

TWO NEW PALEOCENE DINOFLAGELLATES FROM VIRGINIA AND MARYLAND

by DEWEY M. MCLEAN

ABSTRACT. Two new species of *Hystrichokolpoma* (Pyrrhophyta) are described from the Aquia Formation (Upper Paleocene) of Virginia and Maryland. *H. tumescens* is characterized by a large, bulbous antapical process, and *H. mentitum* by a main body which in size, general appearance, and outlines of process bases resembles specimens of *Eisenackia*. With its delicate processes removed, *H. mentitum* is believed to masquerade as *Eisenackia*.

AMONG the extensive dinoflagellate assemblages of the Atlantic Coastal Plain are numerous new species. The purpose of this paper is to report the discovery of two new species of *Hystrichokolpoma* (Pyrrhophyta) from the Aquia Formation (Upper Paleocene) of the Virginia-Maryland Coastal Plain. Each is easily recognizable, and, as presently known, is restricted to Paleocene age sediments. One species, *H. tumescens* sp. nov., displays typical *Hystrichokolpoma* morphological development, but is characterized by a unique bulbous antapical process. The other, *H. mentitum* sp. nov., has hollow, box-like processes typical of the genus, but has a main body resembling that of specimens commonly referred to *Eisenackia*. With the processes broken away, the main body resembles in appearance, size, and tabulation *E. circumtabulata* Drugg 1967, and *E. crassitabulata*, as illustrated by Alberti (1961).

Samples investigated are from three outcrop localities along the Potomac River south of Washington, D.C. They are:

Locality 1. Prince Georges County, Maryland; U.S. Geological Survey Anacostia, Md.-D.C., quad., 7-5 minute series; 38° 45' 10" N., 76° 59' 15" W. Approximately 45 feet (14 m) of lowermost Aquia glauconitic quartz sands are exposed about 0.5 mile west of Friendly, Maryland, along the stream occurring immediately south of, and paralleling, the Old Fort Road.

Locality 2. Stafford County, Virginia; U.S. Geological Survey Passapatanzy, Va.-Md., quad., 7-5 minute series; 38° 22' 15" N., 77° 17' 50" W. This is the type locality of the Aquia Formation. Approximately 70 feet (21 m) of Aquia glauconitic quartz sands are exposed in bluffs along the south bank of Aquia Creek, about 0.5 mile south-east of the Maryland-Virginia Monument No. 37.

Locality 3. Stafford County, Virginia; U.S. Geological Survey Passapatanzy, Va.-Md., quad., 7-5 minute series; 38° 20' 35" N., 77° 17' 17" W. Approximately 35 feet (10 m) of Aquia glauconitic quartz sands are exposed in bluffs along the south bank of Potomac Creek, from 0.05 to 0.15 mile west of the Maryland-Virginia Monument No. 35.

Standard acid maceration techniques were employed for all samples. Palynomorphs were concentrated by use of ZnBr (sp. gr. = 2.0), and were darkened for study and photomicrography by acetolysis. Slides are stored at Stanford University and are assigned Stanford University Paleontological Type Collection (SUPTC) numbers. Coordinates are measurements in millimetres to the right (R) or left (L) and toward the top (+) or bottom (-) of the slide from an index cross engraved on the coverslip near its lower left corner.

[Palaeontology, Vol. 17, Part 1, 1974, pp. 65-70, pl. 8.]

SYSTEMATIC PALAEOLOGY

Division PYRRHOPHYTA Pascher

Class DINOPHYCEAE Pascher

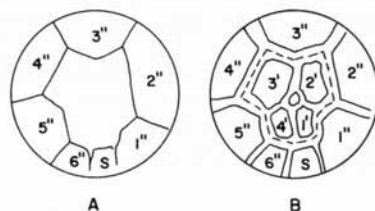
Genus HYSTRICHOKOLPOMA Klumpp 1953

Hystrichokolpoma tumescens sp. nov.

Plate 8, figs. 6-9

Holotype. Plate 8, figs. 7-8. Loc. 2, sample 3394, SUPTC 10075 (R12-5, +4-7).*Diagnosis*. A species of *Hystrichokolpoma* with a large, bulbous antapical process.

