REVISTA ESPAÑOLA DE MICROPALEONTOLOGÍA
Vol. XIV, 1982, pp. 231-246

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SENONIAN HETEROHELICIDAE FROM THE CALABAR FLANK, SOUTHEASTERN NIGERIA

Planktonic foraminifera are described for the first time from the Senonian sediments on the Calabar Flank, southeastern Nigeria.

The species described belong to the family Heterohelicidae Cushman and they were all recovered from the Nkporo Shale. Three of them, *Heterohelix calabarflanki* n. sp., *Heterohelix ivandeklaszi* n. sp., and *Heterohelix nkporoensis* n. sp. are new.

The Nkporo Shale sediments on the flank have hitherto been considered Senonian in age solely on the basis of the formation's stratigraphic position. The Heterohelicid foraminiferal assemblage provides the first conclusive evidence for this age indicating a Santonian-Campanian age for the lower part of the formation.

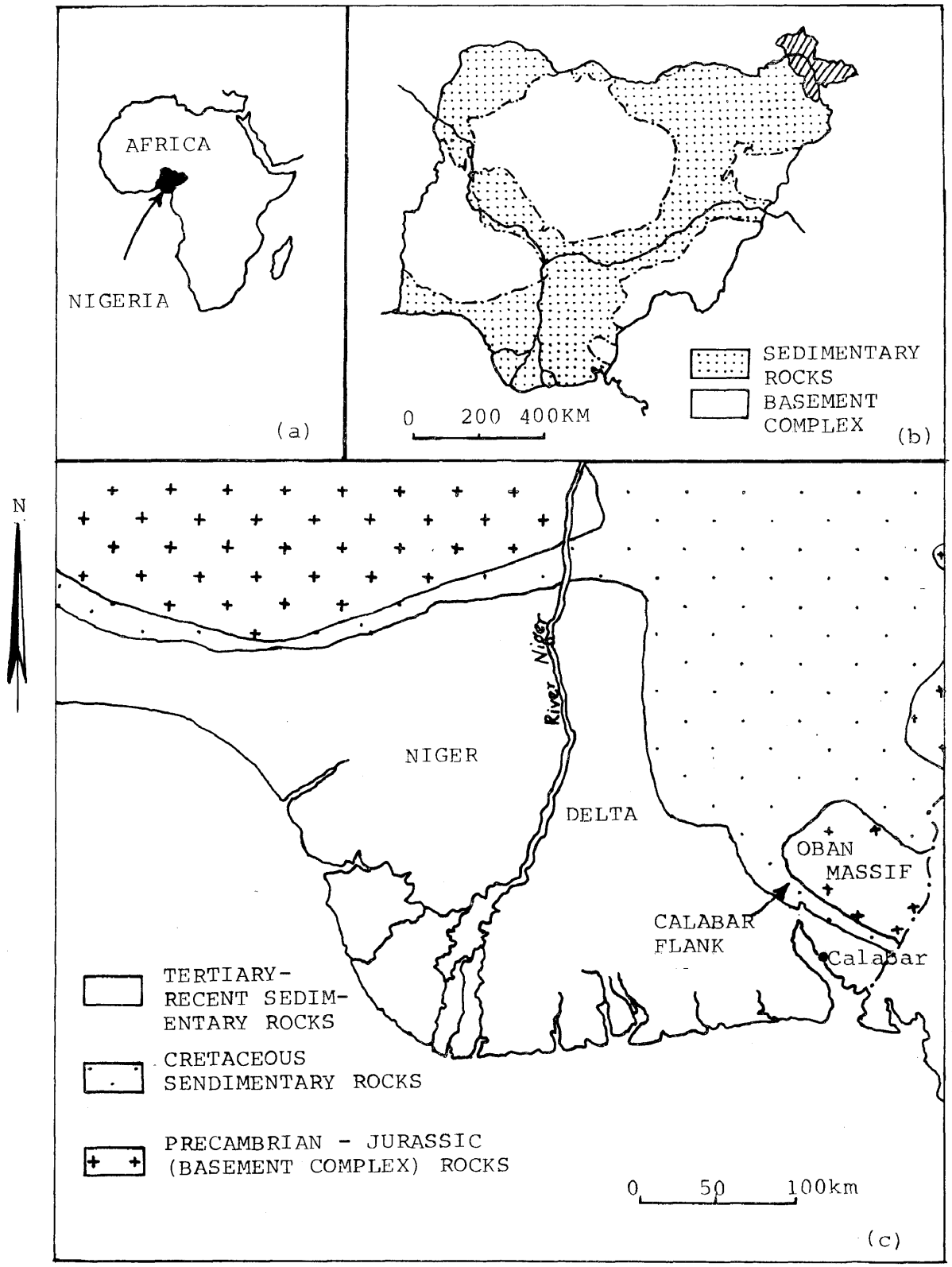
Se describen por primera vez foraminíferos planctónicos del Senoniense del Calabar Flank, Nigeria suroriental.

Las especies descritas pertenecen a la familia Heterohelicidae y proceden de la formación Nkporo. Tres de ellas son nuevas: *Heterohelix calabarflanki, Heterohelix ivandeklaszi* y *Heterohelix nkporoensis.*

Hasta ahora, los sedimentos de la formación Nkporo se habían considerado senonienses, fundándose solamente en su posición estratigráfica. El conjunto de Heterohelícidos permite atribuir al Santoniense-Campaniense la parte inferior de la formación.

INTRODUCTION

The Calabar Flank, situated in the extreme southeastern Nigeria (Text-Fig. 1), is the subsurface continuation of the crystalline Oban Massif. The Oban Massif is predominantly Precambrian in age and belongs to the Nigerian Basement Complex. During the Middle and Upper Cretaceous times relatively thin sequences of continental to largely shallow marine sediments were deposited on the flank by five or more major sedimentary cycles (Murat, 1972; Adeleye and Fayose, 1978; de Klasz and Odébòdé - in press). The last of these resulted in the deposition of predominantly black shaley sediments (Nkporo shale) of Senonian age. Overlying the Senonian sequence (on the flank) to the southwest are Tertiary and Quaternary sediments of the eastern part of the Niger delta.



