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## Taxonomical Notes on North Sea Dinoflagellates I

By MALTE ELBRÄCHTER\*)

**Zusammenfassung:** Taxonomische Bemerkungen zu Nordsee Dinoflagellaten I. — Fünf Dinoflagellatenarten aus der Nordsee werden eingehend beschrieben und abgebildet. Eine der beschriebenen Arten ist neu für die Wissenschaft, eine andere wird vom Niveau einer Varietät zur eigenen Art erhoben, zwei weitere Arten werden als Synonym zu einer anderen Art gestellt.

### Introduction, material and methods

Taxonomy and methods applied in taxonomical studies of dinoflagellates have changed in recent years. Therefore a carefully reexamination and redescription of many species is needed for exact determination. This paper deals with taxonomical relevant facts of five dinoflagellate species found in the plankton off List/Sylt. Further descriptions of dinoflagellates from the North Sea will follow.

The dinoflagellates described below were found in phytoplankton samples taken two times a week off List/Sylt (55°01' N/8°27' E). The biotop and sampling methods are given by DREBES and ELBRÄCHTER (1975). First, the specimens were examined alive under dissecting microscope and then analysed by light microscopy. If possible all taxonomical relevant features, e. g. sulcal plates, were documented by photos. Most of the figures were drawn after photos.

### Taxonomic part

*Gymnodinium heterostriatum* KOFOID et SWEZY

Fig. 1

KOFOID et SWEZY 1921, pp 221—223, Pl. 5 fig. 56

Synonyms: *Gymnodinium spirale* var. *obtusum* DOGIEL 1906, pp 38—43, Pl 2 fig. 50—56 (non SCHÜTT 1895); *G. rhomboides* SCHÜTT, LEBOUR 1917, pp. 190—192, fig. 6 a—e; 1925, p 47, Pl 6 fig. 1 a—c (non SCHÜTT 1895); *G. hyalinum* LEBOUR 1925, p. 48, Pl. 6 fig. 3—4 (non *G. hyalinum* SCHILLING 1891); *G. lucidum* BALLANTINE in PARKE et DIXON 1964, p. 518; *G. striatissimum* HULBURT 1956, p. 206, 217, Pl. 3, fig. 5—6.

Photo: DREBES 1974, p. 118—119, fig. 97 a—b.

Description: A very variable species which can be recognised always by the striation of the periplast, the longitudinal furrow is characteristic, too. Body symmetrical, more or less biconic, sometimes slightly flattened dorsoventrally. Epicone slightly shorter than hypocone with good visible striations, ca 12—14 on the ventral side. On hypocone there are 2—2.5 times as much striations as on epicone. The striation disappeared if cells are dying. The cingulum is submedian, circular, displaced by 1—3 girdle width, more displaced by moribund cells. Longitudinal furrow (see fig. 1) in the uppermost fifth of the epicone very shallow and small, therefore gently overlooked, then it gets three times deeper and two times broader. The nucleus is elliptic, 1.5—2 times longer than broad, the axis is parallel to the body axis, but can be displaced after food ingestion.

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FIG. 1

Tafel 1 (zu M. ELBRÄCHTER)

