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New *Gabonita* species from the Upper Cretaceous of southeastern Nigeria

ABSTRACT: Eight species of the foraminiferal genus *Gabonita* Dieni, 1974, are recorded from the Late Cretaceous Calabar Flank sediments in southeastern Nigeria. Of these eight, only two had previously been recorded from any part of the country and three, *Gabonita centrocostata* sp. n., *G. nigeriensis* sp. n., and *G. quadrata* sp. n., are here described as new species. The lower and upper parts of the *Gabonita*-bearing strata are dated with the associated planktic foraminiferal species and the benthic species *Afrobolivina afra* Reyment as the Senonian (Santonian-Campanian) and Maastrichtian respectively. Paleocologic niches inferred for the *Gabonita* species range from shallow to moderately deep ocean to shallow restricted marine environment.

INTRODUCTION

Early in the current microbiostratigraphic study of Cretaceous strata exposed in southeastern Nigeria, the numerous specimens of the genus *Gabonita* Dieni, 1974, were recovered. The samples come from outcrops on the Calabar Flank, along the Odukpani-Itu Highway, northwest of Calabar (Text-fig. 1).

The Calabar Flank is a structural high which borders the oil-producing Niger delta in its eastern part. The structural high is the subsurface continuation of the Precambrian — Jurassic crystalline Oban Massif in the area of Ikang Trough and Ituk High (Murat 1972). During the Middle and Late Cretaceous, relatively thin sequences of continental to largely shallow marine sediment were deposited on the flank during a minimum of five major sedimentary cycles (Adeleye & Fayose 1978, Fayose 1978, Odébòdé 1982a, b).

The genus *Gabonita* was originally described from the Upper Cretaceous and Tertiary strata of Gabon as *Gabonella* by de Klasz & al. (1960). However, Dieni (1974) demonstrated that the name *Gabonella* was preoccupied by an isopteric insect described by Uvarov (1940) and could thus not be used for a different genus. Dieni (1974) then proposed the

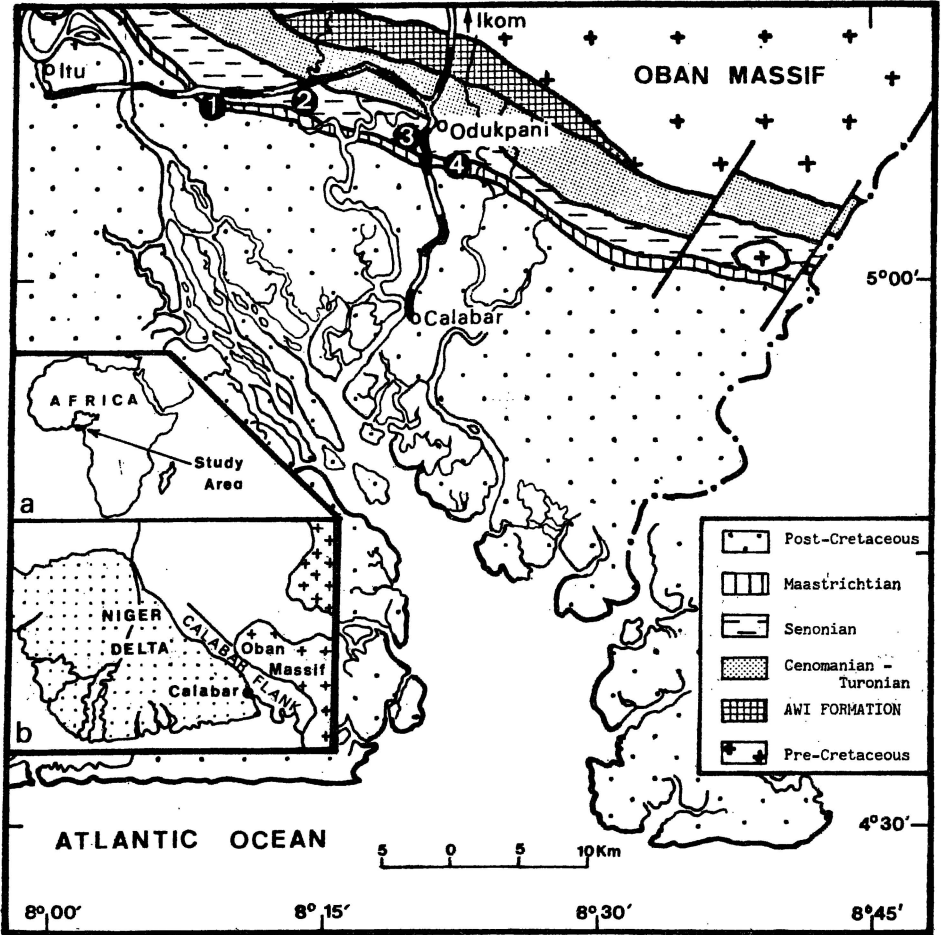


Fig. 1. Generalized geological sketch map of the Calabar Flank, southeastern Nigeria; 1-4 — sampling localities