TEXT-FIGURE 1.

Location and generalised geology of the study area:
(a) Key Map. (b) Sedimentary and crystalline basement rocks in Nigeria.
(c) Niger Delta - Calabar Flank area.

Very little published information exists on the foraminifera of the Cretaceous sediments on the flank. The biostratigraphy of the strata was erected (up to the Turonian) largely on the basis of ammonite content (Reyment 1955; 1957a, b; 1965). The general lack of information on the foraminifera is not unrelated to the absence until recently, of fresh outcrops on the flank. The few publications on foraminifera are on forms recovered from the Cenomanian to Turonian Odukpani Formation. They are those of Dessauvagie (1965, 1968) on *Trocholina,* Dessauvagie (1972) on twelve additional foraminifera species and Fayose (1978) on five previously undescribed agglutinated benthonic forms. The only existing account on Senonian foraminifera was presented by de Klasz and Odébòdé during the

	AGE	FORMATION	LITHOLOGY
CRETACEOUS	SENONIAN	NKPORO SHALE	Carbonaceous shales, mudstones and sandstones
	? CONIACIAN - TURONIAN	EZE - AKU SHALE	Hard grey or black calcareous shale. limestone and siltstone
	TURONIAN - CENOMANIAN	ODUKPANI FORMATION	Limestones, carbonaceous shales and marls.
	ALBIAN - APTIAN	AWI FORMATION	Sandstones, conglomerates, clays and carbonaceous shale.
PRECRET	JURASSIC - PRECAMBRIAN	OBAN MASSIF (BASEMENT COMPLEX)	Gneisses, granites, pegmatites, syenites basalt, dolerite etc.

TEXT-FIGURE 2.

Cretaceous stratigraphic sequence on the Calabar Flank, S. E. Nigeria.

8th African Micropaleontological Colloquium in Paris in July, 1980. (The proceeding of that conference are still in press). That account describes species and subspecies of the benthonic genus *Gabonita* (de Klasz, Marie and Meijer) which had been found to be of stratigraphic value in a number of African sedimentary basins (de Klasz, Marie and Meijer, 1960; Roveda, 1964; El-Shinnawi, 1970).

This paper gives the first account of Senonian planktonic foraminifera from the Calabar Flank sediments. All the specimens described were recovered from the lower part of the Nkporo Shale. The paper thus presents the first conclusive paleontological evidence on the Senonian age of the formation which, on the flank, has hitherto been dated on the basis of its stratigraphic position. Although other foraminiferal families are represented in the specimens recovered, most of them do not appear to be of stratigraphic value. Thus, the species herein described belong to the family Heterohelicidae; three of them are proposed as new species.

This study constitutes part of the doctoral dissertation of the author on the Microbiostratigraphy of the Upper Cretaceous sediments on the Calabar Flank. The doctoral study is funded in part by the Department of Geology, University of Ife, Nigeria to which the author expresses his gratitude. The author acquired considerable experience from interaction with Dr. Sunday Williamson Petters of the University of Ibadan and Professor Dr. Ivan de Klasz formerly of the University of Jos, Nigeria and now of Université d'Abidjan, Côte d'Ivoire. The technical assistance rendered by Messrs Etienne Gilbert de Vautibault and Kunle Ogundele of the University of Ife, Nigeria in producing the scanning electron photomicrographs is also gratefully acknowledged.

STRATIGRAPHY

The Upper Cretaceous sediments on the Calabar Flank unconformably overly the crystalline basement rocks of Precambrian to Jurassic age. Compared to the overlying Tertiary and Quaternary rocks of the adjacent Niger delta, the Cretaceous strata are thin. Recent road cuts in the area show, however, that they are much more widespread than indicated on the Geological Map of Nigeria series Sheet 80 (1957) compiled on scale 1 : 250,000 by the Shell-BP Petroleoum Development Company Ltd., Nigeria for the Geological Survey of Nigeria.

No detailed chronostratigraphic subdivisions of the sediments exist; the only boundary known with some degree of certainty is the Cenomanian-Turonian boundary (see Dessauvagie, 1972). The lithostratigraphic subdivisions are probably diachronous. They consist of the following formations: Awi, Odukpani, Eze-Aku and Nkporo (Text-Fig. 2).

Although not identified to date in the field, the boundary between the Eze-Aku and Nkporo Shale is likely to be erosional. This is because the Awgu-Ndeaboh Shale Group which occurs between the two formations in the adjacent Anambra Basin has not been identified on the flank; it is, in fact, likely to be missing. This is further supported by the fact that Reyment (1965) identified an angular unconformity at the base of the Nkporo Shale in cores.

Of the four formations of Cretaceous age on the Calabar flank, only the Nkporo Shale (from which were recovered the foraminifera recorded in this paper) is herein briefly described. Detailed lithologic descriptions of the other formations are contained in Reyment (1965), Dessauvagie (1972, 1975), Fayose (1978) and Adeleye and Fayose (1978).

At the type locality at Nkporo (Eastern Nigeria) and in boreholes (Reyment, *op. cit.*), the Nkporo Shale consists of 1000 metres of dark shales and mudstones with occasional thin beds of sandy shale and sandstone and sometimes thin bands of shelly limestone.

On the Calabar Flank, the formation con-

sists predominantly of thick layers of black shales alternating with thin bands of brown to greyish siltstone, sandstones and limestones. When present, mudstone layers are thin and brown. The sandy and silty layers become more important towards the top of the formation.