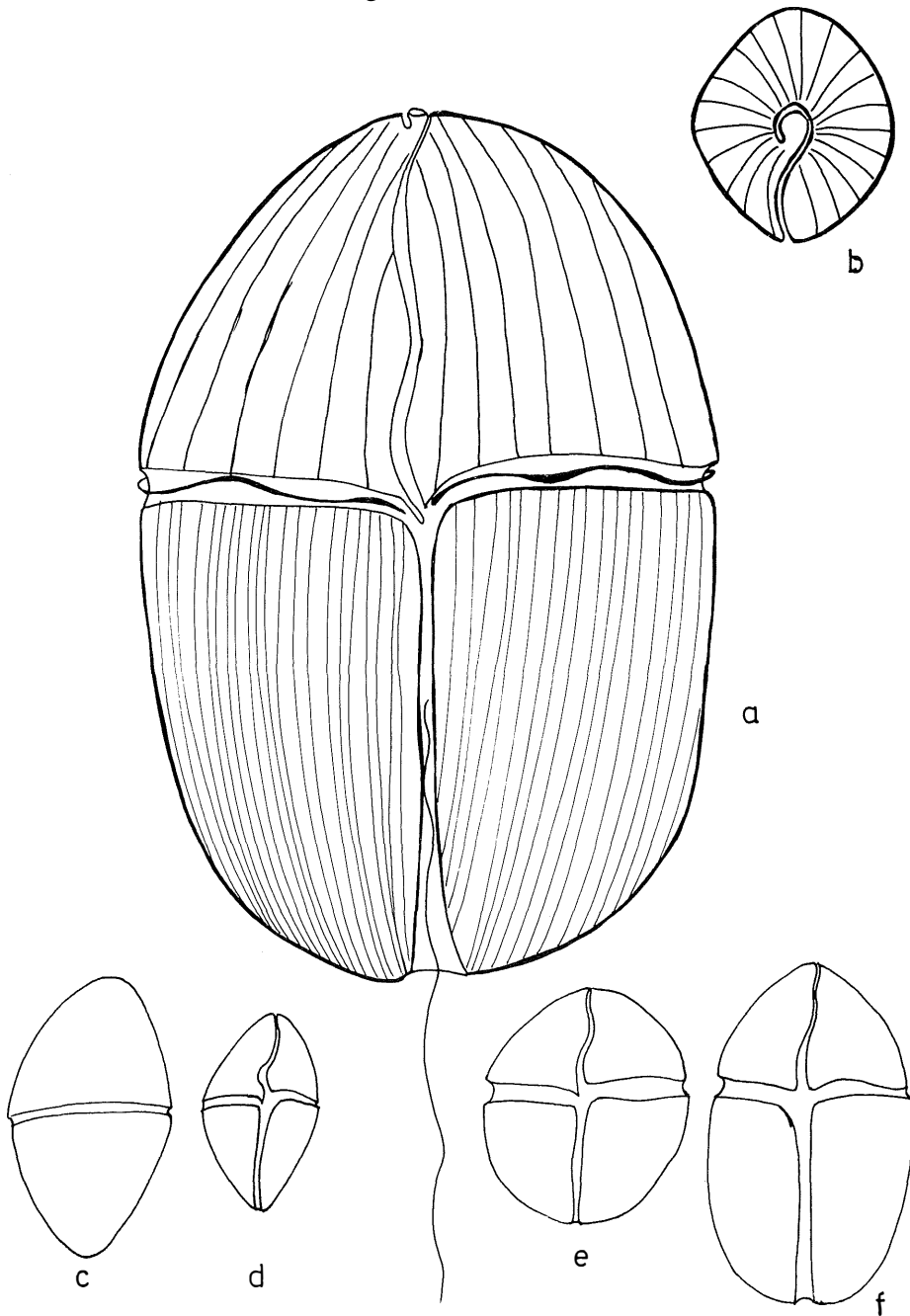


Fig. 1: a—f: *Gymnodinium heterostriatum* KOFOID et SWEZY; a: ventral side, b: apical view, showing longitudinal furrow and body striation, c—f: body shape of several specimens.

