GEOLOGICAL SURVEY OF NIGERIA.

BULLETIN No. 3.

Eocene Mollusca from Nigeria.

BY

R. BULLEN NEWTON, I.S.O., F.G.S.

Geological Department, British Museum (retired).

WITH AN APPENDIX

ON THE FORAMINIFERA FROM THE SAME DEPOSITS.

BY

E. HERON-ALLEN, F.R.S., F.G.S., & A. EARLAND, F.R.M.S.

Price 17/6 net.

WITH A MAP AND 11 PLATES OF FOSSILS.

PUBLISHED BY AUTHORITY OF

THE NIGERIAN GOVERNMENT.

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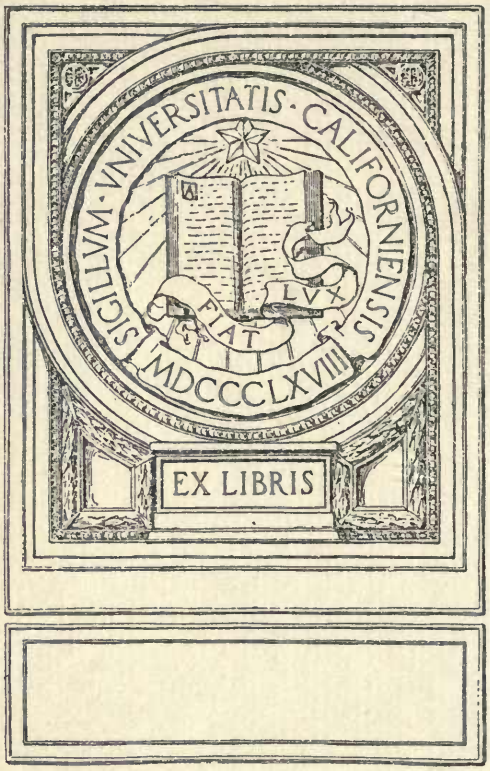

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PREFACE.

On the establishment of the Geological Survey of Nigeria in 1919, it was found that there existed a considerable amount of unpublished information about the geology of the Southern Provinces. Steps were accordingly taken to collect this material and arrange it for publication. Mr. R. Bullen Newton, I.S.O., of the British Museum, kindly undertook the description of the collections of fossil shells from Ameki on the Eastern Railway which had been presented to the Museum at various times by Sir Frederick Lugard, Sir John Eaglesome, and Mr. A. E. Kitson. Mr. Newton secured the co-operation of Mr. E. Heron-Allen, F.R.S., and Mr. A. Earland, F.R.M.S., and the reports of these distinguished authorities which appear in this Bulletin form a most valuable contribution to the Tertiary Geology of Africa.

J. D. FALCONER,
Director.

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INTRODUCTION.

Between the years 1915 and 1917 the Geological Department of the British Museum received as separate donations a large and important series of Tertiary Fossils from the Southern Provinces of Nigeria, the specimens having been collected at Ameki in the district of Omobialla, situated on the route of the Port Harcourt Railway (Plate 1). The collectors and donors of this material were Sir Frederick Lugard, G.C.M.G., a former Governor-General of Nigeria, Sir J. Eaglesome, K.C.M.G., a former Director of Nigerian Railways, and Mr. A. E. Kitson, C.B.E., Director of the Geological Survey of the Gold Coast, but by far the larger part of the collection was that formed by Mr. Kitson, whose presentation of the same was made in conjunction with Mr. W. Heward Bell, F.G.S. Although these donations were received on three different occasions and therefore constitute separate collections, it should be explained that as the specimens were obtained from exactly the same deposits, they are referred to in the text of this report as one collection, the collectors' names, however, being given under the various specimens described. The whole of the Mollusca collected by Mr. Kitson were obtained from several railway cuttings which were numbered consecutively southwards from Ameki Station, those numbers being quoted in the text as a part of the history of each species, although the author thinks that as the deposits present the same facies throughout, no stratigraphical value can be attached to such numbering.

Some of the vertebrate specimens have already been referred to in literature by Dr. A. S. Woodward[1] and Dr. C. W. Andrews[2] the former having noted the occurrence of fish-remains belonging to *Coelorhynchus rectus* Agassiz, *Odontaspis aschersoni* Stromer, *Galeocerdo latidens* Agassiz, *Pristis*, *Propristis schweinfurthi* Dames, *Platyloemus*, and *Arius* (otoliths), an assemblage which was thought to agree best with that found in the European Middle Eocene (Lutetian) and in similarly aged rocks of Egypt, Tunis and Algeria. Among the remaining vertebrates, Dr. Andrews has described a new Zeuglodont Whale under the name of *Pappocetus lugardi*, as well as a new Leathery

Turtle, *Cosmochelys dolloi*, and a large carinate-bird with entirely new characters to which the name of *Gigantornis eaglesomei* was given. Some primitive characters in the Zeuglodont remains induced Dr. Andrews to "favour their reference to the early part of the (Eocene) period." When studying the Molluscan part of this collection I [3] published a description of *Raetomya*, a new genus of Pelecypoda, the type of which characterised the Bartonian or Upper Mokattam deposits of Egypt. It was considered somewhat premature at the time to refer the Nigerian deposits to any particular horizon of the Eocene because a more detailed examination of the whole of the mollusca was necessary before a properly conclusive statement could be made on the subject. It was mentioned, however, that these fossiliferous rocks were of "a very similar lithological facies which would suggest their reference to one distinct series of beds, and which from their fauna would indicate an estuarine origin." Following on this communication, Mr. Kitson [4] read a paper before the Geological Society on the "Geology of Southern Nigeria," in which he alluded to these particular deposits as "a series of Eocene estuarine shales, clays and marls, with septarian nodules and pieces of coal and resin, and a rich fauna consisting principally of Mollusca, but including fragmentary remains of whales, birds, fishes and turtles." In the discussion on that paper I [4] again referred to the invertebrates of the Nigerian deposits, mentioning that the Foraminifera, etc., had been determined by Mr. Heron-Allen who called attention in his notes to the absence of *Nummulites*. Among a few corals were identified *Turbinolia*, *Oculina*, etc., bearing the Lutetian facies, as also a form of *Hydractinia*; Decapod claws, minute Ostracoda, and some small *Serpulae* were also observed in the fauna. The Mollusca were stated to have alliances which often extended throughout the Eocenes and occasionally to recent seas, thus bearing a similarity to forms found in the Claiborne series of the United States, the Mokattam beds of Egypt and the Middle Eocene of Europe. One particular Gastropod determined as Vincent's *Clinuropsis diderrichi* from the Paleocene deposits of the Belgian Congo showed considerable resemblance to *Surcula ingens* (Mayer-Eymar) of the Upper Mokattam beds of Egypt and hence it was considered that the Nigerian deposits should be referred to the oldest Eocene and regarded as of Paleocene age. This view,

however, must now be withdrawn as after a further revision and study of the molluscs I am convinced that the presence of the Congo Gastropod, previously referred to from this Nigerian locality could no longer be supported, its characters agreeing entirely with the Egyptian shell. Considering, therefore, this fact and other details in connection with the fauna, its age must now be attributed to the Upper Lutetian stage of the Eocene formation at the same time recognising that the Bartonian facies is also very apparent.

Before concluding these preliminary observations, it is only right to mention that a good deal of this report had been prepared during my official connection with the Geological Department of the British Museum, and that since my retirement from public service in 1920 I have been enabled to complete it through kindly facilities allowed me by Dr. A. S. Woodward, F.R.S., the Keeper of the Geological Department. I wish to record my thanks to Messrs. E. Heron-Allen, F.R.S., and A. Earland, F.R.M.S., for their valuable "Appendix" on the Foraminifera from these deposits; to Mr. Philip Dollman for his excellent photographs of the shells which form the plates of the report; to Mr. H. B. Rowbotham, of the Geological Department of the British Museum, for his ever willing assistance especially in connection with the typing of my manuscript; as also to Mr. C. D. Sherborn, who from time to time has offered many useful suggestions on questions of literature. Lastly, my best acknowledgments are due to Dr. J. D. Falconer, M.A., F.G.S., Director of the Geological Survey of Nigeria, who has evinced the greatest interest in this work and to whom I am indebted for bringing about its publication.

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[1] Abstracts Proc. Geol. Soc. London, 1916, No. 989, p. 51 ; *ibid.*, 1919, No. 1042, p. 101.

[2] Abstracts Proc. Zool. Soc., London, 1916, No. 158, p. 30; Proc. Zool. Soc., London, 1916, pp. 519-524, text-figures ; *ibid.*, 1920, pp. 309-319, plates 1, 2.

[3] On *Raetomya*, a new genus of Pelecypoda, from the Tertiary Rocks of Egypt and Southern Nigeria : *Proc. Mal. Soc., London*, 1919, Vol. 13, pp. 79-84, plate 1. For the favour of reproducing this published plate and text in the present work, I beg to thank the Council of the Malacological Society of London.

[4] Abstracts Proc. Geol. Soc., London, 1919, No. 1042, pp. 100-105 ; *ibid.*, pp. 101, 102.

DESCRIPTION OF THE MOLLUSCA.

Cephalopoda.

Family BELOSEPIIDÆ.

Belosepia sepioidea (Blainville).

PLATE 2., figs. 1, 2.

Beloptera sepioidea.
Blainville: Man. Malacologie, 1825, p. 622, and 1827 Atlas, pl. 11., fig. 7.

Sepia longispina and *S. longirostris.*
Deshayes: Desc. Coq. Foss. Paris 1835, Vol. 2, p. 757, pl. 101, figs. 4–6 and 10–12.

Belosepia sepioidea.
F. E. Edwards: *Mon. Pal. Soc.* (The Eocene Mollusca of England) 1849, pp. 29–31, pl. 1, figs. 1; Cossmann: Ann. Soc. R. Mal. Belgique, 1891, Vol. 26, pp. 6–7; R. B. Newton and G. F. Harris; Proc. Mal. Soc. London, 1894, Vol. 1, pp. 120, 121, pl. 10., figs. 1–3 (for good figures of the shield).

REMARKS.—The fossil under consideration represents a single rostrum or beak of a *Belosepia*, which is of interest as indicating for the first time the occurrence of this genus in the African Eocene. An examination of the specimen shows that from the dorsal aspect it has steeply divergent sides surmounted by a fragment of the acuminate posterior end of what was once an extensive shield-like structure, bearing a pitted or vermiculate surface which, if perfectly preserved, would have anteriorly presented a series of equidistant hemispherical coarse granulations. The rostrum itself is solid and of the narrow, elongate type such as those figured by Deshayes from the Paris Basin Eocene under the names of *Sepia longispina* and *S. longirostris*; sharp longitudinal ridges and grooves enter into its structure which probably have been accentuated by erosion. The ventral view of the fossil discloses the remains of a stout semi-circular plate furnished with radiating channels and marginal serrations, which is coalescent with the thickened base of the rostrum. Immediately beyond the anterior margin of this plate is a nacreously-lined conical cavity forming the posterior end of the incomplete shield, bearing fine, elevated, concentric lines which represent the septal divisions of an *alveolus* as exhibited in *Belemnites*, and

less strikingly so in the modern *Sepia*. The dimensions of the fossil give a length of 20 mm., width 15, and height 12. Although the rostrum shows rather more curvature than usual, its slender and elongate characters agree with similar specimens of this species from the Bracklesham Beds of England and similarly aged deposits of France and other European Eocene areas.

Gabb's *Belosepia ungula* (Journ. Acad. Nat. Sci., Philadelphia, 1860, New Ser. Vol. 4, p. 376, pl. 67, figs. 1–4) from the Texas Eocene of the United States, appears to be a closely related form.

The species is easily distinguishable from other described forms which have more robust, shorter, broader, and sometimes wedge-shaped rostrums, as for instance, *B. incurvata* of Cossmann and Pissarro (Pal. Indica, Mem. Geol. Surv. India, 1909. New Ser. Vol. 3, Mem. No. 1, pl. 1, figs. 11–13, pp. 2, 3), from the Lower Eocene (Ranikot Series) of India.

The genus *Belosepia* is confined to the Eocene formation.

DISTRIBUTION.—British: Eocene throughout, but chiefly of the Lutetian division. Europe: Paris, Belgium, &c.

OCCURRENCE.—Cutting No. 11.

COLLECTOR.—Mr. Kitson.

Gastropoda.

Family STROMBIDÆ.

Rostellaria bidigitata, sp. nov.

PLATE 4., figs. 8, 9.

