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by

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The dinoflagellates, or peridines, constitute a fairly well-marked group of unicellular organisms, sometimes classified with animals and at other times regarded as plants, but in reality impossible to include in either category, since some members of the group feed like typical animals, capturing and ingesting other organisms, others are saprophytic or parasitic, like the fungi, and still others, including perhaps a majority of the species and certainly a majority of the individuals in the region under consideration, are typically plantlike, possessing chlorophyll and manufacturing their own food from carbon dioxide, water and mineral salts in solution. As sources of food for marine animals, the autophytic dinoflagellates rank second only to the diatoms and at times they greatly outnumber diatoms in the water. This is especially true in late summer when certain species, in New Jersey waters especially *Amphidinium fusiforme* and *Gymnodinium* spp. occur in dense swarms, sometimes imparting a distinct brown or red tint to the water (15). Marshall and Orr (11) have shown that at Plymouth, England, during the summer, the optimum conditions for photosynthesis by diatoms are met with from one to six meters below the surface. In the more southerly latitudes of New Jersey the optimum depth would presumably be greater. There are wide expanses of coastal waters in New Jersey averaging less than two meters in depth, and in these shallow waters dinoflagellates are extremely abundant and flourish in hot weather. It would not be surprising, therefore, to discover that in these areas in summer the dinoflagellates produce more potential food for the larger marine animals than do the diatoms.

Dinoflagellates are largely responsible for the luminescence which is so striking a phenomenon of the ocean at times, although they are not the only organisms concerned. The conditions which are favorable to swarming, namely, warm, quiet weather, are also favorable to luminescence, although a storm coming at the end of such a period may produce a notable display. The species which cause luminescence in New Jersey waters have not been definitely determined, but it is fair to assume that they are very largely the same species as those which occur in the red water.

While the dinoflagellates have been studied extensively on the Pacific coast of North America and in Europe, much less attention has been paid to those occurring on the Atlantic coast of North America. Calkins (3) notes eleven species from Woods Hole and Wright (23) lists twenty-one species from Nova Scotia, not all of which are identified. Willey (22) reports *Peridinium divergens* as common in the Gulf of St. Lawrence. Bigelow (1) lists ten species from the Gulf of Maine, all of which are thecate forms, and notes the occurrence of "an unidentified gymnodinid" in considerable numbers in this region. Martin (14) describes three species from New Jersey. There are doubtless other scattered references to certain species, but no very considerable amount of attention seems to have been given to the group in eastern North America. The recent appearance of comprehensive works on the dinoflagellates, such as those of Kofoid and Swezy (8) and Lebour (9), both of which have constantly been consulted in the preparation of this paper, should stimulate interest in the group.

In size, the dinoflagellates vary from 10 μ or less in length to over a millimeter, but only a few of the New Jersey species exceed 100 μ, which means that the largest individuals are visible only as minute specks in a bottle of water when held in a beam of sunlight. Although unicellular, they are by no means simple in structure, but are, on the contrary, among the most highly elaborated of the unicellular organisms. The individuals are motile, at least for a part of their lives, by means of two flagella, one of which is extended longitudinally, while the other moves in a transverse zone either around the cell or around the longitudinal flagellum. The nucleus is characteristic. It is relatively large and curiously beaded, and as it often may be seen in the living organism, its presence is diagnostic, even in the case of an inactive or encysted individual. The plantlike forms possess chloroplasts which are brownish, yellowish or greenish and may be disk-like or plate-like or may form a radiating and apparently continuous network. The cell may be naked or covered with a bivalve shell or with an elaborate armor of plates. In typical forms it is divided into an anterior and posterior portion by a transverse groove, the *girdle,* within which the transverse flagellum vibrates. On the ventral side the girdle is met or crossed by a longitudinal groove, the *sulcus,* within which the longitudinal flagellum originates from a pore. The sulcus may be short or may extend nearly from apex to antapex. The pore from which the transverse flagellum emerges is commonly at the junction of the girdle and the sulcus. The girdle may be incomplete or complete or in the form of a spiral; the sulcus may be straight or curved. Both girdle and sulcus are lacking in the Adiniferidea.

In the armored forms the theca, or covering, is composed of three sections, the *epitheca,* covering the anterior portion of the cell, the *girdle,* and the *hypotheca,* covering the posterior portion. Each of these may be composed of a single piece but is usually composed of numerous plates, and may be characterized by spines, pores and depressions. The girdle and sulcus are often bordered by thin membranes, the *lists.* These structures reach their greatest development in some of the tropical pelagic forms. Following Kofoid (7), the classification of the armored forms is based largely upon the number and arrangement of the plates, and as a matter of convenience conventional symbols are employed to designate each set of plates. The plates surrounding the anterior end are called *apicals* (′), those bordering the girdle on the anterior side are *the precingulars* (′′). There are frequently one or more intercalated plates between the apicals and the precingulars, and these, when present, are the *anterior intercalaries* (a). Similarly, the plates bordering the girdle posteriorly are the *postcingulars* (′′′), those at the posterior end the *antapicals* (′′′′), and there may be *posterior intercalaries* (p) between these. The girdle plates, and the small plates of the sulcal region are commonly disregarded. Thus the formula 4′ 3a 7′′ 5′′′ 2′′′′, characteristic of the genus *Peridinium,* indicates that the theca is composed of four apical plates, three anterior intercalaries, seven precingulars, five postcingulars and two antapicals, without any posterior intercalaries.

The armored peridines are easily collected and preserved by the usual methods, but the naked forms are extremely delicate and this is one reason why they frequently have been overlooked. Many of the larger forms are injured by contact with a plankton net, which fails very largely to retain the smaller species, and many are destroyed by the usual methods of preservation with alcohol or formalin or so deformed that recognition is difficult or impossible. Few are hardy enough to withstand passage through a power centrifuge, and they are rarely found in examination of the stomach contents of such a plankton feeder as the oyster, because contact with the digestive fluids causes speedy disintegration. Hence, special methods of collection are necessary.

The observations and collections upon which the following notes are based were made on a number of occasions from 1921 to 1928, while engaged in studying the food of oysters in New Jersey. Both experiments and observations strongly suggested that neither plankton collections nor the examination of stomach contents accounted for all the food taken by these animals and that there were grave difficulties in the way of supposing that detritus could supply the deficiency. These results are reported elsewhere (12, 13). It was early realized that nannoplankton forms might account for a considerable part of this food material, but only much later was the importance of the naked dinoflagellates realized. This was due to the fact that these forms are almost never seen in recognizable condition in stomach samples, and, as previously mentioned, they are rarely caught in the plankton net and none of the larger species and few of the smaller are able to survive passage through a power centrifuge. When, however, the use of a hand centrifuge, as suggested by Lebour (9) is resorted to, it is found that such genera as *Amphidinium, Gymnodinium, Gyrodinium* and *Polykrikos* are abundant, in late summer often constituting a greater bulk of potential food than all other organisms combined. The most successful method has been to take 100cc of the water to be examined and to concentrate it in two 50cc tubes, turning about one minute at a moderate rate and decanting the bulk of the water. The one or two cubic centimeters remaining after decantation may readily be removed by a pipette, and usually contains numerous naked dinoflagellates. These are best studied while living. Many of the species swim rapidly for fifteen or twenty minutes, resting occasionally and thus giving opportunity for sketching, then coming to final rest and speedily disintegrating. A number of preservatives and fixatives have been tested. Best results have been secured by adding to the final residue a few drops of one per cent osmic acid, stirring with the pipette. This is allowed to act for two or three minutes, then the tube is filled with weak chrom-acetic solution. This is allowed to act for two or three hours, the material is then washed and finally preserved in weak formalin. Such material may be stained, dehydrated in glycerine, and mounted permanently in

Venetian turpentine. Iron alum haematoxylin has been the most successful of the stains tried. Excellent killing, with little distortion of the cell, but not such satisfactory fixation may be secured by using a very strong solution of iodine in potassium iodide, and replacing with formalin. A saturated solution of bichloride of mercury in sea water, used liberally, gives good fixation in the case of some species. Osmic acid, followed by formalin is fairly good; chrom-acetic solution followed by formalin is usually unsatisfactory. The photographs reproduced on Plate VIII were made from killed and fixed material, usually stained and mounted temporarily in glycerine or permanently in Venetian turpentine. The plates of the armored forms may be brought out by adding a small drop of Javelle water to the mount, or by staining in a very weak aqueous solution of trypan blue.

Many interesting species may sometimes be secured by washing the sand at the end of a wave wash on the beach. The plankton so secured may be centrifuged and preserved in the usual manner. Sometimes the water on the leeward border of a shallow brackish pond will be so rich in dinoflagellates that a single dip of the beaker will result in a rich haul. Tidal pools often contain vast numbers of them. Certainly the abundance and variety of these organisms suggest that a more extensive study will yield rich reward. The collections upon which this report is based have been made almost entirely during the summer months, and while it seems probable that the greater number of the commoner species occurring in the region under consideration have been described, others doubtless occur and may be common locally during the summer, and a study of the winter plankton would surely add to the list. It is hoped, however, that this will help to call attention to an interesting and economically important group which has not been adequately treated by students of the plankton on the Atlantic coast of North America.

Since complete descriptions of nearly all the species may be found in Kofoid and Swezy (8) Lebour (9) and Paulsen (16), the descriptions as given here are in many cases somewhat abbreviated, but critical notes are given rather fully, in the hope that they may be of use to other students.

As a matter of convenience, the classification here adopted follows that used by Kofoid and Swezy and by Lebour. This will doubtless be modified in the future. It has, for example, been claimed on plausible grounds that *Prorocentrum* and *Exuviaella* are reduced rather than primitive genera, belonging much nearer the Dinophysidae than is usually admitted. In the Peridiniidae the dependence upon plate formulae for generic distinctions has perhaps been unduly stressed in view of the frequent uncertainty and at least occasional variability of these structures. For alternative classifications, the works of Paulsen (16) and of Schütt (19) should be consulted, as well as the more general discussion in West (20) and Fritsch (21). The concise but illuminating treatment by Calkins (4) is especially helpful, and a careful comparison of his views with those developed in the very complete discussion by Kofoid and Swezy (pp. 77-105), will suggest many interesting and profitable lines of investigation.

Class FLAGELLATA

Sub-class DINOFLAGELLATA

Flagellates with two flagella, one longitudinal, threadlike, usually posterior and trailing, the other usually ribbon-like and held transversely, commonly encircling the cell. Nucleus beaded. No contractile vacuole. Body naked or thecate. Colonial organization and polymorphism in life cycle may occur.