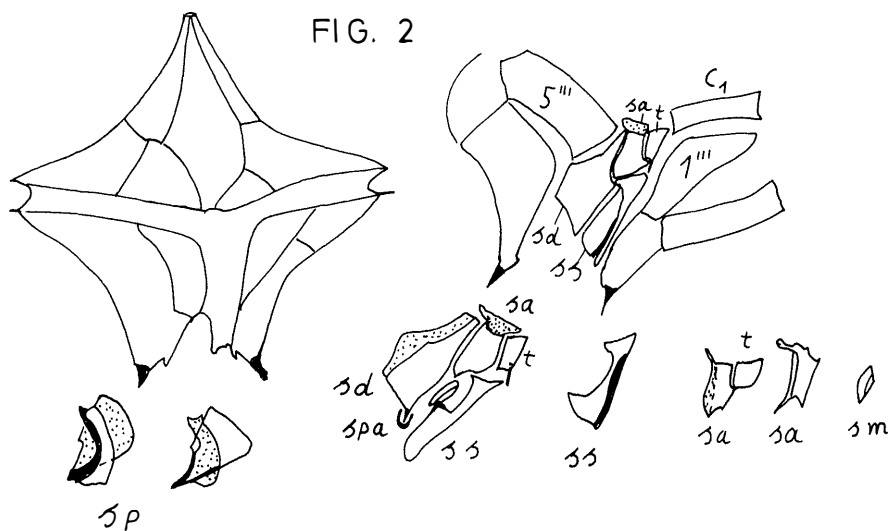


Fig. 2: *Peridinium curtipes* JÖRGENSEN.

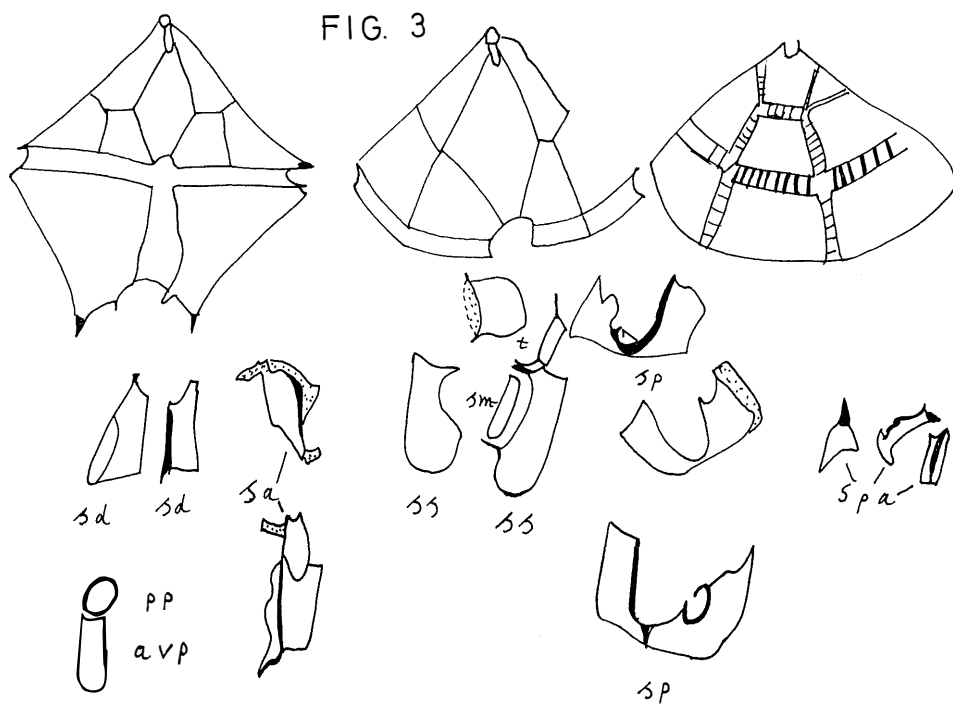


Fig. 3: *Peridinium mariebourae* PAULSEN.

The plasma is clear, greyish to green and appears refractive under the dissecting microscope. Binary fission takes place in motile stage. Fission in thin-walled cysts, which were registered repeatedly, was never observed. Nutrition is holozoic, as food serves diatoms, small dinoflagellates and, if present, *Phaeocystis pouchetii*. Sometimes 2—4 *Gymnodinium* cells were attached to one *Phaeocystis* colony and up to 14 *Phaeocystis* cells were ingested by one *Gymnodinium* cell. LEBOUR (1917) too, described as food *Phaeocystis* in addition to *Thalassiosira* spec. and *Coscinodiscus* spec.

Dimensions: length: 32—66  $\mu$ , diameter 24—50  $\mu$ .

From April to November in the plankton off List/Sylt, sometimes common.