DESCRIPTION.—Shell thick, elongate, narrowly pyramidal, turriculate, depresso-convex; body-whorl compresso-convex, postero-dorsally inflated, canaliculated anteriorly and in rear; spire produced, comprising about 10 deep, flattened whorls, divided by a deep slightly excavated suture; surface of the earlier whorls spirally striate and longitudinally plicated, the later whorls

smoother although retaining a somewhat similar sculpture of closely set spiral striations crossed by numerous longitudinal and more or less sinuous lineations, the union of which produces a marked reticulation at the base; aperture narrow longitudinally and obliquely elliptical, widely notched at the base followed by a straight, narrow canal; labrum smooth within, furnished with a thick reflected nearly perpendicular margin bearing 2 distant spinose digitations, the lowest forming the posterior end of the notch; columella smooth, obliquely excavated, covered with a prominent enamelled callosity which becomes elevated into a thickened tubercle posteriorly where it forms the lateral boundary to a narrow canal in conjunction and parallel with the labrum.

DIMENSIONS.—

	mm.
Alt.	= 80 (approximate)
Lat.	= 27

REMARKS.—This species, although distinguishable from previously described forms of *Rostellaria*, may be compared with the well-known *R. dentata*, Grateloup,[1] from the older Miocene deposits of Europe. That shell, however, presents some interesting distinctions, inasmuch as its spire is narrower, much less turriculate, more elongately acuminate and provided with more depressed whorls united by a lesser depth of suture, while the sutural margins are about on the same plane throughout. The body-whorl is also more uniformly inflated. Further, the prominent internal columella-tubercle, which is well in front of the posterior canal is not present in the Nigerian shell, and moreover, the termination of that canal, which touches the sutural margin of the penultimate whorl and the spreading callosity extending slightly higher up the spire, together with the wide curvature existing behind the posterior region of the labrum, are points considerably differing from those in the present species, which shows that the termination of the posterior canal is nearly parallel with the callosity-covering, and that both exhibit only a diminutive curvature, their terminations rising slightly above the sutural margin of the body-whorl. Sculpture details are very similar in both species. With regard to the digitations of the labrum, only two are present in the Nigerian shell, but on the authority of Grateloup a third one is occasionally developed in the European form, *R. dentata*. The digitate growths are more

[1] Conchyliologie Tertiaires l'Adour, 1840-1846; Vol. 1 Univalves, pl. 1, figs. 1, 2, 3, 4.

numerous among recent examples of *Rostellaria*, although never developed in the young state. The specimens are associated with *Serpula* tubes, which accounts for certain small perforations observed in the test structure.

Occurrence.—Cuttings Nos. 10, 12, 15.

Collectors.—Sir F. Lugard ; Mr. Kitson.

Rostellaria unidigitata, sp. nov.

Plate 4, figs. 3–7.

Description.—Shell robust, pyramidial above, oblong below, depresso-convex ; body-whorl excavated at suture, obtusely margined, compresso-convex, oblong, length exceeding that of the spire, canaliculated anteriorly and in rear ; spire with 7 or 8 high and laterally depressed whorls, suture deep, nuclear whorls smooth and obtusely apexed ; surface with strong spiral bands divided by longitudinally striated grooves, earlier whorls, excluding the nuclear whorls, furnished with numerous vertical plications, and obscure varices, body-whorl more or less smooth, finely and microscopically striated in both directions in nearly half its length, whilst the base is strongly and spirally ornamented ; aperture obliquely elliptical, widely notched below and narrowly canaliculated at each end, the posterior canal is directed backwards from the front along the sutural platform ; labrum smooth within, border posteriorly excavated and outwardly curved below, thick, with wide reflective lip, which forms a single spinose digitation in front, afterwards surrounding the notch, and similarly the inner side of the narrow, curved, anterior canal ; columella smooth, excavated, covered with a strong callosity which is elevated, thick and much enamelled posteriorly where it forms the inner boundary of the canal, which thins out at the angle and extends along the sutural cavity of the body-whorl, besides forming part of the recurved posterior canal.

Dimensions.—

	Adult.	Young.
Alt.	50 ...	32 (from apex to end of anterior canal).
Lat.	24 ...	14 (from apex to digitation).

Remarks.—This shell differs from *R. bidigitata* in the unidigitate character of the labrum, extensive body-whorl, the recurvation of the posterior canal, and the distribution of the callus over nearly half the basal surface of the penultimate

whorl. In its single digitation and prominent notch it somewhat resembles *Rimella*, although differing considerably in form, while the posterior canal in that genus, instead of extending along the sutural region of the body-whorl, is perpendicularly attached to the spire and sometimes nearly reaching the summit, as in *R. rimosa* (Solander) from British and European Eocene deposits. The pyramidal spire fits well into the sunken, sutural cavity of the body-whorl, while the walls of the latter show a swollen character at the periphery, as well as a depression in its dorso-median region. The three whorls following the smooth nuclear volutions are prominently ornamented with numerous longitudinally, obliquely curved costae and strong spiral bands, whereas the next and penultimate whorls are restricted almost entirely to the spiral and vertically striated sculpture. Broad and distant varices are observable on the more sculptured portions of the spire, although much less obvious on the latter whorls. The sutural tabulation of the spire is often scarcely perceptible in younger forms of the species. Less developed and more delicately tested forms of this species are quite numerous, in which the sutural platform of the body-whorl is insignificant, the labrum thin and delicate not margined, being also without the digitation, while the callosity is only feebly indicated and not raised or thickened as in adult examples. The shell, admirably preserved, occurs in great profusion in Nigerian deposits, although only a few specimens show a complete anterior canal, and then only is this preserved in moderately young examples. Tubes of a small *Serpula* and other organisms are sometimes found adherent to the shell, chiefly in the region of the aperture.

Occurrence.—Cuttings Nos. 1, 2, 5, 6, 10, 11, 12, 13, 15.

Collectors.—Sir F. Lugard, Sir J. Eaglesome and Mr. Kitson.

Semiterebellum suturocostatum, sp. nov.

Plate 4, figs. 14–17.

Description.—Shell narrowly conical, depresso-convex; body-whorl compresso-convex, unidigitate, longer than the spire; spire narrow, produced, consisting of 6 or 7 whorls, of which $2\frac{1}{2}$ constitute the smooth protoconch, whorls nearly on the same plane; suture margined with a row of nearly contiguous, short, thick, slightly oblique costae, divided in the centre by an impressed line; aperture narrowly elliptical, notched at base, terminations canaliculated, anterior

canal short, posterior canal long, narrow and curved backwards on to the suture; labrum nearly vertical, unidigitate, thickly margined externally; columella evenly excavated, thickly callused posteriorly, the callosity curving backwards to form the upper border of the posterior canal, then continuing as a smooth band at the base of the whorls; sculpture consisting of minute, smooth, spiral bands divided by thin, microscopically punctuated furrows, as well as obscure longitudinal growth striations.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	...	28 millimetres.
Lat.	...	...	...	...	...	...	...	9 „

REMARKS.—This shell, numerously represented, is closely related in apertural characters to *R. unidigitata*, and agrees in possessing one digitation on the labrum. It differs, however, in being of a narrow, cylindro-conical shape, in possessing a smooth spire, as well as a circlet of short rod-like costae covering the sutural region. There is, likewise, no sutural platform, the whorls being almost on the same plane, while the brephic volutions exhibit no longitudinal costations as shown on the shell selected for comparison. Further features of interest in this Gastropod include the backward extension of the narrow posterior canal on to the margin of the costate, spiral collar, and the presence of a wide callosity covering the base of the whorls of the spire, which, however, has been sometimes obliterated by erosive agencies.

This type of Rostellariform shell may be referred to *Semiterebellum* of Cossmann (Ann. Soc. R. Mal. Belgique, 1889, vol. 24, p. 91), which was founded on *R. marceauxi*, Deshayes from the Lower Eocene of Europe. It is, however, easily distinguishable from that species by the posterior canal being reflected backwards, and resting more or less horizontally on the suture of the body-whorl, whereas in *R. marceauxi* the corresponding canal extends up the spire to within three or four whorls of the summit and in line with the margin of the labrum.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Semiterebellum elongatum, sp. nov.

PLATE 2, figs. 14, 15.

DESCRIPTION.—Shell elongate, subulate, depresso-convex; spire narrow, composed of about ten longitudinally deep volutions obliquely sutured, including about $3\frac{1}{2}$ smooth apical whorls, with an obtuse nucleus; body-whorl cylindrical, considerably taller than the penultimate, nearly parallel-sided; aperture forming a trigono-oval cavity, widely emarginate at the base, narrow posteriorly where it terminates on the suture with a recurved canal; labrum thickly margined, slightly excavated in the centre, but rounded, and enveloping, at the base; columella excavated, covered with a moderately wide callosity; ornamentation consists of spiral striations crossed by numerous oblique, rather obscure costations, the earlier whorls of the spire furnished posteriorly with a minute marginal collar consisting of two or three spiral lines bearing small tubercles, from which descend the more or less feeble longitudinal costae, an obscure carination exists in well preserved specimens a short distance above the suture.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	= 42	millimetres.
Lat.	...	...	...	...	...	...	= 10	,,

REMARKS.—This shell is related to the new form of *Semiterebellum* which I have named *suturocostatum*, having a similarly structured posterior canal. It is more elongate, however, and has no denticle on the labrum, the suture is thin and not ornamented with vertical costae, although the earlier whorls are minutely, narrowly, and spirally banded at the suture, besides being furnished with tubercles of microscopical size, from which emanate a series of obscure longitudinal costations. An obtuse spiral carination is evident about a millimetre above the suture, a structure similarly represented in the type of this genus *Rostellaria marceauxi* of Deshayes, from the older Eocene of Europe, further ornamentation being also in partial agreement with that observed in the figure of the type. According to M. Cossmann *Semiterebellum* is intermediate between *Rostellaria* and *Terebellum*, and is limited to Paleocene and Eocene rocks (Paléoconchologie Comparée, 1904, part 6, pp. 27, 28).

OCCURRENCE.—Cuttings Nos. 5, 6, 10, 12, 14, 15.

COLLECTOR.—Mr. Kitson.

Family CYPRAEIDÆ.

Cypraea cf. bowerbanki, J. de C. Sowerby.

PLATE 3, fig. 13.

Cypraea bowerbanki.

J. de C. Sowerby : In F. Dixon's "Geology and Fossils of Sussex," 1850, p. 189, pl. 8, figs. 1, 2 ; F. E. Edwards : Mon. Pal. Soc. (Eocene Mollusca), 1854, p. 129, pl. 17, figs. 1*c*, 1*d*.

REMARKS.—The specimen herewith determined is in a much fractured condition, although its preparation for photographic purposes has been attended with fairly successful results. It resembles very closely the well known Bracklesham Bay species, *Cypraea bowerbanki*, which, according to the original description, is " Egg-shaped, smooth, beak short, moderately wide ; aperture narrow, curved, without a posterior canal ; outer lip incurved, a little flattened towards the beak, with about thirty to thirty-five teeth, nine or ten of which are elongated on the flat part." The actual basal characters of the present shell are not present, so that uncertainty exists as to the width of the anterior opening, and the presence or otherwise of a columella plication observed in examples of the type. In other respects, however, the shell presents similarities such as its proportional measurements, a completely hidden spire, the absence of a posterior canal, and a well curved labrum and columella region, which enclose an aperture having a uniform width throughout. The dental ridges on both sides of the mouth are also strikingly like those characterising the British shell.

DIMENSIONS.—

(Approximate) ... ... 50 by 40 millimetres

DISTRIBUTION.—Lutetian, British.

OCCURRENCE.—Cutting 6.

COLLECTOR.—Mr. Kitson.

Family AMPHIPERASIDÆ.

Amphiperas nigeriensis, sp. nov.

PLATE 3, figs. 14, 15.

DESCRIPTION.—Shell small, oval-fusoid, ventricose ; extremities produced and widely channelled ; spire involute, without apical cavity ; dorsal and columella surfaces covered with numerous, equi-distant, horizontal ridges, intermediate grooves divided by a single central, horizontal line, and crossed by delicate, equi-distant vertical striations, forming a nearly equi-lateral rectangular structure ;

aperture narrow, semi-circular, with short, broad, canaliculated ends ; labrum widely reflected with slightly divergent, tapering ends, ornamented with strong horizontal ridges continued from dorsal surface, without intermediate vertical striations, inner ridges forming equi-distant, marginal serrations ; columella region elongately ventricose, constricted and tapering at the ends, posterior end coarsely and obliquely ridged, internal margin with minute, equi-distant denticles formed of the thickened terminations of the horizontally ridged sculpture.