In the following synopsis, the genera listed in this report are inserted in parentheses.

Order ADINIFERIDEA

Girdle and sulcus lacking; body naked or with a theca composed of two (lateral ?) valves.

Tribe THECATOIDAE

Family Prorocentridae (*Exuviaella, Prorocentrum*).

Order DINIFERIDEA

Girdle and sulcus present. Body naked or covered with a theca typically composed of at least three elements.

Tribe GYMNODINIOIDAE

Family Gymnodiniidae (*Amphidinium, Gymnodinium, Gyrodinium, Cochlodinium*).

Family Polykrikidae (*Polykrikos*).

Family Pouchetiidae (*Nematodinium*).

Tribe PERIDINIOIDAE

Family Dinophysidae (*Dinophysis*).

Family Glenodiniidae (*Glenodinium*).

Family Peridiniidae (*Gonyaulax, Diplopsalis, Peridiniopsis, Kryptoperidinium, Peridinium, Ceratium*).

The following artificial key to the genera includes only those genera here reported. It should be used therefore with that fact in mind.

1. Girdle and sulcus lacking 2
1. Girdle and sulcus present 3
   2. Body round or oval, anterior spine lacking or very inconspicuous .... *Exuviaella*
   2. Body oval or heart shaped, compressed; a conspicuous tooth-like process at anterior end where flagella emerge .... *Prorocentrum*
3. Body naked 4
3. Body thecate 9
   4. Not colonial and without ocellus 5
   4. Either colonial or with ocellus 8
5. Girdle displaced less than one-fifth body length 6
5. Girdle displaced more than one-fifth body length 7
   6. Girdle far anterior .... *Amphidinium*
   6. Girdle median or submedian .... *Gymnodinium*
7. Girdle encircling body one to one and one-half times .... *Gyrodinium*
7. Girdle encircling body more than one and one-half times .... *Cochlodinium*
   8. Permanently colonial; ocellus lacking .... *Polykrikos*
   8. Not colonial; ocellus present .... *Nematodinium*
9. Theca of at least three parts, but not divided into plates 10
9. Theca composed of numerous plates 11
   10. Body flattened laterally; covered by two lateral valves; girdle anterior, with conspicuous lists .... *Dinophysis*
   10. Body rotund, or if flattened, not laterally; girdle subcentral; no lists .... *Glenodinium*
11. With one antapical plate only 12
11. With two antapical plates 13
   12. Cell angular globose; strongly reticulate .... *Protoceratium*
   12. Cell lens shaped, not reticulate .... *Diplopsalis*
13. First apical very narrow; girdle displaced one to seven times its width, rarely less .... *Gonyaulax*
13. First apical broader; girdle displaced slightly or not at all 14
   14. Three apicals present 15
   14. Four apicals present 16
15. Cell globose or lenticular .... *Peridiniopsis*
15. Cell flattened dorsoventrally; plates thin .... *Kryptoperidinium*
   16. Horns lacking, or if present less than one-half length of body .... *Peridinium*
   16. Horns present, conspicuous, more than one-half length of body .... *Ceratium*

Genus EXUVIAELLA Cienkowsky

Cell ovate or subcircular when viewed from side, and two valves nearly alike; flagellar pore at anterior end usually slightly excavated in one or both valves; spines lacking or inconspicuous. Chromatophores present. Mostly marine.

The chromatophores are described as platelike, but in all of our species they are broken up into numerous irregular or oval bodies. This same characteristic is shown in Lebour's illustrations of *E. marina* (*E. lima* of this paper) and *E. apora*.

1. Under 25 μ in length, usually 17–22 μ .... *E. apora*
1. Over 25 μ in length 2
    2. Cell only slightly compressed, both valves somewhat indented at flagellar pore .... *E. compressa*
    2. Cell strongly compressed, one valve deeply indented at flagellar pore, the other slightly or not at all .... *E. lima*

Exuviaella apora Schiller

Plate III. Figs. 1–4.

Cell compressed, oval, broadest anteriorally, with striations around the margins of the valves. Chromatophores yellow brown, in our specimens broken up into numerous irregular bodies. Schiller (18) describes this species as 30–32 x 21–26 μ. Our specimens are mostly 17–22 x 14–19 μ, agreeing with the dimensions reported by Lebour for neritic forms. I have no hesitation in applying this name in Lebour's sense to our material. Whether it is the same as Schiller's original species is less certain. A very small delicate spine is sometimes present on the left valve. It is seen with difficulty and only in certain positions. Lebour makes no mention of this, but suggests it in her drawing 4a of Plate I.

Common in Barnegat and Delaware Bays, and often found in oysters' stomachs.

Exuviaella compressa (Stein) Ostenfeld

Plate III. Figs. 5–6.

Cell oval, only very slightly flattened. Both valves slightly indented at the flagellar pore, and each said to have a minute tooth adjoining it. Chromatophores yellow brown, described as two, in the form of hour-glasses; in our material numerous, elliptical or irregular and grouped around a central body on either side. Nucleus posterior. Length 27–40 μ.

Locally common in Barnegat Bay and often in oysters' stomachs.

Our specimens are small, and none with hour-glass shaped chromatophores have been seen. The "tooth" mentioned by Paulsen and by Lebour is rather a shallow rim around the pore. This is *Exuviaella marina* in the sense of Schütt. The central bodies on either side, around which the chromatophores are grouped, may easily be mistaken for nuclei when the cell is viewed laterally.

Exuviaella lima (Ehrenb.) Bütschli

Plate I. Figs. 1–2. Plate III. Figs. 7–9.

Cell oval, strongly compressed, broadest behind the middle; one valve deeply indented at flagellar pore, the other only slightly so. Contents yellow brown; chromatophores described as two, platelike; with us, numerous, irregularly elliptical. Length 38–40 μ.

Common in Barnegat Bay and in ocean.

This is *E. marina* Cienkowski in the sense of Lebour. A rather dull orange stigma is often present.

Genus Prorocentrum Ehrenb.

Cell oval or heart-shaped, strongly compressed. Valves and flagellar pore as in Exuviaella, but latter bordered by a strong, tooth-like process, usually winged. Chromatophores present. Marine, brackish.

1. Triangular, minute, 17–22 μ .... *P. triangulatum*
1. Oval or heart-shaped, larger 2
    2. Laterally asymmetrical; posterior end acute .... *P. micans*
    2. Laterally nearly symmetrical; posterior end round or bluntly pointed .... *P. scutellum*

Prorocentrum micans Ehrenberg

Plate III. Figs. 10–13. Plate VII. Fig. 4. Plate VIII. Fig. 3.

Cell oval, compressed, broadest about the middle, the dorsal side more convex than the ventral; anterior end blunt, one valve bearing a pointed, winged tooth; posterior end pointed; contents granular, yellow-brown. A dull orange, two-parted stigma is present, but usually difficult to see. Length, without spine, 40–45 μ (36–48 μ Lebour).

Extremely common both in Barnegat Bay and in the ocean waters. Almost always present in oysters' stomachs and frequently found in great numbers.

According to the published descriptions, the tooth is always on the left valve. I have observed a number of individuals with the tooth clearly on the right valve. The tooth is longer and stouter on specimens from the ocean than on those occurring in brackish water. A very few otherwise normal cells have been seen, in which the tooth was absent.

Prorocentrum scutellum Schroeder

Plate III. Figs. 19–20. Plate VIII. Fig. 4.

Cell oval, or somewhat heart-shaped, compressed; very bluntly pointed or rounded posteriorly and slightly indented in front, with a small tooth and delicate wing usually on the left but not uncommonly on the right valve. Otherwise as in *P. micans.* Length, without spine, 36–45 μ (40–57 μ Lebour).

Common in ocean waters and at times in Barnegat Bay.

In this species, as in *P. micans,* while the tooth is usually on the left valve, it is not infrequently on the right one, and occasionally lacking altogether.

Prorocentrum triangulatum Martin

Plate III. Figs. 14–18.

Cell strongly compressed, triangular as seen from side, rounded behind, the left valve with a delicate tooth. Surface of valves covered with minute poroids, the margins appearing striate. Chromatophores yellow-brown, irregular, commonly broken up into rather small masses. Length, without tooth, 17–22 μ.

Extremely common in Barnegat Bay, where it is occasionally the most abundant organism in oysters' stomachs; also in Delaware Bay.

Genus Amphidinium Clap. and Lachm.

Body usually compressed dorso-ventrally, less commonly compressed laterally or round in section. Girdle far anterior, with little or no displacement, hence epicone minute, often asymmetrical. Sulcus usually extending length of hypocone, sometimes invading epicone. Surface smooth, striate or ridged. Chromatophores usually present.

While but two species are here reported, several others have been seen, but not in sufficient number or under favorable conditions for study.

Body fusiform, not flattened; epicone relatively large, broadly conical .... *A. fusiforme*
Body ovate, flattened, epicone small .... *A. operculatum*

Amphidinium fusiforme Martin

Plate III. Figs. 21–23.

Cell fusiform, about twice as long as broad, circular in cross section. Epicone hemispherical-conical; girdle anterior; hypocone two to two and one-half times as long as the epicone, long conical or somewhat helmet shaped; sulcus obscure, but apparently encroaching upon the epicone and extending at least half way from the girdle to the antapex. Body packed with yellowish green chromatophores except at the posterior end, which is hyaline; a dull orange stigma is visible in the ventral region beneath the girdle. Nucleus central and dorsal, posterior to the girdle. The entire body encased in a delicate pellicle, usually visible only in fixed specimens in which the contents of the cells have become plasmolyzed. Length usually 17–22 μ; diameter 8–11 μ; sometimes larger or smaller.

Barnegat Bay, common. Delaware Bay, exceedingly abundant locally, occurring in dense swarms in the late summer and giving rise to the phenomenon known as red water.

This species is somewhat intermediate between Amphidinium and Gymnodinium, but is placed in the former genus because of the presence of the pellicle, which is an Amphidinium character; because the posterior margin of the epicone is slightly but distinctly smaller than the anterior margin of the hypocone, and because of its obvious relationship to *A. crassum* Lohman.

Amphidinium operculatum Clap. and Lachm.

Plate III. Fig. 24.

Cell flattened ovate, one and one-half times as long as broad; girdle extended posteriorly on the ventral surface to about one-third the length of the cell; sulcus extending from girdle to antapex, deflected posteriorly to the right; epicone tongue-shaped, metabolic; nucleus posterior; chromatophores yellow brown, radiating from a central body. Length, according to Kofoid and Swezy and Lebour 40–50 μ.