Discussion: *Gymnodinium heterostriatum* was excellently described and figured by DOGIEL (1906) as *Gymnodinium spirale* var. *obtusum* from the mediterranean. KOFOID et SWEZY (1921) gave it the rank of a separate species (pp 221—223) and figured it on Pl. 5 fig. 56. The specimen figured on Pl. 2 fig. 24 and textfig. Y,7 is atypical and perhaps do not belong to this species. LEBOUR (1917) described this species under the name of *G. rhomboides* SCHÜTT but noticed that it might be identical with that of the larger species of DOGIEL. In 1925 LEBOUR separated the larger specimens described in 1917 as *G. rhomboides* as *G. heterostriatum*. In addition she described those species being intermediate to both species as *G. hyalinum*. As this is a later homonym to *G. hyalinum* SCHILLING 1891, it was renamed to *G. lucidum* by BALLANTINE in PARKE et DIXON 1964. During this study all these three species were found to integrate one into the other and therefore they are regarded as conspecific, the valid name is *Gymnodinium heterostriatum* KOFOID et SWEZY.

HULBURT (1965) described from the east coast of America a new species, *Gymnodinium striatissimum*, which is conspecific with *G. heterostriatum*, as it is quite in the range of this variable species (see fig. 1). HULBURT compared his species with *G. multistriatum* KOFOID et SWEZY, *G. rubrum* KOFOID et SWEZY and *G. translucens* KOFOID et SWEZY but not with *G. heterostriatum* although it fits very well with fig. 56, Pl. 6 of KOFOID et SWEZY (1921). *G. multistriatum* and *G. rubrum* are different from *G. heterostriatum* by having pusules, which were never observed in *G. heterostriatum* and *G. translucens* has on the epicone only few more striations than on the hypocone.

SCHÜTT (1895) figured on Pl. 21 fig. 63<sub>1,2</sub> *Gymnodinium rhomboides*, his description is only a very short comment on his figures. Fig. 63<sub>2</sub> agrees good with moribund cells of *G. heterostriatum*, fig. 63<sub>1</sub> differs from *G. heterostriatum* having only a few more striations on epicone than on hypocone. It cannot be decided whether *G. rhomboides* SCHÜTT is conspecific with *G. heterostriatum*. SCHILLER (1928) described from the Adria a species as *G. rhomboides* SCHÜTT but this posses chromatophores and therefore it does not belong to the complex *G. heterostriatum* — *rhomboides*. KOFOID et SWEZY (1921) took as basis for their definition of *G. rhomboides* SCHÜTT the definition and description of LEBOUR (1917) but as this is conspecific with *G. heterostriatum*, the description of *G. rhomboides* SCHÜTT remains very imperfect.

*Peridinium curtipes* JÖRGENSEN

Fig. 2

JÖRGENSEN, 1912, p. 8; PAULSEN 1930, p. 64—65; non WOOD, 1954, p. 248 fig. 138;

Synonyms: *P. crassipes* KOFOID, PAULSEN 1907, p. 17—18 fig. 24d; 1908, p. 57 fig. 73; (non PAULSEN 1930, p. 65 fig. 36); SCHILLER, 1937 pp. 223—225 fig. 220 pro parte; auct. plur.; some other references are given in PAULSEN 1930.

Photo: DREBES 1974, p. 136—137, fig. 118a—b.

A medium-sized species with characteristic shape (see fig. 2, and photo by DREBES 1974), the variation of body shape is very small. Apical horn and antapical horns well marked, with concave outlines. Longitudinal furrow deeply excavating the hypocone, cingulum slightly displaced. Sulcal plates see fig. 2. They are quite different of those given by GRAHAM (1942) for *Peridinium crassipes* KOFOID. Sulcal plate sa is longer, smaller and has straight outlines, not convex as in *P. crassipes*. Sd has on the right antapical margin a thick spine clasped by spa. These features are very characteristic and present in all specimens so far analysed (about 50). In addition, all specimens observed alive have as plasma colour yellow and not pinkish as stated for *P. crassipes* by KOFOID. Chromatophores are not observed.

Dimensions: length 80—100  $\mu$ , diameter 80—100  $\mu$ , dorsoventrally not or only slightly flattened.

Distribution: unknown as confused with *P. crassipes* by many authors.

