two points when it is compared with the ventral width of the furrow. The inclination of this furrow is the angle between a perpendicular to midline and the line joining the dorsal points of epitheca and hypotheca. The inclination of the epitheca and of the hypotheca also refers to a perpendicular to midline. The widths (heights) of cingular lists are measured in straight lines dorsally, when the organism is seen in lateral view. The position of posterior cingular list is expressed in the ratio between the shortest distance from apex to this list and the length of the base of this list, measured along the curvature. The inclination of R_2 is the angle between this rib and a perpendicular to midline. The inclination of R_3 is the angle between this rib and a line drawn parallel to midline and through base of rib.

Abbreviations: — *ant. cing. l.*, anterior cingular list; *c. r.*, cross-rib of posterior cingular list; *f.*, frill of posterior cingular list; *f. r.*, fission rib; *hyp.*, hypotheca; *incl. epi.*, inclination of epitheca; *incl. f. r.*, inclination of fission rib; *incl. hyp.*, inclination of hypotheca; *incl. l. a.*, inclination of longitudinal axis; *incl. post. m. r.*, inclination of posterior main rib; *incl. tr. f.*, inclination of transverse furrow; *l. a.*, longitudinal axis; *l. b.*, length of body; *l. sulc. l.*, left sulcal list; *m. l.*, midline; *post. cing. l.*, posterior cingular list; *post. m. r.*, posterior main rib; *t. l.*, total length; *tr. f.*, transverse furrow.

the body, seen in lateral view, is subrotund (*Histioneis costata*, Figure 95: 4; *H. inclinata*, Figure 95: 13) or subrotund and truncate anteriorly (*H. inornata*, Figure 95: 10; *H. reginella*, Figure 95: 2) with symmetrical or subsymmetrical hypotheca. Other shapes of body, seen laterally, recorded in this genus are as follows: — pyriform, with the long axis in the horizontal plane and the greatest height dorsally (*H. hyalina*, Figure 95: 5); bean-shape (*H. pacifica*, Figure 95: 12); short to long canoe-shape, higher ventrally than dorsally (*H. carinata*, Figure 95: 1; *H. navicula*, Figure 95: 3); long canoe-shape, higher dorsally than ventrally (*H. mitchellana*, Figure 96: 4); short to long saddle-shape (*H. dolon*, Figure 96: 6; *H. josephinae*, Figure 96: 7; *H. pulchra*, Figure 96: 2); curved sausage-shape (*H. panaria*, Figure 95: 6; *H. panda*, Figure 95: 9); irregular, dorsoventrally elongated, with fairly long and narrow, well-marked posterodorsal protuberance (*H. biremis*, Figure 95: 11); Y-shape (*H. highleyi*, Figure 95: 14). Between most of these shapes transitions are to be found. Judging by the very limited number of specimens of each species available at the present writing, the shape of the body appears to be fairly constant within the species; see, for instance, Figure 97 and 98 of *H. biremis* and *H. highleyi*.

The *body* is always more or less compressed bilaterally. In some of the species with the body elongated dorsoventrally, the body is about as long as wide in dorsoventral view; and in the species with the most pronounced bilateral compression (*Histioneis costata*, Plate **20**, fig. 10; *H. navicula*, Plate **21**, fig. 3), the ratio between the length and the transdiameter (width) is about 1.6: 1. In the species with the body subrotund in lateral outline, the hypotheca usually is ellipsoidal in dorsoventral view, and the anterior portion of the body is rounded conical (*H. costata*, Plate **20**, fig. 10; *H. longicollis*, Plate **20**, fig. 5). In the more highly differentiated species, with the body more or less elongated dorsoventrally, the body, as a rule, is subrotund to pear-shaped in dorsoventral outline, more or less broadly rounded posteriorly (*e.g.*, *H. carinata*, Plate **21**, fig. 1; *H. pulchra*, Plate **21**, fig. 4; *H. hippoperoides*, Plate **23**, fig. 1).

One of the most characteristic features of Histioneis, when compared with Ornithocercus, is the strikingly small size of the *epitheca*. This structure forms an ellipsoidal to subcircular, gently vaulted to flat disk, the depth of which in lateral view is from about 0.07 to about 0.24 the greatest depth of the hypotheca (*H. panda*, Figure 95: 9; *H. costata*, Figure 95: 4). In some species (*e.g.*, *H. pacifica*, Figure 95: 12) it is subhorizontal; in others it is inclined dorsoposteriorly or ventroposteriorly at somewhere between 1° and 15° (*e.g.*, *H. dolon*, Figure 96: 6; *H. navicula*, Figure 95: 3).

Due to the small size of the epitheca, the *transverse furrow* (*tr. f.*, Figure 94) is always situated near the anterior end of the body. Its distal portion is not displaced posteriorly, *i.e.*, it does not form a spiral about the body; and its postmargin very seldom is straight but usually more or less concave or sigmoid. In all the known species it is strikingly wider dorsally than ventrally, its ventral width being from about 0.50 to about 0.09 the dorsal width (*Histioneis paulseni*, Figure 95: 8; *H. navicula*, Figure 95: 3). Dorsally it either is inclined dorsoposteriorly or dorsoanteriorly, or it is subhorizontal. Dorsoposterior inclination is found among primitive as well as among advanced species (*H. costata*, Figure 95: 4; *H. biremis*, Figure 95: 11); the same is true in the case of the subhorizontal position (*H. inornata*, Figure 95: 10; *H. mitchellana*, Figure 96: 4); but dorsoanterior inclination is found only among the highly differentiated members (*e.g.*, in the PULCHRA and DOLON groups). The maximum dorsoposterior inclination hitherto recorded is about 35° (*H. paulseni*, Figure 95: 8); and the maximum dorsoanterior inclination is about 30° (*H. josephinae*, Figure 96: 7). Sometimes the transverse furrow is nearly flat, sometimes gently to strongly concave. It is flat or nearly so among primitive as well as advanced species (*H. costata*, Figure 95: 4; *H. reginella*, Figure 95: 2); a moderate concavity is also found among both primitive and advanced species (*H. paulseni*, Figure 95: 8; *H. biremis*, Figure 95: 11); on the other hand, a strong concavity has been recorded only among the highly differentiated members (*H. highleyi*, Figure 95: 14; *H. josephinae*, Figure 96: 7). The strong concavity and the great dorsal width of the transverse furrow are correlated with the tendency inherent in this genus to increase the space enclosed by the posterior cingular list. The ratio between the dorsal width of this furrow (measured in a straight line between the dorsal points of the epitheca and of the hypotheca) and the greatest depth of the body ranges from about 0.37: 1 (*H. hippoperoides*, Figure 96: 5) to 0.77: 1 (*H. navicula*, Figure 95: 3). Ventrally this furrow is either flat, or gently concave or convex. The distance from the apex to the posterior cingular list sometimes (*H. paulseni*, Figure 95: 8) is as much as about 0.43 the length of the body, but usually it is very small.

The length of the *longitudinal furrow* is unknown in most species, but judging by the available data it seems nearly always to be short. This furrow has not been found as yet to extend far beyond the fission rib of the left sulcal list, and it appears usually to end at or very near to this rib, which, as a rule, originates but a short distance behind the transverse furrow. Anteriorly it does not extend beyond the girdle, *i.e.*, into the epitheca; and it is at most but slightly impressed.

Just as in Ornithocercus, the *lists of the furrows* are very large, and frequently

FIGURE 95.— Histioneis, right lateral view. × 700. 1, *H. carinata* Kofoid, Station 4724 (300–0 fathoms); 2, *H. reginella* Kofoid and Michener, Station 4681 (300–0 fathoms); 3, *H. navicula* Kofoid, Station 4734 (300–0 fathoms); 4, *H. costata* Kofoid and Michener, Station 4604 (surface); 5, *H. hyalina*

they are also characterized by their high structural differentiation. They arise from low and narrow basal ridges (Plate 20), and although large, they are always hyaline and very delicate.

The *anterior cingular list* (*ant. cing. l.*, Figure 94) is closed and funnel-shaped, and its anterior inclination is at least about 40° on the dorsal side. On the ventral side the inclination is always somewhat steeper than dorsally. With only one known exception, viz., the primitive *Histioneis paulseni* (Figure 95: 8), this list is stalked, *i.e.*, its proximal end forms a narrow tube of subuniform caliber. The stalk may be short, as in *H. costata* (Figure 95: 4); of moderate length, as in *H. carinata* and *H. navicula* (Figure 95: 1, 3); or very long, occupying by far the greater portion (three-fourths) of the very extended list, *e.g.*, in *H. hyalina*, *H. longicollis*, and *H. inornata* (Figure 95: 5, 7, 10). In the most primitive as well as in some of the highly differentiated species, this list has a very pronounced distal flare, and nearly always the dorsal flare is decidedly stronger than the ventral (*H. costata* and *H. mitchellana;* Figure 95: 4; Figure 96: 4). In other species the distal flare is moderate (*H. longicollis*, Figure 95: 7) to very slight (*H. striata* and *H. hippoperoides;* Figure 96: 1, 5). In the species with the most pronounced distal flare (*H. mitchellana*, Figure 96: 4) this list may be as much as about 13 times wider distally than proximally; while in *H. hippoperoides* (Figure 96: 5), which forms the opposite extreme, the corresponding value may be as low as 2. Sometimes (*e.g.*, *H. costata* and *H. carinata;* Figure 95: 4, 1) the right side of this list is distinctly lower than the left, sometimes (*e.g.*, *H. pulchra* and *H. mitchellana;* Figure 96: 2, 4) there is no such difference. In some species (*e.g.*, *H. reginella*, *H. dolon*, and *H. josephinae;* Figure 95: 2; Figure 96: 6, 7) this list has a more or less pronounced ventral notch; and it may be characterized by a dextral torsion (*e.g.*, *H. reginella* and *H. panaria;* Figure 95: 2, 6). Its dorsal height ranges from 0.57 to 2.00 the greatest depth of the body (*H. paulseni* and *H. dolon;* Figure 95: 8; Figure 96: 6); and its ventral height is nearly always somewhat less and never greater than the dorsal. The structural differentiation of this list is characterized by two outstanding peculiarities: — first, it is much more regular among the primitive than among the advanced species; and, second, it is asymmetrical, being, as a rule, better developed on the left than on the right valve.

This phenomenon of the more advanced development of structures on the

Kofoid and Michener, Station 4720 (surface); 6, *H. panaria*, sp. nov., Station 4724 (300–0 fathoms); 7, *H. longicollis* Kofoid, Station 4711 (300–0 fathoms); 8, *H. paulseni* Kofoid, Station 4711 (300–0 fathoms); 9, *H. panda* Kofoid and Michener, Station 4724 (300–0 fathoms); 10, *H. inornata* Kofoid and Michener, Station 4720 (Salpa); 11, *H. biremis* Stein, Station 4709 (300–0 fathoms); 12, *H. pacifica*, sp. nov., Station 4741 (Salpa); 13, *H. inclinata* Kofoid and Michener, Station 4720 (Salpa); 14, *H. highleyi* Murray and Whitting, Station 4722 (300–0 fathoms).

left side is a fundamental one in the Dinoflagellata. The transverse flagellum proceeds from left to right, the left sulcal list is more developed than the right, the ocellus is on the left side, and the intercalary plate of Heterodinium is on the left shoulder. The fact that the centrosome lies in this region (Hall, 1924, 1925) and that the flagella have their origin here, though emerging through the pore in the right valve, is significant in this connection.

The asymmetry is, generally speaking, more pronounced in the primitive than in the highly advanced members. The most primitive condition, resembling that of the species of Ornithocercus, is to be found in *Histioneis paulseni* (Plate 20, fig. 1, 2), the only species in which this list is not stalked. In this species there are on the right valve about six ribs, all of which are simple except the dorsal one, which has three branches; on the left valve the number of ribs in this list is slightly greater. *H. costata* (Plate 20, fig. 3), another primitive species, has the difference between the halves still more accentuated. In this species there are on the right valve only three ribs, of which the dorsal and ventral are simple, while the middle has two branches; on the left valve this list has distally about fifteen ribs, the proximal ends of which form a reticulum. About the same condition as in the latter species is also found in *H. carinata*, *H. navicula*, and *H. biremis*, and in some of their close relatives (Plate 21, fig. 1, 3, 8). The branching of the dorsal rib of the left half or of both the left and right halves is a feature presumably characteristic of the ancestral forms of Histioneis (compare *Ornithocercus formosus*, Plate 17, fig. 4, and the species of Parahistioneis, Plate 19). In some of the highly advanced members of Histioneis, this list is reticulated; the reticulation is either more or less developed, wide meshed, and irregular, as in *H. josephinae* (Plate 22, fig. 1–3), or it is fine meshed, as in *H. mitchellana* (Plate 21, fig. 2). In others of these highly developed forms this list may have, besides some irregular and sometimes reticulated ribs, a submarginal rib with a series of subequidistant anterior branches (*H. reginella* and *H. hippoperoides;* Plate 20, fig. 9; Plate 23, fig. 1, 3). Or, again, it may be nearly without structural differentiation, as in *H. longicollis* (Plate 21, fig. 5). In all these advanced species the ribbing is limited to the distal portion of the list; the stalk lacks structural differentiation. It may finally be mentioned that in some species (*e.g.*, *H. costata* and *H. josephinae;* Plate 20, fig. 3; Plate 22, fig. 2) the tips of the ribs extend slightly beyond the edge of the list.

When fully developed, the *posterior cingular list* (*post. cing. l.*, Figure 94) is closed except posteroventrally, where it probably always opens into the canal formed by the right sulcal list. The presence of this canal has not been established as yet, but appears very probable on account of the peculiar structure of the right sulcal list (see Plate 20, fig. 7, of *Histioneis elongata*). In some of the specimens figured by us (*H. carinata*, *H. biremis*, and *H. josephinae;* Figure 95: 1, 11; Figure 96: 7) the posterior cingular list has a ventral split, but this is presumably but a temporary condition, possibly attending fission, since specimens with and without such a split have been found in the same species (*H. biremis*). In the most primitive species (*H. costata*, *H. paulseni*, *H. inclinata;* Figure 95: 4, 8, 13) this list forms a cylindrical, upright collar of moderate height, about as high ventrally as dorsally or but slightly lower ventrally than dorsally, with nearly straight or but slightly sigmoid dorsal, ventral, and lateral outlines, and with the anterior opening subequal to the basal circumference. The minimum height on the dorsal side is about 0.47 the greatest depth of the body (*H. paulseni*, Figure 95: 8). From this fundamental type a fairly great number of variants have evolved. In some species this list has maintained its original shape but has increased very strikingly in height; as examples of this kind we may mention *H. longicollis* and *H. mitchellana* (Figure 95: 7; Figure 96: 4), in which the dorsal height is 0.91 and 1.10 the greatest depth of the body, respectively. In other species the main change consists in the decided difference between the dorsal and ventral heights; for instance, in *H. highleyi* (Figure 95: 14) the average dorsal height is 0.62, the average ventral height 0.37 the greatest depth of the body. In *H. elongata* (Figure 96: 3) this list is not only higher than in the primitive species, but it is characterized also by a pronounced difference between the dorsal and ventral heights, the dorsal height being about 0.95, the ventral 0.72 the greatest depth of the body. The greatest dorsal height recorded as yet, viz., 1.40–1.42 the greatest depth of the body, was found in *H. dolon* (Figure 96: 6), a species in which this list is characterized also by other changes (see below).

In *H. carinata* (Figure 95: 1) this list grows narrower anteriorly; and this peculiarity reaches its most striking development in *H. panda* (Figure 95: 9), which is characterized by a very narrow anterior opening and a very large basal circumference. In other forms (*e.g.*, *H. navicula*, Figure 95: 3) it is more or less strongly constricted just behind the anterior margin, which thus becomes flaring. *H. inornata* (Figure 95: 10) is characterized by having the anterior opening of this list wider than the basal circumference. In some species the dorsal margin of this list is evenly or irregularly concave (*H. josephinae* and *H. hippoperoides;* Figure 96: 7, 5); in others it is more or less bulging (*H. navicula*, Figure 95: 3). Perhaps the most important change in the shape of this list is due to the development of lateral pouches, one on each side. The pouches are fairly small in some species (*e.g.*, in *H. pulchra* and *H. dolon;* Plate 21, fig. 4; Murray and Whitting, 1899, pl. 33, fig. 5b); in others (*e.g.*, *H. hippoperoides*, Plate **23**, fig. 1) they are of medium size; and they reach their greatest size in *H. panda*, *H. panaria*, and *H. reginella* (Figure 95: 9; Figure 85: 8; Plate **20**, fig. 11). In *H. panaria* the pouches are broadly rounded in dorsoventral view, and each of them is slightly wider than the body; in *H. reginella* they are fairly narrowly rounded, and each of them is slightly narrower than the body.

The structural differentiation of this list is simple and uniform in the primitive species. These have only a pair of simple, dorsal ribs, one rib on either side of the sagittal suture, a similar pair ventrally, and a simple cross-rib running submarginally to the anterior edge of the list, turning posteriorly on the ventral side of it, and connecting with the dorsal ribs. The portion of the list in front of the cross-rib is called the *frill*. From this fundamental type, which can be recognized even in the most advanced members of the genus, some variants have evolved. First, there is a tendency among the advanced species for the frill to become progressively higher. For example, in *H. mitchellana* (Figure 96: 4) it is decidedly larger than the rest of the list. The enlargement of the frill, which is more pronounced on the dorsal side of the list than in the middle, and which progresses until the cross-rib issues from near the base of the dorsal ribs (Figure 96: 6), is in some species (*e.g.*, *H. pacifica*) the only change to be recorded. Second, the cross-rib tends to be branched. Branches may be developed only on its anterior side, in other words in the frill (*e.g.*, *H. panaria*, Figure 95: 6), or on both its anterior and its posterior sides (*e.g.*, *H. reginella*, Figure 95: 2). The branches of this rib are first simple and nearly straight, but they tend to become irregular and branched, and to form a wide-meshed or a fine-meshed reticulum (*H. pulchra*, Figure 96: 2; *H. mitchellana*, Plate **21**, fig. 2). Third, accessory ribbing usually is confined to the frill (*H. mitchellana*, Plate **21**, fig. 2) and is always better developed anteriorly than posteriorly. Irregular ribs may develop posteriorly; for instance, on the lateral pouches of *H. reginella* (Plate **20**, fig. 9, 11) and from the postmargin of this list in *H. hippoperoides* (Plate **23**, fig. 1). Fourth, in some of the species with a high frill a secondary frill is present (*H. panda*, Figure 95: 9; and the species of the Dolon group, Figure 96: 6). The cross-rib that borders this secondary frill may be either simple or branched, and the branches may be present only on the anterior side (*H. dolon*, Figure 96: 6), or anteriorly as well as posteriorly (*H. hippoperoides*, Figure 96: 5).

The *right sulcal list* is known in two species only, viz., in *Histioneis elongata* (Plate **20**, fig. 7) and in *H. josephinae* (Figure 96: 7), and in these it is very small and difficult to detect. In the former species, which may present the condition

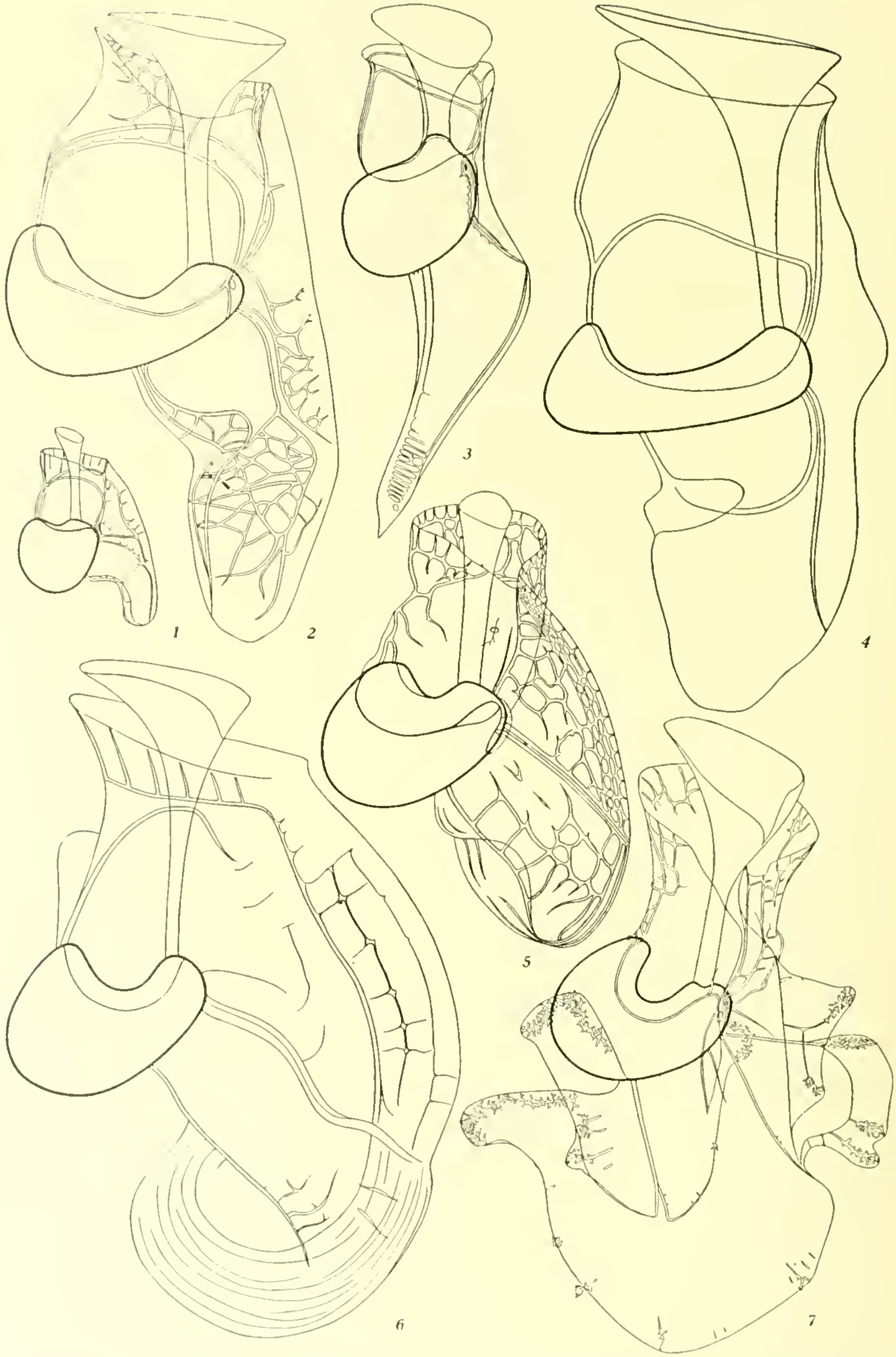

FIGURE 96.— Histioneis, right lateral view. × 700. 1, *H. striata* Kofoid and Michener, Station 4720 (Salpa); 2, *H. pulchra* Kofoid, Station 4730 (300–0 fathoms); 3, *H. elongata* Kofoid and Michener,

primitively typical of this genus, the ventral margin of this list is attached to the base of the left sulcal list. Thus a canal is formed, which opens posteriorly at the fission rib of the left sulcal list and presumably also into the girdle. The water caused by the movements of the transverse flagellum to enter the girdle probably passes out through this canal. In *H. josephinae* the right sulcal list continues beyond the margin of the theca to a distance slightly greater than from that point to the flagellar pore; it is very narrow at this pore, lanceolate posteriorly, and has a rib along the dorsal margin.

The *left sulcal list* (*l. sulc. l.*, Figure 94), which usually is rather large, has undergone very profound structural modifications and affords very important taxonomic features; indeed, the systematic subdivisions of this genus suggested by us are to a very large extent based on differences in this list. In only two of the known species (*Histioneis costata* and *H. mitchellana;* Figure 95: 4; Figure 96: 4) does this list extend slightly beyond the antapex of the body; in the remaining species it ends somewhere between the antapex and the point midway between the antapex and the flagellar pore. In *H. inclinata* (Figure 95: 13), which is characterized by having this list smaller than in any of the other members of this genus, this list ends about midway between the antapex and the flagellar pore, and its maximum width is about 0.30 the greatest depth of the body. In *H. dolon* (Figure 96: 6), which has this list of an extraordinary size, it ends at about the same place as in *H. inclinata*, but its width at the fission rib and at the posterior main rib equals not less than 1.45–1.61 and 1.70–1.80 the greatest depth of the body. Finally, in *H. elongata* (Figure 96: 3), which has this list unusually long and narrow, the posterior main rib of this list measures not less than about 2.14 the greatest depth of the body (in the case of the fission rib of this species, the corresponding value is not more than about 0.57). In one species (*H. reginella*, Figure 95: 2) the posterior portion of this list turns anteriorly on the right side of the body and ends near the posterior end of the longitudinal furrow. In all the known species except one (*H. inclinata*, Figure 95: 13) the portion of this list which is in front of the fission rib is decidedly smaller than the posterior; and it is this posterior portion which has been especially subject to structural differentiation.

The shape of this list is exceedingly variable, as will be seen from the following representative examples. In *H. inornata* (Figure 95: 13) this list is very short, not extending even to the level of the antapex of the body, of subuniform width

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Station 4722 (300–0 fathoms); 4, *H. mitchellana* Murray and Whitting, Station 4699 (300–0 fathoms); 5, *H. hippoperoides* Kofoid and Michener, Station 4590 (300–0 fathoms); 6, *H. dolon* Murray and Whitting, Station 4697 (300–0 fathoms); 7, *H. josephinae* Kofoid, Station 4699 (300–0 fathoms).

throughout and very narrow, its maximum width being only about 0.30 the greatest depth of the body; its ventral margin is gently sigmoid, concave anteriorly, and convex posteriorly; and its postmargin is subcircular. In *H. inclinata* (Figure 95: 10) this list differs from that of the latter species mainly in being slightly longer, extending somewhat beyond the level of the antapex of the body, and in having the postmargin sigmoid instead of subcircular. The left sulcal list of *H. navicula* (Figure 95: 3) is also comparatively small, ending somewhat ventrally to the antapex and having a maximum width, at the posterior main rib, only 0.36 the greatest depth of the body; its ventral margin is moderately and evenly convex, its dorsal margin gently concave, and these margins form together an angle of 60°–70° at the posterior main rib. In *H. costata* (Figure 95: 4) this list is fairly large, extending slightly beyond the antapex and with a maximum width (at the posterior main rib) about 0.67 the greatest depth of the body, and squarish in shape, its margin being angular somewhat behind the fission rib as well as at the posterior main rib. This is the only example of biangularity known in this genus. In many species (*e.g.*, *H. carinata*, *H. hyalina*, *H. paulseni*, *H. pacifica*, Figure 95: 1, 5, 8, 12; *H. pulchra*, *H. elongata*, Figure 96: 2, 3) this list is large and of a narrow tongue-shape; its ventral margin is gently convex or sigmoid; its dorsal margin, gently concave, straight, gently convex, or sigmoid; and posteriorly, *i.e.*, at the posterior main rib, it is acute to subacute, or narrowly to rather broadly rounded. Finally, in some species (*e.g.*, *H. hippoperoides* and *H. dolon*, Figure 96: 5, 6) this list is very large (see above) and broadly tongue-shaped; and in *H. josephinae* (Figure 96: 7) it is very large, broadly rounded posteriorly, and furnished with a narrowly rounded dorsal projection, the length of which is approximately 0.6 the greatest depth of the body. Originally this list was but slightly or gently curved, and this condition is still characteristic of most of the known species (see, for instance, *H. paulseni* and *H. costata*, Plate **20**, fig. 2, 10; *H. carinata* and *H. navicula*, Plate **21**, fig. 1, 3; *H. elongata*, Plate **22**, fig. 4). Sometimes, however, its entire dorsal margin is strongly curled to the right (*H. hyalina*, Figure 95: 5; *H. striata*, Figure 96: 1). This peculiarity is further advanced in *H. pulchra* (Figure 96: 2), in which the middle portion of this margin forms a fairly large, narrowly rounded lobe. It reaches its highest development in *H. mitchellana* (Figure 96: 4); in this species the lobe is represented by a very circumscribed, tongue-shaped to subcircular flap, the dorsoventral width of which is 0.34–0.38 the greatest depth of the body. In *H. navicula* (Plate **21**, fig. 6) the ventral margin is turned to the right; and in *H. reginella* (Plate **20**, fig. 9) the entire list is strongly curled to the right.

In the species of the Dolon group this list is characterized by one to three accessory fins. When only one accessory fin is developed (*H. dolon* and *H. hippoperoides;* Figure 96: 6, 5), this is always posterodorsal and transverse in position. Its shape usually is rounded (*H. dolon*, Murray and Whitting, 1899, pl. 33, fig. 5b) but may be pear-like (*H. milneri*, Murray and Whitting, 1899, pl. 33, fig. 1b). It is either (*H. dolon*) very large, with a diameter not less than 1.64 the depth of the body; or (*H. milneri*) of moderate size, its diameter being only about 0.70 the depth of the body. More than one accessory fin is present in only one of the known species, viz., *H. josephinae* (Figure 96: 7). One of these fins arises along the originally free ventral edge of the list in front of the fission rib, one from the left side of the fission rib, and one, or perhaps better a pair, transversely from the posterior main rib; the first two fins are large and squarish, the last is large and shaped like a pair of butterfly wings.

In no species of this genus does this list have more than two main ribs, viz., the fission rib and the posterior main rib. The *fission rib* (*f. r.*, Figure 94) originally was straight and subhorizontal, and this condition still prevails in some of the primitive species (*H. inornata* and *H. inclinata;* Figure 95: 10, 13). Usually, however, it is more or less deflected posteriorly, and this progressive deflection has reached its maximum in *H. mitchellana* (Figure 96: 4), in which the anterior member of this rib is directed straight posteriorly. Originally the two members of this rib were lying close together along their entire extension, but in the species of the Longicollis and Pulchra groups the posterior member is recurved dorsally and joins the posterior main rib near the middle. In the primitive and in some of the advanced species the fission rib is very short, its minimum length being about 0.12 the greatest depth of the body (*H. navicula*, Figure 95: 3); but it shows a tendency to become progressively longer and in *H. dolon* (Figure 96: 6) it reaches its maximum length, viz., 1.61 the greatest depth of the body. The *posterior main rib* (*post. m. r.*, Figure 94), which is absent in only one of the known species (*H. inclinata*, Figure 95: 13), usually is marginal or submarginal, enforcing the dorsal edge of the list. Only in one species (*H. josephinae*, Figure 96: 7) does it run far from the dorsal margin, and even in this species it arises near the dorsal end of the list. As a rule, this rib extends to the posterior end of the list, but it may be only about half as long as the posterior width of the list (*H. josephinae*, Figure 96: 7). Its length and strength are very variable; it may be weak and only about 0.22 the greatest depth of the body (*H. inornata*, Figure 95: 10), or strong and not less than 2.14 the greatest depth of the body. In only one of the known species (*H. costata*, Figure 95: 4) is it deflected posterodorsally (at about 15°); in the remaining ones it is more or less deflected posteroventrally. Its shape is variable; it may be almost straight (*H. costata*, Figure 95: 4), gently sigmoid (*H. carinata*, Figure 95: 1), or gently to fairly strongly concave dorsally (*H. elongata* and *H. striata;* Figure 96: 3, 1).

Besides the main ribs this list may have the following structural differentiations. First, a few short (incomplete) ribs between the fission rib and the posterior main rib (*H. paulseni*, Figure 95: 8). Second, one to four submarginal ribs along the ventral margin in front of the fission rib (*H. hippoperoides* and *H. dolon;* Figure 96: 5, 6); and one marginal or one submarginal rib along the ventral margin behind the fission rib (*H. paulseni* and *H. elongata;* Figure 95: 8; Figure 96: 3). Third, a number of radial ribs behind the fission rib (*H. inclinata*, Figure 95: 13). Fourth, a wide-meshed or a fine-meshed reticulum. The reticulum varies in extension; sometimes it is confined to the posterior end of the list, where it may be very heavy (*H. elongata*, Figure 96: 3); sometimes it covers the larger portion of it (*H. hippoperoides*, Figure 96: 5; *H. mitchellana*, Plate **21**, fig. 2). Fifth, the posterior transverse fin of most of the species of the Dolon group is characterized by a concentric striation. Sixth, in *H. josephinae* (Figure 96: 7) this list is characterized by peculiar coral-like thickenings.

Parasagittal lists have thus far not been found in this genus.

The *flagellar pore* is a rounded or slightly elongated opening of moderate to rather small size, located to the right in the transverse furrow, *i.e.*, on the right valve, at or slightly behind the posterior cingular list; its maximum diameter is about 3 μ. There are no records of pores of the kind found in Phalacroma (Plate **3**, fig. 1, 2, of *P. pulchrum* and *P. giganteum*) on the ventral side of the left valve, near the sagittal suture, and just in front of the anterior cingular list.

The *longitudinal flagellum* has not been recorded as yet. The *transverse flagellum* has been observed in one species only, viz., in *Histioneis mitchellana* (Plate **21**, fig. 2). In this species it is short, undulating, arises in the flagellar pore, and encircles the narrow base of the anterior cingular list from the right around to the left. The last peculiarity is unquestionably due to a dislocation brought about when the specimen was killed in the preserving fluid (formalin), since in all other known cases this flagellum encircles the body from the left around to the right and since it, on fixation, contracts into a close spiral which is thrown into various positions out of the normal one in the girdle.

In most of the primitive species and in the members of the Remora and Biremis groups, the *thecal wall* is areolate or faintly reticulate as well as porulate. The meshes of the reticulation always are fairly small, subequal, and rounded to angular. In some of these forms nearly every mesh or areole has a central pore (*Histioneis carinata*, Plate **21**, fig. 8); but in others (*H. paulseni*, Plate **20**, fig. 1; *H. inclinata*, Plate **22**, fig. 5) the number of pores is decidedly less than the number of meshes or areoles. In *H. inornata*, *H. reginella*, and *H. panaria*, and in all the members of the highly differentiated species of the Longicollis, Pulchra, and Dolon groups, on the other hand, the thecal wall is porulate but lacks every indication of reticulation and areolation. In these species, too, the number of pores is decidedly variable. In some (*e.g.*, *H. striata*, Plate **20**, fig. 6) it is very small, in others (*e.g.*, *H. josephinae*, Plate **22**, fig. 1, 2) large. When a great number is present, there is usually a close-set row on either side of the posterior cingular list and of the sagittal suture, as well as scattered pores. Originally the theca probably was areolate and porulate. In some species pores have not been observed, but they probably are always present.

Very little is known about the *protoplasmic contents*. The *nucleus*, which has a moniliform chromatin reticulum, may be small, rounded, and located near the center of the body (Plate **22**, fig. 6); or it may be fairly large, ovoidal, and located posterodorsally (Schütt, 1895, pl. 5, fig. 23). At least one large *pusule* opens into the flagellar pore (Plate **22**, fig. 6). *Chromatophores* appear always to be absent.

Ovoidal or round *phaeosomes*, of small or medium sizes, are frequently found in the girdle. Sometimes they occur in very large numbers (*H. highleyi*, Figure 98: 1). Their color is green, pale olivaceous, or yellowish green. The enlarged girdle serves throughout as a generalized phaeosome chamber in this genus.

The *length of the body* ranges within the genus from 13.3 μ (*Histioneis inornata*) to 88.7 μ (*H. biremis*); in our material the maximum length is 66.5 μ (*H. highleyi*).

Distribution: — The species of Histioneis may be compared in some particulars with the orchids and the hummingbirds; they are very multiform, aberrant, and beautiful in shape, brilliant in colors, exceedingly rare, and reach their highest development in the tropics. Like the species of Ornithocercus, Parahistioneis, Amphisolenia, and Triposolenia, they contribute to the striking contrast between the plankton of the warm equatorial regions and that of the cold polar seas. The genus is marine, of circumequatorial distribution, and appears to avoid coastal waters even more than does any other genus of Dinophysoidae. Most of its species seem to be restricted to tropical and subtropical seas; only a few of them occur in the Mediterranean. In the Atlantic Ocean as well as in the Pacific, its northern limit appears to be about lat. 35° N.; the limits of its southern extension are unknown not only in the Atlantic and Indian Oceans but also in the Pacific, since it was found by us at our southernmost station. The general distribution of the genus as a whole as well as of the individual species is very uncertain, due to the scarcity of distributional data available at the present time. This paucity of data undoubtedly arises from the extreme rarity of these highly specialized organisms, and in part from their small size.

Our knowledge of the vertical distribution of the genus is also very incomplete. Nearly all of the records of this genus published at the present writing are from surface hauls. No records based on catches made with closing nets have been published as yet. Every one of the species is very rare.

Representatives of Histioneis were found at thirty-eight (29.9%) of the 127 stations of the Expedition from which dinoflagellates were recorded. These thirty-eight stations are distributed over the whole area covered by the Expedition in the following manner (Plate 30): —

0 (0.0%) out of the 4 stations in the California Current
2 (15.4%) out of the 13 stations in the Mexican Current
2 (11.8%) out of the 17 stations in the Panamic Area
0 (0.0%) out of the 27 stations in the Peruvian Current
5 (50.0%) out of the 10 stations in the Easter Island Eddy
0 (0.0%) out of the 4 stations in the Galapagos Eddy
27 (60.0%) out of the 45 stations in the South Equatorial Drift
2 (66.7%) out of the 3 stations in the South Equatorial Current
0 (0.0%) out of the 2 stations in the Equatorial Counter Current
0 (0.0%) out of the 2 stations in the North Equatorial Current

The numbers of these thirty-eight stations are as follows: — 4590, 4604 (Mexican Current); 4619, 4623 (Panamic Area); 4689, 4691, 4695, 4697, 4699 (Easter Island Eddy); 4679, 4680, 4681, 4683, 4685, 4701, 4705, 4707, 4709, 4711, 4717, 4719, 4720, 4721, 4722, 4724, 4725, 4728, 4730, 4732, 4733, 4734, 4736, 4737, 4739, 4740, 4741 (South Equatorial Drift); 4742, 4743 (South Equatorial Current).

At twenty-eight of these thirty-eight stations Histioneis was taken in vertical hauls and at ten in surface hauls. Most of the vertical hauls are from 300–0 fathoms, some are from 800 and 100–0 fathoms. Vertical hauls were made at only sixty-eight out of the 127 stations. The genus was thus found at 41.2% of the stations at which vertical hauls were made.

Disregarding the stations at which surface catches only were made, the record stations are distributed over the area covered by the Expedition in the following manner: —

0 (0.0%) out of the 4 stations in the California Current
1 (20.0%) out of the 5 stations in the Mexican Current
0 (0.0%) out of the 6 stations in the Panamic Area

0 (0.0%) out of the 22 stations in the Peruvian Current
5 (100.0%) out of the 5 stations in the Easter Island Eddy
0 (0.0%) out of the 2 stations in the Galapagos Eddy
21 (91.3%) out of the 23 stations in the South Equatorial Drift
1 (100.0%) out of the 1 station in the South Equatorial Current

There were no vertical hauls made in the Equatorial Counter Current and in the North Equatorial Current.

The numbers of these twenty-eight vertical stations are as follows: — 4590 (Mexican Current); 4689, 4691, 4695, 4697, 4699 (Easter Island Eddy); 4679, 4681, 4683, 4685, 4701, 4705, 4707, 4709, 4711, 4717, 4719, 4721, 4722, 4724, 4730, 4732, 4734, 4736, 4737, 4739, 4740 (South Equatorial Drift); 4742 (South Equatorial Current).

Surface catches and stomachs of Salpa taken in surface waters (81 surface catches and 24 samples of Salpa stomachs) were examined from eighty-two stations. As previously mentioned, the genus was taken at ten surface stations, *i.e.*, at 12.2% of all the surface stations. Taking into consideration the surface stations only, these ten record stations are distributed in the following manner: —

0 (0.0%) out of the 4 stations in the California Current
1 (11.1%) out of the 9 stations in the Mexican Current
2 (15.4%) out of the 13 stations in the Panamic Area
0 (0.0%) out of the 20 stations in the Peruvian Current
0 (0.0%) out of the 5 stations in the Easter Island Eddy
0 (0.0%) out of the 2 stations in the Galapagos Eddy
6 (26.1%) out of the 23 stations in the South Equatorial Drift
1 (50.0%) out of the 2 stations in the South Equatorial Current
0 (0.0%) out of the 2 stations in the Equatorial Counter Current
0 (0.0%) out of the 2 stations in the North Equatorial Current

The numbers of these ten surface stations are as follows: — 4604 (Mexican Current); 4619, 4623 (Panamic Area); 4680, 4720, 4725, 4728, 4733, 4741 (South Equatorial Drift); 4743 (South Equatorial Current).

As will be seen from these tables, the distribution of Histioneis in the area examined by the Expedition is charactized by the following outstanding facts:— (*1*) the genus is completely absent from the California and Peruvian Currents, two currents of temperate origin; (*2*) it is also absent from the Galapagos Eddy, which is under the direct influence of the Peruvian Current, and from the Equatorial Counter Current and the North Equatorial Current; (*3*) it is very rare in the Mexican Current and the Panamic Area, for in these regions only four out of the twenty-four species of this genus were found, and there are only four record stations out of thirty stations; (*4*) in the Easter Island Eddy and the South

Equatorial Current, on the other hand, the genus occurred at all the vertical stations, and in the South Equatorial Drift it was found at no less than twenty-one (91.3%) out of the twenty-three vertical stations.

These facts indicate that the genus Histioneis is limited in its distribution largely by the temperature, and that its species are stenothermal, warm-water forms. The fact that most of these species avoid the coasts suggests that we are dealing with stenohaline organisms limited to high and uniform salinities. The causes of the rarity of this genus in the Mexican Current and in the Panamic Area are obscure. It may be that they should be sought in the unusually turbulent current conditions of these regions (compare the distributions of *Ornithocercus heteroporus*, *O. splendidus*, and *O. carolinae*).

There are ninety-four records of species of Histioneis from vertical catches. Out of these ninety-four records, five (5.5%; Stations 4590, 4730 [two records], 4732 [two records]) showed a frequency of 1%; the remaining eighty-nine (94.5%) showed a frequency of less than 1%. There are seventeen records of species of this genus from surface catches. Out of these seventeen records, one (5.9%; Station 4619) showed a frequency of 4%; the remaining sixteen (94.1%) showed less than 1% or did not have the frequency established. The average frequency of the individual species of this genus is decidedly less than in any other genus of Dinophysoidae except in Parahistioneis.

Coincident occurrence of different species of Histioneis in catches from 300 (800, 100)–0 fathoms is recorded at the following of the twenty-eight stations mentioned above: — eight species occurred coincidently at one station (3.6%; Station 4724); seven species at one station (3.6%; Station 4730); six species at four stations (21.4%; Stations 4699, 4701, 4722, 4734); five species at one station (3.6%; Station 4737); four species at three stations (10.7%; Stations 4711, 4732, 4740); three species at six stations (21.4%; Stations 4681, 4691, 4695, 4697, 4705, 4742); two species at eight stations (28.6%; Stations 4590, 4679, 4685, 4689, 4709, 4721, 4736, 4739). Coincident occurrence of different species of this genus in surface catches is recorded at the following of the ten surface stations mentioned above: — four species occurred coincidently at one station (10.0%; Station 4720); three species at one station (10.0%; Station 4733); two species at two stations (20.0%; Stations 4725, 4741).

Although the species of Histioneis appear to be well adapted to flotation, they are very rare in surface hauls. During the Expedition only two out of our twenty-four record species were found free-living in surface waters; these two species were *H. costata* and *H. dolon*. The remaining surface records refer to specimens found in the stomachs of Salpa taken near the surface. In Salpa stomachs the following species were found: — *H. biremis*, *H. costata*, *H. dolon*, *H. gubernans*, *H. hyalina*, *H. inclinata*, *H. inornata*, *H. longicollis*, *H. navicula*, *H. pacifica*, and *H. striata*. These facts suggest that Histioneis is not adapted to the highly illumined water near the surface of the sea but may be brought there by Salpa feeding at lower levels.

Out of our twenty-four record species not less than seventeen have never been found outside of the area investigated by the Expedition. It is not probable that these species are limited to this area, nor that the eastern tropical Pacific is richer in species of this genus than other tropical seas. This fact indicates how incomplete is our knowledge in this field. It should be remembered that most writers who have treated Histioneis, such as Murray and Whitting (1899), have had only surface catches at their disposal, and that most of the species of this genus appear to avoid surface waters.

Historical Discussion and Systematics

Stein (1883, p. 25), who established Histioneis, gave no diagnosis but confined himself to some general remarks about the organization and systematic position of this genus and to the representation of five species, viz., *H. biremis*, *H. crateriformis*, *H. cymbalaria*, *H. megalocopa*, and *H. remora*. Of the three generic diagnoses later published by Bütschli (1885, p. 1010), Delage and Hérouard (1896, p. 386), and Schütt (1896, p. 29), the one by Schütt is by far the best and most nearly complete. No extensive description and discussion of the morphology of this genus have appeared hitherto. The amount of original observations available is very small, due to the extreme scarcity of the species and to the nearly complete limitation of the genus to tropical and subtropical seas.

Besides the five specific names of Histioneis introduced by Stein (1883), the following specific and subspecific names of this genus occur in the literature: —

H. gubernans Schütt (1895)
H. dentata Murray & Whitting (1899)
H. dolon Murray & Whitting (1899)
H. francescae Murray & Whitting (1899)
H. helenae Murray & Whitting (1899)
H. highleyi Murray & Whitting (1899)
H. magnifica Murray & Whitting (1899)
H. milneri Murray & Whitting (1899)
H. mitchellana Murray & Whitting (1899)
H. para Murray & Whitting (1899)
H. splendida Murray & Whitting (1899)
H. quadrata Lemmermann (1901a)
H. steini Lemmermann (1901a)
H. magnifica var. *quadrata* Entz (1902b)
H. magnifica var. *steini* Entz (1902b)
H. mitchelliana Schröder (1906a)
H. carinata Kofoid (1907a)
H. garretti Kofoid (1907a)
H. josephinae Kofoid (1907a)
H. longicollis Kofoid (1907a)
H. navicula Kofoid (1907a)
H. paulseni Kofoid (1907a)
H. pulchra Kofoid (1907a)
H. reticulata Kofoid (1907a)
H. costata Kofoid & Michener (1911)
H. diomedeae Kofoid & Michener (1911)
H. elongata Kofoid & Michener (1911)
H. hippoperoides Kofoid & Michener (1911)

H. hyalina Kofoid & Michener (1911)
H. inclinata Kofoid & Michener (1911)
H. inornata Kofoid & Michener (1911)
H. karsteni Kofoid & Michener (1911)
H. panda Kofoid & Michener (1911)
H. reginella Kofoid & Michener (1911)
H. rotundata Kofoid & Michener (1911)
H. striata Kofoid & Michener (1911)
H. kofoidi Forti & Issel (1925)

A representative of this genus was figured also by Cleve (1902b) under the name of *Dinophysis intermedia*. In the present paper we have established two new species, viz., *Histioneis pacifica* and *H. panaria*.

Of these species and subspecies the following are referable to the genus Ornithocercus: — *Histioneis magnifica* and *H. splendida* Murray and Whitting (1899); *H. quadrata* and *H. steini* Lemmermann (1901a); *H. magnifica* var. *quadrata* and *H. magnifica* var. *steini* Entz (1902b). The following have been assigned in the present paper to the new genus Parahistioneis: — *H. crateriformis* Stein (1883), *H. dentata* Murray and Whitting (1899), *H. diomedeae* Kofoid and Michener (1911), *H. franceseae* Murray and Whitting (1899), *H. garretti* Kofoid (1907a), *H. karsteni* Kofoid and Michener (1911), *H. para* Murray and Whitting (1899), *H. reticulata* Kofoid (1907a), *H. rotundata* Kofoid and Michener (1911). *H. mitchelliana* Schröder (1906a) is a *lapsus pennae* for *H. mitchellana*. *Dinophysis intermedia* Cleve (1902b) is too inadequately figured for certainty of specific allocation but appears to be referable to *Histioneis highleyi* Murray and Whitting (1899). *H. cymbalaria* Stein (1883) is a valid but heterogeneous species (see *H. mitchellana*, the section on comparisons). See also *H. elongata*, the section on comparisons.

We have therefore at the present writing twenty-eight presumably valid species of *Histioneis*, viz.: —

H. biremis Stein (1883)
H. carinata Kofoid (1907a)
H. costata Kofoid & Michener (1911)
H. cymbalaria Stein (1883)
H. dolon Murray & Whitting (1899)
H. elongata Kofoid & Michener (1911)
H. gubernans Schütt (1895)
H. helenae Murray & Whitting (1899)
H. highleyi Murray & Whitting (1899)
H. hippoperoides Kofoid & Michener (1911)
H. hyalina Kofoid & Michener (1911)
H. inclinata Kofoid & Michener (1911)
H. inornata Kofoid & Michener (1911)
H. josephinae Kofoid (1907a)
H. kofoidi Forti & Issel (1925)
H. longicollis Kofoid (1907a)
H. megalocopa Stein (1883)
H. milneri Murray & Whitting (1899)
H. mitchellana Murray & Whitting (1899)
H. navicula Kofoid (1907a)
H. pacifica, sp. nov.
H. panaria, sp. nov.
H. panda Kofoid & Michener (1911)
H. paulseni Kofoid (1907a)
H. pulchra Kofoid (1907a)
H. reginella Kofoid & Michener (1911)
H. remora Stein (1883)
H. striata Kofoid & Michener (1911)

All the descriptions of species published hitherto are very incomplete; those by Kofoid (1907a) and Kofoid and Michener (1911) are preliminary and based on the same material as those of the present paper. No subdivision of this genus has been attempted as yet. Bütschli (1885, p. 943) discussed briefly the organization of this genus, and Schütt (1895, p. 19, 114, 116) contributed a few observations on the morphology.

Data on the distribution of this genus are to be found in the following papers, not specifying those previously mentioned in this section: — Cleve (1901a), Daday (1888), Faria and Cunha (1917), Hensen (1911), Jörgensen (1923), Karsten (1907), Lemmermann (1899a, 1901a), Lohmann (1908), Okamura (1912), Ostenfeld and Schmidt (1901), Pavillard (1916), Schröder (1900a, 1906b), Zacharias (1906). Of these investigators only Okamura (1912) and Jörgensen (1923) give original figures by means of which their determinations may be checked.

References to Histioneis or minor contributions to our knowledge of this genus occur also in the following papers: — Balbiani (1884c), Bergh (1884), Calkins (1902), Chun (1886), Gadeceau (1909), Goldschmidt (1907), Hensen (1891), Lindemann (1924), Rudmose Brown (1903), Steuer (1910), Wallengren and Hennig (1911), Walther (1893), Willey and Hickson (1909). Ostenfeld and Schmidt (1901, p. 173) and Steuer (1910, p. 478) wrote Histoneis instead of Histioneis.

Adaptive and Systematic Value of the Characters. Principles used in the Description of the Species

Histioneis occurs almost exclusively in the tropical and subtropical seas, but it is less frequent, relatively, in the surface waters of these regions than is Ornithocercus; its optimum habitat appears to be the lower rather than the upper strata of photosynthesis. In these deeper strata the temperature is decidedly lower than near the surface, and the buoyancy is correspondingly higher. As an example of the decrease in the temperature toward the depth the following readings from one of the tropical stations of the Expedition may be given. At Station 4736 the temperatures at the surface, at 25, 50, 100, 200, and at 300 fathoms were as follows: — 81.1°, 79.6°, 74.7°, 71.7°, 55.4°, and 44.1°. In spite of this fact we find within Histioneis more extreme and beautiful examples of adaptations to flotation than in Ornithocercus or in any other genus of the tribe Dinophysoidae. It should be mentioned in this connection that, judging by their organization, the species of Histioneis are even less active swimmers than the members of Ornithocercus (with regard to the size of the transverse flagellum, see Plate 21, fig. 2).

The adaptations to flotation and to progressive spiral movement found in Histioneis are largely the same as in Ornithocercus, as follows: — (*1*) The specific gravity is relatively low; it probably is but slightly higher than that of the surrounding water. The low specific gravity is due to three different factors. First, the chamber enclosed by the girdle is always very large. In the evolutionary series, *Histioneis elongata* — *H. carinata* — *H. navicula* (Plate 22, fig. 7; Plate 21, fig. 8, 6), it becomes progressively larger, and in some species, *e.g.*, in *H. mitchellana*, *H. pulchra*, and *H. panda* (Plate 21, fig. 2, 7; Figure 95: 9), it is even much larger than the theca. In no other genus of this tribe does this chamber attain a size even approaching that in the last three species. Since this chamber usually contains but few, if any, phaeosomes (Plate 21, fig. 6, 7, 8) and it thus is filled largely with water, its development increases the volume of the organism as a whole, without causing a corresponding increase in the absolute weight. Second, the protoplasm contains fairly large pusules and inclusions of low specific gravity, such as fats and oils. Third, the theca (body) is usually small, when compared with the size of the whole organism. It is true that in the primitive species of this genus, such as *H. paulseni*, *H. costata*, and *H. inclinata* (Figure 95: 8, 4, 13), it still is fairly large; but, on the other hand, among the higher members it becomes, generally speaking, progressively smaller and in the most complex ones, for instance in *H. pulchra*, *H. mitchellana*, *H. dolon*, and *H. josephinae* (Figure 96: 2, 4, 6, 7), it is very small. (*2*) The body is small not only when compared with the whole organism, but also when compared with the body of the species in most of the other genera of this tribe. The largest body of any of the specimens of Histioneis found in the material of the Expedition was 66.5 μ long; and in the great majority of the species of this genus its length is less than 30 μ. The total length of our largest specimen (belonging to *Histioneis mitchellana*) exceeded but slightly the length of the body of *Phalacroma giganteum*, in spite of the fact that its cingular lists and left sulcal list were very large (Figure 96: 4). (*3*) The large cingular lists also increase the surface of resistance, whenever the organism rests on one of its lateral faces. On the other hand, these lists probably do not function as parachutes (as they do in Ornithocercus) when the organism has an upright position, since the posterior of them (which surrounds the anterior) has an anterior inclination of about 90° (Figure 95: 4–8) or is even somewhat contracted anteriorly (Figure 95: 1, 11). Exceptions to the last rule are *Histioneis reginella*, *H. panaria*, and *H. panda* (Plate 20, fig. 11; Figure 85: 1, 8) and other species in which the posterior cingular list has developed more or less large, well-balanced lateral pouches. (*4*) In a few species (*H. inornata* and *H. inclinata*; Figure 95: 10, 13) the left sulcal list is comparatively small and simple. However, this list is usually large; and in several species it is not only of extraordinary size, but also more or less complex, being furnished with one or more accessory fins. When only one accessory fin is developed, this is always posterodorsal and transverse in position; its size may be moderate (*H. milneri*, *H. helenae*; Murray and Whitting, 1899, pl. 33, fig. 1b, 2b) or very large (*H. dolon*, Figure 96: 6). More than one accessory fin is found in one species only, viz., *H. josephinae* (Plate 22, fig. 1–3). This species is by far the most complex and beautiful of all the known members of Dinophysoidae, and it represents the highest degree of adaptation to flotation in this tribe. Whether small or large, simple or complex, this list, of course, increases the surface of resistance whenever the organism is turned upon one of its lateral faces, and its asymmetry causes the organism, when in this position, to sink in a descending spiral or zigzag line. It also acts as a stabilizing rudder and keel in the progressive movement, and this is probably its principal function when small and simple. Furthermore, the fact that its dorsal or ventral margin or the entire list is recurved should be related to the spiral mode of swimming (Plate 21, fig. 1, 4, 6; Plate 20, fig. 9, 11). It should also be observed that this fin has a posterodorsal transverse fin or a recurved flap only in species that are characterized by having the body more or less decidedly higher and heavier dorsally than ventrally (Figure 95: 5, 6, 7, 2, 4). This suggests that these structures function also as organs of balance. Finally, we wish to point out that the accessory fins in *H. josephinae* also increase the surface of resistance when the organism is suspended in an upright position.

The ribs and reticulations of the lists increase the surface of friction. On the other hand, it is a fact worth mentioning in this connection that while the theca is reticulate or areolate in some of the more or less primitive species (Plate 20, fig. 1, 3, 7), it is smooth or almost so in all the highly differentiated members of this genus.

We do not know as yet whether or not the water contained in the girdle passes out posteriorly. It appears probable, however, that it leaves posteroventrally, entering the canal formed by the right sulcal list (Plate 20, fig. 7). This canal opens posteriorly at the place where the left sulcal list crosses over from the left to the right valve. If the water passes through this canal, then it hits the left sulcal list obliquely, thus causing the organism to rotate.

The significance of the profound changes in the shape of the body must be considered as largely uncertain. The extreme dorsoventral elongation is, of course, connected with the increase in the volume of the girdle. At least in some species the asymmetry may be related to the spiral swimming. In other species (*e.g., Histioneis pulchra, H. hippoperoides, H. dolon;* Figure 96: 2, 5, 6) the shifting of the center of gravity toward the dorsal side may counterbalance the extreme development of the left sulcal list.

The large chamber formed by the girdle functions, just as in Ornithocercus, not only to decrease the specific gravity but also as a container for the phaeosomes.

All the external characters have been used in our descriptions and separations of the species of Histioneis. None has been especially emphasized, since all of them are subject to profound changes within the genus. The size, shape, and structure of the body, of the cingular lists, and of the sulcal lists, all furnish characters of great taxonomic importance. The variability of the individual features within the species is, unfortunately, but slightly known, since of most of the species only one or a few specimens have been recorded and figured. However, the rather pronounced constancy of the few species of which a comparatively large number of specimens have been found indicates that the members of this genus are much less variable than those of related genera, *e.g.*, Ornithocercus.

All characteristics given in the diagnoses and descriptions refer to specimens in lateral view, if not otherwise stated. If in the diagnoses there are no statements to the contrary, the posterior cingular list lacks structural differentiation except the dorsal and ventral ribs next to the sagittal suture, the cross-rib, and sometimes a few ribs or an indication of reticulation dorsally and ventrally in the frill, and the left sulcal list has only the three main ribs. Furthermore, the posterior cingular list has a fairly narrow frill and is not or but slightly bulging, and the margins of the left sulcal list are not recurved. The methods of measuring lengths, angles, and proportions as well as the terminology utilized in the present paper are shown in Figure 94. It should be added that when there is a statement that the fission rib is straight, it refers to the posterior as well as to the anterior member of this rib.

Subdivisions. Relationships among the Species

Histioneis exhibits a wider range of structural differentiation than any other genus of Dinophysoidae. While some of its twenty-eight known species are comparatively simple, others are very complex and bizarre, representing the culmination of the evolutionary processes within this tribe. The genus offers striking examples of one of the most interesting and significant features of the processes of evolution, viz., the independent appearance in different evolutionary lines of characteristics that were inherent in but not morphologically expressed by the simpler common ancestors. These interwoven "tendencies," resulting in convergencies, form the most serious obstacle to a natural subdivision of this genus. The subdivision presented below, which is the first one to be attempted as yet, is based largely on the behavior of the posterior fission rib of the left sulcal list, on the presence or absence of a transverse fin on the posterior main rib of this list, on the structural differentiation of the frill of the posterior cingular list, and to a less extent on the shape of the body and of the anterior cingular list.

With the exception of the first group, the groups established below appear to represent progressive evolutionary series. The following characters are especially subject to evolutionary changes within these groups: — the size of the body, the dorsoventral elongation of the body, the size of the organs of flotation, the structure of the posterior cingular and the left sulcal lists, and the size of the phaeosome chamber. A striking feature of these evolutionary processes is the independence of the individual characteristics.

1. Primitive species and highly differentiated species of somewhat isolated positions: — *H. costata, H. paulseni, H. inclinata, H. inornata, H. reginella*, and *H. panaria* (Figure 95: 4, 8, 13, 10, 2, 6).

2. Remora group: — *H. remora, H. elongata, H. carinata*, and *H. navicula* (Stein, 1883, pl. 22, fig. 11; Figure 96: 3; Figure 95: 1, 3).

3. Biremis group: — *H. biremis* and *H. highleyi* (Figure 95: 11, 14).

4. Longicollis group: — *H. kofoidi, H. longicollis, H. hyalina*, and *H. pacifica* (Forti and Issel, 1925, fig. 1; Figure 95: 7, 5, 12).