AGE OF THE NKPORO SHALE

At its type locality and in other parts of the Anambra Basin, the Nkporo Shale was dated Senonian (Upper Campanian-Maastrichtian) by Reyment (1965, p. 47). This age assignment was based on its abundant mollusc (mainly ammonite) fauna. On the Calabar Flank, however, its age has hitherto been based on its stratigraphic position.

The rich foraminiferal assemblage recovered from the lower part of the formation on the flank is constitued mainly by species of *Rugoglobigerina, Hedbergella, Heterohelix, Ventilabrella, Globotruncana* and *Gabonita.* Of these, the Heterohelicid species appear to be the most useful for chronostratigraphic purposes. The geologic ranges of each of the already established Heterohelicid species recovered are shown on Table I. None of the individual species indicates a precise age for

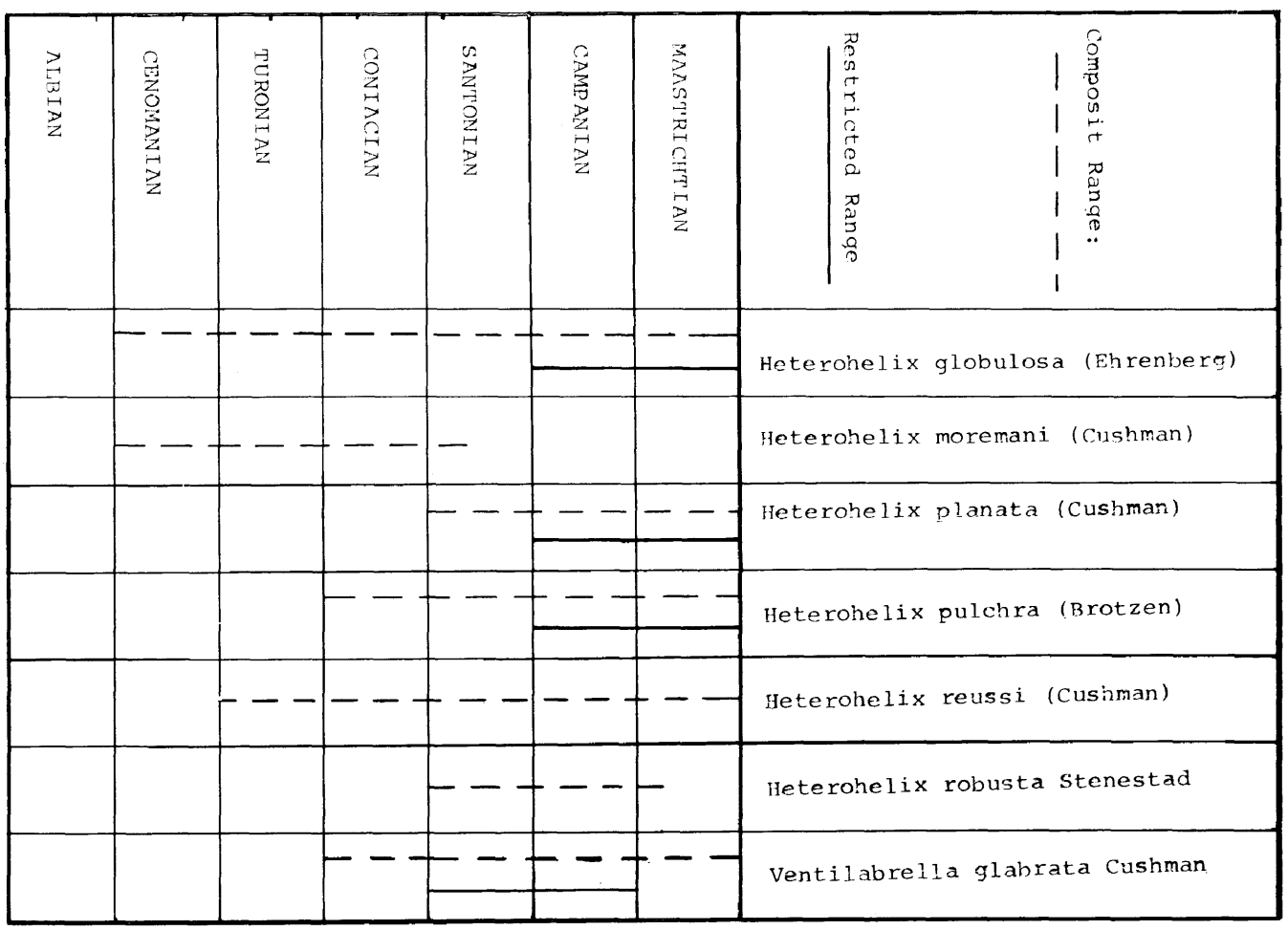


TABLE 1

Stratigraphic Ranges of previously described Heterohelicid species recorded from the strata.

the lower part of the formation. This confirms this author's opinion that fossil assemblages rather than individual «index» fossils should be employed in biostratigraphic dating in the area.

As a group, these species occur throughout the Upper Cretaceous of different strata the world over. Earlier recorded occurrences include widely separated localities in Bohemia, Brazil, Canada, Cuba, Czekoslovakia, Denmark, Egypt, England, France, India, Iran, Iraq, Italy, Libya, Mexico, Nigeria, Pakistan, South Africa and U.S.A. (Ehrenberg, 1840; Brotzen, 1936; Cushman, 1938, 1946; Brönnimann and Brown, 1953; Frizzell, 1954; Nagappa, 1959; Olsson, 1960; Berggren, 1962; Pessagno, 1962, 1967, 1969b; McGugan, 1964; Salaj and Samuel, 1966; Barr, 1968a; Stenestad, 1969; Douglas, 1969a, b; Eicher and Worstell, 1970; Todd, 1970; Dessauvagie, 1972; Govindan, 1972; Darmoian, 1975). Each of them, however, is found with a high degree of frequency, restricted to certain stages of the Upper Cretaceous. Employment of the restristed ranges of the species indicates a fairly specific age for the lower part of the formation. The most important age indicator is the association of *Heterohelix moremani* Cushman which ranges from Cenomanian to Lower Santonian (Darmoian, 1975) with *Ventilabrella glabrata* Cushman and *Heterohelix planata* (Cushman) with ranges of Coniacian to Santonian and Campanian to Maastrichtian respectively (Olsson, 1960; Pessagno, 1962; Govindan, 1972; Martin, 1972; Darmoian, 1975). The association of the species conclusively suggests a Santonian-Campanian age for the lower part of the Nkporo Shale.