Figured by PAULSEN from Murman coast, North Sea, Mediterranean. In plankton off Helgoland and List/Sylt.

Discussion: *Peridinium curtipes* was first figured by PAULSEN (1907) as *P. crassipes* KOFOID. JÖRGENSEN (1912) established *P. curtipes* as a separate species, recognizing that it is quite different from *P. crassipes*. But in 1928 PETERS reunited both species. SCHILLER (1937) followed PETERS and even states: “ich wage es nicht einmal, *curtipes* als forma zu *crassipes* zu stellen” although PAULSEN (1930) has described both species separately after discussion of the problem. Since the monograph of SCHILLER almost all authors regarded both species as conspecific. Recently, BALECH (1971) stated that *P. crassipes* KOFOID described by various authors may be a conglomerate of several species. If we admit that the species GRAHAM (1942) has analysed in detail with sulcal plates is *P. crassipes* KOFOID we have to separate *P. curtipes* JÖRGENSEN as a well defined species, differing from *P. crassipes* in body shape and sulcal plates and perhaps in colour of the plasma. WOOD (1954) described and figured from Australian waters a species which he calls *P. curtipes*. This is not identical with *P. curtipes* JÖRGENSEN as defined above.

*Peridinium mariebourae* PAULSEN

Fig. 3

PAULSEN, 1930, pp. 69—70, fig. 40.

Synonyms: *Peridinium obtusum* KARSTEN, LEBOUR 1925, p. 121—122, fig. 2 a—d, Pl. 24; SCHILLER, 1929, p. 400, fig. 12 a—d; non *P. obtusum* KARSTEN, FAURÉ-FREMIET 1908, pp. 223—224, fig. 9?; non *P. divergens obtusum* KARSTEN 1906, Pl. 15, fig. 8.

This species is well described and figured by LEBOUR (1925), PAULSEN (1930) and SCHILLER (1937), but these authors did not figure the sulcal plates, which are now very important for taxonomy. These plates are figured together with other details of the theca, e. g. apical platelet, ventral apical platelet, and variations of the thecal arrangement of the plates 1' and 2a.

Dimensions: length 48—75  $\mu$ , diameter 45—70  $\mu$  (23 specimens measured), largest diameter of plate 1': 24—28  $\mu$ ; first cingular plate has a length of 10—11  $\mu$ , C<sub>3</sub> has a length of 7—8  $\mu$ ; ventral apical platelet: 5  $\mu$  long and 2—3  $\mu$  in diameter.

Sulcal plates: Sp is very characteristic, in ventral-apical view U-shaped, with two lists forming an elliptical but not closed hole. Sm is a very fragile platelet, remaining very often attached to the protoplast during dissection of the sulcal plates.

FIG. 4

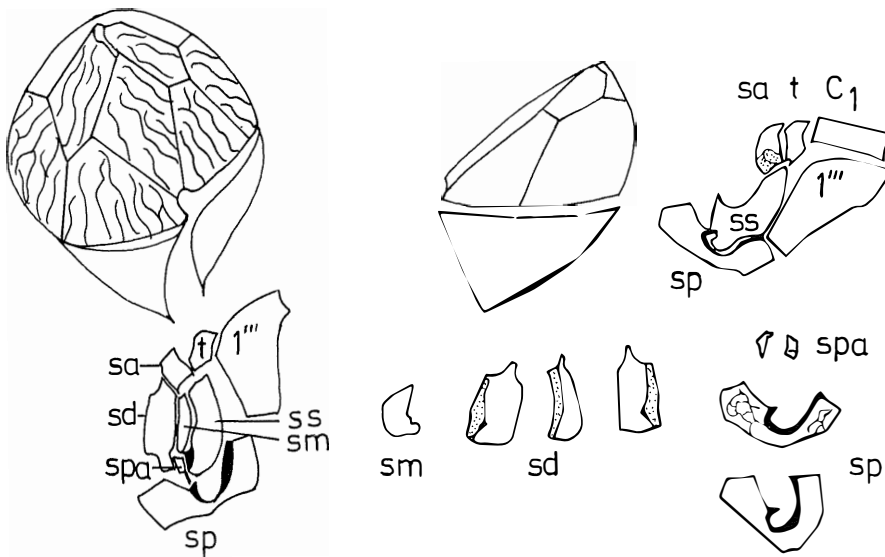


Fig. 4: *Peridinium obtusum* (KARSTEN) SCHILLER.