5. Pulchra group: — *H. gubernans, H. striata, H. pulchra, H. mitchellana, H. cymbalaria*, and *H. panda* (Schütt, 1895, pl. 5, fig. 23; Figure 96: 1, 2, 4; Stein, 1883, pl. 22, fig. 7; Figure 95: 9).

6. Dolon group: — *H. helenae, H. milneri, H. dolon, H. hippoperoides, H. megalocopa*, and *H. josephinae* (Murray and Whitting, 1899, pl. 33, fig. 1, 2; Figure 96: 6, 5; Stein, 1883, pl. 22, fig. 12; Figure 96: 7).

1. Primitive species and highly differentiated species of somewhat isolated positions. This group, as shown by its caption, is made up of two subgroups: (*a*) primitive species and (*b*) highly differentiated species of isolated positions. *Histioneis costata, H. paulseni, H. inclinata*, and *H. inornata* belong to subgroup *a; H. reginella* and *H. panaria* to subgroup *b*. Of the four species of subgroup *a*, the first two are structurally closer to each other than to either of the last two, which in their turn show rather pronounced similarities. The two species of subgroup *b* exhibit rather striking similarities in the cingular lists. They appear not to be connected with any of the remaining five groups but to be derived from an evolutionary line rooted among the primitive members of the genus.

Histioneis costata (Figure 95: 4): — This species is one of the most primitive members of this genus. The following of its characters are more or less primitive: the body is subrotund in lateral outline; the transverse furrow is almost flat and has a rather pronounced dorsoposterior inclination; the thecal wall is areolated; the anterior cingular list has but a short stalk and its anterior opening is very wide; the posterior cingular list is relatively low and simple in structure, its frill being without ribs and reticulation; and the left sulcal list is simple in shape and structure, its fission rib is straight, and its posterior main rib lacks a transverse fin. On the other hand, this species is fairly advanced in size (compare, for instance, *H. inclinata* and *H. inornata;* Figure 95: 10, 13), and its hypotheca expresses, although but slightly, a tendency to elongate dorsoventrally. The angularity of the posteroventral margin of the left sulcal list is a peculiarity not occurring in any other species of this genus. It suggests relationship with *Ornithocercus formosus* (Plate **17**, fig. 5) and is probably the morphological expression of genetic tendencies inherent in the ancestors of the genera Ornithocercus and Histioneis.

Histioneis paulseni (Figure 95: 8): — This species, too, is near the base of the evolutionary scale of Histioneis. In the shape and structure of the anterior cingular list it is more primitive than any other species of this genus; it is, indeed, the only species in which this list is not stalked. Other more or less primitive features are as follows: the transverse furrow is but gently concave and has a decided dorsoposterior inclination; the thecal wall is areolate; the posterior cingular list is relatively low and lacks structural differentiation except the dorsal and ventral ribs and the simple cross-rib; and the left sulcal list is simple in shape and structure, its fission rib is straight, and its posterior main rib lacks a transverse fin. In regard to the size and structure of the body, the differentiation of the posterior cingular list, and the size of the left sulcal list, *H. paulseni* has reached about the same evolutionary stage as *H. costata*. On the other hand, the tendency of the hypotheca to elongate dorsoventrally, which is but slightly materialized in the latter species, is very pronounced in the former.

Histioneis inclinata (Figure 95: 13): — This species is characterized especially by the small size and simple shape of its left sulcal list. The portion of this list which is behind the fission rib is very short and decidedly smaller than the anterior portion; while in other species it is larger, usually even strikingly so. As we have suggested in connection with our treatment of this species, this appears to be a representative of an evolutionary branch which split off at a fairly early stage in the phylogenetic differentiation of this genus and in which either the increase in size of the posterior portion of the left sulcal list was inhibited, or in which this portion became subject to reduction. The comparatively large size of this list is *Histioneis costata* and *H. paulseni* as well as in the primitive members of the related genera Ornithocercus and Parahistioneis appears to support the latter of these alternatives. *Histioneis inclinata* is more primitive than *H. costata* and *H. paulseni* in the small size of its body (length 17.2 μ as compared with 26.4–29.0 μ) and in the subcircular and subsymmetrical lateral outline of its hypotheca. In the shape of the transverse furrow and in the structure and relative size of the posterior cingular list, this species has reached the same evolutionary level as *H. costata*. The thecal wall is still areolate, but the areolation shows a pronounced tendency to disappear, as it has done in most of the higher members of the genus. The anterior cingular list is somewhat more advanced in shape than that of *H. costata*, its stalk being better differentiated. The structure of this list recalls *H. carinata*.

Histioneis inornata (Figure 95: 10): — This species occupies a somewhat isolated position near the base of the evolutionary scale of this genus. The following features are more or less primitive: the body is very small; the hypotheca is subcircular and subsymmetrical in lateral outline; the posterior cingular list is simple in structure, having only the dorsal and ventral ribs and the simple crossrib; and the left sulcal list is simple in shape and structure and its fission rib is straight and subhorizontal. Whether the small size of the left sulcal list is primitive or secondary cannot be decided (see above, the discussion of *H. inclinata*). The subhorizontal position of the transverse furrow, the almost complete lack of structural differentiation in the thecal wall, the very long stalk and narrow anterior opening of the anterior cingular list, and the relatively large and bulging posterior cingular list are all advanced features that set *H. inornata* off rather markedly from the other primitive members of the genus. This species approaches *H. inclinata* in the small size of the body, in the subcircular shape of the hypotheca in lateral view, in the small size of the left sulcal list, and in the straight and subhorizontal fission rib of this list. Most of these similarities, however, are primitive, and so they do not of necessity indicate that these two species are members of the same evolutionary line. We consider these species structurally more closely related to each other than to any other members of this genus and at the same time as representatives of different branches, *H. inornata* being in several respects structurally farther removed from the common ancestral type. *H. inornata* recalls *H. striata* (Figure 96: 1) in the small size and subrotund, anteriorly truncate shape of the body, in the slight structural differentiation of the thecal wall, and in the long stalk and narrow anterior opening of the anterior cingular list. It differs very markedly from this species in having the posterior cingular list bulging and simple in structure, and in its small, narrow, and structurally simple left sulcal list. In spite of these differences, it probably belongs to the same line of evolution as the mentioned species, in which case it would present a small side branch of the evolutionary line that led to the development of the PULCHRA group, in which the increase in size and structural complexity of the posterior portion of the left sulcal list was inhibited. Note in this connection the difference in the shape of the anterior cingular list between *H. inornata* and *H. gubernans* (Schütt, 1895, pl. 5, fig. 23), the most primitive member of the PULCHRA group.

H. reginella (Figure 95: 2): — The position of this species in the natural system of Histioneis is uncertain and isolated. A few of its features are still more or less primitive, but in most respects it is advanced or even very aberrant. The subcircular shape of the hypotheca in lateral outline, the great width of the anterior opening of the anterior cingular list, and the subhorizontal position of the fission rib of the left sulcal list are primitive features. On the other hand, the species is more or less advanced in the following respects: the body is fairly large; the transverse furrow is subhorizontal; the thecal wall lacks reticulation and areolation; the anterior cingular list has a rather long stalk; the posterior cingular list has large lateral pouches and its cross-rib is furnished with branches; and the left sulcal list is strikingly curved and curled and supported by accessory ribs. In the shape of the body and of the anterior cingular list, and in the ribbing of the frill of the posterior cingular list, *H. reginella* recalls *H. gubernans* (Schütt, 1895, pl. 5, fig. 23), which is in several respects the most primitive member of the PULCHRA group. However, a close relationship between *H. reginella* and the members of the PULCHRA group appears very doubtful on account of the large lateral pouches of the posterior cingular list, the curled and curved shape of the left sulcal list, and the subhorizontal position of the posterior fission rib of this list characteristic of *H. reginella*. If *H. reginella* belongs to the same evolutionary line as the species of the PULCHRA group, then it is a highly specialized member of a branch that split off at a very early stage, before the left sulcal list became prolonged posteriorly and before the posterior fission rib of this list became recurved dorsally. The marked similarity between *H. reginella* and *H. inornata* in the shape and structure of the body and in the length of the left sulcal list may possibly be indicative of a relationship of this kind. In the large lateral pouches of the posterior cingular list and in the shape and structure of the anterior cingular list, *H. reginella* resembles *H. panaria* (Figure 85: 8, 9). However, since these species differ so markedly from each other in almost every other respect, *e.g.*, in the shape of the body and of the left sulcal list, these similarities must be considered as due to convergences, and cannot be taken as indicative of close relationship.

Histioneis panaria (Figure 95: 6): — This peculiar and aberrant species occupies a very isolated and uncertain position within its genus. The following of its characteristics are more or less primitive: its anterior cingular list has a wide anterior opening; its left sulcal list is of moderate size and is simple in shape and structure; the posterior fission rib of the last-mentioned list, although decidedly deflected posteriorly, is not recurved dorsally but is almost straight. In most other respects this species is very advanced; in the shape of the body and of the posterior cingular list it has advanced even as far as the most highly differentiated members of this genus. It resembles *H. panda* (Figure 95: 9) in the sausage-like shape of its body, in the large lateral pouches of its posterior cingular list, and in the moderate size and simple shape of its left sulcal list. These similarities, however, undoubtedly are due to convergence and are not indicative of a close relationship, since *H. panda* is a highly specialized representative of the Pulchra group, a group in which even the most primitive members are characterized by having the posterior fission rib of the left sulcal list recurved dorsally. The shape of the anterior cingular list and the large lateral pouches of the posterior cingular list in *H. panaria* recall *H. reginella*. But, again, a close relationship between these two species seems very improbable, since they differ profoundly in most other respects, especially in the shape of the body and in the shape and structure of the left sulcal list. Since *H. panda* and *H. reginella* are the only species showing more or less marked resemblances to *H. panaria*, the relationships of this species must be considered as unknown.

It is to be noted that in connection with the dorsal elongation of the body in this species we find a compensatory posterior elongation of the rudder-like left sulcal list.

2. Remora group (Stein, 1883, pl. 22, fig. 11; Figure 96: 3; Figure 95: 1, 3). Body of varying shapes, but never characterized by a spur-like posterodorsal protuberance. Thecal wall areolate or reticulate, and furnished with pores. Anterior cingular list with moderately long to rather short stalk and wide anterior opening. Posterior cingular list with narrow frill, without lateral pouches, and almost or completely lacking structural differentiation, except the dorsal and ventral ribs and the simple cross-rib. Left sulcal list with straight fission rib and without accessory fins; its posterior main rib is branched posteriorly. The species in this group are comparatively large.

The four species of this group, which are strikingly different in habitus, form in some characters, viz., in the shape of the body and in the size of the posterior cingular list, a well-marked orthogenetic series. In *H. remora* (Stein, 1883, pl. 22, fig. 11), which is the most primitive link in this series, the body is about as deep as long and the hypotheca is subcircular and subsymmetrical. In *H. elongata*, which is structurally very close to *H. remora*, it is decidedly asymmetrical and shows a marked tendency toward dorsoventral elongation. This tendency is materialized in *H. carinata*, which is characterized by having the hypotheca of a short canoe-shape, and reaches its highest expression in *H. navicula*, in which the hypotheca is of a long canoe-shape. The size of the posterior cingular list also increases from *H. remora* to *H. navicula*; in *H. remora* and *H. elongata* it is of a moderate size; in *H. carinata* it is decidedly larger; and in *H. navicula* it is exceptionally large and bulging. In the case of the left sulcal list, on the other hand, the conditions are reversed. This list is exceptionally long in *H. remora* and *H. elongata*, of intermediate length in *H. carinata*, and quite short in *H. navicula*. The posterior branching of the posterior main rib of this list is also simpler in *H. navicula* than in any of the other species of this group. In the structure of the theca and of the cingular lists the four species of this group do not show any distinct advancement but have remained on about the same evolutionary level as *H. costata*.

3. Biremis group (Figure 95: 11, 14). Body characterized by a spur-like posterodorsal protuberance. Thecal wall areolate and porulate. Anterior cingular list with fairly short stalk, and with wide anterior opening. Posterior cingular list with narrow frill, without lateral pouches, and lacking structural differentiation except the dorsal and ventral ribs and the simple cross-rib. Left sulcal list with straight fission rib and without accessory fins; its posterior main rib is branched posteriorly. The species of this group are very large.

The two species included in this group are quite similar and have reached about the same evolutionary stage except in the shape of the hypotheca, in the case of which *H. biremis* is the more primitive.

4. Longicollis group (Forti and Issel, 1925, fig. 1; Figure 95: 7, 5, 12). Body of simple but varying shapes; transverse furrow subhorizontal and flat or almost so. Thecal wall without reticulation and areolation, but usually porulate. Anterior cingular list with moderately to very long stalk; its anterior opening narrow to moderately wide. Posterior cingular list without lateral pouches and lacking structural differentiation except the dorsal and ventral rib and the simple cross-rib. Left sulcal list long and narrow, relatively simple in shape; showing, in some species, the incipient stages of the curling to the right of the dorsal margin; the posterior fission rib recurved to the right, usually joining the posterior main rib near the middle; disregarding the last feature, the structure of this list is usually very simple; without accessory fins. The species in this group are comparatively small.

Of the four species that are included in this group *Histioneis kofoidi* (Forti and Issel, 1925, fig. 1) is on the whole the most primitive and *H. hyalina* the most advanced. However, the species do not form a distinct orthogenetic series, but the differentiation of the individual characters has proceeded with a marked independence, as will be seen from the following examples. In *H. kofoidi* the hypotheca has retained its primitive shape, being subcircular and subsymmetrical; in *H. longicollis* it is decidedly asymmetrical and exhibits a marked tendency toward dorsoventral elongation; in *H. hyalina* and *H. pacifica* this tendency is still more emphasized, the body of these species being pyriform and bean-shaped, respectively, in lateral outline, with the long axis in the horizontal plane. In regard to the anterior cingular list, *H. pacifica* is the most primitive, the stalk of this structure being of moderate length and the anterior opening wide; *H. kofoidi* and *H. longicollis* have reached about the same evolutionary stage, having a very long stalk and an anterior opening of moderate width; *H. hyalina* is the most advanced, the stalk being very long and the anterior opening narrow. The posterior cingular list is lower, and thus in this respect more primitive, in *H. pacifica* and *H. hyalina* than in *H. kofoidi* and *H. longicollis*. In the case of the fission rib of the left sulcal list, *H. longicollis* is more primitive than the other species of this group, which in this feature have reached about the same evolutionary stage; its anterior member is comparatively short and but moderately deflected posteriorly; and its posterior member does not join the posterior main rib. On the other hand, *H. longicollis* is characterized by having the posterior main rib of this list marginal instead of submarginal as in the other species, although the latter condition is presumably the more primitive.

In *H. kofoidi* and *H. longicollis* the left sulcal list is nearly flat, which is the primitive condition; in *H. pacifica* it is somewhat spoon-shaped, but its dorsal margin is not strongly recurved to the right; in *H. hyalina* the portion of this list dorsal to the posterior main rib is strongly curled to the right, a feature emphasized and further developed in the closely related but more highly organized and specialized Pulchra group. The ribbing of the left sulcal list is about the same in *H. kofoidi*, *H. longicollis*, and *H. hyalina;* in *H. pacifica*, on the other hand, it is decidedly more complicated, approaching the condition in *H. pulchra* (Figure 96: 2). A peculiarity that the Longicollis group has in common with the Remora and Biremis groups is that the posterior cingular list has retained its structural simplicity. Even in the most primitive member of the Longicollis group the thecal wall lacks areolation and reticulation; in this respect this group thus is more advanced than the other groups just mentioned.

5. PULCHRA group (Schütt, 1895, pl. 5, fig. 23; Figure 96: 1, 2, 4; Stein, 1883, pl. 22, fig. 7; Figure 95: 9). Body varying in shape; sometimes subrotund and truncate anteriorly, sometimes saddle-, canoe-, or sausage-shaped; transverse furrow gently to strongly concave, subhorizontal or more or less inclined dorso-anteriorly. Thecal wall porulate, but without areolation and reticulation. Anterior cingular list with moderately to very long stalk; its anterior opening narrow to very wide. Posterior cingular list usually (exception, *Histioneis panda*) without large lateral pouches; its frill furnished with longitudinal ribs or with reticulation. Left sulcal list usually very large; posterior fission rib recurved dorsally, joining the posterior main rib near the middle; dorsal margin usually strongly curled to the right either in its entire extent or it forms a fairly small tongue-like flap; no paired accessory fins; besides the main ribs this list has a more or less developed reticulation. The species in this group range from small to very large.

Although the six species included in this group are structurally quite different from each other, they undoubtedly belong to the same evolutionary line. The most primitive of them is *Histioneis gubernans* (Schütt, 1895, pl. 5, fig. 23). This species is characterized by the following more or less primitive features: it is very small; its hypotheca is subcircular, although somewhat asymmetrical; its transverse furrow is subhorizontal and but slightly concave; its anterior cingular list has a moderately long stalk and a very wide anterior opening; its posterior cingular list has no lateral pouches, and lacks structural differentiation except the dorsal and ventral ribs, the cross-rib, and some simple longitudinal ribs in the frill; the reticulation of its left sulcal list is still fairly undeveloped; the anterior fission rib of this list is subhorizontal, and the dorsal margin of this list is not curled to the right. The closest-known relative of *H. gubernans* is *H. striata*. These two species have reached about the same evolutionary level in the size and shape of the body, in the shape and structure of the posterior cingular list, and in the structure of the left sulcal list. *H. striata* is farther advanced in the following respects: its anterior cingular list has a long stalk and a very small anterior opening, and the dorsal margin of its left sulcal list is strongly curled to the right in its entire length. Of the remaining species, *H. pulchra* and *H. panda* occupy rather isolated positions, while *H. mitchellana* and *H. cymbalaria* (Stein, 1883, pl. 22, fig. 7) are structurally very close to each other. *H. pulchra* is in certain respects intermediate between *H. gubernans*-*H. striata* on the one hand, and *H. mitchellana*-*H. cymbalaria* on the other; in some characteristics, *e.g.*, in the shape of the body, it has reached the same evolutionary level as these. The characters in which *H. pulchra* is more or less intermediate between the two groups just mentioned are as follows: the frill of the posterior cingular list is fairly narrow in the middle, and its reticulation is quite incomplete and wide-meshed; the anterior fission rib of the left sulcal list has an intermediate posterior deflection; the reticulation of this list is wide-meshed, and anteriorly it is but slightly developed; although the entire dorsal margin is curled to the right, its middle portion exhibits the incipient stage of becoming differentiated into an individualized tongue-like flap. In the comparatively simple structure of the anterior cingular list, *H. pulchra* and *H. cymbalaria* have reached about the same evolutionary level, while *H. mitchellana* is farther advanced, having this list as finely reticulated as the frill of the posterior cingular list. On the other hand, *H. cymbalaria* is farther advanced than either *H. pulchra* or *H. mitchellana* in having the anterior opening of the anterior cingular list very narrow. Finally it may be mentioned that neither *H. pulchra* nor *H. cymbalaria* and *H. mitchellana* have the posterior cingular list bulging into large lateral pouches. The last member of this group, *H. panda*, is farther advanced than the others in the following respects: the body is more elongated dorsoventrally, being of a narrow sausage-shape; the anterior cingular list has a longer stalk, and its anterior opening is quite narrow; the posterior cingular list bulges out into large lateral pouches, and its very wide frill is furnished with a narrow secondary frill. On the other hand, *H. panda* is more primitive than *H. pulchra*, *H. cymbalaria*, and *H. mitchellana* in being smaller, in having the left sulcal list relatively very small, simple in structure, and characterized by the fact that the middle portion of its dorsal margin shows but the beginning stage in the development of a tongue-like appendage curled to the right. It may finally be mentioned that the cingular lists of *H. panda* are finely reticulated just as in *H. mitchellana*, but the reticulation is so weak that it is very difficult to detect.

6. Dolon group (Murray and Whitting, 1899, pl. 33, fig. 1, 2; Figure 96: 6, 5; Stein, 1883, pl. 22, fig. 12; Figure 96: 7). Body of short saddle-shape, higher dorsally than ventrally; transverse furrow moderately to strongly concave, more or less inclined dorsoanteriorly. Thecal wall porulate, but without areolation and reticulation. Anterior cingular list with long stalk; its anterior opening narrow to very wide. Posterior cingular list sometimes without lateral pouches, sometimes (*Histioneis dolon*, *H. hippoperoides*) with lateral pouches of moderate size; frill reticulate, often with a secondary frill. Left sulcal list large, usually reticulated; posterior fission rib not recurved dorsally, but runs close to anterior fission rib; posterior main rib with a transverse fin. The species of this group range from fairly large to large.

Of the six members of this group, *Histioneis josephinae* occupies a quite isolated position (see our treatment of this species, the section on comparisons), while the remaining ones are structurally, and presumably also phylogenetically, very close. The beautiful and bizarre *H. josephinae* represents without doubt the culmination of the structural differentiation within Dinophysoidae. The accessory fins along the ventral margin and along the fission rib of the left sulcal list, as well as the peculiarly ornamental coral-shaped thickenings of this list are without counterparts in the other known species of this tribe. The curvature of the body is also more extreme in this species than in the remaining five members of the DOLON group. On the other hand, *H. josephinae* is comparatively primitive in the wide anterior opening of its anterior cingular list and in having its posterior cingular list completely without lateral pouches; furthermore, its left sulcal list lacks entirely the reticulation which characterizes the other species of this group. Of the last-mentioned species, *H. helenae* and *H. milneri* (Murray and Whitting, 1899, pl. 33, fig. 1, 2) are the most primitive, since they are characterized by having only one submarginal rib along the ventral margin of the left sulcal list and by the moderate size of the transverse fin of this list. *H. dolon, H. hippoperoides,* and *H. megalocopa* (Stein, 1883, pl. 22, fig. 12) have two to more submarginal ribs and their transverse fin is very large. *H. helenae* and *H. milneri* have reached about the same evolutionary stage, except in the shape of the transverse fin, in which respect *H. helenae* appears to be the more primitive; it may also be mentioned that in the last-named species the reticulation in the frill of the posterior cingular list is less developed. Among these five species *H. megalocopa* is farthest advanced in having the frill of the posterior cingular list finely reticulated, while *H. hippoperoides* is farthest advanced in having the anterior opening of the anterior cingular list very narrow. *H. dolon* and *H. hippoperoides* have the posterior cingular list bulging into lateral pouches of moderate size.

With regard to the interrelationships of these groups, we are able to make but a few suggestions. The BIREMIS group probably originated from an ancestral form fairly closely resembling *Histioneis carinata* of the REMORA group. This assumption is based on the very striking similarities that exist between the members of the BIREMIS group and *H. carinata* in the shape and structure of the cingular list and of the left sulcal list, and in the structure of the body; another important fact is that in *H. biremis* the body has about the same dorsoventral elongation as in the compared species. It should be remembered, however, that some of the similarities are primitive (for an enumeration of primitive features, see the discussion given above of *H. costata* and *H. paulseni*). The LONGICOLLIS and PULCHRA groups probably originated from a common ancestor, characterized especially by the fact that the posterior fission rib of the left sulcal list was recurved dorsally toward the middle of the posterior main rib, and by the inherent tendency for the dorsal margin of this list to curl to the right. Of the known species *H. kofoidi* of the LONGICOLLIS group appears to be structurally closest to this common ancestor. *H. gubernans* and *H. striata*, the most primitive members of the PULCHRA group, appear to represent a small evolutionary branch that split off early, has remained more or less primitive in many respects, and that is characterized by the very great width of the left sulcal list. In the other members of these two groups the left sulcal list is of a long and narrow tongue-shape, approaching the shape found in *H. kofoidi*. As previously mentioned, *H. inornata* may be looked upon as a representative of a small branch near the base of the line of evolution that led to the development of the LONGICOLLIS and PULCHRA groups. As to the origin of the DOLON group, we are still completely ignorant; but presumably this group split off at a very early stage in the evolutionary differentiation of Histioneis (see also the above treatment of *H. reginella*).

Of the "interwoven tendencies, resulting in convergences" mentioned in the introductory paragraph of this section, the following examples may be given. Dorsoventral elongation of the body has developed independently in *Histioneis panaria*, and in the REMORA, BIREMIS, LONGICOLLIS, PULCHRA, and DOLON groups; strong concavity of the transverse furrow in *H. panaria*, and in the BIREMIS, PULCHRA, and DOLON groups; long stalk and narrow anterior opening of the anterior cingular list in *H. inornata*, and in the LONGICOLLIS, PULCHRA, and DOLON groups; lateral pouches in the posterior cingular list in *H. reginella*, *H. panaria*, and in the PULCHRA and DOLON groups; a secondary frill in this list in the PULCHRA and DOLON groups; ribbing of the frill of this list in *H. reginella*, *H. panaria*, and in the PULCHRA and DOLON groups. This list, although by no means complete, is sufficient to illustrate the great difficulties that the taxonomy of this genus offers. It also shows that the arrangement suggested above, on account of these difficulties, must be regarded as tentative, and must possibly be modified and extended as our knowledge of the species of this remarkable genus is enlarged by future exploration, although, for the sake of simplicity in presentation, we have made it quite dogmatic.

Key to the Species of Histioneis

1. Posterior R_2 of left sulcal list recurved dorsally, joining R_3 or nearly so . . . . 2.
1. Posterior R_2 of left sulcal list not recurved . . . . 11.
2. Frill of posterior cingular list lacks structural differentiation or almost so . . . . 3.
2. Frill of posterior cingular list has longitudinal ribs or reticulation . . . . 6.

3. Length: depth of body, 0.85–1.00: 1 .... 4.

3. Length: depth of body, 0.60–0.65: 1 .... 5.

4. R_3 of left sulcal list is marginal .... *H. longicollis* Kofoid.

4. R_3 of left sulcal list is not marginal .... *H. kofoidi* Forti and Issel.

5. R_3 of left sulcal list extends to postmargin of list and forms reticulation posteriorly. *H. pacifica*, sp. nov.

5. R_3 of left sulcal list does not extend to postmargin of list and does not form reticulation posteriorly. *H. hyalina* Kofoid and Michener.

6. Length: depth of body, 0.80–0.95: 1 .... 7.

6. Length: depth of body, 0.30–0.55: 1 .... 8.

7. Anterior cingular list 7–8 times wider distally than proximally .... *H. gubernans* Schütt.

7. Anterior cingular list about 2.5 times wider distally than proximally. *H. striata* Kofoid and Michener.

8. Posterior cingular list with large lateral pouches .... *H. panda* Kofoid and Michener.

8. Posterior cingular list not with large lateral pouches .... 9.

9. Left sulcal list and frill of posterior cingular list with fairly wide-meshed and partly incomplete reticulation .... *H. pulchra* Kofoid.

9. Left sulcal list and frill of posterior cingular list with fine-meshed and complete reticulation .... 10.

10. Anterior cingular list is 8–13 times wider distally than proximally. *H. mitchellana* Murray and Whitting.

10. Anterior cingular list about 4 times wider distally than proximally .... *H. cymbalaria* Stein.

11. R_3 of left sulcal list with transverse fin .... 12.

11. R_3 of left sulcal list without transverse fin .... 17.

12. R_2 of left sulcal list with accessory fin .... *H. josephinae* Kofoid.

12. R_2 of left sulcal list without accessory fin .... 13.

13. Frill of posterior cingular list with rather fine-meshed reticulation .... *H. megalocopa* Stein.

13. Frill of posterior cingular list with comparatively wide-meshed reticulation .... 14.

14. With only one submarginal rib along ventral margin of left sulcal list; transverse fin of this list of moderate size .... 15.

14. With two or more submarginal ribs along ventral margin of left sulcal list; transverse fin of this list large .... 16.

15. Transverse fin of left sulcal list ovate .... *H. helenae* Murray and Whitting.

15. Transverse fin of left sulcal list of pear-shaped outline .... *H. milneri* Murray and Whitting.

16. Anterior cingular list 10–12 times wider distally than proximally. .*H. dolon* Murray and Whitting.

16. Anterior cingular list 2–3 times wider distally than proximally. *H. hippoperoides* Kofoid and Michener.

17. Body has spur-like posterodorsal protuberance .... 18.

17. Body without spur-like posterodorsal protuberance .... 19.

18. Body Y-shaped; transverse furrow very strongly concave .... *H. highleyi* Murray and Whitting.

18. Body not Y-shaped; transverse furrow gently concave .... *H. biremis* Stein.

19. Posterior cingular list with large lateral pouches .... 20.

19. Posterior cingular list without or with but slightly developed lateral pouches .... 21.

20. Body subrotund, truncate anteriorly .... *H. reginella* Kofoid and Michener.

20. Body sausage-shaped .... *H. panaria*, sp. nov.

21. R_3 of left sulcal list, if present, smaller than or subequal to R_2 .... 22.

21. R_3 of left sulcal list larger than R_2 .... 23.

22. Portion of left sulcal list behind R_2 smaller than portion in front of this rib and has four radial ribs. *H. inclinata* Kofoid and Michener.

22. Portion of left sulcal list behind R_2 larger than portion in front of this rib and has not four radial ribs. *H. inornata* Kofoid and Michener.

23. Ventral margin of left sulcal list angular between R_2 and R_3 .... *H. costata* Kofoid and Michener.

23. Ventral margin of left sulcal list not angular between R_2 and R_3 .... 24.

24. Anterior cingular list funnel-shaped but not stalked .... *H. paulseni* Kofoid.

24. Anterior cingular list distinctly stalked .... 25.

25. Length: depth of body, 1.00–1.13: 1 .... 26.

25. Length: depth of body, 0.50–0.65: 1 .... 27.

26. Hypotheca subsymmetrical .... *H. remora* Stein.

26. Hypotheca asymmetrical .... *H. elongata* Kofoid and Michener.

27. R_3 of left sulcal list very strong, about 0.63 the depth of body .... *H. carinata* Kofoid.

27. R_3 of left sulcal list weak, about 0.36 the depth of body .... *H. navicula* Kofoid.

1. Primitive Species and Highly Differentiated Species of Somewhat Isolated Positions. All the six species that belong to this group have been found in the material of the Expedition. They have been treated in the following order, which is partly indicative of their relative positions in the evolutionary scale of the genus:— *Histioneis costata, H. paulseni, H. inclinata, H. inornata, H. reginella,* and *H. panaria.*

Histioneis costata Kofoid and Michener

Plate 20, fig. 3, 10. Figure 95: 4

Histioneis costata Kofoid & Michener, 1911, p. 295.

Diagnosis: — Body subrotund in lateral outline; length: depth, 0.85: 1, hypotheca subsymmetrical. Dorsally the transverse furrow is 0.46 the depth of body, four times wider than ventrally, inclined dorsoposteriorly at 20°–25°, and but slightly concave. Distance from apex to posterior cingular list 0.26 the base of this list. Anterior cingular list with short stalk; its height 0.71 the depth of body. Dorsal height of posterior cingular list 0.58 the depth of body. Left sulcal list with reticulation in front of R_2; R_2 straight, inclined posteriorly at 30°, and 0.34 the depth of body; R_3 submarginal, weak, simple, 0.62 the depth of body, located at antapex, and deflected posterodorsally at 15°; margin strikingly angular somewhat behind R_2. Theca coarsely and deeply pitted. Total length, 67.5 μ.

Eastern tropical Pacific.

Description: — This is a fairly small species, subrotund in lateral outline, deepest in or near the middle. The ratio between the length and the depth of the body is about 0.85: 1. The longitudinal axis is deflected posterodorsally at about 10°–15°.

The epitheca is about 0.24 as deep as the hypotheca, slightly convex, highest somewhat dorsally to the center, and tilted ventroposteriorly at about 20°. Dorsally the transverse furrow is about 0.46 the greatest depth of the body, about four times as wide as ventrally, inclined dorsoposteriorly at 20°–25° to the horizontal plane, and slightly concave, almost flat. The distance from the apex to the posterior cingular list is about 0.26 the base of this list. The hypotheca is subsymmetrical; its anterior margin is but slightly concave, and inclined dorsoposteriorly at about 5° to the horizontal plane; its ventral, posterior, and dorsal margins are well rounded and confluent. In dorsoventral view the body is about 1.6 times longer than wide and widest in the middle; the hypotheca has gently convex side contours and is well rounded posteriorly; the anterior portion of the body is subconical with moderately concave sides.

The anterior cingular list has a short but distinct stalk and is about 3.8 times wider distally than basally; its height is about 0.71 the greatest depth of the body, and its right side is very strikingly lower than its left, declining ventrally; on the right valve it has only three ribs, the dorsal and ventral ones of which are simple, while the middle one has two branches; on the left valve it has distally about fifteen ribs, the proximal ends of which form a reticulum; some of these fifteen ribs, however, correspond to branches of the dorsal rib (Plate 20, fig. 10); the tips of the ribs project slightly beyond the edge of the list. These differences in the ribs on the two sides may have resulted from recent binary fission. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs, and the cross-rib; its dorsal height is about 0.58, its ventral height about 0.29 the greatest depth of the body; its frill is narrow, 0.14–0.17 the dorsal rib; and it is but slightly if at all bulging. The left sulcal list is simple in shape, and has only two ribs, the fission rib and the posterior rib. The fission rib is straight, about 0.34 the greatest depth of the body, and has a posterior inclination of about 30°. The posterior rib is weak, simple, almost straight, about 0.62 the greatest depth of the body, located at or near the antapex, deflected postero-dorsally at about 15°, and submarginal, *i.e.*, the basal width of the portion of the list dorsal to this rib is only about 0.12 the length of the rib. The portion of the list in front of the fission rib is faintly reticulated; in the type specimen it is but slightly developed (following binary fission?), its ventral margin is almost straight, and its posterior width is but slightly more than half the length of the fission rib. The portion between the fission rib and the posterior rib lacks structural differentiation, and its margin forms an angle of about 60°–70° somewhat behind the fission rib. Between the fission rib and the vertex of this angle the margin is nearly straight, and between the vertex and the posterior rib it is gently concave; at the tip of the posterior rib it forms an angle of about 50°–60°, and dorsally to this rib it is almost straight. The portion of this list dorsal to the posterior rib lacks structural differentiation.

The thecal wall is coarsely and deeply pitted, with pores in some of the pits; the number of pores is decidedly less than the number of pits. The pits are of sub-uniform size, and on each valve about thirteen of them border the girdle posteriorly. The pits bordering the girdle posteriorly are but slightly if at all larger than the others. Phaeosomes were not seen.

The proportions of one specimen, the type, were measured.

Dimensions: — Length of body, 26.4 μ. Greatest depth of body, 31.0 μ. Total length, 67.5 μ.

Comparisons: — The description given above is based on the type specimen. Judging by the relatively small size of the anterior portion of the left sulcal list, this specimen appears to have been taken rather shortly after binary fission.

The subrotund body, and the simple shape and structure of the left sulcal list place *Histioneis costata* among the most primitive species of this genus. Still, it is a typical member of Histioneis, since the anterior cingular list is distinctly stalked and has a strikingly asymmetrical structure, and since the posterior cingular list is closed, and has a cross-rib and only two radial ribs, viz., one dorsal and one ventral. It differs from all other known species of this genus in the angularity of the posteroventral margin of the left sulcal list. Its closest relative appears to be *H. paulseni*, from which it is easily distinguished by *(1)* the relatively short anterior portion of the body, *(2)* the less shortened hypotheca, *(3)* the structure and the greater height of the anterior cingular list, and *(4)* by the fact that the left sulcal list has an angular posteroventral margin, a submarginal posterior rib, and lacks a marginal rib posteroventrally. Another close relative of this species probably is *H. crateriformis* Stein (1883, pl. 22, fig. 5, 6). This relationship is indicated by the similarities in the shape of the body and in the cingular list, and by the simple shape and structure of the left sulcal list. However, judging by Stein's (1883) figures, *H. crateriformis* lacks the cross-rib in the posterior cingular list, and thus does not belong to Histioneis *s. str.* (see the historical discussion of this genus). It should also be mentioned that *H. costata* resembles *H. inclinata* in the subrotund shape of the body, and in the shape and structure of the cingular lists. It differs very strikingly from this species in the size of the body, and in the size, shape, and structure of the left sulcal list (see also *H. inclinata*, the section on comparisons).

The two-lobed condition of the left sulcal list and the positions of the ribs of this list relative to the two lobes suggest relationship between *Histioneis costata* and *Ornithocercus formosus*, which in several respects is intermediate between Ornithocercus and Histioneis. Whether these resemblances are due to common inheritance or to convergence is, of course, a matter of conjecture, but the fact that these two species are near the bases of the evolutionary scales of these closely related genera makes it appear highly probable that the formation of the posteroventral lobe in the left sulcal list of *Histioneis costata* is the expression of a tendency inherent in the ancestral forms of these two genera but reaching its full development only in Ornithocercus.

Occurrence: — *Histioneis costata* is recorded at only two of the 127 stations. Both these stations are on the first line of the Expedition; one of them (4604) is in the Mexican Current, the other (4619) in the Panamic Area. Both records are from surface waters; one of them (Station 4619) is from a Salpa stomach. The surface temperatures of these two stations were 84° and 79°, respectively. The frequency was 4% at Station 4619 and less than 1% at Station 4604.

This species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4604 of the Expedition which thus is the type locality.

Histioneis paulseni Kofoid

Plate **20**, fig. 1, 2. Figure 95: 8

Histioneis paulseni Kofoid, 1907a, p. 204, pl. 15, fig. 94. Kofoid & Michener, 1911, p. 295. *non* Okamura, 1912, p. 21, pl. 3, fig. 53, 54.

Diagnosis: — Body depressed in lateral outline; length: depth, 0.86: 1; hypotheca of short canoe-shape, somewhat higher dorsally than ventrally. Dorsally the transverse furrow is 0.50 the depth of body, twice as wide as ventrally, inclined dorsoposteriorly at 30°–35°, and of rather pronounced concavity. Distance from apex to posterior cingular list 0.40 the base of this list. Anterior cingular list broadly funnel-shaped but not stalked; its height 0.57 the depth of body. Dorsal height of posterior cingular list 0.47 the depth of body. Left sulcal list with five very short ribs between R_2 and R_3; R_2 straight, inclined posteriorly at 30°–35°, and 0.18 the depth of body; R_3 marginal, very weak, simple, 0.75 the depth of body, located on midline, and inclined posteroventrally at 20°; ventral margin sigmoid, concave anteriorly and posteriorly and well convex in the middle, with marginal rib posteriorly; with posterior angle of 40°. Theca areolate. Total length, 67.5 μ.

Eastern tropical Pacific.

Description: — This is a fairly small, depressed species, asymmetrically conical anteriorly, broadly rounded posteriorly, and deepest near the middle. The ratio between the length and the depth of the body is about 0.86: 1. The longitudinal axis is deflected posterodorsally at about 5°–10°.

The epitheca is about 0.20 as deep as the hypotheca, slightly convex, highest somewhat dorsally to the center, and tilted posteroventrally at about 5°. Dorsally the transverse furrow is about 0.50 the greatest depth of the body, about twice as wide as ventrally, inclined dorsoposteriorly at 30°–35° to the horizontal plane, and with a rather pronounced concavity. The distance from the apex to the posterior cingular list is about 0.40 the base of this list. The hypotheca is of short canoe-shape, distinctly higher dorsally than ventrally; its anterior margin is moderately concave, and inclined dorsoposteriorly at about 10° to the horizontal plane; its dorsal, posterior, and ventral margins are confluent; posterodorsally it is fairly strongly convex, posteroventrally rather flattened. In dorsoventral view the body is about 1.2 times longer than wide and widest in the middle; the outline of the hypotheca is subcircular; the anterior portion of the body is rounded conical, with gently concave sides.

The anterior cingular list is very broadly and rather symmetrically funnel-shaped, but not stalked, and about 4.2 times wider distally than basally; its height is about 0.57 the greatest depth of the body, and its right side is distinctly lower than the left; on the right valve it has about six ribs, all of which are simple except the dorsal one which has three branches; on the left valve the number of ribs is slightly greater; the tips of the ribs project slightly beyond the edge of the list. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs and the cross-rib; its dorsal height is about 0.47, its ventral height about 0.38 the greatest depth of the body; its frill is fairly narrow, 0.36 the dorsal rib; and it is but slightly if at all bulging. The left sulcal list is simple in shape and structure and has two main ribs and between these about five very short riblets. The fission rib is straight, about 0.18 the greatest depth of the body, and has a posterior inclination of about 30°–35°. The posterior rib is marginal, very weak, simple, but slightly convex dorsally, about 0.75 the greatest depth of the body, located on the midline, and inclined posteroventrally at about 20°. The ventral margin of this list is sigmoid, concave anteriorly and posteriorly, and quite convex in the middle. It is furnished posteriorly with a marginal rib of the same type and of about the same length as the posterior rib. The ventral and dorsal margins of this list form a posterior angle of about 40°. Except for the ribs mentioned above, this list appears to lack structural differentiation.

The thecal wall is areolate with scattered pores in some of the areoles. The areoles in the transverse furrow and those bordering the girdle posteriorly are somewhat larger than the remaining ones. On each valve about 19 areoles border the girdle posteriorly, and just behind these areoles there is a cross-row of about 16–17 pores on each valve. A moderate number of medium-sized, oval phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 29.0 μ. Greatest depth of body, 33.9 μ. Total length, 67.5 μ.

Comparisons: — The description given above is based on the type specimen. The closest-known relative of *Histioneis paulseni* probably is *H. costata*. In the shape and structure of the anterior cingular list *H. paulseni* is the more primitive of these two species, while with regard to the shape of the body in lateral view and to the marginal position of the posterior rib of the left sulcal list it is the more advanced. In the size of the body and in the shape and structure of the posterior cingular list these species have reached the same evolutionary stage. For the distinguishing characters and for further discussion of the relationships of these two forms, see *H. costata*, the section on comparisons.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Histioneis paulseni*. The specimens recorded under this name from Japanese waters by Okamura (1912, p. 21, pl. 3, fig. 53, 54) are not determined correctly but presumably belong to *H. carinata;* unfortunately, they are too incompletely figured for certainty of specific assignment.

Occurrence: — *Histioneis paulseni* is recorded at only one of the 127 stations. This station (4711) is on the fourth line of the Expedition and in the South Equatorial Drift. The depth is 300–0 fathoms, the surface temperature 75°, and the frequency less than 1% (one specimen).

This species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4711 of the Expedition, which thus is the type locality.

Histioneis inclinata Kofoid and Michener

Plate **22**, fig. 5. Figure 95: 13

Histioneis inclinata Kofoid & Michener, 1911, p. 297.

Diagnosis: — Body subrotund in lateral outline; length: depth, 0.96: 1. Dorsally the transverse furrow is 0.46 the depth of body, twice as wide as ventrally, inclined dorsoposteriorly at 15°–20°, and gently concave. Distance from apex to posterior cingular list 0.25 the base of this list. Anterior cingular list with short stalk, flaring in its distal 0.6 in a wide concave funnel with twice as much dorsal as ventral extension, with no ventral notch, and slight dextroventral slope; its height 0.76 the depth of body. Dorsal height of posterior cingular list 0.50 the depth of body. Left sulcal list short, ending about midway between R_2 and midline, broadly rounded posteriorly; R_2 straight, subhorizontal, 0.26 the depth of body; portion behind R_2 with four partly anastomosing ribs. Theca finely reticulate; 17–18 meshes along girdle. Total length, 29 μ.

Eastern tropical Pacific.

Description: — This is a very small species, subrotund in lateral outline, deepest in or near the middle. The ratio between the length and the depth of the body is about 0.96: 1. The longitudinal axis is deflected posterodorsally at about 7°.

The epitheca is about 0.15 as deep as the hypotheca, slightly convex, highest in or somewhat dorsally to the center, and tilted ventroposteriorly at about 5°–10°. Dorsally the transverse furrow is about 0.46 the greatest depth of the body, about twice as wide as ventrally, inclined dorsoposteriorly at 15°–20° to the horizontal plane, and gently concave. The distance from the apex to the posterior cingular list is about 0.25 the base of this list. The anterior margin of the hypotheca is subhorizontal and but slightly concave; the ventral, posterior, and dorsal margins are well convex and confluent; the dorsal margin is somewhat less convex posteriorly than anteriorly.

The anterior cingular list has a short but distinct stalk and is about 4.3 times wider distally than basally; it flares widely in its distal 0.6, with slightly concave sides, twice as much dorsal as ventral flare, no ventral notch, and about 30° dextroventral inclination; its height is 0.76 the greatest depth of the body, and its right side is but slightly lower than its left; on the right valve it has but two ribs, the ventral one of which has one, the dorsal three branches; its ribs on the left valve are also few; the tips of the ribs project very slightly beyond the edge of the list. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs, and the cross-rib; its dorsal height is about 0.50, its ventral height about 0.54 the greatest depth of the body; its frill is of moderate height, about 0.33 the dorsal rib; and it is but slightly or not at all bulging. The left sulcal list is simple in shape, short, ending about midway between the fission rib and the midline, and rather broadly rounded, subcircular posteriorly. The fission rib is straight, subhorizontal, and about 0.26 the greatest depth of the body. The portion of the list behind the fission rib has four partly anastomosing denticulate ribs, which converge toward the base of the fission rib; just in front of the fission rib a few anastomosing ribs also are to be found. The ventral margin of this list is gently sigmoid, concave anteriorly, and convex posteriorly.

The thecal wall is characterized by a fine reticulum, the meshes of which become more and more difficult to distinguish toward the sagittal suture; most of the meshes are subuniform in size, and 17–18 of them border the girdle posteriorly on each valve. The pores are few and scattered. A few small, round phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 17.2 μ. Greatest depth of body, 17.8 μ. Total length, 29 μ.

Comparisons: — The description given above is based on the type specimen. *Histioneis inclinata* appears to be a representative of an evolutionary branch which split off at a fairly early stage in the phylogenetic differentiation of this genus and in which either the increase in size of the posterior portion of the left sulcal list was inhibited or in which this portion became subject to reduction. The small size, the subrotund shape of the body, the shape of the anterior cingular list, and the shape and structure of the posterior cingular list place it among the most primitive species of this genus. The straight, subhorizontal fission rib of the left sulcal list is also a primitive feature. The structure of the anterior cingular list is simple, but exhibits characteristics that recall *H. costata* and *H. carinata.* The small size, rounded shape, and peculiar structure of the portion of the left sulcal list which is behind the fission rib are unique features by which *H. inclinata* can readily be distinguished from the remaining species of this genus. Its closest relative is probably *H. inornata* (see this species, the section on comparisons).

Occurrence: — *Histioneis inclinata* is recorded at two of the 127 stations. These two stations (4720, 4728) are located on the fifth line of the Expedition and in the South Equatorial Drift. Only two specimens were found, both occurring in Salpa taken in surface waters. The surface temperatures of these two stations were 76° and 77°, respectively.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720 of the Expedition, which thus is the type locality. The restriction of the record stations to the South Equatorial Drift is noteworthy.

Histioneis inornata Kofoid and Michener

Figure 85: 2; 95: 10

Histioneis inornata Kofoid & Michener, 1911, p. 297.

Diagnosis: — Body subrotund in lateral outline, truncate anteriorly; length: depth, 0.83: 1. Dorsally the transverse furrow is 0.53 the depth of body, three times wider than ventrally, inclined dorsoposteriorly at 8°, and gently concave. Distance from apex to posterior cingular list 0.11–0.12 the base of this list. Anterior cingular list with long stalk, flaring dorsally in its distal 0.16; its height 1.03 the depth of body. Dorsal height of posterior cingular list 0.76 the depth of body. Left sulcal list short, ending about midway between R_2 and antapex, rounded and recurved posteriorly; R_2 straight, inclined anteriorly at 10°, 0.30 the depth of body; R_3 marginal, short, 0.22 the depth of body, strikingly concave dorsally, directed posteriorly. Theca with pores only. Total length, 34 μ.

Eastern tropical Pacific.

Description: — This species is very small, its body subrotund in lateral outline, truncate anteriorly, and deepest near the girdle. The ratio between the length and the depth of the body is about 0.83: 1. The longitudinal axis is deflected posterodorsally at about 7°.

The epitheca is about 0.10 as deep as the hypotheca, flat, and subhorizontal. Dorsally the transverse furrow is about 0.53 the greatest depth of the body, about three times wider than ventrally, inclined dorsoposteriorly at about 8° to the horizontal plane, and gently concave. The distance from the apex to the posterior cingular list is only about 0.11–0.12 the base of this list. The hypotheca is subsymmetrical; the anterior margin is subhorizontal and but slightly concave; the ventral, posterior, and dorsal margins are well convex and confluent; the ventral margin is somewhat more rounded than the dorsal. In dorsoventral view the hypotheca is about as wide as long, ellipsoidal, with evenly convex side contours, and well rounded posteriorly.

The anterior cingular list has a long, slender stalk and is about 5.6 times wider distally than basally; its height is about 1.03 the greatest depth of the body, and its right side is but slightly lower than its left; in the type specimen it appeared to lack structural differentiation. Its stalk flares a trifle, enlarging abruptly in its distal 0.16 in an asymmetrical funnel, with a mainly dorsal flare. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs and the cross-rib; its dorsal height is about 0.76, its ventral height about 0.71 the greatest depth of the body; its frill is narrow, about 0.10 the dorsal rib; and it is moderately bulging. The left sulcal list is simple in shape and short, ending about midway between the fission rib and the antapex; its ventral margin is gently sigmoid, concave anteriorly, convex posteriorly; its posterior portion is well rounded, and recurved dorsally, and it has no structural differentiation except the fission rib and the posterior rib. The fission rib is straight, inclined anteriorly at about 10°, and about 0.30 the greatest depth of the body. The posterior rib is marginal, rather weak, short, about 0.22 the depth of the body, strikingly concave dorsally, and directed posteriorly; at its tip the margin of the list is subrectangular.

The thecal wall is smooth. Along the anterior margin of the hypotheca there is a series of about ten pores. Phaeosomes were not seen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 14.3 μ. Greatest depth of body, 17.3 μ. Total length, 34 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis inornata is in several respects very primitive and occupies a somewhat isolated position near the base of the evolutionary scale of Histioneis. It is structurally more closely related to *H. inclinata* than to any of the other species of this genus. The fact that the differences between these species are more marked than the similarities, indicates, however, that we are concerned with representatives of two different evolutionary lines. The most important distinguishing characteristics are to be found in the shape of the anterior cingular list and in the shape, structure, and relative size of the posterior portion of the left sulcal list. The size, shape, and structure of the left sulcal list of *H. inornata* distinguish this species from all the other known members of this genus. Note, for instance, the curved marginal and exceptionally short posterior main rib of this list.

Occurrence: — *Histioneis inornata* is recorded at only one of the 127 stations, 4720, on the fifth line of the Expedition in the South Equatorial Drift, in a Salpa taken in surface waters, at a surface temperature of 76°.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720 of the Expedition, which thus is the type locality.

Histioneis reginella Kofoid and Michener

Plate **20**, fig. 9, 11. Figure 95: 2

Histioneis reginella Kofoid & Michener, 1911, p. 296, 299, 300.

Diagnosis: — Body subrotund in lateral outline, truncate anteriorly; length: depth, 0.96: 1. Dorsally the transverse furrow is 0.46 the depth of body, three times wider than ventrally, subhorizontal, and gently concave. Distance from apex to posterior cingular list 0.20 the base of this list. Anterior cingular list with stalk of moderate length, flaring in the distal 0.5 in a wide, ventrally notched funnel; its height 1.20 the depth of body. Posterior cingular list forms big, rather narrowly rounded lateral pouches, which have irregular reticulation distally; its dorsal height 0.81 the depth of body; cross-rib with some short alternating branches. Left sulcal list extends somewhat beyond a point midway between flagellar pore and antapex, then turns anteriorly, and ends near posterior end of longitudinal furrow; of moderate width; ventral portion strikingly curled to the right; posterior portion slightly bilobed, extending but little behind antapex;

with irregular, moderately developed reticulation. Theca with pores only. Total length, 55 μ.

Eastern tropical Pacific.

Description: — This species is fairly small, subrotund in lateral outline, truncate anteriorly, and deepest near the middle. The ratio between the length and the depth of the body is about 0.96 : 1. The longitudinal axis is deflected posterodorsally at about 10°.

The epitheca is about 0.17 as deep as the hypotheca, flat, and subhorizontal. Dorsally the transverse furrow is about 0.46 the greatest depth of the body, about three times wider than ventrally, subhorizontal, and gently concave. The distance from the apex to the posterior cingular list is about 0.20 the base of this list. The hypotheca is subsymmetrical; the anterior margin is inclined dorsoanteriorly at 10°–15° to the horizontal plane and moderately concave; the ventral, posterior, and dorsal margins are well convex and confluent, but the convexity is somewhat more pronounced posteroventrally than posterodorsally. In dorsoventral view the body has about the same shape as in lateral view, but it is distinctly narrower.

The anterior cingular list has a stalk of moderate length and is about six times wider distally than basally; it flares in its distal 0.5 in a very wide subsymmetrical funnel (seen obliquely in Figure 95 : 2) with an acute ventral notch; its height is about 1.20 the greatest depth of the body, and its right side is but slightly lower than its left; along its entire distal edge this list has a submarginal rib with a moderate number of short branches on both sides; and just behind this rib it has dorsally an irregular and fairly coarse reticulum. The posterior cingular list is closed and forms on both sides a big, rather narrowly rounded pouch; when seen in dorsoventral view, each pouch is somewhat narrower than the body; the dorsal height is about 0.81, the ventral height about 0.93 the greatest depth of the body; the frill is of moderate height, about 0.27 the dorsal rib; the cross-rib has a moderate number of short, alternating branches; and each pouch has distally an irregular reticulum, from which a simple rib runs on the posterior side to the base of the list. The left sulcal list extends somewhat beyond a point midway between the flagellar pore and the antapex, then turns anteriorly on the right side of the body, and ends near the posterior end of the longitudinal furrow. It is of moderate width; its ventral portion is strikingly curled to the right; and its posterior portion is subtruncate, slightly bilobed, and extends but little behind the antapex. The anterior main rib has two branches near the middle. The anterior fission rib is recurved anteriorly and has a few short distal branches. The posterior fission rib is simple, subhorizontal, and about 0.62 the greatest depth of the body.

Posteriorly this list has two ribs; one of these is simple, rather short, about 0.34 the greatest depth of the body, deflected posteroventrally at about 20°, and ends between the two posterior lobes of this list; the other is located just in front of the first and has two branches, one fairly short posterior, and one long anterior, which distally branches into a coarse, irregular reticulum.

The thecal wall is smooth. The hypotheca has a close-set row of pores along the girdle and a moderate number of scattered pores. In the transverse furrow there are two dense rows of pores, one along the posterior cingular list and one along the sagittal suture. Numerous fairly small, ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 23.3 μ. Greatest depth of body, 24.3 μ. Total length, 55 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis reginella occupies a rather isolated position. It is especially characterized by the subrotund body, the relatively wide anterior opening of the anterior cingular list, the narrowness of the frill, the large lateral pouches of the posterior cingular list, and by the relatively short, strikingly curled left sulcal list, the posterior end of which turns anteriorly on the right side of the body and the posterior fission rib of which is subhorizontal. In the large lateral pouches of the posterior cingular list it resembles *H. panaria*, but it differs strikingly from this species in the shape of the body and in the shape and structure of the left sulcal list. In the shape of the body and of the anterior cingular list and to some extent also in the structure of the left sulcal list it recalls *H. gubernans;* but again, a close relationship to this species is brought in doubt by the large lateral pouches of the posterior cingular list and by the curved and curled shape of the left sulcal list.

Occurrence: — *Histioneis reginella* is recorded at only one of the 127 stations, 4681, on the third line of the Expedition and in the South Equatorial Drift, in a haul from 300–0 fathoms, at a surface temperature of 68°. The frequency is less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4681 of the Expedition, which thus is the type locality.

Histioneis panaria, sp. nov.

Figure 85: 8, 9; 95: 6

Diagnosis: — Body sausage-shaped; dorsal and ventral heights subequal; length: depth, 0.49: 1. Dorsally the transverse furrow is 0.59 the depth of body, eight times wider than ventrally, inclined dorsoanteriorly at 25°–30°, and strongly concave. Distance from apex to posterior cingular list 0.09 the base of this list. Anterior cingular list with stalk of moderate length, flaring gradually from very near its base with an increase in its distal 0.5 so that a slight concavity results, with broad ventral notch, deflected dextrally nearly 90°, and a dextroventral inclination of 45°; its height subequal to depth of body. Posterior cingular list forms big, broadly rounded lateral pouches; its dorsal height 0.51 the depth of body; frill broad, 0.56 the dorsal rib, with about ten simple, longitudinal ribs on each valve. Left sulcal list: R_2 almost straight, inclined posteriorly at 70°, and 0.35 the depth of body; R_3 marginal, weak, simple, gently concave dorsally, 0.68 the depth of body, located midway between midline and antapex, inclined posteroventrally at 20°–25°; ventral margin gently sigmoid, convex posteriorly; posterior end narrowly rounded. Total length, 62 μ.

Eastern tropical Pacific.

Description: — This species has a rather small body, sausage-shaped in lateral outline, and its dorsal and ventral heights are subequal. The ratio between the length and the depth of the body is about 0.49: 1. The longitudinal axis is deflected posterodorsally at about 30°–35°.

The epitheca is about 0.10 as deep as the hypotheca, gently convex, highest in the center, and subhorizontal. Dorsally the transverse furrow is about 0.59 the greatest depth of the body, about eight times wider than ventrally, inclined dorsoanteriorly at 25°–30° to the horizontal plane, and strongly concave. The distance from the apex to the posterior cingular list is only about 0.09 the base of this list. The anterior margin of the hypotheca is inclined dorsoanteriorly at about 25°, and well concave, subsemicircular; the dorsal, posterior, and ventral margins are confluent and well convex, subsemicircular. In dorsoventral view the body is ovate, about 1.4 times longer than wide, and wider near the middle.

The anterior cingular list has a stalk of moderate length and is about seven times wider distally than proximally; its height is subequal to the greatest depth of the body. It flares through nearly its whole length but more in the distal 0.5 with resulting concavity more accentuated near its middle. It exhibits a maximum amount of dextral torsion with the wide ventral notch nearly 90° from the midventral plane of the body and a dextroventral inclination of the subsymmetrical top of about 45°. There is much less torsion in the postcingular list. On the left valve it has distally about ten simple, equidistant ribs, the bases of which are connected by a transverse rib; on the right valve it has a somewhat smaller number of distal ribs, the middle portions of which are connected by a transverse rib. The posterior cingular list is closed and forms on both sides a broadly rounded lateral pouch; when seen in dorsoventral view, each pouch is slightly wider than the body; the dorsal and ventral heights are subequal and about 0.51 the greatest depth of the body; the frill is broad, about 0.56 the dorsal rib; the list lacks structural differentiation except the dorsal and ventral ribs, the cross-rib, and, on each valve, about ten simple, subequidistant, longitudinal ribs in the frill. The left sulcal list is of moderate size, simple in shape and structure, and has only two ribs, the fission rib and the posterior main rib. The fission rib is almost straight, inclined posteriorly at about 70°, and about 0.35 the greatest depth of the body. The posterior main rib is marginal, weak, simple, gently concave dorsally, about 0.68 the greatest depth of the body, located about midway between the midline and the antapex, and inclined posteroventrally at 20°–25°. The ventral margin of this list is gently sigmoid, concave anteriorly, convex posteriorly; and the posterior end of the list is narrowly rounded.

The structure of the theca was not recorded. Phaeosomes were not observed.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 14.3 μ. Greatest depth of body, 29.3 μ. Total length, 62 μ.

Comparisons: — This species is established on two outline drawings of a single specimen found in the material of the Expedition. Although our description is incomplete and perhaps somewhat uncertain in a few details on account of the fact that the type specimen was lost before the drawings were completed, it probably is sufficient for full certainty of specific identification.

Histioneis panaria is very aberrant and occupies an isolated and uncertain position in the natural system of its genus. The shape of its body and the shape and structure of its posterior cingular list are very advanced. Its left sulcal list, on the other hand, has remained relatively simple in size, shape, and structure. An especially important feature is that the posterior fission rib of the left sulcal list is nearly straight. The species shows marked similarities to *H. panda,* but these cannot be considered as indicative of a close relationship, since *H. panda* is a very highly specialized representative of the Pulchra group, in which even the most primitive members have the posterior fission rib of the left sulcal list recurved dorsally. *H. panaria* is easily recognized from all the other species of this genus by having at the same time the left sulcal list simple in structure and the posterior cingular list furnished with large lateral pouches.

Occurrence: — *Histioneis panaria* is recorded at only one (4724) of the 127 stations, on the fifth line of the Expedition, in the South Equatorial Drift, from 300–0 fathoms, at a surface temperature of 79°. The frequency is less than 1%.