The implications of this new age assignment are important in the elucidation of the geologic history of the Upper Cretaceous of Nigeria. It shows that the deposition of the Nkporo Formation on the Calabar Flank and probably also in the Anambra Basin commenced earlier than heretofore held. Moreover, the only strata held to be of Santonian age before now belong to the Sekule Formation in the Upper Benue Basin in northeastern Nigeria

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PLATE I

(Scanning Electron Photomicrographs)
Each bar scale is 40 microns

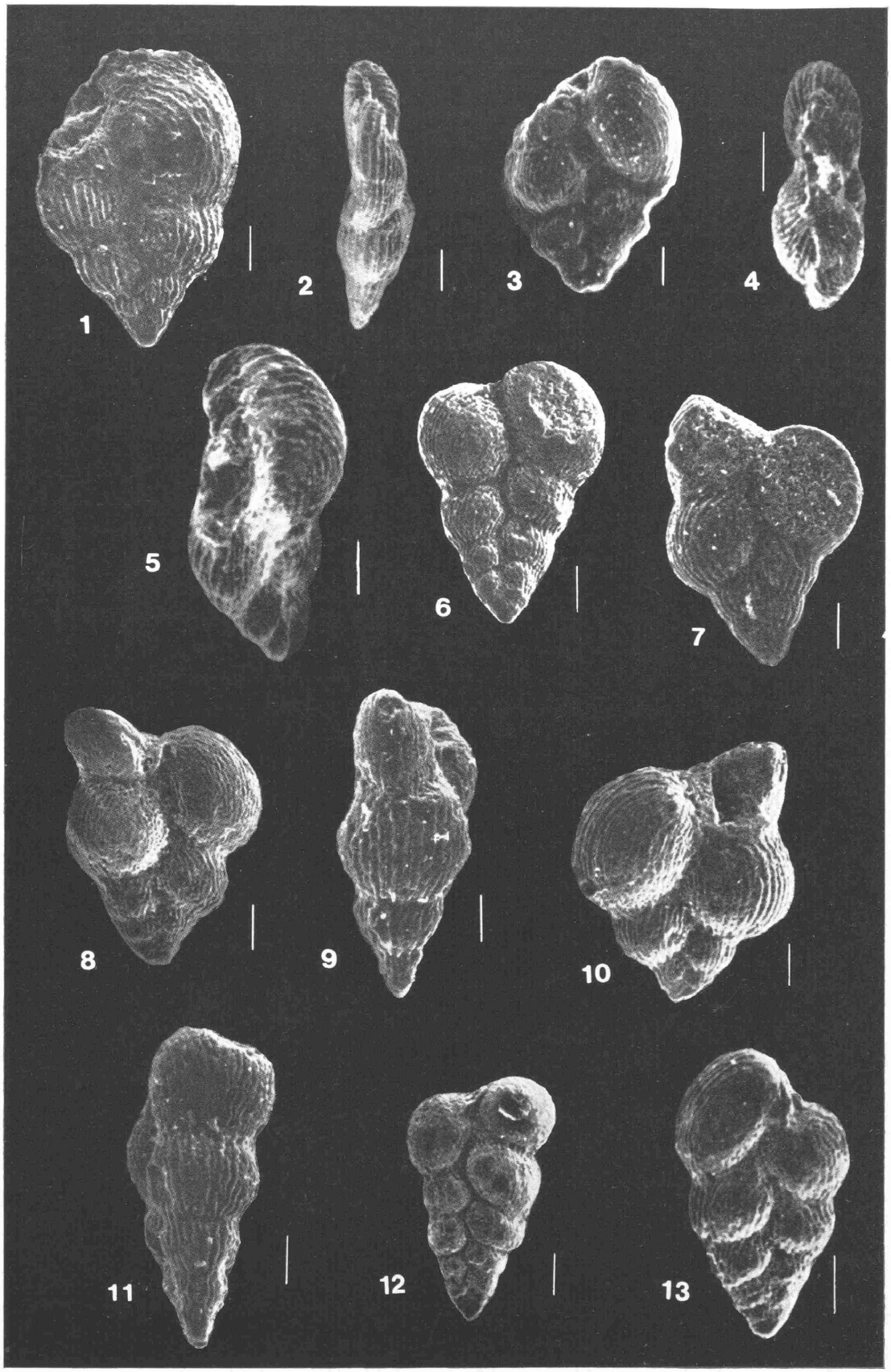
Figs. 1-5. *Heterohelix calabarflanki* Odébòdé, n. sp. UNIFE GMMC No. K1.
1. Holotype; 2-5. Paratypes.
2. Side view; 4. Apertural view; 5. Partial side view.
(Figs. 2 and 5 show the pronounced flattening characteristic of the species.)

Figs. 6-7. *Heterohelix globulosa* (Ehrenberg) UNIFE GMMC No. K2.
(Specimen in Fig. 7 is partly damaged.)

Figs. 8-11. *Heterohelix ivandeklaszi* Odébòdé, n. sp. UNIFE GMMC No. K3.
8. Holotype; 9-11. Paratypes.
(Figs. 8 and 10 show the highly reduced final chamber diagnostic of *H. ivandeklaszi;* it is broken in Fig. 10. Fig. 9 is a side view from the reduced final chamber end and Fig. 11 the side view from the normal-sized penultimate chamber end.