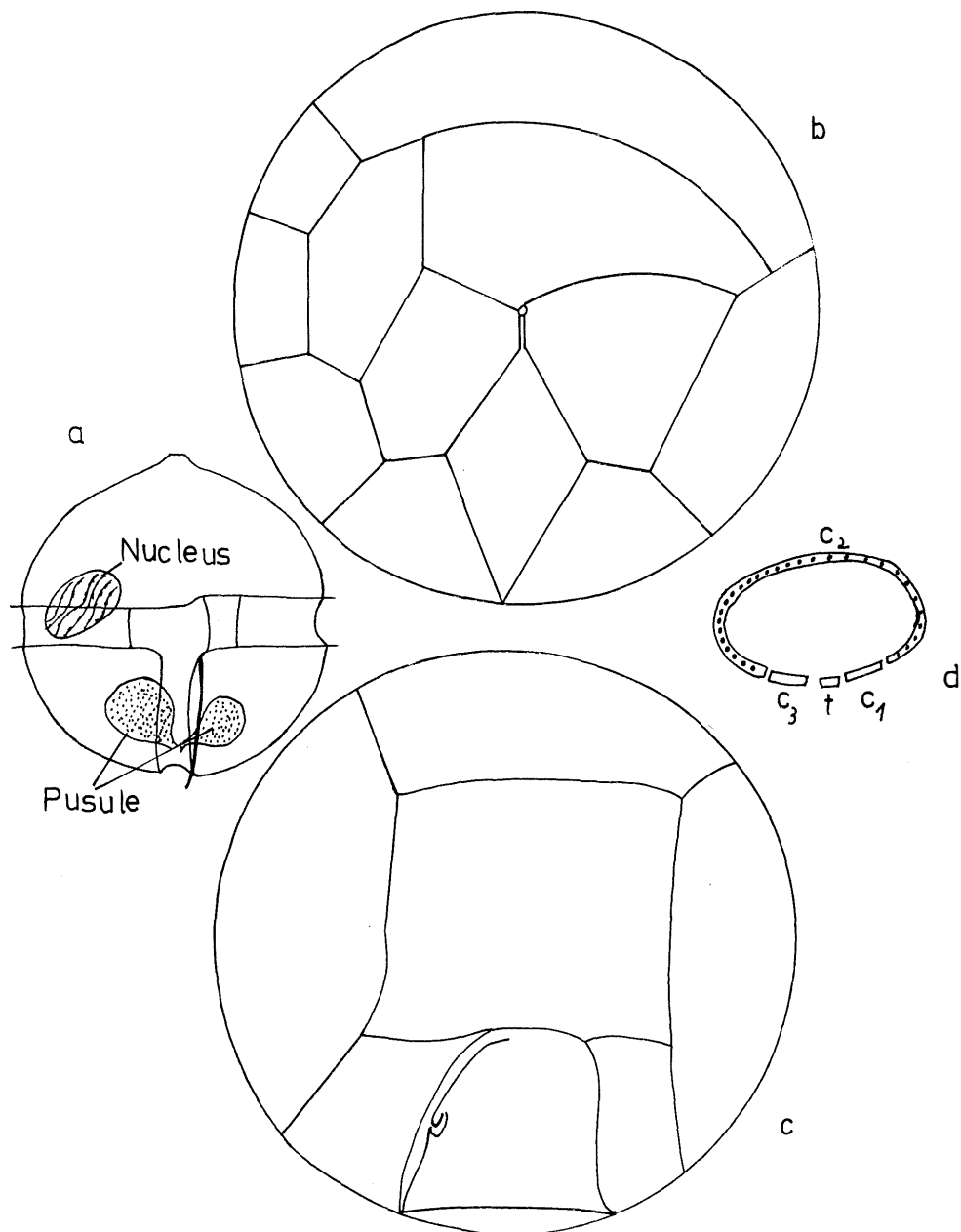


Fig. 5: *Zygaikodinium pseudooblea* spec. nov., a: ventral side, b: epitheca, c: hypotheca, d: cingular plates.