DIMENSIONS.—

Alt.	19	millimetres.
Lat.	11	„
Depth	9	„

REMARKS.—This shell is placed in the genus *Amphiperas* of Gronovius 1781 (= *Ovula* Bruguière, 1789, established on the type of *Bulla ovum*, Linnaeus), on account of the absence of any external evidence of a spire, together with its possession of short and broadly canaliculated extremities, and the elongately oval contour of the columella region. In its ornamentation there is greater agreement with Swainson's *Cypraedia* of 1840 (*Type* = *Cypraea elegans*, Defrance—Eocene, France), and rather less so with *Cypraeovula* of Gray (*Type* = *Cypraea capensis*, Gray of Recent Seas), both genera belonging to the true Cypraeidae, a family which invariably exhibits in the posterior region some external indication of the presence of a spire. In both these genera also the posterior end of the labrum curves towards the summit region, whereas in *Amphiperas* the extremities on both sides of the aperture are more or less vertically extended and open. When writing "On the Relations of the Amphiperasidae," Dr. T. Gill[1] has stated that the members of that Family "have not even spiral shells, the testaceous envelope being simply a shell loosely rolled on itself, and more or less attenuated and twisted at the extremities." Such remarks apply to the present specimens from Nigeria although differing from the smooth surfaced type of *Amphiperas* in being horizontally ridged throughout and possessing a columella-margin with equi-distant denticles formed of the delicately thickened edges of the ridges. This species is represented by a number of examples.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

[1] American Journ. Conch. 1870-71, Vol. 6, pp. 183-187.

Family TURRIDÆ (= Pleurotomidæ.)

Surcula ingens (Mayer-Eymar).

PLATE 2, figs. 3-5.

Pleurotoma ingens.
Mayer-Eymar: Journ. Conchyl. 1895, Vol. 43, pp. 50, 51, pl. 4, fig. 1.

Pleurotoma (*Surcula*) *ingens.*
Oppenheim: Palaeontographica 1906, Vol. 30, part 3, pp. 332-333, pl. 24, figs. 26.

REMARKS.—This determination applies to a remarkably fine example of this species measuring 92 by 50 millimetres, equalling in dimensions as well as excelling in structural details that figured by Oppenheim from the Upper Mokattam (= Bartonian) beds of the Fayoum of Egypt, which however, is only about half the size of Mayer-Eymar's giant type from the same locality possessing a length and width respectively of 170 by 65 millimetres. In general form the present example is more or less biconical and turreted, while the spire is much shorter than the body whorl. The posterior floor of the whorls is wide, slightly concave, and separated above by a deep linear and rather irregular suture, while below is a conspicuous periphery composed of wedge-shaped, equi-distant tubercles flattened at the top and forming short, oblique, rod-like swellings on the anterior face of the whorl, which is vertical and narrow compared to the broadened surface above, besides being furnished with a few strong, irregular, spiral costae which are continued as fine striations over the tubercles. The wide posterior surface of the whorls is covered with extremely fine, close, and deeply oval sinuated lines, which are well within the tubercled or peripheral margin and the suture, these lines being crossed by a series of equi-distant and delicate spiral striations. The spire consisting of 9 whorls is complete with the exception of the protoconch, while the body whorl, occupying about three-fifths of the longitudinal axis of the shell, has a piriform mouth which is prolonged into a slightly twisted canal; there is besides, a smooth internal surface to the labrum, and a prominent smooth callosity covering the columella region from the posterior angle to the termination of the canal. The deeply sinuous lines on the posterior surface of the body-whorl are continued over the periphery and inflated region below, as graceful outward curvatures which on the canal surface become nearly perpendicular to the end of the canal, where they merge into a twisted condition. Crossing the lines of curvature and slightly below the periphery occur three

strong and irregular spiral costae of which the two upper nearly touch and form a pair, while the third is further removed and followed to the end of the canal by a series of nearly equi-distant spiral costae which are more or less obscure. The strong spiral costae are, therefore, confined to the anterior walls of the volutions while the finer spiral sculpture, composed of more regular striations, characterise the ornamentation of the wide posterior surfaces, and are particularly significant on the earlier whorls. Neither the type of this species as figured by Mayer-Eymar nor Oppenheim's example exhibit anything like perfect sculpture characters, and it can only be imagined that erosive agencies have removed some of the finer and more delicate ornamentation from those specimens. It was thought at first, by the present writer [1] that Mayer-Eymar's species from Egypt might include *Clinuropsis diderrichi* of E. Vincent[2] from the Paleocene beds of the Belgian Congo, no very important differences seeming to separate the two forms, although, from their closer study it now seems advisable to keep them distinct, because the whorls of the Congo shell appear to be more depressed and less excavated, the peripheral tubercles are nearer to the suture, while the general aspect of the spire is more funnel-shaped or pagodiform rather than turreted. The possession of the very marked sinuated labrum in both species would at once suggest their reference to H. & A. Adams' *Surcula*, which was founded on *Murex javanus* of Linnaeus (= Lamarck's *Pleurotoma nodifera*) from the Indian Ocean. M. Vincent, however, placed the Congo species under the then new generic name of *Clinuropsis*, his type being *Pleurotoma ampla* of Briart and Cornet [3] from the Paleocene (= Montian) of Belgium, and moreover, recognised it as possessing Fusoid characters resembling *Buccinofusus*. The presence of the sinus and other details do not appear to favour such a classification, *Clinuropsis* being here considered a true *Surcula* and therefore, belonging to the family of the Turridæ. Further forms related to *S. ingens* would include :—*Pleurotoma keelei* of F. E. Edwards [4] from British older Eocene deposits ;

[1] R. B. Newton : Abst. Proc. Geol. Soc. London, 1919, No. 1042, p. 102.

[2] La Faune Paléocène de Landana (Mollusques) : *Ann. Mus. Congo Belge*, 1913. Ser. 3, Vol. 1, Géol., p. 21, pl. 2, figs. 8-11.

[3] Mém. Cour. Acad. R. Sci. Belgique, 1871, Vol. 36, pl. 4, fig. 8, p. 51 ; *ibid.*, 1880, Vol. 43, pl. 15, fig. 7, p. 28. It should be mentioned that *Pleurotoma ampla* is regarded by M. Cossmann under Dr. Dall's *Ancistrosyrinx* but since that genus has never been figured, so far as can be ascertained, it can only be referred to as of doubtful value—Essais Paléoconch. Comp., 1896, part 2, p. 71.

[4] Mon. Palaeontographical Soc. 1856, pl. 26, fig. 6, p. 219.

C. White's *Fusus* (*Serrifusus*)[1] from the Paleocene of Pernambuco, Brazil; Von Koenen's *Fusus morchi*[2] from the Danish Paleocene; and Dr. Oppenheim's rather recently described *Pleurotoma togoensis*[3] from the older Eocene beds of Togoland.

DISTRIBUTION.—Eocene (Upper Mokattam Beds) Egypt = Bartonian.

OCCURRENCE.—Cuttings, Nos. 11, 6.

COLLECTOR.—Mr. Kitson.

Surcula africana, sp. nov.

PLATE 2, figs. 6-8.

DESCRIPTION.—Shell turreted, elongately bi-conical, spire shorter than body-whorl; volutions 9 or 10 divided by a linear suture, posteriorly wide and depresso-concave, narrow and nearly vertical in front, last whorl furnished with a straight canal which is slightly twisted at the base, apex consisting of two or three smooth inflated whorls (protoconch not preserved); labrum smooth interiorly, wide and angulate at periphery, provided in rear with a deeply ovate central sinus; columella nearly straight, covered with a thin callus exposing the spiral ornamentation. Sculpture composed of close, deeply ovate, longitudinally sinuous lines contained within the periphery and the suture where they are thickest and there forming a necklet of short equi-distant oblique costae, all being crossed by regular and well marked spiral lines; the periphery bears a circlet of small, equi-distant, bead-like tubercles succeeded below on the penultimate whorl by two or three similar rows of tubercles arranged beneath each other and which are fewer on the earlier stages of the spire; the tubercled periphery of the body-whorl is followed in front by numerous circlets of nearly contiguous tubercles, each circlet being separated by a row of smaller tubercles, while the whole of this spiral ornament is crossed by strong, outwardly curved and crowded lineations which proceed from the sinuations in rear of the periphery, and which are continued perpendicularly over the surface of the canal.

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[1] Archiv. Mus. Nacion: Rio de Janeiro, 1888, Vol. 7, pl. 18, figs. 1, 2, p. 135.

[2] Ueber eine Paleocäne Fauna von Kopenhagen, 1885, pp. 18, 19, pl. 1, fig. 13.

[3] Beitr. Geol. Erf. Deutsch. Schutzgeb., 1915, part 12, pl. 5, fig. 5, p. 59.

DIMENSIONS.—

	Adult.	Young.	
Alt.	43 ...	19	millimetres
Lat.	20 ...	9	„

REMARKS.—Most of the characters of this species are drawn up from an adult form, younger examples having a plainer and smoother periphery on the latest whorl, while the spiral striations on the posterior surface of the volutions are more distinct than the sinuous lines that cross them. This shell differs from *S. ingens* by its smaller size and more complicated sculpture, although the sinus is relatively as deep and presents similar features of detail but on a smaller scale. The species is fairly common, quite a number of examples having been found in the Nigerian deposits.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 15.

COLLECTORS.—Sir J. Eaglesome and Mr. Kitson.

Eopleurotoma nigeriensis, sp. nov.

PLATE 2, figs. 11, 12.

DESCRIPTION.—Shell fusoid, conically acuminate, spire of same length as body-whorl; volutions 11 or 12, depresso-convex, strongly costated longitudinally and spirally striated, posteriorly narrow and only half the depth of the anterior part of the whorl; body-whorl moderately inflated, canaliculated, and slightly twisted at termination where a thin umbilical slit is present; columella nearly straight, covered with a smooth callus which is thick and elevated at the posterior end, thin in the centre and afterwards thickening to the termination in front; outer lip moderately thin, with a curvature towards the front, margin slightly serrated, furnished with a widely rounded, or sub-triangular sinus at the shoulder; aperture narrowly oval, canaliculated; sculpture exhibiting numerous, thick, spiral lines crossed by about thirty equally strong, longitudinal ribs which are obliquely inclined anteriorly but more or less vertical on the narrow or posterior division of the whorl, thus forming a sub-triangular bend which gives rise to the sinuation; minute nodosities mark the junctions of the costae.

DIMENSIONS.—

Alt.	44	millimetres
Lat.	13	„

REMARKS.—This species is closely related to *Pleurotoma lajonkairii* and *P. multicostata*[1] which respectively belong to the Lower and Middle Eocene of the Paris Basin, the second species forming the type of M. Cossmann's *Eopleurotoma*.[2] It differs from both, however, in the spire being of equal length with the body-whorl and not longer as in the European forms, besides being furnished with a better defined posterior division to the whorls. No bifurcation of the ribs is visible as in *P. multicostata*. One specimen much resembles the figures of *P. lajonkairii*, although examples examined of that species do not appear to equal the detail shown in the original illustrations. Resemblances may also be traced with Edwards's *P. abnormis*[3] from the British Lower Eocene which, like the other forms referred to, is provided with a spire exceeding the length of the body-whorl.

OCCURRENCE.—Cuttings Nos. 1, 10.

COLLECTOR.—Mr. Kitson.

Family CONIDÆ.

Conospirus[4] **cf. parisiensis** (Deshayes).

PLATE 3, figs. 8, 9.

Conus antediluvianus.

Deshayes: Desc. Coq. Foss. Paris, 1835, Vol. 2, pl. 98. figs. 13, 14, pp. 749, 750, *non* Bruguière.

Conus parisiensis.

Deshayes: Supplement Desc. Coq. Foss. Paris, 1865, Vol. 3, p. 418.

De Gregorio: Ann. Géol. Pal. 1890, part 7, p. 21; Cossmann: Essais Paléoconch. Comp., 1896, part 2, pp. 155, 156.

REMARKS.—The small Coniform shells here determined as related to *C. parisiensis* of Deshayes from the Middle and Upper Eocene beds of Europe, are of fairly frequent occurrence in the Nigerian deposits. They are of more or less uniform dimensions, the largest measuring 19 by 10 m.m., while those represented by figs. 8 and 9 of Plate 3 are a little under that size, the measurements of the type as given by Deshayes being 38 by 17 mm. The

[1] Deshayes: Desc. Coq. Foss. Paris, 1834, Vol. 2, pl. 64, figs. 8–13, pl. 65, figs. 18–20, pp. 466–8; *ibid.*, Suppl., 1865. Vol. 3, pp. 370, 71.

[2] Cossmann: Ann. Soc. R. Mal. Belgique, 1889, Vol. 24, p. 269.

[3] F. E. Edwards: Eocene Mollusca England-Mon. Pal. Soc. 1860, pl. 30, fig. 14, pp. 294, 5.

[4] *Gregorio, A. De.* Ann. Géol. Pal. 1890, part 7, p. 21. *Type of Conospirus = C. antediluvianus* Bruguière from the Upper Tertiaries of Italy.

spire of widely conical and pagoda-like shape is composed of three smooth, elevated, embryonic whorls with an obtuse nucleus, while the succeeding whorls have a depresso-concave surface, furnished with a microscopically fine reticulate sculpture caused by the delicate spiral striations being crossed by longitudinal lineations which are deeply sinuated. Minute equi-distant tubercles ornament the sutural margins, while the sculpture of the body-whorl is somewhat coarsely reticulate, the spiral costae being well pronounced and bearing regular tubercles at the junctions with the longitudinal striations. It is in some of these details that the Nigerian shells agree with *C. parisiensis*, although the latter has a less pagodiform spire and an ornamentation on the body-whorl which is much less accentuated, a difference, however, which may be due to erosion.