Barnegat Bay. Not uncommon in shallow, clear water over a sandy bottom.

The specimens I refer to this species are all rather small, ranging in length from 43 μ down to 25 μ. They seem to include *A. klebsi* in Lebour's sense, but not in that of Kofoid and Swezy. As a complete series of intermediate stages seems to be present, I include them all in a single species. Scattered reddish brown pigment bodies are often present.

Genus Gymnodinium Stein emend. K. & S.

Cell naked, without torsion; girdle central to subcentral; if displaced, not more than one-fifth the total length of the body; sulcus long or short, but nearly straight; surface smooth, ridged or furrowed. Chromatophores present or absent. Marine and in brackish and fresh water.

All New Jersey species observed possess chromatophores and have a smooth surface.

1. Minute, 9–15 μ in length .... *G. punctatum*
1. Larger, over 40 μ in length 2
   2. Cell only slightly flattened dorso-ventrally; girdle shallow; length 40–55 μ .... *G. subrufescens*
   2. Cells strongly flattened; girdle moderately to deeply impressed; usually larger 3
3. Cell markedly flaring on either side of girdle; chromatophores oval .... *G. nelsoni*
3. Cell flaring little or not at all at girdle; chromatophores elongated .... *G. splendens*

Gymnodinium nelsoni n. sp.

Plate III. Figs. 25–26.

Cell flattened, broadly fusiform, flaring above and below girdle; girdle deeply impressed, subcentral, displaced less than its own width; sulcus encroaching very slightly upon epicone, expanding posteriorly and dividing hypocone into two double lobes; longitudinal flagellum shorter than the body; nucleus central; chromatophores yellow brown, oval; no stigma observed. Length 70 μ.

Barnegat Bay, not uncommon. Delaware Bay, occasional.

Close to *G. splendens,* but broader, flatter, with a conspicuous flare in the center, and with oval instead of elongated chromatophores. The individuals are sluggish in their movements and have a marked tendency to rest at an angle to the horizontal when mounted on a microscopic slide, which makes it difficult to measure their length accurately.

Gymnodinium punctatum Pouchet

Plate I. Figs. 3 & 4.

Cell nearly as broad as long; epicone blunt, hypocone blunt and notched; girdle median, broad and shallow; sulcus nearly straight, running from notch in hypocone to girdle; nucleus very large, beaded, occupying the greater part of the epicone; chromatophores brownish green, two large ones in the hypocone, several smaller ones in the epicone; pigment spot present. Length 9–15 μ.

A minute autophytic species, extremely abundant in Barnegat Bay. Pouchet, in his original description, (quoted by Kofoid and Swezy) gave the length as 10 μ. This is similar in appearance to the very minute species, ranging from 1.7 to 7 μ described by Lebour as *G. simplex,* but the minimum size of the New Jersey forms is above the maximum as given by that author. Kofoid and Swezy apply the name *G. simplex* to a species 20 μ in length.

It is possible that these puzzling forms represent zoospores of one or more larger species.

Gymnodinium splendens Lebour

Plate I. Figs. 5–11. Plate VIII. Fig. 1.

Lebour's description is as follows: "Cell oval, flattened dorso-ventrally, convex dorsally, flat or concave ventrally. Epicone and hypocone nearly equal. Girdle slightly impressed, displaced about a girdle width, anterior pore at the junction of sulcus and girdle. Sulcus not extending on to epicone, expanding posteriorly and deeply notching the antapex. Posterior pore about two girdle widths behind the anterior pore. Longitudinal flagellum longer than the body. Transverse flagellum nearly encircling the girdle. Nucleus subcentral, slightly anterior. Large elongated bright yellow chromatophores radiating from outside the center to periphery, leaving the center clear. Length 54–56μ."

Our specimens agree very well with this description, except that the variation in length is very much greater, ranging from 50 to 77 μ. The girdle, while not deep, is very distinct as compared with that of *G. subrufescens.* A double pigment spot is sometimes visible on the ventral side near the junction of the girdle and sulcus. Sometimes the chromatophores appear as though fused into a network, at other times they are fairly distinct, although never as definitely outlined as in certain other species. There is not infrequently a suggestion of a mucilaginous envelope surrounding the cell. This is strongly brought out if the living cells are killed with a strong solution of iodine in potassium iodide (Plate I, Fig. 9). Frequently brown or greenish bodies are observed in the epicone above the nucleus. Sometimes the right central portion of the upper margin of the girdle, at its junction with the sulcus, is slightly extended as if to form a rudimentary tentacle. The nucleus is strongly beaded, and is very distinctly larger in living cells than in those that have been preserved. Otherwise, preservation by the osmic, chrom-acetic, formalin method is very satisfactory.

This handsome dinoflagellate is the most abundant large species in Barnegat Bay, occurring in dense swarms in August and September, yet it had never been observed in preserved plankton collections. On one occasion fifty gallons of water were pumped portion of the body is less extended, and in the somewhat larger size. One specimen, 42 μ long, was found in ocean plankton on a prepared slide.

Atlantic Ocean. Rare.

Cochlodinium helix (Pouch.) Lemm. ex Lebour

Plate II. Fig. 4.

Cell oval, with marked girdle and sulcus, the former making two complete turns and ending in a characteristic posterior process. I follow Lebour in applying this name to a small greenish species. But one specimen seen, in which the nucleus was obscured by a large food body occupying most of the anterior portion of the cell. Length 30 μ.

Barnegat Bay, rare.

Genus Polykrikos Bütschli

A permanent colony, usually of 4 or 8, sometimes 2 or 16 zooids; nuclei half as many or one-fourth as many as the zooids. Chromatophores usually absent; each zooid with a girdle which may or may not be displaced; sulcus continuous on the ventral side of the colony; each zooid with a transverse and a longitudinal flagellum. Nematocysts usually present. Marine.

Two species known from New Jersey.

Chromatophores present; nematocysts lacking ....*P. barnegatensis*
Chromatophores lacking; nematocysts present ....*P. kofoidi*

Polykrikos barnegatensis Martin

Plate IV. Fig. 2.

Body ovate, nearly circular in cross section, slightly concave on ventral side, composed of two zooids, closely united, with a very slight constriction between the individual zooids and a single large beaded nucleus in the center; the girdle of each zooid a descending left spiral, displaced twice its width; the sulcus extending from just below the anterior end to the posterior end, which is slightly two-lobed. Ground protoplasm colorless, but containing numerous oval, yellow brown chromatophores. Nematocysts lacking; evidently autophytic. Length 46 μ; diameter 31.5 μ.

Barnegat Bay, Sept. 7, 1928. But one individual seen, which was observed in living condition for nearly a half hour, when it underwent cytolysis.

Polykrikos kofoidi Chatton

Plate IV. Figs. 3–4. Plate VIII. Fig. 9.

Unit composed of four or eight, sometimes two or sixteen zooids, forming a subcylindrical or ovate whole, with half the number of nuclei that there are zooids; the girdle of each zooid a descending left spiral, displaced one-sixth the diameter of the zooid or slightly more; the sulcus extending the entire length of the colony. The hypocone of each zooid is ribbed. Color pale rose to deep pink. Nematocysts present. Length of chain of four zooids 85-110 μ; diameter 50 μ or more, rarely 75 μ.

Barnegat Bay; Delaware Bay. Abundant.

The nuclei of the New Jersey specimens are large, with conspicuously beaded strands of chromatin, and except when pushed aside by food bodies, nearly in the center of the two zooids with which they seem to be associated. The ribbed hypocones are best seen by cutting down the light admitted through the condenser.

This species is preserved fairly well by the methods described in the introduction, especially by the saturated bichloride solution, but the cytoplasm in preserved specimens tends to become yellow brown and very dense, obscuring details of structure, and for some reason does not stain well either with iron alum haematoxylin or with the trypan blue-phloxine combination.

Genus Nematodinium K. & S.

With ocellus and nematocysts. Girdle overlapping, displaced more than one-half the diameter of the cell. Sulcus with torsion of three-fourths of the circumference or more. Nutrition usually holozoic, but yellow brown pigment frequently present. Marine.

But one species known from New Jersey.

Nematodinium armatum (Dogiel) K. & S.

Plate II. Figs. 5–7.

Body ellipsoidal, about one and one-half times as long as broad; girdle a descending left spiral of one and one-half turns, displaced three-fourths of the transverse diameter; sulcus a spiral, extending beyond ends of girdle, ocellus posterior, simple, lens spheroidal, pigment mass subhemispherical, black; nucleus large, anterior; nematocysts usually 4–8, dorsal. Color yellowish to yellowish brown. Length 48–55 μ.

Barnegat Bay. Abundant August 1927.

Some confusion exists concerning this species. Dogiel originally described it as 50 μ in length, which agrees with our specimens. Kofoid and Swezy describe a species from California under this name, but it is much larger, 95–100 μ in length. They suggest that Dogiel made a mistake in indicating the magnification of his figure. Lebour describes a small form, ranging from 28–44 μ in length, from Plymouth, as this species. Her figure 5a on Plate X depicts a more slender and more fusiform organism than Dogiel's. It is quite possible that there are not only two, as she suggests, but three species in this series, one from Plymouth (Lebour), one from La Jolla (Kofoid and Swezy) and a third from the Mediterranean (Dogiel), the last named being the true *N. armatum* and agreeing with the specimens from New Jersey.

Genus Dinophysis Ehrenb.

Thecate, theca composed of two lateral halves united at the edges; cell compressed laterally; epitheca very small, often not protruding from the large, oblique girdle lists, these and the conspicuous longitudinal list supported by strong spines. Chromatophores usually, perhaps always, present. Marine.

1. Hypotheca divided into a broad anterior and a slender posterior portion .... *D. caudata*
1. Hypotheca ovate in lateral view 2
   2. Longitudinal list extending about half way down the hypotheca, supported by spines all of which are directed forward .... *D. acuminata*
   2. Longitudinal list extending two-thirds of the way down the hypotheca; posterior spine directed backward .... *D. ovum*

Dinophysis acuminata Clap. and Lach.

Plate II. Figs. 8–9. Plate VIII. Fig. 6.