The majority of the cells have a spiny surface, sometimes the cells have only a very fine reticulation or punctation. From the end of August to beginning of September 1974 most of the cells had broad intercalary bands, so that the shape of the cells were quite different. In addition, they were full with reserve material. Normally the plasma is clear and pinkish.

Distribution: common in the North Sea; Alboran Sea. Perhaps often confused with *P. conicum* (GRAN) OSTENFELD et SCHMIDT and *P. leonis* PAVILLARD. The former is larger and the sulcus excavates deeper the hypocone. *P. leonis* is in general broader than long, furthermore in apical view the plate arrangement is different. In *P. mariebourae* the intercalary bands between the plates from the apex to the cingulum show on the dorsal side straight lines whereas in *P. leonis* these lines are zig-zagging, see SCHILLER, 1937, fig. 236 b and 239e. This is the reason I believe FAURÉ-FREMIET (1908) described *P. leonis* and not *P. mariebourae* as was supposed by PAULSEN (1930).

*Peridinium obtusum* (KARSTEN) SCHILLER

Fig. 4

SCHILLER, 1937, p. 240—241, fig. 241 a—b; BALECH, 1949, p. 396—398, fig. 41—68; HALIM, 1968, p. 241, fig. 81; HERMOSILLA, 1973, p. 33—34, Pl. 15, fig. 1—22; non *P. obtusum* KARSTEN, FAURÉ-FREMIET 1908,; non LEBOUR 1925, non SCHILLER, 1929.

Synonym: *Peridinium divergens obtusum* KARSTEN 1906, p. 149, Pl. 23 fig. 12. This species has been confused with *P. mariebourae* PAULSEN and *P. leonis* PAVILLARD. It seems that it has not been checked with certainty until now in the North Sea. Although it has been described recently in detail by BALECH (1949) and HERMOSILLA (1973) it should be presented once more as it is now compared with *P. mariebourae* with which it has been confused repeatedly in the North Sea. *Peridinium obtusum* can be identified very easily by the following features.: plate 1' is 'ortho', but strongly asymmetrically, the upper triangle much more shorter than the lower one and the right one larger than the left one. Furthermore the cingulum is inclined very much, in addition the plates of the epitheca have a 'longitudinal striation'. These features are clearly visible under dissecting microscope. In contrast all specimens observed are reticulated and not striated on the hypotheca. In *P. mariebourae* the plate 1' is 'ortho', too, but the plate is regular as in *P. leonis*, striation is never observed in *P. mariebourae* and the cingulum is circular and not inclined. In addition the sulcal plates are different. As these plates are described and figured by BALECH (1949) and HERMOSILLA (1973) I only mention spa because it was omitted by these authors. The plate spa is a small four-sided plate with a spine on his upper margin.

The species has no chromatophores, the plasma is pinkish.

Dimensions: length 62  $\mu$ , transdiameter 53  $\mu$ .

In August and September some specimens in the plankton off List/Sylt.

*Zygabikodinium pseudooblea* spec. nov.

Fig. 5

This species first was confused with *Oblea rotunda* (LEBOUR) BALECH. But the plate pattern analysed by dissection under high magnification showed a quite different picture compared with that of *Oblea rotunda* or any other species described elsewhere. Thus it is described as a new species. Tentatively it is placed into the genus *Zygabikodinium* LOEBLICH Jr. et LOEBLICH III, although it differs slightly in the plate pattern of the epitheca.