DISTRIBUTION.—Middle and Upper Eocene of Europe.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 14, 15.

COLLECTOR.—Mr. Kitson.

Family VOLUTIDÆ.

Athleta lugardi, sp. nov.

PLATE 5, figs. 1–3.

DESCRIPTION.—Shell elongate, laterally sloping, widely coniform, robust, spire short, spreading, depresso-convex, comprising seven whorls divided by a rather irregular, linear or slightly canaliculate suture; body-whorl flattened and wide above, obtusely angulate at shoulder, laterally oblique, about five-sixths higher than the spire, anteriorly twisted and broadly notched at base; aperture bi-canaliculated, narrowly oval, slightly oblique; columella evenly excavated, its basal part flattened and tapering, having a wide callosity which is very elevated, and thickened posteriorly, bearing well within one or two obscure, oblique plications succeeded by a twisted curvature at the basal extremity; parallel with the outer lateral margin of the columella lies a long, wide, funiculate growth, the "bourrelet" of French authors, which forms a closely twisted lamellate structure, ending in a broadly excavated notch of the short and wide canal, between the "bourrelet" and the columella, is a narrow umbilical slit; labrum, slightly sinuous, not dilated, thin, smooth within, rounded at the anterior corner, in rear obtusely angled, thickened, widely excavated and channelled; surface

more or less smooth being covered with longitudinal sinuous lines considerably twisted at the base, the whole being crossed by a continuous series of fine and nearly obsolete spiral striations.

DIMENSIONS.—

	Adult.	Young.
Alt.	78	40
Lat.	54	25

REMARKS.—This shell shows affinities with *Voluta selseiensis* of Edwards[1] from the Lutetian beds of England, a species which it is considered also occurs in the Paris basin deposits judging from a specimen figured by Messrs. Cossmann and Pissarro[2] which they determine as *Athleta* (*Neoathleta*) *bulbula* of Lamarck. Although never figured by Lamarck, *Voluta bulbula* was recognised as "ovato-fusiformis" in contour, a fact well displayed in the first illustration of the shell by Deshayes[3] but which does not possess the pyriform shape, shortened spire, and thickened callosity of *V. selseiensis*.

The Nigerian fossil differs from the British species in its coniform contour, its wider and more depressed spiral region, in the absence of strong, oblique, dorso-basal striations, and its fewer columella plications which, however, are set so far back as to be only visible in fractured specimens. The obscure spiral striations that cover the whorls are sometimes more evident in examples that have been more or less eroded. Following M. Cossmann[4] with regard to *Voluta selseiensis*, the new species here described is placed under Conrad's *Athleta* which was founded on *V. rarispina* Lamarck, from the French Miocene; it is clearly very different from Swainson's *Volutilithes*[5] (= *Psephaea*, Crosse, 1871), which was established on Lamarck's *V. muricina* from the European Eocene.

OCCURRENCE.—Cuttings Nos. 1, 6, 10, 12.

COLLECTORS.—Sir F. Lugard, Sir J. Eaglesome and Mr. Kitson.

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[1] Mon. Pal. Soc. 1854, pl. 22, figs. 3, pp. 168, 169.

[2] Iconog. Coq. Eocene Paris, 1910–1913, Vol. 2, pl. 45, figs. 205–18.

[3] Desc. Coq. Foss. Paris, 1835, Vol. 2, pl. 90, figs. 13, 14, p. 685.

[4] Essais Paléoconchologie Comparée, 1899, Vol. 3, pp. 140–142.

[5] See R. B. Newton: On *Volutilithes*—Proc. Mal. Soc. London, 1906, Vol. 7, pp. 100–104, pl. 12, fig. 1.

Volutospina conicoturrita, sp. nov.

PLATE 3, figs. 1, 2.

DESCRIPTION.—Shell turbinate, conico-turreted, depresso-ventricose; body-whorl inflated and rather more than twice the length of the spire which consists of six or seven volutions; surface spirally and depressedly striated, and longitudinally costated; suture deep and encircled by a moderately wide depresso-concave platform, with obliquely projecting, hook-shaped, equi-distant, marginal spines furnished antero-laterally with an elongate opening; marginal spines succeeded anteriorly by a row of equi-distant, compressed tubercles (absent in young shells) forming part of the widely distant longitudinal costae; aperture sub-crescentic, elongate, posteriorly horizontal, anteriorly constricted, terminating in a short and widely notched canal, labrum horizontally costated within, margin thin and not crenulated; columella sinuous, twisted, closely and spirally striated behind, but smooth in front, bearing three or more central, oblique plications of which the basal is strongest; a moderately thin callosity overspreads the postero-frontal face of the body-whorl; protoconch smooth, obtusely apexed, comprising about $2\frac{1}{2}$ deep and laterally depressed whorls.

DIMENSIONS.—

	Adult.	Young.	
Alt.	62 ...	12	millimetres.
Lat.	36 ...	6	,,

REMARKS.—This shell, which is of abundant occurrence, is characterised by its prominent sutural platform and hook-shaped marginal spines, the tall and distantly ribbed whorls of the spire with their flattened sides, together with the presence below, in the adult stage, of a row of equi-distant, compressed tubercles on the posterior region of the longitudinal costae. Wide and deep avenues are formed between the longitudinal costae, while the entire surface of the shell is more or less transversely and longitudinally striated, the striations being less obvious on the central area of the body-whorl as also that covered by the callosity.

The spiral sculpture is composed of equi-distant, undulating flattened circlets, possessing thickened and rather serrated posterior margins. There appears to be no species with which to compare this shell unless it be *V. spinosa*, Linnaeus, a typical species of the Paris Basin Eocene and the

type of my *Volutospina*.[1] That form, however, is much less inflated, its sutural platform is more excavated and more oblique, its spire is shorter and more spreading not turreted, and although possessing distant peripheral spines the adult forms exhibit no compressed tubercles on the longitudinal costae. None of the younger examples of this Nigerian shell are provided with the large costal tubercle, but the longitudinal costae exhibit a minutely beaded character at the junction of the spiral and longitudinal striae. Further, it may be mentioned that the spiral ornamentation is usually rather stronger than the longitudinal sculpturing. On account of its general resemblance, however, to the Linnaean "*Conus spinosus*" from the European and British Eocenes, this shell is regarded under *Volutospina*, a generic name which was proposed to replace *Volutilithes* of Swainson, 1840, because it differed from that author's first interpretation of his genus published in 1831.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTORS.—Mr. Kitson; Sir F. Lugard.

Volutospina multispinosa, sp. nov.

PLATE 3, figs. 3–5.

DESCRIPTION.—Shell turbinate, turreted, depresso-ventricose; body-whorl inflated, twice the length of the spire which comprises seven or eight volutions; surface with spiral and closely perpendicular striations, equi-distantly and longitudinally costated; suture deep, encircled by a horizontally-oblique spirally ribbed platform, the outer margin of which is equi-distantly and minutely spined at the posterior ends of the longitudinal costae, this spinose character being continued on the succeeding circlets but less obviously; aperture elongately rounded, constricted near base into a short, wide and notched canal, labrum horizontally ribbed within, margin crenulated, not thickened; columella nearly straight, twisted, spirally striated, base smooth, furnished in the centre with three equi-distant, similar, oblique plications; protoconch comprising about three whorls, two of which are smooth and laterally depressed whilst the earliest whorl is more inflated and obtuse.

DIMENSIONS.—

	Adult.	Young.
Alt.	43 ...	16 millimetres.
Lat.	25 ...	8 ,,

[1] R. B. Newton; Proc. Mal. Soc. London, 1906, Vol. 7, p. 103.

Remarks.—The sculpture of this shell is very striking and at once removes it from *V. conicoturrita* which is smoother and more prominently spined, besides having a more turreted spire with laterally depressed volutions. With the exception of the protoconch, the whorls are furnished with innumerable longitudinal striations crossed by strong, more or less equi-distant, spiral striae mostly forming pairs, the interspaces being sometimes occupied by a single striation of less strength; this spiral ornamentation is usually the most evident. The distant longitudinal costae are generally well marked and more numerous than in *V. conicoturrita*, so that the depressed avenues between are narrower than in that species. The marginal spines of the shoulder, which are smaller and much less significant than those of *V. conicoturrita*, are continued on some of the circlets below, but less obviously. In young specimens, the merging of the sculpture lines at their junctions produces a series of minutely rounded tubercles.

Occurrence.—Cuttings Nos. 6, 10, 12, 13, 15.

Collectors.—Mr. Kitson; Sir F. Lugard.

Family LOTORIIDÆ (= Tritoniidae).

Hilda turriculata, sp. nov.

Plate 4, figs. 24, 25.

Description.—Shell conico-turriculate; spire angulate, rather shorter than body-whorl, comprising six volutions, of which three constitute the protoconch, protoconch smooth, sub-globular, papillose, later whorls deeply sutured, postero-obliquely shelved, vertically walled in front, body-whorl of equal length and width; aperture narrowly ovate, obliquely margined in rear, contracted at base into a short recurved canal; labrum nearly vertical, strongly varixed from the suture, regularly plicated within; columella slightly excavated, well defined, bearing three plications anteriorly, besides numerous short, irregular, close, horizontal ridges, which cover almost its entire surface; sculpture, consisting of numerous, equi-distant, longitudinal costae, crossed by stronger transverse ridges at their junctions producing minute tubercles, extremely fine, close, longitudinal striations enter, also, into the microscopical structure of the test.

Dimensions.—

Alt.	... ...	20 millimetres.
Lat.	... ...	10 „

REMARKS.—This elegantly formed and closely ornamented shell is recognised as a member of the Lotoriidæ (or Tritoniidæ) on account of the rigid character of the columella, while its narrow ovate aperture and strongly varixed labrum, the varix not proceeding up the spire, links it with Hoernes and Auinger's[1] genus *Hilda* from the Miocene of Austro-Hungary founded on their type of *Triton (Hilda) transsylvanicum*. It differs, however, from this European species, in being wider and of more coniform shape, besides possessing angulate whorls, a deeper suture, and a prominent sutural platform, over the floor of which is continued the equi-distant longitudinal costae and the strong spiral ridges. This shell seems to be quite unknown in Eocene times, M. Cossmann's[2] analysis of the genus *Hilda*, including a reference only to the type species from Miocene rocks.

OCCURRENCE.—Cuttings Nos. 5, 6, 10, 12, 13.

COLLECTOR.—Mr. Kitson.

Family MURICIDÆ.

Pteropurpura cf. tricarinata (Lamarck).

PLATE 4, figs. 26, 27.

Murex tricarinatus.

Lamarck: Ann. Mus. Hist. Nat. [Paris], 1803. Vol. 2, p. 223; Deshayes: Desc. Coq. Foss. Paris, 1835. Vol. 2, pl. 82, figs. 7-10, pp. 597, 598; J. de C. Sowerby: Mineral Conchology, 1823. Vol. 5, pl. 416, figs. 1, p. 15.

Pteropurpura tricarinata.

Cossmann: Essais Paléoconchologie Comparée, 1903, part 5, pp. 18–20.

REMARKS.—This determination applies to a single specimen of moderate size (36 × 18 mm.), which is obviously related to Lamarck's *Murex tricarinatus*, from the European Lutetian, a species regarded by M. Cossmann as belonging to M. Jousseaume's genus *Pteropurpura* (Revue Mag. Zoologie, 1881, Ser. 3, Vol. 7, p. 334), which was founded on *Murex macropterus*, Deshayes of recent seas. The Nigerian shell, however, has rounder varices than the true *M. tricarinatus* with no indication of a postero-lateral spine, the aperture is narrowly oval instead of being widely pyriform, while the columella posteriorly

[1] Die Gasteropoden der Meeres-Ablagerungen der Ersten und Zweiten Miocänen Mediterran-Stufe in der Österreichisch-Ungarischen Monarchie (Wien), 1884, p. 182, pl. 22, figs. 17-20.

[2] Essais de Palèoconchologie Comparée, 1903. Vol. 5, pp. 106, 107, pl. 5, figs. 4, 5.

is furnished with a well-elevated plication, which forms the inner or left boundary to the short posterior canal. In its possession of a smooth protoconch, well excavated columella, regularly spiral and ridge-like sculpture crossed by longitudinal striations, the long and nearly closed condition of the anterior canal and other details suffice to illustrate its connection with the European species. In many ways, also, the fossil approaches *Murex asper*, Solander from British Eocene deposits although that shell differs by having a prominent postero-lateral and canaliculated spine situated at the posterior angulation of the labrum. As acknowledged by M. Cossmann, both *M. tricarinatus* and *M. asper* present close affinities with each other, although he separates them, respectively, under *Pteropurpura* and Bayle's *Alipurpura* (type = *M. acanthopterus*, Lamarck of Eastern seas: Bayle, in Fischer's "Manuel Conchyliologie," 1884, p. 641), and refers to differences which appear somewhat trivial for real purposes of distinction, and extremely difficult to trace. The spire of the Nigerian shell is covered in places with a polyzoan growth (*Membranipora*).