Description. Cyst main body ellipsoidal, bearing simulate, hollow, box-like processes. Cyst bi-layered; processes, formed of the periphragm, reflect tabulation of 4', 0a, 6'', 6c, 6''', 1p, 1'''. Archeopyle apical (Type \bar{A}) with simple, free operculum; corresponds to 4(?) apical plates (see Discussion). Cingulum and sulcus reflected by processes. Cingulum levorotatory, ends separated vertically up to one cingulum width and transversely up to one and one-half cingulum widths. Sulcal area (see Discussion) reflected at top and bottom by anterior and posterior sulcal processes, respectively, and in between by two pairs of small processes. Of the anterior-most pair the left member is the larger and is designated as the 1''; the other pair is between processes 6''' and 1p. Individual processes of the two small process pairs occur either as single spine-like elements, or as several spine-like elements branching from a common base.



TEXT-FIG. 1. Comparison of apical archeopyle outline of *Hystrichokolpoma tumescens*, A, with that of *H. mentitum*, B.

EXPLANATION OF PLATE 8

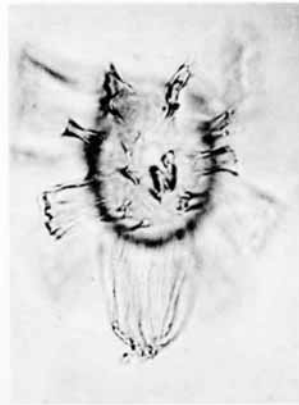
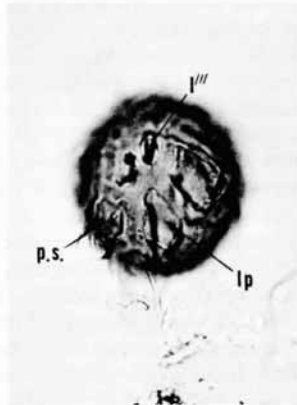
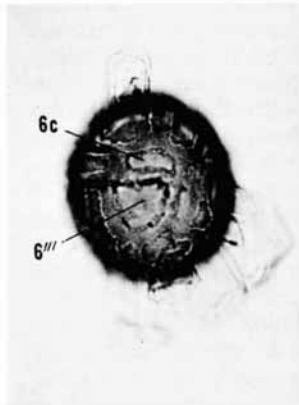
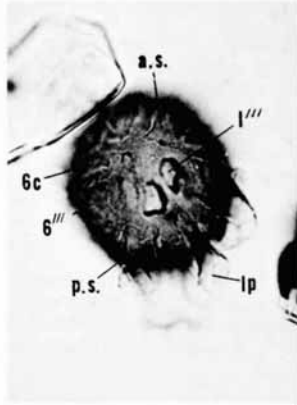
All specimens are from the Aquia Formation (Upper Paleocene) of the Virginia-Maryland Coastal Plain, from outcrops along the Potomac River south of Washington, D.C. All photographs are focused on the upper surface of the specimen unless otherwise indicated.

Figs. 1-5. *Hystrichokolpoma mentitum* sp. nov. Several views of holotype, $\times 625$. 1, apical view showing four apical plate-equivalents with an apical pore closing platelet in their midst. 2, sulcal view. 3, antapical view, showing pentagonal base of antapical process. 4, right-lateral view. 5, left-lateral view. Dimensions: $L \times W = 48 \times 45 \mu\text{m}$; process lengths up to $15 \mu\text{m}$. Loc. 1, sample 3372, SUPTC 10073 (R4-0, +11-4).

Fig. 6. *Hystrichokolpoma tumescens* sp. nov. Ventral view, $\times 640$. Note the characteristic large, bulbous antapical process ornamented with longitudinal striations; tip drawn out and broken open. Dimensions: main body $L \times W = 50 \times 38 \mu\text{m}$; antapical process $L \times W = 42 \times 27 \mu\text{m}$; remaining process lengths up to $24 \mu\text{m}$. Loc. 2, sample 3413, SUPTC 10074 (R21-7, +16-4).

Figs. 7-8. *Hystrichokolpoma tumescens* sp. nov. Holotype, $\times 645$. Ventral views at slightly different focus levels. Antapical process has closed tip. Dimensions: main body $L \times W = 45 \times 37 \mu\text{m}$; antapical process $L \times W = 37 \times 26 \mu\text{m}$; remaining process lengths up to $25 \mu\text{m}$. Loc. 2, sample 3394, SUPTC 10075 (R12-5, +4-7).

Fig. 9. *Hystrichokolpoma tumescens* sp. nov. Dorsal view, $\times 580$. Dimensions: main body $L \times W = 55 \times 42 \mu\text{m}$; antapical process $L \times W = 50 \times 27 \mu\text{m}$; remaining processes up to $27 \mu\text{m}$. Loc. 3, sample 3429, SUPTC 10076 (R3-7, +8-7).