name *Gabonita* to replace it. Since its erection, about forty species of the genus have been described from Africa, Europe and the Middle East (de Klasz & al. 1961, 1978; Roveda 1964; Hamaoui 1965; Barbieri 1966; Kerdary & Fahmy 1968; El-Shinnawi 1972). Prior to the present study, only two species, *Gabonita elongata* and *G. spinosa* had been recorded from Nigeria. These were recovered from the Dahomey Basin in the west by Reyment (1965) and Jan du Chêne & al. (1977). The Dahomey Basin has a different megatectonic setting and stratigraphic and structural history than the eastern Nigerian basins. In addition to the two species, Petters (1980) recorded a form which he could not unequivocally assign to the genus from the southern Benue trough.

This paper reports the *Gabonita* species from eastern Nigeria (three of the recorded species are new), and presents their paleoecologic niches.

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BIOSTRATIGRAPHY AND AGE

The *Gabonita*-bearing strata are the youngest Cretaceous sediments on the Calabar Flank. They are referable to the Nkporo Shale, a formation erected in the nearby Anambra Basin by Reyment (1965), on the basis of lithologic similarity and stratigraphic position. Underlying are the increasingly older sediments of the Ezeaku Shale, Odukpani Formation and Awi Formation. On the flank, the Nkporo Shale strata consist predominantly of dark, sometimes carbonaceous richly fossiliferous shales and a few calcareous and silty to sandy intercalations. The arenaceous bands progressively thicken towards the top. Fossil faunas commonly encountered include ammonite fragments, foraminifera, ostracodes, fish teeth, echinoderm spines and fragments, microgastropods, and *Inoceramus* prisms. Palynomorphs have also been recovered from some of the carbonaceous horizons.

The strata can be divided into two distinct parts. The lower part is totally marine, probably transgressive-regressive in origin, and it invariably consists only of shales. The upper part, with important sandy shale bends, varies from marine at its base through brackish to fresh water at the top; its lower section is thus obviously a marine regression deposit.

The species *Gabonita distorta*, *G. nigeriensis*, *G. parva*, *G. quadrata* and *G. spinosa* together with a number of planktic foraminiferal species occur in the lower part. The planktic forms, particularly the Heterohelicids (*Heterohelix moremani*, *H. planata*, *H. pulchra* and *Ventilabrella glabrata* — see Odébové 1982a) and globotruncanids (*Dicarinella conca-vata*, *Globotruncana ventricosa*, *G. plummerae* and *Marginotruncana paraconca-vata*) date this part as the Senonian (Upper Santonian — Campanian). The overlap of the stratigraphic ranges of *Gabonita distorta*, *G. parva*, and *G. spinosa* from other countries, especially in West Africa (i.e. Santonian to Campanian) is consistent with this age assignment (see also de Klasz & Rérat 1963).

From the upper part were recovered *Gabonita centrocostata*, *G. elongata*, *G. lata* and *G. nigeriensis* together with large numbers of *Afroboliviana afra* and rotaliforms (probably *Anomalina*) and few specimens

of *Rugoglobigerina* species. Although *Gabonita elongata* ranges from the Campanian to Maastrichtian in other places, the occurrence of *Afroboliviana afra* is an important indicator of the Maastrichtian in Nigeria (Reyment 1960, Reyment & Reyment 1979). Moreover, Maastrichtian spores belonging to the genus *Ariadnaesporites* and some *Azolla* fragments were recorded from the same part by Odébòdé & Skarby (1980).

The lower and upper parts of the strata together with their constituent *Gabonita* species are thus respectively Senonian (Santonian — Campanian) and Maastrichtian in age.

PALEOECOLOGY

Abundant and highly diversified (both at generic and specific levels) planktic foraminifera dominate the microfauna of the lower part of the Nkporo Shale strata studied. The abundance of foraminifera together with the diversity of other groups (echinoderms, ostracodes, molluscs, etc.) indicates an open marine depositional environment for the lower part. Although occurring in large numbers, the planktic foraminifera are mostly relatively small-sized apparently due to stunted growth. This nanism was also observed in the benthic foraminifera, particularly the genus *Gabonita* (see chapter on systematic paleontology) and is here interpreted as a consequence of non-optimal environmental conditions. The latter was in turn, probably due to the final phase of the Santonian tectonic episode, widespread in Nigeria (Reyment 1965, Burke & *al.* 1972), which shoaled the Calabar Flank sea. The sea, moderate depth is also indicated by the abundant *Inoceramus* fragments and fish remains. Moreover, based on the relationship between planktic foraminiferal morphology and Cretaceous sea-depth-stratification (Douglas & Savin 1973, 1978), a warm relatively shallow (not deeper than 100 m) marine environment was inferred for the Senonian strata by Odébòdé (1982b).