Body oval, compressed, rounded behind and usually with three or four small wart-like or spine-like protuberances at the posterior end, which may, however, be lacking. Epitheca small, not protruding beyond the rather flat funnel formed by the posterior girdle list. Left longitudinal list delicate, extending little more than half way down the body of the cell, supported by spines all of which are directed forward. Surface covered with numerous poroids. Chromatophores yellow. Length, excluding spines and lists. 38–48 μ.

Barnegat Bay and Ocean. Fairly common.

Jörgensen's figures, as reproduced by Paulsen, show the posterior spine directed backwards. Lebour's figures, on the other hand, show all the spines directed forward, which agrees with our material.

Dinophysis caudata Kent

Plate IV. Fig. 14.

Cell irregular when viewed laterally, the epitheca small, not protruding above the posterior girdle list; the hypotheca broad anteriorly but abruptly narrowed to a subcylindrical horn-like posterior portion. A dorsal fin is often present. Length, excluding projecting list, 87 μ.

Barnegat Inlet. But one individual seen.

Dinophysis ovum Schütt

Plate II. Fig. 10. Plate VIII. Fig. 5.

Cell oval, somewhat flattened and asymmetric when viewed from the side, broadest behind the middle, rounded behind. Epitheca small, not protruding above the posterior girdle list. Longitudinal list broad, extending more than two-thirds down the cell, supported by two spines in addition to the one which also helps to support the posterior girdle list, the posterior spine directed backward. Theca with numerous poroids; color yellow brown.

Occasional—Barnegat Bay and ocean, 1927.

According to Lebour the length of this species is 44–54 μ; Paulsen gives the estimated length as 70 μ. Our specimens are all over 50 μ, the largest one seen being 65 μ in length.

Genus Glenodinium (Ehrenb.) Stein

Theca of three parts; epitheca, girdle and hypotheca, not divided into plates. Globose, or flattened dorso-ventrally or antero-posteriorly, never laterally. Chromatophores always present. Chiefly living in fresh and brackish water, with a few marine forms. Many species formerly included in this genus are now known to have plates and have therefore been transferred to various genera of the Peridiniidae.

But one species known from New Jersey.

Glenodinium danicum Paulsen

Plate II. Fig. 11. Plate III. Figs. 27–30.

Nearly globose, slightly pointed anteriorly. Girdle left-handed, displaced about a girdle's width. Hypocone rounded, obscurely divided into two lobes by the sulcus. Contents deep greenish brown, with a conspicuous stigma, commonly composed of two parts, one straight, the other bent, these usually united, but often separate or nearly so. Length 22–32 μ.

Barnegat Bay, very common, frequently coloring tidal pools brown and often in oysters' stomachs.

Genus PROTOCERATIUM Bergh

Body oval or spherical, somewhat angular; girdle central. Plate formula 2′, 6″, 6‴, 1p, 1⁗. Apical pore probably lacking. There is but one species.

Protoceratium reticulatum (Clap. & Lachm.) Bergh

Plate IV. Fig. 10.

Angular globose; girdle equatorial, displaced about its own width, with narrow lists supported by spines. Ventral area not quite reaching antapex. Theca strongly reticulated and with minute spines obscuring the plates. Length 28–56 μ (Lebour).

Barnegat Bay. But one individual, 43 μ in diameter, collected. Scarcely angular, but the plates of the epitheca and the distinctive reticulate markings unmistakable.

Genus GONYAULEX Diesing emend. Kofoid

Body variously shaped, covered with a compound theca. Formula 3–6′, 0–3a, 6″, 6g, 6‴, 1p. 1⁗. There is in addition, a rounded apical platelet. Apex rounded or truncate, never acutely symmetrically pointed; antapex various; girdle subequatorial, forming a descending left spiral, displaced one-half to seven girdle widths, sometimes with over-hang. Surface usually reticulate. Lists present or absent. Chromatophores always present. Marine, and in brackish and fresh water.

The spirally descending girdle and the single posterior intercalary and antapical plates are characteristic.

No antapical spines, cell rotund .... *G. scrippsae*
With 1—several antapical spines, rarely none; cell more elongated .... *G. spinifera*

Gonyaulax scrippsae Kofoid

Plate III. Figs. 31–32.

Cell subglobose, not flattened. Epitheca subhemispherical, contracted abruptly to form a small apical horn, with apex tilted toward ventral face. Hypotheca nearly hemispherical. Girdle equatorial, descending, displaced 2–3 girdle widths and with an overhang of 0.1 to 1 girdle width, with marginal ridges but without lists. Ventral area sigmoid, rather narrow. Plate formula 3′, 6″, 6‴, 1p, 1⁗. Length 29-39 μ; diameter 27–34 μ.

Our specimens agree satisfactorily with Kofoid's original description (7) of which the above is an abridgment.

Barnegat Bay. Common.

Gonyaulax spinifera (Clap. & Lachm.) Diesing ex Kofoid

Plate III. Fig. 33.

Cell irregularly ovoid, elongated anteriorly into a blunt apical horn, sometimes broken at tip into short spine-like processes. Girdle a descending left spiral, displaced one to two widths, wide, with marked overhang. Hypocone rounded, somewhat lobed, tipped by one or more antapical spines, rarely spineless. Contents deep greenish brown, due to numerous chloroplasts. Stigma double, conspicuous, bright red. Length, without spines, 28–32 μ. (24–50 μ Kofoid).

There are usually three strong antapical spines; if more, they are apt to be smaller. A variety with one spine, which may vary greatly in size and contour, is often common. Not infrequently individuals approaching *G. digitale*, and 35–40 μ in length, occur. These are larger than the common form and have less girdle overhang. Kofoid gives 37 μ as the smallest observed length of *digitale*, and cites that as exceptional. It is possible, however, that some of our forms would fit into that species.

Barnegat Bay. Delaware Bay. Common.

Genus DIPLOPSALIS Bergh

Cell lens-shaped, with an apical pore and a conspicuous left longitudinal list. Plate formula 3′, 1a, 6″, 5‴, 1⁗.

Diplopsalis lenticula Bergh

Plate IV. Figs. 11–13.

With the characters of the genus. Color pale pink. Girdle central, not displaced, girdle lists supported by fine spines. Longitudinal furrow reaching nearly to the center of the hypotheca. Length, in our specimens, 28–30 μ; diameter 39–45 μ. (29–34 μ x 33–40 μ Lebour).

Our specimens are somewhat flatter than as described by Lebour and I have been unable to make out the complete plate structure. I assign them to this species on account of the shape and size, the prominent left longitudinal list and the characteristic first apical plate.

Barnegat Bay. Apparently not common.

Genus PERIDINIOPSIS Lemmermann

Cell globose, conical or lenticular. Plate formula 3′, 1–2a, 6″, 5‴, 2″″. Differing from Diplopsalis mainly in having two antapical plates.

Peridiniopsis rotunda Lebour

Plate II. Figs. 12–16. Plate III. Figs. 34–35.

Plate VIII. Fig. 2.

Cell globose. Epicone slightly conical with a minute apical projection bearing the apical pore; girdle central, not displaced, broad, with wide lists; hypocone flattened hemispherical; longitudinal furrow not reaching to the center of the hypotheca, provided with lists, the left one conspicuous and wing-like. Nucleus beaded. Contents pinkish, often nearly colorless. Diameter 20–28 μ.

Barnegat Bay. Extremely abundant in plankton and often in oysters' stomachs. What seems to be a larger phase of the same species, 25–32 μ in diameter, is common in ocean samples.

This is probably the species listed by Paulsen as ***Diplopsalis pillula*** Ostenfeld. The plates are difficult to see but the large intercalary extending from the first apical to beyond the center of the dorsal region is characteristic and can usually be made out in specimens stained very lightly with trypan blue. In our material the protuberance bearing the apical pore is usually much less prominent than indicated in Lebour's drawings. Lebour is not quite certain that there are six precingulars. I am able to make out only five.

Genus KRYPTOPERIDINIUM Lindemann

Cell with a very thin theca, divided into plates which are recognizable only with the help of reagents. Apical pore present; longitudinal furrow small; girdle not displaced. Plate formula 3′, 2a, 7″, 5‴, 2″″. Occasionally with four apicals.

Kryptoperidinium foliaceum (Stein) Lindemann

Plate IV. Figs. 5–9.

Cell flattened dorsiventrally; convex dorsally, concave ventrally. Epitheca rounded, hypotheca somewhat oblong. Girdle excavated, without lists. Color greenish brown, with a red stigma. Length 35–40 μ.

Lebour says "twisted on its axis" but what this means is not apparent from her plates. Our specimens are less compressed than indicated in her drawings, and there is a conspicuous wing, bordering the left side of the anterior ventral excavation. They may belong to a distinct species.

Barnegat Bay. August. Not uncommon.

Genus PERIDINIUM Ehrenb.

Cell thecate, more or less top-shaped; apical pore and apical horn usually present. Plate formula 4′, 3a, 7″, 5‴, 2″″. Chromatophores present or absent. Marine and in brackish and fresh water.

This very large genus is typical of the armored peridines, although the successive segregation of groups of species once included in it, to form new genera, has greatly narrowed its scope.

For forms with only two anterior intercalaries the genus *Archaeperidinium* was established by Jörgensen. This is regarded by Lebour as a subgenus of *Peridinium*. I have found but one species of *Archaeperidinium* in New Jersey—a small oval form that was abundant in a collection of ocean plankton made in September—and I have been unable to find a description that fits it.

The treatment as here given is based on that of Jörgensen (5), who divides the genus into two subgenera and seven sections, as follows:

Subgenus *Orthoperidinium*. First apical touching neither precingulars 2 nor 6, but only 1 and 7 (Plate VII, Fig. 15). Girdle descending (with reference to left ventral end) or circular.

Section I. *Tabulata*. Second anterior intercalary plate touching two precingulars only (Plate VII, Figs. 11–12). Girdle usually descending. Apical and antapical horns undeveloped.

Section II. *Conica*. Second anterior intercalary plate touching three precingulars, one broadly and two at the corners (Plate VII, Fig. 14). Girdle usually circular. Horns developed slightly or not at all.

Section III. *Oceanica*. Second anterior intercalary plate touching only the middle precingular (Plate VII, Fig. 13). Girdle usually descending. Horns usually prominent.

Subgenus *Metaperidinium*. First apical touching precingulars 1, 2 and 7 (Plate VII, Fig. 16), and, in the section Paraperidinium, also 6 (Plate VII, Fig. 17). Girdle circular or ascending.

Section IV. *Pyriformia*. Second anterior intercalary as in Tabulata. Girdle ascending. A short apical horn and usually solid and more or less conspicuously winged antapical spines present.