2. Remora Group. Of the four species of this group only *Histioneis remora* was not found in the material of the Expedition. The others have been treated in the following order: — *H. elongata*, *H. carinata*, and *H. navicula*, suggestive of relationships.

Histioneis elongata Kofoid and Michener

Plate **20**, fig. 7; Plate **22**, fig. 4, 6, 7. Figure 96: 3

Histioneis elongata Kofoid & Michener, 1911, p. 295. Jörgensen, 1923, p. 39.

Diagnosis: — Body obliquely subrotund in lateral outline; length: depth, 1.13: 1. Dorsally the transverse furrow is 0.47 the depth of body, inclined dorsoposteriorly at 30°–35°, 3.4 times wider than ventrally, and gently concave. Distance from apex to posterior cingular list 0.26 the base of this list. Anterior cingular list with short stalk, gradually flaring distally; its height 1.07 the depth of body. Posterior cingular list with a few ribs in frill; its dorsal height 0.95 the depth of body. Left sulcal list long and narrow, with submarginal rib between main ribs and posterior reticulation; R_2 straight, 0.57 the depth of body, inclined posteriorly at 30°; R_3 of moderate strength, submarginal, 2.14 the depth of body, located on midline, directed posteriorly; ventral margin sigmoid, rather strongly convex in the middle; posterior angle, 20°–30°. Theca reticulate. Total length, 116 μ.

Eastern tropical Pacific.

Description: — This is a medium-sized, obliquely subrotund species. The ratio between the length and the depth of the body is about 1.13: 1. The longitudinal axis is deflected posterodorsally at 15°–20°.

The epitheca is about 0.23 as deep as the hypotheca, slightly convex, highest in or near the center, and tilted dorsoposteriorly at 5°–10°. Dorsally the transverse furrow is about 0.47 the greatest depth of the body, about 3.4 times wider than ventrally, inclined dorsoposteriorly at 30°–35° to the horizontal plane, and gently concave. The distance from the apex to the posterior cingular list is about 0.26 the base of this list. The anterior margin of the hypotheca is gently concave and inclined dorsoposteriorly at 15°–20° to the horizontal plane; the ventral, posterior, and dorsal margins are confluent; the dorsal margin is somewhat more rounded than the posterior and ventral margins, and the postmargin is subparallel to the anterior margin. In dorsoventral view the body is about 1.6 times longer than wide and widest in the middle; the outline of the hypotheca is ellipsoidal; the anterior portion of the body is rounded conical, with gently concave sides.

The anterior cingular list has a fairly short but distinct stalk and is about 4.3 times wider distally than basally, flaring in the distal 0.5 in a concave cone of approximately 60°; its height is about 1.07 the greatest depth of the body, and its right side is strikingly lower than its left; it has on both valves several ribs, the proximal ends of which are poorly or not at all developed; the number of ribs on the right valve is smaller than on the left; the dorsal rib on each valve is branched (Plate **22**, fig. 4); the ends of the ribs project slightly beyond the edge of the list. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs, the cross-rib, and a few (two in the type specimen) ribs in the frill; its dorsal height is about 0.95, its ventral height about 0.72 the greatest depth of the body; it bulges but slightly or not at all, and its frill is narrow, about 0.14 the dorsal rib. The left sulcal list is simple in shape and has two main ribs, between which there is a submarginal rib, and heavy reticulation posteriorly. The fission rib is straight, about 0.57 the greatest depth of the body, and inclined posteriorly at about 30°. The posterior rib is of moderate strength, submarginal proximally and marginal distally, with a few short and weak secondary ribs, about 2.14 the greatest depth of the body, gently concave dorsally, located on or near the midline, and directed posteriorly. The ventral margin of this list is sigmoid, rather strongly convex in the middle; the dorsal margin is moderately concave. The ventral and dorsal margins form a posterior angle of about 20°–30°. Except for the ribs and reticulation mentioned above and a couple of very short ribs dorsally to the posterior rib, this list lacked structural differentiation in the type specimen.

The thecal wall is reticulated. The meshes are of subuniform size and closely set. On each valve about 13–14 meshes border the girdle posteriorly. The pores are scattered and much fewer than the meshes. A few small, ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 31.4 μ. Greatest depth of body, 27.9 μ. Total length, 116 μ.

Comparisons: — Our description and figures are based on the type specimen.

Histioneis elongata undoubtedly is most closely related to *H. remora.* These species differ in the shape of the anterior cingular list and, especially, in the shape of the hypotheca, which is symmetrical in *H. remora* and strikingly asymmetrical in *H. elongata*. The ventral split in the anterior cingular list, as well as the dorsal split and the absence of a frill in the posterior cingular list in Stein's (1883, pl. 22, fig. 11) figure of *H. remora* evidently are due to Stein's overlooking parts of these delicate membranes. The marked lack of asymmetry in Stein's *H. remora* as compared with *H. elongata* may be due in part at least to the general tendency in Stein's delineations of this genus to accentuate all the symmetrical features. Our own observations as shown in our attempts at an accurate delineation of these most elaborate organisms do not confirm this trend so strikingly shown in Stein's figures. This is an exception to the general evaluation of the work of this indefatigable pioneer in protozoölogy, for as a general rule his figures are exceptional in the accuracy of detail with which he portrayed the Protozoa. His sense of symmetry and proportion was evidently too strong when he drew Histioneis. The highly developed structure of the left sulcal list of the type specimen of *H. remora* indicates that this specimen was further advanced ontogenetically than the specimen of *H. elongata* represented by our Plate **22**, figure 7. The question of the specific separation of these two forms cannot be regarded as settled but should be reconsidered. For further discussion about the relationships of these species, see *H. carinata* and *H. navicula*, the sections on comparisons.

Synonymy: — This species was established by Kofoid and Michener (1911) under the name of *Histioneis elongata*. This name was considered by Jörgensen (1923, p. 39) as a possible synonym of *H. remora* Stein. With regard to *H. remora* Jörgensen (1923), see *H. carinata*, the section on synonymy.

Occurrence: — *Histioneis elongata* is recorded at three of the 127 stations. All of these three stations (4722, 4730, 4734) are located on the fifth line of the Expedition and in the South Equatorial Drift. The depth is 300–0 fathoms, the surface temperature 78.3° (75°–81°), and the frequency in each case less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4722 of the Expedition, which thus is the type locality. The restriction of the three record stations to the South Equatorial Drift is noteworthy.

Histioneis carinata Kofoid

Plate **21**, fig. 1, 8. Figure 95: 1

Histioneis carinata Kofoid, 1907a, p. 203, pl. 16, fig. 98.
? *Histioneis paulseni* Okamura, 1912, p. 21, pl. 3, fig. 53, 54.
? *Histioneis remora* Jörgensen, 1923, p. 39, fig. 55.

Diagnosis: — Body of short canoe-shape, distinctly higher ventrally than dorsally; length: depth, 0.63: 1. Dorsally the transverse furrow is 0.54 the depth of body, 5 times wider than ventrally, inclined dorsoposteriorly at 15°–20°, and gently concave. Distance from apex to posterior cingular list 0.11 the base of this list. Anterior cingular list with stalk about 0.4 its total height and including an angle of 70°; its height 0.60 the depth of body. Posterior cingular list with slight ventral reticulation; its dorsal height 0.59 the depth of body. Left sulcal list with well-developed reticulation; R_2 straight, 0.18 the depth of body, inclined posteriorly at 25°–30°; R_3 marginal, strong, reticulated posteriorly, 0.63 the depth of body, located on midline, directed posteriorly; ventral margin sigmoid, well convex posteriorly; narrowly rounded or subangular posteriorly. Theca reticulate. Total length, 88 μ.

Eastern tropical Pacific.

Description: — This is a medium-sized species of short canoe-shape, distinctly higher ventrally than dorsally. The ratio between the length and the depth of the body is about 0.63: 1. The longitudinal axis is deflected posterodorsally at about 15°–20°.

The epitheca is about 0.19 as deep as the hypotheca, slightly convex, highest in or near the center, and tilted ventroposteriorly at about 10°. Dorsally the transverse furrow is about 0.54 the greatest depth of the body, about five times wider than ventrally, inclined dorsoposteriorly at 15°–20° to the horizontal plane, and gently concave. The distance from the apex to the posterior cingular list is only about 0.11 the base of this list. The anterior margin of the hypotheca is inclined dorsoposteriorly at about 10° to the horizontal plane and moderately sigmoid, convex ventrally, and concave dorsally; the ventral, posterior, and dorsal margins are confluent; the ventral and dorsal margins are well rounded, the posterior margin is gently rounded. In dorsoventral view the body is about 1.2 times longer than wide, widest in the middle; the outline of the hypotheca is subcircular; the anterior portion of the body is rounded conical, with gently concave sides.

The anterior cingular list has a short but distinct stalk and is about three times wider distally than basally; its height is about 0.60 the greatest depth of the body, and its right side is strikingly lower than its left. The short stalk is about 0.4 the total height. The flaring funnel has straight sides, the ventral much steeper than the dorsal, and the angle included between the two is about 70°. On the right valve it has only three ribs, the ventral one of which is simple, the dorsal furnished with one short distal branch, and the middle with three branches; on the left valve it has about 14–15 ribs, the proximal parts of which form a reticulum; the ends of the ribs project slightly beyond the edge of the list. The posterior cingular list was open ventrally in the type specimen but is probably closed when fully developed just as in *Histioneis navicula;* or the delicate membrane may have been overlooked; it lacks structural differentiation except the dorsal and ventral ribs, the cross-rib, and a slight reticulation between the bases of the ventral ribs; its dorsal height is 0.59, its ventral height 0.34 the greatest depth of the body; it bulges but slightly; its frill is narrow, 0.14 the dorsal rib. The left sulcal list is simple in shape, and has two main ribs and well-developed reticulation. The fission rib is straight, about 0.18 the greatest depth of the body, and inclined posteriorly at about 15°. The posterior rib is marginal, strong, reticulated distally, sometimes with a few short and weak secondary ribs, about 0.63 the greatest depth of the body, sigmoid, concave anteriorly, convex posteriorly, located on or near the midline, and directed posteriorly. The ventral margin of this list is sigmoid, moderately concave anteriorly, and well convex posteriorly. Its posterior end is narrowly rounded or subangular. Basally between the fission rib and the posterior rib as well as posteriorly, this list is heavily reticulated with subhorizontally elongated reticulation; and in front of the fission rib it has fine reticulations of the subcircular type.

The thecal wall is reticulated. The meshes are fairly closely set and of subuniform size. On each valve about 21 meshes border the girdle posteriorly. In most of the meshes a central pore is to be found. A few small, ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 31.4 μ. Greatest depth of body, 50.0 μ. Total length, 88 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis carinata appears to be most closely related to *H. elongata* and *H. navicula*, and in several respects occupies structurally an intermediate position between these two species. From *H. elongata* it is easily recognized by its relatively deeper body and narrower left sulcal list. It differs from *H. navicula* in its less depressed body, in its relatively narrower transverse furrow and smaller posterior cingular list, and in the longer and stronger posterior main rib of the left sulcal list. Another close relative is *H. remora*, a species very nearly related to and possibly somewhat more primitive than *H. elongata*. It should also be mentioned that *H. biremis* and *H. highleyi* probably originated from an ancestral form fairly closely resembling *H. carinata*. These two species are readily recognized from *H. carinata*, as well as from all the other species of this genus, by the posterior spur-like projection of the body. *Parahistioneis paraformis* (Plate 19, fig. 3), which has the posterior rib of the left sulcal list of about the same size, structure, and position as in the present species, probably is structurally fairly close to the ancestral form from which originated the group of species mentioned in this section (see also *Histioneis navicula*, the section on comparisons).

The specimen represented by Figure 85: 4 has been referred to *Histioneis carinata*, but it is of a somewhat uncertain specific allocation. In several respects it is intermediate between this species and *H. navicula;* for instance, in the shape and structure of the left sulcal list it approaches *H. carinata*. This specimen is not considered in our description of *H. carinata*, and its locality is not included in the distributional data.

Synonymy: — This species was established by Kofoid (1907a) under the name of *Histioneis carinata*. The specimens from Japanese waters recorded by Okamura (1912, p. 21, pl. 3, fig. 53, 54) as *H. paulseni* are too inadequately figured for certainty of specific assignment. At least one of them (fig. 53a), however, appears to belong to *H. carinata*. The relatively short dorsoventral diameter and the greater dorsal height of the body in this specimen as drawn by Okamura probably are only apparent and due to foreshortening. The specimen represented by Okamura's (1912) figure 54a may also belong to this species, but the structure of its left sulcal list makes this assignment quite uncertain. The shortness of the dorsoventral diameter of the body is probably at least to some extent due to foreshortening. The specimen from the Mediterranean figured by Jörgensen (1923, fig. 55) as *H. remora* resembles *H. carinata* rather closely, except in the greater posterior width and the weaker posterior main rib of the left sulcal list, in which respects it is intermediate between *H. carinata* and *H. remora*. This specimen can hardly be referred to *H. remora*, but its assignment to *H. carinata* is also questionable. We have not included these specimens of Okamura (1912) and Jörgensen (1923) in our description or in our account of the distribution of *H. carinata*, but they have tentatively been assigned to this species.

Occurrence: — *Histioneis carinata* is recorded at only one (4724) of the 127 stations, on the fifth line of the Expedition and in the South Equatorial Drift, from 300–0 fathoms, at a surface temperature of 79°. The frequency is less than 1% (one specimen).

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4724 (not 4734 as stated originally) of the Expedition, which thus is the type locality (see also the section on synonymy).

Histioneis navicula Kofoid

Plate 21, fig. 3, 6. Figure 95: 3

Histioneis navicula Kofoid, 1907a, p. 204, pl. 16, fig. 96. Kofoid & Michener, 1911, p. 298.

Diagnosis: — Body canoe-shaped, somewhat higher ventrally than dorsally; length: depth, 0.52: 1. Dorsally the transverse furrow is 0.77 the depth of body, 11 times wider than ventrally, inclined dorsoposteriorly at 10°–15°, and well concave. Distance from apex to posterior cingular list 0.10 the base of this list. Anterior cingular list with short stalk, flaring asymmetrically dorsosinistrally; its height 0.75 the depth of body. Posterior cingular list large; its dorsal height 0.75 the depth of body; frill with slight reticulation dorsally and ventrally and with a few ribs. Left sulcal list: R_2 straight, 0.12 the depth of body, inclined posteriorly at 40°–50°; R_3 weak, submarginal, with short distal branches, 0.36 the depth of body, located somewhat dorsally to midline, inclined posteroventrally at 10°–15°; ventral margin sigmoid, convex posteriorly, partly curled to the right; posterior angle, 60°–70°. Theca reticulate. Total length, 87 μ.

Eastern tropical Pacific.

Description: — This is a fairly large species, with canoe-shaped body, distinctly higher ventrally than dorsally. The ratio between the length and the depth of the body is about 0.52: 1. The longitudinal axis is deflected posterodorsally at about 30°–35°.

The epitheca is about 0.12 as deep as the hypotheca, slightly convex, highest somewhat dorsally to the center, and tilted ventroposteriorly at about 10°. Dorsally the transverse furrow is about 0.77 the greatest depth of the body, about eleven times wider than ventrally, inclined dorsoposteriorly at 10°–15° to the horizontal plane, and well concave. The distance from the apex to the posterior cingular list is only about 0.10 the base of this list. The shape of the hypotheca determines the shape of the body as a whole, since the anterior margin extends almost as far anteriorly as that of the transverse furrow. The anterior margin of the hypotheca is inclined dorsoposteriorly at about 5°–10° to the horizontal plane and is somewhat less concave than the transverse furrow; the ventral margin is well and broadly rounded; the posterior margin is flat and confluent with the ventral margin; the short dorsal margin forms a broadly rounded corner with the posterior margin. In dorsoventral view the body is about 1.6 times longer than wide and widest in the middle; the outline of the hypotheca is ellipsoidal; the anterior portion of the body is rounded conical, with gently concave sides.

The anterior cingular list has a short but distinct stalk and is about 5.7 times wider distally than basally; its height is about 0.75 the greatest depth of the body, and its right side is strikingly lower than its left. It flares distally, beginning very near the base, and increases at an accelerated rate dorsosinistrally to a distal angle of 80°. On the right valve it has only two ribs, the ventral one of which is simple, the dorsal furnished with five to six branches; on the left valve it has 10–15 irregular ribs, the proximal ends of which form a reticulum; the tips of the ribs project slightly beyond the edge of the list. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs, the cross-rib, and a slight reticulation dorsally and ventrally and a few ribs on the frill; its dorsal height is 0.75, its ventral height 0.39 the greatest depth of the body; it bulges moderately dorsally and but slightly laterally; and its frill is narrow, 0.16 the dorsal rib. The left sulcal list is simple, with the posterior half of the ventral margin recurved to the right, and with only two ribs. The fission rib is straight, very weak, about 0.12 the greatest depth of the body, and inclined posteriorly at 40°–50°. The posterior rib is stronger, submarginal proximally, marginal distally, with short distal branches both horizontal and vertical in direction, almost straight, about 0.36 the greatest depth of the body, located somewhat dorsally to the midline, and inclined posteroventrally at 10°–15°. The ventral margin of this list is sigmoid, moderately concave anteriorly, and convex posteriorly. The ventral and dorsal margins of this list form a posterior angle of 60°–70°. The dorsal margin is gently concave. Except for the ribs mentioned above, this list appears to lack structural differentiation.

The thecal wall is reticulated. The meshes are closely set and of subuniform size. On each valve about 33 meshes border the girdle posteriorly. Pores were not observed. A few small ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 31.2 μ. Greatest depth of body, 59.6 μ. Total length, 87 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis navicula probably is most closely related to *H. carinata*. This relationship is suggested by the depressed shape of the body, by the similarities in the shape and structure of the anterior cingular list, and by the simple and almost similar structure of the posterior cingular list. The first species is readily distinguished from the last by its more depressed body, by its relatively wider transverse furrow and larger posterior cingular list, and by the shorter and weaker posterior rib in its left sulcal list. In the degree of depression of the body, in the relative width of the transverse furrow, and in the relative size of the posterior cingular list, *H. navicula* represents the end link in the orthogenetic series: *H. remora — H. carinata — H. navicula*. In the shape and structure of the anterior cingular list the two last species have reached almost the same evolutionary stage. In the relative width and in the structure of the left sulcal list *H. navicula* is the most primitive.

Occurrence: — *Histioneis navicula* is recorded at three of the 127 stations. All of these three stations are in the South Equatorial Drift, and one of them (4701) is on the fourth and two (4733, 4734) are on the fifth line of the Expedition. At one station (4733) the species was found in surface waters (in Salpa); the two remaining records refer to hauls from 300–0 fathoms.

The temperature range of these three stations at the surface was 72°–81°; the average was 77.7°. The frequency is in all cases less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4734 of the Expedition which thus is the type locality. The restriction of the three record stations to the South Equatorial Drift is noteworthy.

3. Biremis Group. Both the species belonging to this group, viz., *Histioneis biremis* and *H. highleyi*, were recorded from the material of the Expedition.

Histioneis biremis Stein

Figure 97; 95: 11

Histioneis biremis Stein, 1883, pl. 22, fig. 13. Bütschli, 1885, p. 943. Murray & Whitting, 1899, p. 332, pl. 32, fig. 6, tab. 3, 6, 8, 9. Lemmermann, 1899, p. 374. Kofoid, 1907a, p. 204.

Diagnosis: — Body obliquely depressed; with posterodorsal protuberance 1.3–2.3 times longer than deep; length : depth, 0.99–1.08 : 1. Dorsally the transverse furrow is 0.55–0.65 the depth of body, three to six times wider than ventrally, inclined dorsoposteriorly at 25°–30°, and gently or moderately concave. Distance from apex to posterior cingular list 0.08–0.23 the base of this list. Anterior cingular list with short stalk flaring widely distally; its height 0.59–0.81 the depth of body. Dorsal height of posterior cingular list 0.64–0.85 the depth of body. Left sulcal list with two main ribs, between which may be some short ribs, reticulation, or a submarginal rib; R_2 almost straight, inclined posteriorly at 5°–30°, and 0.22–0.33 the depth of body; R_3 usually marginal, strong, reticulated distally, 0.85–1.20 the depth of body, located on midline, and inclined posteroventrally at 1°–15°; margin between R_2 and R_3 gently sigmoid or convex; angular at 10°–30° or narrowly rounded posteriorly. Theca areolate and porulate. Total length, 101–193 μ.

Widely distributed in warm seas.

Description: — This is a large, strikingly asymmetrical species, in which the body is postero-obliquely depressed and furnished with a spur-like posterodorsal protuberance. The ratio between the length and the depth of the body is 1.03 (0.99–1.08): 1. The longitudinal axis (drawn through the apex and the posterior end of the posterior process) is inclined posterodorsally at 40° (35°–45°).

The epitheca is 0.21 (0.19–0.22) as deep as the hypotheca, slightly convex, highest in or near the center, and subhorizontal or tilted dorsoposteriorly at 1°–10°. Dorsally the transverse furrow is 0.60 (0.55–0.65) the greatest depth of the body, three to six times wider than ventrally, inclined dorsoposteriorly at 25°–30° to the horizontal plane, and gently or moderately concave. The distance from the apex to the posterior cingular list is 0.17 (0.08–0.23) the base of this list. The hypotheca is strikingly asymmetrical and has a spur-like posterodorsal protuberance, which is about 1.3–2.3 times longer than deep and well rounded distally. The anterior margin of the hypotheca is inclined dorsoposteriorly at 13° (8°–15°) to the horizontal plane, gently sigmoid, convex ventrally and concave dorsally (Murray and Whitting, 1899, pl. 32, fig. 6), gently concave (Stein, 1883, pl. 22, fig. 13), or almost straight (Figure 97: 3); the ventroposterior margin is strongly sigmoid, convex ventrally, and concave posterodorsally; the dorsal margin is almost straight (Murray and Whitting, 1899, pl. 32, fig. 6), gently concave (Figure 97: 1, 3), or gently sigmoid, convex anteriorly and concave posteriorly (Stein, 1883, pl. 22, fig. 13).

The anterior cingular list has a short but distinct stalk and is about three to five times wider distally than basally; its height is 0.72 (0.59–0.81) the greatest depth of the body, and its right side is strikingly lower than its left; the sides of the flaring funnel are straight but longer dorsally; its structure appears always to be about the same as in *Histioneis carinata*. The posterior cingular list, when fully developed, appears to be closed; it lacks structural differentiation except the dorsal and ventral ribs, and the cross-rib; its dorsal height is 0.74 (0.64–0.85), its ventral height 0.48 (0.39–0.59) the greatest depth of the body; its frill is rather narrow, 0.19 (0.17–0.21) the dorsal rib; and usually it is but slightly if at all bulging (for exception, see Figure 97: 2). The left sulcal list is simple in shape and has two main ribs and between these, in older specimens, a few short ribs, reticulation, and a more or less developed submarginal rib. The fission rib is straight or gently sigmoid, 0.27 (0.22–0.33) the greatest depth of the body, and inclined posteriorly at 15° (5°–30°). The posterior rib is strong, reticulated distally, sometimes with a few short and weak secondary ribs (Murray and Whitting, 1899, pl. 32, fig. 6), 1.01 (0.85–1.20) the greatest depth of the body, somewhat concave dorsally, located about midway between the transverse furrow and the posterodorsal spur-like protuberance of the body, inclined posteroventrally at 1°–15°, and either marginal throughout, or its proximal half is submarginal (Figure 97: 1, 2), or the list extends to the base of the posteroventral protuberance, in which case the portion of the list dorsal to this rib is very low (Murray and Whitting, 1899, pl. 32, fig. 6). The margin between the fission rib and the posterior rib is gently sigmoid or convex; and at the tip of the posterior rib the margin is either narrowly rounded or it forms an angle of 10°–30°. The portion of this list in front of the fission rib is but slightly developed; its ventral margin is gently concave or almost straight, and its posterior width sometimes (Figure 97: 3) is only about half the length of the fission rib; in no case does its maximum width exceed the

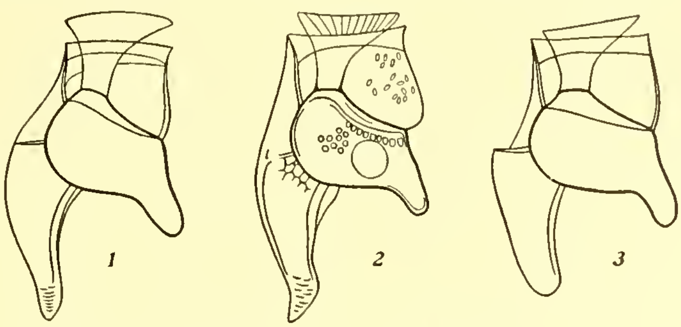

FIGURE 97.— *Histioneis biremis* Stein, left lateral view; in 2, structure of theca indicated and outline of nucleus shown. × 375. 1, 3, from Station 4722 (300–0 fathoms); 2, from Station 4724 (300–0 fathoms).

length of this rib; in relatively old specimens it may be reticulated (Murray and Whitting, 1899, pl. 32, fig. 6).

The thecal wall is areolate and porulate. The areoles along the anterior margin of the hypotheca differ in shape from the remaining ones, being flattened anteriorly. There is as a rule one pore in each areole. In the girdle a varying number of small, ovoidal phaeosomes are to be found.

The dimensions of five of our specimens, of the type specimen (Stein, 1883, pl. 22, fig. 13), and of the specimen figured by Murray and Whitting (1899, pl. 32, fig. 6) were measured.

Dimensions: — Our specimens: Length of body, 46.8–54.1 μ (average, 48.2 μ). Greatest depth of body, 44.5–54.5 μ (average, 46.8 μ). Total length, 101–114 μ (average, 109 μ). The size of the type specimen as drawn by Stein (1883, pl. 22, fig. 13) is unknown. According to Stein's (1883) information about the magnifications of his figures given in an introductory remark to the explanations of the plates, this specimen had a total length of somewhere between 103 μ and 158 μ. Specimen figured by Murray and Whitting (1899, pl. 32, fig. 6): Length of body, 88.7 μ; greatest depth of body, 88.7 μ; total length, 193 μ.

Variations: — The shape and structure of the body and of the anterior cingular list are strikingly constant. The posterior cingular list, too, is usually very constant; however, in some specimens (Figure 97: 2) it is rather bulging. The shape and structure of the left sulcal list vary with age. The most variable character is the size. None of our specimens had a total length exceeding 114 μ, while in the specimen figured by Murray and Whitting (1899) the corresponding value was not less than 193 μ.

Comparisons: — Our specimens show a close agreement with the type, disregarding some evident inaccuracies in Stein's (1883, pl. 22, fig. 13) representation of the cingular lists. They differ strikingly in size from, but agree very closely in shape and structure with, the specimen of this species figured by Murray and Whitting (1899, pl. 32, fig. 6). In spite of the great variations in size, there can hardly be any doubt that the species as conceived in the present paper is a natural systematic unit.

Histioneis biremis presumably is most closely related to *H. highleyi*. This relationship is indicated by the posterodorsal spur-like process of the body, which is a unique feature of these two species, and by the great similarities in the cingular and sulcal lists. The first species is easily recognized from the last by the gentle, sigmoid curvature of the anterior margin of its hypotheca. These two species probably evolved from an ancestral form closely resembling *H. carinata*. This relationship is strongly suggested by the depressed shape of the body in the last species and by the striking similarities in the shape and structure of the cingular and sulcal lists and in the structure of the thecal wall. Of the two species, *H. biremis* and *H. highleyi*, the former is the more primitive. On the other hand, judging by the shape of the hypotheca, *H. highleyi* probably did not pass through a *biremis* stage, but these two species rather appear to have evolved independently from a common ancestral form.

Synonymy: — This species was established by Stein (1883) under the name of *Histioneis biremis*, a name also used by all the succeeding authors in this field.

Occurrence: — *Histioneis biremis* is recorded at nine of the 127 stations. There are 0, 0, 0, 2, 4, and 3 stations on the six lines of the Expedition. Of these nine stations, seven (4701, 4709, 4722, 4724, 4732, 4737, 4740) are in the South

Equatorial Drift; two (4742, 4743) are in the South Equatorial Current. At one station (4743) the species was taken in a surface haul. All the remaining records refer to hauls from 300–0 fathoms.

The temperature range of these nine stations at the surface was 72.0°–81.5°; the average was 77.2°.

The frequency is 1% at one station (4732), and less than 1% at the remaining stations.

Stein (1883) first recorded this species "aus der Südsee." Murray and Whitting (1899) found it at twelve localities in the Atlantic Ocean and the Caribbean Sea, between lat. 10° N. and lat. 31° N., and between long. 35° 30′ W. and long. 79° 80′ W. (Panama), in surface waters of 76° (67°–84°).

The species evidently is widely distributed but rare in tropical and subtropical waters. Judging by available data, the most noteworthy features of its occurrence in the region investigated by the Expedition are its rareness in surface waters and its absence from the coastal currents.

HISTIONEIS HIGHLEYI Murray and Whitting

Figure 98; 95: 14

Histioneis highleii MURRAY & WHITTING, 1899, p. 334, pl. 32, fig. 5, tab. 6, 8, 9. LEMMERMANN, 1899a, p. 374. FARIA & CUNHA, 1917, p. 79.
Histioneis highlei OKAMURA, 1912, p. 20, pl. 3, fig. 52.

Diagnosis: —Body (and hypotheca) asymmetrically Y-shaped, with posterior protuberance 1.5–2.5 times longer than deep; length: depth, 1.17–1.33: 1. Dorsally the transverse furrow is 0.54–0.65 the depth of body, five to eight times wider than ventrally, inclined dorsoposteriorly at 1°–10°, and very strongly concave. Distance from apex to posterior cingular list 0.09 the base of this list or even less. Anterior cingular list with very short stalk; its height 0.73–0.78 the depth of body; flaring widely with straight sides to funnel which is nearly twice as long dorsally as ventrally. Dorsal height of posterior cingular list 0.57–0.70 the depth of body. Left sulcal list with two main ribs, between which may be some short ribs and a submarginal rib; R_2 almost straight, inclined posteriorly at 1°–20°, and 0.19–0.39 the depth of body; R_3 marginal, strong, reticulated distally, 0.73–0.83 the depth of body, located on midline, and inclined posteroventrally at 10°–30°; margin between R_2 and R_3 gently sigmoid; posterior angle, 30°–40°. Theca areolate. Total length, 83–114 μ.

Widely distributed in warm seas.

Description: — This is a large, strikingly asymmetrical, Y-shaped or saddle-shaped species. The ratio between the length and the depth of the body is 1.23

(1.17–1.33) : 1. The longitudinal axis (drawn through the apex and the posterior end of the posterior process) is inclined posterodorsally at 31° (28°–32°).

The epitheca is 0.17 (0.13–0.25) as deep as the hypotheca, slightly convex, highest in or near the center, and tilted dorsoposteriorly at 10°–25°. Dorsally the transverse furrow is 0.60 (0.54–0.65) the greatest depth of the body, five to eight times wider than ventrally, inclined dorsoposteriorly at 6° (1°–10°) to the horizontal plane, and very strongly concave. The distance from the apex to the posterior cingular list is only 0.09 the base of this list or even less. The shape of the hypotheca determines the shape of the body as a whole, since its anterior margin extends almost as far anteriorly as that of the transverse furrow. The anterior margin of the hypotheca has almost the same concavity as the transverse furrow; the ventroposterior margin is strongly sigmoid, convex anteriorly, and concave posteriorly; the dorsal margin is moderately or rather strongly concave. The anterodorsal shank of the hypotheca is less than half as large as the anteroventral, and about 1.5–2.5 times longer than high; the posterior process usually is somewhat larger than the anterodorsal shank but never as large as the anteroventral, and about 1.5–2.5 times longer than deep. All the three processes are well rounded distally.

The anterior cingular list has a short but distinct stalk and is about 4.5 (3.2–5.5) times wider distally than basally; its height is 0.75 (0.73–0.78) the greatest depth of the body, and its right side is strikingly lower than its left, but not ventrally notched. It flares widely with nearly straight sides, the ventral 0.5 the length of the dorsal and slightly concave. Its structure appears to be the same as in *Histioneis carinata*. The posterior cingular list, when fully developed, appears to be closed; it lacks structural differentiation except the dorsal and ventral ribs and the cross-rib; its dorsal height is 0.62 (0.57–0.70), its ventral height 0.37 (0.32–0.42) the greatest depth of the body; its frill is of moderate height, 0.25 (0.19–0.33) the dorsal rib, and it is but slightly if at all bulging. The left sulcal list is simple in shape and has two main ribs and between these, in older specimens, a few short ribs, faint reticulation, and a more or less developed submarginal rib. The fission rib is straight or gently sigmoid, 0.28 (0.19–0.39) the greatest depth of the body, and inclined posteriorly at 10° (1°–20°). The posterior rib is marginal, strong, reticulated distally, sometimes with a few short and weak secondary ribs (Murray and Whitting, 1899, pl. 32, fig. 5), 0.79 (0.73–0.83) the greatest depth of the body, slightly concave dorsally, located about midway between the transverse furrow and the posterior process, and inclined posteroventrally at 10°–30°. The margin between the fission rib and the posterior rib is gently sigmoid, or almost straight; and at the tip of the posterior rib the margin forms an angle of 30°–40°. The portion of this list in front of the fission rib is but slightly developed; its ventral margin is gently concave or almost straight, and its posterior width sometimes is only half the length of the fission rib; in no case does its maximum width exceed the length of this rib.

The thecal wall is areolate (probably with scattered pores). In the girdle either a moderate number of large or numerous small phaeosomes are to be found (Murray and Whitting, 1899, pl. 32, fig. 5; Figure 98: 1). The phaeosomes are greenish in color; the large ones are spheroidal, the small ovoidal or spheroidal.

The dimensions of five of our specimens, of the type specimen (Murray and Whitting, 1899, pl. 32, fig. 5), and of the specimen figured by Okamura (1912, pl. 3, fig. 52) were measured.

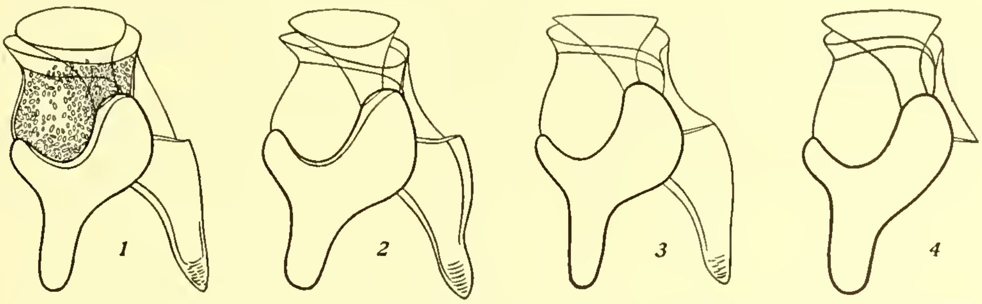

FIGURE 98.—*Histioneis highleyi* Murray and Whitting, right lateral view. × 375. 1, from Station 4705 (300–0 fathoms); 2, 3, 4, from Station 4722 (300–0 fathoms).

Dimensions: —Our specimens: Length of body, 62.2–66.5 μ (average, 64.2 μ). Greatest depth of body, 51.0–54.8 μ (average, 53.1 μ). Total length, 92–99 μ (average, 97 μ). Type specimen (Murray and Whitting, 1899, pl. 32, fig. 5): Length of body, 76.8 μ; greatest depth of body, 57.8 μ; total length, 114 μ. Specimen figured by Okamura (1912, pl. 3, fig. 52): Length of body, 51.4 μ; greatest depth of body, 46.1 μ; total length, 83 μ.

Variations: — This species is relatively constant. The most variable characteristics are the size, and the relative length and width of the three shanks of the Y-shaped body. The structure of its left sulcal list evidently varies with age: in relatively young specimens probably only the fission rib and the posterior rib are present; later the submarginal rib and the short ribs or even a faint reticulation (Okamura, 1912, pl. 3, fig. 52) appear. Another peculiarity worth mentioning in this connection is the great variation found in the size and the number of the phaeosomes.

Comparisons: — The specimens assigned by us to *Histioneis highleyi* agree very closely with the type as figured by Murray and Whitting (1899) as well as with the specimen figured under this name by Okamura (1912). The most noteworthy difference between our specimens and those figured by these investigators is the size. The total length of the type specimen was 114 μ, that of the specimen figured by Okamura (1912), only 83 μ. Our specimens were of intermediary sizes, measuring 92–99 μ in length. The species as conceived in the present paper undoubtedly is a natural systematic unit.

Histioneis highleyi appears to be most closely related to *H. biremis*. This relationship is indicated by the posterior process of the body, which is a unique feature of these two species, and by the great similarities in the cingular and sulcal lists. The first species is readily recognized from the last by the strong concavity of the transverse furrow and of the anterior margin of the hypotheca (see also *H. biremis*, the section on comparisons).

Synonymy: — This species was established by Murray and Whitting (1899) under the name of *Histioneis highleii*, and the same name was used by all the succeeding authors in this field. It should be mentioned, however, that the specimen figured by Cleve (1902b, p. 30) as *Dinophysis intermedia*, sp. n., may belong to this species. Unfortunately, this specimen appears to be figured too poorly for certainty of specific assignment.

Occurrence: — *Histioneis highleyi* is recorded at six of the 127 stations. There are 0, 0, 0, 3, 3, and 0 stations on the six lines of the Expedition. Of these six stations, one (4699) is in the Easter Island Eddy; five (4705, 4707, 4721, 4722, 4730) are in the South Equatorial Drift. All records refer to hauls from 300–0 fathoms.

The temperature range of these six stations at the surface was 72°–79°; the average was 74.7°. The frequency is in all cases less than 1%.

Murray and Whitting (1899) recorded this species at six localities in the Atlantic, between lat. 24° N. and lat. 31° N. and between long. 35° W. and long. 51° W., in surface waters of 67°–77°. Faria and Cunha (1917) found it near Rio de Janeiro; Okamura (1912) in Japanese waters.

The species evidently is widely distributed but rare in tropical and subtropical waters. The most outstanding feature of its occurrence in the material of the Expedition is its absence from surface catches and from hauls made in the coastal currents.

4. Longicollis Group. Four species belong to this group. Of these, *Histioneis kofoidi* has been recorded only from the Mediterranean. The remaining ones have been treated in the present paper in the following order: — *H. longicollis*, *H. hyalina*, and *H. pacifica*, indicative of their systematic positions.

Histioneis longicollis Kofoid

Plate 20, fig. 5; Plate 21, fig. 5. Figure 95: 7

Histioneis longicollis Kofoid, 1907a, p. 204, pl. 16, fig. 100.

Diagnosis: — Body obliquely subrotund in lateral outline, truncate anteriorly; length: depth, 0.89: 1. Dorsally the transverse furrow is 0.48 the depth of body, 2.4 times wider than ventrally, inclined dorsoposteriorly at 7°, and but slightly concave. Distance from apex to posterior cingular list 0.17 the base of this list. Anterior cingular list with long stalk; funnel with nearly straight sides, ventral scarcely inclined, dorsal abruptly and widely flaring; height 1.10 the depth of body. Dorsal height of posterior cingular list 0.91 the depth of body. Left sulcal list long, narrow, gently sigmoid ventrally, narrowly rounded posteriorly, gently concave dorsally; length of dorsal margin 1.36 the depth of body; anterior R_2 almost straight, inclined posteriorly at 35°–40°, and 0.28 the depth of body; posterior R_2 recurved dorsally toward middle of R_3 but does not join this rib; R_3 marginal, weak, extending along two thirds of dorsal margin of list, with a few short branches distally, located on midline, and inclined posteroventrally at 25°. Theca without structure. Total length, 72 μ.

Eastern tropical Pacific.

Description: — This is a fairly small, and relatively simple species, obliquely subrotund in lateral outline, truncate anteriorly. The ratio between the length and the depth of the body is about 0.89: 1. The longitudinal axis is deflected posterodorsally at about 25°.

The epitheca is about 0.12 as deep as the hypotheca, slightly convex, highest in or near the center, and subhorizontal. Dorsally the transverse furrow is about 0.48 the greatest depth of the body, about 2.4 times wider than ventrally, inclined dorsoposteriorly at about 7° to the horizontal plane, and but slightly concave. The distance from the apex to the posterior cingular list is about 0.17 the base of this list. The hypotheca is asymmetrical; the anterior margin is subhorizontal and gently concave; the ventral, posterior, and dorsal margins are well convex and confluent; the dorsal margin is somewhat more rounded than the ventral. In dorsoventral view the body is about 1.3 times longer than wide and widest in or near the middle; the outline of the hypotheca is ellipsoidal; the anterior portion of the body is rounded conical, with gently concave sides.

The anterior cingular list has a long, slender stalk and is about four times wider distally than basally; its height is about 1.10 the greatest depth of the body, and its right side is but slightly lower than its left; on the left side it has a submarginal rib, to the middle of which a radial rib is attached. Its funnel is quite asymmetrical, the ventral side gradually and but slightly flaring, the dorsal abruptly and widely. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs and the cross-rib; its dorsal height is about 0.91, its ventral height about 0.80 the greatest depth of the body; its frill is of moderate height, about 0.23 the dorsal rib; and it is very slightly if at all bulging. The left sulcal list is flat, long, and narrow; its ventral margin is gently sigmoid, concave anteriorly, and convex posteriorly; posteriorly it is narrowly rounded, and its dorsal margin is gently concave. This list appears to lack structural differentiation except the fission rib and the posterior main rib. The anterior fission rib is almost straight, inclined posteriorly at 35°–40°, and about 0.28 the greatest depth of the body. The posterior fission rib is recurved dorsally toward the middle of the posterior main rib, but it does not join this rib; in the type specimen it has a very short distal branch. The posterior main rib is marginal, weak, extends along two thirds of the dorsal margin of the list, which is 1.36 the depth of the body, has a few short distal branches, is located on or near the midline, and is deflected posteroventrally at about 25°.

The thecal wall appears to lack pores and other structural differentiation. Numerous medium-sized, ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 20.3 μ. Greatest depth of body, 22.8 μ. Total length, 72 μ.

Comparisons: — The description given above is based on the type specimen.

The structurally closest-known relative of *Histioneis longicollis* is *H. kofoidi.* The former species differs from the latter mainly in the pronounced asymmetry of the hypotheca, in having the posterior main rib of the left sulcal list marginal instead of submarginal, and in the fact that the recurved posterior fission rib of this list does not join the posterior main rib. Other close relatives of *H. longicollis* are *H. hyalina* and *H. pacifica,* two species that are very readily distinguished from the first mentioned by the marked dorsoventral elongation of the body; *H. hyalina* is also characterized by having the dorsal margin of the left sulcal list strongly curled to the right, *H. pacifica* by having the posterior portion of this list spoon-shaped and furnished with a fairly highly developed reticulation. The close relationship of these four species is indicated by similarities in the structure of the thecal wall, and in the shape and structure of the cingular and sulcal lists; especially noteworthy in this connection is the fact that the posterior fission rib of the left sulcal list is recurved dorsally. These four species may be regarded as comparatively primitive representatives of the line of evolution that led to the development of *H. pulchra* and related species. Regarding the specimen represented by Stein's (1883) Plate 22, figure 10, see *H. hyalina*, the section on comparisons.

Occurrence: — *Histioneis longicollis* is recorded at three of the 127 stations. One of these three stations (4680) is on the third, one (4711) on the fourth, and one (4741) on the sixth line of the Expedition; and all of them are in the South Equatorial Drift. At one station (4711) the species was taken in a haul from 300–0 fathoms; at the two remaining stations it was found in Salpa from surface waters.

The surface temperature of these three stations ranged from 68° to 80°; the average was 74.3°.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4711 of the Expedition, which thus is the type locality. The restriction of the record stations to the South Equatorial Drift is noteworthy.

Histioneis hyalina Kofoid and Michener

Plate 20, fig. 4. Figure 95: 5

Histioneis hyalina Kofoid & Michener, 1911, p. 296.

Diagnosis: — Body pyriform in lateral outline, somewhat higher dorsally than ventrally; length: depth, 0.61: 1. Dorsally the transverse furrow is 0.52 the depth of body, three times wider than ventrally, subhorizontal, and very slightly concave. Distance from apex to posterior cingular list 0.09 the base of this list. Anterior cingular list slender, with long stalk, flaring in distal 0.25; funnel with straight sides, slightly wider dorsally; height 0.95 the depth of body. Dorsal height of posterior cingular list 0.63 the depth of body. Left sulcal list relatively long and narrow, wedge-shaped posteriorly; length of dorsal margin 1.05 the depth of body; anterior R_2 almost straight, inclined posteriorly at 70°, and 0.56 the depth of body; posterior R_2 recurved dorsally, joining R_3 near middle; R_3 submarginal, weak, simple, extending along two thirds of dorsal margin of list, located midway between midline and antapex, and inclined posteroventrally at 10°–15°; narrow edge of list dorsally to R_3 recurved to the right. Theca without structure. Total length, 54 μ.

Eastern tropical Pacific.

Description: — The body of this species is small, depressed, and pyriform in lateral outline. The ratio between the length and the depth of the body is about 0.61 : 1. The longitudinal axis is deflected posterodorsally at 30°–40°.

The epitheca is about 0.10 as deep as the hypotheca, slightly convex, highest in or near the center, and inclined dorsoposteriorly at about 10°. Dorsally the transverse furrow is about 0.52 the greatest depth of the body, about three times wider than ventrally, subhorizontal, and very slightly concave. The distance from the apex to the posterior cingular list is about 0.09 the base of this list. The hypotheca is of short canoe-shape, distinctly higher dorsally than ventrally; its anterior margin is inclined dorsoanteriorly at about 10° and gently sigmoid, concave dorsally and convex ventrally; its dorsal, posterior, and ventral margins are confluent; dorsally it is rather strongly convex, posteroventrally it is flattened.

The anterior cingular list has a long, slender stalk and is about 3.5 times wider distally than basally; its height is about 0.95 the greatest depth of the body, and its right side is but slightly lower than its left; distally it has a few ribs anastomosing into a wide-meshed reticulum. The funnel has straight sides, flaring at the same level but about twice as much dorsally as ventrally. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs and the cross-rib (in the type specimen the frill also had a T-shaped rib on the left side, but this structure is probably not constant); its dorsal height is about 0.63, its ventral height about 0.57 the greatest depth of the body; its frill is of moderate height, about 0.37 the dorsal rib; and it is very slightly if at all bulging. The left sulcal list is relatively long and narrow; its ventral margin is almost straight anteriorly and posteriorly, and forms a very broadly rounded corner at the distal end of the fission rib; posteriorly it is narrowly rounded or subacute, and its dorsal margin is gently concave. This list appears to lack structural differentiation except the fission rib and the posterior main rib. The anterior fission rib is almost straight, inclined posteriorly at about 70°, and is about 0.56 the greatest depth of the body. The posterior fission rib is recurved dorsally and joins the posterior main rib near the middle of this rib. The posterior main rib is submarginal, weak, simple, extends along two thirds of the dorsal margin of the list, is located about midway between the midline and the antapex, and is deflected posteroventrally at about 10°–15°. An important character of this species is that the narrow portion of this list dorsally to the posterior main rib is recurved to the right.

The thecal wall appears to lack pores and other structural differentiation. A few small round phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 13.3 μ. Greatest depth of body, 21.8 μ. Total length, 54 μ.

Comparisons: — Our description and figures are based on the type specimen.

The closest-known relatives of *Histioneis hyalina* probably are *H. longicollis* and *H. kofoidi,* from which it is easily distinguished by the strikingly depressed shape of its body (see *H. longicollis,* the section on comparisons). These three species appear to belong to the same line of evolution as *H. pulchra* and *H. cymbalaria,* but they have remained relatively undifferentiated in several respects, *e.g.,* in the structure of the left sulcal list. Among the specimens of this genus figured by previous investigators, the one represented by Stein (1883, pl. 22, fig. 10) as a young stage of *H. cymbalaria* resembles *H. hyalina* very strikingly. This specimen appears to be specifically different from *H. cymbalaria* (see *H. mitchellana*) as well as from *H. hyalina;* but, on the other hand, it undoubtedly is very closely related to the latter. Disregarding some differences, *e.g.,* the absence of a frill in the posterior cingular list and the dorsal and ventral splits in this list, which probably are due to Stein's overlooking some exceedingly delicate membranes, this specimen differs from *H. hyalina* in the shape and structure of the body, and in the structure of the left sulcal list. The posterior main rib of this list extends to the tip of the list and the posterior fission rib is longer and has short branches.

Occurrence: — *Histioneis hyalina* is recorded at only one (4720) of the 127 stations, on the fifth line of the Expedition in the South Equatorial Drift. The only specimen that was found occurred in a Salpa taken in surface waters at 76°.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720 of the Expedition which thus is the type locality.

Histioneis pacifica, sp. nov.

Plate 20, fig. 8. Figure 95: 12

Diagnosis: — Body bean-shaped in lateral outline; length: depth, 0.65: 1; hypotheca of short canoe-shape, somewhat higher dorsally than ventrally. Dorsally the transverse furrow is 0.52 the depth of body, 3.5 times wider than ventrally, subhorizontal, and almost flat. Distance from apex to posterior cingular list 0.18 the base of this list. Anterior cingular list with stalk of moderate length, flaring in its distal 0.5 to a wide and very asymmetrical funnel with deep ventral notch, sides concave, wider dorsally, top sloping dextrally, with some ventral inclination, about 45°; its height 0.78 the depth of body. Dorsal height of posterior cingular list 0.51 the depth of body. Left sulcal list fairly long and narrow, well rounded posteriorly, gently concave dorsally; spoon-shaped posteriorly, portion dorsally to R_3 curled to the right; anterior R_2 almost straight, inclined posteriorly at 50°–60°, and 0.34 the depth of body; posterior R_2 recurved dorsally, joining R_3 near middle, with few short branches; R_3 submarginal, fairly weak, gently sigmoid, 0.79 the depth of body, forming branches and irregular reticulum posteriorly, located midway between midline and antapex, and inclined posteroventrally at 5°–10°. Theca with pores only. Total length, 63 μ.

Eastern tropical Pacific.

Description: — The body of this species is small, depressed, and bean-shaped in lateral outline. The ratio between the length and the depth of the body is about 0.65: 1. The longitudinal axis is deflected posterodorsally at 25°–30°.

The epitheca is about 0.14 as deep as the hypotheca, flat, and subhorizontal. Dorsally the transverse furrow is about 0.52 the greatest depth of the body, about 3.5 times wider than ventrally, subhorizontal, and flat or very slightly concave. The distance from the apex to the posterior cingular list is about 0.18 the base of this list. The hypotheca is of short canoe-shape, distinctly higher dorsally than ventrally; its anterior margin is inclined dorsoanteriorly at about 10° and well concave; its dorsal, posterior, and ventral margins are well convex and confluent; the convexity is most pronounced on the dorsal side. In dorsoventral view the body is subcircular; the ratio between the length and the width is about 0.83: 1.

The anterior cingular list has a stalk of moderate length and is about four times wider distally than basally; it flares widely and asymmetrically in the distal 0.5, with concave sides, about twice as wide dorsally as ventrally; the ventral notch is well defined and the top inclines dextrally rather steeply (45°) with less of a ventral component than usual; its height is about 0.78 the greatest depth of the body, and its right side considerably lower than its left; distally it has a few ribs anastomosing into an irregular, wide-meshed reticulum. The posterior cingular list is closed and lacks structural differentiation except the dorsal and ventral ribs and the cross-rib; its dorsal height is about 0.51, its ventral height about 0.53 the greatest depth of the body; the frill is of moderate height, about 0.50 the dorsal rib, and it is very slightly if at all bulging. The left sulcal list is fairly long and narrow; its ventral margin is almost straight, slightly convex in the middle; posteriorly it is well rounded, and its dorsal margin is gently concave; posteriorly it is spoon-shaped, the portion dorsally to the posterior main rib being curled to the right. The list has two main ribs and in front of the fission rib a few branched and irregularly anastomosing ribs. The anterior fission rib is almost straight, inclined posteriorly at 50°–60°, and 0.34 the greatest depth of the body. The posterior fission rib is recurved dorsally, joins the posterior main rib near the middle of this rib, and has a few short branches; in the type specimen one of these joins the posterior main rib somewhat proximally to the middle. The posterior main rib is submarginal, fairly weak, gently sigmoid, extends to the posterior margin of the list, is about 0.79 the greatest depth of the body, located about midway between the midline and the antapex, inclined posteroventrally at 5°–10°, and forms branches and an irregular reticulum posteriorly.

The thecal wall lacks structural differentiation except pores. On the hypotheca there are a few scattered pores and a dense row of pores along the girdle. In the transverse furrow there are two dense rows of pores, one along the posterior cingular list and one along the sagittal suture. Phaeosomes were not observed.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 18.6 μ. Greatest depth of body, 28.8 μ. Total length, 63 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis pacifica is probably most closely related to *H. hyalina*. This relationship is indicated by the similarities in the shape of the body, and in the shape and structure of the posterior cingular list and of the left sulcal list; for instance, the transverse furrow is flat and subhorizontal, the hypotheca is of short canoe-shape, the frill of the posterior cingular list is rather wide, and the posterior fission rib of the left sulcal list is recurved dorsally and joins the posterior main rib. The first species is readily distinguished from the last by the shorter stalk of its anterior cingular list and by the fact that the posterior main rib of its left sulcal list extends to the posterior edge of this list and has branches and an irregular reticulation posteriorly. Furthermore, *H. pacifica* is in some respects intermediate between the relatively simple *H. hyalina* and *H. longicollis* on the one hand and the highly differentiated *H. pulchra* on the other; for instance, the posterior portion of its left sulcal list is spoon-shaped, the posterodorsal portion of this list being rather strikingly curled to the right.

Occurrence: — *Histioneis pacifica* is recorded at two of the 127 stations. One of these two stations (4733) is on the fifth, the other (4741, the type locality) on the sixth line of the Expedition; and both are in the South Equatorial Drift. Only two specimens were found, both occurring in Salpa taken in surface waters. The surface temperature of these two stations was 80°.

5. Pulchra Group. One of the six species of this group, viz., *Histioneis cymbalaria*, was not found by us. The remaining species have been treated in the

following order: — *H. gubernans*, *H. striata*, *H. pulchra*, *H. mitchellana*, and *H. panda*.

Histioneis gubernans Schütt

Histioneis gubernans Schütt, 1895, pl. 5, fig. 23; 1896, p. 29, fig. 42A. Lemmermann, 1899a, p. 374. Zacharias, 1906, p. 509, 518. Kofoid & Michener, 1911, p. 296, 299, 300.

Since no drawings or records of variations were made of the specimens of this species found in the material of the Expedition, we do not give any diagnosis or description, but refer the reader to Schütt's (1895) figure of the type specimen (this figure is reproduced in Schütt, 1896). With regard to relationships, see *Histioneis striata* and *H. reginella*, the sections on comparisons.

Occurrence: — *Histioneis gubernans* is recorded at five of the 127 stations. There are 0, 0, 1, 1, 3, 0 stations on the six lines of the Expedition, all of them (4679, 4711, 4730, 4733, 4737) located in the South Equatorial Drift. At one station the species was found in a Salpa taken in surface waters; the four remaining records refer to hauls from 300–0 fathoms. The temperature range of these five stations at the surface was 69.0°–81.5°; the average was 76.9°. The frequency is in each case less than 1%.

Schütt (1895), who was the first to record this species, does not give any information as to the type locality; however, he probably obtained his material either at Naples or in the warm region of the Atlantic Ocean. Zacharias (1906) found this species in the Adriatic Sea. The most outstanding feature about the distribution of this form in the region investigated by the Expedition is the restriction of all the record stations to the South Equatorial Drift.

Histioneis striata Kofoid and Michener

Plate 20, fig. 6. Figure 96: 1

Histioneis striata Kofoid & Michener, 1911, p. 300.

Diagnosis: — Body subrotund in lateral outline, truncate anteriorly; length: depth, 0.94: 1. Dorsally the transverse furrow is 0.43 the depth of body, three times wider than ventrally, subhorizontal, and moderately concave. Distance from apex to posterior cingular list 0.16 the base of this list. Anterior cingular list with long stalk, flaring gradually in its distal 0.33 in the slightly developed, slightly asymmetrical funnel; its height 1.21 the depth of body. Dorsal height of posterior cingular list 0.87 the depth of body; frill 0.50 the dorsal rib, with three to six ribs on each valve. Left sulcal list rather broad, gently convex ventrally, narrowly rounded posteriorly, and strongly concave dorsally; anterior R_2 straight, subhorizontal, 0.64 the depth of body; posterior R_2 recurved to posterior end of list, with a few short branches and a cross-rib to middle of R_3; R_3 submarginal, weak, subequal to depth of body, strongly sigmoid, with some short branches, located somewhat ventrally to midline, inclined posteroventrally at 40°–50°; a submarginal rib with some short branches along anterior portion of ventral margin; portion dorsally to R_3 curled to the right. Theca with pores only. Total length, 43 μ.

Eastern tropical Pacific.

Description: — This species is very small, with the body subrotund in lateral outline, truncate anteriorly, and deepest somewhat behind the girdle. The ratio between the length and the depth of the body is about 0.94 : 1. The longitudinal axis is deflected posterodorsally at about 20°.

The epitheca is about 0.15 as deep as the hypotheca, gently convex, highest in the center, and subhorizontal. Dorsally the transverse furrow is about 0.43 the greatest depth of the body, about three times wider than ventrally, subhorizontal, and moderately concave. The distance from the apex to the posterior cingular list is about 0.16 the base of this list. The hypotheca is subsymmetrical; the anterior margin is inclined dorsoanteriorly at about 10° and gently concave; the ventral, posterior, and dorsal margins are well convex and confluent, but the convexity is somewhat more pronounced dorsally than ventrally.

The anterior cingular list has a long, slender stalk and is about 2.5 times wider distally than basally; it flares in its distal 0.33 gradually into a feebly developed, slightly asymmetrical funnel with somewhat more dorsal than ventral flare; it has no ventral notch and its anterior end slopes dextroventrally; its height is about 1.21 the greatest depth of the body, and its right side is but slightly lower than its left; distally it has a few short longitudinal ribs. The posterior cingular list is closed but not inflated; its dorsal and ventral heights are subequal and about 0.87 the greatest depth of the body; its frill is fairly high, about 0.50 the dorsal rib, and furnished with three to six longitudinal ribs on each valve. The left sulcal list is rather broad, gently convex ventrally, narrowly rounded posteriorly, and strongly concave dorsally. The anterior fission rib is straight, subhorizontal, and about 0.64 the greatest depth of the body. The posterior fission rib is recurved to the posterior end of the list and has some short branches, most of which are on its ventral side, and a ventral branch that joins the posterior main rib near the middle of this rib. The posterior main rib is submarginal, rather weak, subequal to the greatest depth of the body, strongly sigmoid, concave anteriorly and convex posteriorly, with some short branches on its ventral side, located somewhat ventrally to the midline, and inclined posteroventrally at about 40°–50°. A submarginal rib with some short ventral branches runs along the anterior portion of the ventral margin of this list, ending near the posterior fission rib. The portion of the list dorsally to the posterior main rib is curled to the right.

The thecal wall is smooth. The hypotheca has a row of about seven pores along the girdle and a transverse row of about three pores midway below. A moderate number of medium-sized, ovoidal phaeosomes were found in the girdle of the type specimen.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 15.7 μ. Greatest depth of body, 16.8 μ. Total length, 43 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis striata is, next to *H. gubernans*, the most primitive member of the PULCHRA group. These two species resemble each other in being small, in having the hypotheca subcircular and the transverse furrow subhorizontal and gently concave, in the shape and structure of the posterior cingular list, and in the structure of the left sulcal list. The former species differs from the latter in the long stalk and narrow anterior opening of its anterior cingular list and in the fact that the dorsal margin of its left sulcal list is strongly curled to the right in its entire length.

Occurrence: — *Histioneis striata* is recorded at two of the 127 stations. These two stations (4720, 4725) are located on the fifth line of the Expedition and in the South Equatorial Drift. Only two specimens were found, both occurring in Salpa taken in surface waters. The surface temperatures of these two stations were 76° and 77°, respectively.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4720 of the Expedition, which thus is the type locality. The restriction of the record stations to the South Equatorial Drift is noteworthy.