In the upper part, benthic foraminiferal individuals except the buliminids are better developed and thus larger but the reverse holds for the planktic species. Agglutinated forms also occur and sometimes constitute a considerable part of the microfauna. Moreover, faunal diversity is generally extremely low, with some samples yielding mono- or bispecific foraminiferal assemblages. All these facts seem to indicate a restricted shallow marine environment for the upper part of the Nkporo Shale.

On the Calabar Flank, therefore, *Gabonita distorta*, *G. parva*, *G. quadrata* and *G. spinosa* inhabited a shallow to moderately deep open sea. The species *Gabonita centrocostata*, *G. elongata* and *G. lata* flourished, on the other hand, in a shallow restricted environment and *G. nigriensis* survived in both environment types.

SYSTEMATIC DESCRIPTION

The taxonomic position of *Gabonita* is still to be unequivocally established beyond the generic level. Hofker (1964) demonstrated that the genus cannot belong to the Heterohelicidae as indicated by de Klasz & al. (1960) and de Klasz & Rérat (1961). Hofker (1964) places *Gabonita* in the same group as *Siphogaudryina* and *Valvobifarina* apparently implying that it belongs to the Buliminidae. A different view is held by Loeblich & Tappan (1964) who place it in the family Bolivinitidae; this very view is kept in the present paper.

The holotypes and some paratypes of the new *Gabonita* species are deposited in the micropaleontological collection of the University of Ife. Additional paratypes are kept in the Natural History Museum, University of Ife, Nigeria.

Phylum Protozoa Goldfuss, 1818
 Subphylum Sarcodina Schmarda, 1871
 Class Rhizopoda von Siebold, 1849
 Order Foraminiferida Eichwald, 1830
 Suborder Rotaliina Delage & Hérouard, 1896
 Superfamily Buliminaceae Jones, 1875
 Genus GABONITA Dieni, 1974

Gabonita centrocostata sp. n.

(Pl. 2, Fig. 4 and Pl. 4, Figs 5, 7)

Holotype: The specimen presented in Pl. 4, Fig. 7.

Paratype: The specimen presented in Pl. 4, Fig. 5.

Type level: Maastrichtian.

Type locality: Strata exposed along Calabar — Itu Highway, Calabar Flank, southeastern Nigeria.

Derivation of the name: After the prominent central ridge on the test.

Diagnosis: Elongate invariably non-flared test with a prominent centrally placed ridge.

Dimensions: Length 440—600 μm , maximum width 135—160 μm .

Description. — Test medium-sized, elongate, twisted towards longitudinal axis, three to four times longer than wide, generally progressively increases in width to the last chambers. Height of chambers (8 to 13 pairs) also increases but very slowly. Sutures deeply depressed after initial two or three chamber pairs. Transverse section rhomboid to almost rectangular. Proloculus large, spherical. A conspicuous median ridge of transparent thickened shell material separates the two rows of chambers.

Remarks. — The persistent elevated median ridge distinguishes this species from *Gabonita elongata*. Like in other *Gabonita* species, there is some conspicuous variation in character ratios in individuals of *G. centrocostata*.

Occurrence. — Maastrichtian of the Calabar Flank, southeastern Nigeria, localities 1 and 4.

Gabonita distorta (de Klasz & Meijer, 1960)

(Pl. 1, Fig. 5 and Pl. 3, Figs 1, 4, 5)

1960. *Gabonella distorta* de Klasz & Meijer n. sp.; I. de Klasz, P. Marie & M. Meijer, p. 174, Pl. 2, Fig. 2a-c.

Remarks. — Specimens recovered from the Calabar Flank, southeastern Nigeria, are identical to those described from Gabon in all respects but size. Gabonese forms average 0.6 mm in length while the Calabar Flank forms average 0.36 mm. This pronounced nanism is apparently due to unfavorable ecological conditions.

Occurrence. — The species occurs in the Senonian of Gabon and the Maastrichtian of Angola (de Klasz & al. 1960). In the present study area, it was recovered only in localities 2 and 3, i.e. the Senonian.

Gabonita elongata (de Klasz & Meijer, 1960)

(Pl. 2, Figs 1, 2, 7, 8 and Pl. 3, Fig. 6)

1960. *Gabonella elongata* de Klasz & Meijer n. sp.; I. de Klasz, P. Marie & M. Meijer, p. 171, Pl. 1, Fig. 1a-b.