Section V. *Paraperidinium.* First apical bordering more or less on precingular 6, in addition to 1, 2 and 7 (Plate VII, Fig. 17). Second anterior intercalary as in Conica. Girdle ascending. A short apical horn present, and usually solid, more or less winged antapical horns, the left one possessing a similar ventral accessory spine.

Section VI. *Humilia.* Second anterior intercalary as in Oceanica. Girdle ascending. Horns lacking or poorly developed, but one or two solid spines often present.

Section VII. *Divergens.* Second anterior intercalary as in Oceanica. Girdle usually circular. Apical and antapical horns strongly developed, the latter with or without solid terminal spines.

Within the sections as listed above, the following species have been distinguished:

Orthoperidinium

I. *Tabulata* .... *P. claudicans*
II. *Conica*
  1. Chlorophyll present .... *P. trochoideum*
  1. Chlorophyll lacking 2
    2. Posterior horns minute or lacking .... *P. achromaticum*
    2. With conspicuous posterior horns or spines 3
  3. Sides convex .... *P. leonis*
  3. Sides strongly concave .... *P. excavatum*

Metaperidinium

V. *Paraperidinium*
  1. Pale yellowish green, with chlorophyll (?) .... *P. pallidum*
  1. Pale yellow, no chlorophyll .... *P. pellucidum*
VI. Humilia .... *P. brevipes*

Peridinium claudicans Paulsen

Plate V. Figs. 1–3. Plate VII. Fig. 3.

Cell somewhat ovate, depressed dorso-ventrally, with two large, hollow, antapical horns, the right somewhat longer than the left. Epitheca subconical, the sides distinctly convex, and the apex continued into a conspicuous horn; girdle descending, very slightly excavated, with lists. Contents pale yellowish. Diameter (our specimens) 53–58 μ.

Tuckerton Bay. Common.

Peridinium trochoideum (Stein) Lemm.

Plate V. Figs.11–12. Plate VII. Figs. 5–6.
Plate VIII. Fig. 7.

Cell pear-shaped, with conspicuous apical horn; hypotheca hemispherical; girdle descending, with inconspicuous lists; longitudinal furrow short, enlarged posteriorly, with narrow lists; no spines. Cell densely packed with deep greenish brown chromatophores. Stigma present. Length 20–32μ, diameter 17–23 μ.

The plates are very delicate, and this fact, together with the dense contents, makes them very difficult to see, except in an empty or nearly empty theca very lightly stained in trypan blue. Lebour gives the cell diameter as 23–28 μ; Paulsen (using the name *Glenodinium trochoideum*) as 23 μ.

Barnegat Bay. Extremely abundant.

Peridinium achromaticum Levander

Plate V. Figs. 4–7.

Cell somewhat rhombic in dorsal or ventral view. Epicone with nearly straight or somewhat convex sides; girdle nearly circular or slightly descending, excavated, with narrow lists; hypotheca with convex sides; longitudinal furrow broadening behind, with sharp margins somewhat resembling spines. Contents colorless. Diameter 28–49 μ (Lebour) 31–44 μ (Paulsen); in our specimens mostly 35–45 μ.

Tuckerton Bay, Barnegat Bay. Not rare.

In most of the individuals seen the surface was nearly smooth. Some forms apparently belonging here had the surface reticulate and spiny. Several thecae were seen in which an extra intercalary plate had been cut off from the fourth apical, so as to lie between the fourth apical and the sixth and seventh precingulars, sometimes touching the first apical as well.

Peridinium leonis Pavillard

Plate VI. Figs. 3–5.

Cell more or less pentagonal, with a deep depression between the posterior horns, each of which is tipped with a solid spine. Color pink. Lebour gives the diameter of this species at 65–95 μ. Our forms range from 60–65 μ.

Delaware Bay, abundant. Barnegat Bay, common.

Peridinium excavatum n. sp.

Plate V. Figs. 8–10.

Cell short and broad, with concave sides and strong antapical spines. In ventral and dorsal view about as broad as long; somewhat flattened dorso-ventrally; kidney-shaped in apical view. Epitheca conical, concave. Girdle median, circular, tilted, the main axis making an angle of 10–15° with it; highest posteriorly, with broad, thin lists supported by spines. Hypotheca strongly concave, ending in two conspicuous horns each tipped by a strong solid spine, often with minute accessory spine-like processes. Color pink. Diameter 56–71 μ. Plate formula 4′, 3a, 7″, 5‴, 2⁗. Belonging to the section *Conica* of the subgenus Orthoperidinium. Close to *P. leonis*, from which it differs chiefly in the conspicuously concave sides and the much greater divergence of the posterior horns.

Barnegat Bay, common.

Both this and the preceding species bear a superficial resemblance to small forms of *P. divergens*, from which species they differ in the arrangement of the plates and in the possession of solid antapical spines at the tips of the horns. The true *P. divergens* has not been recognized from the area under consideration.

Not infrequently the pink contents of the cells of *P. excavatum* are aggregated into irregular chromatophore-like bodies, suggesting that this species, and perhaps other pink species possess a photosynthetic pigment similar to that of the red algae.

Peridinium pallidum Ostenfeld

Plate VI. Figs. 1–2.

Cell ovate, flattened dorso-ventrally; epitheca conical, somewhat convex, with short apical horn; girdle ascending, not excavated, with broad lists supported by numerous spines; hypotheca rounded, the right lobe ending in one, the left lobe in two strong winged spines, the wing of the left side extending upward along the left margin of the longitudinal furrow. Length 70–90 μ (Paulsen).

According to Lebour this species, which is common in Europe, contains numerous yellowish green chromatophores.

Tuckerton Bay. But one specimen seen, 75 μ long by 56 μ broad. The conspicuous anterior borders of the first apical were continued in a nearly straight line as ridges between the first and second and sixth and seventh precingulars, while the posterior margins of the first apical were very faint.

Peridinium pellucidum (Bergh) Schütt

Plate VII. Figs. 1–2.

Cell broadly oval, very slightly flattened dorso-ventrally. Girdle excavated, slightly ascending, with lists supported by spines. Right lobe ending in one, left in two antapical spines, which may be with or without wings. Contents colorless or pale pinkish or yellowish. Breadth 36–70 μ (Lebour).

Barnegat Bay, rare. But one individual seen. The contents were pale yellow and the median antapical spine was less conspicuous than as shown by Lebour, being apparently a continuation of the left longitudinal list.

Peridinium brevipes Paulsen

Plate VII. Figs. 8–10.

Cell somewhat rhombic, with rounded sides and a conical apex; girdle ascending, excavated, with very narrow lists; longitudinal furrow broadening toward antapex which may or may not bear two small spines. Colorless. Length 18–36 μ.

A small colorless form, agreeing in size and shape with this species, and usually having two spines, is often abundant in various parts of Barnegat Bay. As the plates have not been completely made out, the assignment is tentative.

Genus Ceratium Schrank

Cell usually flattened dorso-ventrally, with usually three, rarely two, conspicuous horns. Plate formula 4′, 5″, 5‴, 2⁗. Girdle somewhat left handed, with lists. Chromatophores always present. Marine and fresh water.

1. Right posterior horn nearly suppressed; long fusoid .... *C. fusus*
1. Three horns prominently developed 2
   2. Very small; posterior horns short and nearly straight .... *C. minutum*
   2. Medium to large; posterior horns long and curved forward 3
3. Posterior horns converging forward .... *C. bucephalum*
3. Posterior horns not converging .... *C. tripos*

Ceratium bucephalum Cleve

Plate VI. Fig. 6. Plate VIII. Fig. 8.

Epitheca triangular, with convex sides, merging into the straight somewhat tapering apical horn. Hypotheca truncate, nearly the same length as the epitheca; posterior horns nearly equal, curved upward and inward, closed. Breadth at girdle, 55 μ, length 125 μ.

Rare, only a few specimens seen.

The length of our specimens is less than in the published descriptions, and the apical horn is open, otherwise the agreement is satisfactory.

Ceratium fusus (Ehrbg.) Clap. and Lachm.

Plate VI. Fig. 7.

Very long and narrow; left posterior horn only developed, the right represented by a small toothlike protuberance. Girdle central. Length 300–600 μ; breadth 15–30 μ. (Lebour). Our specimens mostly about 400 x 28 μ.

A well known pelagic species brought into Barnegat Bay by currents. Common in ocean plankton.

Ceratium minutum Jörgensen

Plate II. Figs. 17–19. Plate V. Figs. 13–14.

Epitheca subtriangular with a nearly straight apical horn; hypotheca blunt, rounded or truncate; left posterior horn nearly straight, shorter than hypotheca; right posterior horn similar, shorter. Rarely a thin membranous wing connects the two horns. Length 80–105 μ; diameter 25–31 μ.

Common in ocean plankton, occasional in Barnegat Bay.

Ceratium tripos Ehrenb.

Plate VII. Fig. 7.

The largest peridine here reported. The three horns are well developed, the apical horn ending in a pore, the antapical horns closed, the right shorter and less bent than the left. Length 350–400 μ; breadth at girdle 70–80 μ.

This familiar oceanic species has been collected only at or near Barnegat Inlet where it is fairly common. Our specimens all seem to belong to the variety *atlantica* Ostenfeld.

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EXPLANATION OF PLATES

All figures outlined with camera lucida. Inasmuch as they were drawn over a period of several years, using various combinations of lenses mounted on different microscopic stands, it has been impossible to reduce the drawings to the same scale. The actual dimensions are therefore given for each figure. Where two or more drawings are connected by a dotted line, it indicates that they are different views of the same individual.

Plate I.

Figs. 1-2. *Exuviaella lima*. 1. Left lateral, showing chromatophores and pigment spot, 39 x 28 μ. 2. Right side of distorted cell 42 x 32 μ.

Figs. 3-4. *Gymnodinium punctatum*. 3. 10 μ long. 4. 17 μ long.

Figs. 5-11. *Gymnodinium splendens*. 5. Ventral, 62 μ long. 6. Dorsal, 71 μ long. 7. Ventral, with rudimentary tentacle, 64 μ long. 8. Ventral, strongly convoluted, 68 μ long. 9. Dorsal, after treatment with IKI, showing sheath, 50 μ long. 10. Transverse optical section in outline. 11. Longitudinal optical section.