HISTIONEIS PULCHRA Kofoid

Plate **21**, fig. 4, 7; Plate **23**, fig. 2. Figure 96: 2; 99

Histioneis pulchra KOFOID, 1907a, p. 205, pl. 16, fig. 99. KOFOID & MICHENER, 1911, p. 298.

Diagnosis: — Body saddle-shaped in lateral outline, strikingly higher dorsally than ventrally; length: depth, 0.44–0.46: 1. Dorsally the transverse furrow is 0.62–0.66 the depth of body, eight times wider than ventrally, inclined dorso-anteriorly at 20°–25°, and strongly concave. Distance from apex to posterior cingular list 0.09–0.12 the base of this list. Anterior cingular list with fairly long stalk, flaring in its distal 0.5 in a stout subsymmetrical funnel with slightly concave sides, no notch, and slightly inclined top; its height 1.06–1.15 the depth of body. Dorsal height of posterior cingular list 0.74–0.86 the depth of body; frill high, 0.77–0.79 the dorsal rib, with a moderate number of irregular, partly anastomosing longitudinal ribs. Left sulcal list tongue-shaped, narrowly rounded posteriorly; anterior R_2 gently sigmoid, inclined posteriorly at 50°–60°, and 0.68–0.75 the depth of body; posterior R_2 recurved dorsally, joining R_3 somewhat in front of middle; portion of list behind posterior R_2 coarsely reticulated; R_3 runs somewhat inside dorsal margin of list, weak, 1.10–1.14 the depth of body, located somewhat ventrally to antapex, inclined posteroventrally at 10°–20°; portion dorsally to R_3 curled to the right. Theca with pores only. Total length, 131–136 μ.

Eastern tropical and subtropical Pacific.

Description: — This is a large species with body saddle-shaped in lateral outline, strikingly higher dorsally than ventrally. The ratio between the length and the depth of the body is about 0.44–0.46: 1. The longitudinal axis is deflected posterodorsally at about 40°–45°.

The epitheca is about 0.11–0.12 as deep as the hypotheca, gently convex, highest in the center, and subhorizontal. Dorsally the transverse furrow is 0.62–0.66 the greatest depth of the body, about eight times wider than ventrally, inclined dorsoanteriorly at 20°–25° to the horizontal plane, and strongly concave. The distance from the apex to the posterior cingular list is 0.09–0.12 the base of this list. The anterior margin of the hypotheca is inclined dorsoanteriorly at 20°–25° to the horizontal plane, and well, but sometimes somewhat irregularly concave; posteroventrally the hypotheca is flattened, gently convex; posterodorsally and dorsally it is strongly convex, subcircular. Seen in dorsoventral view, the body is subcircular posteriorly and rounded conical anteriorly.

The anterior cingular list has a fairly long stalk, and it is 4.6–6.5 times wider distally than proximally; its height is 1.06–1.15 the greatest depth of the body, and its right side is but slightly if at all lower than its left. It flares in its distal 0.5 at first gradually, then abruptly, into a subsymmetrical funnel with slightly concave sides, subequal dorsal and ventral extent, no notch, and slight dextroventral inclination. Distally it has a moderate, but varying number of irregular and partly anastomosing ribs. The posterior cingular list is closed and has basally on both sides the rudiment of a lateral pouch; its dorsal and ventral heights are subequal and 0.74–0.86 the depth of the body; its frill is dorsally about 0.77–0.79 the dorsal rib, of moderate height in the middle, and has a moderate but varying number of irregular, partly anastomosing longitudinal ribs. The left sulcal list is tongue-shaped and relatively large; its ventral margin either is irregularly undulating (Plate 23, fig. 2), or it is almost straight anteriorly and posteriorly, and broadly rounded at the anterior fission rib; the posterior portion of this list is narrowly rounded; the dorsal margin is gently concave or broadly indented near the middle. From the proximal end of the anterior main rib a fairly long, simple or branched rib runs in a posteroventral direction. The anterior fission rib is gently sigmoid, inclined posteriorly at 50°–60°, and 0.68–0.75 the greatest depth of the body; either it is simple, or it has on its ventral side some irregular, partly anastomosing branches. The posterior fission rib is recurved dorsally and joins the posterior main rib somewhat in front of the middle of this rib. The portion of the list behind the posterior fission rib is coarsely reticulated. The posterior main rib runs somewhat inside the dorsal margin of the list, is weak, about 1.10–1.14 the greatest depth of the body, extends nearly to the tip of the list, is bent ventrally at the place where it is joined by the posterior fission rib, located somewhat ventrally to the antapex, and inclined posteroventrally at 10°–20°. The portion of the list dorsally to the posterior rib is curled to the right, forms near the middle a fairly large, narrowly rounded lobe, and might have its edge reënforced by a fine rib, from which some branches may arise.

The thecal wall is smooth. The hypotheca has a close-set row of pores along the girdle and a moderate number of scattered pores. In the transverse furrow there is a close-set row of pores along the posterior cingular list. A varying number of small, ovoidal phaeosomes are to be found in the girdle. As to the colors of this species, see Plate 23, figure 2.

The dimensions of two specimens were measured.

Dimensions: — Length of body, 22.4–23.1 μ (type, 22.4 μ). Greatest depth of body, 49.7–50.1 μ. Total length, 131–136 μ (type, 136 μ).

Variations: — This species appears to be relatively constant. The most variable of its characters are the relative width of the distal opening of the anterior cingular list and the structure of this list and of the frill of the posterior cingular list. The anterior fission rib sometimes is simple, sometimes more or less branched on its ventral side.

Comparisons: — The description given above is based on the type specimen.

Histioneis pulchra occupies morphologically and probably also phylogenetically an intermediate position between *H. kofoidi* — *H. longicollis* — *H. hyalina* on the one hand and *H. cymbalaria* (Stein, 1883, pl. 22, fig. 7) — *H. mitchellana* on the other. In *H. kofoidi* the body is subsymmetrical, subrotund, and truncate anteriorly; in *H. longicollis* it is subrotund, higher dorsally than ventrally, and truncate anteriorly; in *H. hyalina* it is pear-shaped, elongated dorsoventrally, higher dorsally than ventrally, and its transverse furrow is flat; in *H. pulchra*, *H. cymbalaria*, and *H. mitchellana* it is saddle- or canoe-shaped, higher dorsally than ventrally, with the transverse furrow strongly concave. The structure of the cingular lists is simple in *H. kofoidi*, *H. longicollis*, and *H. hyalina*, of moderate complexity in *H. pulchra*, and very elaborate in *H. cymbalaria* and *H. mitchellana*. The frill of the posterior cingular list is rather narrow in *H. longicollis*, of moderate width in *H. hyalina*, and wide in *H. pulchra*, *H. cymbalaria*, and *H. mitchellana*.

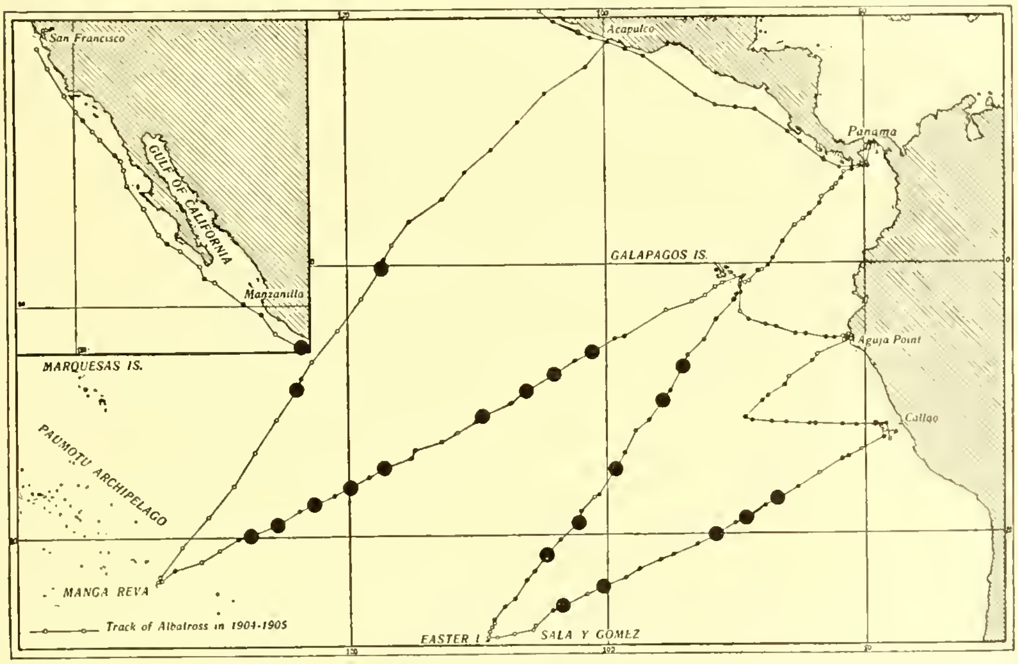

FIGURE 99.— Occurrence of *Histioneis pulchra* Kofoid. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

The structure of the left sulcal list is simple in *H. kofoidi*, *H. longicollis*, and *H. hyalina*, fairly complex in *H. pulchra*, and very elaborate in *H. cymbalaria* and *H. mitchellana*. The posterior main rib of this list is marginal in *H. longicollis*; in *H. kofoidi* and *H. hyalina* it is submarginal, and the narrow portion of the list dorsally to it is curled to the right in *H. hyalina*. In *H. pulchra*, *H. cymbalaria*, and *H. mitchellana* the portion dorsally to this rib is not only curled to the right, but it is relatively wide in the middle, where it forms a narrowly rounded lobe, which is especially well defined in *H. cymbalaria* and *H. mitchellana*. Observe also the progressive development in the relative length and the direction of the anterior fission rib in these six species. The outstanding characteristic of these species is the shape of the posterior fission rib. See also *H. pacifica* and *H. panda*, the sections on comparisons.

Occurrence: — *Histioneis pulchra* is recorded at twenty-two of the 127 stations. There are 1, 0, 5, 5, 9, and 2 stations on the six lines of the Expedition. Of these twenty-two stations, one (4590) is in the Mexican Current; three (4689, 4691, 4699) are in the Easter Island Eddy; seventeen (4679, 4681, 4683, 4701, 4705, 4709, 4711, 4719, 4721, 4722, 4724, 4730, 4732, 4734, 4736, 4737, 4740) are in the South Equatorial Drift; and one (4742) is in the South Equatorial Current. At one station (4681) the species was taken in a haul from 800–0 fathoms; at one station (4737) it was taken in hauls both from 100–0 fathoms and 300–0 fathoms; all the remaining records refer to hauls from 300–0 fathoms only.

The temperature range of these twenty-two stations at the surface was 68°–83°; the average was 75.6°.

The frequency is less than 1% except at Station 4590 where it is 1%.

Although the species has been recorded only from the material of the Expedition, we have found it to be the most common representative of this genus in the eastern tropical Pacific. The most striking features of its occurrence in the eastern Pacific, according to our data, are its predominance in the South Equatorial Drift and the Easter Island Eddy and its absence from surface waters.

Histioneis mitchellana Murray and Whitting

Plate 21, fig. 2. Figure 96: 4; 100

Histioneis mitchellana Murray & Whitting, 1899, p. 333, 335, pl. 33, fig. 3, tab. 1, 6, 8, 9. Lemmermann, 1899a, p. 374. Kofoid, 1907a, p. 205.
Histioneis mitchelliana Schröder, 1906a, p. 329.

Diagnosis: — Body canoe-shaped, higher dorsally than ventrally; length: depth, 0.32–0.53: 1. Dorsally the transverse furrow is 0.60–0.65 the depth of body, 8–11 times wider than ventrally, inclined dorsoanteriorly at 1°–15° or dorsoposteriorly at 1°–3°, and fairly strongly concave. Distance from apex to posterior cingular list 0.11–0.20 the base of this list. Anterior cingular list with fairly long stalk, flaring abruptly and asymmetrically in its distal 0.33 into a very wide funnel without notch and with almost symmetrical, slightly sloping top. Dorsal height of posterior cingular list 0.87–1.10 the depth of body; frill about half as high as list or even somewhat more, finely reticulated. Left sulcal list tongue-shaped, rounded posteriorly, with flap-like lobe curled to the right near middle of dorsal margin, finely reticulated; anterior R_2 gently sigmoid, directed posteriorly, 0.86–0.95 the depth of body; posterior R_2 recurved dorsally, joining

R_3 near anterior margin of dorsal flap-like lobe; R_3 located somewhat dorsally to antapex, its distal portion often broken up into a reticulum; length of list, 0.88–1.08 the depth of body. Theca with pores only. Total length, 110–150 μ.

Widely distributed in tropical and subtropical seas.

Description: — This is a large species with body canoe-shaped in lateral outline, somewhat higher dorsally than ventrally. The ratio between the length and the depth of the body is 0.40 (0.32–0.53) : 1. The longitudinal axis is deflected posterodorsally at about 30°–40°.

The epitheca is 0.09 (0.08–0.12) as deep as the hypotheca, gently convex, highest in or near the center, and either subhorizontal or inclined dorsoposteriorly at about 5°–10°. Dorsally the transverse furrow is 0.62 (0.60–0.65) the greatest depth of the body, 8–11 times wider than ventrally, fairly strongly concave and either subhorizontal, or inclined dorsoanteriorly at 1°–15° or dorsoposteriorly at 1°–3° to the horizontal plane. The distance from the apex to the posterior cingular list is 0.16 (0.11–0.20) the base of this list. The anterior margin of the hypotheca is well concave, and either subhorizontal, or inclined dorsoanteriorly at 1°–15° or dorsoposteriorly at 1°–5° to the horizontal plane; the ventral margin is well rounded; the posterior margin is flat and confluent with the ventral and dorsal margins; the dorsal margin is strongly convex, or its anterior portion is flattened and forms a well-rounded corner with its posterior portion. Seen in dorsoventral view the body is subcircular posteriorly and rounded conical anteriorly.

The anterior cingular list has a fairly long stalk and is 10 (8–13) times wider distally than proximally; its height is 1.27 (1.18–1.33) the greatest depth of the body, and its right side is but slightly if at all lower than its left. It flares symmetrically and gradually in its middle 0.33 and abruptly and asymmetrically in its distal 0.33 into a funnel with concave sides, with nearly three times as much dorsal as ventral flare, no ventral notch, and an almost symmetrical top with slight ventral inclination. Its distal half is finely reticulated, and its distal margin may have some short and fine spinules. The posterior cingular list is closed; when seen in dorsoventral view (Murray and Whitting, 1899, pl. 33, fig. 3b) it is rather inflated in the middle and constricted near its anterior end; the dorsal height is 0.99 (0.87–1.10), the ventral height 0.87 (0.80–0.91) the greatest depth of the body; the frill is about half as high as this list, or even slightly more, and finely reticulated; the anterior edge may have some fine and rather short spinules. The left sulcal list is tongue-shaped, rounded posteriorly, and finely reticulated; its ventral margin is either moderately convex (Murray and Whitting, 1899, pl. 33, fig. 3a), or gently convex in front of the anterior fission rib and gently concave at the distal end of this rib (Plate 21, fig. 2), or irregularly undulating (Figure 96:4); its dorsal margin is either almost straight, or somewhat irregular and undulating; in or somewhat in front of the middle of the dorsal margin, it has a flap-like lobe, which is curled to the right, subcircular or tongue-shaped, and whose dorsoventral width is 0.36 (0.34–0.38) the greatest depth of the body. The anterior fission rib is gently sigmoid, directed posteriorly, and 0.91 (0.86–0.95) the greatest depth of the body. The posterior fission rib is recurved dorsally and joins the posterior main rib near the anterior margin of the dorsal, flap-like lobe. The posterior main rib is located somewhat dorsally to the antapex, deflected somewhat posteroventrally, and either extends to near the posterior end of the list (Murray and Whitting, 1899, pl. 33, fig. 3a), or its distal portion is broken up into a reticulum (Plate 21, fig. 2). The length of this list is 0.98 (0.88–1.08) the greatest depth of the body.

The thecal wall is smooth. The hypotheca has a close-set row of pores along the girdle and a varying number of scattered pores. In the transverse furrow there is a close-set row of pores along the posterior cingular list. A varying number of large, round phaeosomes are to be found in the girdle.

The dimensions of two of our specimens and of the type specimen (Murray and Whitting, 1899) were measured.

Dimensions: — Our specimens: Length of body, 18.9–22.2 μ. Greatest depth of body, 42.1–55.3 μ. Total length, 112–150 μ. Type specimen (Murray and Whitting, 1899, pl. 33, fig. 3a): Length of body, 15.3 μ. Greatest depth of body, 48.4 μ. Total length, 110 μ.

Variations: — This species appears to be relatively constant. The most variable characters are the size of the organism, the course of the cross-rib of the posterior cingular list, the shape of the ventral margin of the left sulcal list, and the shape and relative size of the flap-like dorsal lobe of the last-mentioned list.

Comparisons: — The specimens assigned by us to *Histioneis mitchellana* agree very closely with the type as figured by Murray and Whitting (1899), and the systematic unity of this species, as conceived in the present paper, can be regarded as certain.

Histioneis mitchellana is very closely related to *H. cymbalaria* Stein (1883, pl. 22, fig. 7). It is easily recognized from this species by the fact that its body is more elongated dorsoventrally, by the greater distal width of the anterior cingular list, and by the course of the posterior fission rib of the left sulcal list. It should be mentioned in this connection that, according to our opinion, all the three specimens figured by Stein (1883, pl. 22, fig. 7–10) as *H. cymbalaria* are specifically different from each other, and that the specimen represented by his Plate 22, figure 7, should be regarded as the type of *H. cymbalaria*. Other relatives of *H. mitchellana* are *H. kofoidi, H. longicollis, H. hyalina*, and *H. pulchra* (see the last species, the section on comparisons).

Synonymy: — This species was established by Murray and Whitting (1899) under the name of *Histioneis mitchellana*. Later Schröder (1906a) used the designation *H. mitchelliana*.

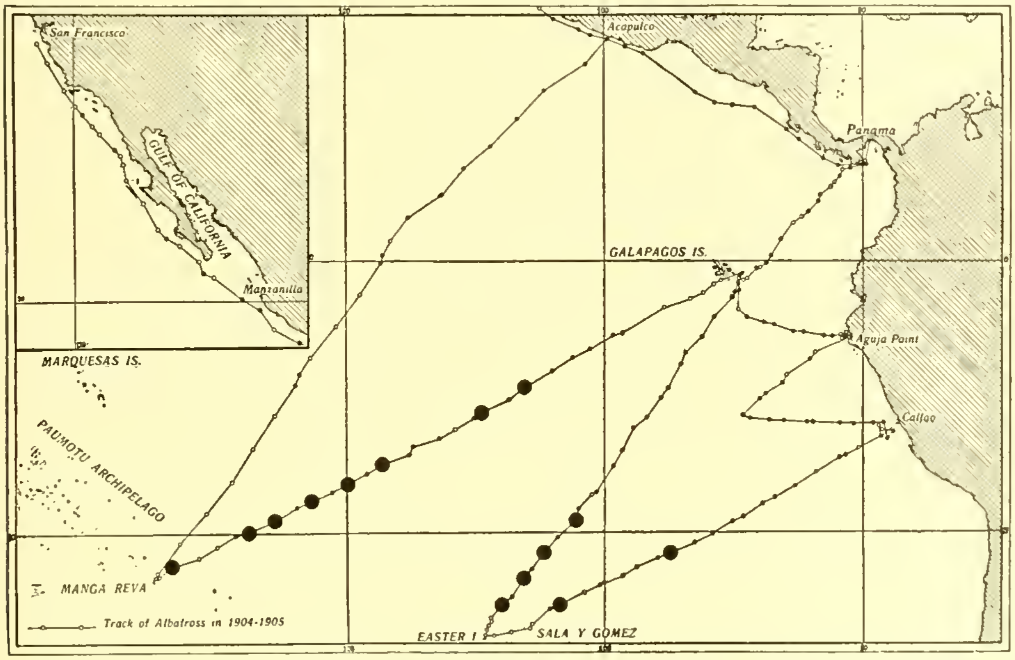

FIGURE 100.— Occurrence of *Histioneis mitchellana* Murray and Whitting. Large, solid circles indicate records from vertical hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

Occurrence: — *Histioneis mitchellana* is recorded at fourteen of the 127 stations. There are 0, 0, 2, 4, 8, and 0 stations on the six lines of the Expedition. Of these fourteen stations, four (4691, 4695, 4697, 4699) are in the Easter Island Eddy; and ten (4685, 4701, 4722, 4724, 4730, 4732, 4734, 4736, 4737, 4739) are in the South Equatorial Drift. At one station (4737) the species was taken in a haul from 100–0 fathoms as well as in a haul from 300–0 fathoms. All other records refer to hauls from 300–0 fathoms only.

The temperature range of these fourteen stations at the surface was 72.0°–81.5°; the average was 76.8°.

The frequency is less than 1% except at two stations (4730, 4732), where it is 1%.

Murray and Whitting (1899), who were the first to record this species, found it at twelve stations in the Atlantic Ocean and the Caribbean Sea, between lat. 15° 50′ N. and lat. 34° 30′ N., and between long. 30° W. and long. 70° W., in surface waters of 64°–81°. Schröder (1906a) found it in the Indian Ocean, between Ceylon and Singapore in surface collections.

This species is eupelagic and widely distributed in tropical and subtropical seas. The most outstanding features of its occurrence in the Eastern Pacific, according to our data, are its absence from surface waters and its restriction to the Easter Island Eddy and the South Equatorial Drift. However, all records from other seas are from surface collections, and the limitation in our records to vertical hauls is either a coincidence or an indication of relatively greater abundance in deeper waters rather than an exclusion from the surface.

Histioneis panda Kofoid and Michener

Figure 85: 1; 95: 9

Histioneis panda Kofoid & Michener, 1911, p. 298.

Diagnosis: — Body sausage-shaped, slightly higher dorsally than ventrally; length: depth, 0.36: 1. Dorsally the transverse furrow is 0.74 the depth of body, 9.5 times wider than ventrally, inclined dorsoanteriorly at 25°–30°, and strongly concave. Distance from apex to posterior cingular list 0.04 the base of this list. Anterior cingular list with long stalk; it flares in its distal 0.35 in a gradually increasing rate with slight concavity. Its asymmetry is marked by an unusual degree of dextral torsion, steep dextroventral inclination of the top, and deep acute dextroventral notch; its height is subequal to depth of body. Posterior cingular list large and forms lateral pouches of moderate size; its dorsal height 0.73 the depth of body; frill broad, 0.67 the dorsal rib, with narrow secondary frill and faint reticulation. Left sulcal list subtriangular posteriorly; anterior R_2 gently curved, directed posteriorly, 0.34 the depth of body; posterior R_2 recurved dorsally, joining R_3 somewhat behind middle, its distal half with short branches; R_3 runs at a distance from dorsal margin of list 0.13 the depth of body, fairly weak, 0.59 the depth of body, its distal half with short branches, located midway between midline and antapex, inclined posteroventrally at 10°–15°; portion dorsally to R_3 curled to the right in the middle; posterior angle, 70°. Theca with pores only. Total length, 79 μ.

Eastern tropical Pacific.

Description: — This species is of medium size, sausage-shaped in lateral outline, and slightly higher dorsally than ventrally. The ratio between the length and the depth of the body is about 0.36: 1. The longitudinal axis is deflected posterodorsally at about 40°–45°.

The epitheca is about 0.07 as deep as the hypotheca, gently convex, highest in or near the center, and subhorizontal. Dorsally the transverse furrow is about 0.74 the greatest depth of the body, about 9.5 times wider than ventrally, inclined dorsoanteriorly at 25°–30° to the horizontal plane, and strongly concave. The distance from the apex to the posterior cingular list is about 0.04 the base of this list. The anterior margin of the hypotheca is inclined dorsoanteriorly at 25°–30° to the horizontal plane, and well concave, forming almost an arc of a circle; the dorsal, posterior, and ventral margins are confluent and convex, the convexity more pronounced dorsally than ventrally.

The anterior cingular list has a long slender stalk and is five to six times wider distally than proximally; its height is subequal to the greatest depth of the body. It flares in its distal 0.35 gradually, with a slight concavity of the sides as seen in lateral view of the body, with a marked and unusual torsion of the structure so that the acute ventral notch is carried to the right nearly 80° from the midventral line and with a steep dextroventral inclination of the top. On the left valve it has distally a faint reticulation of moderate-sized meshes; on the right valve it almost lacks structure. The posterior cingular list is closed and large, forms on both sides a lateral pouch of moderate size, is strikingly contracted distally, and has an asymmetry paralleling that of the anterior list; its dorsal height is about 0.73, its ventral height about 0.61 the greatest depth of the body; its frill is broad, about 0.67 the dorsal rib; the cross-rib is simple but has a strikingly undulating course; it has a narrow secondary frill, bordered by a well-developed cross-rib, and a faint reticulation of the same kind as that of the anterior cingular list. The left sulcal list is narrow anteriorly and subtriangular posteriorly, with only two ribs. The anterior fission rib is gently concave posteriorly, deflected posteriorly at about 85°, and about 0.34 the greatest depth of the body. The posterior fission rib is recurved dorsally, joining the posterior main rib somewhat behind the middle of this rib, and its distal half is furnished with short, irregular branches. The posterior main rib runs at a distance from the dorsal margin of this list equaling about 0.13 the greatest depth of the body and extends to the posterior end of the list; it is fairly weak, slightly irregular, about 0.59 the greatest depth of the body, located about midway between the midline and the antapex, inclined posteroventrally at about 10°–15°, and its distal half has short, irregular branches. The ventral margin of this list is nearly straight anteriorly and gently convex posteriorly; and the ventral and dorsal margins form a posterior angle of about

70°. The portion of the list that is dorsal to the posterior main rib is curled to the right in the middle.

The thecal wall lacks structural differentiation except pores. On the hypotheca there is a close-set row of pores along the girdle. In the transverse furrow there are two close-set rows of pores, one along the posterior cingular list and one along the sagittal suture. Phaeosomes were not observed.

The dimensions of one specimen, the type, were measured.

Dimensions: — Length of body, 15.0 μ. Greatest depth of body, 41.4 μ. Total length, 79 μ.

Comparisons: — The description given above is based on the type specimen.

Histioneis panda is a fairly aberrant and in some respects highly differentiated member of the PULCHRA group. It is readily distinguished from the other members of this group by the large lateral pouches of its posterior cingular list, and by the relatively small size and simple structure of its left sulcal list. It shows similarities to *H. panaria* in the shape of the body and of the posterior cingular list, but these are evidently due to convergences and not to close relationship. It may also be mentioned that it resembles *H. dolon* in having the posterior cingular list furnished with a secondary frill; here again we are concerned with an example of convergence.

Occurrence: — *Histioneis panda* is recorded at only one (4724) of the 127 stations, on the fifth line of the Expedition, in the South Equatorial Drift, from 300–0 fathoms, at a surface temperature of 79°. The frequency is less than 1% (one specimen).

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4724 of the Expedition which thus is the type locality.

6. DOLON GROUP. Only one of the six species of this group, viz., *Histioneis megalocopa*, was not found by us in the Pacific. The remaining species are treated in the following order: — *H. helenae*, *H. milneri*, *H. dolon*, *H. hippoperoides*, and *H. josephinae*.

HISTIONEIS HELENAE Murray and Whitting

Histioneis helenae MURRAY & WHITTING, 1899, p. 333, 335, pl. 33, fig. 2, tab. 1, 6, 8, 9. LEMMERMANN, 1899a, p. 374. KOFOID, 1907a, p. 204.

No drawings or records of variations were made of the specimens of this species found in the material of the Expedition, and so we do not give any diagnosis or description, but refer the reader to Murray and Whitting's (1899) description and figures of the type specimen. With regard to relationships, see *Histioneis dolon*, the section on comparisons.

Occurrence: — *Histioneis helenae* is recorded at five of the 127 stations. There are 0, 0, 0, 2, 2, and 1 stations on the six lines of the Expedition, all of them (4701, 4705, 4730, 4734, 4740) located in the South Equatorial Drift. All records refer to hauls from 300–0 fathoms. The temperature range of these five stations at the surface was 72°–81°; the average was 77.0°. The frequency is less than 1% except at Station 4730 where it is 1%.

Murray and Whitting (1899), who were the first to record this species, found it at five stations in the Atlantic Ocean and the Caribbean Sea, between lat. 31° N. and lat. 14° N. and between long. 35° W. and long. 77° W. The fact that all our record stations are restricted to the South Equatorial Drift is noteworthy.

Histioneis milneri Murray and Whitting

Histioneis milneri Murray & Whitting, 1899, p. 333, 334, pl. 33, fig. 1, tab. 3, 6, 8, 9. Lemmermann, 1899a, p. 374.

No drawings or records of variations were made of the specimens of this species found in the material of the Expedition. This indicates that these specimens agreed well with the type as figured and described by Murray and Whitting (1899). With regard to relationships, see *Histioneis dolon*, the section on comparisons.

Occurrence: — *Histioneis milneri* is recorded at five of the 127 stations. There are 0, 0, 0, 1, 3, and 1 stations on the six lines of the Expedition. Of these five stations, one (4699) is in the Easter Island Eddy; three (4722, 4724, 4730) are in the South Equatorial Drift; and one (4742) is in the South Equatorial Current. All records refer to hauls from 300–0 fathoms. The temperature range of these five stations at the surface was 75°–79°; the average was 77.0°. The frequency is in each case less than 1%.

Murray and Whitting (1899), who were the first to record this species, found it at seven stations in the Atlantic Ocean and the Caribbean Sea, between lat. 35° N. and lat. 10° N., and between long. 29° W. and long. 80° W., in surface waters of 76.0° (62°–84°). With regard to the distribution of this species in the region investigated by the Expedition, the absence of record stations in the coastal currents is the most outstanding feature.

Histioneis dolon Murray and Whitting

Figure 96: 6; 101

Histioneis dolon Murray & Whitting, 1899, p. 333, 335, pl. 33, fig. 5, tab. 6, 8. Lemmermann, 1899a, p. 374. Schröder, 1906b, p. 263. Karsten, 1907, p. 272. Gadeceau, 1909, p. 9, fig. 2. Kofoid & Michener, 1911, p. 296.

Diagnosis: — Body short saddle-shaped, strikingly higher dorsally than ventrally; length: depth, 0.77–0.78: 1. Dorsally the transverse furrow is 0.49–0.56 the depth of body, 10–15 times wider than ventrally, inclined dorsoanteriorly at 1°–10°, and strongly concave. Distance from apex to posterior cingular list 0.08–0.10 the base of this list. Anterior cingular list with long stalk; its height 1.72–2.00 the depth of body; 10–12 times wider distally than proximally, flaring in the distal 0.5, and widely in the distal 0.2. Dorsal height of posterior cingular list 1.40–1.42 the depth of body; frill wide; with secondary frill 0.18–0.33 as high as list, having six to seven simple ribs. Left sulcal list large, tongue-shaped; with large, rounded posterodorsal transverse fin, 1.48–1.64 the depth of body; R_2 almost straight, deflected posteriorly at about 35°; R_3 located midway between R_2 and antapex, almost unbranched; length of list 1.70–1.88 the depth of body. Theca with pores only. Total length, 139–156 μ.

Widely distributed in tropical and subtropical seas.

Description: — This is a large species, short saddle-shaped, strikingly higher dorsally than ventrally. The ratio between the length and the depth of the body is 0.77–0.78: 1. The longitudinal axis is deflected posterodorsally at about 35°–45°.

The epitheca is 0.08–0.17 as deep as the hypotheca, gently convex, highest in or near the center, and tilted dorsoposteriorly at 5°–15°. Dorsally the transverse furrow is 0.49–0.56 the greatest depth of the body, 10–15 times wider than ventrally, strongly concave, and inclined dorsoanteriorly at 1°–10° to the horizontal plane. The distance from the apex to the posterior cingular list is 0.08–0.10 the base of this list. The anterior margin of the hypotheca is strongly concave and subparallel to the outline of the dorsal portion of the transverse furrow. Its ventral, posterior, and dorsal margins are confluent; posteroventrally it is flattened, posterodorsally strongly convex. When seen in dorsoventral view, the body is pear-shaped, broadly rounded posteriorly, narrowly rounded anteriorly, and but slightly longer than wide (Murray and Whitting, 1899, pl. 33, fig. 5b).

The anterior cingular list has a long stalk and is 10–12 times wider distally than proximally; its height is 1.72–2.00 the greatest depth of the body, and its right side is moderately lower than its left, the margin curving abruptly to the shallow ventral notch; distally it has a submarginal rib with a series of 15–20 subequidistant anterior branches on each valve. The posterior cingular list is closed; when seen in dorsoventral view, it has, posteriorly, lateral pouches of moderate size (Murray and Whitting, 1899, pl. 33, fig. 5b); its dorsal height is 1.40–1.42, its ventral height 1.25–1.35 the greatest depth of the body; the frill is dorsally about 0.80–0.90 the dorsal rib, of moderate height in the middle, and has a secondary frill, which is 0.18–0.33 as high as the dorsal rib and has a series of six to seven subequidistant, simple longitudinal ribs on each valve; behind the secondary frill, this list has an irregular, wide-meshed reticulum; its lateral pouches lack structural differentiation.

The left sulcal list is very large, tongue-shaped, and is characterized especially by a large, rounded posterodorsal transverse fin, the diameter of which is 1.48–1.64 the greatest depth of the body. The margin of this list in front of the fission rib is rather strongly convex. The two fission ribs run close to each other, are nearly straight or gently undulating, and have a posterior deflection of about 35°; their length is 1.45–1.61 the greatest depth of the body. The posterior main rib is located about midway between the fission ribs and the antapex, runs about parallel to the fission ribs, is simple or furnished with but a few weak branches, and measures, when fully developed, 1.70–1.80 the greatest depth of the body. In front of the fission ribs, this list has two or three ribs running about parallel to the ventral margin of the list and in most specimens connected by a number of subperpendicular branches; dorsally to these ribs some irregular ribs may also be found. The posterodorsal transverse fin is characterized by very fine concentric striations. The length of the left sulcal list is 1.70–1.88 the greatest depth of the body.

The theca is smooth. The hypotheca has a dense row of pores along the girdle and a fairly great number of scattered pores. In the transverse furrow there is a dense row of pores along the posterior cingular list and along the sagittal suture, and also scattered pores. Phaeosomes have not been observed.

The dimensions of one of our specimens and of the type (Murray and Whitting, 1899, pl. 33, fig. 5) were measured.

Dimensions: — Our specimen: Length of body, 28.9 μ. Greatest depth of body, 37.1 μ. Total length, 139 μ. Type specimen (Murray and Whitting, 1899, pl. 33, fig. 5a): Length of body, 30.0 μ. Greatest depth of body, 38.8 μ. Total length, 156 μ.

Variations: — Judging by the comparatively few specimens recorded as yet, this species appears to be quite constant in shape and structure. The size, too, is fairly constant.

Comparisons: — Our specimens agree so closely with the type as figured by Murray and Whitting (1899, pl. 33, fig. 5a, b) that there can be no doubt as to the correctness of their specific allocation.

This species is certainly very closely related to *Histioneis milneri, H. helenae, H. hippoperoides,* and *H. megalocopa.* These relationships are suggested by striking similarities in the shape of the body, and in the shape and structure of the cingular and sulcal lists. The body is of short saddle-shape, strikingly higher dorsally than ventrally. The anterior cingular list has, except possibly in *H. megalocopa,* a submarginal rib with a series of subequidistant anterior branches. The posterior cingular list is characterized by a very broad frill, which, except in *H. megalocopa,* has a fairly narrow secondary frill bordered by a cross-rib furnished with a series of subequidistant anterior branches. The left sulcal list is very large, of broad tongue-shape, has a transverse fin posterodorsally, has one or more ribs running parallel to the ventral margin, and its two fission ribs run close to each other and have but a moderate posterior deflection. *H. dolon* differs from *H. milneri* and *H. helenae* in the very large size of the transverse posterodorsal fin of its left sulcal list and in the better-developed lateral pouches of its posterior cingular list. *H. hippoperoides,* which agrees with *H. dolon* in these two characters, differs from this species in its somewhat smaller size, in the narrower opening of its anterior cingular list, and in the better-developed structural differentiation of its left sulcal list. *H. megalocopa* is readily recognized from all these species by having the whole frill of the posterior cingular list furnished with rather fine-meshed reticulation.

Synonymy: — This species was established by Murray and Whitting (1899) under the name of *Histioneis dolon,* a name also used by all the succeeding investigators in this field. Gadeceau (1909) gives reproductions of Murray and Whitting's (1899) figures of the type specimen.

Occurrence: — *Histioneis dolon* is recorded at sixteen of the 127 stations. There are 1, 0, 4, 4, 6, and 1 stations on the six lines of the Expedition. Of these sixteen stations, one (4623) is in the Panamic Area; five (4689, 4691, 4695, 4697, 4699) are in the Easter Island Eddy; and ten (4681, 4685, 4701, 4717, 4724, 4725, 4732, 4734, 4737, 4740) are in the South Equatorial Drift. At one station (4623) the species was found in a surface catch; at one station (4725) in a Salpa from surface waters; at one station (4737) it was taken in a haul from 100–0 fathoms as well as in one from 300–0 fathoms; at three stations (4681, 4701, 4724) in hauls from both 800–0 fathoms and 300–0 fathoms. The remaining records refer to hauls from 300–0 fathoms only.

The temperature range of these sixteen stations at the surface was 68.0°–81.5°; the average was 75.9°. At Stations 4623 and 4725, in the surface catches of which this species was found, the surface temperatures were 79° to 77°, respectively. The frequency is in all cases less than 1%.

Murray and Whitting (1899) found this species at two stations in the Sargasso Sea, in surface waters of 67° and 74°; Karsten (1907) found it in the Indian Ocean, at lat. 7° 43′ N., long. 88° 44′ E. Karsten (1907) does not give any figures, and so his determinations cannot be checked.

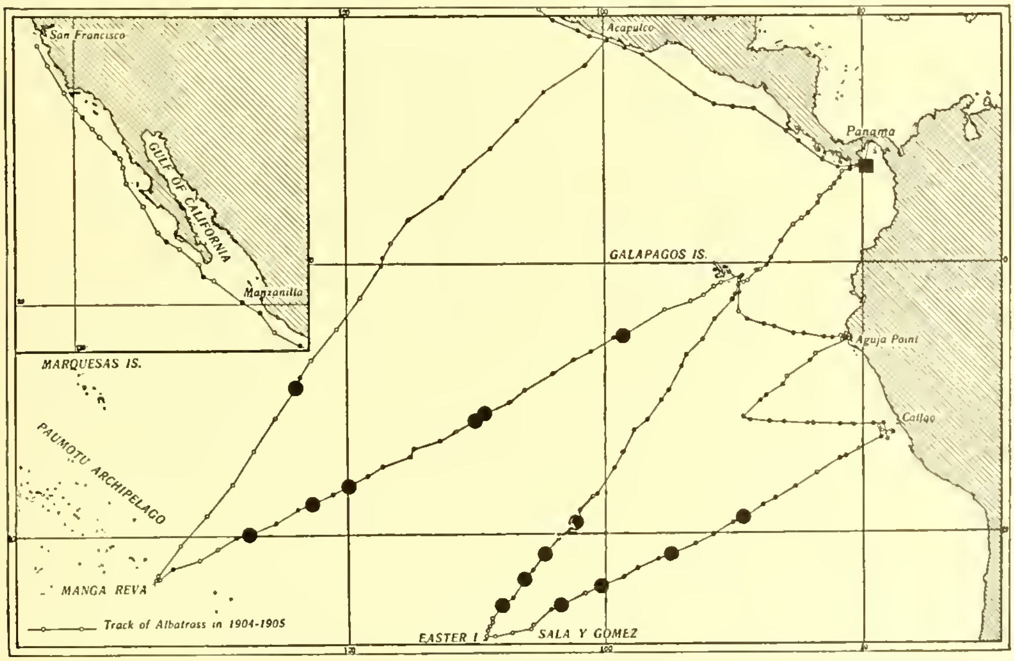

FIGURE 101.— Occurrence of *Histioneis dolon* Murray and Whitting. Large, solid circles indicate records from vertical hauls; squares, records from surface hauls; small, solid circles, stations at which this species was not found; small, open circles, stations from which no plankton catches were examined.

This species is eupelagic and widely distributed but rare in tropical and subtropical seas. The most characteristic features of its occurrence in the eastern Pacific, according to our data, are its rarity in surface waters and the concentration of its record stations in the Easter Island Eddy and in the South Equatorial Drift.

HISTIONEIS HIPPOPEROIDES Kofoid and Michener

Plate 23, fig. 1, 3. Figure 96: 5

Histioneis hippoperoides KOFOID & MICHENER, 1911, p. 296.

Diagnosis: — Body short saddle-shaped, higher dorsally than ventrally; length: depth, 0.77: 1. Dorsally the transverse furrow is 0.37 the depth of body, five to six times wider than ventrally, inclined dorsoanteriorly 5°–10°, and moderately concave. Distance from apex to posterior cingular list about 0.20 the base of this list. Anterior cingular list with long stalk; its height 1.03 the depth of body; 2.0–2.5 times wider distally than proximally, flaring but little and only in the distal 0.3. Dorsal height of posterior cingular list 0.91 the depth of body; frill wide; with secondary frill 0.15–0.17 as high as list, having 12–17 simple ribs. Left sulcal list rather large, tongue-shaped; with large, rounded posterodorsal transverse fin, 1.0 the depth of body; R_2 almost straight, deflected posteriorly at about 35°; R_3 located midway between R_2 and antapex, with a few perpendicular ventral branches; length of list 1.12 the depth of body. Theca with pores only. Total length, 95 μ.

Eastern tropical Pacific.

Description: — This is a fairly large species, of short saddle-shape, higher dorsally than ventrally. The ratio between the length and the depth of the body is 0.77 : 1. The longitudinal axis is deflected posterodorsally at about 40°–45°.

The epitheca is 0.13 as deep as the hypotheca, gently convex, highest in or near the center, and subhorizontal. Dorsally the transverse furrow is 0.37 the depth of the body, five to six times wider than ventrally, moderately concave, and inclined dorsoanteriorly at 5°–10° to the horizontal plane. The distance from the apex to the posterior cingular list is about 0.20 the base of this list. The anterior margin of the hypotheca is strongly concave and inclined dorsoanteriorly at 15°–20° to the horizontal plane. Its ventral, posterior, and dorsal margins are confluent; posteroventrally it is flattened, gently convex; posterodorsally it is strongly and evenly convex. When seen in dorsoventral view, the body is pear-shaped, broadly rounded posteriorly, narrowly rounded anteriorly, and about as long as wide.

The anterior cingular list has a long stalk and is 2.0–2.5 times wider distally than proximally; its height is about 1.03 the greatest depth of the body, and its right side is but slightly, if at all, lower than its left; distally it has a submarginal rib with a series of subequidistant anterior branches; behind this rib some more ribs may be present. The distal flare is subuniform and confined mainly to the distal third. The posterior cingular list is closed; in the type specimen its dorsal margin is irregularly undulating, with a fairly pronounced concavity (possibly an artifact) near the middle; when seen in dorsoventral view, it has, posteriorly, lateral pouches of fairly large size; its dorsal height is about 0.91, its ventral height 0.73 the greatest depth of the body; the frill is dorsally about 0.62 the dorsal rib, somewhat narrower in the middle, and has a secondary frill, which is about 0.15–0.17 as high as the dorsal rib and has a series of 12–17 simple, subequidistant longitudinal ribs on each valve; behind the secondary frill this list has an irregular, wide-meshed reticulum; its lateral pouches almost lack structural differentiation. The left sulcal list is fairly large, tongue-shaped, and is characterized especially by a large, rounded posterodorsal transverse fin, the diameter of which is about 1.0 the greatest depth of the body. The ventral margin of this list is rather strongly and almost evenly convex. The two fission ribs run close to each other, are nearly straight, and have a posterior deflection of about 35°; their length is about 0.95 the greatest depth of the body. The posterior main rib is located about midway between the fission ribs and the antapex, runs about parallel to the fission ribs, is furnished with a few almost perpendicular branches, and is but slightly longer than the fission ribs. In front of the fission ribs, this list has three ribs running about parallel to the ventral margin of the list and connected by a great number of subperpendicular branches, thus forming a regular reticulum of rectangular meshes; dorsally to these ribs an irregular wide-meshed reticulum is developed. Behind the fission ribs this list has an irregular wide-meshed reticulum with a tendency to elongation in the periphery; and the posterodorsal transverse fin has a few incomplete, concentric ribs. The length of this rib is about 1.12 the greatest depth of the body.

The theca is smooth. The hypotheca has a close-set row of pores along the girdle and a fairly great number of scattered pores. In the transverse furrow there is a close-set row of pores along the posterior cingular list and along the sagittal suture, and also scattered pores. Phaeosomes have not been observed.

The dimensions of the type specimen only were measured.

Dimensions: — Length of body, 29.2 μ. Greatest depth of body, 38.2 μ. Total length, 95 μ.

Comparisons: — Our description and figures are based on the type material.

The species is very closely related to *Histioneis milneri*, *H. helenae*, *H. dolon*, and *H. megalocopa*. For a discussion of these relationships and for the distinguishing characteristics of these species, see *H. dolon*, the section on comparisons.

Occurrence: — *Histioneis hippoperoides* is recorded at only one of the 127 stations. This station (4590) is on the first line of the Expedition and in the Mexican Current. Depth, 300–0 fathoms; surface temperature, 82°–83°. The frequency was less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid and Michener (1911) from Station 4590 of the Expedition, which thus is the type locality.

Histioneis josephinae Kofoid

Plate 22, fig. 1–3; Plate 23, fig. 4. Figure 96: 7

Histioneis josephinae Kofoid, 1907a, p. 204, pl. 15, fig. 91.

Diagnosis: — Body of short saddle-shape, strongly curved, strikingly higher dorsally than ventrally; length: depth, 0.63–0.64: 1. Dorsally the transverse furrow is 0.39 the depth of body, five to six times wider than ventrally, inclined dorsoanteriorly at 25°–30°, and strikingly concave. Distance from apex to posterior cingular list about 0.06 the base of this list. Anterior cingular list with long stalk, 0.5 its total length; its height 1.45–1.50 the depth of body, flaring distally asymmetrically to 50°. Dorsal height of posterior cingular list 0.96–1.00 the depth of body; frill about half as high as this list, with irregular reticulation. Left sulcal list very large, broadly rounded posteriorly; with long, narrowly rounded posterodorsal projection, a pair of large transverse fins from R_3, a large left fin from R_2, and one along ventral margin in front of R_2; posterodorsal projection and accessory fins bear coral-like thickenings distally near margin; R_2 almost straight, deflected posteriorly at 45°. Theca with pores only. Body pink, fins pale blue. Total length 115–135 μ.

Eastern tropical Pacific.

Description: — This is a large and very handsome species, with body of short saddle-shape, strongly concave anteriorly, strikingly higher dorsally than ventrally. The ratio between the length and the depth of the body is 0.63–0.64: 1. The longitudinal axis is deflected posterodorsally at 50°–60°.

The epitheca is about 0.13 as deep as the hypotheca, gently convex or concave, and subhorizontal. Dorsally the transverse furrow is about 0.39 the greatest depth of the body, five to six times wider than ventrally, strikingly concave, and inclined dorsoanteriorly at 20°–30° to the horizontal plane. The distance from the apex to the posterior cingular list is about 0.06 the base of this list. The anterior margin of the hypotheca is strongly concave and subparallel to the outline of the dorsal portion of the transverse furrow. Its ventral, posterior, and dorsal margins are evenly convex and confluent; the convexity is most pronounced posterodorsally. When seen in dorsoventral view, the body is broadly ovoidal, broadly rounded posteriorly, narrowly rounded anteriorly, and about as long as wide.

The anterior cingular list has a long stalk and is about seven times wider distally than proximally; its height is 1.45–1.50 the greatest depth of the body, its right margin is distinctly lower than its left, and it is notched ventrally; distally it has a submarginal rib with a number of rather irregular, anastomosing anterior branches; behind this rib some more ribs may be present. The posterior cingular list was open in the type specimen but is probably closed when typically developed (compare *Histioneis carinata*); its dorsal margin may be gently concave or of about the same irregular shape as in *H. hippoperoides;* no lateral pouches are present, although there is some outward bulging of the left side; its dorsal height is 0.96–1.00, its ventral height 0.78–1.10 the greatest depth of the body; the frill is about half as wide as this list and has typically a secondary frill, which is about 0.15 as high as the dorsal rib and has a number of subequidistant longitudinal ribs; between the ribs of the primary and secondary frills an irregular, wide-meshed reticulum may be present; behind the primary frill this list has less structural differentiation.

The right sulcal list continues beyond the margin of the theca to a distance slightly greater than from that point to the flagellar pore; it is very narrow at this pore, lanceolate posteriorly, and has a rib along the dorsal margin. The left sulcal list is very large, broadly rounded posteriorly, and has a narrowly rounded dorsal projection, the length of which is approximately 0.6 the greatest depth of the body. The two fission ribs run close to each other, are simple and nearly straight, and have a posterior deflection of about 45°; their length is subequal to the greatest depth of the body. The posterior main rib arises at a point somewhat dorsally to the point midway between the fission ribs and the antapex, is simple, runs about parallel to the fission ribs, and ends near the middle of the posterior portion of this list; its length is about 0.66 the greatest depth of the body. The width of this list at the posterior main rib is about 1.64 the greatest depth of the body. Arising from the originally free ventral edge of this list, there is in front of the fission rib a subtrapeziform accessory fin, the basal length and the greatest width of which are 1.06 and 0.46 the greatest depth of the body, respectively; the greatest width is located near the anterior end; near the posterior end this accessory fin is only 0.23 the greatest depth of the body (compare the accessory left sulcal list in *Amphisolenia laticincta* and *A. curvata*). On the left side of this list, arising along the entire length of the fission ribs, there is a large, squarish accessory fin, the anterior and posterior margins of which are nearly straight, while the ventral margin is sigmoid; the anterior and posterior widths of this accessory fin are 0.95 and 1.18 the greatest depth of the body, respectively; and its distal extension is about 1.36 the greatest depth of the body.

Finally, a pair of large, accessory fins, resembling a pair of butterfly wings, originate from the posterior main rib of this list, one fin on either side of the list.

The length and the anterior width of these fins are 0.83–0.88 and 0.70 the greatest depth of the body; they are widest anteriorly and gradually decrease in width posteriorly; their anterior margins are strongly curved, their lateral margins are gently sigmoid. In front of the fission rib this list has one or a few simple ribs. Along the dorsal and distal margins of the posterodorsal projection of this list, there is a chain of coral-like thickenings; and a few small irregular thickenings are also found on the posterior margin of this list. The accessory fin of the ventral margin of this list has a bifurcate rib, originating near the middle of the base of the fin; its two branches, which extend to the anterior and posterior angles of the fin, are furnished with coral-like thickenings. The accessory fin of the fission rib is bordered anteriorly by a rib, the distal end of which has coral-like thickenings; from the base of the thickened end of this rib an exceedingly fine rib runs about parallel to the ventral margin of this fin, ending at the tip of the fission rib; thus this fin is divided into two segments, a large basal one, which lacks structural differentiation, and an excessively thin and hyaline marginal one, the average width of which is about 0.26 the greatest depth of the body, and which has four ribs posteriorly, the two anterior ones with coral-like thickenings, the two posterior ones simple, very small and weak. Each of the accessory fins of the posterior main rib has a chain of coral-like thickenings along its anterior margin. The right one of these fins is divided by a very fine, longitudinal rib into two segments, the outer one of which is somewhat larger than the inner and excessively thin and hyaline; the outer segment has four ribs posteriorly, three of which have coral-like thickenings.

The thecal wall is smooth. The hypotheca has a dense row of pores along the girdle and a fairly great number of scattered pores. In the transverse furrow there is a dense row of pores along the posterior cingular list and along the sagittal suture, and also scattered pores. Phaeosomes were not observed. The body is pink, the anterior cingular list canary yellow, the posterior cingular list pale pearl-gray, the sulcal lists pale yellow (Plate 23, fig. 4), and the coral-like thickenings have pearl-gray sheen.

The dimensions of two specimens were measured.

Dimensions:— Length of body, 22.6–23.5 μ (type, 23.5 μ). Greatest depth of body, 35.6–36.7 μ (type, 36.7 μ). Total length, 112–135 μ (type, 135 μ).

Comparisons: — Our figures and description are based on the type material.

This species, which is characterized by the most striking development of the organs of flotation among the dinoflagellates, occupies apparently a fairly isolated position within its genus. The shape of the body, the development of transverse fins from the posterior main rib of the left sulcal list, the position of this rib, and the shape and direction of the fission rib of this list seem to indicate relationships to *Histioneis dolon*, *H. milneri*, *H. helenae*, *H. hippoperoides*, and *H. megalocopa;* but in most other respects *H. josephinae* has such a unique structure that even these relationships must be considered as questionable. If *H. josephinae* is not closely related to the mentioned species, then we are confronted by a new example of the independent appearance in highly elaborated forms of characteristics that were inherent in but not expressed by the common ancestors.

Occurrence: — *Histioneis josephinae* is recorded at four of the 127 stations. Of these four stations, three (4695, 4697, 4699) are on the fourth line of the Expedition and in the Easter Island Eddy; one (4739) is on the fifth line and in the South Equatorial Drift. All records refer to hauls from 300–0 fathoms. The surface temperature was 75.8° (74°–79°); the frequency in all cases was less than 1%.

The species has been found only in the material of the Expedition. It was first recorded by Kofoid (1907a) from Station 4699 of the Expedition, which thus is the type locality. The restriction of all the record stations to the Easter Island Eddy and the South Equatorial Drift is noteworthy.

4. CITHARISTIDAE, fam. nov.

Diagnosis: — Body reversed C-shaped in right lateral view. Transverse furrow narrow except dorsally where it forms the large phaeosome chamber, occupying the concavity of the C. Posterior cingular list narrow except dorsally where it encloses the phaeosome chamber. Length of body, 38.2–66.6 μ.

Only one genus, Citharistes, which is marine, eupelagic, and circumequatorial.

Citharistes Stein

Citharistes Stein, 1883, p. 24. Bütschli, 1885, p. 944, 1010. Schütt, 1896, p. 29. Delage & Hérouard, 1896, p. 385.
Cytharistes Hensen, 1911, p. 162 (*lapsus pennae*).

Diagnosis: — Body reversed C-shaped in right lateral view; length: depth, 1.11–1.60: 1. Epitheca low, disk-like, 0.25–0.37 as deep as hypotheca. Transverse furrow narrow, 0.10–0.18 the greatest depth of body, except dorsally where it forms the large phaeosome chamber, occupying the concavity of the C. Anterior cingular list funnel-shaped; its dorsal height 0.17–0.43 the greatest depth of body; with 5–13 simple, complete ribs on each valve. Posterior cingular list of about the same anterior inclination as and somewhat narrower than the anterior, except dorsally where it encloses the phaeosome chamber; with a pair of dorsal ribs, one on each side of sagittal suture arising at tip of posterior shank of the C-shaped body, and 0.70–0.96 the greatest depth of body; besides these ribs, this list may have 10–11 ribs of the same kind as those of the anterior list. Right sulcal list small, ending somewhat in front of or behind fission rib of left sulcal list. Left sulcal list of moderate size, ending posteroventrally, with a maximum width 0.14–0.38 the greatest depth of body, rounded posteriorly, and with a varying number of radial ribs. With phaeosomes in the phaeosome chamber.

TYPE.— *Citharistes regius* Stein.

Distribution: — Citharistes is marine, eupelagic, of circumequatorial distribution, and restricted to tropical, subtropical, and warm-temperate seas. At the present writing, it has been found in the Atlantic, between the equator and lat. 40° N., in the Caribbean Sea, in the Mediterranean, and in the Pacific, at lat. 7° N., long. 133° E. Our knowledge of the distribution of the genus as a whole, as well as that of the individual species is very fragmentary.

The vertical distribution of the genus is unknown. Most of the published records refer to surface hauls, and there are no records based on catches made with closing nets. The species are very rare.

Representatives of Citharistes were found at fifteen (11.8%) out of the 127 stations of the Expedition from which dinoflagellates were recorded. One (4590) of these fifteen stations is in the Mexican Current; one (4635) is in the Panamic Area; three (4695, 4697, 4699) are in the Easter Island Eddy; nine (4680, 4681, 4701, 4709, 4712, 4717, 4720, 4737, 4741) are in the South Equatorial Drift; one (4541) is in the Equatorial Counter Current. At two (4635, 4541) of these fifteen stations the genus was taken in surface hauls; at five stations (4680, 4709, 4712, 4720, 4741) it was found in Salpa taken in surface waters. The remaining eight records refer to hauls from 300–0 fathoms (Figure 103).

These data show that the genus was not taken by the Expedition in the California and Peruvian Currents, both of which are of cold origin, in the Galapagos Eddy, which is under the direct influence of the Peruvian Current, nor in the South and the North Equatorial Currents. Most (nine out of fifteen) of the record stations are in the South Equatorial Drift. The genus evidently is stenothermal and stenohaline, and limited to waters of relatively high temperatures and salinities.

Historical Discussion: — Citharistes, which was established by Stein (1883), comprises two known species, viz., *C. regius* Stein (1883) and *C. apsteini* Schütt

(1895), for neither of which a specific diagnosis and description have as yet been given. Of the three generic diagnoses published by Bütschli (1885, p. 1010), Delage and Hérouard (1896, p. 385), and Schütt (1896, p. 29), the one by Schütt is the most nearly complete and critical. Short discussions of the genus are found in Stein (1883, p. 24) and Bütschli (1885, p. 944).

Besides Stein (1883) the following investigators have contributed data on the distribution of this genus: — Cleve (1901c), Entz (1907, 1909), Gräf (1909), Hensen (1911), Lemmermann (1899a, 1901a), Murray and Whitting (1899), and Schröder (1900a). Of these only Murray and Whitting (1899) give original figures. References to this genus or minor contributions are found in Balbiani (1884c), Bergh (1884), Calkins (1902), Hensen (1891), and Lang (1901). Hensen (1911) wrote Cytharistes instead of Citharistes.

Citharistes regius Stein

Figure 102: 6; 103

Citharistes regius Stein, 1883, pl. 22, fig. 1–4. Bütschli, 1885, pl. 55, fig. 5. Lemmermann, 1899a, p. 374. Murray & Whitting, 1899, p. 336, tab. 6. Entz, 1907, p. 11; 1909, p. 246.
Cytharistes regius Hensen, 1911, tab. 15.
Citharistes sp. Hensen, 1891, p. 68, tab. 2.

Diagnosis: — Body reversed C-shaped in right lateral view, deepest somewhat behind the middle; length: depth, 1.34–1.60: 1. Its transection subuniform throughout anterior half of curvature, 0.28–0.36 the depth of body, and strikingly greater posteriorly than anteriorly; greatest height of posterior shank, 0.59–0.74 the depth of body. Distance between tips of C, 0.65–0.70 the depth of body. Postmargin strongly and evenly convex, often nearly semicircular. Height of anterior cingular list 0.27–0.43 the depth of body. Dorsal ribs of phaeosome chamber gently sigmoid, concave or subangular anteriorly; their length 0.77–0.96 the depth of body. Left sulcal list ends at posteroventral corner of body, widest near posterior end; its greatest width 0.38 the depth of body; its margin gently concave or nearly straight anteriorly, strongly convex posteriorly. Length, 38.2 μ.

Tropical and subtropical seas.

Description: — This is a fairly small species, the body of which is reversed C-shaped in right lateral view and deepest somewhat behind the middle. The ratio between the length and the depth of the body is 1.34–1.60: 1. The longitudinal axis is perpendicular. The transection is subuniform throughout the anterior half of the curvature of the C, 0.28–0.36 the greatest depth of the body, and strikingly greater posteriorly than anteriorly; the greatest height of the posterior shank is 0.59–0.74 the greatest depth of the body. The anterior tip of the C is well rounded, the posterior is well rounded or subrectangular. The distance between these tips is 0.65–0.70 the greatest depth of the body. The epitheca is 0.25–0.28 as deep as the hypotheca, gently convex and highest in or near the center, or flattened. The ventral margin of the body is gently and evenly convex (Figure 102: 6) or gently sigmoid (Stein, 1883, pl. 22, fig. 1–4), and confluent with the postmargin. The postmargin is subsemicircular or slightly flattened. The very strongly concave dorsal margin is subsemicircular.