Remarks. — This is the most abundant *Gabonita* species in the studied sequence. Typical specimens of the species were found in the upper (i.e. Maastrichtian) part of the sequence. It is possible that it also occurs in the top part of the lower section. The latter corresponds to the latest age determination of the Gabonese local stratigraphic units (see also de Klasz & al. 1978). In addition to the typical forms, some other recorded ones show marked variation in size and shape.

Occurrence. — This species has been recorded from virtually all basins where the genus *Gabonita* occurs. Previous record in Nigeria is limited to the Dahomey Basin (boreholes west of Lagos). In the present study area, *Gabonita elongata* was encountered in localities 1 and 4.

Gabonita lata (de Klasz & Meijer, 1960)

(Pl. 1, Figs 1—2)

1960. *Gabonella lata* de Klasz & Meijer n. sp.; I. de Klasz, P. Marie & M. Meijer, p. 172, Pl. 1, Fig. 4.

Remarks. — This species is rare and the specimens recovered display nanism.

Occurrence. — The species was first recorded in the Senonian to questionable Maastrichtian strata of Gabon by de Klasz & al. (1960). On the Calabar Flank, it occurs in localities 1 and 4. The latter occurrence in the Maastrichtian strata confirms the extended range of the species.

Gabonita nigeriensis sp. n.

(Pl. 1, Fig. 8, Pl. 2, Fig. 6, Pl. 3, Figs 3, 7, 8 and Pl. 4, Figs 1, 3)

Holotype: The specimen presented in Pl. 4, Fig. 3.

Paratype: The specimen presented in Pl. 3, Fig. 3.

Type level: Senonian (Santonian-Campanian).

Type locality: Strata exposed on Calabar-Itu Highway, Calabar Flank, southeastern Nigeria.

Derivation of the name: After Nigeria, the country of its discovery.

Diagnosis: Slightly twisted test with deeply depressed sutures occurring only in its latter part.

Dimensions: Length 260—320 μm , maximum width 170—200 μm .

Description. — Test small, biserial, generally two to two and one half times as long as maximum width, tapers uniformly, rather strongly compressed, thickness invariably less than half the width. Aperture low, arch-shaped, interior-marginal. Sutures slightly depressed in initial part but strongly so between last two or three chambers.

Remarks. — The species shows some similarity to *G. elongata* (e.g. their apertures are identical in shape) but it is much smaller and less elongate. Moreover,

the sutures are deeply depressed only between the two or three last chambers whereas they are deeply depressed throughout the test of *Gabonita elongata*. The species *Gabonita nigeriensis* is much less twisted than *G. distorta* to which it also shows some superficial resemblance.

Occurrence. — In the study area, *Gabonita nigeriensis* occurs both in the lower and upper parts (localities 1—4), i.e. in the Senonian and Maastrichtian strata. It is, however, more abundant and better preserved in the Senonian.

Gabonita parva (de Klasz & Meijer, 1960)
(Pl. 1, Figs 1, 7)

1960. *Gabonella parva* de Klasz & Meijer n. sp.; I de Klasz, P. Marie & M. Meijer, p. 175, Pl. 2, Fig. 4a-b.

Remarks. — This extremely slender form is abundant in the study area. The aperture of recovered specimens is not apparent; this is probably a result of obliteration due to post-mortem changes in the tests.

Occurrence. — In Gabon and Angola, *Gabonita parva* was encountered in bore-hole samples from the Senonian and possibly Upper Turonian. On the Calabar Flank, it occurs in the Senonian strata of localities 2 and 3.

Gabonita quadrata sp. n.
(Pl. 1, Fig. 6, Pl. 2, Figs 3, 5, Pl. 3, Fig. 2 and Pl. 4, Figs 2, 6)

Holotype: The specimen presented in Pl. 1, Fig. 6.

Paratypes: The specimens presented in Pl. 2, Fig. 3 and Pl. 4, Figs 2, 6.

Type level: Senonian.

Type locality: Calabar Flank, southeastern Nigeria.

Derivation of the name: After the shape of transverse section of the test.

Diagnosis: Moderately elongate test with losenge to oval transverse section.

Dimensions: Length 250—280 μm , maximum width 136—150 μm .

Description. — Test medium-sized, rhombohedral to oval in transverse section, width about one-half of length, rapidly increasing towards top; chambers somewhat inflated and elongate with prominent pointed margins, margins less pointed in final chambers. Sutures between whorls deeply depressed, those between chambers only slightly so. Aperture as interiomarginal semicircular opening on final chamber.

Remarks. — The species is similar to *G. billmani* described by Roveda (1964) from Western (Spanish) Sahara. It, however, differs from the latter in having a rhombohedral to oval, rather than an irregularly rounded, transverse section. Moreover, its chambers are not conical as in *G. billmani* but more or less elongate, and the lower edges of its chambers are not lobate (a feature characteristic of *G. billmani*).