Figs. 12-21. *Gyrodinium pellucidum*. 12 and 13. Ventral and anterior dorsal view of individual 32 μ long, 14 and 15. Two dorsal views of individual 25 μ long. 16. Dorsal, 31 μ long. 17. Ventral, 27 μ long. 18. Ventral, 31 μ long. 19. Ventral, 34 μ long drawn from dorsal surface, hence reversed. 20. Dorsal, 31 μ long. 21. Ventral, with large food body, 35 μ long.

Fig. 22. *Cochlodinium helicoides*. 42 μ long.

PLATE I

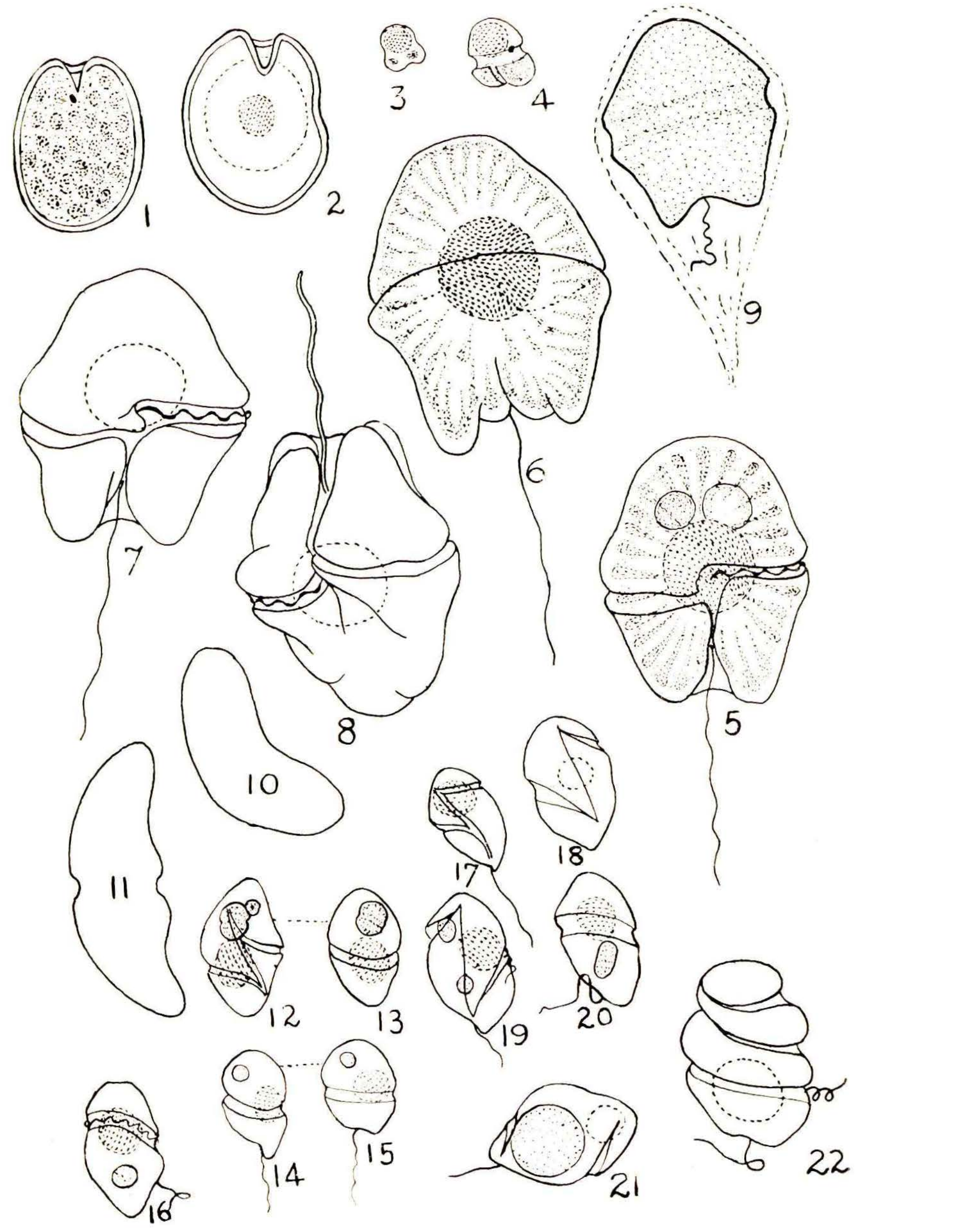

Plate II.

Figs. 1-3. *Gyrodinium pingue*. 1. Slender individual, 57 μ long. 2. Stout individual, 55 μ long. 3. Equatorial optical section of individual similar to that shown in Fig. 1.

Fig. 4. *Cochlodinium helix*, 32 μ long.

Figs. 5-7. *Nematodinium armatum*. 5. Right, somewhat dorsal posterior, with large food body, 47 μ as drawn in oblique position. 6 & 7. Right ventral and right lateral views of same cell, 55 μ long.

Figs. 8-9. *Dinophysis acuminata*. 8. Right lateral, 45 μ long, excluding list. 9. Left lateral, 43 μ long.

Fig. 10. *Dinophysis ovum*. Left lateral, 61 μ long.

Fig. 11. *Glenodinium danicum*. Anterior ventral, 27 μ long.

Figs. 12-16. *Peridiniopsis rotunda*. 12. Ventral 23 μ long. 13. Dorsal, 23 μ long. 14. Left lateral, 22 μ long. 15. Dorsal, with food bodies, 24 μ long. 16. Antapical, 22 μ in diameter.

Figs. 17-19. *Ceratium minutum*. 17. Ventral, diameter at girdle 27 μ. 18 & 19. Lateral and left dorsal outlines of same individual.

PLATE II

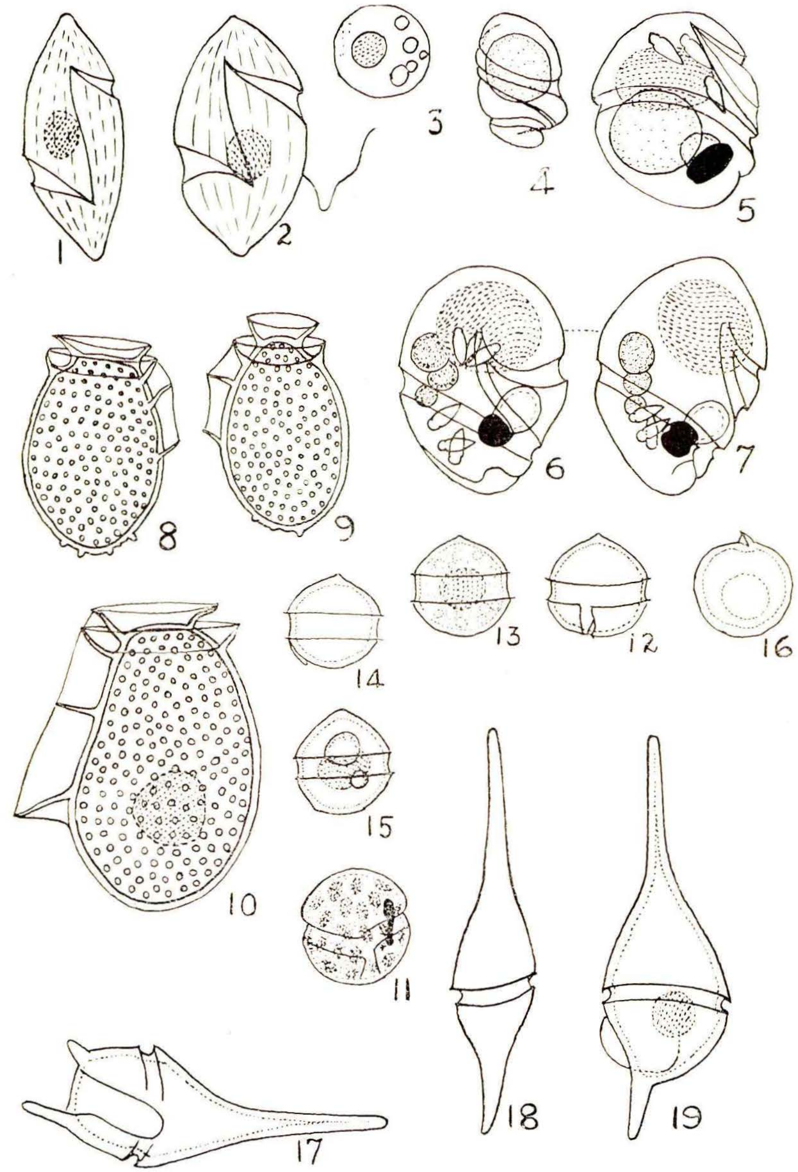

Plate III.

Figs. 1-4. *Exuviaella apora.* 1 & 2. Right lateral and dorsal view of individual 21 μ long. 3 & 4. Left lateral, showing minute spine, and posterior view of individual 18 μ long.

Figs. 5-6. *Exuviaella compressa.* 5. Lateral, 27 μ long. 6. Dorsal 26 μ long.

Figs. 7-9. *Exuviaella lima.* 7. Left lateral, showing chromatophores and stigma, 39 μ long. 8 & 9. Right lateral and dorsal views of cell 42 μ long.

Figs. 10-13. *Prorocentrum micans.* 10. Left lateral, ocean form with strong spine, 48 μ long excluding spine. 11. Empty theca, ocean form, splitting into the two halves, showing spine on right valve, 47 μ long. 12. Right dorsal, from ocean, 45 μ long. 13. Left lateral view of form from Barnegat Bay, showing small anterior spine and unusually numerous spines on sides of theca, 43 μ long.

Figs. 14-18. *Prorocentrum triangulatum.* 14 & 15. Right and left lateral views of individual 18 μ long, excluding spine. 16, 17 & 18. Right lateral, optical transverse section from anterior end of individual 16 μ long.

Figs. 19-20. *Prorocentrum scutellum.* 19. Right lateral, cell with exceptionally thick wall, 40 μ long, excluding spine. 20. Left lateral, 42 μ long.

Figs. 21-23. *Amphidinium fusiforme.* 21. Dorsal, showing chromatophores, 27 μ long. 22. Ventral, 30 μ long. 23. Dorsal, 18 μ long.

Fig. 24. *Amphidinium operculatum,* ventral, 43 μ long.

Figs. 25-26. *Gymnodinium nelsoni.* 25. Dorsal, 69 μ long. 26. Ventral, as drawn, 65 μ long, but at an angle, therefore longer.

Figs. 27-30. *Glenodinium danicum.* 27. Left ventral, showing chromatophores and stigmas, 26 μ long. 28. Ventral, 32 μ long. 29. Empty theca, dorsal, 22 μ long. 30. Empty theca, optical section 18 μ broad.