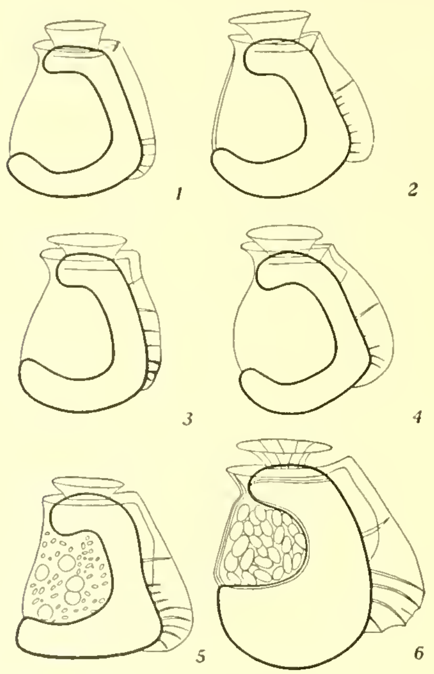

FIGURE 102.— Citharistes, right lateral view. 1–5, *C. apsteini* Schütt. × 340. 6, *C. regius* Stein. × 700. 1, from Station 4681 (300–0 fathoms); 2, from Station 4701 (300–0 fathoms); 3, from Station 4695 (300–0 fathoms); 4, from Station 4697 (300–0 fathoms); 5, from Station 4720 (Salpa); 6, from Station 4717 (300–0 fathoms).

The anterior cingular list is funnel-shaped and sometimes strikingly flaring distally; its flares equally extended dorsally and ventrally with concave sides and horizontal base and top; the dorsal height is 0.27–0.43 the greatest depth of the body; and it has on each valve five to ten simple, complete subequidistant radial ribs. The posterior cingular list is somewhat narrower than the anterior and appears to lack structural differentiation. The distance from the apex to the base of this list is 0.07–0.11 the length of the body. The portion of this list that includes the phaeosome chamber may have a weak reticulation posteriorly; and its two dorsal ribs are 0.77–0.96 the greatest depth of the body and gently sigmoid, concave, or subangular anteriorly. The right sulcal list ends somewhat in front of or behind the fission rib, is of subuniform width anteriorly and decreases gradually in width posteriorly; its anterior width is about 0.13 the greatest depth of the body. The left sulcal list ends at the posteroventral corner of the body and is widest near its posterior end; its greatest width is about 0.38 the greatest depth of the body; its margin is gently concave or convex, or nearly straight anteriorly, and rather strongly convex posteriorly. Its fission rib is located near the middle and is subhorizontal or slightly deflected anteriorly. Behind this rib the list has three to six ribs, most of which are simple and complete, but some of which may be incomplete or branched.

The thecal wall of the hypotheca is reticulate (and probably porulate); about 9–11 meshes border the girdle posteriorly. In the phaeosome chamber there are numerous ovoidal phaeosomes of medium size.

The dimensions of one of our specimens and of the specimens figured by Stein (1883, pl. 22, fig. 1–4) were measured.

Dimensions: — One of our specimens: Length of body, 38.2 μ. Greatest depth of body, 28.6 μ. The size of the specimens figured by Stein (1883) is unknown. According to Stein's (1883) information about the magnifications of his figures given in an introductory remark to the explanations of the plates, they had a length of body somewhere between 50.5 μ and 84.5 μ.

Variations: — Judging by the few specimens figured up to the present time, this species appears to be decidedly constant.

Comparisons: — Disregarding a possible difference in size (see the paragraph on dimensions), our specimens differ from those figured by Stein (1883, pl. 22, fig. 1–4) mainly in two respects: — (*1*) the anterior cingular list is somewhat narrower and (*2*) the dorsal ribs of the phaeosome chamber join the posterior cingular list. Stein makes these ribs end on the dorsal side of the body at a short distance behind the posterior cingular list, except in his Plate 22, figure 4, in which they can be traced clear up to the posterior margin of this list. The latter of these two differences undoubtedly is apparent only, and due to Stein's overlooking the anterior portions of the above-mentioned ribs. The unity of this species may be considered as certain.

Citharistes regius differs strikingly from *C. apsteini* in having the posterior portion of the horseshoe-shaped body decidedly thicker than the anterior.

Synonymy: — This species was established by Stein (1883), under the name of *Citharistes regius*, and this name was used also by the succeeding investigators who have treated this form. Of the three specimens figured by Stein (1883, pl. 22, fig. 1–4) we regard the one represented by his Plate 22, figure 1, as the type. Bütschli (1885, pl. 55, fig. 5) gives a reproduction of this last figure.

Occurrence: — *Citharistes regius* is recorded at five of the 127 stations. There are 0, 0, 1, 2, 1, and 1 stations on the six lines of the Expedition, and all of them (4680, 4709, 4712, 4717, 4741) are located in the South Equatorial Drift. Eight specimens were found, one of which was taken in a haul from 300–0 fathoms at Station 4717, the remaining ones occurring in Salpa taken in surface waters. The surface temperatures of these five stations ranged from 68° to 80°; the average was 73.8°.

Stein (1883) recorded this species "aus dem Atlantischen Meer und der

Südsee." Murray and Whitting (1899) found it at one station in the Atlantic Ocean, viz., at lat. 31° N., long. 35° 30′ W.; temperature, 70°. Hensen (1911) recorded it from five stations in the Atlantic Ocean, viz., in the Sargasso Sea and the Canary Current and off the coast of Brazil. It was taken by Entz (1907, 1909) in the Gulf of Naples.

The species is eupelagic and widely distributed but very rare in tropical, subtropical, and warm-temperate seas. The restriction of all our record stations to the South Equatorial Drift is noteworthy.

Citharistes apsteini Schütt

Figure 102: 1–5; 103

Citharistes apsteinii Schütt, 1895, pl. 5, fig. 24; 1896, p. 30, fig. 43. Lemmermann, 1899a, p. 374; 1901a, p. 377. Murray & Whitting, 1899, p. 336, pl. 31, fig. 3, tab. 3, 6, 8, 9. Cleve, 1901c, p. 236.
Citharistes apstein Gräf, 1909, p. 194.
Citharistes (sp.) Delage & Hérouard, 1896, p. 385, fig. 675.

Diagnosis: — Body reversed C-shaped in right lateral view, deepest near posterior end; length: depth, 1.11–1.27: 1. Its transection either subuniform throughout the entire curvature, 0.19–0.30 the depth of body, or it forms a broadly rounded to subangular posteroventral protuberance, in which case its transection at this place is greater than elsewhere, 0.44–0.48 the depth of body. Distance between tips of C is 0.50–0.66 the depth of body. Postmargin well and evenly convex, gently convex, or gently sigmoid. Height of anterior cingular list 0.17–0.27 the depth of body. Dorsal ribs of phaeosome chamber gently sigmoid, concave anteriorly, their length 0.70–0.92 the depth of body. Left sulcal list ends at or somewhat behind posteroventral corner of body; of subuniform width throughout and rounded posteriorly, or gently decreasing in width posteriorly; its greatest width 0.14–0.30 the depth of body. Length, 59.0–66.6 μ.

Tropical and subtropical seas.

Description: — This is a medium-sized species, the body of which is reversed C-shaped in right lateral view and deepest near the posterior end. The ratio between the length and the depth of the body is 1.15 (1.11–1.27): 1. The longitudinal axis is subperpendicular. The transection of the C is either subuniform throughout the entire curvature, 0.23 (0.19–0.30) the greatest depth of the body, or there is a broadly rounded to subangular posteroventral protuberance, in which case the transection at this place is more or less strikingly greater than elsewhere, viz., 0.44–0.48 the greatest depth of the body. The tips of the C are well rounded, and the distance between them is 0.60 (0.50–0.66) the greatest depth of the body. The epitheca is 0.30 (0.25–0.37) as deep as the hypotheca, gently convex, and highest in or near the center, or flattened. The ventral margin of the body is gently and evenly convex (Figure 102: 3), nearly straight (Figure 102: 1), or gently sigmoid (Figure 102: 5); and it either is confluent with the postmargin, or these margins form together a more or less pronounced, usually well-rounded corner. The postmargin is either evenly and rather strongly convex, or gently convex; or again, it may be gently sigmoid, concave in the middle. The very strongly concave dorsal margin usually is subparallel to the anterior, ventral, and posterior margins; exceptions are the specimens with a posteroventral protuberance. Seen in dorsoventral view (Murray and Whitting, 1899, pl. 31, fig. 3b) the body has straight, parallel sides, and is strongly convex posteriorly; the ratio between the length and the width is 3.2: 1.

The anterior cingular list is funnel-shaped, sometimes strikingly flaring distally; it flares with somewhat greater dorsal than ventral extension, with straight ventral and more or less dorsal sides and nearly horizontal flat top; its dorsal height is 0.23 (0.17–0.27) the greatest depth of the body; and it has on each valve 7–13 simple, complete, subequidistant radial ribs. The posterior cingular list is usually somewhat narrower than the anterior and has on each valve about 10–11 ribs of the same kind as the anterior list. The distance from the apex to the base of the posterior cingular list is 0.07 (0.05–0.11) the length of the body. The portion of this list that includes the phaeosome chamber is reticulated anteriorly and may have an irregular and incomplete reticulation posteriorly (Schütt, 1895, pl. 5, fig. 24: 2); its dorsal ribs are 0.83 (0.70–0.92) the greatest depth of the body and gently sigmoid, being concave anteriorly and convex posteriorly. The right sulcal list ends somewhat behind the fission rib and decreases gradually in width posteriorly; its anterior width is somewhat less than in the left sulcal list, and it may be reticulated. The left sulcal list ends at or somewhat behind the posteroventral corner of the body; and it either is of subuniform width throughout and rounded posteriorly, or it decreases gently in width posteriorly; its greatest width equals 0.20 (0.14–0.30) the greatest depth of the body. This list has a varying number (about 5–12) of ribs, most of which are in the posterior half of the list; some of these ribs are complete, others incomplete; some of them are simple, others are branched and may anastomose. The fission rib, which is near the middle of the list, is subhorizontal or somewhat inclined anteriorly.

The thecal wall of the hypotheca, outside the phaeosome chamber, is porulate and reticulated; the meshes are subuniform, of medium size, 9–11 of them border the girdle posteriorly, and each of them has a pore in the center. In the phaeosome chamber we find a varying number of large, spheroidal, and in some cases also small, ellipsoidal phaeosomes (Schütt, 1895, pl. 5, fig. 24: 1, 2. Figure 102: 5).

The dimensions of five of our specimens and of the specimens figured by Schütt (1895, pl. 5, fig. 24: 1, 2) and Murray and Whitting (1899, pl. 31, fig. 3) were measured.

Dimensions: — Our specimens: Length of body, 59.2–63.5 μ (average, 61.6 μ). Greatest depth of body, 50.4–57.0 μ (average, 53.5 μ). The specimens figured by Schütt (1895, pl. 5, fig. 24: 1, 2) were 59.0–62.9 μ long (type, 59.0 μ) and 50.5–55.2 μ deep (type, 50.5 μ). The specimen represented by Murray and Whitting (1899, pl. 31, fig. 3a) was 66.6 μ long and 52.3 μ deep.

Variations: — This species is fairly variable in the shape of the body and in the structure and relative size of the left sulcal list. Sometimes the body is of subuniform dimensions throughout, sometimes it is comparatively deep posteroventrally, forming at this place a broadly rounded to subangular protuberance. The postmargin may be evenly and fairly strongly convex (Schütt, 1895, pl. 5, fig. 24: 1), gently convex (Figure 102: 5), or sigmoid, concave in the middle (Schütt, 1895, pl. 5, fig. 24: 2). The left sulcal list sometimes is rather wide posteriorly, and its ribs vary in number, shape, and position.

Comparisons: — The two specimens figured by Schütt (1895, pl. 5, fig. 24: 1, 2) as *Citharistes apsteinii* are quite different, and their specific unity may be questionable. The one represented by his figure 24: 1, the type, has the body in left lateral view shaped like a regular and evenly curved C, subuniform in dimensions throughout; and its left sulcal list is relatively narrow posteriorly. In the other specimen (his fig. 24: 2) the body is relatively deep posteroventrally, forming at this place a broadly rounded protuberance; and its postmargin is gently sigmoid, being concave in the middle; moreover, the left sulcal list is rather wide posteriorly. Since our data are not sufficient for a definite solution of this question, we accept tentatively Schütt's (1895) decision and thus regard these two specimens as specifically identical. The specimen figured by Murray and Whitting (1899, pl. 31, fig. 3a) is in some characteristics, *e.g.*, in the shape of the body, intermediate between the two specimens represented by Schütt (1895). Most of our specimens (Figure 102: 1–3) agree fairly well with the type, except in the fact that their bodies are somewhat more slender. One specimen (Figure 102: 5) shows a striking resemblance to the one figured by Murray and Whitting (1899), and one (Figure 102: 4) is in certain respects intermediate between the last specimen and our typical representatives of this species.

This species is readily distinguished from *Citharistes regius* by having the posterior portion of the horseshoe-shaped body of about the same height as the anterior.

Synonymy: — This species was established under the name of *Citharistes apsteinii* by Schütt (1895), who figured two specimens, of which the one represented by his Plate 5, figure 24: 1, should be regarded as the type. This specific name was used also by the succeeding investigators in this field. Delage and Hérouard (1896, fig. 675) and Schütt (1896, fig. 43) give somewhat modified reproductions of Schütt's (1895) Plate 5, figure 24: 2.

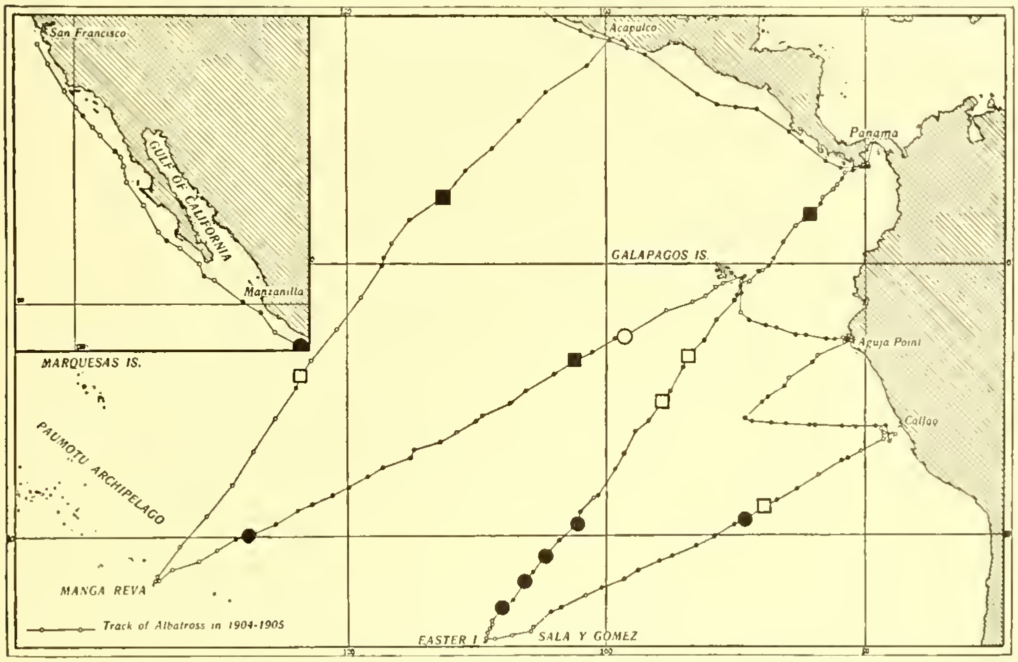

FIGURE 103.— Occurrence of *Citharistes apsteini* Schütt and of *C. regius* Stein. Large, solid circles indicate records of *C. apsteini* from vertical hauls; solid squares, records of *C. apsteini* from surface hauls; large open circles, records of *C. regius* from vertical hauls; open squares, records of *C. regius* from surface hauls; small, solid circles, stations at which these species were not found; small, open circles, stations from which no plankton catches were examined.

Occurrence: — *Citharistes apsteini* is recorded at ten of the 127 stations. There are 1, 1, 1, 4, 2, and 1 stations on the six lines of the Expedition. Of these ten stations, one (4590) is in the Mexican Current; one (4635) is in the Panamic Area; three (4695, 4697, 4699) are in the Easter Island Eddy; four (4681, 4701, 4720, 4737) are in the South Equatorial Drift; and one (4541) is in the Equatorial Counter Current. At two stations (4635, 4541) the species was taken in surface waters only; at one station (4720), in a Salpa from surface waters; all the remaining records refer to hauls from 300–0 fathoms only.

The temperature range of these ten stations at the surface was 68°–83°; the average was 76.4°.

The frequency is in all the cases less than 1%.

Schütt (1895) did not give any information as to the localities of his specimens; however, his material probably was taken either at Naples or in the tropical or the subtropical regions of the Atlantic. Murray and Whitting (1899) found this species at fourteen stations in the Atlantic Ocean and the Caribbean Sea, between lat. 39° N. and lat. 8° N., and between long. 39° W. and long. 80° W., in surface waters of 60°–84°. Cleve (1901c) recorded it from the Atlantic Ocean and the Caribbean Sea, between lat. 29° N. and lat. 10° N., and between long. 20° W. and long. 80° W.; temperature, 73.1° (70.0°–81.9°), thirteen observations; salinity, 36.63, one observation. Gräf (1909) found it at one station in the Pacific Ocean, at lat. 7° 36′ N., long. 133° 12′ E.; temperature, 82.4°; salinity, 34.11.

The species is eupelagic and widely distributed but rare in tropical and subtropical seas. With regard to its distribution in the Eastern Pacific, according to available data, its absence from the Peruvian Current is noteworthy.

III. Distribution of Dinophysoidae at the Stations of the Expedition

The following is a record of the various genera and species of Dinophysoidae noted by us as the result of the examinations, often repeated, of the plankton catches at the various stations of the Expedition. The stations are listed in the numerical order of their record numbers. Their distribution on the six lines of the Expedition is marked off in the list by the insertion of middle headings such as "San Francisco-Panama line" followed by the inclusive station numbers.

With each station number we have given the appropriate data including the temperature at the surface in degrees Fahrenheit. Fuller data will be found in the record of stations in Alexander Agassiz's (1906) report of the Expedition.

The records of occurrence of species at the stations are recorded according to the catch under "Surface" and "300–0 fathoms to the surface," etc. At nearly all stations we have collections made with both No. 12 and No. 20 silk nets. The records of species in the two collections have been combined in a single list. The differences between the two catches lie mainly in the greater proportional loss of the smaller species in the No. 12 net with the coarser mesh. This, together with the fact that the No. 20 catches were more thoroughly examined than those from the No. 12 nets, has made the lists of species from the former somewhat the longer. Since the No. 20 collection generally contained all of the species found in the No. 12 and in larger numbers, there is no change resulting from this combination of the records, except that in a few instances in the No. 12 of additional species, or of larger numbers of individuals of species common to both collections, the sum of the percentages of all species of Dinoflagellates is slightly in excess of 100. This, however, does not appear in the tables since these present only the Dinophysoidae.

There were no Dinophysoidae detected in ten plankton collections from the surface and in five Salpa from surface catches, taken from fifteen different stations as follows: —

Collections of the Expedition in which no Dinophysoidae were found

Station Number	Nature of collection	Surface temperature	Time of day	Contents
4652	surface	66°	8 P.M.	No Dinoflagellata
4655	surface	65°	8 P.M.	No Dinophysoidae
4661	surface	69°	8 P.M.	No Dinophysoidae

Station Number	Nature of collection	Surface temperature	Time of day	Contents
4663	surface	69°	8 P.M.	No Dinophysoidae
4665	surface	67°	8 P.M.	No Dinophysoidae
4667	Salpa	68.5°	8 P.M.	No Dinophysoidae
4671	surface	66°	8 P.M.	No Dinophysoidae
4673	surface	66°	8 P.M.	No Dinophysoidae
4677	surface	68°	8 P.M.	No Dinophysoidae
4683	Salpa	70°	8 A.M.	No Dinophysoidae
4704	Salpa	73°	8 P.M.	No Dinophysoidae
4705	Salpa	72°	8 P.M.	No Dinophysoidae
4706	surface	72°	8 P.M.	No Dinophysoidae
4710	surface	74°	8 P.M.	No Dinophysoidae
4735	Salpa	81°	8 P.M.	No Dinophysoidae

At one of the stations, 4652, no Dinoflagellata of any sort were detected in the surface collection. All of these collections devoid of Dinophysoidae were from the surface and, with the exception of the Salpa from Station 4683 taken at 8 A.M., were taken at 8 P.M. These stations were all within the Peruvian Current or its westward extension, with the sole exception of the last one. They also significantly were made in the waters of lower temperatures, only five being above 70°. These facts reënforce the relations of the Dinophysoidae to the typical tropical environment and to subsurface and deeper waters. The absence of all Dinophysoidae from fourteen of twenty-nine surface collections in the Peruvian Current and its immediate sphere of influence but not the surface collections elsewhere and not from the subsurface collections at these same fourteen stations, is suggestive of the interaction of other factors with temperature in the oceanic distribution of this group.

Distribution by Stations

All records of temperature refer to the surface. P = frequency of less than 1%. All Salpa taken at the surface.

4571

Lat. 33° 40′ N., long. 119° 35′ W. October 7, 1904. Temperature, 71°.

Surface: — *Dinophysis caudata*, 72%.

300 fathoms to surface: — *Phalacroma parvulum*, P; *Dinophysis caudata*, 9%; *D. hastata*, 1%; *Amphisolenia globifera*, 1%; *Triposolenia bicornis*, 2%.

4574

Lat. 30° 35′ N., long. 117° 15′ W. October 8, 1904. Temperature, 69°.

Surface: — *Phalacroma parvulum*, 1%; *Dinophysis caudata*, 1%.

300 fathoms to surface: — *Dinophysis caudata*, 2%; *D. schröderi*, P; *Amphisolenia bidentata*, P; *A. quadrispina*, 1%; *Triposolenia bicornis*, 1%.

4580

Lat. 24° 55′ N., long. 112° 45′ W. October 10, 1904. Temperature, 76°.

Surface: — *Dinophysis caudata*, P.

300 fathoms to surface: — *Phalacroma parvulum*, 1%; *P. rapa*, P; *Dinophysis caudata*, P; *D. hastata*, 1%; *Amphisolenia bidentata*, 1%; *A. extensa*, P; *A. quadrispina*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. intermedia*, P; *T. longicornis*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus quadratus*, 2%.

4583

Lat. 22° 45′ N., long. 110° 5′ W. October 11, 1904. Temperature, 83°.

Surface: — *Phalacroma doryphorum*, P; *Dinophysis caudata*, P; *D. hastata*, P; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. thurni*, P.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. rapa*, P; *Dinophysis caudata*, P; *D. hastata*, P; *Amphisolenia bidentata*, 2%; *A. bifurcata*, P; *A. bispinosa*, P; *A. extensa*, 1%; *A. quadrispina*, P; *Triposolenia bicornis*, 1%; *T. intermedia*, P; *T. longicornis*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, 1%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, P.

4587

Lat. 20° 42′ N., long. 107° 25′ W. October 12, 1904. Temperature, 82°.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, P; *P. favus*, P; *P. ovum*, P; *P. porodictyum*, P; *P. rapa*, P; *Dinophysis hastata*, 1%; *D. schütti*, P; *Amphisolenia bidentata*, 3%; *A. extensa*, P; *A. lemmermanni*, P; *A. palmata*, P; *A. rectangulata*, P; *A. schauinslandi*, P; *A. thrinax*, P; *Triposolenia ambulatrix*, P; *T. fatula*, P; *T. ramiciformis*, P; *Ornithocercus magnificus*, P; *O. quadratus*, 2%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, P.

4588

Lat. 19° 52′ N., long. 106° 22′ W. October 12, 1904. Temperature, 81°–83°.

Surface: — *Phalacroma doryphorum*, P; *Dinophysis caudata*, 1%; *D. hastata*, P; *Amphisolenia bidentata*, P; *A. schauinslandi*, P; *Ornithocercus magnificus*, 3%; *O. quadratus*, P.

Salpa stomach: — *Phalacroma doryphorum*, one specimen; *Dinophysis uracantha*, one specimen; *Ornithocercus heteroporus*, one specimen; *O. magnificus*, two specimens; *O. thurni*, one specimen.

Only fourteen specimens of dinoflagellates were recorded.

4590

Lat. 18° 50′ N., long. 104° 50′ W. October 13, 1904. Temperature, 82°–83°.

Surface: — *Phalacroma rapa*, P; *Ornithocercus magnificus*, 7%; *O. steini*, 1%; *O. thurni*, 1%.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, 4%; *P. favus*, P; *P. porodictyum*, P; *P. rapa*, P; *Dinophysis hastata*, P; *D. uracantha*, 1%;

Amphisolenia bidentata, 3%; *A. globifera*, P; *A. lemmermanni*, 2%; *A. schauinslandi*, 1%; *A. thrinax*, 1%; *Triposolenia ramiciformis*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, 4%; *O. quadratus*, 4%; *O. steini*, P; *O. thurni*, P; *Histioneis hippoperoides*, P; *H. pulchra*, 1%; *Citharistes apsteini*, P.

4592

Lat. 18° 20′ N., long. 103° 40′ W. October 13, 1904. Temperature, 84°.

Surface: — *Phalacroma doryphorum*, P; *P. favus*, P; *Dinophysis uracantha*, 1%; *Amphisolenia bidentata*, 2%; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. steini*, P; *O. thurni*, 2%.

4594

Lat. 17° 20′ N., long. 101° 32′ W. October 14, 1904. Temperature, 84°.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, P; *P. favus*, P; *P. rapa*, P; *Dinophysis caudata*, P; *D. hastata*, P; *Amphisolenia bidentata*, P; *A. extensa*, P; *A. lemmermanni*, P; *A. thrinax*, 1%; *Triposolenia fatula*, P; *T. longicornis*, P; *Ornithocercus magnificus*, P; *O. quadratus*, 1%; *O. thurni*, P.

4596

Lat. 16° 47′ N., long. 100° 27′ W. October 14, 1904. Temperature, 84°.

Surface: — *Phalacroma doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, P; *D. hastata*, P; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 5%; *O. quadratus*, 1%; *O. thurni*, 2%.

4598

Lat. 15° 58′ N., long. 98° 13′ W. October 15, 1904. Temperature, 84°.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, 3%; *P. porodictyum*, P; *P. rapa*, 1%; *Dinophysis caudata*, 2%; *D. jörgenseni*, P; *Amphisolenia extensa*, 1%; *A. schröderi*, P; *Triposolenia ambulatrix*, 1%; *T. bicornis*, P; *T. fatula*, 1%; *T. longicornis*, P; *T. ramiciformis*, 1%; *Ornithocercus magnificus*, 3%; *O. quadratus*, P; *O. steini*, 15%; *O. thurni*, 4%; *Parahistioneis reticulata*, 1%.

4600

Lat. 15° 36′ N., long. 97° 0′ W. October 15, 1904. Temperature, 82°.

Surface: — *Phalacroma doryphorum*, 1%; *P. rapa*, 1%; *Dinophysis caudata*, P; *Ornithocercus magnificus*, 5%; *O. quadratus*, 3%; *O. steini*, 6%; *O. thurni*, 2%.

4604

Lat. 12° 21′ N., long. 92° 13′ W. October 17, 1904. Temperature, 84°.

Surface: — *Phalacroma doryphorum*, 3%; *P. favus*, 1%; *P. rapa*, P; *Dinophysis caudata*, P; *Ornithocercus magnificus*, 13%; *O. quadratus*, 6%; *O. steini*, 1%; *O. thurni*, 7%; *O.* sp. indet., division stage, P; *Parahistioneis reticulata*, P; *Histioneis costata*, P.

4605

Lat. 12° 21′ N., long. 92° 13′ W. October 17, 1904. Temperature, 85°.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *P. porodictyum*, P; *P. rapa*, P; *Dinophysis caudata*, P; *D. hastata*, P; *D. uracantha*, P;

Amphisolenia bidentata, 1%; *A. bispinosa*, P; *A. curvata*, P; *A. extensa*, P; *A. lemmermanni*, P; *A. quadrispina*, P; *A. schröderi*, P; *Triposolenia bicornis*, 1%; *T. ramiciformis*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, 4%; *O. steini*, 8%; *O. thurni*, P; *O.* sp. indet., P; *O.* sp. indet., division stage, P.

4607

Lat. 12° 0′ N., long. 91° 30′ W. October 17, 1904. Temperature, 83°.

Surface: — *Phalacroma rapa*, P; *Ornithocercus magnificus*, 4%; *O. quadratus*, 15%; *O. steini*, 14%; *O. thurni*, 10%.

4609

Lat. 11° 05′ N., long. 89° 35′ W. October 18, 1904. Temperature, 81°.

300 fathoms to surface: — *Phalacroma cuneus*, 2%; *P. doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, 2%; *D. jörgenseni*, P; *Amphisolenia bidentata*, 1%; *Triposolenia bicornis*, P; *Ornithocercus magnificus*, 8%; *O. quadratus*, P; *O. steini*, P; *O. thurni*, 4%.

4611

Lat. 10° 33′ N., long. 88° 30′ W. October 18, 1904. Temperature 78°.

Surface: — *Phalacroma doryphorum*, P; *Dinophysis caudata*, 29%; *Ornithocercus magnificus*, P; *O. steini*, P.

4613

Lat. 9° 45′ N., long. 86° 20′ W. October 19, 1904. Temperature, 80°.

300 fathoms to surface: — *Phalacroma cuneus*, 6%; *P. doryphorum*, 1%; *P. fimbriatum*, P; *P. porodictyum*, P; *P. rapa*, 1%; *Dinophysis caudata*, 1%; *D. hastata*, P; *D. jörgenseni*, 1%; *Amphisolenia bidentata*, 1%; *A. extensa*, P; *A. globifera*, 1%; *A. quadrispina*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. intermedia*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. magnificus*, 5%; *O. splendidus*, P; *O. steini*, 12%; *O. thurni*, 16%.

4615

Lat. 9° 7′ N., long. 85° 11′ W. October 19, 1904. Temperature, 80°.

Surface: — *Phalacroma rapa*, 2%; *Dinophysis caudata*, 6%; *Ornithocercus magnificus*, 2%; *O. quadratus*, 3%; *O. steini*, 4%; *O. thurni*, 10%.

4617

Lat. 7° 45′ N., long. 82° 25′ W. October 20, 1904. Temperature, 78°.

Surface: — *Phalacroma doryphorum*, 1%; *P. favus*, P; *P. rapa*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. orbiculatus*, P; *O. steini*, 1%; *O. thurni*, 5%.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. favus*, P; *P. ovum*, P; *P. rapa*, 1%; *Dinophysis caudata*, 1%; *Amphisolenia bidentata*, 1%; *A. bispinosa*, P; *A. quadrispina*, 1%; *A. rectangulata*, P; *Triposolenia bicornis*, 1%; *T. longicornis*, 1%; *T. truncata*, P; *Ornithocercus magnificus*, 5%; *O. quadratus*, 1%; *O. steini*, 8%; *O. thurni*, 2%.

4619

Lat. 7° 15′ N., long. 82° 8′ W. October 20, 1904. Temperature, 79°.

Surface: — *Phalacroma rapa*, 1%; *Ornithocercus magnificus*, 6%; *O. quadratus*, 2%; *O. steini*, 2%; *O. thurni*, 23%; *O.* sp. indet., P; *O.* sp. indet., division stage, P.

Salpa stomach: — *Phalacroma doryphorum*, 5%; *P. latiwelatum*, 1%; *Dinophysis sphaerica*, 1%; *Ornithocercus magnificus*, 4%; *O. quadratus*, 4%; *O. steini*, 1%; *O. thurni*, 37%; *Parahistioneis diomedeae*, 2%; *P. karsteni*, P; *Histioneis costata*, 4%.

4623

Lat. 6° 58′ N., long. 80° 46′ W. October 21, 1904. Temperature, 78°–81°.

Surface: — *Amphisolenia lemmermanni*, P; *Ornithocercus steini*, P; *O. thurni*, P; *Histioneis dolon*, P.

4624

Lat. 6° 58′ N., long. 80° 46′ W. October 21, 1904. Temperature, 79°.

Surface: — *Phalacroma rapa*, 2%; *Ornithocercus magnificus*, 2%.

4627

Lat. 7° 21′ N., long. 79° 55′ W. November 2, 1904. Temperature, 81.5°.

Surface: — *Ornithocercus magnificus*, 2%.

4631

Lat. 6° 26′ N., long. 81° 49′ W. November 3, 1904. Temperature, 82°.

Surface: — *Phalacroma doryphorum*, P; *Dinophysis caudata*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. thurni*, 2%.

4634

Lat. 4° 35′ N., long. 83° 32′ W. November 4, 1904. Temperature, 80°.

300 fathoms to surface: — *Phalacroma cuneus*, 2%; *P. doryphorum*, 1%; *P. porodictyum*, 1%; *P. rapa*, P; *P. striatum*, P; *Dinophysis caudata*, P; *D. hastata*, 1%; *Amphisolenia bidentata*, P; *A. extensa*, P; *A. quadrispina*, P; *Triposolenia ramiciformis*, P; *T. truncata*, 1%; *Ornithocercus magnificus*, 7%; *O. quadratus*, 3%; *O. steini*, 3%; *O. thurni*, 2%.

4635

Lat. 3° 52′ N., long. 84° 14′ W. November 4, 1904. Temperature, 79°.

Surface: — *Phalacroma parvulum*, 1%; *P. rapa*, P; *Ornithocercus magnificus*, 9%; *O. quadratus*, P; *O. steini*, 4%; *Citharistes apsteini*, P.

4637

Lat. 1° 31′ N., long. 86° 32′ W. November 5, 1904. Temperature, 76°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. porodictyum*, P; *P. rapa*, P; *P. striatum*, P; *Dinophysis caudata*, 1%; *D. hastata*, P; *D. jörgenseni*, P; *D. uracantha*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *T. truncata*, 1%; *Ornithocercus magnificus*, 6%; *O. quadratus*, 1%; *O. steini*, 3%; *O. thurni*, P; *O.* sp. indet., P.

4638

Lat. 0° 27′ N., long. 87° 13′ W. November 6, 1904. Temperature, 75°.

Surface: — *Dinophysis caudata*, P; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 2%; *O. quadratus*, 4%; *O. steini*, 1%; *O. thurni*, 2%.

300 fathoms to surface: — *Phalacroma circumsutum*, 1%; *P. cuneus*, 1%; *P. mucronatum*, 2%; *P. striatum*, P; *Dinophysis caudata*, 2%; *D. hastata*, P; *D. norvegica* (?), 1%; *D. swezyi*, P; *D. uracantha*, 1%; *Amphisolenia bidentata*, 1%; *A. extensa*, 2%; *Triposolenia bicornis*, P; *T. truncata*, P; *Ornithocercus magnificus*, 4%; *O. quadratus*, 7%; *O. steini*, 7%; *O. thurni*, 6%; *O.* sp. indet., P.

4639

Lat. 0° 4′ S., long. 87° 39′ W. November 6, 1904. Temperature, 76°.

Surface: — *Dinophysis caudata*, 9%; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. steini*, 1%.

4640

Lat. 0° 39′ S., long. 88° 11′ W. November 6, 1904. Temperature, 75°.

Surface: — *Phalacroma rapa*, P; *Dinophysis caudata*, 5%; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 1%; *O. quadratus*, 1%; *O. steini*, 3%; *O. thurni*, 1%.

4644

Lat. 2° 13′ S., long. 89° 42′ W. November 7, 1904. Temperature, 72°.

Surface: — *Phalacroma doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, 2%; *Ornithocercus magnificus*, 1%; *O. steini*, P; *O. thurni*, P.

4646

Lat. 4° 1′ S., long. 89° 16′ W. November 8, 1904. Temperature, 72°.

Surface: — *Ornithocercus steini*, P; *O. thurni*, P.

Salpa stomach: — *Ornithocercus thurni*, two specimens.

Only six specimens of dinoflagellates were recorded.

300 fathoms to surface: — *Phalacroma doryphorum*, P; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. steini*, P; *O. thurni*, P.

4647

Lat. 4° 33′ S., long. 87° 42′ W. November 9, 1904. Temperature, 70°.

800 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *Dinophysis caudata*, 1%; *D. uracantha*, P; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. steini*, P; *O. thurni*, 1%.

4648

Lat. 4° 43′ S., long. 87° 7′ W. November 9, 1904. Temperature, 71°.

Surface: — *Phalacroma doryphorum*, P; *Amphisolenia bidentata*, 1%; *Ornithocercus steini*, 2%.

300 fathoms to surface: — *Phalacroma doryphorum*, 1%; *P. parvulum*, 1%; *P. porodictyum*, 1%; *Dinophysis uracantha*, 1%; *Amphisolenia bidentata*, 8%; *Triposolenia bicornis*, 1%; *T. ramiciformis*, 2%; *Ornithocercus magnificus*, 1%.

4649

Lat. 5° 17′ S., long. 85° 19′ W. November 10, 1904. Temperature, 70°.

Surface: — *Dinophysis caudata*, 11%.

4650

Lat. 5° 22′ S., long. 84° 39′ W. November 10, 1904. Temperature, 71°.

Surface: — *Phalacroma rapa*, 2%; *Dinophysis caudata*, 2%.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, 3%; *D. hastata*, P; *D. jörgenseni*, P; *Amphisolenia extensa*, P; *Triposolenia bicornis*, P; *T. depressa*, 1%; *T. ramiciformis*, 1%; *T. truncata*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. steini*, P.

4651

Lat. 5° 41′ S., long. 82° 59′ W. November 11, 1904. Temperature, 66°.

800 fathoms to surface: — *Phalacroma doryphorum*, 1%; *P. parvulum*, 1%; *Dinophysis caudata*, 2%; *D. hastata*, P; *D. jörgenseni*, P.

4652

Lat. 5° 44′ S., long. 82° 39′ W. November 11, 1904. Temperature, 66°.

100 fathoms to surface: — *Phalacroma argus*, P; *P. doryphorum*, P; *Dinophysis caudata*, P; *D. jörgenseni*, P; *D. schütti*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P.

4655

Lat. 5° 57′ S., long. 80° 50′ W. November 12, 1904. Temperature, 65°.

400 and 300 fathoms to surface: — *Phalacroma argus*, 1%; *P. cuneus*, P; *P. doryphorum*, P; *P. reticulatum*, P; *Dinophysis caudata*, 2%; *D. jörgenseni*, P; *Dinofurcula ventralis*, P; *Triposolenia depressa*, 1%; *T. truncata*, P.

4657

Lat. 7° 12′ S., long. 84° 9′ W. November 13, 1904. Temperature, 69°.

Surface: — *Phalacroma cuneus*, 1%; *Dinophysis caudata*, 3%.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. ovum*, 1%; *Dinophysis caudata*, 1%; *Triposolenia bicornis*, 1%.

4659

Lat. 8° 54′ S., long. 86° 5′ W. November 14, 1904. Temperature, 69°.

Surface: — *Dinophysis caudata*, 3%.

300 fathoms to surface: — *Phalacroma doryphorum*, P; *Dinophysis caudata*, 12%; *D. hastata*, P; *D. jörgenseni*, P; *D. uracantha*, P; *Dinofurcula ventralis*, P; *Amphisolenia bidentata*, 2%; *A. schröderi*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. longicornis*, P; *T. ramiciformis*, 1%; *Ornithocercus steini*, P.

4660

Lat. 9° 55′ S., long. 87° 30′ W. November 15, 1904. Temperature, 69°.

Salpa stomach: — *Phalacroma cuneus*, one specimen; *P. doryphorum*, four specimens; *Dinophysis caudata*, five specimens; *D.* sp. indet., one specimen. Only seventy-seven specimens of dinoflagellates were recorded.

4661

Lat. 10° 17′ S., long. 88° 2′ W. November 15, 1904. Temperature, 69°.

Salpa stomach: — *Phalacroma rapa*, one specimen; *Dinophysis* spp., four specimens.

Only fifty-six specimens of dinoflagellates were recorded.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, P; *Dinofurcula ultima*, P.

4662

Lat. 11° 13′ S., long. 89° 35′ W. November 16, 1904. Temperature, 69°.

800 fathoms to surface: — *Phalacroma cuneus*, 4%; *P. doryphorum*, P; *P. lenticula*, P; *P. porodictyum*, P; *Amphisolenia bispinosa*, P; *A. globifera*, 1%; *Triposolenia depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P.

4663

Lat. 11° 20′ S., long. 88° 52′ W. November 16, 1904. Temperature, 69°.

300 fathoms to surface: — *Phalacroma cuneus*, 10%; *P. doryphorum*, 5%; *Dinophysis caudata*, 1%; *D. jörgenseni*, 1%; *Triposolenia ramiciformis*, 2%.

4664

Lat. 11° 30′ S., long. 87° 19′ W. November 17, 1904. Temperature, 68°.

Surface: — *Phalacroma cuneus*, 1%.

Salpa stomach: — *Phalacroma cuneus*, one specimen; *P. doryphorum*, one specimen; *Ornithocercus thurni*, one specimen.

Only seven specimens of dinoflagellates were recorded.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, 40%; *P. doryphorum*, 3%; *P. lenticula*, P; *Dinophysis hastata*, P.

4665

Lat. 11° 45′ S., long. 86° 5′ W. November 17, 1904. Temperature, 68°.

300 fathoms to surface: — *Heteroschisma inaequale*, P; *Phalacroma cuneus*, 1%; *P. doryphorum*, P; *P. favus*, P; *P. rapa*, P; *Dinophysis hastata*, P; *D. jörgenseni*, P; *Triposolenia longicornis*, P; *T. ramiciformis*, P.

4666

Lat. 11° 55′ S., long. 84° 20′ W. November 18, 1904. Temperature, 67°.

Surface: — *Phalacroma rapa*, 1%; *Dinophysis caudata*, 1%; *D. hastata*, 1%.

800 fathoms to surface: — *Phalacroma cuneus*, 6%; *P. porodictyum*, P; *Dinophysis hastata*, P; *Amphisolenia globifera*, 1%; *Triposolenia ramiciformis*, 1%.

4667

Lat. 11° 59′ S., long. 83° 40′ W. November 18, 1904. Temperature, 68°.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, 3%; *P. limbatum*, P; *Dinophysis caudata*, 1%; *D. fortii*, P; *Amphisolenia bidentata*, 1%; *A. extensa*, P; *A. lemmermanni*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P.

4668

Lat. 12° 9′ S., long. 81° 45′ W. November 19, 1904. Temperature, 67°.

300 fathoms to surface: — *Phalacroma cuneus*, P; *Dinophysis caudata*, P; *Amphisolenia bispinosa*, 1%; *A. extensa*, P; *A. globifera*, 1%; *A. palaeotheroides*, P; *Triposolenia bicornis*, 1%; *T. longicornis*, P; *T. ramiciformis*, 1%.

4669

Lat. 12° 12′ S., long. 80° 25′ W. November 19, 1904. Temperature, 67°.

Surface: — *Phalacroma cuneus*, 4%; *P. doryphorum*, 2%; *Dinophysis caudata*, 10%.

4670

Lat. 12° 8′ S., long. 79° 2′ W. November 20, 1904. Temperature, 66°.

800 fathoms to surface: — *Phalacroma cuneus*, P; *Dinophysis caudata*, 1%; *Triposolenia bicornis*, P; *T. ramiciformis*, P.

4671

Lat. 12° 6′ S., long. 78° 28′ W. November 20, 1904. Temperature, 66°.

300 fathoms to surface: — *Heteroschisma aequale*, P; *Phalacroma circumcinctum*, P; *P. cuneus*, 3%; *P. doryphorum*, 1%; *Dinophysis caudata*, 2%; *D. collaris*, P; *D. uracantha*, 1%; *Dinofurcula ultima*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. ramiciformis*, 1%; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. thurni*, P.

4673

Lat. 12° 30′ S., long. 77° 49′ W. November 21, 1904. Temperature, 67°.

300 fathoms to surface: — *Phalacroma porodictyum*; *Dinophysis caudata* f. *acutiformis; D. okamurai;* frequencies unknown.

4675

Lat. 12° 54′ S., long. 78° 33′ W. November 22, 1904. Temperature, 68°.

Surface: — *Phalacroma cuneus*, 2%; *P. doryphorum*, 2%.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 2%; *Dinophysis caudata*, 2%; *D. hastata*, P; *Triposolenia longicornis*, 1%; *T. ramiciformis*, P.

4676

Lat. 14° 28′ S., long. 81° 24′ W. December 5, 1904. Temperature, 69°.

Surface: — *Phalacroma doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, 3%; *D. hastata*, P; *D. schütti*, P; *Amphisolenia bidentata*, 1%.

800 and 300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *P. limbatum*, 1%; *P. porodictyum*, P; *Dinophysis caudata*, 2%; *D. hastata*, P; *D. schütti*, P; *D. uracantha*, P; *Triposolenia depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P; *Ornithocercus splendidus*, P.

4677

Lat. 14° 37′ S., long. 81° 41′ W. December 5, 1904. Temperature, 68°.

Surface: — No species of Dinophysoidae.

4678

Lat. 16° 31′ S., long. 85° 3′ W. December 6, 1904. Temperature, 68°.

Surface: — *Phalacroma doryphorum*, P; *P. rapa*, P; *Dinophysis caudata*, P.

4679

Lat. 17° 26′ S., long. 86° 46′ W. December 7, 1904. Temperature, 69°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. lenticula*, P; *P. porodictyum*, 1%; *P. rapa*, P; *P. striatum*, P; *Dinophysis collaris*, P; *D. hastata*, P; *D. jörgenseni*, P; *D. schütti*, P; *D. swezyi*, P; *D. uracantha*, 1%; *Amphisolenia bidentata*, P; *A. extensa*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *Ornithocercus quadratus*, P; *O. splendidus*, P; *O. thurni*, 1%; *Histioneis gubernans*, P; *H. pulchra*, P.

4680

Lat. 17° 55′ S., long. 87° 42′ W. December 7, 1904. Temperature, 68°.

Surface: — *Phalacroma rapa*, P; *Dinophysis hastata*, P; *Ornithocercus thurni*, P.

Salpa stomach: — *Phalacroma rapa*, one specimen; *Histioneis longicollis*, one specimen; *Citharistes regius*, one specimen.

Only seventeen specimens of dinoflagellates were recorded.

4681

Lat. 18° 47′ S., long. 89° 26′ W. December 8, 1904. Temperature, 68°.

800 and 300 fathoms to surface: — *Phalacroma argus*, 2%; *P. cuneus*, 1%; *P. doryphorum*, P; *P. limbatum*, P; *P. mucronatum*, P; *P. ovum*, P; *P. porodictyum*, 1%; *P. porosum*, P; *P. rapa*, 1%; *P. reticulatum*, P; *P. striatum*, P; *P. turbineum*, P; *Dinophysis collaris*, P; *D. hastata*, 1%; *D. jörgenseni*, P; *D. schütti*, 1%; *D. urceolus*, P; *Dinofurcula ventralis*, P; *Amphisolenia elongata*, P; *A. inflata*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. quadratus*, 3%; *O. splendidus*, 3%; *O. thurni*, 2%; *Histioneis carinata* (?), P; *H. dolon*, P; *H. pulchra*, P; *H. reginella*, P; *Citharistes apsteini*, P.

4682

Lat. 19° 7′ S., long. 90° 10′ W. December 8, 1904. Temperature, 69°.

Surface: — *Ornithocercus quadratus*, P; *O. thurni*, 2%.

4683

Lat. 20° 2′ S., long. 91° 52′ W. December 9, 1904. Temperature, 70°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, P; *P. rapa*, P; *Dinophysis hastata*, P; *D. schütti*, P; *Amphisolenia extensa*, 1%; *Triposolenia bicornis*, P; *T. depressa*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. quadratus*, P; *O. splendidus*, 1%; *O. thurni*, 4%; *Histioneis pulchra*, P.

4684

Lat. 20° 40′ S., long. 93° 19′ W. December 9, 1904. Temperature, 71°.

Surface: — *Ornithocercus thurni*, P.

4685

Lat. 21° 36′ S., long. 94° 56′ W. December 10, 1904. Temperature, 72°.

300 fathoms to surface: — *Phalacroma rapa*, P; *P. striatum*, P; *Triposolenia longicornis*, P; *Ornithocercus magnificus*, 1%; *O. quadratus*, P; *O. splendidus*, 1%; *O. thurni*, P; *Histioneis dolon*, P; *H. mitchellana*, P.

4686

Lat. 22° 2′ S., long. 95° 52′ W. December 10, 1904. Temperature, 71°.

Surface: — *Ornithocercus magnificus*, P; *O. thurni*, P.

4687

Lat. 22° 49′ S., long. 97° 30′ W. December 11, 1904. Temperature, 73°.

300 fathoms to surface: — *Phalacroma limbatum*, P; *Dinophysis hastata*, P; *D. schütti*, P; *Triposolenia bicornis*, P; *Ornithocercus magnificus*, 2%; *O. quadratus*, P; *O. splendidus*, 1%.

4688

Lat. 23° 17′ S., long. 98° 37′ W. December 11, 1904. Temperature, 72°.

Surface: — *Amphisolenia palmata*, 1%.

4689

Lat. 24° 5′ S., long. 100° 20′ W. December 12, 1904. Temperature, 72°.

800 and 300 fathoms to surface: — *Phalacroma cuneus*, 2%; *P. doryphorum*, 2%; *P. hindmarchi*, 1%; *P. porodictyum*, 1%; *P. rapa*, 1%; *Dinophysis hastata*, 2%; *D. schütti*, 1%; *Amphisolenia bidentata*, 3%; *A. palaeotheroides*, 1%; *Ornithocercus magnificus*, 6%; *O. quadratus*, 2%; *O. splendidus*, 2%; *O. thurni*, 1%; *Histioneis dolon*, P; *H. pulchra*, P.

4691

Lat. 25° 27′ S., long. 103° 29′ W. December 13, 1904. Temperature, 73°.

300 fathoms to surface: — *Phalacroma argus*, 1%; *P. cuneus*, P; *P. doryphorum*, 1%; *P. hindmarchi*, P; *P. porodictyum*, P; *P. rapa*, P; *Dinophysis hastata*, P; *D. monacantha*, P; *D. nias*, P; *D. similis*, P; *D. schütti*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 1%; *A. bifurcata*, P; *A. extensa*, P; *A. lemmermanni*, 1%; *A. palaeotheroides*, P; *A. thrinax*, P; *Triposolenia ramiciformis*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, 5%; *O. quadratus*, 2%; *O. splendidus*, P; *O. thurni*, 1%; *O.* sp. indet., division stage, P; *Histioneis dolon*, P; *H. mitchellana*, P; *H. pulchra*, P.

4692

Lat. 25° 40′ S., long. 104° 1′ W. December 13, 1904. Temperature, 73°.

Surface: — *Phalacroma rapa*, P; *Ornithocercus magnificus*, 5%; *O. steini*, 2%; *O. thurni*, P.

4694

Lat. 26° 34′ S., long. 108° 57′ W. December 22, 1904. Temperature, 72°.

Surface: — *Amphisolenia bidentata*, P.

4695

Lat. 25° 22′ S., long. 107° 45′ W. December 23, 1904. Temperature, 74°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. giganteum*, P; *P. rapa*, 3%; *P. reticulatum*, P; *Dinophysis hastata*, P; *D. schütti*, 2%; *Amphisolenia bidentata*, 1%; *A. bifurcata*, P; *A. quadricauda*, P; *Ornithocercus carolinae*, P; *O. magnificus*, 9%; *O. quadratus*, 1%; *O. splendidus*, 1%; *O. thurni*, 2%; *Histioneis dolon*, P; *H. josephinae*, P; *H. mitchellana*, P; *Citharistes apsteini*, P.

4696

Lat. 24° 40′ S., long. 107° 5′ W. December 23, 1904. Temperature, 74°.

Surface: — *Ornithocercus magnificus*, 9%; *O. thurni*, 5%.

4697

Lat. 23° 24′ S., long. 106° 2′ W. December 24, 1904. Temperature, 75°.

300 fathoms to surface: — *Phalacroma apicatum*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. hindmarchi*, P; *P. porodictyum*, P; *P. rapa*, 2%; *P. reticulatum*, P; *Dinophysis hastata*, P; *D. schütti*, P; *D. sphaerica*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 3%; *A. extensa*, P; *A. lemmermanni*, P; *A. palmata*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *Ornithocercus formosus*, P; *O. magnificus*, 4%; *O. quadratus*, 1%; *O. splendidus*, 2%; *O. thurni*, P; *Parahistioneis paraformis*, P; *P. reticulata*, P; *Histioneis dolon*, P; *H. josephinae*, P; *H. mitchellana*, P; *Citharistes apsteini*, P.

4698

Lat. 22° 50′ S., long. 105° 31′ S. December 24, 1904. Temperature, 75°.

Surface: — *Ornithocercus magnificus*, P.

4699

Lat. 21° 39′ S., long. 104° 29′ W. December 25, 1904. Temperature, 75°.

Salpa stomach: — *Heteroschisma aequale*, one specimen.

Only ten specimens of dinoflagellates were recorded.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 2%; *P. giganteum*, 1%; *P. hindmarchi*, P; *P. limbatum*, P; *P. porodictyum*, 1%; *P. pulchrum*, P; *P. rapa*, P; *P. reticulatum*, 1%; *P. striatum*, P; *Dinophysis hastata*, P; *D. schütti*, 1%; *D. uracantha*, P; *Amphisolenia bidentata*, P; *A. bifurcata*, P; *A. extensa*, P; *A. globifera*, P; *A. lemmermanni*, P; *A. palaeotheroides*, 1%; *A. schauinslandi*, P; *Triposolenia bicornis*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, 9%; *O. quadratus*, 1%; *O. splendidus*, P; *O. thurni*, 1%; *Parahistioneis diomedeae*, P; *P. para*, 1%; *P. reticulata*, P; *Histioneis dolon*, P; *H. highleyi*, P; *H. josephinae*, P; *H. milneri*, P; *H. mitchellana*, P; *H. pulchra*, P; *Citharistes apsteini*, P.

4700

Lat. 20° 28′ S., long. 103° 26′ W. December 25, 1904. Temperature, 74°.

Surface: — *Amphisolenia bidentata*, P; *A. palmata*, P; *Ornithocercus magnificus*, P; *O. thurni*, P.

4701

Lat. 19° 11′ S., long. 102° 24′ W. December 26, 1904. Temperature, 72°.

800 and 300 fathoms to surface: — *Heteroschisma aequale*, P; *Phalacroma argus*, P; *P. cuneus*, 1%; *P. doryphorum*, 1%; *P. hindmarchi*, P; *P. lenticula*, P; *P. porodictyum*, P; *P. pulchrum*, P; *P. rapa*, 1%; *P. reticulatum*, P; *P. striatum*, P; *Dinophysis caudata*, P; *D. hastata*, P; *D. jörgenseni*, P; *D. schütti*, 1%; *D. similis*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 2%; *A. bifurcata*, P; *A. extensa*, 1%; *A. globifera*, P; *A. laticincta*, P; *A. lemmermanni*, P; *A. palaeotheroides*, P; *A. projecta*, P; *A. schauinslandi*, P; *A. schröderi*, P; *A. thrinax*, 1%; *Triposolenia bicornis*, P; *T. depressa*, P; *T. ramiciformis*, 1%; *Ornithocercus carolinae*, P; *O. formosus*, P; *O. heteroporus*, P; *O. magnificus*, 1%; *O. quadratus*, 2%; *O. splendidus*, 1%; *O. steini*, P; *O. thurni*, 2%; *O.* sp. indet., division stage, P; *Parahistioneis paraformis*, P; *P. reticulata*, P; *Histioneis biremis*, P; *H. dolon*, P; *H. helenae*, P; *H. mitchellana*, P; *H. navicula*, P; *H. pulchra*, P; *Citharistes apsteini*, P.

4702

Lat. 18° 39′ S., long. 102° 0′ W. December 26, 1904. Temperature, 73°.

Surface: — *Ornithocercus magnificus*, 1%; *O. splendidus*, P.

4704

Lat. 16° 55′ S., long. 100° 24′ W. December 27, 1904. Temperature, 73°.

Surface: — *Ornithocercus steini*, P.

4705

Lat. 15° 5′ S., long. 99° 19′ W. December 28, 1904. Temperature, 72°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. limbatum*, 1%; *P. porodictyum*, P; *P. pulchrum*, P; *P. rapa*, P; *P. striatum*, P; *Dinophysis caudata*, P; *D. hastata*, P; *D. schütti*, P; *D. uracantha*, P; *Amphisolenia bidentata*, P; *A. lemmermanni*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. ramiciformis*, P; *Histiophysis rugosa*, P; *Ornithocercus carolinae*, P; *O. magnificus*, P; *O. quadratus*, 1%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, 1%; *Histioneis helenae*, P; *H. highleyi*, P; *H. pulchra*, P.

4706

Lat. 14° 18′ S., long. 98° 45′ W. December 28, 1904. Temperature, 72°.

Salpa stomach: — *Phalacroma cuneus*, one specimen.

Only ten specimens of dinoflagellates were recorded.

4707

Lat. 12° 33′ S., long. 97° 42′ W. December 29, 1904. Temperature, 72°.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, P; *P. striatum*, P; *Dinophysis hastata*, P; *Amphisolenia extensa*, 1%; *A. palaeotheroides*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. quadratus*, 1%; *O. splendidus*, P; *Histioneis highleyi*, P.

4708

Lat. 11° 40′ S., long. 96° 55′ W. December 29, 1904. Temperature, 72°.

Surface: — *Amphisolenia bidentata*, P.

4709

Lat. 10° 15′ S., long. 95° 40′ W. December 30, 1904. Temperature, 72°.

Salpa stomach: — *Phalacroma rapa*, one specimen; *Dinophysis exigua*, one specimen; *Ornithocercus quadratus*, one specimen; *Parahistioneis rotundata*, one specimen; *Citharistes regius*, two specimens. Only forty-eight specimens of dinoflagellates were recorded.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, P; *P. ovum*, P; *P. porosum*, P; *P. rapa*, 5%; *P. reticulatum*, P; *Dinophysis jörgenseni*, P; *D. trapezium*, P; *Amphisolenia extensa*, 1%; *A. lemmermanni*, P; *A. palaeotheroides*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. intermedia*, P; *T. longicornis*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. quadratus*, 2%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, P; *Histioneis biremis*, P; *H. pulchra*, P.

4711

Lat. 7° 47′ S., long. 94° 5′ W. December 31, 1904. Temperature, 75°.

300 fathoms to surface:—*Phalacroma contractum*, P; *P. cuneolus*, P; *P. cuneus*, P; *P. doryphorum*, P; *P. mucronatum*, P; *P. ovum*, P; *P. rapa*, P; *Dinophysis collaris*, P; *D. hastata*, P; *D. jörgenseni*, P; *D. schutti*, P; *D. sphaerica*, P; *D. uracantha*, P; *Dinofurcula ultima*, P; *Amphisolenia extensa*, P; *A. globifera*, P; *A. quadrispina*, P; *Triposolenia ambulatrix*, P; *T. bicornis*, P; *T. depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus quadratus*, P; *O. steini*, 1%; *Histioneis gubernans*, P; *H. longicollis*, P; *H. paulseni*, P; *H. pulchra*, P; *Parahistioneis reticulata*, P.

4712

Lat. 7° 5′ S., long. 93° 35′ W. December 31, 1904. Temperature, 74°.

Surface: — *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 1%; *O. quadratus*, P; *O. steini*, 2%.

Salpa stomach: — *Ornithocercus steini*, 1 specimen; *Citharistes regius*, one specimen. Only ninety-one specimens of dinoflagellates were recorded.

4713

Lat. 5° 35′ S., long. 92° 21′ W. January 1, 1905. Temperature, 73°.

300 and 150 fathoms to surface: — *Phalacroma cuneus*, 2%; *P. doryphorum*, 3%; *P. expulsum*, P; *P. lens*, P; *P. porodictyum*, P; *P. pulchrum*, P; *P. pyriforme*, P; *P. striatum*, P; *Dinophysis caudata*, P; *D. collaris*, P; *D. jörgenseni*, P; *D. schütti*, P; *Amphisolenia astragalus*, P; *A. bidentata*, 4%; *A. bispinosa*, P; *A. extensa*, P; *A. globifera*, 1%; *A. inflata*, P; *Triposolenia ambulatrix*, P; *T. bicornis*, 1%; *T. depressa*, P; *T. longicornis*, 1%; *T. ramiciformis*, P; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. steini*, P; *O. thurni*, 10%; *O.* sp. indet., division stage, P.