Diagnosis: Biflagellate, motile cells, subglobose with marked apex, dorsoventrally not flattened. Epicone and hypocone subequal, ratio of girdle width to cell length 1 : 5. Sulcus weak, at the left side with a list. Dinokaryon elliptic,  $5\ \mu\text{m} \times 3\ \mu\text{m}$ . Plasma clear, with two pusules. Theca thin, cellulosic, without structure. Cingular plate  $C_2$  with one row of pores. Plate pattern: apical platelet, 4', 1a, 7'', 3C, t + ?s, 5''', 1'''''. No chromatophores. Habitat: Plankton off the island of Sylt. Holotype: fig. 5.

Diagnosis: Cellulae mobiles biflagellatae, in statu erratico subglobosa, apice apiculato, non applanata dorsoventraliter, 23—28  $\mu\text{m}$  lata. Epiconus et hypoconus subaequaliter, ratione latitudine cingulo et longitudinis cellula 1 : 5. Sulcus non profundus cum ala ad margine sinistro. Dinokaryon elliptica,  $5\ \mu\text{m} \times 3\ \mu\text{m}$ . Plasma clarus, duo pusulae. Theca tenera e cellulosa constans, non ornatis. Lamella cingularis  $C_2$  cum una seria porae. Tabulatio thecalis: lamella pori apicalis, 4', 1a, 7'', 3C, t + ?s, 5''', 1'''''. Chromatophora absente. Habitatio: planctonica, in aquis marinis prope insulam Sylt. Holotypus: fig. 5.

Description: Cells globular, epicone and hypocone subequal, width of cingulum one fifth of body length. Porus on epicone clearly visible in outline. Sulcus shallow, not notching the antapex, on the left side with a large list. Dinokaryon in the region of the cingulum, dorsal near the cell wall, oval, about  $5\ \mu\text{m}$  long and  $3\ \mu\text{m}$  broad. Longitudinal flagellum reaching about 25—30  $\mu\text{m}$  over the antapex. Plasma clear, refractive, shining pale green, with small granula. Two, mostly large pusules in the hypocon. No chromatophores, nutrition may be saprophytic as food bodies were never observed. Plates of the theca in the light microscope without visible structure, only cingular plate  $C_2$  has one row of pores, about  $2\ \mu\text{m}$  each from the other.

Plate 1' is 'ortho', slightly asymmetric as the upper triangle is smaller than the lower one. Plate 2' is five sided, the boarder line to 3' is convex. Plate 3' is asymmetric, the very long boarder line to 3'' is convex. Plate 4' is six sided but in contrast to 2' smaller and without any curved lines. The plates 1'' and 7'' are equal, 2'', 4'' and 5'' are four sided, 6'' is five sided. Plate 3'' is very long, reniform. The hypotheca has the typical plate pattern of the genus *Zygabikodinium* with only one antapical plate. The cingular plates  $C_1$  and  $C_3$  are subequal, about  $5\ \mu\text{m}$  broad.  $C_2$  is very large as in the marine members of the genus *Peridinium*. The transitional plate t is small, rectangular. The sulcal plates are until now, not investigated as they always rested attached to the plasma.

Dimensions: length 23—28  $\mu\text{m}$ , diameter 23—28  $\mu\text{m}$ , dorsoventrally not flattened

Habitat: Plankton off List/Sylt, marine, March to June.

This species resembles in plate pattern to *Zygabikodinium perlata* (BALECH) comb. nov. (basonym: *Diplopetopsis perlata* BALECH, 1971, Revta Mus. Argent. Cienc. Nat., Hidrobiol. III, 1, p. 81—83, Pl. 13, fig. 198—207) but the species of BALECH differs in having an other plate pattern of the epitheca. In addition, that species is larger and has a characteristic ornamentation to which refers the name.

I like to express my severe thanks to Prof. BALECH (Argentina) for his critical comments on this species.

### Summary

1. Five species of planktonic dinoflagellates are described and figured from the plankton off List/Sylt ( $55^{\circ}01'N$ ,  $8^{\circ}27'E$ ).
2. One of these is a species new for science; *Zygabikodinium pseudooblea* spec. nov.
3. With *Gymnodinium heterostriatum* KOFOID et SWEZY are conspecific *G. rhomboides* SCHÜTT, LEBOUR, *G. hyalinum* LEBOUR 1925 and *G. striatissimum* HULBURT 1956.

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