Figs. 31-32. *Gonyaulax scrippsae.* 31. Dorsal, 33 μ long. 32. Anterior ventral, 34 μ long as drawn.

Fig. 33. *Gonyaulax spinifera.* Ventral, 34 μ long.

Figs. 34-35. *Peridiniopsis rotunda.* 34. Ventral, 20 μ long. 35. Dorsal, 22 μ long.

PLATE III

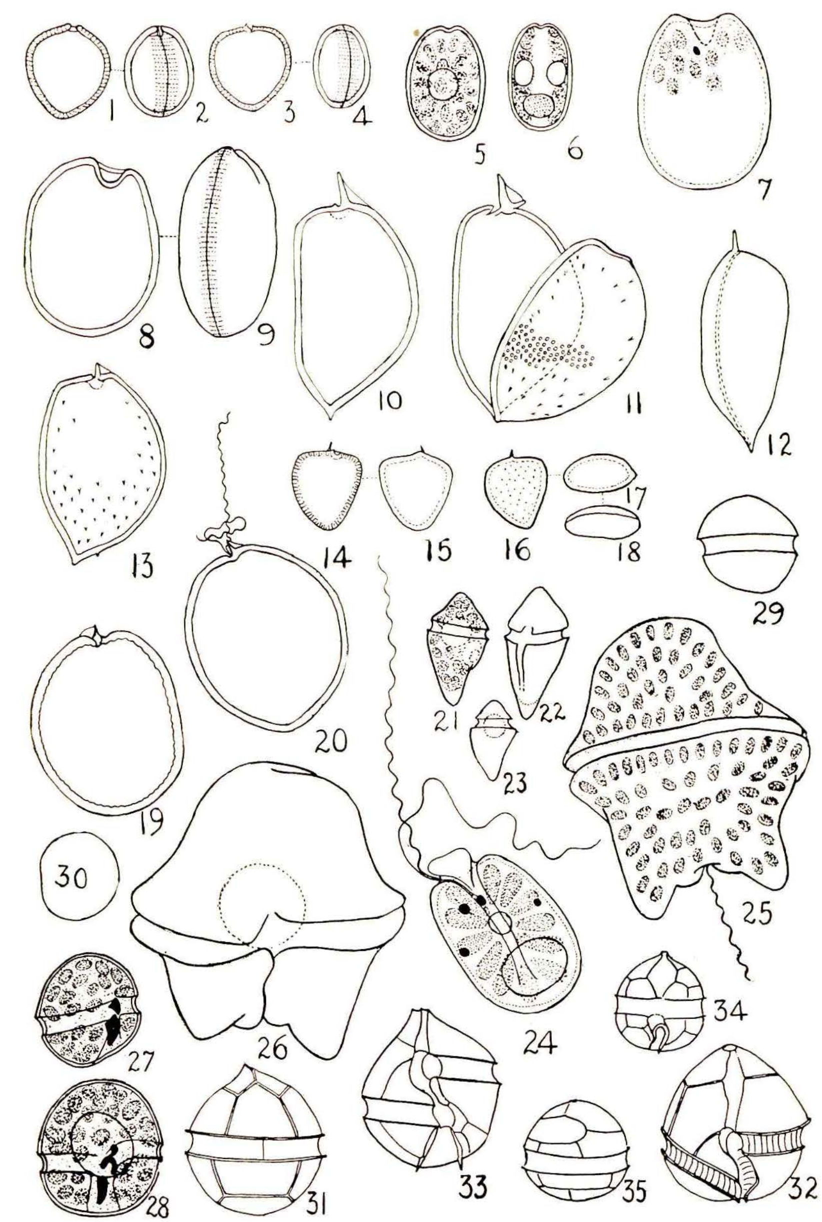

Plate IV.

Fig. 1. *Gymnodinium subrufescens.* Ventral, 54 x 43 μ.

Fig. 2. *Polykrikos barnegatensis.* Ventral, 47 μ long.

Figs. 3-4. *Polykrikos kofoidi.* 3. Ventral, showing fluted hypocones, 88 μ long. 4. Dorsal, 93 μ long, specimen distorted by large armored dinoflagellate taken as food.

Figs. 5-9. *Kryptoperidinium foliaceum.* 5, 6, 7 & 8. Left lateral, dorsal, right posterior, and left posterior ventral of individual 36 μ long. 9. Ventral, 40 μ long.

Fig. 10. *Protoceratium reticulatum.* Ventral, 40 μ long. The dotted lines indicate plate structure adapted from Lebour.

Figs. 11-13. *Diplopsalis lenticula.* 11. Anterior, 39 μ in diameter. 12. Posterior, 44 μ in diameter. 13. Right lateral, 28 μ from apex to antapex. The dotted lines in Figs. 11 and 12 indicate plate structure adapted from Lebour.

Fig. 14. *Dinophysis caudata.* 87 μ long excluding anterior list. Note dorsal fin.

PLATE IV

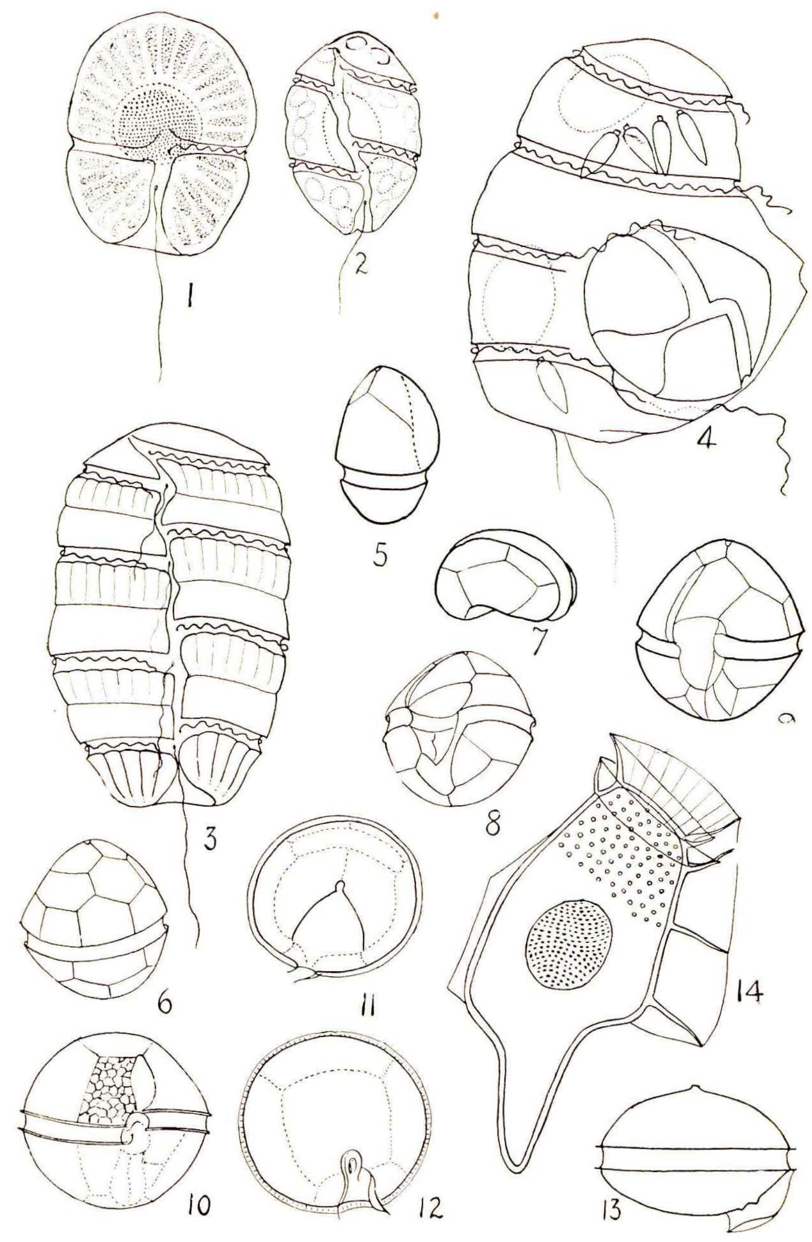

Plate V.

Figs. 1-3. *Peridinium claudicans.* 1. Ventral, 55 μ broad. 2. Right anterior lateral. 3. Dorsal, 56 μ broad.

Figs. 4-7. *Peridinium achromaticum.* 4. Ventral, 45 μ broad. Note extra anterior intercalary plate. 5. Ventral, 37 μ broad. 6. Ventral posterior, 42 μ broad. 7. Dorsal, 35 μ broad.

Figs. 8-10. *Peridinium excavatum.* 8. Ventral, 60 μ broad. 9. Dorsal, 60 μ broad. 10. Left lateral.

Figs. 11-12. *Peridinium trochoideum.* 11. Dorsal, 19 x 14 μ. Dotted lines are plate margins adapted from Lebour. 12. Ventral, 24 x 20 μ.

Figs. 13-14. *Ceratium minutum.* 13. Ventral, 24 μ broad. Note wing between posterior spines. 14. Dorsal, 28 μ broad.