4714

Lat. 4° 19′ S., long. 91° 28′ W. January 1, 1905. Temperature, 75°.

Surface: — *Ornithocercus steini*, 5%; *O. thurni*, 2%.

4715

Lat. 2° 40′ S., long. 90° 19′ W. January 2, 1905. Temperature, 75°.

800 and 300 fathoms to surface: — *Phalacroma doryphorum*, 3%; *P. striatum*, P; *P. turbineum*, P; *Dinophysis caudata*, 1%; *D. jörgenseni*, 1%; *D. schütti*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, 1%; *T. truncata*, 1%; *Ornithocercus quadratus*, 1%; *O. steini*, 2%; *O. thurni*, 7%.

4716

Lat. 2° 18′ S., long. 90° 2′ W. January 2, 1905. Temperature, 75°.

Surface: — *Dinophysis caudata*, 1%; *Ornithocercus magnificus*, 1%; *O. steini*, 1%; *O. thurni*, 2%.

4717

Lat. 5° 10′ S., long. 98° 56′ W. January 13, 1905. Temperature, 75°.

800 and 300 fathoms to surface: — *Phalacroma doryphorum*, P; *P. expulsum*, P; *P. lens*, P; *P. striatum*, P; *Dinophysis hastata*, P; *D. jörgenseni*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 2%; *A. lemmermanni*, 1%; *A. globifera*, 1%; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus heteroporus*, P; *O. quadratus*, 1%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, 2%; *Histioneis dolon*, P; *Citharistes regius*, P.

4718

Lat. 5° 32′ S., long. 99° 32′ W. January 13, 1905. Temperature, 76°.

Surface: — *Amphisolenia bidentata*, 1%; *Ornithocercus quadratus*, P; *O. steini*, P.

4719

Lat. 6° 28′ S., long. 101° 16′ W. January 14, 1905. Temperature, 75°.

300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *P. porodictyum*, 1%; *P. rapa*, P; *P. striatum*, P; *Dinophysis uracantha*, P; *Amphisolenia bidentata*, 4%; *A. extensa*, P; *A. lemmermanni*, 1%; *Triposolenia longicornis*, P; *Ornithocercus carolinae*, P; *O. quadratus*, P; *O. steini*, 2%; *O. thurni*, P; *Histioneis pulchra*, P.

4720

Lat. 7° 13′ S., long. 102° 31′ W. January 14, 1905. Temperature, 76°.

Surface: — *Amphisolenia bidentata*, 2%; *A. lemmermanni*, P; *Ornithocercus magnificus*, 2%; *Parahistioneis diomedeae*, P.

Salpa stomach: — *Phalacroma expulsum*, P; *P. doryphorum*, 1%; *Dinophysis sphaerica*, 4%; *Amphisolenia bidentata*, 1%; *Ornithocercus quadratus*, 4%; *O. steini*, 1%; *Parahistioneis rotundata*, 1%; *Histioneis hyalina*, P; *H. inclinata*, P; *H. inornata*, P; *H. striata*, P; *Citharistes apsteini*, P.

4721

Lat. 8° 7′ S., long. 104° 10′ W. January 15, 1905. Temperature, 75°.

800 and 300 fathoms to surface: — *Heteroschisma aequale*, P; *Phalacroma doryphorum*, P; *P. ovum*, P; *P. porodictyum*, P; *P. porosum*, 1%; *P. rapa*, 1%; *P. striatum*, P; *Dinophysis hastata*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 2%; *A. extensa*, 1%; *A. globifera*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. longicornis*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. magnificus*, P; *O. quadratus*, 7%; *O. splendidus*, P; *O. steini*, 11%; *O. thurni*, P; *O.* sp. indet., division stage, P; *Histioneis highleyi*, P; *H. pulchra*, P.

4722

Lat. 9° 31′ S., long. 106° 30′ W. January 16, 1905. Temperature, 75°.

300 fathoms to surface: — *Phalacroma argus*, P; *P. doryphorum*, 1%; *P. limbatum*, P; *P. rapa*, P; *P. striatum*, P; *Dinophysis hastata*, P; *D. schütti*, P; *D. triacantha*, P; *D. uracantha*, 1%; *Amphisolenia bidentata*, 1%; *A. extensa*, P; *A. globifera*, P; *A. lemmermanni*, P; *A. quadrispina*, P; *A. schauinslandi*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *Ornithocercus carolinae*, P; *O. formosus*, P; *O. heteroporus*, P; *O. magnificus*, P; *O. quadratus*, 4%; *O. splendidus*, 1%; *O. steini*, 7%; *O. thurni*, P; *O.* sp. indet., P; *Parahistioneis paraformis*, P; *P. reticulata*, 1%; *Histioneis biremis*, P; *H. elongata*, P; *H. highleyi*, P; *H. milneri*, P; *H. mitchellana*, P; *H. pulchra*, P.

4723

Lat. 10° 14′ S., long. 107° 45′ W. January 16, 1905. Temperature, 76°.

Salpa stomach: — *Amphisolenia bidentata*, one specimen; *A. lemmermanni*, one specimen; *Ornithocercus quadratus*, three specimens; *O. steini*, three specimens.

Only fifty-eight specimens of dinoflagellates were recorded.

4724

Lat. 11° 13′ S., long. 109° 39′ W. January 17, 1905. Temperature, 79°.

800 and 300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, P; *P. expulsum*, P; *P. lenticula*, P; *P. ovum*, P; *P. parvulum*, P; *P. porodictyum*, P; *P. rapa*, P; *P. reticulatum*, P; *P. striatum*, P; *Dinophysis hastata*, 1%; *D. uracantha*, P; *Amphisolenia bidentata*, 2%; *A. bifurcata*, P; *A. extensa*, P; *A. globifera*, P; *A. inflata*, P; *A. lemmermanni*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. formosus*, P; *O. heteroporus*, P; *O. magnificus*, P; *O. quadratus*, 5%; *O. splendidus*, 4%; *O. steini*, 1%; *O. thurni*, P; *Parahistioneis diomedeae*, P; *P. paraformis*, P; *Histioneis biremis*, P; *H. carinata*, P; *H. dolon*, P; *H. milneri*, P; *H. mitchellana*, P; *H. panaria*, P; *H. panda*, P; *H. pulchra*, P.

4725

Lat. 11° 38′ S., long. 110° 5′ W. January 17, 1905. Temperature, 77°.

Surface: — *Amphisolenia bidentata*, 2%; *A. schauinslandi*, P; *Ornithocercus magnificus*, 1%; *O. quadratus*, P.

Salpa stomach: — *Phalacroma rapa*, one specimen; *Ornithocercus quadratus*, one specimen; *Parahistioneis rotundata*, one specimen; *Histioneis dolon*, one specimen; *H. striata*, one specimen. Only fifty-four specimens of dinoflagellates were recorded.

4727

Lat. 13° 3′ S., long. 112° 44′ W. January 18, 1905. Temperature, 77°.

Surface: — *Dinophysis jörgenseni*, P; *Amphisolenia bidentata*, P; *Ornithocercus magnificus*, P; *O. steini*, P; *O. thurni*, P.

4728

Lat. 13° 47′ S., long. 114° 21′ W. January 19, 1905. Temperature, 77°.

Salpa stomach: — *Histioneis inclinata*, one specimen.

Only thirty specimens of dinoflagellates were recorded.

800 and 300 fathoms to surface: — *Phalacroma cuneus*, P; *P. doryphorum*, P; *Dinophysis uracantha*, P; *D.* sp. indet., 1%; *Amphisolenia asymmetrica*, P; *A. bidentata*, 3%; *A. extensa*, P; *A. lemmermanni*, P; *A. palaeotheroides*, P; *A. quadrispina*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *Ornithocercus carolinae*, P; *O. magnificus*, 2%; *O. quadratus*, 8%; *O. splendidus*, 1%; *O. steini*, P; *O. thurni*, 1%.

4729

Lat. 14° 15′ S., long. 114° 13′ W. January 19, 1905. Temperature, 78°.

Surface: — *Amphisolenia bidentata*, P; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. steini*, 1%.

4730

Lat. 15° 7′ S., long. 117° 1′ W. January 20, 1905. Temperature, 79°.

300 fathoms to surface: — *Phalacroma apicatum*, P; *P. argus*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. favus*, P; *P. giganteum*, P; *P. hindmarchi*, P; *P. lens*, P; *P. mucronatum*, P; *P. ovum*, P; *P. porodictyum*, P; *P. porosum*, P; *P. protuberans*, P; *P. pulchrum*, P; *P. reticulatum*, P; *Dinophysis collaris*, P; *D. hastata*, P; *D. jörgenseni*, P; *D. monacantha*, P; *D. schütti*, P; *D. uracantha*, P; *Amphisolenia bidentata*, 1%; *A. lemmermanni*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, P; *O. quadratus*, 2%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, 4%; *Histioneis elongata*, P; *H. gubernans*, P; *H. helenae*, 1%; *H. highleyi*, P; *H. milneri*, P; *H. mitchellana*, 1%; *H. pulchra*, P.

4731

Lat. 15° 47′ S., long. 118° 22′ W. January 20, 1905. Temperature, 79.5°.

Surface: — *Phalacroma cuneus*, P; *P. hindmarchi*, 1%; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 2%; *O. quadratus*, 1%; *O. steini*, 1%; *O. thurni*, P.

4732

Lat. 16° 32′ S., long. 119° 59′ W. January 21, 1905. Temperature, 79°.

800 and 300 fathoms to surface: — *Phalacroma apicatum*, P; *P. cuneus*, 1%;

P. doryphorum, P; *P. hindmarchi*, P; *P. porodictyum*, P; *P. porosum*, P; *P. reticulatum*, P; *P. striatum*, 1%; *Dinophysis hastata*, P; *D. jörgenseni*, P; *D. schütti*, P; *D. swezyi*, P; *D. uracantha*, P; *Amphisolenia asymmetrica*, 1%; *A. bidentata*, 1%; *A. extensa*, P; *A. globifera*, P; *A. lemmermanni*, P; *A. palaeotheroides*, P; *A. schauinslandi*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *T. depressa*, P; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, 3%; *O. quadratus*, 1%; *O. splendidus*, 1%; *O. steini*, 1%; *O. thurni*, 1%; *Parahistioneis garretti*, P; *P. paraformis*, P; *Histioneis biremis*, 1%; *H. dolon*, P; *H. mitchellana*, 1%; *H. pulchra*, P.

4733

Lat. 16° 57′ S., long. 120° 48′ W. January 21, 1905. Temperature, 80°.

Surface: — *Phalacroma cuneus*, P; *Ornithocercus magnificus*, 3%; *O. quadratus*, 1%; *O. steini*, 2%; *O. thurni*, 1%; *O.* sp. indet., 1%.

Salpa stomach: — *Amphisolenia bidentata*, one specimen; *A. globifera*, one specimen; *A. truncata*, one specimen; *Ornithocercus heteroporus*, one specimen; *O.* sp. indet., one specimen; *Parahistioneis paraformis*, one specimen; *P. reticulata*, one specimen; *P. rotundata*, one specimen; *Histioneis gubernans*, one specimen; *H. navicula*, two specimens; *H. pacifica*, one specimen. Only eighty-eight specimens of dinoflagellates were recorded.

4734

Lat. 17° 36′ S., long. 122° 35′ W. January 22, 1905. Temperature, 81°.

300 fathoms to surface: — *Phalacroma apicatum*, P; *P. cuneus*, P; *P. doryphorum*, P; *P. giganteum*, P; *P. hindmarchi*, 1%; *P. porodictyum*, P; *P. porosum*, P; *Dinophysis hastata*, 1%; *D. uracantha*, P; *Amphisolenia bidentata*, 2%; *A. extensa*, P; *A. lemmermanni*, P; *A. palaeotheroides*, P; *A. palmata*, P; *A. rectangulata*, P; *A. schauinslandi*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, 3%; *O. quadratus*, 1%; *O. splendidus*, P; *O. steini*, P; *O. thurni*, 2%; *Parahistioneis paraformis*, P; *P. reticulata*, P; *Histioneis dolon*, P; *H. elongata*, P; *H. helenae*, P; *H. mitchellana*, P; *H. navicula*, P; *H. pulchra*, P.

4735

Lat. 18° 16′ S., long. 123° 34′ W. January 22, 1905. Temperature, 81°.

Surface: — *Amphisolenia schauinslandi*, P; *Ornithocercus magnificus*, 1%; *O. thurni*, P.

4736

Lat. 19°4′ S., long. 125° 5′ W. January 23, 1905. Temperature, 81°.

300 fathoms to surface: — *Phalacroma bipartitum*, P; *P. cuneus*, P; *P. hindmarchi*, P; *Dinophysis schütti*, P; *Amphisolenia bidentata*, 2%; *A. bispinosa*, P; *A. brevicauda*, P; *A. extensa*, P; *A. clavipes*, P; *A. schauinslandi*, P; *A. schröderi*, P; *A. thrinax*, P; *Ornithocercus magnificus*, 5%; *O. quadratus*, 1%; *O. splendidus*, P; *O. steini*, 1%; *O. thurni*, 1%; *Histioneis mitchellana*, P; *H. pulchra*, P.

4737

Lat. 19° 57′ S., long. 127° 20′ W. January 24, 1905. Temperature, 81.5°.

100 and 300 fathoms to surface: — *Phalacroma apicatum*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *P. favus*, P; *P. hindmarchi*, P; *P. ovum*, P; *P. porodictyum*, P; *P. rapa*, P; *Dinophysis hastata*, 1%; *D. swezyi*, P; *Amphisolenia bidentata*, 3%; *A. bispinosa*, P; *A. clavipes*, P; *A. complanata*, P; *A. elongata*, P; *A. lemmermanni*, P; *A. palaeotheroides*, 1%; *A. palmata*, P; *A. quinquecauda*, P; *A. schauinslandi*, P; *A. schröderi*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *T. truncata*, P; *Ornithocercus carolinae*, 1%; *O. formosus*, P; *O. heteroporus*, P; *O. magnificus*, 3%; *O. quadratus*, 1%; *O. splendidus*, 2%; *O. steini*, 1%; *O. thurni*, 2%; *O.* sp. indet., division stage, P; *Histioneis biremis*, P; *H. dolon*, P; *H. gubernans*, P; *H. mitchellana*, P; *H. pulchra*, P; *Citharistes apsteini*, P.

4738

Lat. 20° 27′ S., long. 128° 30′ W. January 24, 1905. Temperature, 81°.

Surface: — *Amphisolenia bidentata*, 1%.

4739

Lat. 22° 11′ S., long. 133° 21′ W. January 26, 1905. Temperature, 79°.

300 fathoms to surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, 1%; *P. hindmarchi*, 1%; *P. porodictyum*, P; *P. reticulatum*, P; *P. rapa*, P; *Dinophysis hastata*, P; *D. uracantha*, P; *Amphisolenia asymmetrica*, P; *A. bidentata*, 6%; *A. complanata*, P; *A. extensa*, P; *A. quinquecauda*, P; *A. rectangulata*, P; *A. schauinslandi*, P; *A. schröderi*, P; *A. thrinax*, 1%; *Triposolenia bicornis*, 1%; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. magnificus*, 2%; *O. quadratus*, 1%; *O. splendidus*, 3%; *O. steini*, P; *O. thurni*, 1%; *Histioneis josephinae*, P; *H. mitchellana*, P.

4740

Lat. 9° 2′ S., long. 123° 20′ W. February 11, 1905. Temperature, 81°.

Salpa stomach: — *Amphisolenia bidentata*, one specimen; *Ornithocercus magnificus*, one specimen. Only twenty-seven specimens of dinoflagellates were recorded.

800 and 300 fathoms to surface: — *Phalacroma argus*, P; *P. cuneus*, 2%; *P. doryphorum*, P; *P. lenticula*, P; *P. porosum*, P; *P. pulchrum*, P; *P. reticulatum*, P; *P. rapa*, P; *P. striatum*, P; *Dinophysis hastata*, 1%; *D. schütti*, P; *D. uracantha*, 1%; *Amphisolenia bidentata*, 4%; *A. brevicauda*, P; *A. extensa*, P; *A. laticincta*, P; *A. lemmermanni*, P; *A. palaeotheroides*, P; *A. rectangulata*, P; *A. schauinslandi*, P; *A. thrinax*, P; *Triposolenia bicornis*, P; *T. ramiciformis*, P; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. magnificus*, 2%; *O. quadratus*, 10%; *O. splendidus*, 2%; *O. steini*, P; *O. thurni*, 4%; *Histioneis biremis*, P; *H. dolon*, P; *H. helenae*, P; *H. pulchra*, P.

4741

Lat. 8° 29′ S., long. 122° 56′ W. February 11, 1905. Temperature, 80°.

Surface: — *Phalacroma rapa*, P; *Dinophysis hastata*, P; *Amphisolenia bi-*

dentata, 2%; *A. lemmermanni*, P; *A. thrinax*, P; *Ornithocercus magnificus*, P; *O. quadratus*, 2%; *O. steini*, 4%; *O. thurni*, P.

Salpa stomach: — *Phalacroma favus*, one specimen; *Amphisolenia bidentata*, one specimen; *Ornithocercus steini*, one specimen; *Parahistioneis rotundata*, one specimen; *Histioneis longicollis*, one specimen; *H. pacifica*, one specimen; *Citharistes regius*, three specimens. Only thirty-four specimens of dinoflagellates were recorded.

4742

Lat. 0° 3′ S., long. 117° 15′ W. February 15, 1905. Temperature, 77°.

300 fathoms to surface: — *Phalacroma cuneus*, 3%; *P. doryphorum*, P; *P. giganteum*, P; *P. hindmarchi*, P; *P. praetextum*, P; *P. rapa*, P; *P. striatum*, 1%; *Dinophysis hastata*, 1%; *D. jörgenseni*, P; *Amphisolenia bidentata*, 1%; *A. extensa*, P; *A. globifera*, P; *A. lemmermanni*, P; *A. quadrispina*, P; *A. thrinax*, P; *Triposolenia bicornis*, 1%; *T. depressa*, P; *T. ramiciformis*, 1%; *T. truncata*, P; *Ornithocercus carolinae*, P; *O. heteroporus*, P; *O. magnificus*, P; *O. quadratus*, 10%; *O. splendidus*, 2%; *O. steini*, P; *O. thurni*, 1%; *O.* sp. indet., P; *Histioneis biremis*, P; *H. milneri*, P; *H. pulchra*, P.

4743

Lat. 0° 21′ N., long. 117° 2′ W. February 15, 1905. Temperature, 78°.

Surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *P. rapa*, P; *Amphisolenia bidentata*, 1%; *A. thrinax*, P; *Ornithocercus carolinae*, P; *O. quadratus*, P; *O. splendidus*, P; *O. steini*, P; *O. thurni*, P; *Histioneis biremis*, P.

4540

Lat. 3° 25′ N., long. 115° 5′ W. February 17, 1905. Temperature, 79°.

Surface: — *Phalacroma argus*, P; *P. cuneus*, P; *P. doryphorum*, 1%; *Amphisolenia bidentata*, P; *Ornithocercus quadratus*, P; *O. splendidus*, P; *O. steini*, P; *O. thurni*, 2%.

4541

Lat. 4° 55′ N., long. 112° 27′ W. February 18, 1905. Temperature, 80°.

Surface: — *Phalacroma cuneus*, P; *P. doryphorum*, 1%; *Amphisolenia bidentata*, P; *Ornithocercus quadratus*, 1%; *O. splendidus*, 1%; *O. steini*, 1%; *O. thurni*, P; *Citharistes apsteini*, P.

4542

Lat. 7° 8′ N., long. 110° 45′ W. February 19, 1905. Temperature, 80°.

Surface: — *Phalacroma cuneus*, 3%; *P. doryphorum*, P; *P. favus*, 1%; *Dinophysis hastata*, 1%; *Amphisolenia bidentata*, P; *Ornithocercus magnificus*, 3%; *O. quadratus*, 1%; *O. steini*, 1%; *O. thurni*, P.

4543

Lat. 8° 52′ N., long. 108° 54′ W. February 20, 1905. Temperature, 79.5°.

Surface: — *Phalacroma doryphorum*, 1%; *Amphisolenia bidentata*, 1%; *Ornithocercus magnificus*, 2%; *O. quadratus*, 8%; *O. steini*, 13%.

4544

Lat. 10° 38′ N., long. 106° 47′ W. February 21, 1905. Temperature, 80°.

Surface: — *Dinophysis caudata*, 2%.

Salpa stomach: — *Ornithocercus magnificus*, two specimens. Only ten specimens of dinoflagellates were recorded.

4545

Lat. 12° 42′ N., long. 104° 45′ W. February 22, 1905. Temperature, 79°.

Surface: — *Phalacroma cuneus*, 3%; *P. doryphorum*, 1%; *P. favus*, P; *Dinophysis caudata*, P; *D. exigua*, P; *Amphisolenia thrinax*, P; *Ornithocercus magnificus*, 5%; *O. quadratus*, 3%; *O. steini*, 10%.

4546

Lat. 14° 50′ N., long. 101° 31′ W. February 23, 1905. Temperature, 81°.

Surface: — *Phalacroma doryphorum*, 7%; *Dinophysis caudata*, P; *Ornithocercus magnificus*, 21%; *O. quadratus*, 6%; *O. steini*, 3%.

Acapulco Harbor, Mexico. February 26, 1905. Temperature, 83°.

Surface: — *Phalacroma cuneus*, 1%; *P. doryphorum*, 1%; *P. porodictyum*, P; *Dinophysis hastata*, P; *Amphisolenia bidentata*, P; *Ornithocercus magnificus*, P; *O. quadratus*, P; *O. thurni*, P.

Panama Harbor. October 25, 1904

Surface: — *Dinophysis caudata*, thirty specimens.

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INDEX

I. Names of Systematic Units Higher than Species.

Synonyms are in italics; the main page references are in bold-face.

II. Specific and Subspecific Names.

Synonyms are in italics, the main page references are in bold-face.

EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

Fig. 1. *Heteroschisma inaequale*, sp. nov., right lateral view, somewhat tilted ventrally; type specimen. Station 4665 (300–0 fathoms). × 1090.

Fig. 2. The same, ventral view. Note that left sulcal list crosses over to right valve at level of posterior cingular list. × 1090.

Fig. 3. *Phalacroma porosum* Kofoid and Michener, oblique ventral view, somewhat tilted posteriorly; type specimen. Station 4721 (300–0 fathoms). × 525.

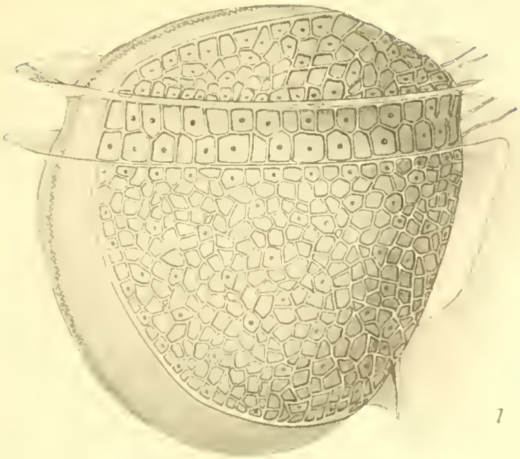
Fig. 4. *Phalacroma circumcinctum* Kofoid and Michener, ventral view; type specimen. Station 4671 (300–0 fathoms). The irregular, hyaline appendage, issuing from near the posterior main rib of left sulcal list is probably a temporary structure. × 665.

Fig. 5. The same, right lateral view. See explanation of Figure 4. × 665.

Fig. 6. *Phalacroma porosum* Kofoid and Michener, right lateral view; type specimen. Station 4721 (300–0 fathoms). × 1690.

Fig. 7. *Heteroschisma aequale*, sp. nov., ventral view; type specimen. Station 4671 (300–0 fathoms). Note that left sulcal list crosses over to right valve at level of posterior cingular list × 1090.

Fig. 8. The same, right lateral view, tilted ventrally. × 1090.



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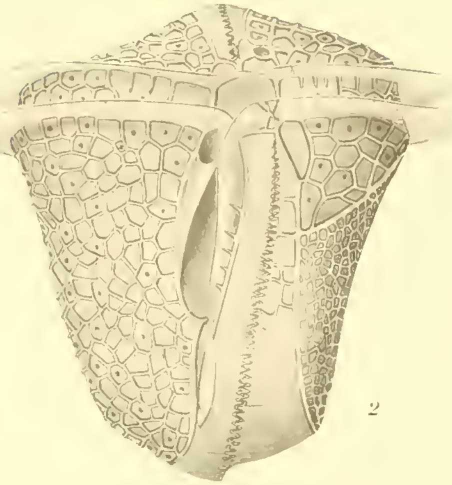

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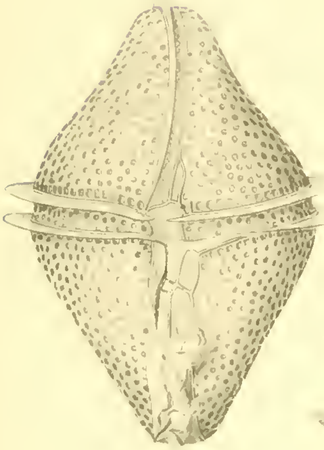

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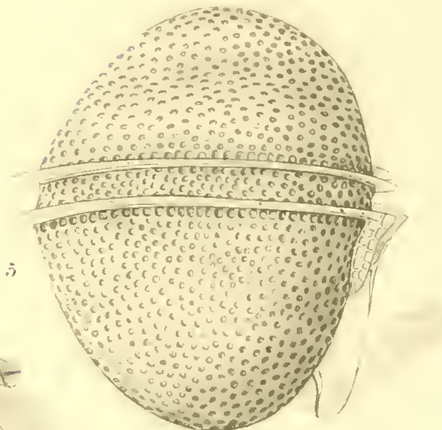

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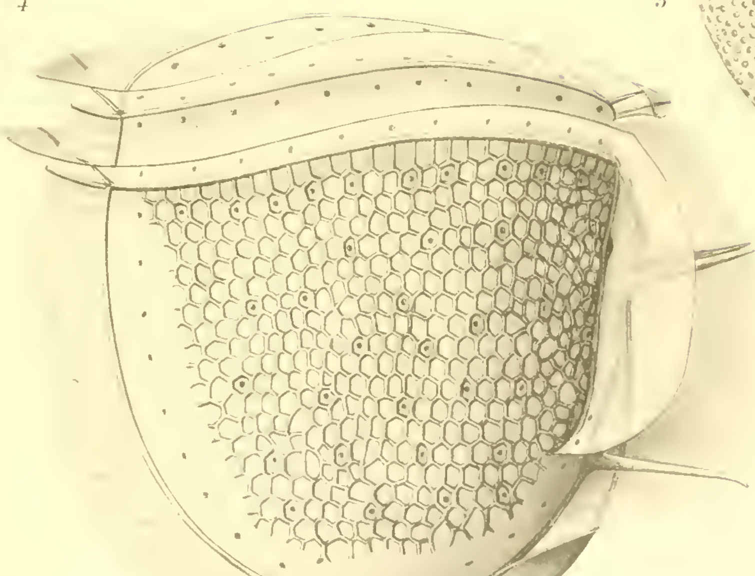

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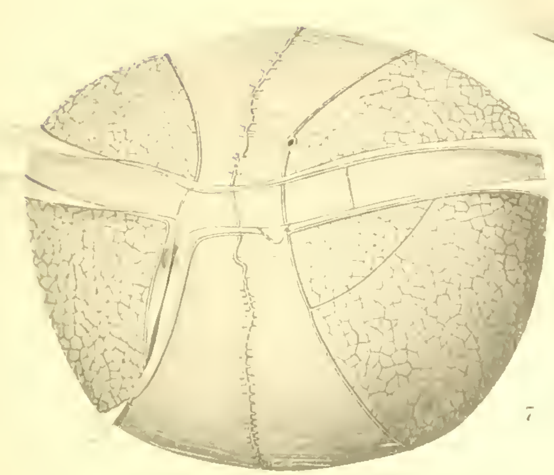

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PLATE 2.

PLATE 2.

Fig. 1. *Phalacroma fimbriatum* Kofoid and Michener, ventral view; type specimen. Station 4613 (300–0 fathoms). Note the heavy rib that indicates the presence of a postcingular plate in the left hypotheca. × 580.

Fig. 2. *Phalacroma giganteum* Kofoid and Michener, right lateral view of right detached valve; type specimen. Station 4734 (300–0 fathoms). × 525.

Fig. 3. *Phalacroma turbineum* Kofoid and Michener, right lateral view; type specimen. Station 4681 (300–0 fathoms). × 1090.

Fig. 4. *Phalacroma giganteum* Kofoid and Michener, structure of thecal wall near sagittal suture, which is serrated. Station 4699 (300–0 fathoms). × 1090.

Fig. 5. *Phalacroma striatum* Kofoid, ventral view, somewhat tilted posteriorly; type specimen. Station 4705 (300–0 fathoms). × 700.

Fig. 6. *Phalacroma turbineum* Kofoid and Michener, protoplasmic contents, apparently shrunken, showing the large, round nucleus with moniliform chromatin and three nucleoli. Station 4715 (300–0 fathoms). × 525.

Fig. 7. *Phalacroma favus* Kofoid and Michener, right lateral view; type specimen. Station 4737 (300–0 fathoms). × 1090.

Fig. 8. *Phalacroma striatum* Kofoid, right lateral view; type specimen. Station 4705 (300–0 fathoms). × 700.

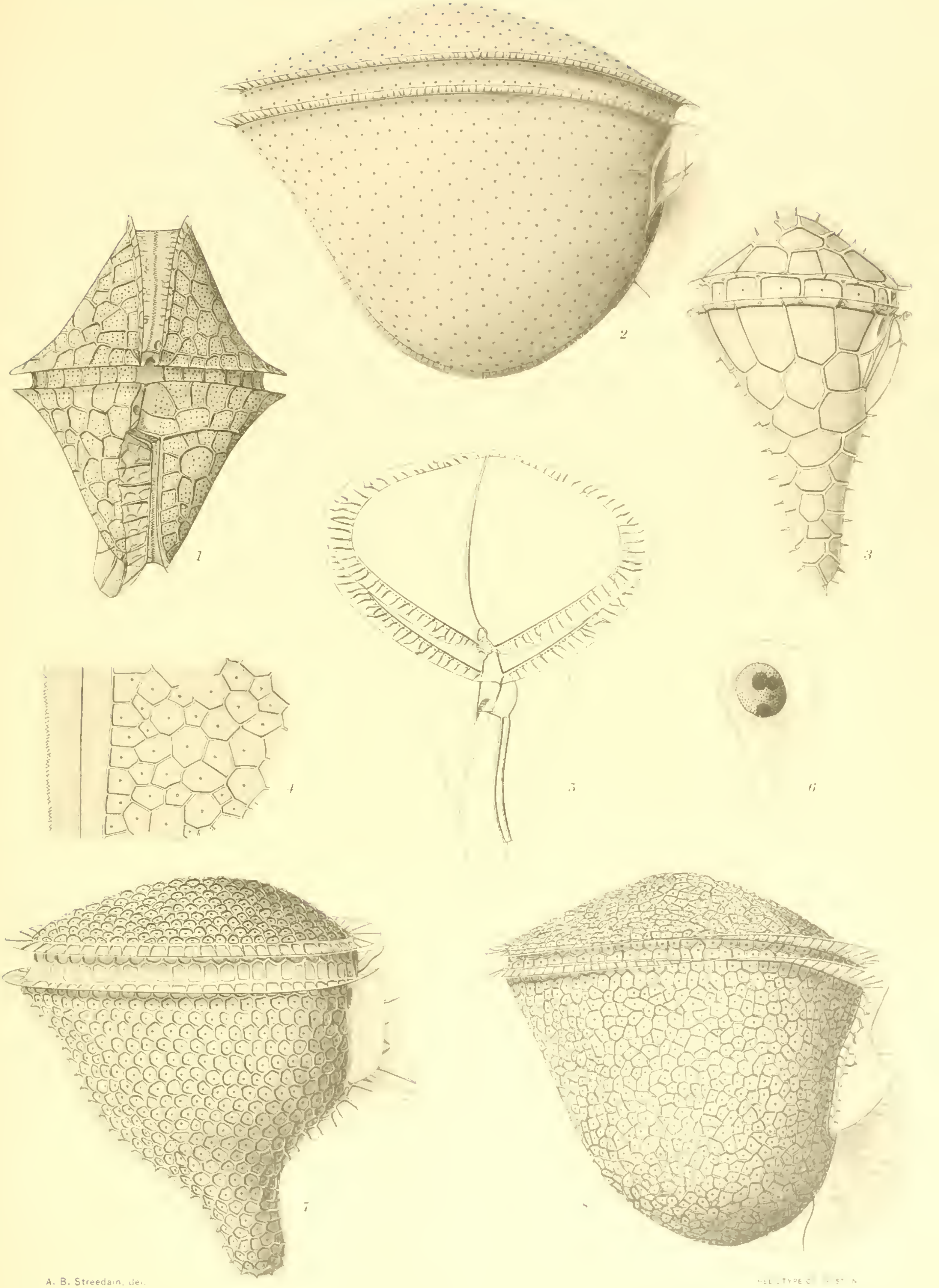

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PLATE 3.

PLATE 3.

Fig. 1. *Phalacroma pulchrum* Kofoid and Michener, ventral view; type specimen. Station 4699 (300–0 fathoms). × 1090.

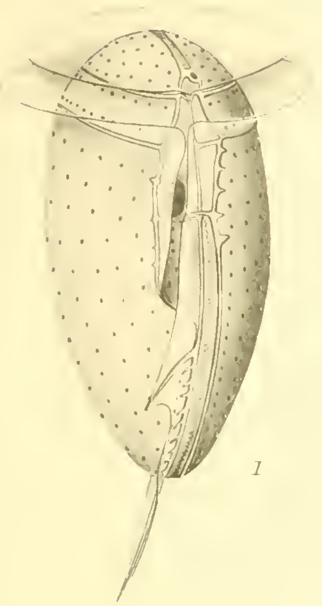
Fig. 2. *Phalacroma giganteum* Kofoid and Michener, seen from above. Station 4699 (300–0 fathoms). Note the two pores on ventral side of epitheca, near anterior cingular list (on upper side of figure). × 785.

Fig. 3. *Phalacroma limbatum* Kofoid and Michener, ventral view; type specimen. Station 4667 (300–0 fathoms). × 1090.

Fig. 4. *Phalacroma limbatum* Kofoid and Michener (?), right lateral view of specimen of uncertain allocation; parasagittal lists apparently not yet fully developed. Station 4687 (300–0 fathoms). × 1090.

Fig. 5. *Phalacroma limbatum* Kofoid and Michener, right lateral view; type specimen. Station 4667 (300–0 fathoms). × 925.

Fig. 6. *Phalacroma pulchrum* Kofoid and Michener, right lateral view; type specimen. Station 4699 (300–0 fathoms). × 1090.



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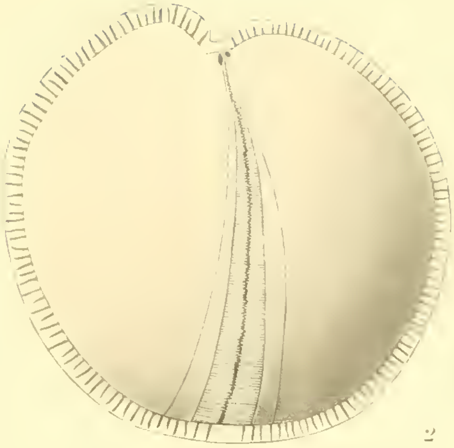

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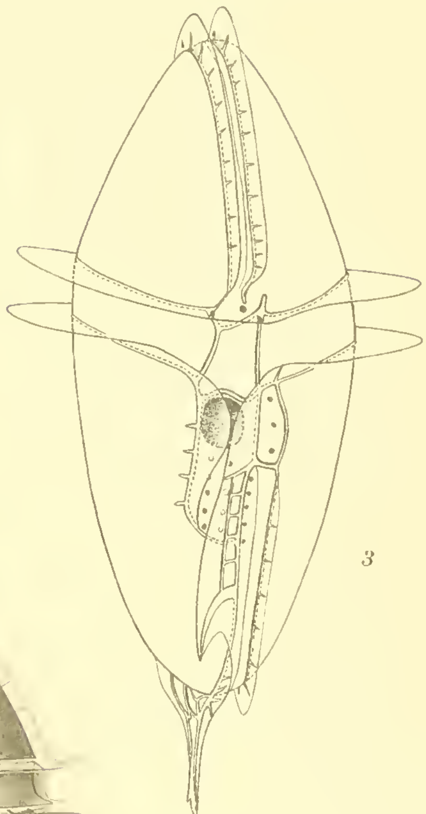

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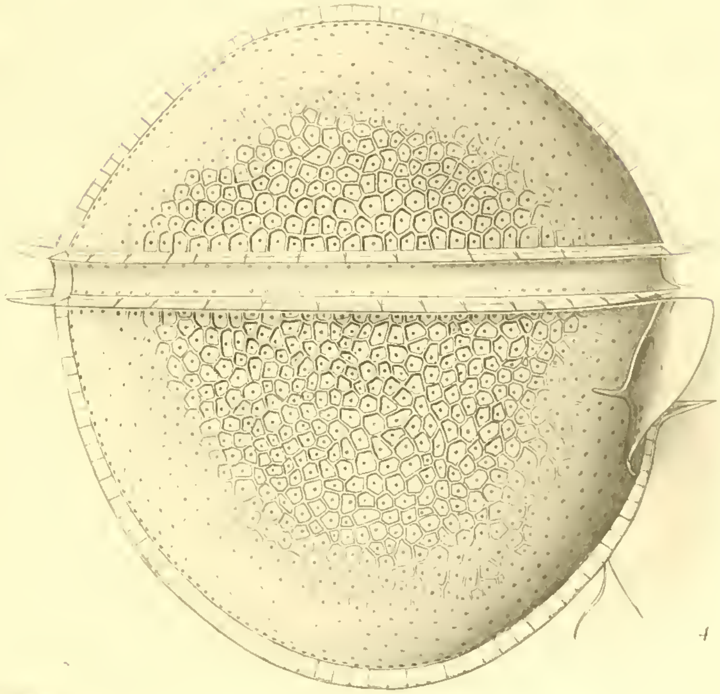

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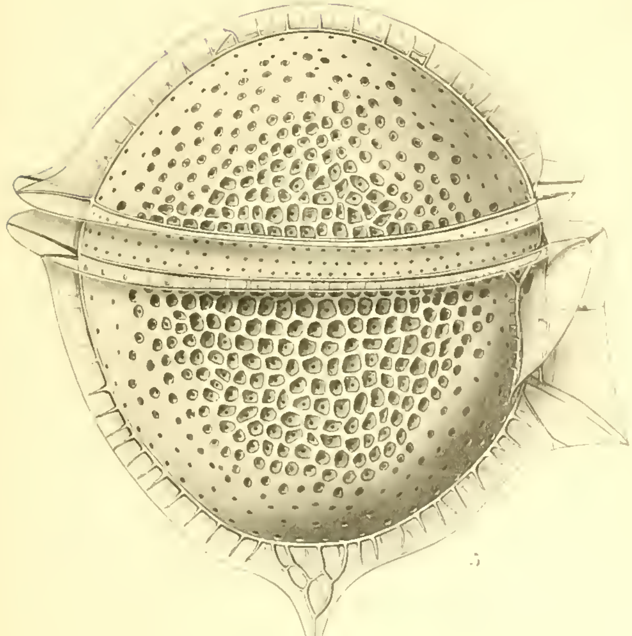

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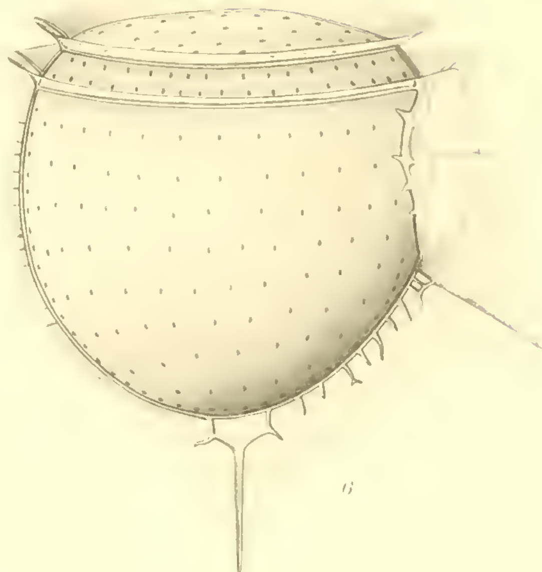

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PLATE 4.

PLATE **4**.

Fig. 1. *Phalacroma turbineum* Kofoid and Michener, ventral view; type specimen. Station 4681 (300–0 fathoms). × 1090.

Fig. 2. The same, dorsal view, somewhat tilted to the left. × 1090.

Fig. 3. *Phalacroma reticulatum* Kofoid, right lateral view, somewhat tilted ventrally; type specimen. Station 4740 (300–0 fathoms). × 525.

Fig. 4. *Phalacroma fimbriatum* Kofoid and Michener, right lateral view; type specimen. Station 4613 (300–0 fathoms). × 1090.

Fig. 5. *Phalacroma reticulatum* Kofoid, dorsal view; type specimen. Station 4740 (300–0 fathoms). × 525.

Fig. 6. *Phalacroma praetextum* Kofoid and Michener, right lateral view; type specimen. Station 4742 (300–0 fathoms). × 1090.

Fig. 7. The same, ventral view. Note the large cribriform plate, a unique feature in this genus. × 1090.

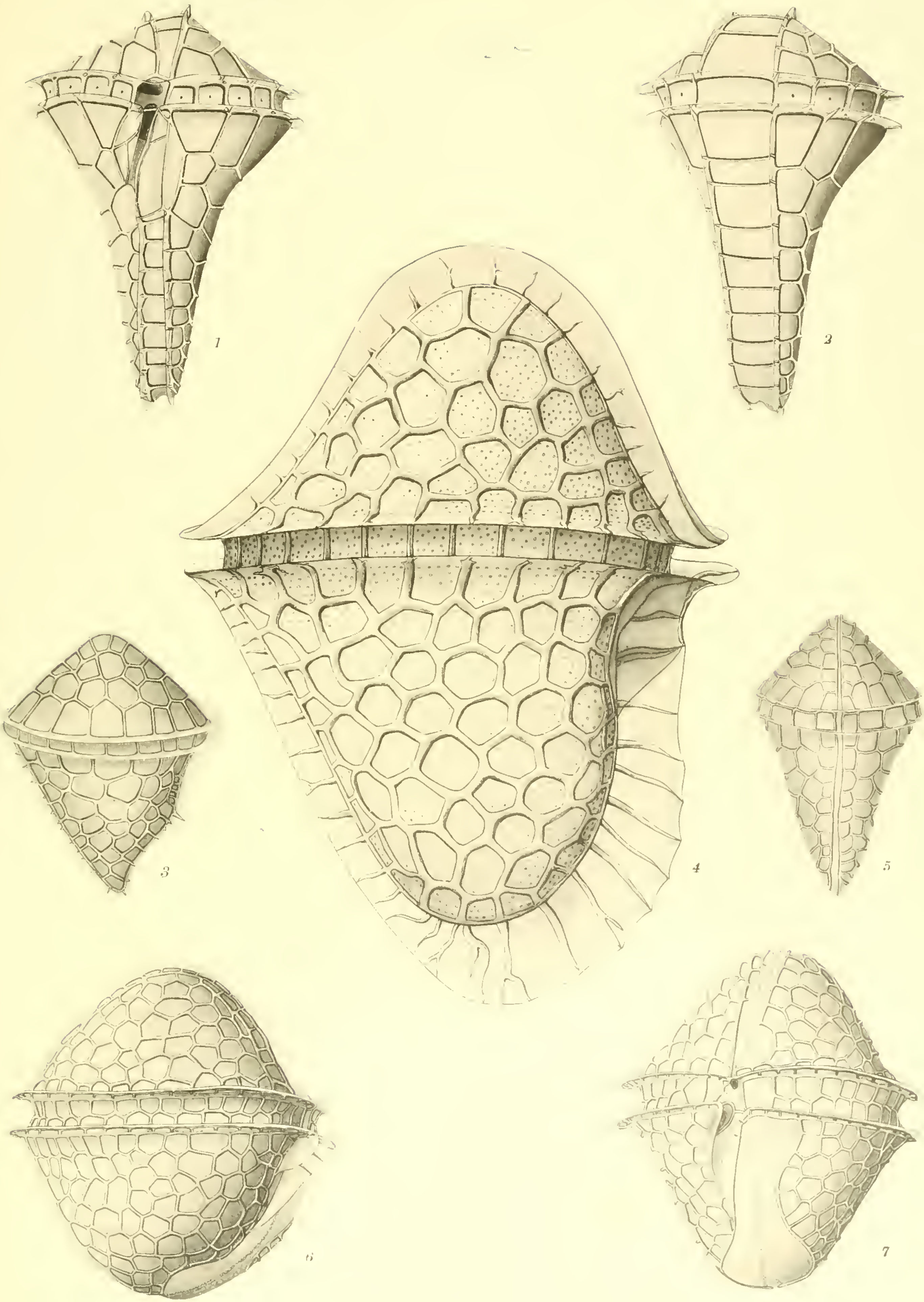

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PLATE 5.

PLATE 5.

Fig. 1. *Phalacroma expulsum* (Kofoid and Michener), right lateral view; type specimen. Station 4717 (300–0 fathoms). × 1090.

Fig. 2. *Dinophysis collaris* Kofoid and Michener, right lateral view; type specimen. Station 4671 (300–0 fathoms). × 665.

Fig. 3. *Dinophysis jörgenseni*, sp. nov., ventral view of type specimen, the two halves of which have broken apart, showing that the larger portion of the longitudinal furrow and the entire flagellar pore belong to the right valve and that the two members of the fission rib belong to different valves. The valves were separated by the pressure of the cover-glass. Station 4727 (surface). × 1090.

Fig. 4. *Dinofurcula ultima* (Kofoid), right lateral view; type specimen. Station 4711 (300–0 fathoms). × 1090.

Fig. 5. *Histiophysis rugosa* (Kofoid and Michener), right lateral view; type specimen. Station 4705 (300–0 fathoms). × 1090.

Fig. 6. *Dinofurcula ultima* (Kofoid), ventral view, showing that the two posterior processes do not lie in the same plane but form an angle of about 20°; type specimen. Station 4711 (300–0 fathoms). × 1090.

Fig. 7. *Dinophysis jörgenseni*, sp. nov., right lateral view; type specimen. Station 4727 (surface). × 1090.

Fig. 8. *Dinophysis collaris* Kofoid and Michener, ventral view; type specimen. Station 4671 (300–0 fathoms). × 665.

Fig. 9. *Dinophysis swezyi*, sp. nov., right lateral view; type specimen. La Jolla, California. × 975.

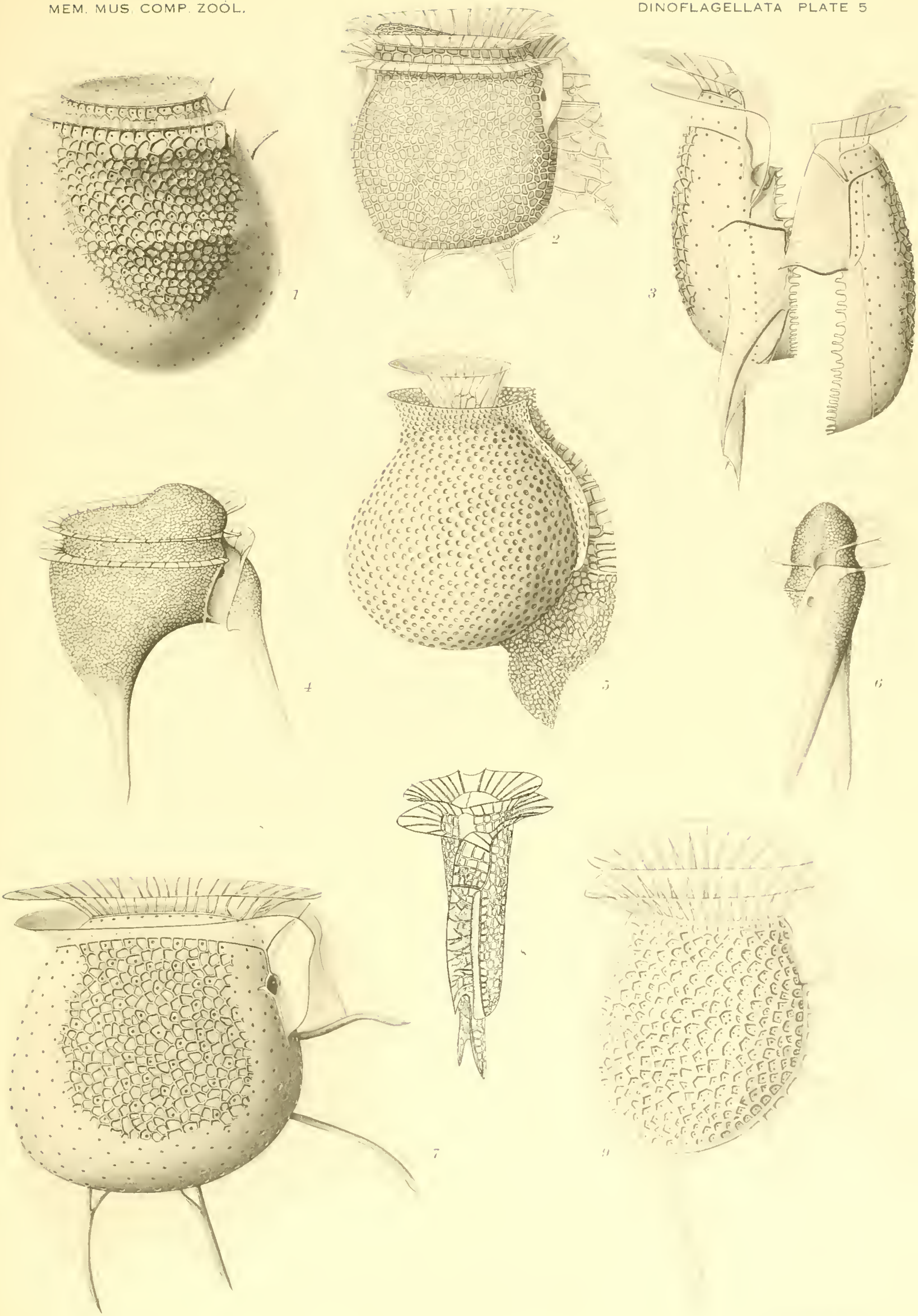

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PLATE 6.

PLATE 6.

Fig. 1. *Amphisolenia brevicauda* Kofoid, right lateral view of anterior portion of body; type specimen. Station 4740 (300–0 fathoms). × 1100.

Fig. 2. *Amphisolenia inflata* Murray and Whitting, right lateral view of anterior portion of body showing structural differentiation of thecal wall, reticulation of right sulcal list, and peculiar differentiation of left sulcal list near flagellar pore. Station 4681 (300–0 fathoms). × 1100.

Fig. 3. *Amphisolenia extensa* Kofoid, right lateral view of anterior portion of body showing irregular ribs anteriorly on sulcal lists; type specimen. Station 4699 (300–0 fathoms). × 1100.

Fig. 4. *Amphisolenia brevicauda* Kofoid, dorsal view of posterior portion of body showing short antapical, not inflated posteriorly, and the pointed antapex lacking spinules; type specimen. Station 4740 (300–0 fathoms). × 1100.

Fig. 5. *Amphisolenia extensa* Kofoid, dorsal view of the inflated, club-shaped, and subtruncate posterior portion of antapical lacking spinules; type specimen. Station 4699 (300–0 fathoms). × 2200.

Fig. 6. *Amphisolenia laticincta* Kofoid, lateral view of posterior portion of antapical showing the rounded but not inflated antapex with a minute spinule (in typical specimens probably one minute spinule on each valve); type specimen. Station 4740 (300–0 fathoms). × 2200.

Fig. 7. *Amphisolenia inflata* Murray and Whitting, right lateral view showing protoplasmic contents with rather large ovoidal nucleus, numerous small chromatophores, and metaplasmic inclusions. Station 4681 (300–0 fathoms). × 530.

Fig. 8. *Amphisolenia laticincta* Kofoid, right lateral view of anterior portion of body showing "accessory sulcal list" on left sulcal list; type specimen. Station 4740 (300–0 fathoms). × 2200.

Fig. 9. The same, lateral view of anterior process and midbody showing vacuolated protoplasm with large, oblong nucleus. × 1100.

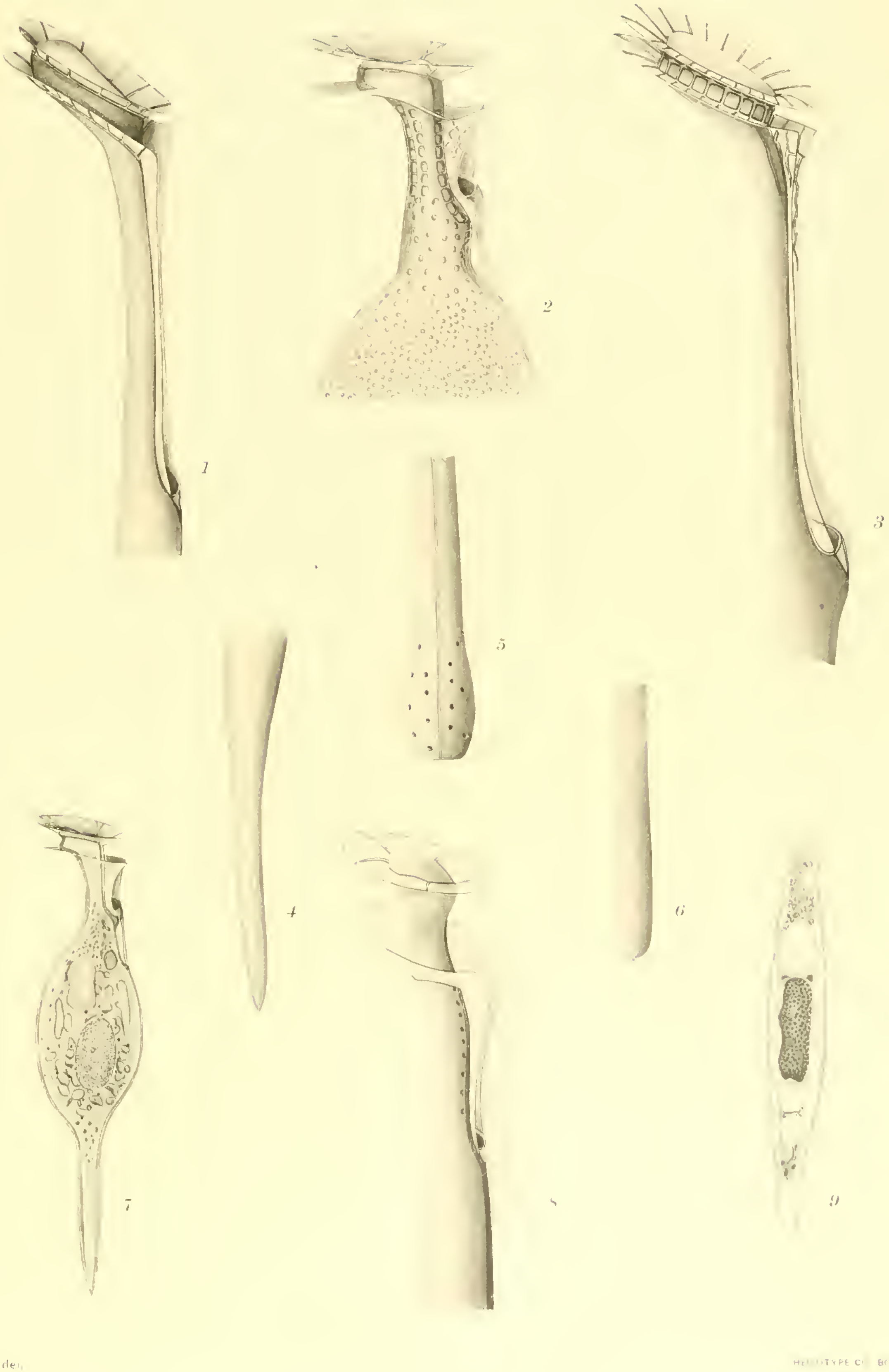

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PLATE 7.

PLATE 7.

Amphisolenia schauinslandi Lemmermann. Station 4736 (300–0 fathoms).

Fig. 1. Right lateral view of anterior portion of body. × 1100.

Fig. 2. Right lateral view of middle portion of body showing protoplasmic contents somewhat shrunken away from thecal wall. Nucleus of moderate size, elongate, somewhat irregular, and with ventral depression, in which a centrosome (?) is located. Chromatophores are rod-shaped, moniliform, and longitudinal. In anterior portion of midbody there are irregular and filamentous rhabdosomes (?) and spirally arranged, segmented structures of unknown nature. In posterior portion of midbody segmented and irregularly arranged filaments and crystalline aggregations are seen. × 1100.

Fig. 3. Right lateral view of anterior portion of body showing thickness of thecal wall and flagellum. × 1100.

Fig. 4. Right lateral view. × 235.

Figs. 5, 6, 7. Posterior portion of antapical. Antapex is truncate and somewhat inflated, with four spinules arranged symmetrically, two on each valve, two dorsal and two ventral. Figure 5, in right lateral view, showing porulation; figure 6, in right lateral view, showing thickness of thecal wall; figure 7, in dorsoventral view. × 1100.

Fig. 8. Right lateral view of body with protoplasmic contents. × 235.

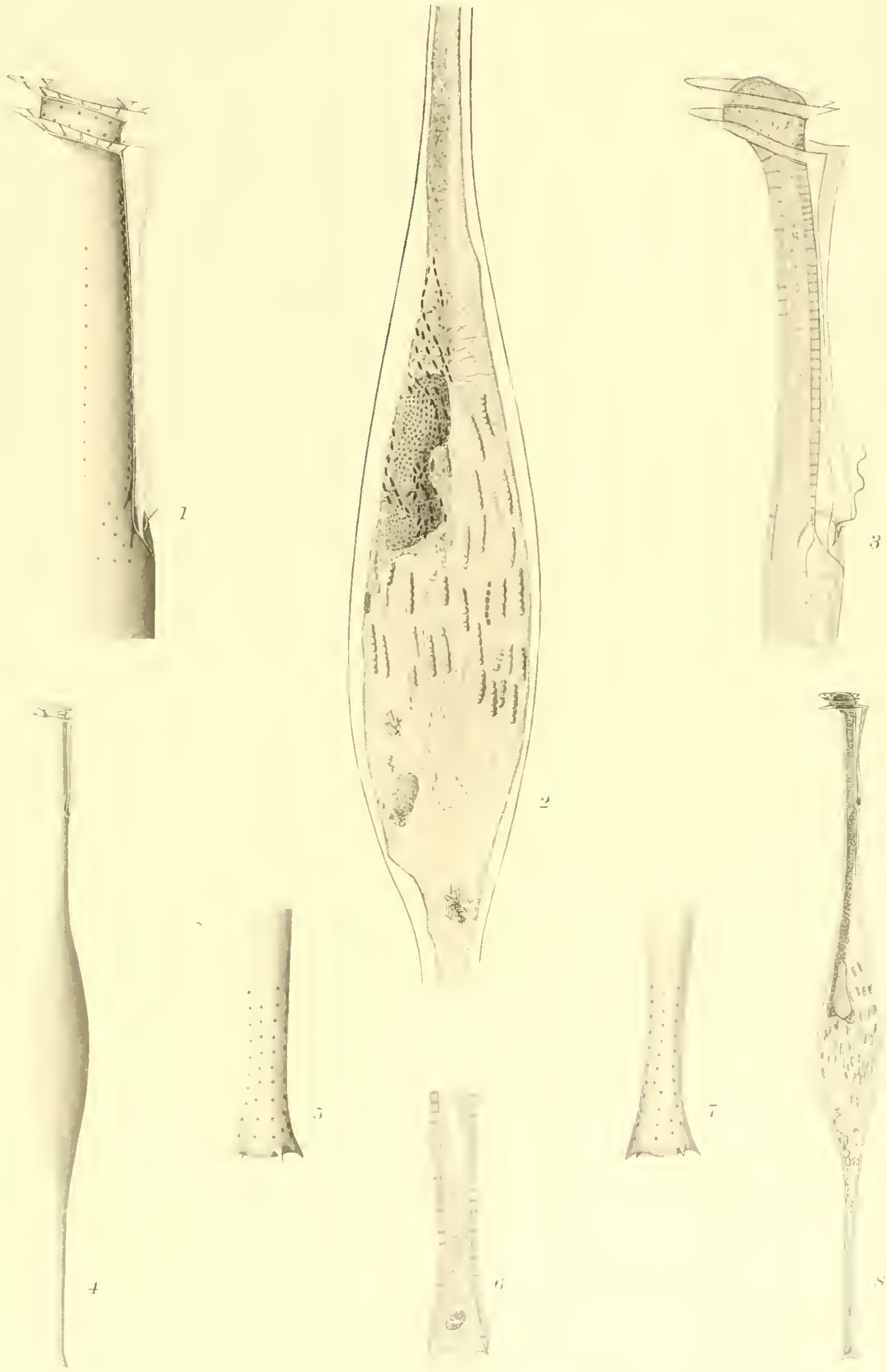

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PLATE 8.