DISTRIBUTION.—Lutetian to Bartonian. Europe.

OCCURRENCE.—Cutting No. 1.

COLLECTOR.—Mr. Kitson.

Poirieria cf. calcitrapa (Lamarck).

PLATE 3, figs. 22, 23.

Murex calcitrapa.[1]
Lamarck: Ann. Mus. Hist. Nat. Paris, 1803. Vol. 2, p. 223.

Murex calcitrapoides.
Lamarck: Hist. Nat. Anim. sans Vert., 1822. Vol. 7, p. 573.

Murex calcitrapa.
Deshayes: Desc. Coq. Foss. Paris, 1835. Vol. 2. pp. 588, 589, pl. 81, figs. 26, 27.

Murex (*Poirieria*) *calcitrapoides.*
Cossmann & Pissarro: Icon. Coq. Foss. Éocène Paris, 1911. Pl. 36, figs. 169 (22).

REMARKS.—The collection contains rather more than 30 examples of a small Muriciform shell exhibiting close relation with Lamarck's *M. calcitrapa*

[1] Lamarck founded the name of *Murex calcitrapa*, for a French Eocene shell in 1803, using the same name afterwards for another Gastropod belonging to recent seas (*Hist. Nat. Anim. sans Vert.*, 1822. Vol. 7, p. 162). With the view probably of preventing the double employment of a specific designation, Lamarck altered the fossil species to *M. calcitrapoides*, instead of substituting a name for the second *M. calcitrapa*. This confusion of nomenclature has existed for a long period and even modern writers have adopted *M. calcitrapoides* for the fossil instead of the original *M. calcitrapa*, which has priority of several years, notwithstanding the fact that the latter name had been accepted by Bronn in 1848 and by Orbigny in 1850, for the fossil shell.

from the Upper Calcaire Grossier of France. Some differences exist, however, such as a relatively longer spire, a more delicate sculpture, and less developed spines. In other details there is almost perfect agreement, the number of varices being similar (= seven), the ovate aperture presenting the same characters including the possession of a nearly horizontal posterior canaliculation and anteriorly a narrow, elongate, perpendicular canal. The interior of the labrum is similarly furnished with transverse ridges, while the tubulosity of the peripheral spines is well marked. Sculpture details are more or less delicate, the embryonal whorls being quite smooth while the posterior faces of the succeeding whorls show little ornamentation being nearly smooth. The anterior regions of the volutions, however, are strongly decorated with spiral costæ, especially the last whorl, and microscopically fine longitudinal striations. The largest example in the collection shows a length of 21 mm. and a diameter of nearly 13 mm. Following M. Cossmann (Essais Paléoconch. Comp. 1903, vol. 5, pp. 30-32) this species is included in Jousseaume's *Poirieria*, of which the type is *Murex zelandicus*, Q. & G. of recent seas.

DISTRIBUTION.— Lutetian and Bartonian of Europe.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 15.

COLLECTOR.—Mr. Kitson.

Family FUSIDÆ.

Rhopalithes africanus, sp. nov.

PLATE 2, figs. 9, 10.

DESCRIPTION.—Shell elongate, fusiform, without sutural shelf; spire obtusely apiciform, produced, conical, concavo-ventricose, comprising seven or eight marginally thickened whorls, deep, separated by a thin indented suture; body-whorl one-fifth longer than the spire, depresso-globose, narrowly and perpendicularly canaliculated; aperture narrow, vertically elliptical, outer margin posteriorly sinuated; columella strong, border elevated, interiorly uni-plicated; surface of protoconch (= $2\frac{1}{2}$ whorls) smooth, succeeding four or five whorls distantly costated and spirally striate, remaining whorls crowded with extremely fine longitudinal and spiral striations, the former being sinuated while the spiral ornament presents a minutely wrinkled or serrate character especially on the body-whorl.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	77 millimetres.
Lat.	...	...	...	...	...	...	23 „

REMARKS.—This species of which there are only five examples is closely related to *Murex noae* of Chemnitz from British and European Eocene deposits, the type of Dr. Grabau's[1] genus *Rhopalithes*. It differs, however, in the absence of a sutural platform, having no posterior canal, possessing a generally narrower axis with rather more inflated whorls which are slightly excavated posteriorly, while the sculpture of the later volutions is of a more microscopical texture without any strong spiral striations the sinuated longitudinal lines being more apparent than those running transversely. The features of the earlier portion of the spire are similar to those observed in *R. noae* showing equally well the smooth, depressed protoconch and the four or five succeeding whorls marked by strong equi-distant swollen costae crossed by fine spiral striations. A fractured specimen shows the presence of a single oblique plication on the internal surface of the columella, there being usually two of these in the European species.

OCCURRENCE.—Cuttings Nos. 6, 10.

COLLECTORS.—Sir F. Lugard; Mr. Kitson.

Family STREPTURIDÆ (Cossmann).

Strepsidura spirata, sp. nov.

PLATE 3, figs. 24, 25.

DESCRIPTION.—Shell pyriform, excavated antero-laterally; spire widely coniform, slightly elevated, comprising $5\frac{1}{2}$ depresso-convex whorls, divided by a canaliculated suture, protoconch consisting of $2\frac{1}{2}$ smooth whorls with an obtuse summit; body-whorl elongate, inflated posteriorly, laterally excavated below, about four times the length of the spire, labrum arched, excavated below, serrated at margin, submarginally thickened and dentated within; aperture elongately oval, and contracted below into a narrowly elongate, recurved canal; columella with slight callosity, bearing four or five contiguous spiral ridges succeeded by a thick oblique plication and a twisted funiculate extension to the mouth of the canal; surface, excluding the protoconch,

[1] Phylogeny of *Fusus* and its Allies; Smithsonian Miscell. Coll., 1904, Vol. 44, No. 1417, p. 135.

equi-distantly and spirally ridged and crossed by microscopically fine, close longitudinal striations, the spiral sculpture of the central part of the body-whorl being sometimes more or less obsolete, one or two whorls immediately succeeding the protoconch bear a series of equi-distant longitudinal costae.

DIMENSIONS.—

	Adult.	Young.	
Alt.	27	9	millimetres.
Lat.	18	6	„

REMARKS.—Numerous specimens represent this form of *Strepsidura*, which is distinguishable from other species on account of the predominance of the spirally ridged ornamentation of the external surface, the longitudinal striations being much less evident because of their microscopically fine structure. Although the spiral sculpture is usually continuous over the whole shell, with the exception of the protoconch which is smooth, there are some examples exhibiting a smoothness in the central region of the body-whorl where the spiral lines are more or less obsolete, a character probably due to erosion. In the British and European Eocene shell, *Murex turgidus*, Solander, which is the type of Swainson's genus, *Strepsidura*, it is noticeable that the columella is biplicated, that there are no spiral ridges above the folds on the columella, and that the predominant sculpture in well preserved specimens consists of distant, more or less swollen, longitudinal costae whereas the spiral striations are extremely fine and much less prominent.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 13, 15.

COLLECTOR.—Mr. Kitson.

Family TURBINELLIDÆ.

Cornulina minax (Solander).

PLATE 3, figs. 6, 7.

Murex minax.
Solander, Brander's: Fossilia Hantoniensia, 1766, pl. 5, fig. 62, p. 30.

Fusus minax.
Deshayes: Desc. Coq. Foss. Paris, 1835. Vol. 2, pl. 77. figs. 1-4, p. 568.

Cornulina minax.
Conrad: Proc. Acad. Nat. Sci. Philadelphia, 1853, Vol. 6, p. 321; Cossmann: Essais de Paléoconchologie Comparée, 1901, part 4, pl. 4, fig. 5, and pl. 5, fig. 10, pp. 87, 88.

REMARKS.—The collection contains a small (25 × 18 mm.) and well preserved example of this species although its terminal regions are imperfect.

The sculpture consists of strong spiral ridges and grooves crossed by fine longitudinal striations; there are besides two distant but parallel rows of canaliculated spines on the body-whorl, the older or posterior series forming the periphery being much the larger and more prominent. It is this double row of spines more particularly which characterises Conrad's *Cornulina* of which the type is Solander's *Murex minax*. This species differs from Conrad's originally described form of *Monoceros armigerus* from the Alabama Eocene deposits, afterwards recognised by Conrad as belonging to *Cornulina*, in possessing depressed and more angulate whorls besides having a greater number of peripheral spines in each of the rows, the American shell having a very globulose body-whorl which is furnished with more distantly arranged spines. The best interpretation of Conrad's genus is that offered by M. Cossmann in his work quoted above.

The species is characteristic of the Lutetian formation although occurring in Bartonian and rarely in slightly higher horizons.

DISTRIBUTION.—British and European.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Bulbifusus nigeriensis, sp. nov.

PLATE 4, figs. 1, 2.

DESCRIPTION.—Shell thin, nearly smooth, ovato-fusiform, inflated; spire conically acuminate and obtusely pointed, comprising 7 or 8 thinly sutured, depresso-convex whorls, the penultimate being about twice the depth of the preceding; body-whorl $2\frac{1}{2}$ times the length of the spire, spirally and narrowly banded below the suture, elongately inflated, terminating with a short and wide canaliculation; aperture elongately oval, labrum margin simple, excavated posteriorly and anteriorly, outwardly curved, internally plicated; columella excavated, slightly twisted at the base with an obscure and elongate fold, callosity rudimentary or absent; surface of nuclear whorls ($= 1\frac{1}{2}$) smooth, remainder covered with extremely fine, close, longitudinally sinuous lines crossed by nearly obsolete, spiral striations.

DIMENSIONS.—

	Adult.
Alt.	approx. 55 millimetres.
Lat.	28 „

REMARKS.—The shell herewith described consists of nearly a dozen specimens which on account of their somewhat delicate and fragile character are more or less fractured. In general form it approximates to Conrad's *Fusus inauratus*[1] from the Alabama (Claiborne) Eocene (= Lutetian), a species which was later selected by Conrad as the type of his genus *Bulbifusus*,[2] although Isaac Lea's *F. fittoni* of an earlier date from the same deposits and identically the same shell, should more accurately be regarded as the type of that genus.

The Nigerian mollusc undoubtedly belongs to *Bulbifusus* and moreover approaches very closely to its type species only slight differences appearing to separate the two forms, as for instance the presence in the African shell of a minute band encircling the posterior margin of the body whorl, and the non-appearance of sutural crenulations on the spire. Lea's figure of *Fusus fittoni* well illustrates the fine, longitudinally sinuous lines seen in the present species.

The genus *Bulbifusus*, only known in the United States, exhibits a relationship to Bayle's *Sycum* which has for its type *Fusus bulbiformis* of Lamarck from the European Eocenes. *Sycum*, however, has a well-developed callosity covering the columella, a generally more angulate and deeper-whorled spire, as well as possessing a strong spiral ornamentation on the basal surface; it is also a relatively wider shell, rather more excavated at the posterior margin, and with a less sinuous labrum.

OCCURRENCE.—Cuttings Nos. 1, 6, 10.

COLLECTOR.—Mr. Kitson.

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[1] Fossil shells of the Tertiary Formations of North America, 1835, Vol. 1, No. 3, pl 18, fig. 2, p. 53.

[2] American Journ. Conch., 1865, Vol. 1, p. 17, *F. inauratus*, Conrad is a synonym of *F. fittoni*. Lea: "Contributions to Geology," 1833, pl. 5, fig. 156, p. 150.

Family BUCCINIDÆ.

Buccinorbis kitsoni, sp. nov.

PLATE 3, figs. 16-19.

DESCRIPTION.—Shell robust, sub-globose, spirally furrowed and funiculate at the base; spire elevated, conical, acuminate with about 7 depresso-convex whorls divided by a canaliculated suture, protoconch smooth, composed of $2\frac{1}{2}$ whorls, apex obtuse; body-whorl rounded, rather higher than wide, about twice the height of the spire, in age provided with a broad sutural platform, semi-ovately notched at the base; labrum nearly vertical, sharply margined, posteriorly sinuate, and with a thickened callosity, smooth within, basal margin with a dentiform projection at the furrow and an angulation at the notch; aperture narrowly oval, bicanaliculated, widely notched in front; columella smooth, excavated in the centre, slender and twisting outwardly at the base, callosity extensive, thickest posteriorly where it forms a narrow canal in conjunction with the raised callosity on the labrum, the umbilical region auriculate, excavated, and terminally pointed; surface possessing nearly vertical growth, lines sinuated at the suture and crossed by more or less obscure spiral striations, basal striations strongest on young specimens.