Fig. 12. *Heterohelix moremani* (Cushman) UNIFE GMMC No. K4.

Fig. 13. *Heterohelix planata* (Cushman) UNIFE GMMC No. K5.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(Reyment, 1957a; Carter *et al.*, 1963). The discovery of Santonian sediments on the flank suggests that sediments of that age may be much more widespread than presently known. Finally, the new age demonstrates that the important Santonian tectonic (mainly folding) episode in Nigeria did not span the whole of the stage.

SYSTEMATIC PALEONTOLOGY

This section contains a brief discussion of the Heterohelicid species recorded to date from the strata studied. Seven of them have previously been described from other localities the world over. All are illustrated herein by scanning electron photomicrographs (plates I-III). The classification employed is largely that of Loeblich and Tappan (1964). The latter, however, does not recognise the genus *Ventilabrella* Cushman. In view of the fact that Martin (1972) has firmly established the identity of that genus, *Ventilabrella* is recognised in this study.

Order FORAMINIFERIDA Eichwald, 1830
Superfamily GLOBIGERINACEA Carperter, Parker and Jones, 1862
Family HETEROHELICIDAE Cushman, 1927
Subfamily HETEROHELICINAE Cushman, 1927
Genus **Heterohelix** Ehrenberg, 1843

Heterohelix calabarflanki Odébòdé, n. sp.
Plate I, figures 1-5

Description: Test small, biserial, strongly compressed, expanding moderately to rapidly, maximum breadth at about middle of last pair of chambers, median line moderately to strongly zig-zag, periphery lobate throughout but less so in initial portion; chambers in five to seven pairs, initial chambers small, moderately compressed, subsequent chambers fairly large, strongly compressed, increasing in height towards apertural end, final chamber large, ovoid; sutures deeply depressed, only slightly curved; wall calcareous perforate, surface ornamented by prominent striae; aperture a tiny lunate, low interiomarginal opening on final chamber.

Remark: H. calabarflanki is characterised by its strongly compressed test. It differs from *H. glabrans* Cushman which is also compressed by not having a smooth and shiny surface. Some specimens encountered in the formation have one side less compressed than the other, giving rise to individuals with flat and subglobular sides. The species is fairly abundant in the lower part of the Nkporo Formation.

The species is named after the Calabar Flank, southeastern Nigeria.

Dimensions: The holotype measures 210 microns in length, 175 microns in width and 50 microns in maximum thickness. Other specimens vary from 218 to 258 microns in length, 174 to 187 microns in width and 62 to 65 microns in maximum thickness.

Type Locality: Strata exposed between 36 and 37 kilometres NW of Calabar, southeastern Nigeria.

Repository: Micropaleontological Collection, University of Ife Geology Museum, Ile-Ife, Nigeria.

Heterohelix globulosa (Ehrenberg)
Plate I, figures 6-7

Textularia striata EHRENBERG, 1840, p. 135, pl. 4, figs. 1α, 2α, 3α.

Textularia globulosa EHRENBERG, 1840, p. 135, figs. 1β, 2β, 4β, 5β, 7β, 8β.

Gümbelina striata (Ehrenger) – EGGER, 1900, p. 33, pl. 14, figs. 5-7, 10-11, 37-39.

Pseudogümbelina striata (Ehrenberg) – BRÖNNIMANN and BROWN, 1953, p. 154, text-fig. 6.

Heterohelix striata (Ehrenberg) – OLVERA, 1959, pp. 71-72, pl. 2, figs. 4, 8.

Heterohelix globulosa (Ehrenberg) – TAKAYANAGI, 1965, pp. 198-199, pl. 20, fig. 1a, b.

Heterohelix striata striata (Ehrenberg) – DARMOIAN, 1975, pp. 194-196, pl. 2, figs. 4-7.

Remarks: H. globulosa is the most abundant *Heterohelix* species in the formation. Specimens described from other localities have a wide range of variation especially in the type and degree of striation. A good review on the ornamentation, geographic and stratigraphic distribution of the species is contained in Darmoian (1975). As pointed out by Todd (1970), there appears to be no diagnostic difference between *H. globulosa* and *H. striata*. She favours the name *globulosa* which according to her includes variable forms that have moderately inflated chambers and finely striate wall. Darmoian (*op. cit.*) also could not find a morphological basis for separation of the forms into two different species in his specimens from Iraq. He grouped the specimens together under *Heterohelix striata striata*. By contrast, Govindan (1972) is of the opinion that *H. striata* differs from *H. globulosa* in the degree of surface ornamentation.

All the specimens encountered in the present study fall easily within a group. This author thus agrees with the suggestion that only one specific name should be retained. Since most *Heterohelix* species are striate at least at a stage in their life span (Brown, 1969), it is suggested that *striata* be dropped in favour of *globulosa*.

Heterohelix ivandeklaszi Odébòdé, n. sp.
Plate I, figures 8-11

Description: Test small, biserial, expanding moderately to rapidly, maximum breadth at pair formed by two penultimate chambers, median line weakly zig-zag, periphery lobate; chambers in six to eight pairs; early chambers small, subglobular; later chambers increasingly inflated, except the final one; last chamber considerably reduced (about one-third of penultimate chamber), flattened, with outline somewhat triangular; sutures straight, deeply depressed, inclined in early but approximately horizontal in later chambers; wall calcareous perforate; surface ornamented by prominent curved striae; aperture a lunate opening on inner margin of ultimate chamber, often obscured.

Remarks: H. ivandeklaszi differs from *H. globulosa* by its reduced non-globular last chamber and the presence of surface ornamentation throughout the test. The penultimate pair of chambers are always well developed in *H. ivandeklaszi*, invariably constituting one-third to one-half of the test. It is fairly abundant in the lower part of the Nkporo Shale.

The species is named for Professor Dr. Ivan de Klasz of Université d'Abidjan, Côte d'Ivoire, who has contributed immensely to the study of Cretaceous micropaleontology in Africa.

