ABSTRACT
Investigation of Cretaceous radiolarian assemblages from North America, the West Indies, Europe, Australia, and the East Indies has shown the necessity of emending the definition of Artostrobium, and of erecting the new genus Amphipyndax.

Two Cretaceous radiolarian genera

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INTRODUCTION
In the course of an investigation of Cretaceous radiolarian assemblages from several widely scattered localities, problems were encountered in the generic assignment of some of the species. These could not be resolved simply by applying available generic names or by creating new ones in accordance with the framework of Haeckel's system. Therefore, the definition of one genus has been substantially modified, and a new genus has been defined on the basis of characteristics different from those generally used in the past for delimiting radiolarian genera.

A detailed list of locality data will be found at the end of the paper.

ACKNOWLEDGMENTS

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TAXONOMY
Genus Artostrobium Haeckel, 1887, emend. Foreman
Artostrobium Haeckel, 1887, p. 1482.

Type species: Lithocampe aurita Ehrenberg 1844, p. 84; 1854, pl. 22, fig. 25 (designated by Campbell in 1954), from probably Miocene sediments of Sicily.

Discussion: At least one four-segmented cyrtoid with a lateral tubule on the cephalis occurs in the late Cretaceous Cuban material examined. This cephalic tubule is evidently similar to that described by Riedel (1958, p. 243, text-fig. 12) for a species of Siphocampium in Recent sediments. The structure of the cephalis is thus quite different from that of the type species of Artostrobus (Cornuella? annulata Bailey, 1856), but apparently similar to that of the type species of Artostrobium, which was originally proposed as a subgenus of Artostrobus. This difference in cephalic structure indicates that A. (Artostrobus) and A. (Artostrobium) are probably not closely related, and therefore Artostrobium is here raised to generic rank and used as a name for stichocystids in which the cephalis bears both a strong apical horn and a lateral tubule. The pores of at least the post-thoracic segments are commonly arranged in transverse rows.

Genus Amphipyndax Foreman, new genus
Diagnosis: Lithocampids in which the cephalis is divided into two chambers by a relatively thick, transverse partial septum; the upper of these chambers usually considerably larger than the lower.

Etymology: The name is derived from the Greek amphi, double, and pyndax, bottom of a vessel (masculine).

Type species: Amphipyndax enesseffi Foreman, n. sp.

Discussion: A close examination of the cephalic structures in Cretaceous lithocampids has revealed three different though apparently related types. In some species the cephalis is a simple subspherical chamber with the regular collar pores at its base (text-figures 1–3). In others, the vertical spine gives off two opposite lateral branches which form a thin, usually narrow shelf or ridge on the inner surface of the cephalic wall, and in some orientations, the cephalis therefore appears to be divided into three parts (text-figures 4–6). The transverse or inclined shelf or ridge which subdivides the cephalis varies in the extent to which it incircles the cephalic cavity and in its distance above the collar pores. In still other species this transverse shelf is more strongly developed, always completely encircling, and situated nearer to the collar pores than to the apex (text-figures 7–9). It is this last group which is herein separated taxonomically from the other lithocampids of generally similar external form.
Some of the Cretaceous species described by Campbell and Clark (1944) may belong to *Amphipyndax* – *Phormocampe alamedaensis*, *Stichocapsa megaloscephala*, and *S. (?) stocki*. Wetzel (1961, pl. 3, fig. 1) also figured a specimen of "Dictyomitra" which appears to belong in this genus. Pessagno (1963) described two species, *Lithostrobus punctulatus* and *L. pseudoconulus*, each with an internally constricted cephalis which he interpreted as a cephalis and a small thorax.

**Occurrence:** Members of this genus have been found in the Moreno, Panoche, Forbes and Funks Formations, all of California; in the DeGrey Member of the Pierre Shale of South Dakota; in sediments of late Campanian age in Bavaria; in the Cariblanco Formation and Parguera Limestone of Puerto Rico; in the late Cretaceous of Cuba; in the probably Turonian or early Senonian sediments of the island of Roti, southwest of Timor in Indonesia; and in the Gearle Siltstone and the Thirindine Formation, both of Western Australia.

**Amphipyndax enesseffi** Foreman, new species

Text-figures 10–11

*Lithostrobus punctulatus* Pessagno, 1963, p. 210, pl. 5, figs. 4–5 (not holotype, pl. 1, fig. 1).