DIMENSIONS.—

	Adult.	Young.
Alt.	47 ...	17 millimetres.
Lat.	32 ...	9 „

REMARKS.—This shell differs from the true *Pseudoliva* (=*crassa*, Gmelin =*plumbea* of Chemnitz) of the Atlantic in its more produced spire, in the development of a prominent sutural platform especially in the adult stage, as also in the presence of the elongately auricular, umbilical cavity, such characters mostly belonging to the allied genus, *Buccinorbis* of Conrad[1] founded on *Monoceros pyruloides* and *M. fusiformis* both of Lea,[2] which are equivalent to Conrad's *Monoceros vetustus*, from the Claibornian Eocene beds of Alabama. The present species is, however, less inflated at the periphery, not pyruliform, more angulate at the suture, and possessing a shallower

[1] American Journ. Conch., 1865, Vol. 1, p. 21, and Fossil Shells of the Tertiary Formations of North America, 1835, Vol. 1, No. 3, p. 37, pl. 15, fig. 3.

[2] Contributions to Geology, 1833, pp. 161, 162, pl. 5, figs. 166, 167.

umbilical cavity. Notwithstanding these distinctions it appears to be more closely related to American forms than to species found in the European Eocene.

Moreover, in a general way, the African shell exhibits a resemblance to *Pseudoliva perspectiva*, as figured by Gabb[1] and more recently by M. Cossmann,[2] who regards it as *Buccinorbis*, from the Eocene deposits of Texas and Mississippi (Jackson), although its more produced spire, more prominent sutural shelf, and absence of striations on the internal surface of the labrum, are details tending to separate the two species. According to M. Cossmann, *Buccinorbis* occurs in the Indian Cretaceous (Senonian), in the Eocene of the United States, as also in the Miocene (formerly referred to the Eocene) of Australia.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 13, 15.

COLLECTORS.—Sir F. Lugard; Mr. Kitson.

Liomesus africanus, sp. nov.

PLATE 3, figs. 20, 21.

DESCRIPTION.—Shell small, ovato-conical, moderately ventricose; spire short, conoidal, comprising $5\frac{1}{2}$ whorls, canaliculate at the suture, protoconch with $2\frac{1}{2}$ smooth, depresso-convex whorls, obtusely apexed; body-whorl elongately oval, moderately inflated, 3 times the length of the spire; labrum arched, slightly excavated anteriorly, interior covered with microscopically fine horizontal striations; aperture narrowly sub-crescentic, contracted below into a short recurved, well-notched canal; columella excavated in the centre, with slight callosity, spirally striated, uniplicate below, funiculate, and twisted at the base; surface, excluding the protoconch, exhibiting a pair of regularly parallel, spiral striations immediately in front of the suture with deeply indented grooves, beyond which anteriorly the whorls are ornamented with spiral striations of more or less obsolete character, while a series of strong, equi-distant, obliquely spiral ridges cover the basal half of the shell to its

[1] Journ. Acad. Nat. Sci. Philadelphia, 1860, N. Ser., Vol. 4, p. 381, pl. 67, fig. 29.

[2] Essais de Paléoconchologie Comparée, 1901, part 4, pl. 8, figs. 19, 20, p. 193.

extremity, crossing which are extremely fine and close longitudinal striations which, however, are stronger and more prominent within the spiral grooves of the basal region of the shell.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	...	18 millimetres.
Lat.	...	...	...	...	...	...	...	11 „

REMARKS.—This shell is of apparently rare occurrence, only two examples having been collected. It is, however, of considerable interest because it belongs to Stimpson's genus *Liomesus*[1] (=*Buccinopsis*, Jeffrey 1867, *non* Conrad 1857) of which the type is *Buccinum dalei* of J. de C. Sowerby found in the Pliocene formation and which also exists in British and Northern Seas. Without the aid of magnification the central region appears to be quite smooth, the spiral striae being almost obsolete. The specimens show the characteristic plication at the base of the columella and parallel with it above is the strong carination which follows the twist of the basal region, the area between being marked with the spiral ornamentation. The species is chiefly distinguished from *Buccinum dalei* by its more cylindrical form, in having a more coniform and depressed spire, and in the possession of the prominent spiral striations immediately anterior to the suture. The shell besides possesses a narrower aperture and is much more contracted at the base. According to M. Cossmann,[2] who has published probably the latest account of this genus, *Liomesus* is confined to Pliocene and Recent seas, so that its occurrence in Eocene rocks is a feature of interest in connection with its geological distribution.

OCCURRENCE.—Cutting, No. 6.

COLLECTOR.—Mr. Kitson.

Cominella douvillei, sp. nov.

PLATE 2, figs. 18, 19.

DESCRIPTION.—Shell turriculate, ovately-fusiform, spire short, about half the length of the body-whorl, anterior extremity forming a small broad canal; volutions 5 or 6, deeply sutured, sloping and angulate posteriorly, sides

[1] Canadian Naturalist, 1865, N. Ser., Vol. 2, p. 366.

[2] Essais de Paléoconchologie Comparée, 1901, part 4, pp. 145, 146, pl. 5, figs. 12, 13.

vertical; nucleus smooth, rounded, depressed at summit; aperture narrow elongately oval, posteriorly sinuate; labrum strongly plicated within and feebly dentated at inner margin; columella slightly excavated, twisted in front, covered with a thin callus, spirally striated above but smooth below, bearing a single central plication; ornamentation consisting of numerous strong spiral striations with intermediate and finer circlet lines, crossed by correspondingly numerous fine and strong longitudinal striations which follow a sinuous course on the last whorl, general surface microscopically nodulato-reticulate.

DIMENSIONS (an adult example).—

Alt.	... ...	18 millimetres.
Lat.	... ...	9 „

REMARKS.—This strikingly ornamented shell exhibits a small almost microscopical sculpture, besides being furnished with a turriculate spiral region which is only half the length of the last whorl, and which somewhat resembles in its dorsal aspect, *Bela turricula* of recent seas. It is not to be confused, however, with the recent mollusc, on account of its possession of a plicated labrum and an almost hidden central fold on the columella, which are characters suggestive of *Cominella* and, therefore, of the Family Buccinidae. The sutural shelf is wide and oblique, while the sides of the whorls are tall and more or less vertical; the spire is of conical shape, whereas the body-whorl is of pyriform contour. With exception of the smooth protoconchal region, the whole of the outer surface is covered with a beautiful reticulate structure, minute nodulations marking the junctions of the numerous transverse and longitudinal striations. A somewhat similarly nodulated structure is associated with *Buccinum montense* of Briart and Cornet[1] from the Montian beds (Paleocene) of Belgium, a species regarded by M. Cossmann[2] under *Cominella*, but which differs from the African shell in having a more produced spire, in the absence of a sutural shelf, and being ornamented by a less complicated system of reticulate sculpture, besides having no posterior sinuation, with which exception the shape of the aperture is in perfect agreement with the present shell. The new species is still further removed from some other older Tertiary forms referred by M. Cossmann to the genus

[1] Mém. Cour. Acad. R. Sci. Belgique, 1871, Vol. 36, p. 30, pl. 2, fig. 9.
[2] Essais Paléoconch. Comp. 1901, part 4, p. 150.

Cominella. This small species is moderately represented in the collection. It is named after Prof. H. Douvillé, the accomplished paleontologist of France, who has contributed some valuable memoirs on Tertiary faunas from Africa and other countries.

Occurrence.—Cuttings Nos. 1, 5, 6, 10, 11, 15.

Collector.—Mr. Kitson.

Janiopsis nigeriensis, sp. nov.

Plate 4, figs. 22, 23.

Description.—Shell narrow, fusoid, moderately ventricose, rather deeply sutured; spire longer than body-whorl, composed of eight volutions, apex obtuse, succeeded by three erect, smooth and laterally compressed whorls, last whorl of equal width and length, funiculose and non-umbilicate at base; aperture narrowly ovate, slightly canaliculate posteriorly, contracted below into a short, widely excavated canal; labrum thickly margined externally, regularly plicated within; columella uniplicate below, obscurely ridged above, and with a strong posterior dentiform plication; sculpture includes a series of longitudinal, swollen costae (nine on the last whorl) separated by moderately wide furrows, crossed by thickened, equi-distant, transverse ridges, entire surface covered with microscopical, closely-set longitudinal striations.

Dimensions.—

Alt.	...	...	...	...	...	...	20 millimetres.
Lat.	...	...	...	...	...	...	9 „

Remarks.—There are rather more than a dozen specimens representing this elegantly formed shell, its characters associating it with Rovereto's *Janiopsis*[1], which was established to replace *Janiа*[2] of Bellardi, a pre-occupied name, founded on Brocchi's *Murex angulosus*[3] from the Upper Tertiaries of Italy. The features of the aperture show a prominent plication on the posterior part of the columella behind being a feeble canaliculation, and a rather more oblique plication occurring in front, while on the space

[1] Rovereto: Atti. Soc. Ligust. Sci. Nat. Geogr. 1899, Vol. 10, p. 104.

[2] Bellardi: Molluschi Terziarii Piemonte, 1872, part 1, p. 147.

[3] Brocchi: Conchiologia Fossile Subapennina, 1814, Vol. 2, pl. 7, fig. 16, p. 411.

between the two folds some obscure ridges are often observable. It chiefly differs from the type in its smaller and narrower dimensions, as well as possessing more regular plications within the labrum. From Eocene, examples of *Janiopsis*, as recognised by M. Cossmann,[1] such as *Turbinella parisiensis* and *Fusus herouvallensis*, both of Deshayes, the African shell differs in having a narrower axis, more produced spire, and distantly situated plications on the columella, one being high up in the posterior region, while the other is anterior; moreover, in the Eocene forms both plications are anterior and closely parallel to each other; in those species also, the body-whorl is longer than the spire. Such evidence, therefore, is in favour of the African shell being more closely related to Upper Tertiary forms than to species of older age—it may be known as *Janiopsis nigeriensis*.

OCCURRENCE.—Cuttings Nos. 6, 10, 12.

COLLECTOR.—Mr. Kitson.

Family CANCELLARIIDÆ.

Cancellaria multiplicis, sp. nov.

PLATE 3, fig. 26.

DESCRIPTION.—Shell narrowly turriculate; spire shorter than body-whorl, with sub-angulose, convex, oblique and deeply sutured volutions; elongately and narrowly umbilicated, umbilical cavity with an outer, rounded, marginal inflation; mouth trigono-ovate, with a short and wide canaliculation at base; labrum internally plicated, external margin minutely and distantly dentated; columella slightly excavated, strongly triplicate, with three further obscure plications in rear; sculpture consisting of distant, longitudinally curved, swollen costae divided by wide sulcations, outer surface entirely covered with closely-set, microscopically fine, longitudinal striations, crossed by prominent equi-distant spiral ridges.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	...	20 millimetres
Lat.	...	...	...	...	...	...	...	11 ,,

[1] Essais de Paléoconchologie Comparée, 1901, part 4, pp. 176–178.

REMARKS.—Only one specimen represents this species, which, with the exception of an absent protoconch, is in an excellent state of preservation. In contour it bears some resemblance to the original figure of Brocchi's *Voluta varicosa*, the type of Jousseaume's genus, *Sveltia*, of 1888, from the Italian Pliocene formation (Conch. Foss. Subapennina, 1814, Vol. 2, p. 311, pl. 3, fig. 8), although differing in the possession of an umbilicus. It is related, likewise, to De Blainville's *Trigonostoma*, founded on the Lamarckian type of *Cancellaria trigonostoma*, of Eastern Seas, but shows no disjointed or staged character of the whorls, and is moreover without the prominent sutural platform of that genus, the ends of the swollen costae touching the suture, and being a generally rounded and much less angulate shell. It is apparently an intermediate form between these two genera, *Cancellaria* and *Trigonostoma*, and from the absence of further examples is provisionally regarded under the more comprehensive term of *Cancellaria*. One unusual peculiarity of the shell is the presence of three weaker folds on the posterior surface of the columella, in addition to the ordinary plications of the antero-central region; hence the creation of the specific name, *multiplicis*, which it is proposed to bestow upon this shell.

OCCURRENCE.—Cutting No. 12.

COLLECTOR.—Mr. Kitson.

Trigonostoma decorata, sp. nov.

PLATE 5, figs. 18, 19.

DESCRIPTION.—Shell turriculate; spire equal in height to the body whorl, composed of five whorls, which, with the exception of those forming the protoconch, are suturally excavated, and staged, besides bearing irregular, marginal, vertical, spinose projections, nearly three volutions forming the protoconch, which are smooth, the basal being well elevated, plano-convex, apex rounded and obtuse; base exhibiting a small slit-like umbilicus; aperture trigono-angulate, obtusely spined posteriorly, excavated below into a short, wide, canal-like furrow; labrum rounded, posteriorly angulate and horizontal, plicated within, and varixed externally; columella triplicated, an upper, and two nearly contiguous folds below, on the space between being a small rounded tubercle; sculpture comprises numerous longitudinal costae, including a more inflated series at equally spaced distant intervals, and a finer series of two or three occurring between, these are crossed by many equi-distant transverse ridges;

the surface of the sutural platform is radially costated; extremely fine longitudinal, close, microscopical striations enter, also, into the sculpture of the shell.