Dimensions: The holotype measures 260 microns in length, 220 microns in width and 87 microns in maximum thickness. Other specimens vary from 240 to 257 microns in length, 171 to 224 microns in width and 103 to 109 microns in maximum thickness.

Type Locality: Strata exposed between 36 and 37 kilometres NW of Calabar, southeastern Nigeria.

Repository: Micropaleontological Collection, University of Ife Geology Museum, Ile-Ife, Nigeria.

Heterohelix moremani (Cushman)
Plate I, figure 12

Gümbelina moremani CUSHMAN, 1938, p. 10, pl. 2, figs. 1a-b, 2.

Heterohelix moremani (Cushman) – PETRI, 1962, pp. 88-89, pl. 11, figs. 1, 2a-b.

Remarks: This species is rare in the strata. Forms encountered are generally stouter than previously described ones but their identity is not in doubt. They range from completely smooth to finely striate.

Previous records of occurrence from the U.S.A. and Brazil show that *H. moremani* ranges from early Cenomanian to Lower Santonian (Darmoian, 1975). The Nigerian occurrence extends this range to Upper Santonian and possibly Lower Campanian.

Plate II, figures 2-5

Heterohelix nkporoensis Odébòdé, n. sp.

Description: Test small, biserial, expanding moderately except at the top, maximum breadth at horizontal line at middle of final chamber through penultimate chamber pair, median line slightly to moderately zig-zag, pehiphery lobate; chambres in 6-9 pairs; early chambers small, subglobular, later chambers uniformly increasingly inflated till the penultimate one; final chamber globose, highly inflated, constituting one-third to one-half the test size; sutures curved, moderately to deeply depressed, inclined all through length of test; wall calcareous perforate; surface ornamentation prominent curved striae; aperture a small oval to circular interiomarginal opening on final chamber.

Remarks: H. nkporoensis differs from *H. globulosa* by its highly inflated final chamber and the oval to circular aperture. These features also serve to distinguish it from *H. ivandeklaszi.*

The species is fairly abundant in the Nkporo Formation, after which it is named.

Dimensions: The holotype measures 217 microns in length, 186 microns in breadth and 123 microns in maximum thickness. Other specimens vary from 179 to 240 microns in length, 160 to 196 microns in width and 108 to 157 microns in maximum thickness.

Type Locality: The strata exposed between 36 and 37 kilometres NW of Calabar, southeastern Nigeria.

Repository: Micropaleontological Collection, University of Ife Geology Museum, Ile-Ife, Nigeria.

Heterohelix planata (Cushman)

Plate I, figure 13; Plate II, figure 1

Gümbelina planata Brotzen, 1936, p. 121, pl. 9, figs. 2a-b, 3a-b.

Heterohelix planata (Cushman) – Gallitelli, 1957, p. 20, pl. 2, figs. 9-10.

Heterohelix pulchra (Brotzen) – Pessagno, 1962, p. 385, pl. 1, fig. 3.

PLATE II

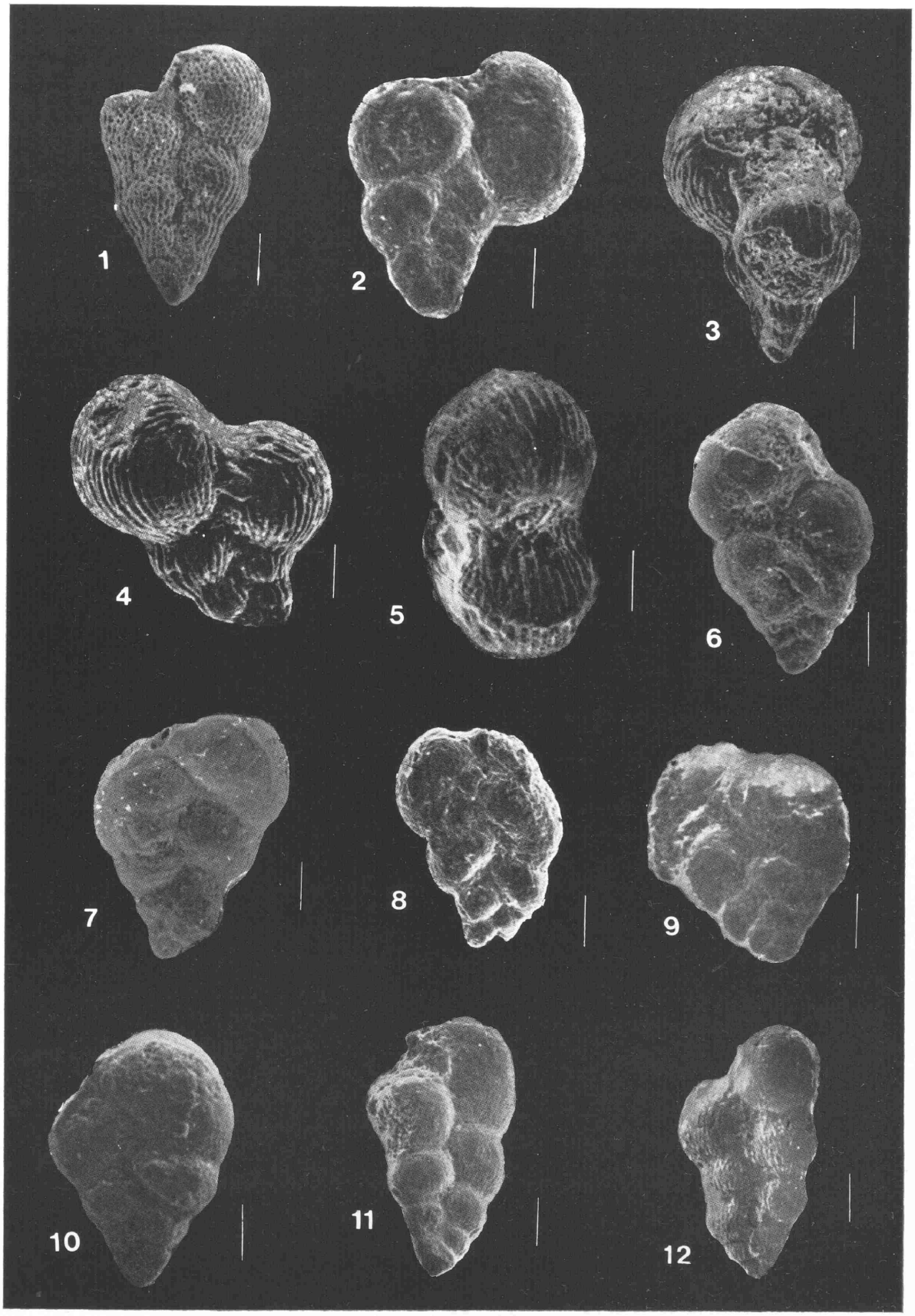
(Scanning Electron Photomicrographs)
Each bar scale is 40 microns