**Description:** Shell acutely conical, sometimes becoming cylindrical distally, composed of seven or eight segments increasing slightly in length toward the aperture, the last-preserved segment occasionally slightly narrower than the preceding one. Cephalis conical, clear, poreless, thickened at the apex, smooth, except for some specimens which have one or more tiny protrusions apically, occasionally one protrusion more prominent than the others. Cephalis constricted internally by a round smooth ring, so that it appears as two segments, the upper subspherical, the lower an apically flattened ellipsoid. Four collar pores are present. Externally, the stricture between the cephalis and the thorax is not well marked, and the wall of the thorax partly obscures the lower part of the cephalis. The
thoracic pores are small, subcircular and widely spaced in slightly irregular transverse rows. The abdomen and post-abdominal segments have pores tending to be arranged in transverse rows, three to five rows in the first two abdominal segments, five to six rows (rarely four) in the third to sixth abdominal segments. The strictures of the abdominal segments, and occasionally the lumbar stricture, each have a single row of large nodes, generally with papillae, not equally spaced, about twelve to fifteen per circumference on the distal strictures, from which transverse and diagonal ridges radiate. The diagonal ridges, when well-developed, cross to form large diamonds, triangles or more irregular shapes, which enclose groups of pores. The distal edge of the shell is ragged, usually with a few pores or scallops beyond the stricture of the last segment. There is some evidence to suggest a fragile constricted last segment beyond the seven or eight mentioned above.

**Dimensions:** Length of seven segments 180–200μ, width of seventh segment (measured midway along length of segment, not at stricture) 90–100μ. Based on fifteen specimens.

**Occurrence:** *A. enesiβi* is common in Cuba, Loc. B 191, and Puerto Rico, Loc. OP 135.

**Discussion:** Specimens from Cuba (Loc. B 191 of Bermúdez) agree well with Pessagno’s 1963 paratypes, USNM 648542, with the photographs of other paratypes (plate 5, figures 4–5) of *Lithostrobus punctulatus*, and with additional specimens found in material from the type locality for *L. punctulatus*, OP 135. They differ from the original description (p. 210) only in not having a horn, unless the slightly thickened apex is so considered. They do not, however, agree with the holotype, USNM 648541, or its drawing (plate 1, figure 1). On the holotype the size of the nodes at the strictures is much smaller and their number much greater than on the paratypes. As the holotype is mounted dry, it is impossible to observe the internal features of the cephalis, but its external shape and size are such that it is extremely unlikely that this specimen has an internally constricted cephalis. Careful examination of OP 135 has failed to produce a specimen with both an internally constricted cephalis and small regular numerous nodes at the strictures. There is in the Cuban material and in OP 135 a species (not yet described) with small, regular, numerous nodes and a simple cephalis very like the specimen selected for the holotype of *L. punctulatus*.

**Holotype:** USNM 146102, N39/1 from Cuba, Loc. B 191.

**Localities**

1) Marca Shale Member and Dos Palos Member (Maestrichtian to Danian) of the Moreno Formation, Cima Hill, Fresno County, California. Core holes I to III of California Research Corporation, in NW 1/4 Sec. 8 (Hole I) and NE 1/4 Sec. 7 (Holes II and III), T. 15 S., R. 12 E., Mount Diablo Base & Meridian, Chounet Ranch quadrangle. From A. R. Loeblich, Jr.

2) Top of Marca Shale Member (Maestrichtian) of the Moreno Formation, Panoche Hills, Fresno County, California. Sec. 6, T. 15 S., R. 12 E., M. D. B. & M., Chounet Ranch quadrangle, 450 ft. north and 1,950 ft. west of the SE corner of Sec. 6. From M. B. Payne.

3) Moreno Formation, Panoche Hills, Fresno County, California. Sec. 6, T. 15 S., R. 12 E., M. D. B. & M., Chounet Ranch quadrangle. Loc. 3 (Maestrichtian) of Long, Fuge and Smith (1946). This is Loc. 1144, California Academy of Science. From G. D. Hanna.

4) Moreno Formation, Panoche Hills, Fresno County, California. Sec. 11, T. 14 S., R. 11 E., M. D. B. & M., Chounet Ranch quadrangle, Moreno Gulch, type locality of the Moreno Formation. Loc. 2 (Maestrichtian) of Long, Fuge and Smith (1946). Known also as Water Canyon from personal locality name of James Smith, according to G. D. Hanna (personal communication). From G. D. Hanna.
5) Panoche Formation (Campanian to Cenomanian), SE side of Ortigalita Creek, Ortigalita Peak NW quadrangle, Merced County, California. Ortigalita Section A of Richfield Oil Corporation, samples nos. 80–81 and 83–84. Sample 80–81 is from approximately 1600 ft. west and 1250 ft. north of NE corner Sec. 32, T. 11 S., R. 10 E., M. D. B. & M., where the strike is N 30° W and the dip 40°. Sample 83–84 is from 30 ft. stratigraphically below and in a SW direction from no. 80–81. From R. W. Crouch.

6) Forbes, Funks, Sites and Yolo Formations (Campa- nian to Turonian), Lake Berryessa quadrangle, Yolo County, California. North side of Putah Creek and toward Grapevine Spring, Secs. 23, 27 and 28, T. 8 N., R. 2 W. Diamond core holes of Shell Oil Company. From E. H. Stinemeyer.