PLATE V

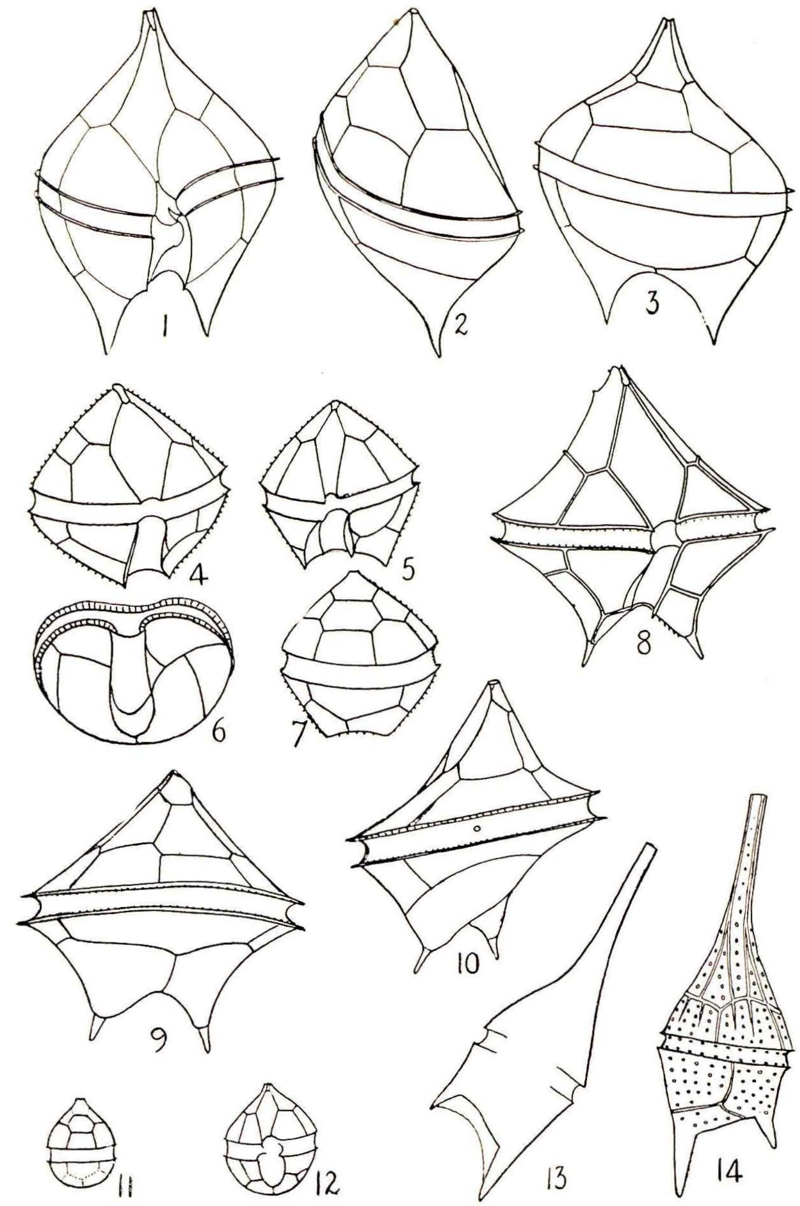

Plate VI.

Figs. 1-2. *Peridinium pallidum.* 1. Ventral, 57 μ broad. 2. Dorsal, same individual.

Figs. 3-5. *Peridinium leonis.* 3. Right ventral, about 65 μ broad. 4. Dorsal, 60 μ broad. 5. Anterior, 61 μ broad, excluding lists.

Fig. 6. *Ceratium bucephalum,* dorsal, 50 μ broad at girdle.

Fig. 7. *Ceratium fusus,* 28 μ wide above girdle.

PLATE VI

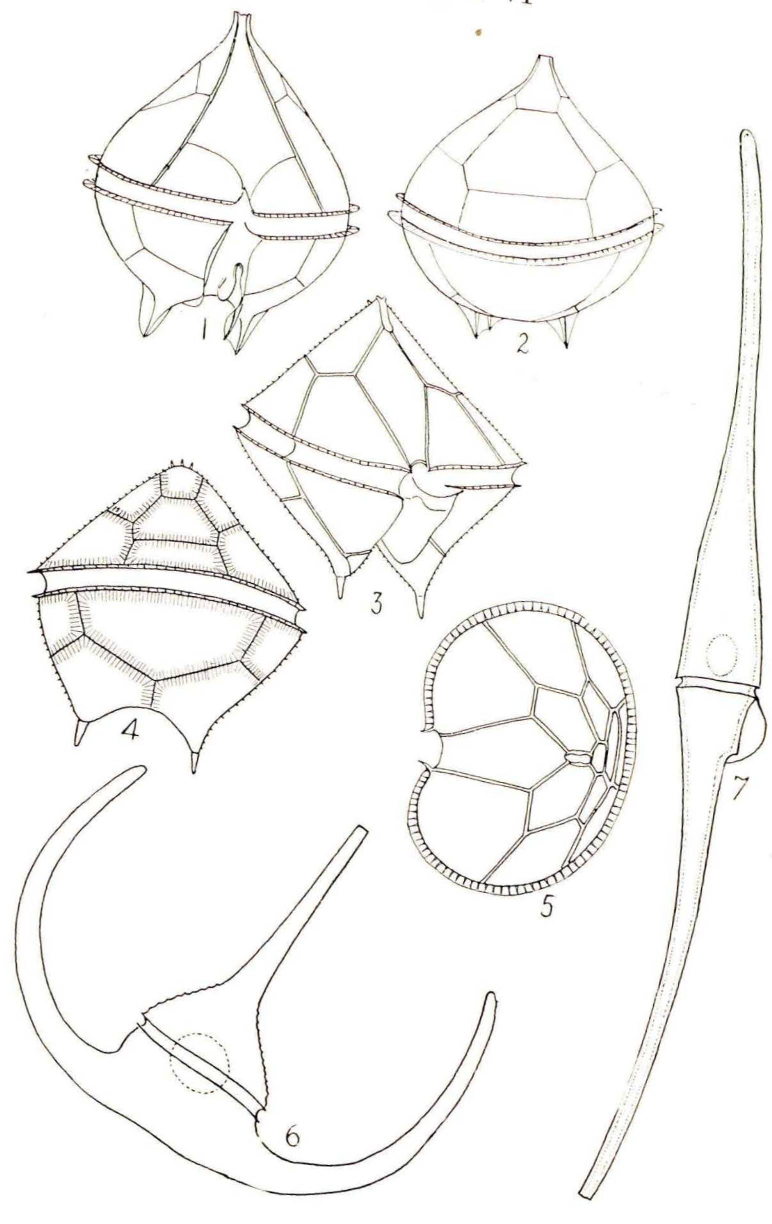

Plate VII.

Figs. 1-2. *Peridinium pellucidum.* 1. Ventral, 45 μ broad. 2. Same individual, dorsal.

Fig. 3. *Peridinium claudicans,* about 55 μ broad, left dorsal.

Fig. 4. *Prorocentrum micans,* 44 μ long. Left ventral, showing chromatophores and stigma.

Figs. 5-6. *Peridinium trochoideum,* 30 x 24 μ. 5. Ventral, showing stigma. 6. Dorsal, nucleus posterior.

Fig. 7. *Ceratium tripos,* dorsal. 380 μ long in axis of anterior horn.

Figs. 8-10. *Peridinium brevipes.* 8. Ventral, 19 μ long, dotted margins of plates uncertain. 9. Dorsal, 18 μ. 10. Ventral, 19 μ.

Figs. 11-17. Plate arrangements in subgenera and sections of genus Peridinium. Redrawn from Jörgensen and Lebour. 11-12. Relation of second anterior intercalary to surrounding plates in Tabulata and Pyriformia. 13. Same in Oceanica, Divergens and Humilia. 14. Same in Conica and Paraperidinium. 15. Relation of first apical to surrounding plates in subgenus Orthoperidinium. 16. Same in subgenus Metaperidinium, excepting section Paraperidinium. 17. Same in Metaperidinium section Paraperidinium.

PLATE VII

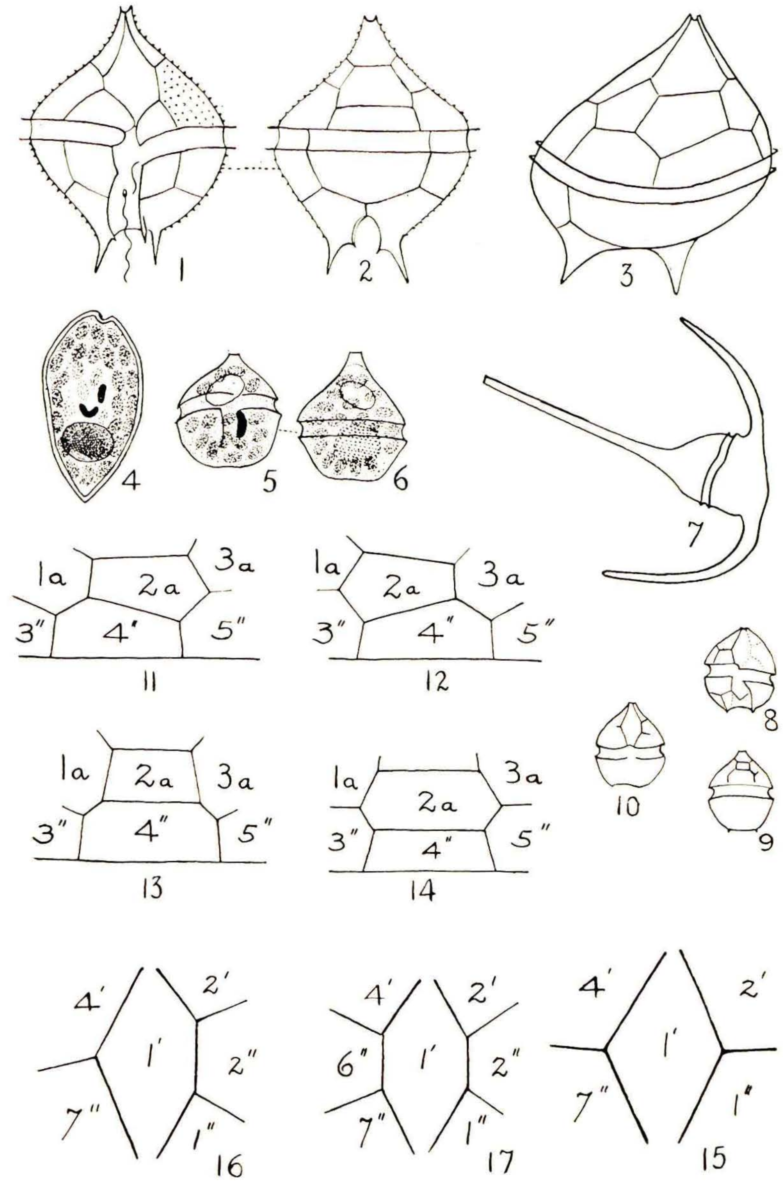

Plate VIII

Fig. 1. *Gymnodinium splendens*, x 380.

Fig. 2. *Peridiniopsis rotunda*, x 575.

Fig. 3. *Prorocentrum micans*, x 575. Ocean type with large spine.

Fig. 4. *Prorocentrum scutellum*, x 575, showing flagella.

Fig. 5. *Dinophysis ovum*, x 575.

Fig. 6. *Dinophysis acuminata*, x 575.

Fig. 7. *Peridinium trochoideum*, x 800.

Fig. 8. *Ceratium bucephalum*, x 380.

Fig. 9. *Polykrikos kofoidi*, x 575. The large black mass is a food body. Just below it is a small armored dinoflagellate. Of the four nuclei, the three posterior are displaced by the food mass.

PLATE VIII