McLEAN, *Hystrichokolpoma*

Wall layers appressed except under processes. Endophragm *ca.* 0.75–1.25 μm thick, and smooth to faintly granulate externally. Periphragm *ca.* 0.5 μm thick, and smooth to faintly granulate externally. Processes simulate, one per plate-equivalent, hollow and box-like, closed and denticulate at tips, non-branching except for 1p and sulcal processes, externally smooth, faintly striate, or faintly granulate, and may show numerous, tiny longitudinal folds; do not communicate with endocoel. Precingular processes nearly equidimensional except for relatively small 6'' process. Processes 2'', 4'', and 6'' have four-sided bases, and processes 1'', 3'', and 5'' have five-sided bases. Cingular process bases rectangular. Postcingular process bases characteristically four-sided; processes 3''', 4''', and 5''' are largest, 6''' is intermediate in size, and 1''' is smallest. Process 1p has an irregular basal outline, and may branch into several spine-like elements. Antapical process bulbous, with pentagonal base and narrow, drawn-out tip which may be broken open.

Dimensions. Holotype main body L \times W (excluding operculum which is missing): 45 \times 37 μm ; processes up to 25 μm long; antapical process 37 μm long by 26 μm at base. Observed range (twenty-six specimens measured): main body length (excluding opercula which were universally missing): 45–62 μm (mean 52 μm); main body transdiameter: 37–53 μm (mean 42 μm); length of main body together with antapical process: 76–99 μm .

Discussion. The postcingular tabulation is interpreted as consisting of six plate-equivalents; however, uncertainty exists concerning interpretation of the anterior-most pair of small processes in the sulcal area. If both members of the pair are interpreted as sulcal processes, five postcingulars are indicated. If, however, the left, larger member of the pair is interpreted as a postcingular plate-equivalent, six postcingulars are indicated. Because thecae of many modern dinoflagellate species display reduced 1''' plates (personal communication, David Wall, Woods Hole Oceanographic Institute), the latter course was followed in interpreting the fossil.

Although no opercula were observed, the archeopyle outline resembles that of *Hystrichokolpoma mentitum* (below), the operculum of which is simple and free and displays four apical plate-equivalents and an apical pore closing platelet. Each species shows the anterior edges of the 3'' and 5'' plate-equivalents to be gable shaped, whereas those of the 1'', 2'', and 4'' plate-equivalents are straight; the similarity of the archeopyle outlines suggests similarity of the archeopyle tabulation. Studies of several species representing various genera have shown that when the anterior edges of the precingular plate-equivalents are straight, they usually contact only one apical plate-equivalent, whereas when gable shaped, they usually contact two apical plate-equivalents. This relationship is shown in text-fig. 1 which compares the archeopyle outlines of *H. tumescens* sp. nov. and *H. mentitum* sp. nov.

Comparison with similar species. *Hystrichokolpoma tumescens* resembles *H. rigaudae* Deflandre and Cookson 1955, but differs in two respects: (1) the antapical process of the new species has an inflated, bulbous structure and is convex outward along its length, whereas the antapical process of *H. rigaudae* is outwardly concave and, (2) the cingular processes of the new species do not bifurcate whereas those of *H. rigaudae* bifurcate near the base into two thin processes per plate-equivalent.

Occurrence. Loc. 2, 3% of phytoplankton content throughout basal 10 feet (3 m) of section; Loc. 3, 4% through a 40 foot (12 m) interval beginning 20 feet (6 m) above the base of the section.

Hystrichokolpoma mentitum sp. nov.

Plate 8, figs. 1–5

Holotype. Plate 8, figs. 1–5. Loc. 1, sample 3372, SUPTC 10073 (R4-0, +11-7).

Diagnosis. A species of *Hystrichokolpoma*, the main body of which, in size, shape, and tabulation, resembles specimens of *Eisenackia*.

Description. Cyst main body spheroidal to slightly ellipsoidal, bearing simulate, hollow, box-like processes. Cyst wall bi-layered; processes, formed of the periphragm, reflect tabulation of 4', 0a, 6'', 6c, 6''', 1p, 1'''''. Archeopyle apical (Type \bar{A}) with simple, free operculum; corresponds to four apical plates and an apical pore closing platelet. Cingulum and sulcus reflected by processes. Cingulum levorotatory, ends separated vertically about one-half cingulum width and transversely about two cingulum widths. Sulcal area (see Discussion) reflected at top and bottom by anterior and posterior sulcal processes, respectively, and in between by two pairs of small processes. Of the anterior-most pair the left member is the larger and is designated as the 1''''; the other pair is between the 6''' and 1p processes.