PLATE 8.

Fig. 1. *Amphisolenia globifera* Stein, ventral view of posterior portion of antapical, showing terminal knob, neck-like constriction with protoplasmic sheath in front of knob, inflation in front of constriction, porulation, and two antapical spinules, one on each valve. Station 4613 (300–0 fathoms). × 2200.

Fig. 2. The same, right lateral view of anterior portion of body. × 1100.

Fig. 3. *Amphisolenia rectangulata* Kofoid, right lateral view of anterior portion of body; type specimen. Station 4740 (300–0 fathoms). × 1100.

Fig. 4. *Amphisolenia globifera* Stein, right lateral view of posterior portion of antapical of specimen represented by figure 1. × 2200.

Fig. 5. *Amphisolenia rectangulata* Kofoid, right lateral view of posterior portion of antapical showing slight inflation and porulation. Antapex is truncate with four spinules arranged symmetrically, two on each valve, two dorsal and two ventral; only the two spinules of right valve are visible; type specimen. Station 4740 (300–0 fathoms). × 2200.

Fig. 6. The same specimen, dorsal view of posterior portion of antapical showing bilateral compression. × 2200.

Fig. 7. The same specimen, right lateral view showing protoplasmic contents with large, elongate nucleus and pusule opening at flagellar pore. × 235.

Fig. 8. *Amphisolenia globifera* Stein, right lateral view of middle portion of protoplasmic body showing ovoidal nucleus of moderate size, pusule opening at flagellar pore, and several rather small, ovoidal chromatophores. Station 4613 (300–0 fathoms). × 530.

Fig. 9. *Amphisolenia rectangulata* Kofoid, sublateral view of posterior portion of antapical; type specimen. Station 4740 (300–0 fathoms). × 2200.

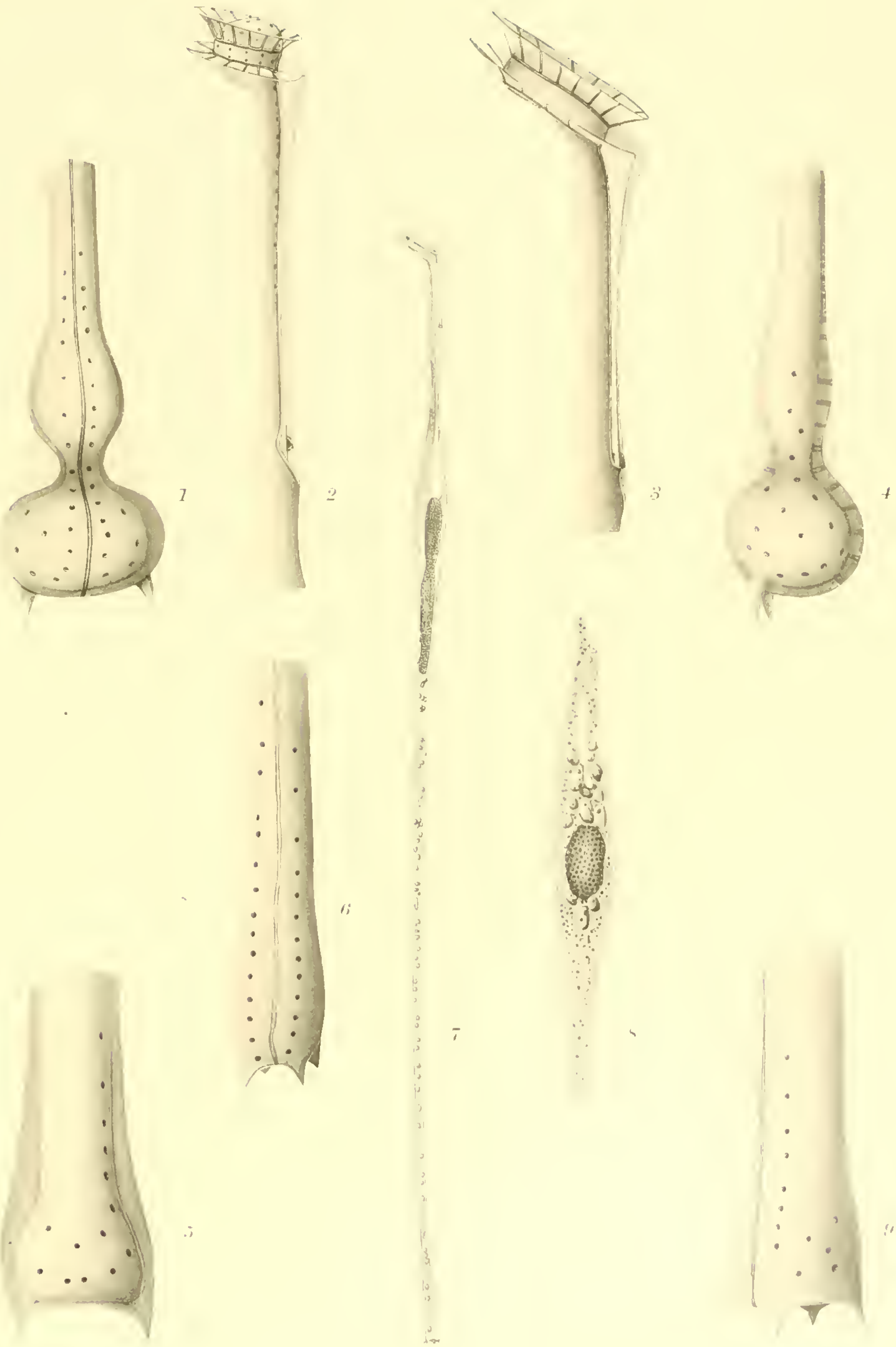
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PLATE 9.

PLATE 9.

Fig. 1. *Amphisolenia bispinosa* Kofoid, right lateral view of anterior portion of body showing longitudinal ridge on neck; type specimen. Station 4605 (300–0 fathoms). × 1100.

Fig. 2. *Amphisolenia quadrispina* Kofoid, ventral view of posterior portion of neck and anterior portion of anterior process showing flagellar pore, anterior portion of efferent duct of pusule, and cytopharyngeal depression; type specimen. Station 4711 (300–0 fathoms). × 785.

Fig. 3. The same specimen, ventral view of anterior portion of body in front of portion shown in figure 2. × 785.

Fig. 4. The same specimen, lateral view of posterior portion of antapical showing terminal knob, neck-like constriction in front of knob, inflation in front of constriction, porulation, and four antapical spinules placed symmetrically on the two valves. × 785.

Fig. 5. *Amphisolenia curvata* Kofoid, right lateral view of anterior portion of body showing longitudinal ridge on neck and "accessory sulcal list" on left sulcal list; type specimen. Station 4605 (300–0 fathoms). × 1100.

Fig. 6. *Amphisolenia bispinosa* Kofoid, lateral view of middle portion of body showing protoplasmic contents with rather large, elongate, irregular nucleus and, anteriorly and posteriorly, some small rounded or ovoidal chromatophores; type specimen. Station 4605 (300–0 fathoms). × 530.

Fig. 7. The same specimen, dorsal view of posterior portion of antapical showing the truncate antapex with two long lateral spinules, one on right and one on left valve, and porulation. × 1100.

Fig. 8. The same specimen, right lateral view of posterior portion of antapical showing slight inflation and rounded antapex. × 1100.

Fig. 9. *Amphisolenia curvata* Kofoid, ventral view of posterior portion of antapical showing short, strong antapical spinule on left valve, irregular ridges, and porulation; in typical specimens probably one spinule on each valve; type specimen. Station 4605 (300–0 fathoms). × 1100.

Fig. 10. The same specimen, right lateral view of posterior portion of antapical showing slight inflation and rounded antapex. × 1100.

Fig. 11. *Amphisolenia lemmermanni* Kofoid, right lateral view of posterior portion of antapical of atypic specimen showing abrupt expansion of posterior end, truncate antapex with only one spinule, and protoplasmic sheath in front of expanded posterior end. Station 4734 (300–0 fathoms). × 1060.

Fig. 12. The same, right lateral view of posterior portion of antapical of type specimen showing abrupt expansion of porulose posterior end and in front of this expansion slight inflation and protoplasmic sheath; antapex is truncate with two rather strong sagittal spinules, both belonging to left valve. Station 4730 (300–0 fathoms). × 1400.

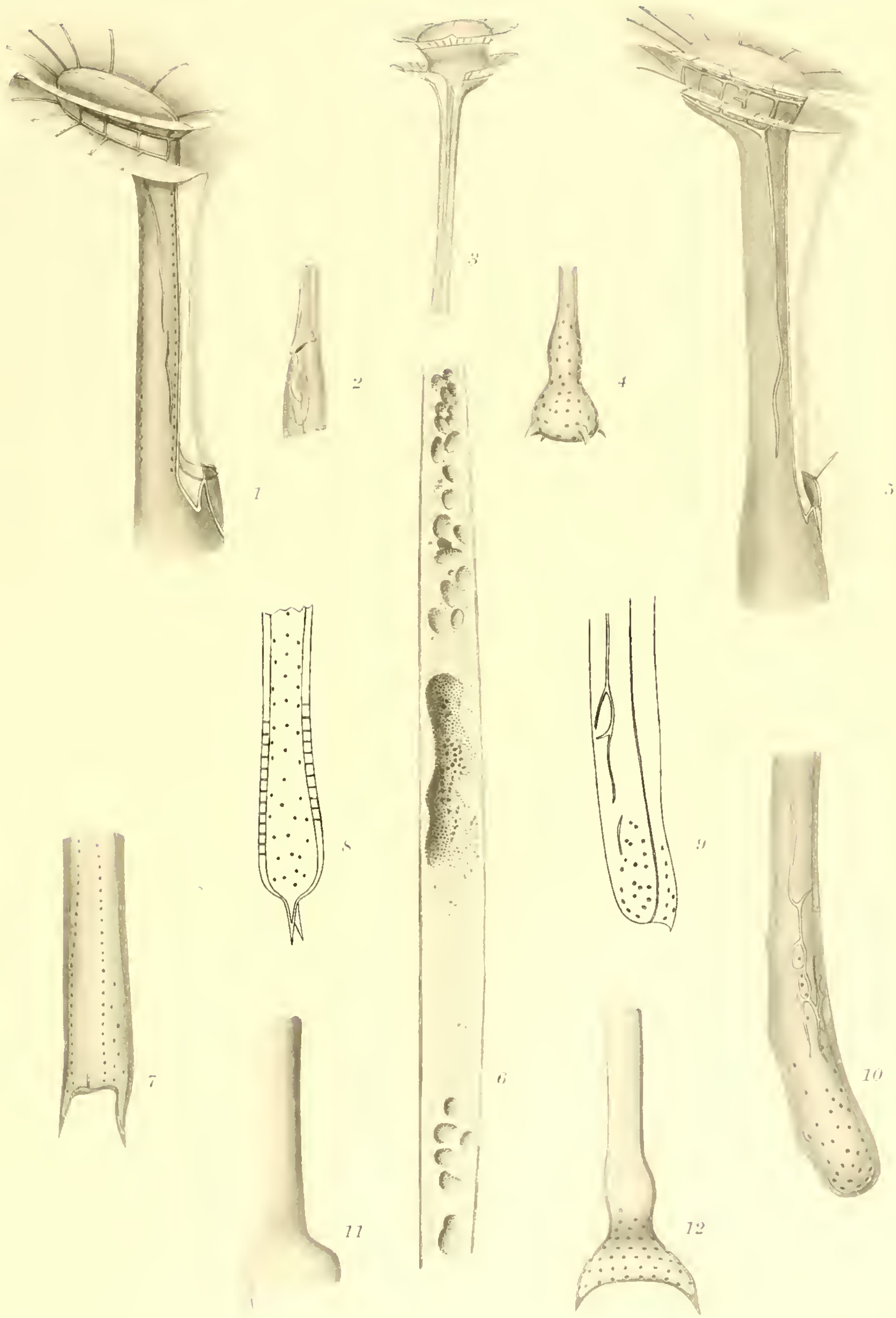

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PLATE 10.

PLATE 10.

Fig. 1. *Amphisolenia astragalus* Kofoid, right lateral view of anterior portion of body showing longitudinal ridge on neck and longitudinal rib on right sulcal list; type specimen. Station 4713 (300–0 fathoms). × 1100.

Fig. 2. *Amphisolenia schröderi* Kofoid, right lateral view of posterior portion of antapical; type specimen. Station 4737 (300–0 fathoms). × 1100.

Fig. 3. The same specimen, right lateral view of anterior portion of body. × 1100.

Fig. 4. The same specimen, ventral view of posterior portion of antapical showing slight inflation, porulation, and, on antapex, two small sagittal spinules both probably belonging to left valve. × 1100.

Fig. 5. *Amphisolenia complanata*, sp. nov., right lateral view of anterior portion of body. Station 4739 (300–0 fathoms). × 1100.

Fig. 6. *Amphisolenia astragalus* Kofoid, right lateral view of posterior foot-like portion of antapical showing porulation, rounded heel without any "heel-spinule," the rather strong, pointed spinule on antapex, and the rounded, wart-like protuberance somewhat in front of antapex; type specimen. Station 4713 (300–0 fathoms). × 2200.

Fig. 7. *Amphisolenia complanata*, sp. nov., dorsal view of posterior portion of antapical showing slight inflation, porulation, and, on antapex, two rather strong sagittal spinules both probably belonging to left valve. Station 4739 (300–0 fathoms). × 1100.

Fig. 8. *Amphisolenia astragalus* Kofoid, right lateral view of midbody showing protoplasmic contents with rather large, elongate nucleus, some rather small, rounded or ovoidal chromatophores, and metaplasmic inclusions; type specimen. Station 4713 (300–0 fathoms). × 530.

Fig. 9. *Amphisolenia complanata*, sp. nov., right lateral view of posterior portion of antapical of specimen represented by figure 7 showing very slight inflation. Station 4737 (300–0 fathoms). × 1100.

Fig. 10. *Amphisolenia astragalus* Kofoid, ventral view of posterior portion of antapical; type specimen. Station 4713 (300–0 fathoms). × 2200.

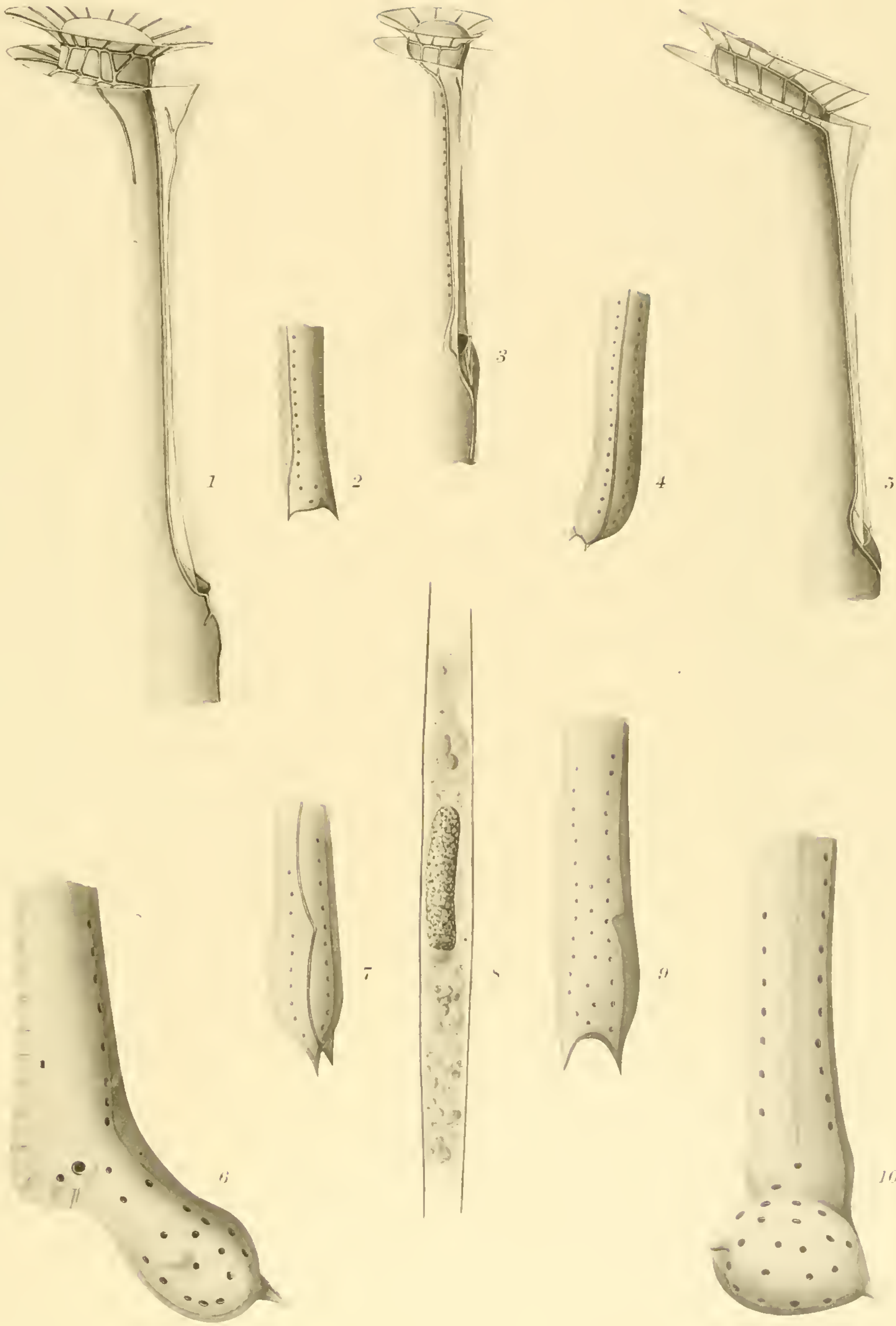

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PLATE 11

PLATE 11.

Fig. 1. *Amphisolenia truncata* Kofoid and Michener, right lateral view of anterior portion of body; right sulcal list omitted; type specimen. Station 4733 (surface). × 1100.

Fig. 2. *Amphisolenia palaeotheroides* Kofoid, dorsal view of porulose posterior portion of antapical. Distal end foot-like and bent to the right. Foot-like portion about twice as long as wide. Left valve with three strong spinules: one, the "heel-spinule," placed at point of bending, the two others distal. Right valve with one spinule only which is placed between the distal spinules of left valve, and about as strong as or somewhat stronger than distal spinules of left valve; type specimen. Station 4732 (300–0 fathoms). × 1100.

Fig. 3. The same specimen, right sublateral view of posterior portion of antapical showing inflation. × 1100.

Fig. 4. The same specimen, right lateral view of anterior portion of body. Left sulcal list with fission rib. With numerous pores. × 1100.

Fig. 5. *Amphisolenia asymmetrica* Kofoid, right lateral view of posterior portion of antapical of type specimen showing inflation. Station 4732 (300–0 fathoms). × 1100.

Fig. 6. *Amphisolenia asymmetrica* Kofoid, ventral view of anterior portion of body of specimen described by Kofoid (1907a) as *A. dolichocephalica*. Cingular lists not yet developed following binary fission. Station 4728 (300–0 fathoms). × 530.

Fig. 7. *Amphisolenia asymmetrica* Kofoid, posterior portion of antapical of type specimen in dorsal view. It differs from *A. palaeotheroides* (fig. 2) mainly in having the foot-like portion about seven to eight times longer than wide. Station 4732 (300–0 fathoms). × 1100.

Fig. 8. *Amphisolenia clavipes* Kofoid, right lateral view of anterior portion of body, with distal portion of efferent canal of pusule; type specimen. Station 4736 (300–0 fathoms). × 1100.

Fig. 9. The same specimen, left lateral view of posterior portion of antapical. Distal end somewhat inflated and gently curved toward the ventral side. Antapex is truncate, with two rather small sagittal spinules, one dorsal and one ventral, both probably belonging to left valve. × 1100.

Fig. 10. The same specimen, ventral view of posterior portion of antapical. Distal end strongly bent to the right; with rounded antapex. × 1100.

Fig. 11. The same specimen, lateral view of the middle portion of body showing protoplasmic contents. Behind the rather large, elongate nucleus some rod-shaped chromatophores are seen. × 1100.

Fig. 12. *Amphisolenia truncata* Kofoid and Michener, lateral view of posterior portion of body; antapex truncate, not inflated, and without spinules; type specimen. Station 4733 (surface). × 1100.

Fig. 13. *Amphisolenia asymmetrica* Kofoid, right lateral view of anterior portion of type specimen showing the extremely elongated head. Station 4732 (300–0 fathoms). × 530.

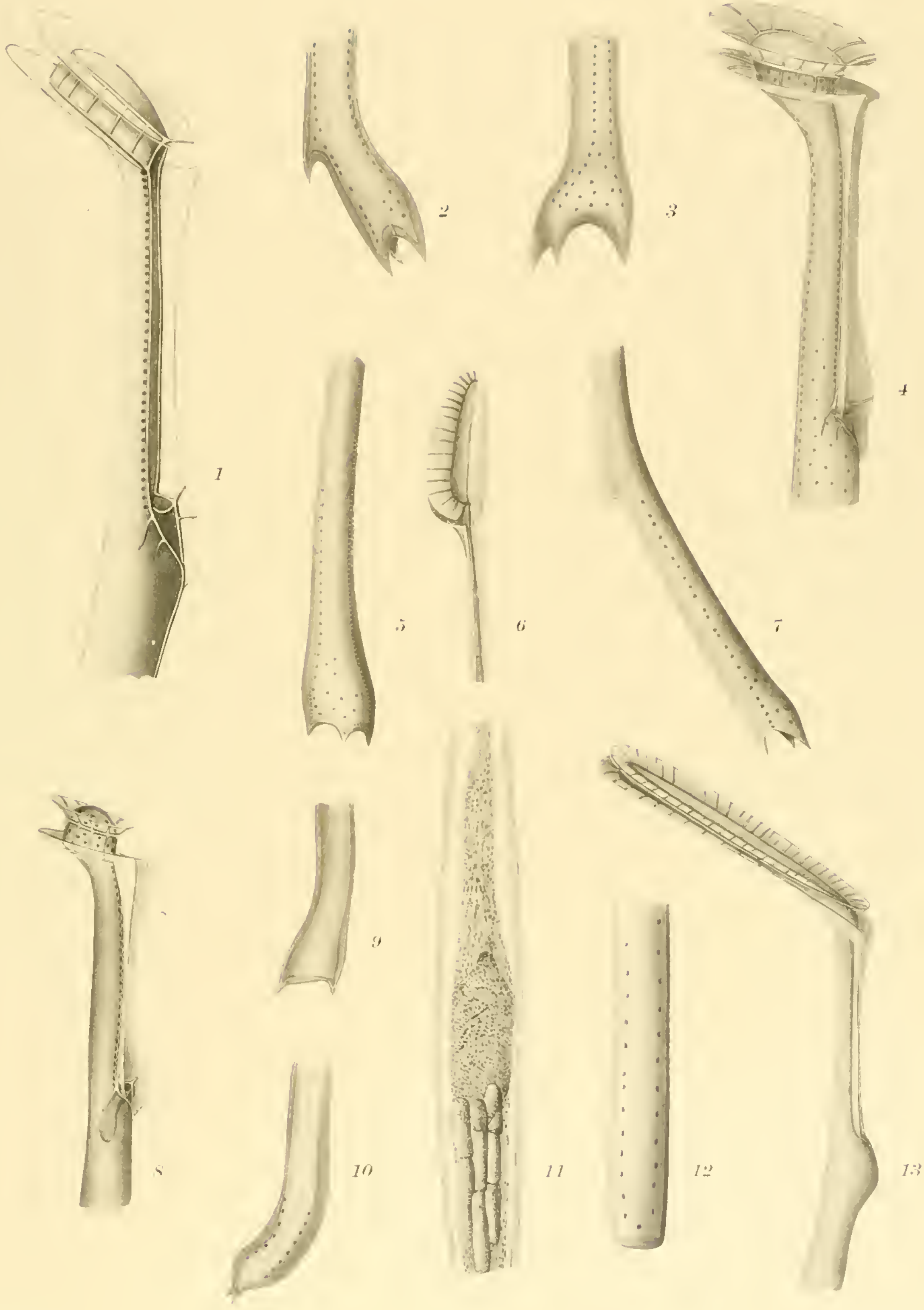

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PLATE 12.

PLATE 12.

Fig. 1. *Amphisolenia bifurcata* Murray and Whitting, subventral view of posterior portion of body showing bilateral compression and porulation. Distal end of both antapical stem and antapical branch has the same structure as distal end of antapical in *A. palmata;* see explanation of figure 7. Distal spinules of left valve unintentionally omitted. Station 4699 (300–0 fathoms). × 530.

Fig. 2. *Amphisolenia thrinax* Schütt, lateral view of midbody and anterior portion of antapical showing protoplasmic contents with large dumbbell-shaped nucleus, fairly numerous large, ovoidal or spheroidal chromatophores, and numerous groups of three to five very small, spheroidal bodies of unknown nature. In anterior portion of midbody a pusule is seen. Shape of nucleus probably indicates approaching division. Station 4732 (300–0 fathoms). × 530.

Fig. 3. *Amphisolenia bifurcata* Murray and Whitting, lateral view of posterior portion of body. Station 4699 (300–0 fathoms). × 530.

Fig. 4. *Amphisolenia palmata* Stein, right lateral view of posterior portion of antapical showing inflation, porulation, and three strong distal spinules. Station 4737 (300–0 fathoms). × 2200.

Fig. 5. *Amphisolenia bifurcata* Murray and Whitting, left lateral view of middle portion of body showing protoplasmic contents with ovoidal nucelus, many spheroidal metaplasmic inclusions of various sizes, and anterior portion of efferent canal of pusule. Station 4699 (300–0 fathoms). × 530.

Fig. 6. *Amphisolenia thrinax* Schütt, right lateral view of atypic specimen with antapical stem in front of first antapical branch very short, and with antapical stem behind second branch very inflated and of about the same shape and size as midbody and anterior process. Station 4594 (300–0 fathoms). × 120.

Fig. 7. *Amphisolenia palmata* Stein, ventral view of porulose posterior portion of antapical. Distal end is foot-like and bent to the right. Foot-like portion is two to three times longer than wide. Left valve has three strong spinules: one, the "heel-spinule," placed at point of bending, the two others distal. Right valve has one spinule only which is placed between and sometimes larger than distal spinules of left valve. Station 4737 (300–0 fathoms). × 220.

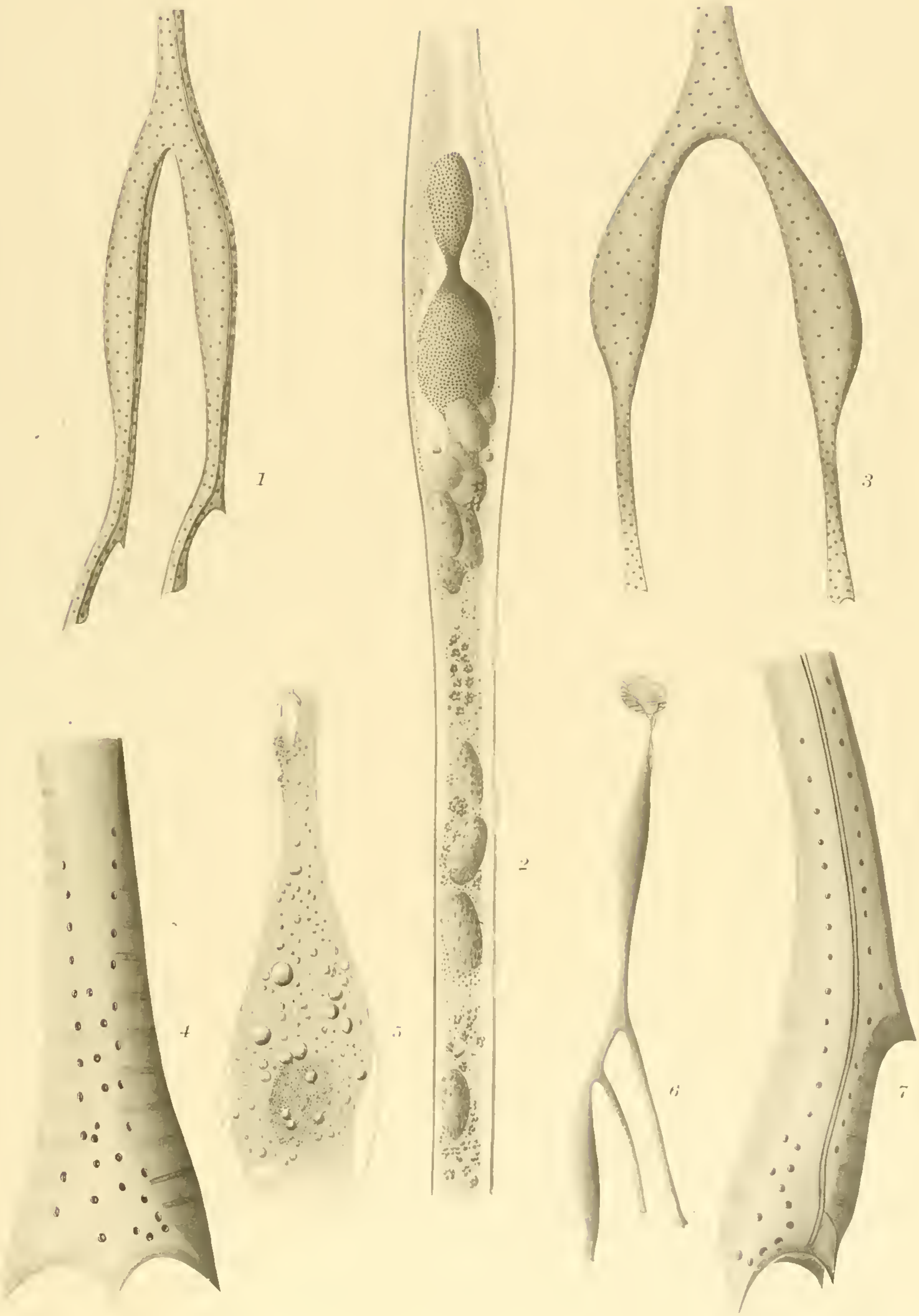

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PLATE 13.

PLATE 13.

Fig. 1. *Amphisolenia quadricauda* Kofoid, ventral view of anterior portion of right valve showing that the line of fission runs along middle of head, along left side of sulcus, crossing left sulcal list at fission rib, which is seen just in front of flagellar pore, to the left of flagellar pore and cytopharyngeal depression, and along the middle of anterior process; type specimen. Station 4695 (300–0 fathoms). × 1100.

Fig. 2. The same specimen, left valve of posterior portion of antapical stem seen from within showing elongate inner opening of cavity of "heel-spinule," cross-ridge near antapex, and porulation. × 1100.

Fig. 2a-d. Four optical cross-sections of thecal wall of portion represented by figure 2 at places corresponding to positions of the four figures, showing shape and thickness of thecal wall. × 1100.

Fig. 3–5. The same specimen, distal portions of left valve of third, second, and first antapical branches, respectively, seen from within showing that the first branch (fig. 5) has "heel-spinule" and is porulate, while the second and third branches lack "heel-spinule" and porulation. × 1100.

Fig. 6. The same specimen, right lateral view of anterior portion of right valve showing the part of left sulcal list, behind fission rib, that belongs to right valve. × 800.

Fig. 7. *Amphisolenia quinquecauda* Kofoid, somewhat twisted; anterior portion seen in ventral view, posterior in right lateral view; type specimen. Station 4739 (300–0 fathoms). × 120.

Fig. 8. *Amphisolenia quadricauda* Kofoid, left lateral view of anterior portion of left valve showing the part of left sulcal list, in front of fission rib, that belongs to left valve, ribs of the cingular and sulcal lists, and ridges and porulation of thecal wall; type specimen. Station 4695 (300–0 fathoms). × 825.

Fig. 9–13. *Amphisolenia quinquecauda* Kofoid, distal portion of antapical stem and of fourth, third, second, and first antapical branches. Antapical stem (fig. 9) and first antapical branch (fig. 13) are porulose and of *palmata* type (Pl. 12, fig. 7) with long and slender "foot." Second, third, and fourth antapical branches (figs. 12, 11, 10) lack "heel-spinule" and porulation; type specimen. Station 4739 (300–0 fathoms). × 1100.

Fig. 14. The same specimen, right lateral view of anterior portion of body showing structural differentiation of lists and porulation of thecal wall, anterior portion of efferent canal of pusule, protoplasm of anterior process, and cytopharyngeal depression. × 1100.

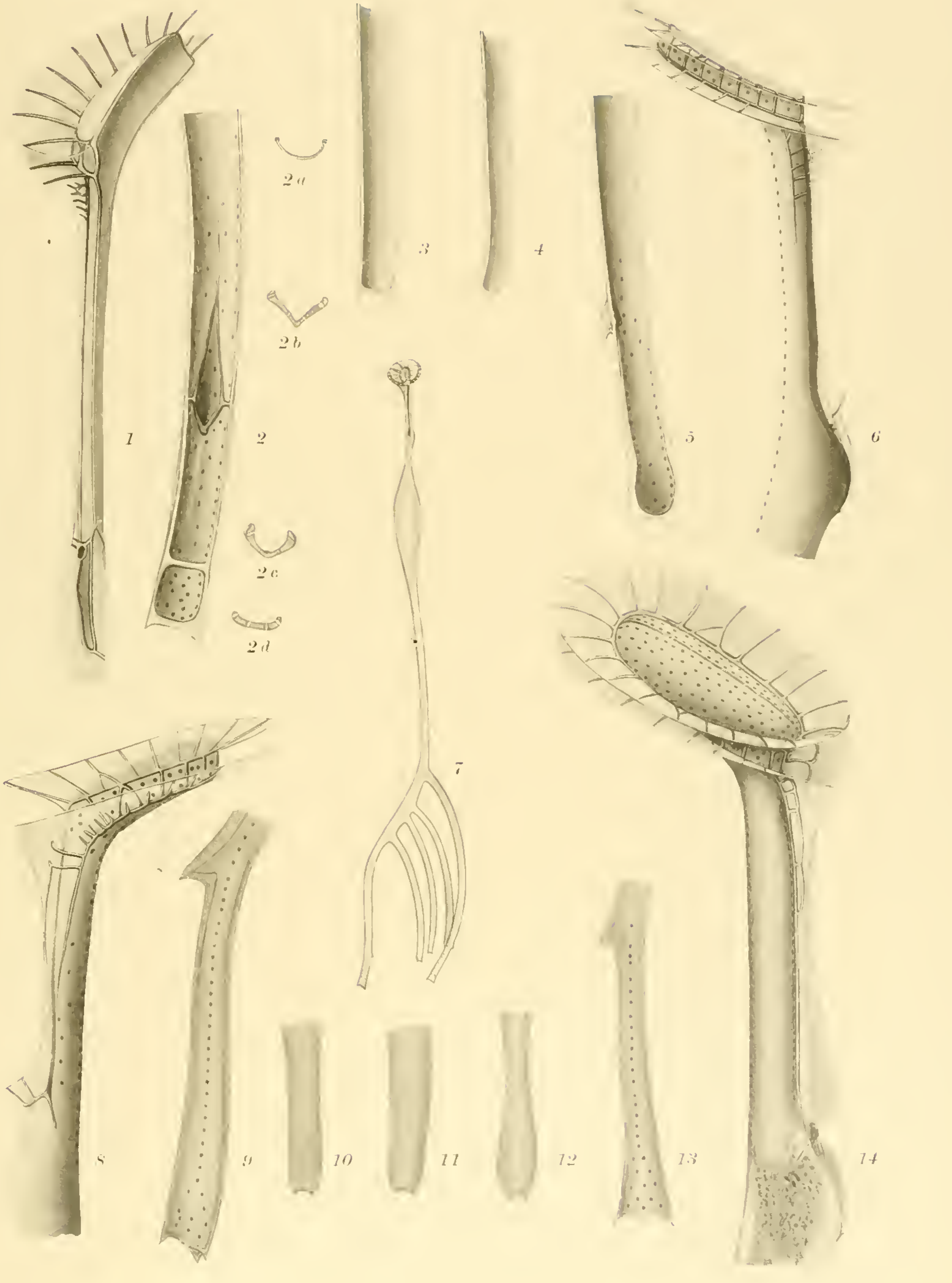

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PLATE 14.

PLATE 14.

Triposolenia truncata Kofoid.

Fig. 1. Right lateral view of anterior portion of body showing surface differentiation of thecal wall. Of the three ribs of left sulcal list, the anterior is the fission rib. Station 4742 (300–0 fathoms). × 1100.

Figs. 2, 3. Right lateral view of posterior portions of dorsal and ventral antapicals of specimen represented by figure 1. × 1100.

Triposolenia depressa Kofoid.

Fig. 4. Right lateral view. Station 4580 (300–0 fathoms). × 530.

Fig. 5. Right lateral view showing protoplasmic contents with large ovoidal nucleus and pusule opening at flagellar pore. Station 4580 (300–0 fathoms). × 530.

Fig. 6. Right lateral view of anterior portion of body. Station 4580 (300–0 fathoms). × 1100.

Figs. 7, 8. Right lateral view of posterior portions of dorsal and ventral antapicals showing thickness of thecal wall. Station 4580 (300–0 fathoms). × 1100.

Fig. 9. Dorsoventral view of body. Station 4580 (300–0 fathoms). × 550.

Triposolenia intermedia, sp. nov.

Fig. 10. Left lateral view of type specimen showing fine striation of thecal wall. Station 4580 (300–0 fathoms). × 530.

Triposolenia ambulatrix Kofoid.

Fig. 11. Right lateral view of type specimen. Station 4711 (300–0 fathoms). × 530.

Fig. 12. Right lateral view showing protoplasmic contents with large rounded nucleus, many rounded or ovoidal, highly refractive bodies, and distal end of efferent canal of pusule. Station 4711 (300–0 fathoms). × 530.

Fig. 13. Dorsoventral view of body. Station 4711 (300–0 fathoms). × 530.

Fig. 14. Right lateral view of anterior portion of body. Station 4711 (300–0 fathoms). × 1100.

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PLATE 15.

PLATE 15.

Triposolenia longicornis Kofoid.

Fig. 1. Right lateral view. Station 4583 (300–0 fathoms). × 530.

Fig. 2. Right lateral view showing protoplasmic contents with large rounded nucleus and pusule opening at flagellar pore. Station 4583 (300–0 fathoms). × 530.

Fig. 3. Dorsoventral view of body. Station 4583 (300–0 fathoms). × 530.

Fig. 4. Right lateral view of anterior portion of body. Station 4583 (300–0 fathoms). × 1100.

Figs. 5, 6. Right lateral view of posterior portions of dorsal and ventral antapicals showing thickness of thecal wall. Station 4583 (300–0 fathoms). × 1100.

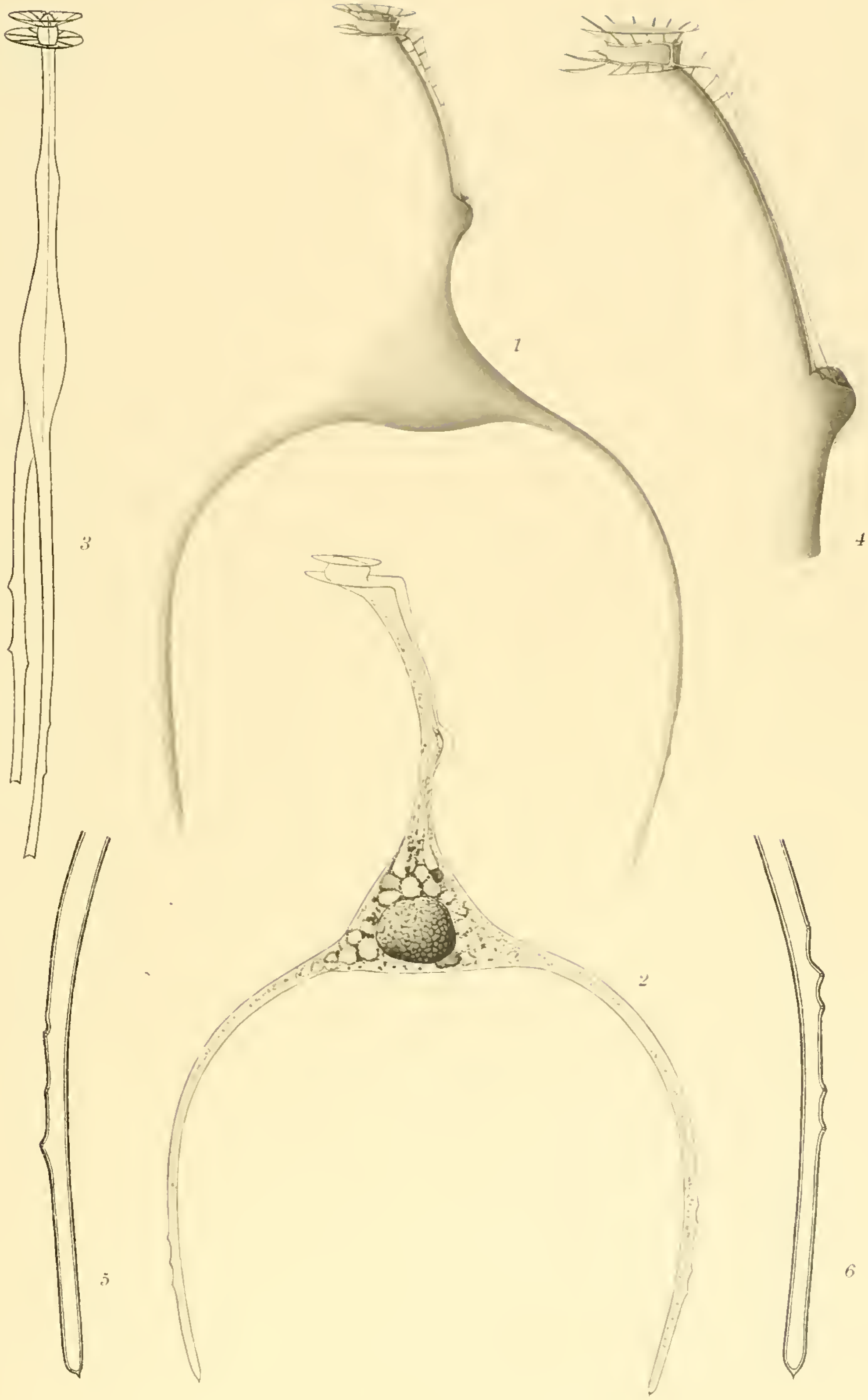

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PLATE 16.

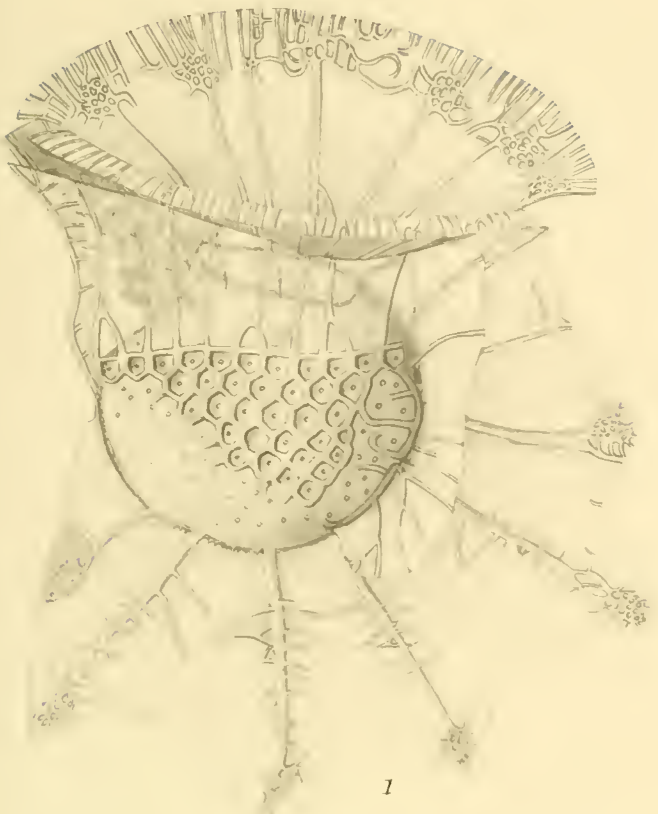
PLATE 16.

Fig. 1. *Ornithocercus steini* Schütt, *s. str.*, right lateral view. Under the pressure of the cover-glass, the anterior cingular list has split dorsally and ventrally and the posterior cingular list dorsally. La Jolla, California. × 625.

Fig. 2. *Ornithocercus splendidus* Schütt, seen from above, showing the structural differentiation of the anterior cingular list (structure of theca omitted). The sinuation on the left side of the figure is on the ventral side of the organism. La Jolla, California. × 975.

Fig. 3. *Ornithocercus magnificus* Stein, *s. str.*, right lateral view. La Jolla, California. × 975.

Fig. 4. *Ornithocercus splendidus* Schütt, right lateral view. La Jolla, California. × 975.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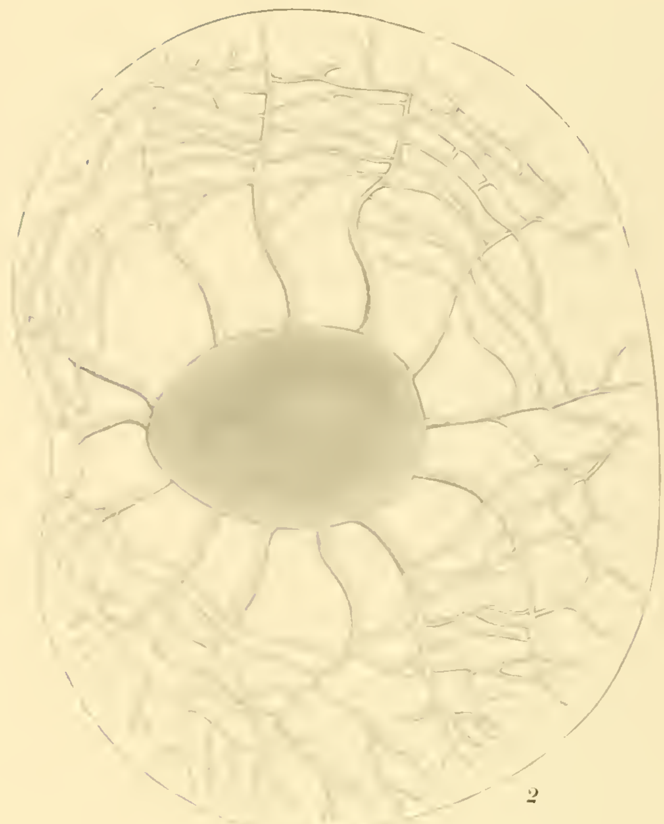
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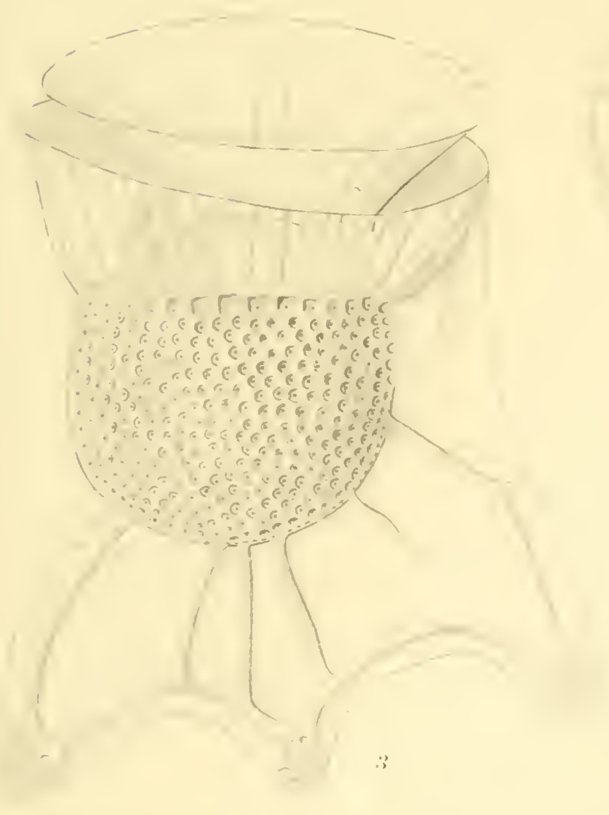
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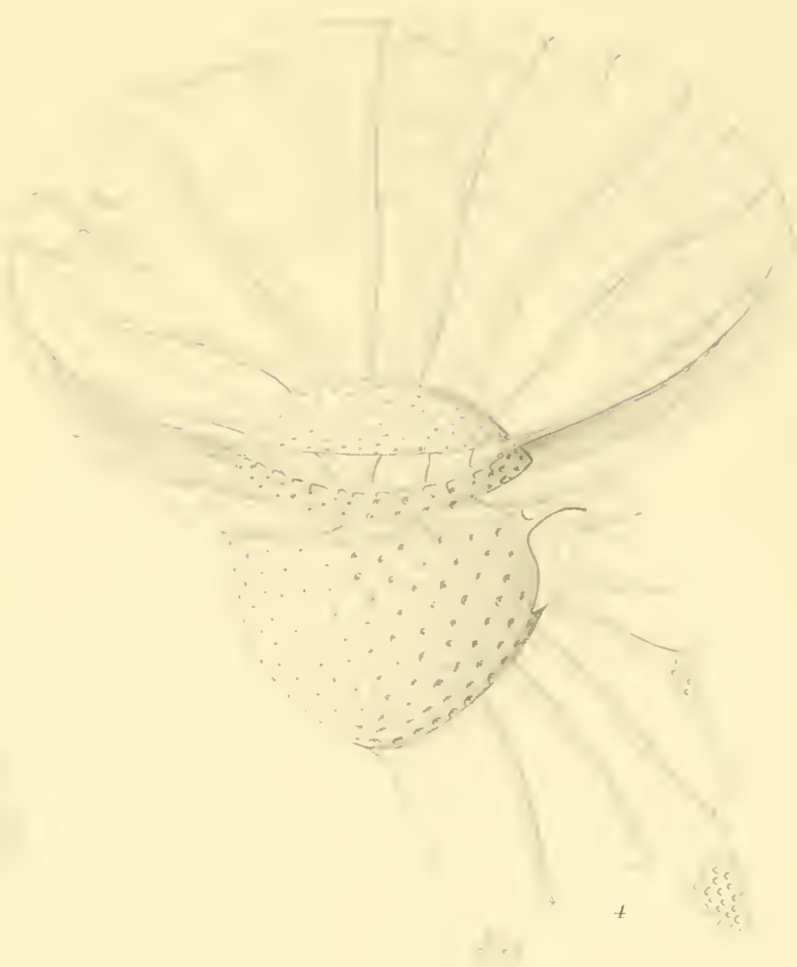
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PLATE 17.

PLATE **17**.

Fig. 1. *Ornithocercus carolinae* Kofoid, right lateral view; type specimen. Station 4730 (300–0 fathoms). × 695.

Fig. 2. *Ornithocercus quadratus* Schütt, f. *simplex*, nov., right lateral view; type specimen. Station 4681 (300–0 fathoms). × 525.

Fig. 3. *Ornithocercus splendidus* Schütt, right lateral view. From the material of the Expedition; station unknown. × 525.

Fig. 4. *Ornithocercus formosus* Kofoid and Michener, ventral view; type specimen. Station 4697 (300–0 fathoms). × 1090.

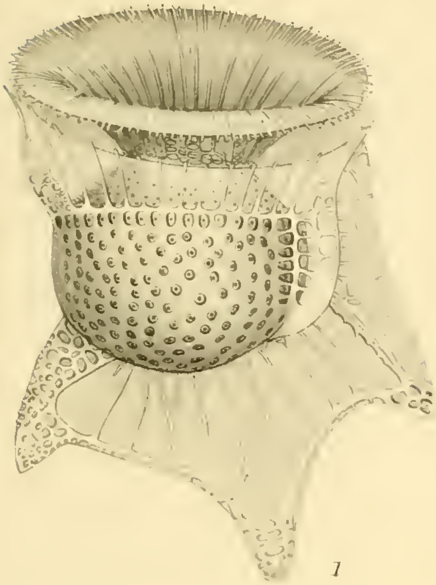
Fig. 5. The same specimen, right lateral view. Observe the adherence of right sulcal list to left sulcal list. × 1090.

Fig. 6. *Ornithocercus carolinae* Kofoid, dorsal view; type specimen. Station 4730 (300–0 fathoms). × 695.

Fig. 7. *Ornithocercus orbiculatus* Kofoid and Michener, right lateral view; type specimen. Station 4617 (300–0 fathoms). × 525.

Fig. 8. *Ornithocercus quadratus* Schütt, f. *schütti*, nov., right lateral view; right sulcal list omitted; type specimen. Station 4737 (100–0 fathoms). × 525.

Fig. 9. *Ornithocercus steini* Schütt, *s. str.*, right lateral view, right sulcal list omitted. Station 4737 (300–0 fathoms). × 525.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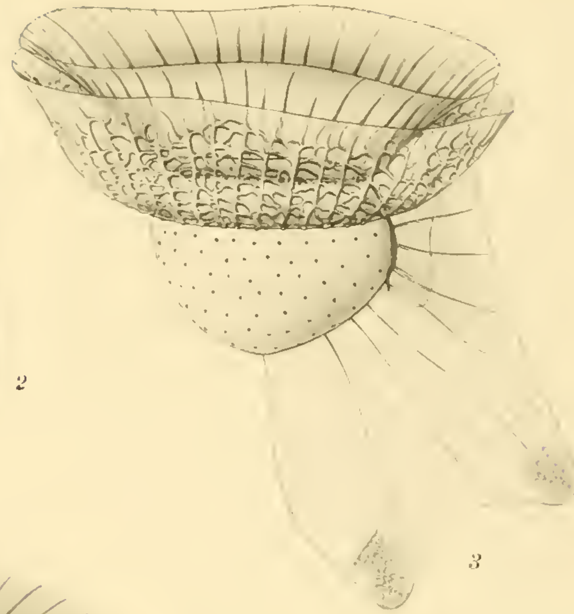
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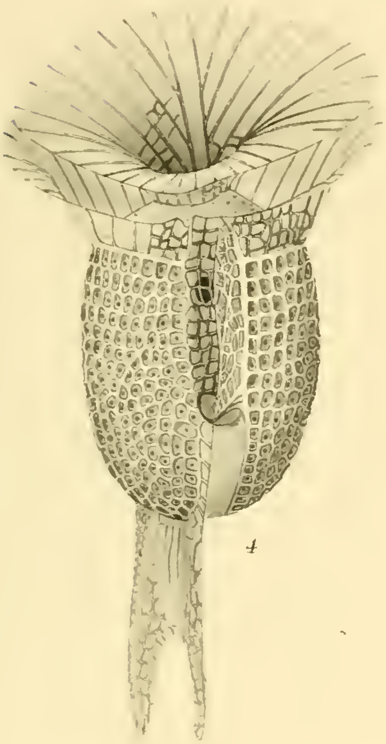
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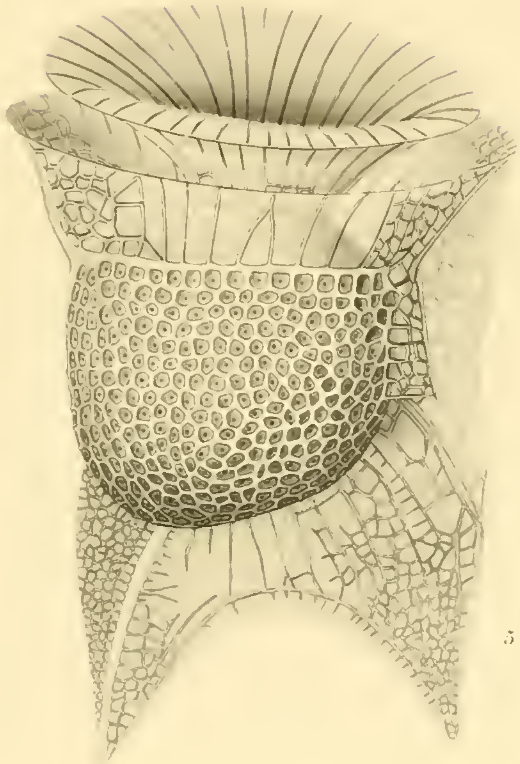
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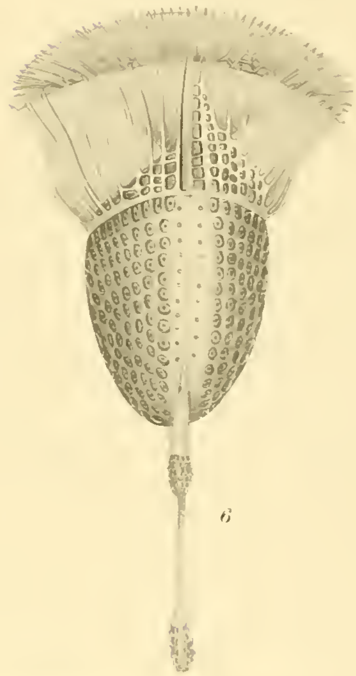
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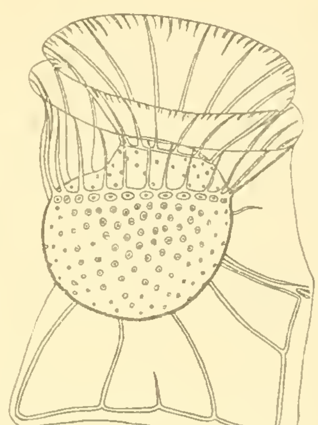

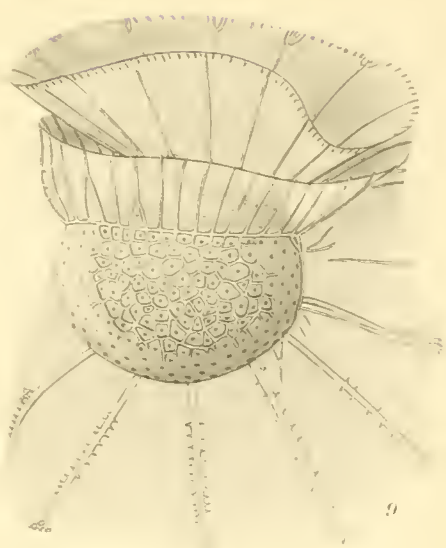
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PLATE 18.

PLATE 18.

Fig. 1. *Ornithocercus heteroporus* Kofoid, oblique ventral view; right sulcal list omitted. Observe the two kinds of pores. Type specimen. Station 4699 (300–0 fathoms). × 1090.

Fig. 2. *Ornithocercus* sp. indet., lateral view of two schizonts adhering to each other, following fission, by means of dorsal bridge, and both strikingly smaller than parent. Edges of old posterior half of left sulcal list (of specimen to the right) show signs of resorption. Station 4737 (100–0 fathoms). × 525.

Fig. 3. *Ornithocercus heteroporus* Kofoid, right lateral view; right sulcal list omitted. Observe the two kinds of pores. Type specimen. Station 4699 (300–0 fathoms). × 1090.

Fig. 4. *Ornithocercus thurni* (Schmidt), two schizonts in oblique ventrolateral view. Old lists not resorbed in fission. In specimen to the right the posterior half of left sulcal list still undeveloped. In specimen to the left the anterior half of this list partly developed. Station 4740 (300–0 fathoms). × 525.

Fig. 5. *Ornithocercus thurni* (Schmidt), posterior view of the two schizonts represented by figure 4; showing bridge of adherence on dorsal side. × 525.