DIMENSIONS.—

Alt.	...	...	...	...	...	...	...	10 millimetres
Lat.	...	...	...	...	...	...	...	6 „

REMARKS.—This small and highly ornamented shell, of which there are only three specimens, forms an excellent example of De Blainville's *Trigonostoma*,[1] (type = *Delphinula trigonostoma*, Deshayes), sharing most of its characters, but bearing only the slightest evidence of an umbilicus instead of the prominent basal cavity which is so significant of the type, a recent shell from Ceylon seas. It is interesting to observe that among fossil forms the new shell exhibits closest affinities with *Cancellaria* (*Trigonostoma*) *propegemmata* of De Gregorio[2] from the Eocene deposits of Alabama, especially in size, contour, and the very restricted character of the umbilicus. The sculpture, however, is less complicated in the American shell, where the costae are of one order only and considerably less inflated, while the spinose sutural margins are much more regular, and moreover there is a lack of definition about the transverse striations which appear to be almost obsolete. This Cancellariform shell is apparently unknown in the European Eocene fauna, nothing similar having been noticed by M. Cossmann[3] in his analysis of *Trigonostoma*.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Bonellitia cf. evulsa (Solander).

PLATE 5, figs. 14, 15.

Buccinum evulsum.

Solander: Brander's "Fossilia Hantoniensia," 1766, pl. 1, fig. 14, p. 13.

Cancellaria evulsa.

J. de C. Sowerby: Mineral Conchology, 1822, Vol. 4, pl. 361, figs. 2-4, p. 84.

Bonellitia evulsa.

Jousseaume: Le Naturaliste, 1887, Ser. 2, Vol. 1, p. 223; Cossmann: Essais Paléoconch, Comp., 1899; Vol. 3, pp. 32-34.

REMARKS.—It is difficult to separate this Cancellariform shell from the well known *Buccinum evulsum* of Solander, belonging to the Bracklesham and

[1] Manuel Malacologie. 1825, p. 652.
[2] Ann. Géol. Pal. (Palermo), 1890, part 7., p. 46, pl. 3, figs. 14, 15.
[3] Essais Paléoconchologie Comp., 1899, part 3, pp. 24-26.

Barton Beds of British localities. If anything it may be smaller, slightly narrower, and possessing a greater number of spiral striations, although its convex and varicosed whorls, general sculpture characters, formation of the aperture with its wide and short anterior canal, the thinly callused and triplicate columella showing the two lower folds as close together and distant from the upper, together with the non-umbilicated base, all of which characters typify the British species. Following Dr. Jousseaume the shell is recognised as belonging to his genus, *Bonellitia*, which was founded on *Cancellaria bonellii* of Bellardi (Mem. R. Ac. Sci. Torino, 1841, Ser. 2, Vol. 3, pl. 3, figs. 3, 4, p. 248), from the Mio-Pliocenes of Italy, a similar adoption having been favoured by M. Cossmann. *Bonellitia*, according to its author, occurs also in Recent seas. An adult form of the Nigerian specimens, which are well represented, measures 15 mm. in altitude and 8 in diameter, whereas one of the largest British examples gives a length of 25 mm. and a diameter of 14 mm. The protoconch assumes a smooth and rather mammillated appearance with few whorls, the actual summit or nucleus being slightly depressed, agreeing well with M. Cossmann's Text-figure 5, p. 33 in the "Essais de Paléoconchologie Comparée," part 3, 1899.

DISTRIBUTION.—Lutetian to Bartonian, Britain and Europe.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 14, 15.

COLLECTOR.—Mr. Kitson.

Family CERITHIIDÆ.

Exechestoma cossmanni, sp. nov.

PLATE 5, figs. 8, 9.

DESCRIPTION.—Shell short, conical, widely based; whorls turriculate, about eight or nine, sub-centrally projecting and angulate, deeply sutured, with irregular, distant and deeply sinuated varices especially on the penultimate and last volutions; aperture roundedly sub-quadrangular, canaliculated at base; labrum excavated at margin but less so than the varices; columella short, callose, biplicate below; sculpture exhibiting deeply sinuated, close, longitudinal striations, large equi-distant, compressed tubercles, microscopically ridged and striated beneath forming the sub-medium angulation of each whorl, basal

surface spirally ridged, an outer pair of ridges being prominent, well separated, and parallel to each other; posterior surface of whorls decorated with a pair of distant, finely-beaded circlets.

Dimensions.—

Alt. (approximate)	65 millimetres.
Lat.	29 „

Remarks.—There are only three specimens to illustrate this species and these unfortunately have imperfect terminations with consequently fractured apertures. The spires, also, have been very much smoothed by erosion, although this is interesting as tending to prove an estuarine origin for the deposits. The species is undoubtedly related to *Cerithium angulosum* of Lamarck, from the European Eocene, which Cossmann has selected as the type of his genus *Exechestoma*.[1] It chiefly differs, however, in its flatter and more expansive base, besides having more prominent peripheral tubercles, as well as possessing the pair of beaded circlets on the posterior surface of the whorls without any further spiral ornamentation, besides being furnished with a pair of spiral ridges which are just within the outer margin of the basal region. *Exechestoma* is grouped with *Potamides*—forms of the Cerithiidae as well as being closely related to De Montfort's genus *Pyrazus* of which the type is *Cerithium ebeninum* of Bruguière belonging to Recent seas, a genus, however, which has a more elongate aperture and a columella of deeper excavation.

The specific name is in honour of Monsieur Maurice Cossmann, the distinguished palaeoconchologist of Paris.

Occurrence.—Cutting No. 6.

Collector.—Mr. Kitson.

Terebralia, sp. A.

Plate 4, fig. 10.

Description.—This specimen, deficient in the apical region, is elongately conical, and composed of nearly six whorls of which the last is about double the height of the penultimate and furnished with a rounded and inflated

[1] Cossmann: Ann. Soc. R. Mal. Belgique, 1889, Vol. 24, p. 71, and Essais de Palaéoconchologie Comparée, 1906, part 7, p. 111.

periphery, while all the volutions have depressed sides. Each whorl bears about 12 robust, longitudinally oblique costæ which are slightly excavated or bent backwards, being thickest anteriorly, and separated by wide furrows. The whorls likewise bear strong, closely-set spiral ridges (about 12) which in passing over the summits of the costæ set up depressed tubercled thickenings forming a more or less scalloped margin to the suture, the spiral ridges divided by sulcations of corresponding width are continued over the basal surface of the last whorl. The columella is excavated and smooth while the aperture exhibits an ovate contour, although the labrum and other essential characters of the basal whorl are not preserved.

DIMENSIONS (fragmentary specimen).—

Length	50 millimetres.
Diameter	20 ,,

REMARKS.—This strikingly ornamented shell which is the only example in the collection is so imperfect at both ends that its position even generically is somewhat uncertain. Its reference, however, to *Terebralia* appears to be justified on account of its shape and sculpture, while certain erosive agencies are evident on the earlier part of the spire which would indicate a former existence spent in more or less brackish waters. Rather similarly marked shells are known in the latest Cretaceous of Egypt, Dr. J. Wanner having described and figured one as *Cerithium dachelense* (Palaeontographica, 1902. Vol. 30, part 2, p. 130, pl. 18, figs 25-28) which he regarded as being related to J. de C. Sowerby's *Cerithium corrugatum* from the Nummulitic Beds of Western India (Cutch) and since recognised in Archiac's memoir as *C. pseudocorrugatum* of Orbigny (Archiac & Haime, " Desc. Anim. Foss. Nummu litique Inde," 1853). Both the Cretaceous and Tertiary species here mentioned bear somewhat similar vertical costæ but they are more irregular being interrupted by occasional varices which are not present in the Nigerian shell. Again, a certain agreement in sculpture may be observed on some forms from the Ronca beds of Italy as originally described by Brongniart especially his *Cerithium multisulcatum*, and which are of Upper Lutetian age. (Mém. Terr. Calc.-Trapp. Vicentin, 1823, pl. 3, pp. 67, 68).

OCCURRENCE.—Cutting No. 10.

COLLECTOR.—Mr. Kitson.

Terebralia, sp. B.

PLATE 4, fig. 11.

DESCRIPTION.—Shell elongately conical, whorls compressed and on the same plane, basal whorl about twice the height of the penultimate; each whorl ornamented with 20 closely set, slightly oblique, perpendicular costæ, crossed by about 10 closely fitting spiral ridges forming at their junctions regular columns of depresso-rounded tubercles which constitute the costæ, thus producing more or less tubercled serrations at the suture.

DIMENSIONS (fragmentary specimen).—

Length	...	...	...	...	...	37 millimetres.
Diameter	...	...	...	...	...	17 „

REMARKS.—The only example of this form is unfortunately imperfect, its apex being absent while its principal basal characters are also wanting. About $5\frac{1}{2}$ whorls are preserved, all of which are on the same plane having flattened sides, the peripheral region of the last volution being fairly rounded. It has generic relations with the shell previously described as *Terebralia sp. A.*, but differs in its very much closer ornamentation, and rather more depressed whorls. There is, however, another species, described by Oppenheim from the Upper Mokattam deposits of Egypt (Palaeontographica, 1906, Vol. 30, part 3, p. 285, pl. 25, fig. 11), *Cerithium apisidis*, which shows considerable resemblance. Nevertheless that shell, although bearing a very similar contour and sculpture has less regular costæ on account of varicose interruptions which are not observable in the Nigerian shell.

OCCURRENCE.—Cutting No. 12.

COLLECTOR.—Mr. Kitson.

Family TURRITELLIDÆ.

Turritella mauryana, sp. nov.

PLATE 5, figs. 4–6.

DESCRIPTION.—Shell thick, elongately conical, pagodiform; whorls about twenty-two, flattened, excavated, finely and deeply sutured, with a projecting subhorizontal shelf at two-thirds the depth of the whorl, the anterior space beyond concave to the suture; labrum deeply sinuated; whorls covered

throughout with numerous close, microscopically fine, spiral striations which are crossed by equally fine, deeply sinuated longitudinal lines; sutural margins small, rounded, delicately reticulate or microscopically beaded in earlier growth; between the posterior suture and peripheral carina or shelf are two distant slightly elevated circlets with reticulate or beaded margins, according to age; base depresso-convex, surrounded by a prominent carination (following the peripheral shelf), and two distant minor carinae; aperture subquadrangular, with two horizontal grooves within marking the external carinae in rear of the base.

DIMENSIONS.—

Alt. (approximate)	...	...	=	113	millimetres.
Lat.	...	...	=	29	„

REMARKS.—This species is interesting as showing relationships to *T. transitoria* of Mayer-Eymar[1] from the Lutetian of Egypt, and *T. mortoni* of Conrad[2] from the older Eocene deposits of Maryland, United States, as also occurring in the Alabama Eocene. From the first-named it differs in having only two circlets on the posterior surface of the whorls instead of three or four, in possessing a more pronounced peripheral carina and a rather deeper sinuation at the labrum; the spiral ornamentation is likewise much less evident on account of its microscopically small character. The new species presents a similar pagoda-like axis to *T. mortoni*, a shell much less prolonged, however, and having only a single carina on the basal whorl being without the second carination which forms the sutural margin of the previous whorls. This elegant and finely sculptured shell is generally well preserved and although the spires are never complete, there are fragments, exhibiting the earliest period of growth in which a minute, rounded and smooth nucleus can be traced.

I have ventured to name this shell in honour of a well known palæoconchologist of the United States, Dr. Carlotta Maury, the authoress of memoirs dealing with Tertiary Mollusca from Trinidad, San Domingo, &c.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 13.

COLLECTORS.—Mr. Kitson, Sir F. Lugard.

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[1] Palaeontographica, 1883, Vol. 30, pt. 1, pl. 23, fig. 6, p. 76.

[2] Journ. Acad. Nat. Sci. Philadelphia, 1830, Vol. 6, p. 221, pl. 10, fig. 2.

Turritella cf. sulcifera, Deshayes.

PLATE 5, fig. 7.

Turritella sulcifera.

Deshayes : Desc. Coq. Foss. Paris, 1832, Vol. 2, p. 278, pl. 35, figs. 5, 6, pl. 36, figs. 3, 4, pl. 37, figs. 19, 20.