Wall layers appressed except under processes. Endophragm *ca.* 2.0 μm thick, and externally smooth. Periphragm *ca.* 0.5 μm thick, and externally microreticulate on main body; muri 0.5–1.0 μm across. Processes simulate, one per plate-equivalent, hollow and box-like, closed at tips, nearly parallel sided, faintly punctate externally, and do not communicate with endocoel. Precingular processes nearly equidimensional except for relatively small 6''; processes 2'' and 4'' have four-sided bases, and 1'', 3'', and 5'' are five-sided. Cingular process bases rectangular. Postcingular processes variable in size and shape; processes 3''', 4''', and 5''' are largest of series, are nearly equidimensional, and contain distinctive U-shaped partitions, which open upward, in their anterior portions; process 6''' is intermediate in size and 1'''' is the smallest of the series; postcingular process bases are commonly four-sided except for 4'''' and 6'''' which may be five-sided. Process 1p and the posterior sulcal process bases are four-sided. Antapical process base pentagonal.

Dimensions. Holotype main body L \times W: 48 \times 45 μm ; process lengths up to 15 μm . Observed range (three specimens recovered): main body length 48–50 μm , width 42–45 μm .

Discussion. Although the postcingular tabulation is interpreted as consisting of six plate-equivalents, uncertainty exists concerning interpretation of the anterior-most pair of small processes in the sulcal area. If both members of the pair are considered as sulcal processes, five postcingulars are indicated. If, however, the left, larger member of the pair is considered a postcingular plate-equivalent, six postcingulars are indicated. Because thecae of many modern dinoflagellate species display reduced 1'''' plates (personal communication, David Wall, Woods Hole Oceanographic Institute), the latter course was followed in interpreting the fossil.

Comparison with similar species. The box-like processes and distinctive U-shaped partitions of the postcingular plate-equivalents of the new species differentiate it from *H. poculum* Maier 1959 (pp. 312–313, pl. 31, fig. 3), which has cylindrically shaped processes. The new species, with its delicate processes broken away, resembles *Eisenackia circumtabulata* Drugg 1967 (p. 15, pl. 1, figs. 12–13), and *E. crassitabulata* as illustrated by Alberti (1961, p. 32, pl. 3, fig. 19).

Occurrence. Loc. 1, less than 1% of the phytoplankton content of one sample 20 feet (6 m) above the base of the Tertiary section; Loc. 2, less than 1% in one sample 17 feet (5 m) above the base of the exposed section.

Acknowledgements. Thanks go to Dr. Wm. R. Evitt, Stanford University, and to the National Science Foundation which sponsored the investigation under Grants GB-4702 and GB-4711 (to Evitt).

REFERENCES

- ALBERTI, G. 1961. Zur Kenntnis mesozoischer und alttertiärer Dinoflagellaten und Hystrichosphaerideen von Nord- und Mitteldeutschland sowie einigen anderen europäischen Gebieten. *Palaeontographica*, **116**, A, 1–58.

- DEFLANDRE, G. and COOKSON, I. C. 1955. Fossil microplankton from Australian late Mesozoic and Tertiary sediments. *Aust. J. Marine Freshwater Res.* **6**, (2), 243-313.
- DRUGG, W. S. 1967. Palynology of the upper Moreno Formation (Late Cretaceous-Paleocene) Escarpado Canyon, California. *Palaeontographica*, **120**, B, 1-71.
- KLUMPP, B. 1953. Beitrag zur Kenntnis der Microfossilien des Mittleren und Oberen Eozän. *Ibid.* **103**, A, 377-406.
- MAIER, D. 1959. Planktonuntersuchungen in tertiären und quartären marinen Sedimenten. Ein Beitrag zur Systematik, Stratigraphie und Ökologie der Coccolithophorideen, Dinoflagellaten und Hystrichosphaerideen vom Oligozän bis zum Pleistozän. *Neues Jb. Geol. Paläont. Abh.* **107**, (3), 278-340.

D. M. MCLEAN

Department of Geological Sciences
Virginia Polytechnic Institute and State University
Blacksburg
Virginia 24061, U.S.A.

Revised typescript received 8 January 1973