Occurrence. — The species occurs in localities 2 and 3 of the study area which have Senonian strata. The species thus occurs in younger strata than *Gabonita billmani* (Turonian — Coniacian) and may actually have evolved from the latter.

Gabonita spinosa (de Klasz & Meijer, 1960)
(Pl. 1, Fig. 4 and Pl. 4, Fig. 4)

1960. *Gabonella spinosa* de Klasz & Meijer n. sp.; I. de Klasz, P. Marie & M. Meijer, p. 173, Pl. 1, Fig. 5a-d.

Remarks. — This species characterized by chambers prolonged into spines and a symmetrical crescentic aperture situated at the base of the last chamber, is fairly abundant in the study area.

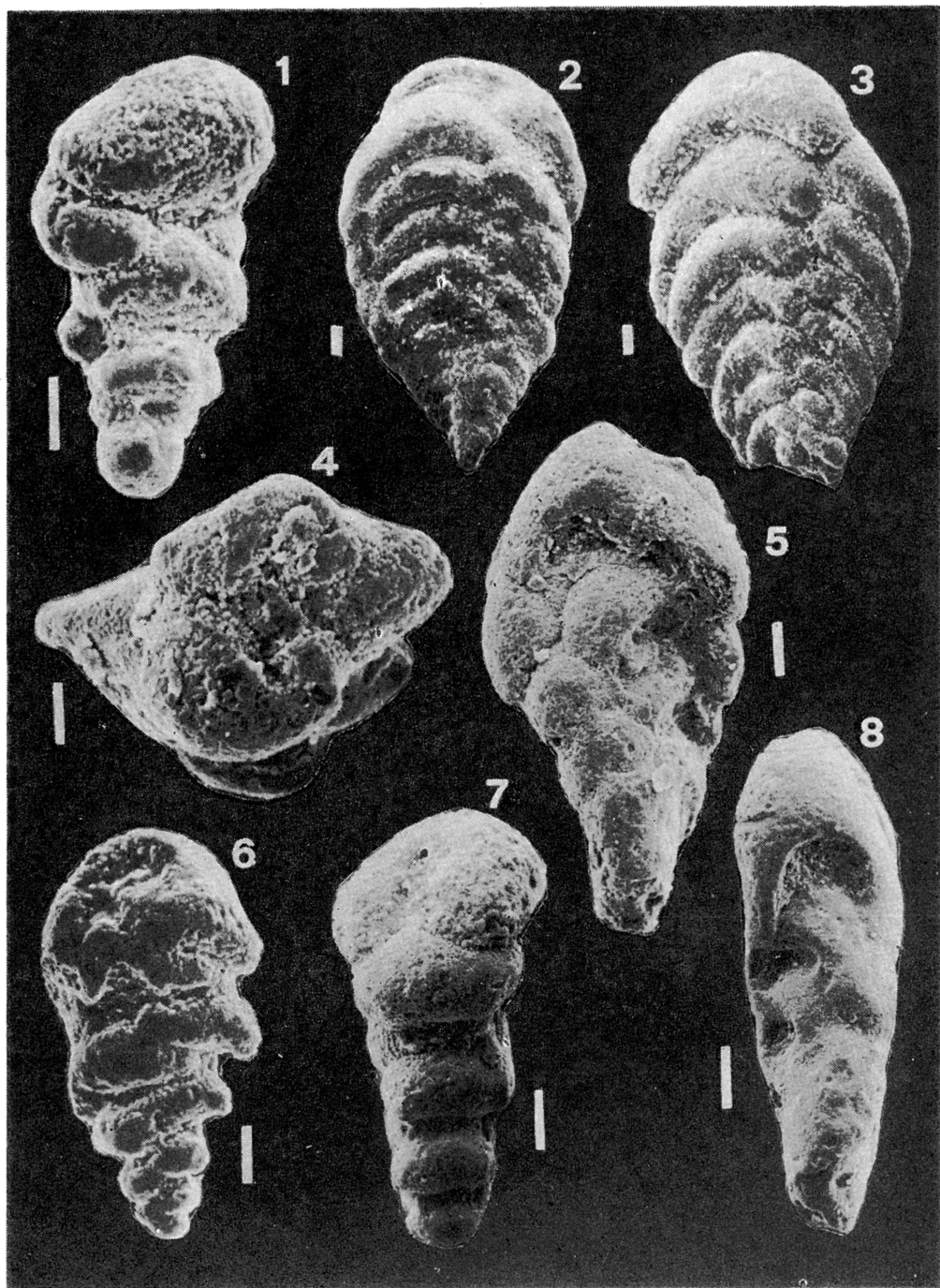
Occurrence. — Like many *Gabonita* species, *G. spinosa* is widespread. It has been recorded in the Senonian strata of Gabon, Angola and western Nigeria (de Klasz & al. 1960, Reyment 1965, Jan du Chêne & al. 1977). On the Calabar Flank, it occurs in the strata exposed in localities 2 and 3, also of Senonian age.