Fig. 1. *Heterohelix planata* (Cushman) UNIFE GMMC No. K5.

Figs. 2-5. *Heterohelix nkporoensis* Odébòdé, n. sp. UNIFE GMMC No. K6.
4. Holotype; 2, 3, 5. Paratypes.
(Figs. 2 and 4 show the highly inflated final chamber; Figs. 3 and 5 the apertural view.)

Figs. 6-10. *Heterohelix pulcra* (Brotzen) UNIFE KMMC No. K7.
(Each figure shows a different variety of the species.)

Figs. 11-12. *Heterohelix reussi* (Cushman) UNIFE GMMC No. K8.
(Specimen in Fig. 11 is partially damaged.)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Remarks: This species is rare in the basal part of the Nkporo Formation. Forms observed have subglobular chambers with no observable apertural flaps and with the supplimentary apertures obliterated.

Heterohelix pulchra (Brotzen)
Plate II, figures 6-10

Gümbelina pulchra BROTZEN, 1936, p. 121, pl. 9, figs. 2a-b, 3a-b.

Gümbelina pseudotessera CUSHMAN, 1938, p. 14, pl. 2, figs. 19-21.

Heterohelix pulchra Brotzen.—HOFKER, 1956b, p. 77, pl. 9, fig. 69.

Heterohelix pulchra (Brotzen) – GALLITELLI, 1957, p. 134, pl. 31, fig. 20.

Heterohelix cf. *planata* (Cushman)—TAKAYANAGI, 1965, p. 197, pl. 20, fig. 2.

Heterohelix dentata STENESTAD, 1969, p. 658, pl. 1, figs. 9-10, 14; pl. 3, fig. 4.

Heterohelix pseudotessera (Cushman)—BROWN, 1969, pl. 4, figs. 1-2.

Remarks: Specimens referable to *H. pulchra* in the samples are rather highly varied, variations occurring in test and chamber shape, size, sutures and appearance of the final chamber. The tests are invariably elongate, but short flared ones occur infrequently. The chambers are generally distinctly reniform in shape but sometimes tend toward triangular in outline. The sutures are moderately to deeply depressed and are inclined at varying angles. The final chamber is either reniform or tends to globose. Apertural flaps are not observed on the specimens; if initially present, they must have subsequently been broken.

The species is fairly abundant in the strata studied.

Heterohelix reussi (Cushman)
Plate II, figures 11-12

Gümbelina reussi CUSHMAN, 1938, p. 11, pl. 2, figs. 6a-9b.

Heterohelix reussi (Cushman) – ANSARY and TEWFIK, 1966, pp. 40-41, pl. 3, figs. 5a-b; PESSAGNO, 1967, p. 263, pl. 85, figs. 1-9, pl. 86, figs. 1-2.

Remarks: Forms herein referred to *H. reussi* have slightly compressed chambers and fine to moderately coarse costae. Earlier described forms (see Pessagno, 1967; Darmoian, 1975) are all finely costate. The species is rare in the Nkporo Formation.