7) Forbes Formation? Outcrop on the north side of Putah Creek, Sec. 23, T. 8 N., R. 2 W, Lake Berryessa quadrangle, Yolo County, California. Samples 280–296 of the Superior Oil Company, taken at five-foot intervals in the upper 70 feet of the exposed Forbes Shale (no. 280 lowest, no. 296 highest). From W. G. Binkley.

8) Pierre Shale, South Dakota. Top foot of Gregory Member (Campanian) from an outcrop just east of Rousseau, South Dakota, and samples of the Gregory and DeGrey Members (Crandell, 1950) representing 142 ft. of depth in a drill hole at the Oahe Dam site north of Pierre, South Dakota. From K. M. Waage.


12) Chalky sediments collected near Bebalain on the island of Roti, near Timor, Indonesia. Sample series VIII, nos. 149, 150 and 154 collected by the first Netherlands Timor Expedition (1910–1912) (Brouwer, 1922). From H. A. Brouwer and H. J. de Wijs. Dr. M. N. Bramlette has kindly examined the calcareous nanoplankton of these samples. He finds the assemblages to contain relatively few species, poorly preserved, and tentatively suggests that all three samples are Turonian or early Senonian in age.

13) Schrader Bluff Formation (Upper Cretaceous), Fish Creek area, Alaska. NPR 4, Fish Creek Test Well no. 1, lat. 70° 19’ 15” N, long. 151° 58’ 08” W, approx. twenty miles west of the mouth of the Colville River (Robinson and Collins, 1959). From H. R. Bergquist and Arthur Grantz.

14) Gearle Siltstone (Cenomanian or Turonian), Western Australia. Sample C. C. 19 of the Bureau of Mineral Resources, near the top (460 feet above the base, 15 feet from the top) of the type section, east of Remarkable Hill, Cardabilia Station. From D. J. Belford.

15) Level of limestone fragments in the “Scaglia Bianca” (Cenomanian), Val Dorbia, Umbria, central Italy. Marly, cherty limestone, sample RM 312, of AGIP Mineria (1959, pl. 86). From M. A. Chierici.


**TYPE**

The holotype of *Amphipyndax enesseffi* is deposited in the U. S. National Museum, Washington, D.C. The position of the specimen on the slide is indicated by coordinates from an England Finder (Riedel and Foreman, 1961) given after the USNM number.

**REFERENCES**

AGIP Mineria


Baily, J. W.

1856 – *Notice of microscopic forms found in the soundings of the Sea of Kamtschatka*. Amer. Jour. Sci. and Arts, ser. 2, vol. 22, no. 64, pp. 1–6, pl. 1.

Bermúdez, P. J.


Brouwer, H. A.


Campbell, A. S.


Campbell, A. S., and Clark, B. L.


Crandell, D. R.


Ehrenberg, C. G.


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The Catalogue of Index Larger Foraminifera

The first two volumes of a three-volume Catalogue of Index Larger Foraminifera have already been issued. This Catalogue contains illustrations, data on stratigraphic and geographic distribution, and references to species of larger foraminifera. These were selected because of their restricted stratigraphic ranges, as reflected in the files of the Department of Micropaleontology. The identifications and age determinations are those provided by the author of each article.

We have been aided in this work by a panel of specialists on the larger foraminifera. This panel consists of N. K. Brown’ Jr., W. S. Cole, R. C. Douglass, K. N. Sachs, Jr., N. J. Sander, and H. Schaub. The groups selected for inclusion are the miogypsinsids, lepidocyclines, discocyclines, pseudorbitoids, Cretaceous orbitoids, sulcoperculines, orbitolines, nummulites, assilines, Spirolyapheus, Coskinolina (and related genera), and Lockhartia.

The larger discoidal foraminifera were singled out for attention because they are among the best index foraminifera and also because the chaotic state of the literature makes them the hardest of all groups for the non-specialist to use. In view of this, the Catalogue was designed with the non-specialist in mind. It will provide him with the means of using these fossils in stratigraphic work without having to consult the material contained in hundreds of separate papers.

The first volume contains species of miogypsinsids and lepidocyclines. The second volume contains species of nummulites, assilines, orbitolines, Coskinolina (and related genera), and Lockhartia. These volumes are bound in loose-leaf binders similar to those used for the Catalogue of Foraminifera and Catalogue of Ostracoda. Volume 3 of this study will be issued later this year.

The price of the entire set of three volumes is $100.00. Subscriptions are now being accepted for this three-volume set. Inquiries and subscriptions should be directed to The Department of Micropaleontology, American Museum of Natural History, Central Park West at 79th Street, New York, N. Y., 10024.