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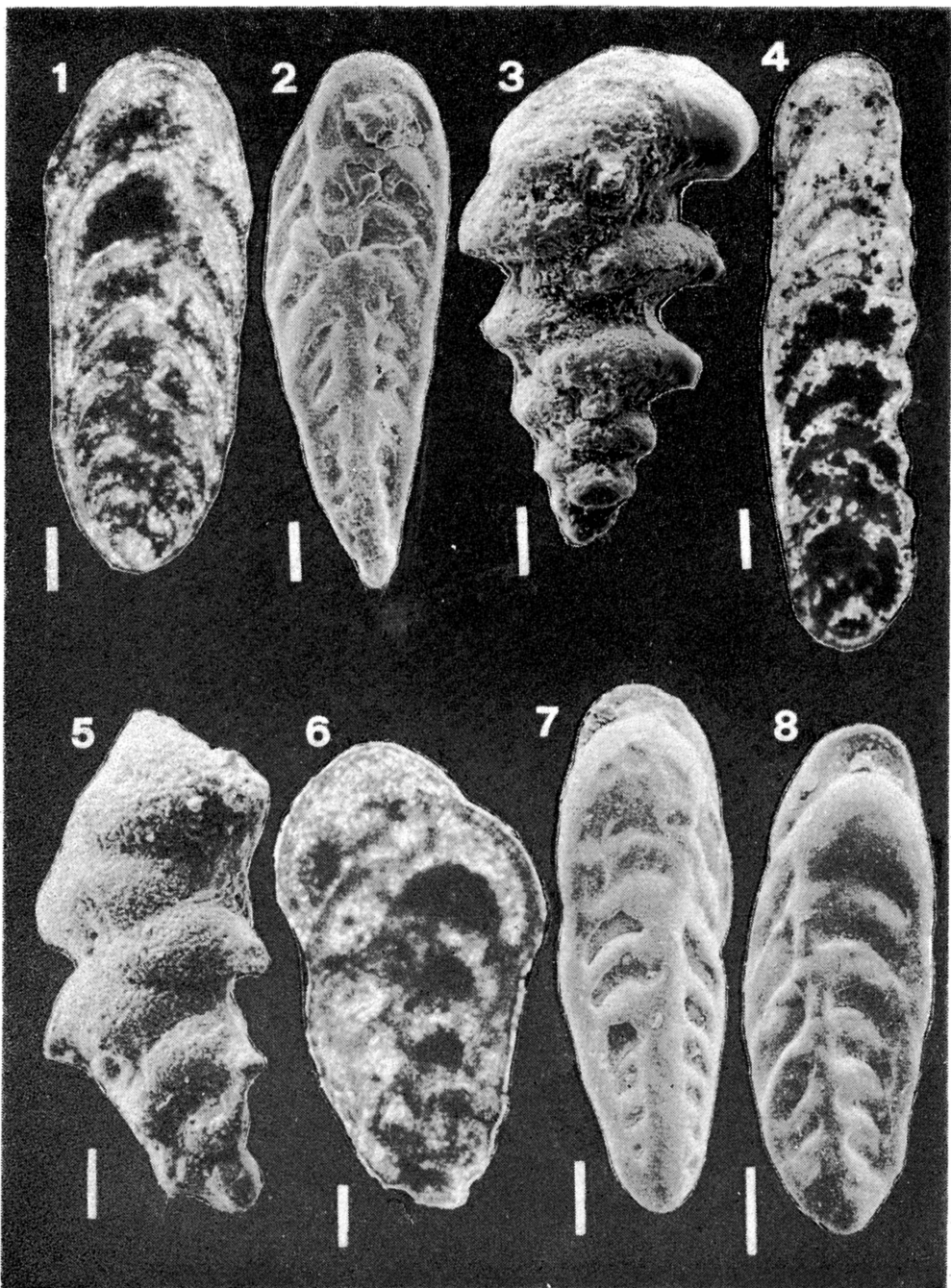
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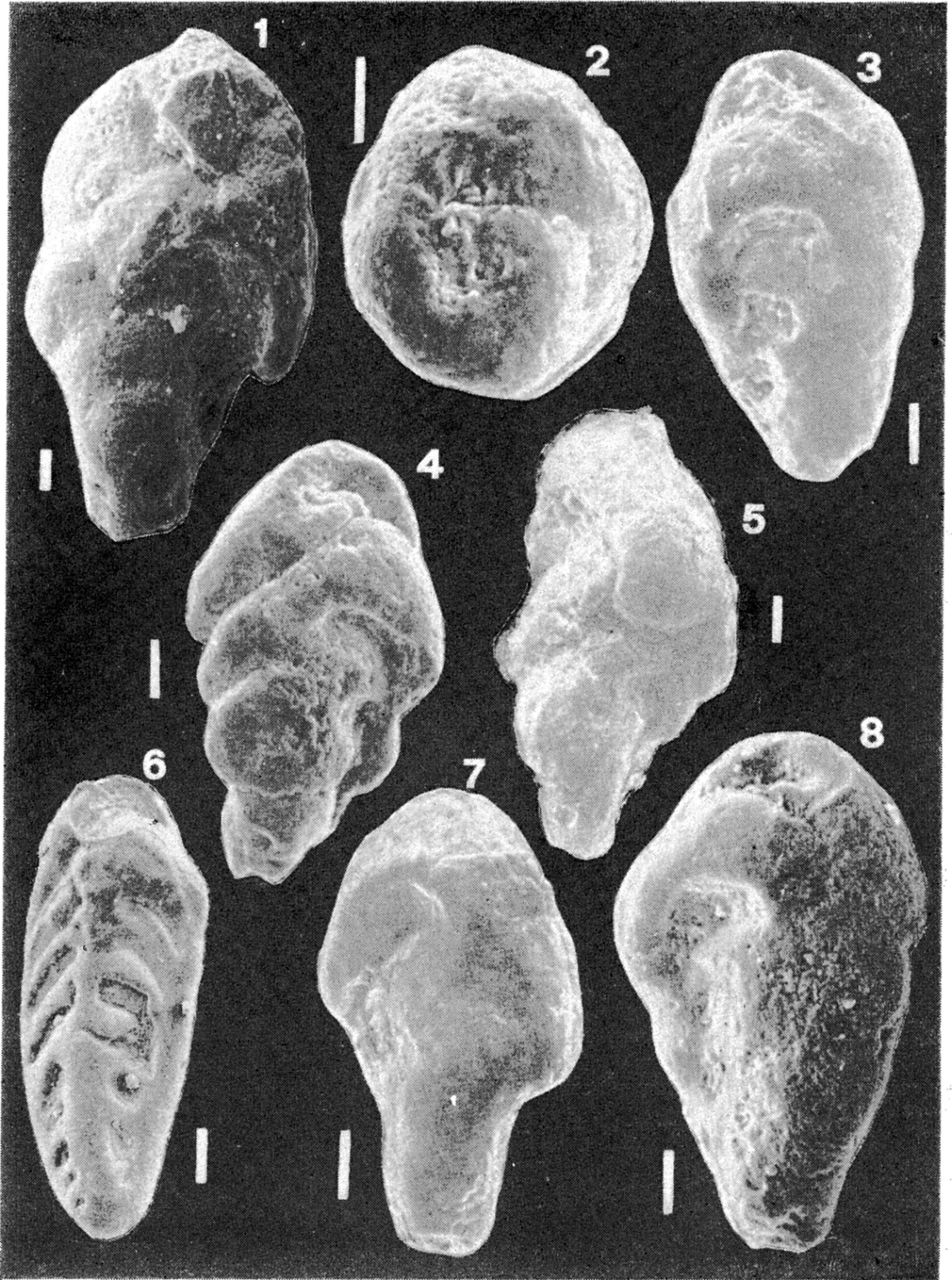
- 1 and 7 — *Gabonita parva* (de Klasz & Meijer); opposite sides; Senonian
 2 and 3 — *Gabonita lata* (de Klasz & Meijer); opposite sides; Maastrichtian
 4 — *Gabonita spinosa* (de Klasz & Meijer); top view; Senonian
 5 — *Gabonita distorta* (de Klasz & Meijer); side view; Senonian
 6 — *Gabonita quadrata* sp. n.; holotype; Senonian
 8 — *Gabonita nigeriensis* sp. n.; oblique-edge view; Senonian