Fig. 6. *Ornithocercus thurni* (Schmidt), oblique dorsal view of the two schizonts represented by figures 4, 5; showing bridge of adherence, and that cingular lists of new valves are still undeveloped.

Fig. 7. *Ornithocercus* sp. indet., posterior view of the two schizonts represented by figure 2; showing length of bridge of adherence and lack of differentiation of new valves. Station 4737 (100–0 fathoms). × 525.

Fig. 8. *Ornithocercus* sp. indet., right lateral view of specimen, the depth of which has been reduced by unequal fission. Station 4701 (300–0 fathoms). × 1090.

Fig. 9. *Ornithocercus* sp. indet., right lateral view, showing a stage in the kind of unequal fission that results in specimens of the elongated type represented in figure 8. On dorsal side of body remains of thecae of parent and grandparent are still present. Theca of grandparent was subcircular in lateral outline as in most species of this genus. Left sulcal list is being resorbed posterodorsally. Station 4604 (surface). × 865.

Fig. 10. *Ornithocercus* sp. indet., ventral view of specimen represented by figure 8. Station 4701 (300–0 fathoms). × 1090.

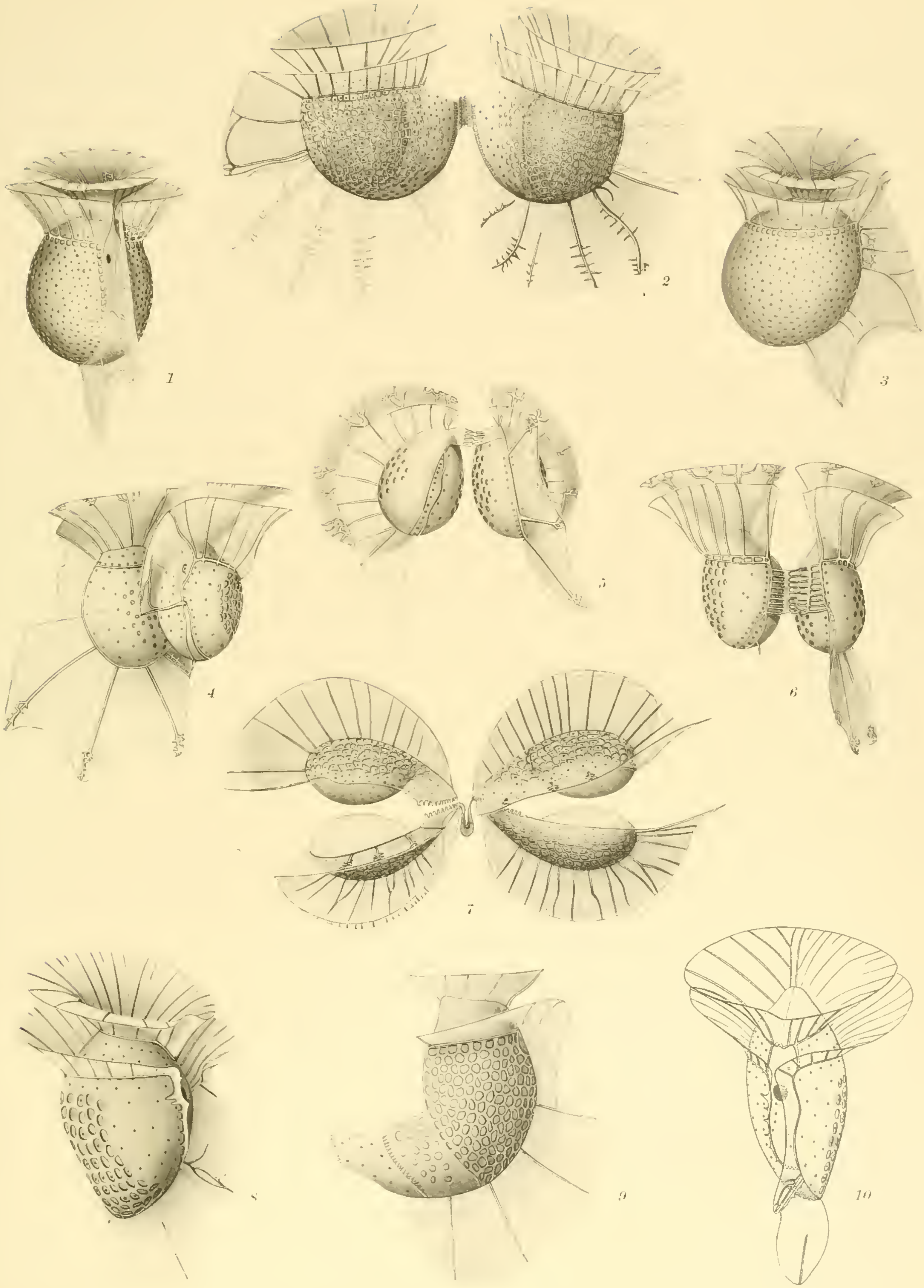

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PLATE 19.

PLATE 19.

Fig. 1. *Parahistioneis garretti* (Kofoid), right lateral view, right sulcal list omitted; type specimen. Station 4732 (300–0 fathoms). × 1090.

Fig. 2. *Parahistioneis karsteni* (Kofoid and Michener), right lateral view, right sulcal list omitted; type specimen. Station 4619 (Salpa). × 1090.

Fig. 3. *Parahistioneis paraformis*, sp. nov., right lateral view, slightly tilted ventrally; right sulcal list omitted; type specimen. Station 4724 (300–0 fathoms). × 1090.

Fig. 4. *Parahistioneis diomedeae* (Kofoid and Michener), ventral view; type specimen. Station 4699 (300–0 fathoms). × 1090.

Fig. 5. The same specimen, right lateral view. × 1090.

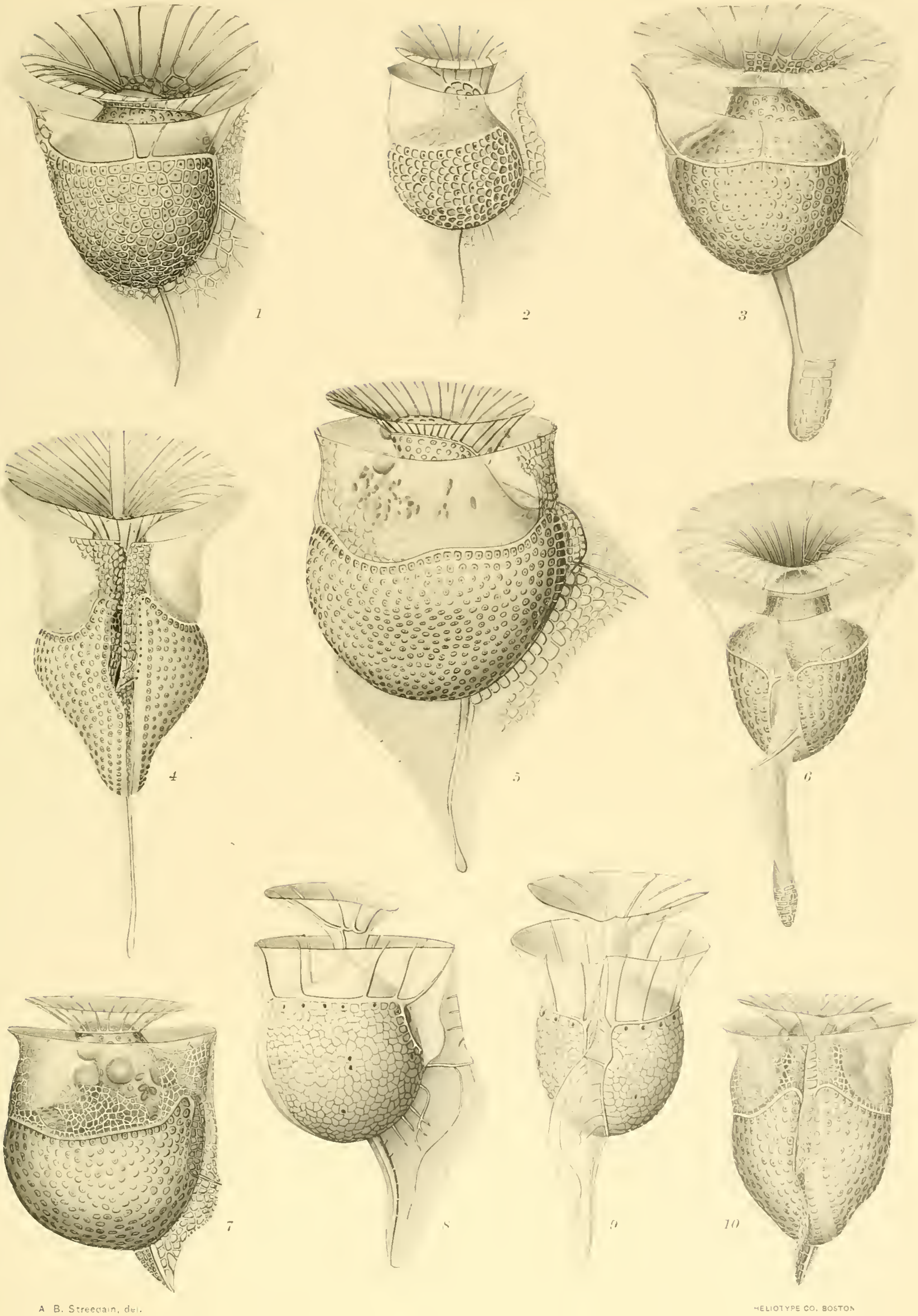
Fig. 6. *Parahistioneis paraformis*, sp. nov., ventral view; type specimen. Station 4724 (300–0 fathoms). × 1090.

Fig. 7. *Parahistioneis reticulata* (Kofoid), right lateral view, right sulcal list omitted; type specimen. Station 4699 (300–0 fathoms). × 1090.

Fig. 8. *Parahistioneis rotundata* (Kofoid and Michener), right lateral view. The border on the dorsal side indicates that the specimen was megacytic. Type specimen. Station 4720 (Salpa). × 2180.

Fig. 9. The same specimen, ventral view. The dotted line indicates the thickness of the thecal wall. × 2180.

Fig. 10. *Parahistioneis reticulata* (Kofoid), ventral view; type specimen. Station 4699 (300–0 fathoms). × 1090.



A. B. Streedain, del.

HELIOTYPE CO. BOSTON

PLATE 20.

PLATE 20.

Fig. 1. *Histioneis paulseni* Kofoid, right lateral view; type specimen. Station 4711 (300–0 fathoms). × 1090.

Fig. 2. The same specimen, ventral view. × 1090.

Fig. 3. *Histioneis costata* Kofoid and Michener, right lateral view; type specimen. Station 4604 (surface). × 1090.

Fig. 4. *Histioneis hyalina* Kofoid and Michener, right lateral view; type specimen. Station 4720 (surface). × 1090.

Fig. 5. *Histioneis longicollis* Kofoid, ventral view; type specimen. Station 4711 (300–0 fathoms). × 1090.

Fig. 6. *Histioneis striata* Kofoid and Michener, right lateral view; type specimen. Station 4720 (Salpa). × 1640.

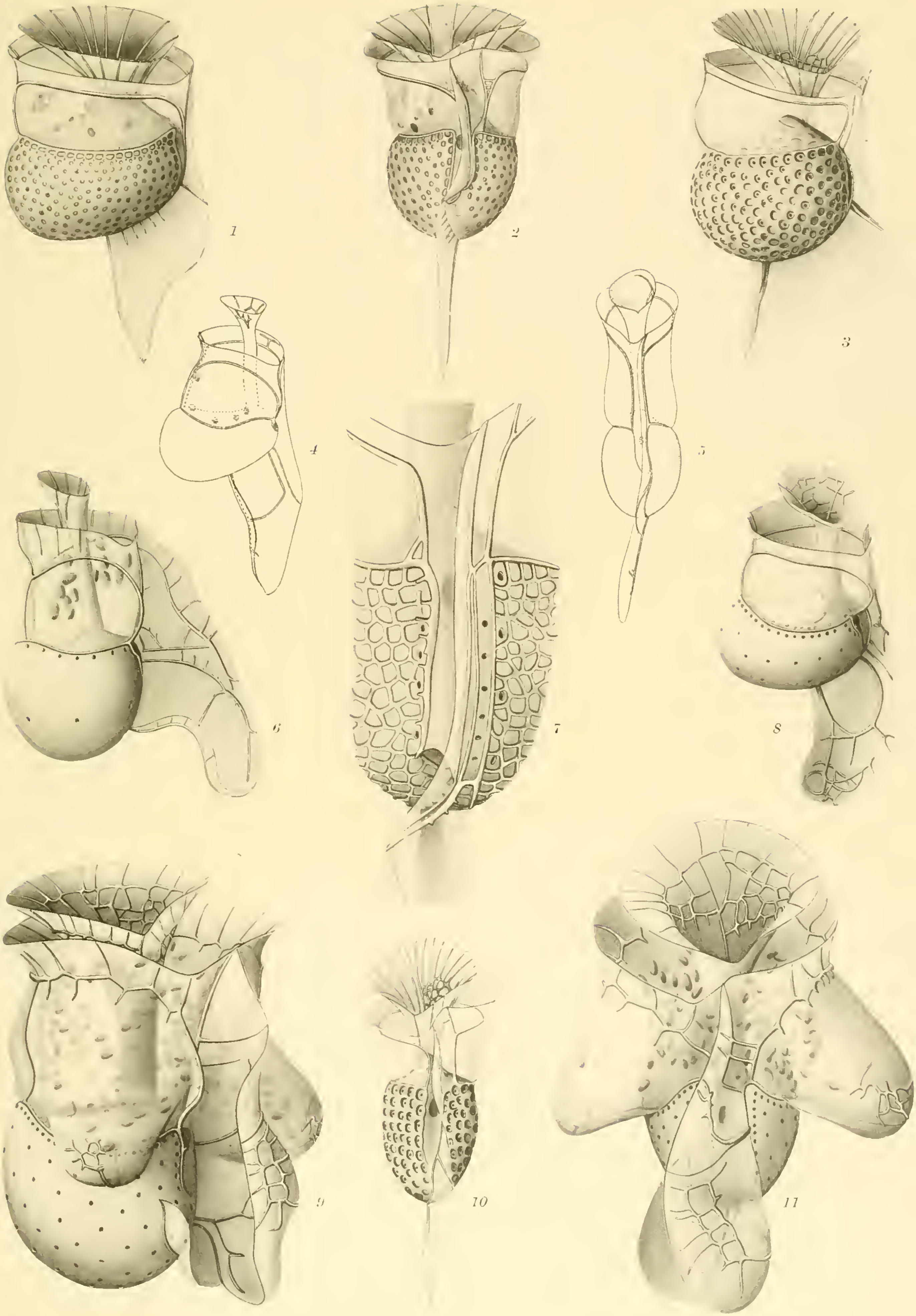
Fig. 7. *Histioneis elongata* Kofoid and Michener, ventral view of body, showing canal formed by right sulcal list, opening anteriorly into girdle and posteriorly at fission rib of left sulcal list; type specimen. Station 4722 (300–0 fathoms). × 2180.

Fig. 8. *Histioneis pacifica*, sp. nov., right lateral view; type specimen. Station 4741 (Salpa). × 1090.

Fig. 9. *Histioneis reginella* Kofoid and Michener, right lateral view; type specimen. Station 4681 (300–0 fathoms). × 1640.

Fig. 10. *Histioneis costata* Kofoid and Michener, ventral view; type specimen. Station 4604 (surface). × 1090.

Fig. 11. *Histioneis reginella* Kofoid and Michener, ventral view; type specimen. Station 4681 (300–0 fathoms). × 1640.



A. B. Streedain, del

HELIOTYPE CO. BOSTON

PLATE 21.

PLATE 21.

Fig. 1. *Histioneis carinata* Kofoid, ventral view; type specimen. Station 4724 (300–0 fathoms). × 1090.

Fig. 2. *Histioneis mitchellana* Murray and Whitting, left lateral view. The transverse flagellum displaced, encircles the anterior cingular list in the wrong direction. Station 4730 (300–0 fathoms). × 1090.

Fig. 3. *Histioneis navicula* Kofoid, ventral view; type specimen. Station 4734 (300–0 fathoms). × 1090.

Fig. 4. *Histioneis pulchra* Kofoid, ventral view; type specimen. Station 4730 (300–0 fathoms). × 695.

Fig. 5. *Histioneis longicollis* Kofoid, right lateral view; type specimen. Station 4711 (300–0 fathoms). × 1090.

Fig. 6. *Histioneis navicula* Kofoid, right lateral view; type specimen. Station 4734 (300–0 fathoms). × 1090.

Fig. 7. *Histioneis pulchra* Kofoid, right lateral view; type specimen. Station 4730 (300–0 fathoms). × 695.

Fig. 8. *Histioneis carinata* Kofoid, right lateral view; type specimen. Station 4724 (300–0 fathoms). × 1090.

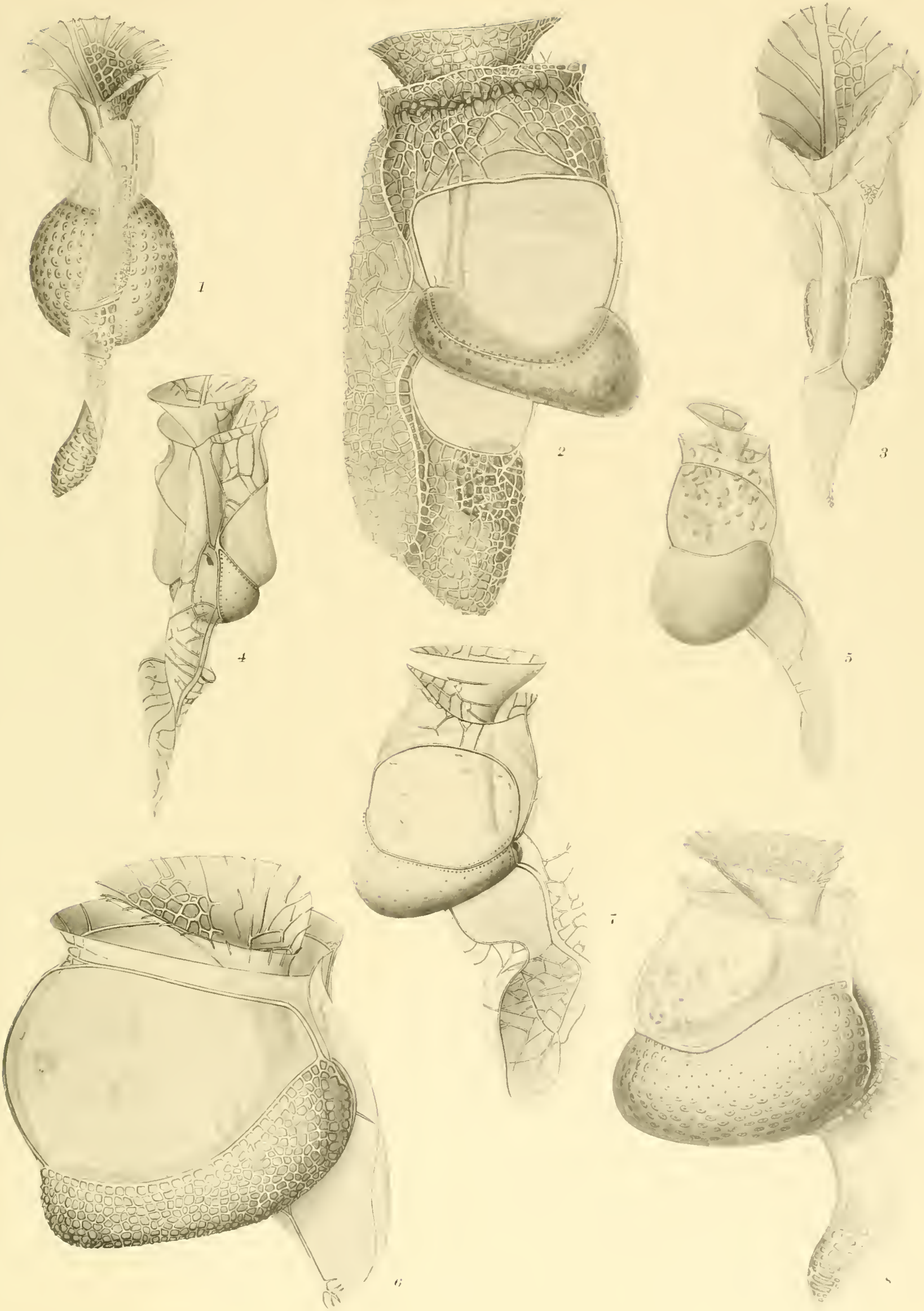

1
2
3
4
5
6
7

PLATE 22.

PLATE 22.

Fig. 1. *Histioneis josephinae* Kofoid, oblique ventral view; type specimen. Station 4699 (300–0 fathoms). × 935.

Fig. 2. The same specimen, right lateral view. × 935.

Fig. 3. The same specimen, dorsal view. × 935.

Fig. 4. *Histioneis elongata* Kofoid and Michener, ventral view; type specimen. Station 4722 (300–0 fathoms). × 1090.

Fig. 5. *Histioneis inclinata* Kofoid and Michener, right lateral view; type specimen. Station 4720 (Salpa). × 2180.

Fig. 6. *Histioneis elongata* Kofoid and Michener, body and anterior cingular list in right lateral view, showing the small, round nucleus and a large pusule. Round body in cingular list of unknown nature. Station 4722 (300–0 fathoms). × 1090.

Fig. 7. The same specimen, right lateral view. × 1090.

A. B. Streedain, del.

HELIOTYPE CO. BOSTON

PLATE 23.

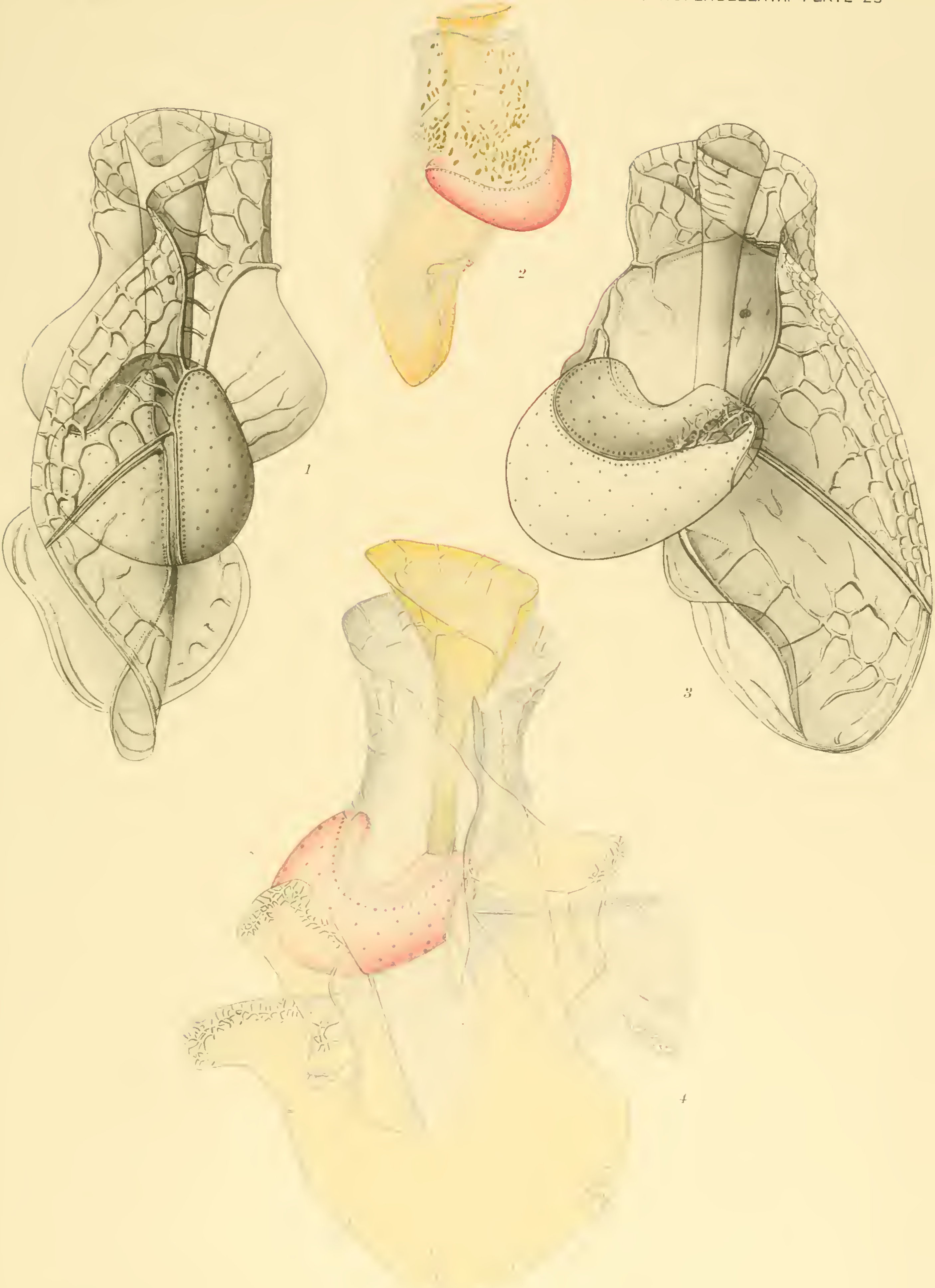
PLATE 23.

Fig. 1. *Histioneis hippoperoides* Kofoid and Michener, ventral view; type specimen. Station 4590 (300–0 fathoms). × 1310.

Fig. 2. *Histioneis pulchra* Kofoid, left lateral view, showing colors of living specimen. Station 4734 (300–0 fathoms). × 630.

Fig. 3. *Histioneis hippoperoides* Kofoid and Michener, right lateral view; type specimen. Station 4590 (300–0 fathoms). × 1310.

Fig. 4. *Histioneis josephinae* Kofoid, right lateral view, showing colors of living specimen. Station 4699 (300–0 fathoms). × 1125.



A. B. Streedain, del.

HELIOTYPE CO. BOSTON

PLATE **24**.

PLATE 24.

Distribution of the species of Phalacroma.

All record stations are marked by circles on the lines of the route. Solid circles indicate surface hauls; open circles, vertical hauls; open circles including solid circles, vertical and surface hauls at the same station. The occurrences of the species at the various stations are indicated by radii, the keys to which are to be found in the key stars on the left side of the chart. The frequencies are indicated by Roman numerals at the distal ends of the radii; these numerals should be read from the distal toward the proximal end of the radius. Absence of Roman numerals indicates that the species were "present" (*i.e.*, frequency of less than 1%).

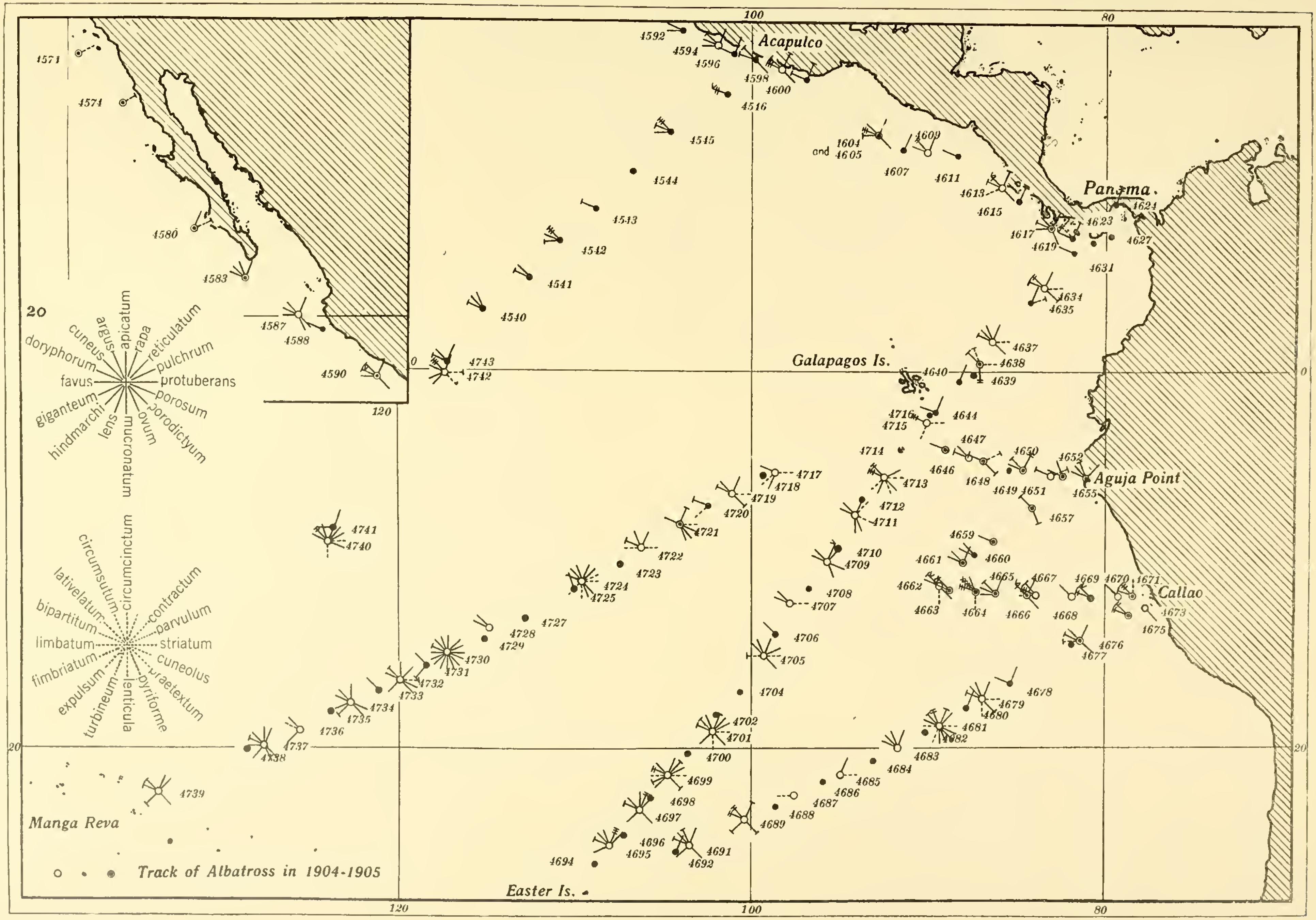
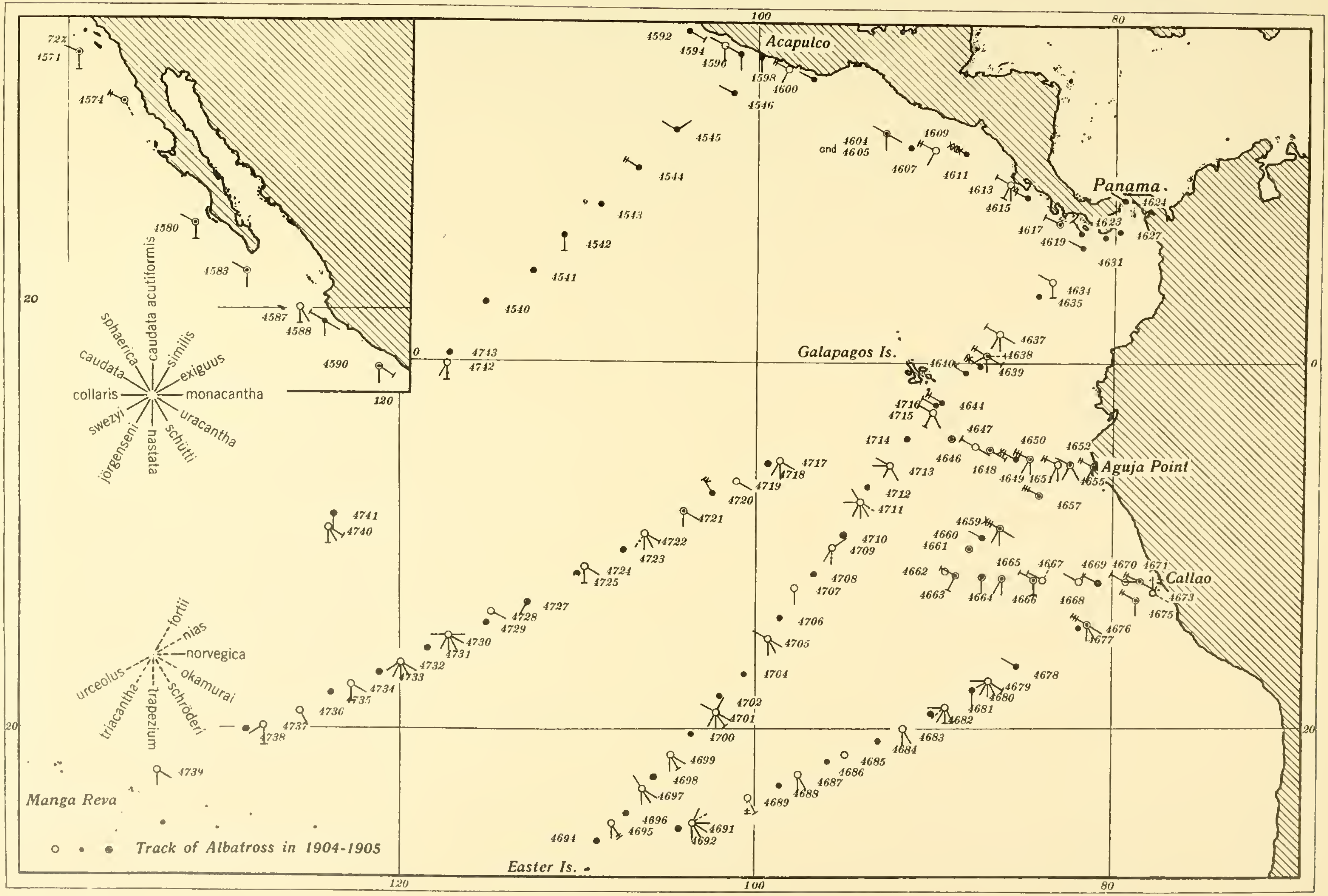

Acapulco
Panama
Galapagos Is.
Aguja Point
Callao
Easter Is.
Manga Reva
Track of Albatross in 1904-1905
apicatum
rapa
reticulatum
pulchrum
protuberans
porosum
porodictyum
ovum
mucronatum
lens
hindmarchi
giganteum
favus
doryphorum
cuneus
argus
circumcinctum
contractum
parvulum
striatum
cuneolus
praetextum
pyriforme
lenticula
turbineum
expulsum
fimbriatum
limbatum
bipartitum
lativelatum
circumsutum
1604 and 4605
100
80
120
20
0

PLATE 25.

PLATE **25**.

Distribution of the species of Dinophysis.

The explanations of the symbols will be found in the explanation to Plate **24**.



HELIOTYPE CO. BOSTON

PLATE **26**.

PLATE **26**.

Distribution of the species of Amphisolenia.

The explanations of the symbols will be found in the explanation to Plate **24**.

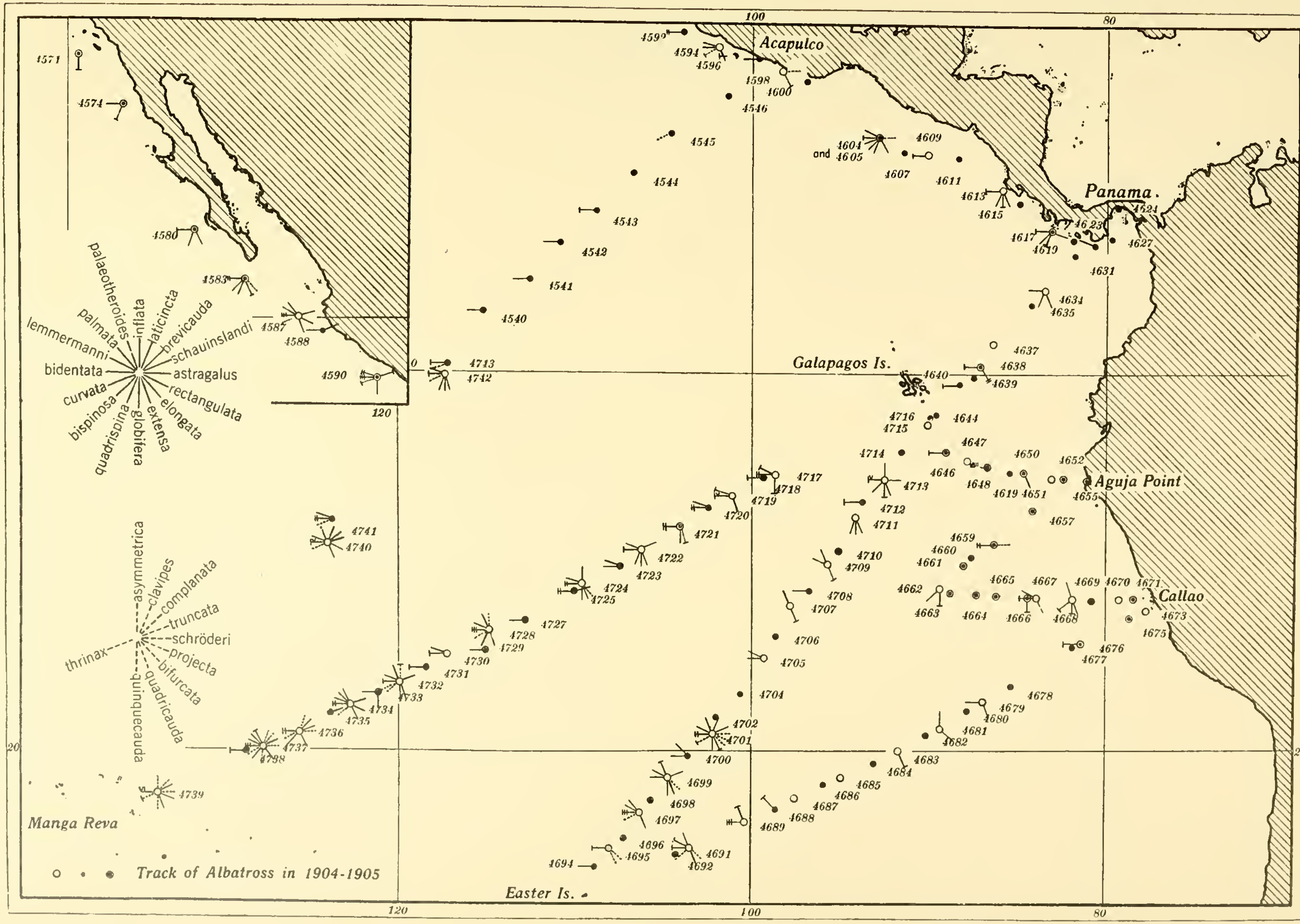

Acapulco
Panama.
Galapagos Is.
Aguja Point
Callao
Easter Is.
Manga Reva
palaeotheroides
inflata
laticincta
brevicauda
schauinslandi
astragalus
rectangulata
elongata
extensa
globifera
quadrispina
bispinosa
curvata
bidentata
lemmermanni
palmata
asymmetrica
clavipes
complanata
truncata
schröderi
projecta
bifurcata
quadricauda
quinquecauda
thrinax
Track of Albatross in 1904-1905

PLATE 27.

PLATE 27.

Distribution of the species of Triposolenia.

The explanations of the symbols will be found in the explanation to Plate **24**.

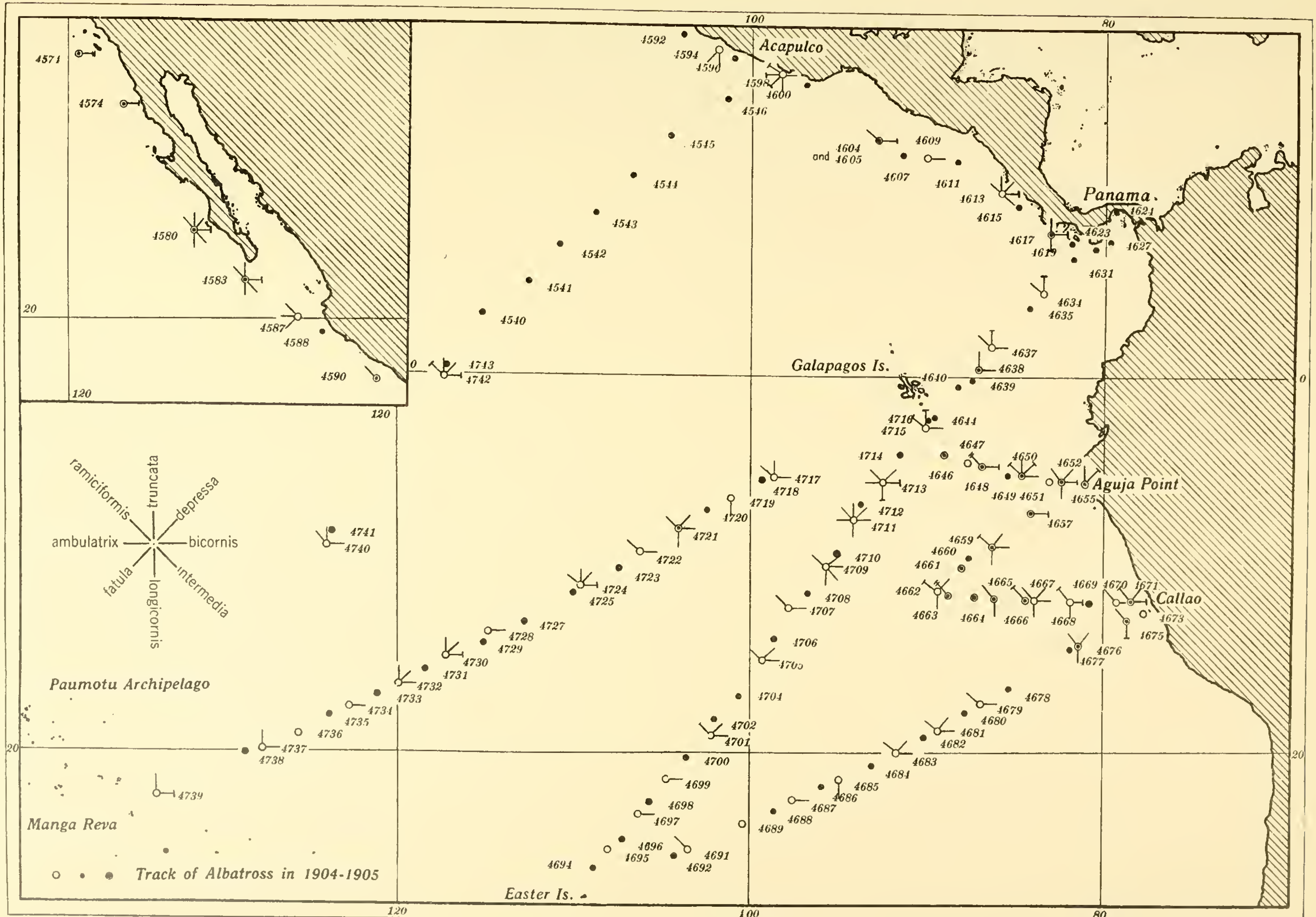

Acapulco
Panama
Galapagos Is.
Aguja Point
Callao
Easter Is.
Paumotu Archipelago
Manga Reva
Track of Albatross in 1904-1905
truncata
depressa
bicornis
intermedia
longicornis
fatula
ambulatrix
ramiciformis
100
80
120
20
0

PLATE 28.

PLATE **28**.

Distribution of the species of Ornithocercus.

The explanations of the symbols will be found in the explanation to Plate **24**.

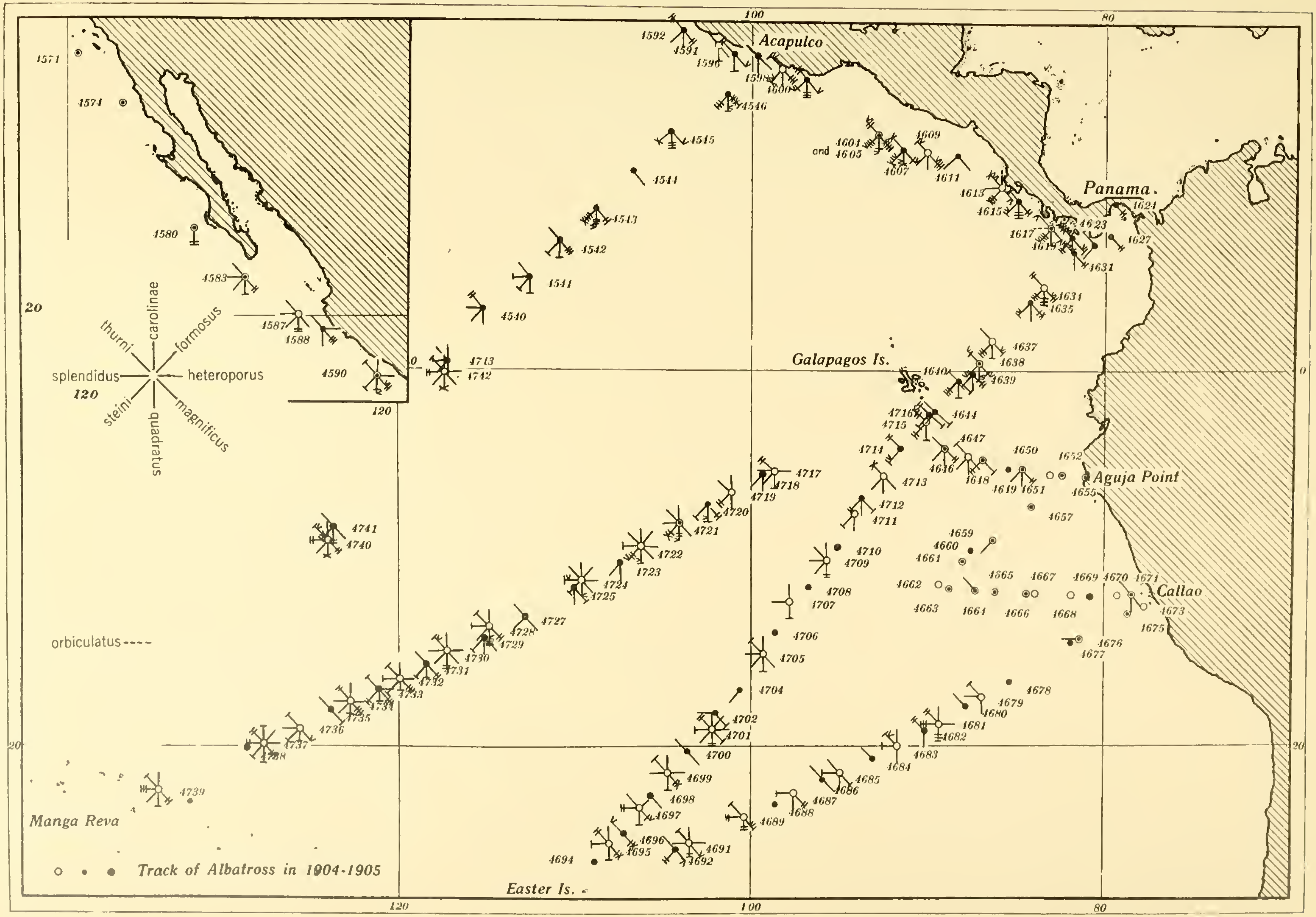
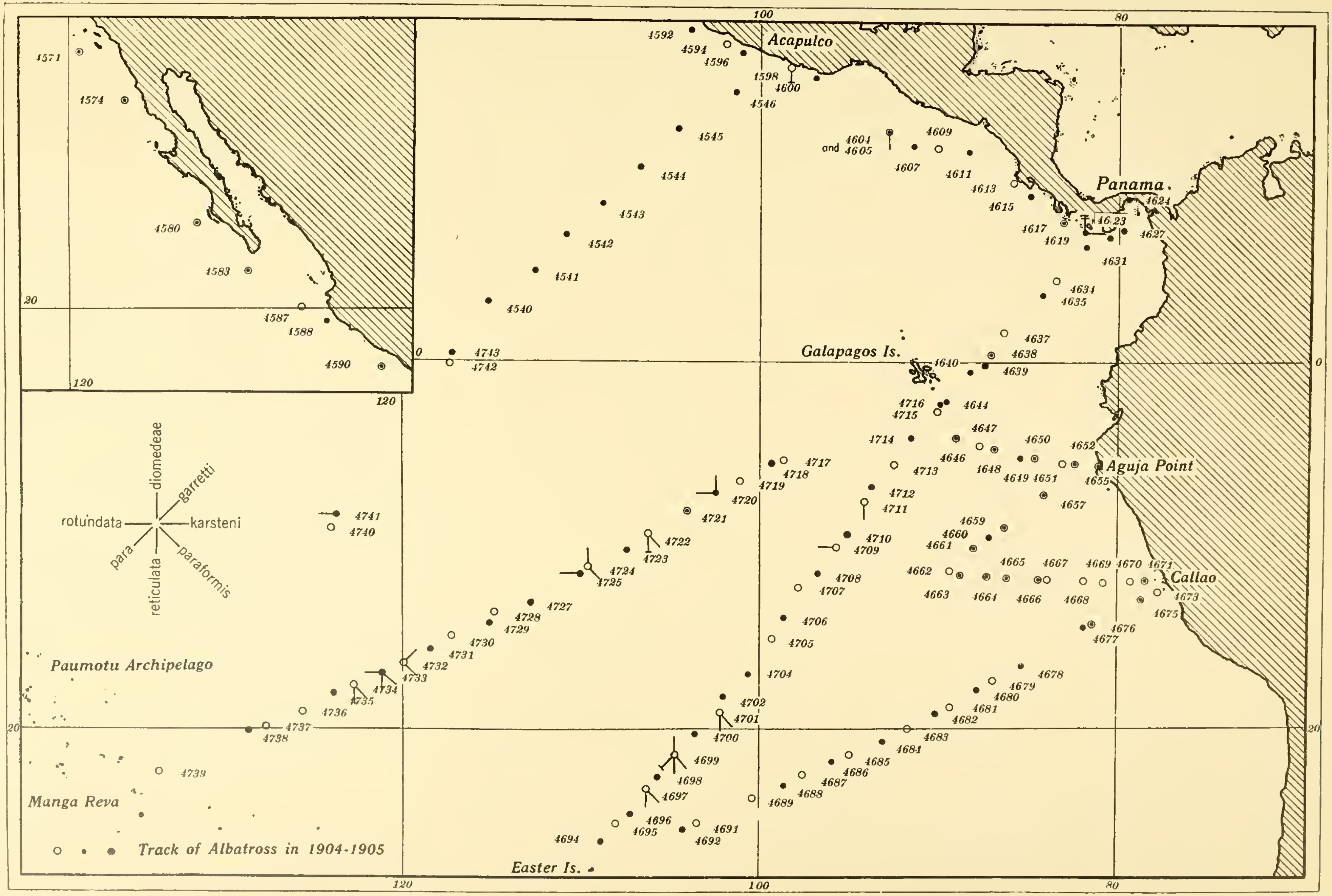

Acapulco
Panama
Galapagos Is.
Aguja Point
Callao
Easter Is.
Manga Reva
carolinae
formosus
heteroporus
magnificus
quadratus
steini
splendidus
thurni
orbiculatus
Track of Albatross in 1904-1905
100
80
120
20
0

PLATE 29.

PLATE **29**.

Distribution of the species of Parahistioneis.

The explanations of the symbols will be found in the explanation to Plate **24**.



HELIOTYPE CO. BOSTON

PLATE 30.

PLATE 30.

Distribution of the species of Histioneis.

The explanations of the symbols will be found in the explanation to Plate 24.

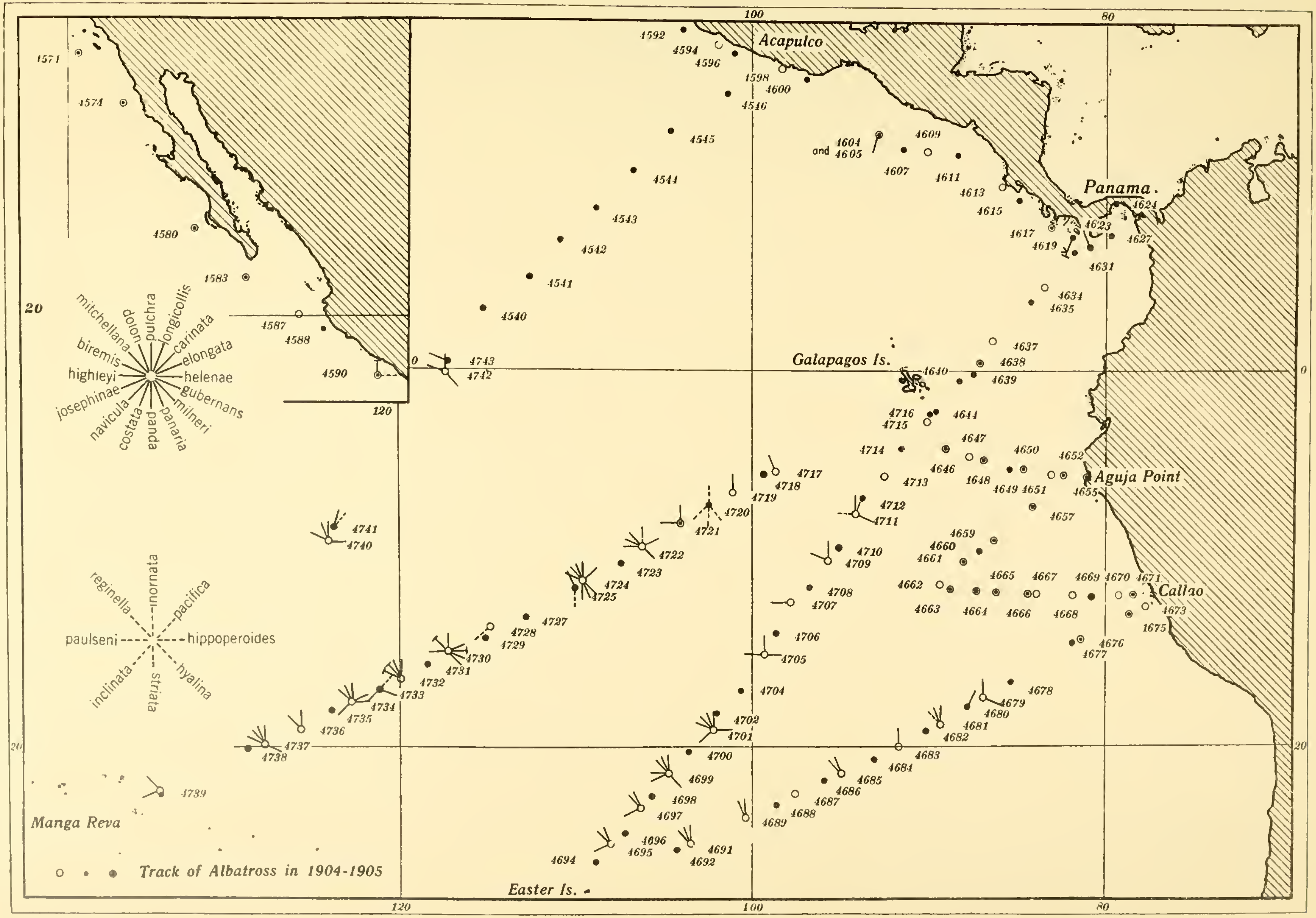
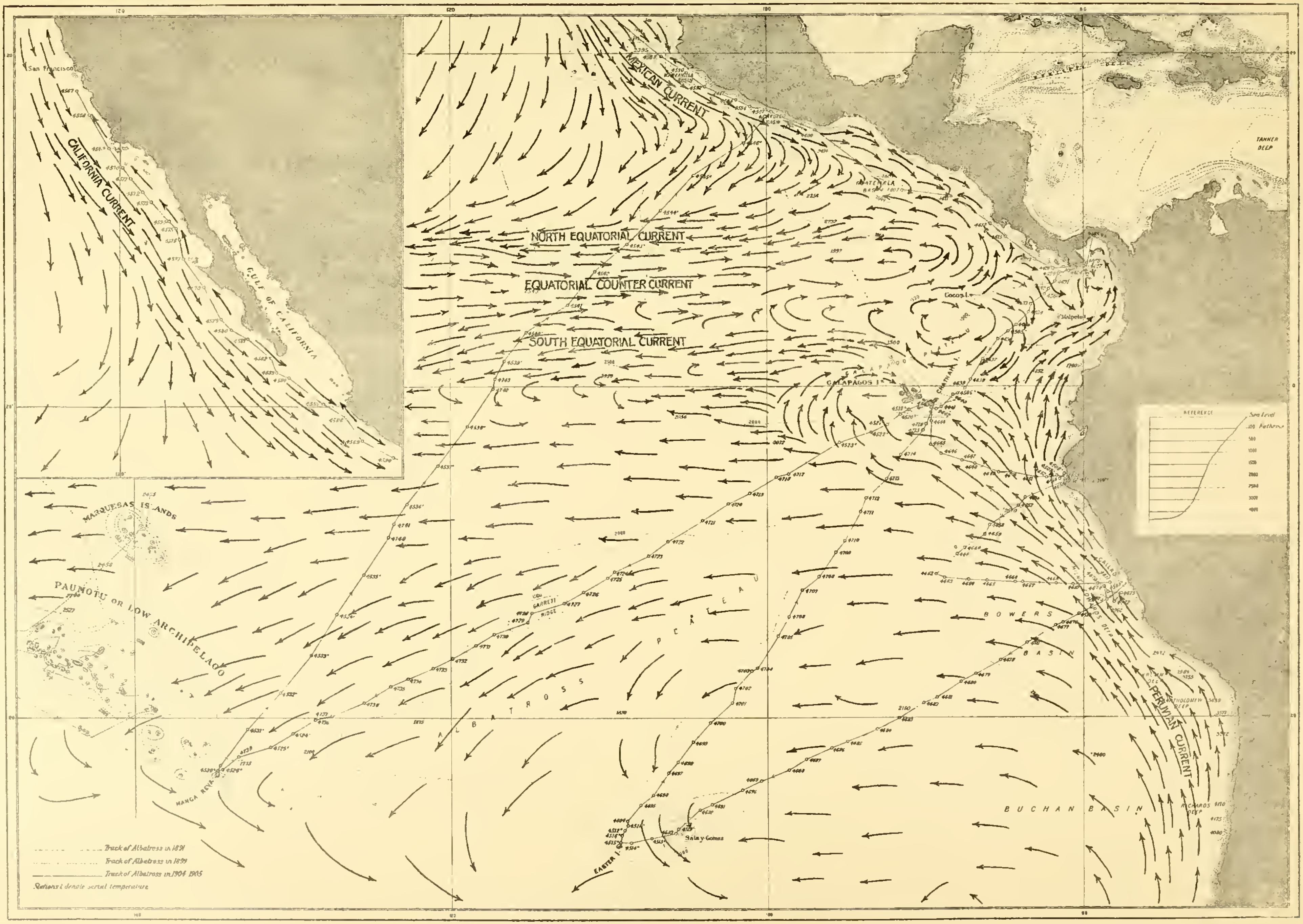

Acapulco
Panama.
Galapagos Is.
Aguja Point
Callao
Easter Is.
Manga Reva
Track of Albatross in 1904-1905
mitchellana
dolon
pulchra
longicollis
carinata
elongata
helenae
gubernans
milneri
panaria
panda
costata
navicula
josephinae
highleyi
biremis
reginella
inornata
pacifica
hippoperoides
hyalina
striata
inclinata
paulseni

PLATE 31.

PLATE 31.

Current chart.

This chart represents the prevalent currents in the Eastern Pacific during the two winter quarters. It is based on the combined data contained in the "Quarterly Current Charts for the Pacific Ocean" published by the Hydrographic Department, Admiralty, London, and in the Pilot Charts issued quarterly by the Hydrographic Office of the United States Navy.


San Francisco
CALIFORNIA CURRENT
GULF OF CALIFORNIA
MEXICAN CURRENT
NORTH EQUATORIAL CURRENT
EQUATORIAL COUNTER CURRENT
SOUTH EQUATORIAL CURRENT
Cocos I.
Malpelo I.
GALAPAGOS I.
CHATHAM I.
TANNER DEEP
MARQUESAS ISLANDS
PAUMOTU OR LOW ARCHIPELAGO
MANGA REVA
GARRETT RIDGE
ALBATROSS PLATEAU
BOWERS BASIN
BUCHAN BASIN
PERUVIAN CURRENT
CALLAO
RICHARDS DEEP
Sala y Gomez
EASTER I.
REFERENCE
Sea Level
Track of Albatross in 1891
Track of Albatross in 1899
Track of Albatross in 1904-1905
Stations ⊙ denote serial temperature