PLATE III

(Scanning Electron Photomicrographs)
Each bar scale is 40 microns

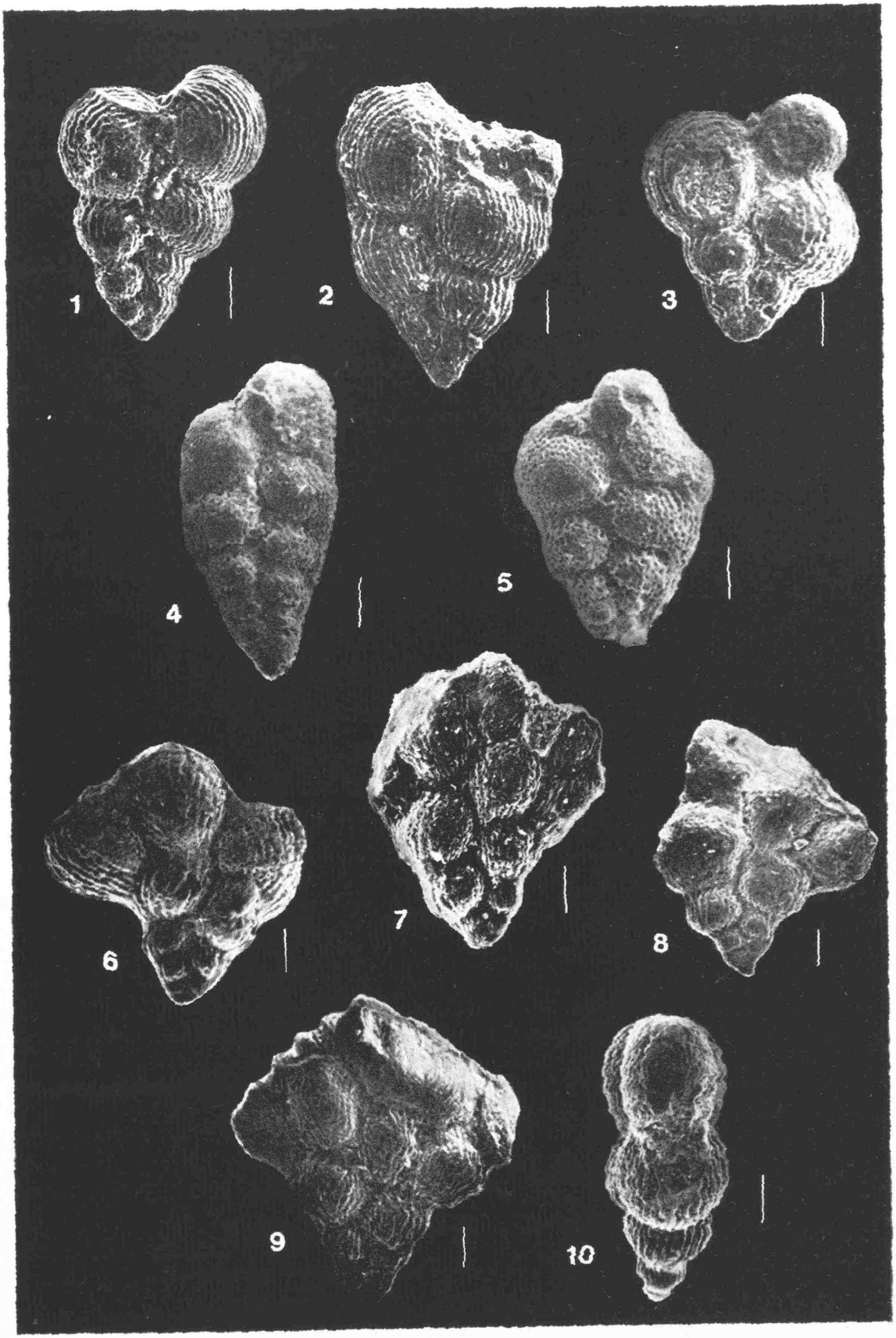
Fig. 1. *Heterohelix* sp. aff. *H. globulosa* (Ehrenberg) UNIFE GMMC No. K9.

Fig. 2. *Heterohelix robusta* Stenestad UNIFE GMMC No. K10.

Fig. 3. *Heterohelix* sp. 1. UNIFE GMMC No. K11.

Figs. 4-5. *Heterohelix* sp. 2. UNIFE GMMC No. K12.

Figs. 6-10. *Ventilabrella glabrata* Cushman UNIFE GMMC No. K13. (Fig. 10 shows the side view.)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Heterohelix robusta Stenestad
Plate III, figure 2

Pseudoguembelina palpebra Brönnimann and Brown–Pessagno, 1967, p. 267, pl. 89, figs. 3-4.

Pseudoguembelina sp. aff. *P. palpebra* Brönnimann and Brown–Pessagno, 1967, p. 267, pl. 89, figs. 5, 12-14.

Heterohelix robusta Stenestad, 1969, pp. 658-659, pl. 1, fig. 17; pl. 2, fig. 3; text-fig. 13a-c.

Remarks: This species is the least abundant in the samples studied. It is represented by forms with sutures slightly to moderately depressed and fairly large globular chambers increasing moderately rapidly in size. The costae are average to coarse. They lack apertural flaps; they are thus similar to forms described from Iraq by Darmoian (1975).

Heterohelix sp. aff. **H. globulosa** (Ehrenberg)
Plate III, figure 1

Cf. *Textularia striata* Ehrenberg, 1840, p. 135, pl. 4, figs. 1, 2, 3.

Remarks: This species is very similar to typical *Heterohelix globulosa* (Ehrenberg) and may in fact be a variety of the species. Ornamentation appears coarser, however, than in typical *H. globulosa.*

The species is fairly abundant in the lower part of the Nkporo Shale.

Heterohelix sp. 1
Plate III, figure 3

Remarks: A few specimens of a species which is close to *Heterohelix globulosa* (Ehrenberg). It, however, has its final chamber highly reduced. It differs from *H. ivandeklaszi* n. sp. by globose nature of its final chamber.

The species is rare in the lower part of the Nkporo Formation.

Heterohelix sp. 2
Plate III, figures 4-5

Remarks: Several specimens of a species that is moderately flattened, slightly keeled, with strongly depressed sutures. The chambers tend to being slightly reniform, thus superficially resembling *H. pulchra* (Brotzen). The median line is strongly zig-zag with triangular depressions between the chambers.

This form is rare in the Nkporo Shale.

Genus Ventilabrella Cushman, 1928

Ventilabrella glabrata Cushman
Plate III, figures 6-10

Ventilabrella eggeri Cushman, 1928, p. 2, pl. 1, fig. 11; p. 92, pl. 14, fig. 8.

Ventilabrella eggeri var. *glabrata* Cushman, 1938, p. 26, pl. 4, figs. 15-17.

Planoglobulina glabrata (Cushman) – Gallitelli, 1957, p. 142, pl. 32, figs. 10-12.

Planoglobulina acervulinoides (Egger) – Olsson, 1960, pp. 28-29, pl. 4, fig. 11.

Ventilabrella glabrata Cushman – Salaj and Samuel, 1966, p. 231, pl. 37, fig. 7.

Planoglobulina acervulinoides glabrata (Cushman)–Bandy, 1967, p. 25, text-fig. 12 (7).

Remarks: Martin (1972) indicates that the adult test of this species has twenty-six or more chambers. All the specimens recovered are broken and the greatest number of chambers recorded in any specimen is 14. All the forms are moderately to heavily costate over the whole surface of the test.

V. glabrata is only fairly abundant in the strata of the Nkporo Formation on the Calabar Flank.

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Manuscrito recibido el 25-VII-1981