The length of each bar is 40 μ m.



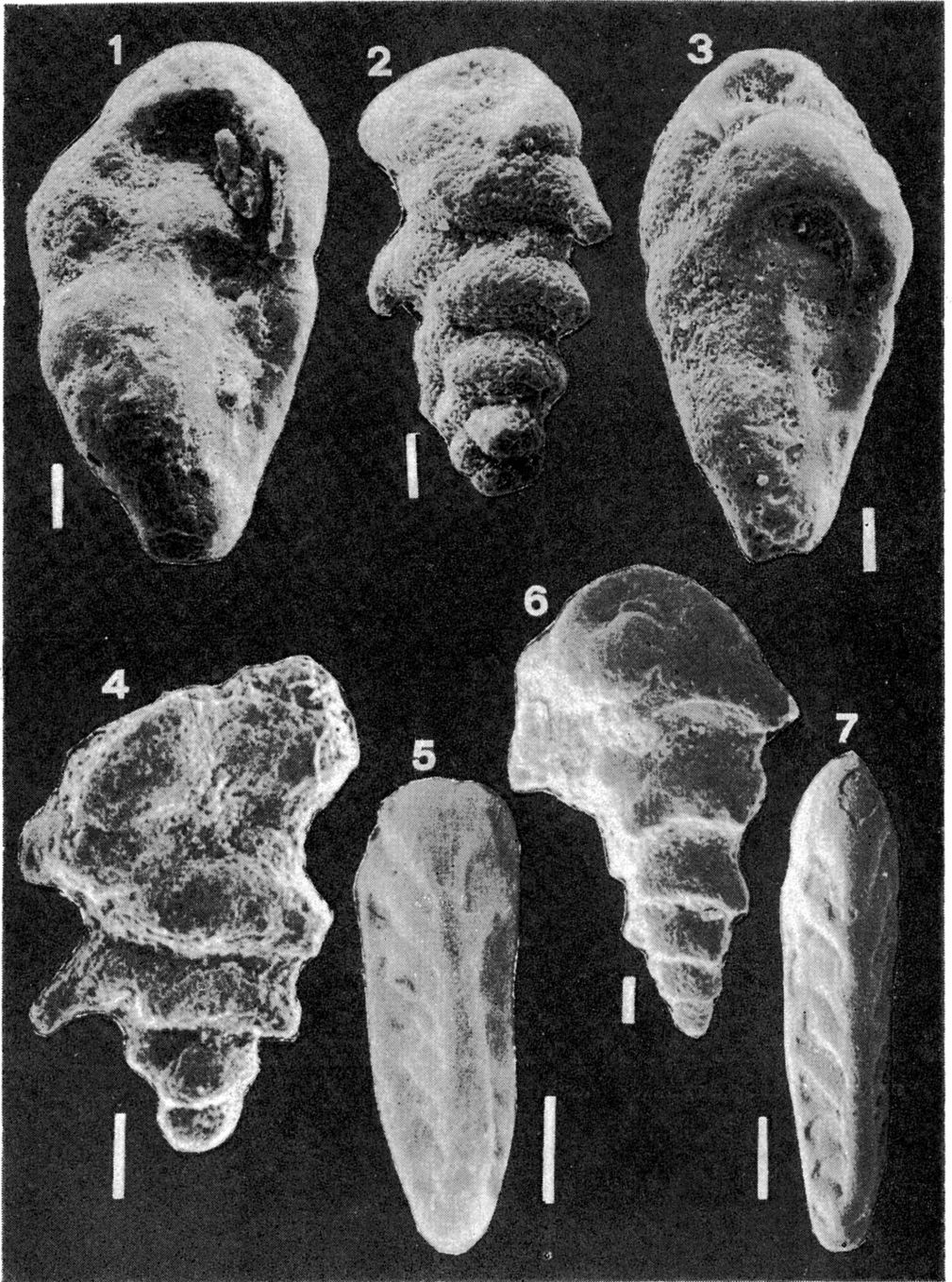
1, 2, 7 and 8 — *Gabonita elongata* (de Klasz & Meijer); different varieties and different views (Figure 1 is a thin section photograph); Maastrichtian
 3 — *Gabonita quadrata* sp. n.; paratype; Senonian
 4 — *Gabonita centrocostata* sp. n.; thin section; Maastrichtian
 5 — *Gabonita quadrata* sp. n.; Senonian
 6 — *Gabonita nigriensis* sp. n.; thin section; Senonian

The length of each bar is 100 μ m except for Figures 3, 5 and 6 where it is 40 μ m



1, 4 and 5 — *Gabonita distorta* (de Klasz & Meijer); different views; Senonian
 2 — *Gabonita quadrata* sp. n.; top view; Senonian
 3 — *Gabonita nigriensis* sp. n.; paratype; Senonian
 6 — *Gabonita elongata* (de Klasz & Meijer); Maastrichtian
 7 and 9 — *Gabonita nigriensis* sp. n.; Senonian

The length of each bar is 40 μ m except for Figure 8 where it is 100 μ m



- 1 — *Gabonita nigriensis* sp. n.; Senonian
- 2 and 6 — *Gabonita quadrata* sp. n.; paratypes; Senonian
- 3 — *Gabonita nigriensis* sp. n.; holotype; Senonian
- 4 — *Gabonita spinosa* (de Klasz & Meijer); Senonian
- 5 — *Gabonita centhocostata* sp. n.; paratype; Maastrichtian
- 7 — *Gabonita centrocostata* sp. n.; holotype; Maastrichtian

The length of each bar is 40 μ m except for Figures 5 and 7 where it is 100 μ m