REMARKS.—This is an abundant shell in the Nigerian deposits, being of small size when compared with the rather giant forms of the above species as occur in the European Eocene deposits. The specimen figured is one of maximum dimensions showing an altitude of 39 and a diameter of 11 millimetres. The axis is composed of 16 whorls of convex character at the centre with an obliquity dipping down at each end to a moderately deep suture. Ornamentation comprises about 12 fine spiral ridges with occasional finer lines between. The spiral ridges are pretty generally equi-distant although in the antero-peripheral region they are a little more separated with the result that the sulcations are wider and more prominent. The whole of this sculpture is crossed by obscure, microscopically fine, longitudinal striations which are more or less sinuous or curved. Although of much smaller size this shell not only resembles *T. sulcifera* in its elongate, narrow and many whorled spire from the Eocene but in like characters it approaches some recent forms, such as *T. terebra*, Linnaeus and *T. spectrum* of Reeve now existing in Eastern seas. The Nigerian shell bears a somewhat similar relationship to Cossmann's *T. boghosi* from the Lutetian of Egypt (Bull. Inst. Egypt, 1901, Ser. 4, No. 1, part 6, pl. 2, figs. 9–11, p. 12), Oppenheim's figures of that species being rather better than the original (Palaeontographica, 1906, Vol. 30, part. 3, pl. 23, figs. 11, 12).

DISTRIBUTION.—Lutetian–Bartonian, Europe.

OCCURRENCE—Cuttings Nos. 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Family EPITONIIDÆ (= Scalidæ).

Acrilla cf. affinis (Deshayes).

PLATE 3, figs. 10–12.

Scalaria affinis:

Deshayes : Desc. Anim. Sans Vert. Suppl. Coq. Foss. Paris, 1861, Vol. 2, p. 339, pl. 12, figs. 4, 5.

Acrilla affinis :

Cossmann : Ann. Soc. R. Mal. Belgique, 1888, Vol. 23, p. 134.

REMARKS.—Some remarkable good fragments of a Scaliform shell are included under this determination, the longer specimen figured with imperfect

terminations and possessing nine whorls measures 27 millimetres, while a disconnected basal whorl has a diameter of 9mm. They belong to an elongately narrow, imperforate shell which had probably about a dozen volutions of gradually increasing growth, showing considerable convexity, and divided by a deep suture. The ornamentation consists of prominently elevated, well separated, longitudinal costae with terminal curvatures at the suture, the intervening furrows being strongly and transversely striated. The basal disc has a well defined spiral carination which encloses a floor decorated with well marked radial and concentric sculpture. In most of these characters a relationship is traceable to the European species, *Acrilla affinis*, which M. Cossmann refers to the Upper Eocene, although the Nigerian shell is probably a narrower type with less gradually increasing whorls. A further closely related form is *Scalaria multilamella*, Deshayes (Desc. Coq. Foss, Paris, 1832, Vol. 2, p. 196, pl. 22, figs. 15, 16), which on account of that specific name having been used at an earlier date by Basterot, for another shell, has been re-named by M. du Boury as *Acrilla gallica* (Desc. Scalidae Nouveaux Eocènes, Paris, &c., 1887, p. 11), a form, however, with less elevated and more numerous longitudinal lamellae.

DISTRIBUTION.—Upper Eocene, Europe.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Family XENOPHORIDÆ.

Tugurium nigeriense, sp. nov.

PLATE 4, figs. 20, 21.

DESCRIPTION.—Shell small, of conically spreading form, composed of 6 or 7 depressed whorls the earliest of which (4 or 5) are rounded, smooth, obtusely apexed, and divided by a well marked regular suture, the remaining whorls being irregularly sutured on account of peripheral angulation; base umbilicated but cavity partially covered by a thin columella callosity; ornamentation of the upper surface consisting of strong spiral ridges and rather finer radial striations, basal region also spirally costated and furnished with radial and well excavated lines of growth producing reticulation; umbilical cavity deep

with well circumscribed walls marked by roundly excavated lines of growth but without spiral ridges; aperture depressed, ovate, inner lip-margin deeply excavated; agglutinations of comminuted shells &c. occur in the neighbourhood of the suture and at the periphery.

DIMENSIONS.—

Alt.	10 millimetres.
Diam.	17 „

REMARKS.—This small species varying in diameter from 5 to 17 mm. is quite well represented, and at first sight appears to be Lamarck's *T. agglutinans* from the Lutetian-Bartonian deposits of Europe, but that species has a smooth base while the sculpture of the upper surface is much more irregular consisting of longitudinally-oblique riblets rather than the regular spiral ornamentation characterising the present shell. The presence of an umbilicus indicates that this species belongs to Fischer's genus *Tugurium* of which *Trochus indicus* of Gmelin of recent seas is the type. Some examples of this shell are associated with *Teredo* tubes (see p. 102).

OCCURRENCE.—Cuttings Nos. 5, 6, 10, 12, 15.

COLLECTOR.—Mr. Kitson.

Family ARCHITECTONICIDÆ (= Solariidæ).

Stellaxis bicingulata, sp. nov.

PLATE 5, figs. 10, 11.

DESCRIPTION.—Shell broadly conical, summit depressed, basal width about twice the altitude; whorls 7, smooth, depresso-convex, suture thin; peripheral border subangulate, with a narrow, slightly elevated cord-like circlet; base depressed prominently umbilicated, cavity deep, infundibuliform, reaching to the apex; aperture subquadrangular, angulose at periphery; sculpture consisting of very obscure, distant, spiral lines and numerous fine radial striations; the base possessing 2 cordiform cingulae the thicker forming the periphery, divided by a narrow furrow, there are besides obscure spiral striations and numerous radial lines of growth; umbilical margins are strongly nodulated while the internal walls are covered with fine vertical striations.

DIMENSIONS.—

Alt.	12 millimetres.
Diam.	24 „

REMARKS.—This shell exhibits affinities with both *Solarium bistriatum* of Deshayes (Desc. Coq. Foss. Paris, 1832, Vol. 2, p. 215, pl. 25, figs. 19, 20) from the older Eocene (Ypresian) of France and *S. carocollatum*, Lamarck (Hist. Nat. Anim. Sans Vert., 1822, Vol. 7, p. 6; Basterot: Mém. Soc. Hist. Nat. Paris, 1825, Vol. 2, pl. 1, fig. 12, p. 34) from the Miocene (Burdigalian) of the same country. From the former it differs chiefly in being of much more robust and less depressed character, besides possessing an obtusely angulate instead of an acutely thin periphery and being furnished with prominently nodulated umbilical edges in place of short radial plications. The Miocene shell has a well marked narrow canaliculation surrounding the umbilical region not present in the shell from Nigeria while the marginal edges of the same consist of short radial plications instead of more or less nodulated tubercles. Some striking analogies are also traceable to Oppenheim's *Solarium subpatulum* from the Egyptian Eocene but without actual examples for comparison it is difficult to recognise it as identical with the shell from Nigeria. The European forms referred to present affinities with Conrad's *Solarium alveatum* from the United States Eocene which Dr. Dall has used as the type of his *Stellaxis* (Trans. Wagner Free Inst. Sci. Philadelphia, 1892, Vol. 3, part 2, p. 323), hence the present shell is determined as belonging to that genus. In the Nigerian deposits this species is numerously represented.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Solariaxis cf. spectabilis (J. de C. Sowerby).

PLATE 5, figs. 12, 13.

Solarium spectabile.

J. de C. Sowerby: Dixon's "Geology of Sussex" 1850, pl. 6, fig. 2, p. 179.

REMARKS.—It is interesting to find among the Nigerian shells of this family, a species showing close relations with *Solarium spectabile* which was long ago described by J. de C. Sowerby from the Middle Eocene deposits of Bracklesham Bay, Sussex, the type of which is in the British Museum, having been described as "convex, striated, margin thin, sharp, deflected; whorls about six, slightly convex, their upper edges prominent, crenated; the spaces between the striae unequal, alternately granular; umbilicus nearly equal

in its diameter to half that of the shell, with a crenulated margin; aperture rhomboidal. Height about half the diameter of the base. Covered within the umbilicus, as well as over the other parts, with alternately linear and granulated ridges, which are largest towards the upper edges of the whorls and the margin of the umbilicus." The Nigerian adult forms of this apparently related shell are of smaller size than those from Sussex, the former showing an altitude of 13 mm. and a diameter of 25 mm., while the latter measure 15 by 32 mm. Most of the characters referred to in the original diagnosis are quite well represented in the examples from Africa. There is besides a well pronounced canaliculation surrounding the suture noticeable in both shells from these widely separated localities. The alternately linear and granulate character of the spiral ornamentation is also well displayed on the upper surface while the base shows a well separated series of granulate spiral lines with, however, only one or two intervening lineations, these latter being much better expressed and more numerous in the English type. The sculpture of the deep and wide umbilical cavity shows the marginal ridge composed of robust granulations while rows of smaller and more delicate tubercles ornament the internal walls; the peripheral edge of the Nigerian shell should be mentioned as being obtusely angulated rather than acute as in the British species. This species evidently belongs to Dr. Dall's *Solariaxis*, which was established on Conrad's *Solarium elaboratum* from the Claiborne Eocene of the United States (Trans. Wagner Free Inst. Sci. Philadelphia, 1892, Vol. 3, part 2, pp. 323, 324). It is abundantly represented in the Nigerian deposits.

DISTRIBUTION.—Lutetian, England.

OCCURRENCE.—Cuttings Nos. 6, 12, 13, 15.

COLLECTOR.—Mr. Kitson.

Solariaxis cf. canaliculata (Lamarck).

Turbo.

Solander: Brander's "Foss. Hantoniensia," 1766, p. 10, pl. 1, figs. 7, 8.

Solarium canaliculatum.

Lamarck: Ann. Mus. Hist. Nat. Paris, 1804, Vol. 4, p. 53; Deshayes: Desc. Coq. Foss. Paris, 1832, Vol. 2, p. 220, pl. 24, figs. 19-21; Oppenheim: Palaeontographica, 1906, Vol. 30, part 3, pl. 20, fig. 13, p. 231.

Solariaxis canaliculata.

Cossmann: Essais Paléoconch. Comp., 1915, Vol. 10, p. 170, pl. 6, figs. 37-39.

REMARKS.—There are several examples of a small sized, rather compressed and suturally grooved shell which resemble *Solarium canaliculatum* from the

Lutetian-Bartonian beds of England and Europe, but they are more rounded at the periphery, true forms of the species being more angulate and sharp. The wide and deep umbilical cavity is of similar construction and bears the same character of ornamentation, consisting of finely granulate spirals and radial striations, the marginal granulations of the whorls being rather larger and more prominent than the remainder. Larger tubercles or nodulations make up the umbilical circlets, while beyond smaller and more rounded granulations form the circlets to the periphery; the well sculptured furrows of the base are furnished with stout radial plications. One of the largest examples of this collection has an altitude of 6 mm. and a diameter of 12 mm.

DISTRIBUTION.—Lutetian–Bartonian of Europe, England, Egypt.

OCCURRENCE.—Cuttings Nos. 1, 6, 10, 14, 15.

COLLECTOR.—Mr. Kitson.

Family NATICIDÆ.

Neverita cf. calvimontana (Deshayes).

PLATE 5, figs. 16, 17.

Natica calvimontana.
Deshayes: Desc. Anim. Sans. Vert. Coq. Foss., Paris, 1864, Vol. 3, p. 60, pl. 68, figs. 9, 10.

Neverita calvimontensis.
Cossmann: Ann. Soc. R. Mal., Belgique, 1888, Vol. 23, p. 163.

REMARKS.—This shell is represented by three examples showing similarity of size (25 × 22 mm.) and details of structure which strongly suggest a close relationship to *Natica calvimontana* of Deshayes from the Lutetian of Europe, and chiefly differs in possessing an obtuse apex rather than one that is somewhat acute as mentioned in the original diagnosis, *apice acutiuscula.* It preserves the same depresso-globose form besides having a widely spreading, short, conical spire minutely canaliculated at the suture, whilst the base is furnished with a prominent funiculate callosity which merges into the posterior regions of the columella. In many of its characters, as with the European shell, it closely resembles *Natica josephinia* Risso's type of *Neverita* (Hist. Nat. Europe Méridionale, 1826, Vol. 4, p. 149), found in the Upper Tertiaries and Recent seas (Mediterranean), a fact already alluded to in M. Cossmann's notice of this species. This shell differs also from *Neverita cleopatrae*,

Oppenheim, from the Lutetian of Egypt, which has an acute apex and consequently a more elevated spire, besides being of less conoidal shape.

DISTRIBUTION.—Lutetian of Europe.

OCCURRENCE.—Cuttings Nos. 6, 12.

COLLECTOR.—Mr. Kitson.

Sinum cf. clathratum (Gmelin).

PLATE 2, figs. 16, 17.

Nerita clathrata.

Gmelin's 13th Ed. "Systema Naturae" by Linnaeus, 1790, p. 3675.

Sigaretus canaliculatus.

J. de C. Sowerby, 1823, Vol. 4, pl. 384, pp. 115, 116; Deshayes: Desc. Coq. Foss. Paris, 1829, Vol. 2, pl. 21, figs. 13, 14, p. 182; Dixon's "Geol. Sussex," 1850, pl. 5, fig. 9, p. 98; Cossmann: Ann. Soc. R. Mal., Belgique, 1888, Vol. 23, pp. 168, 169.

REMARKS.—This shell is represented by about eighteen examples of varying dimensions, one of those figured being the largest collected. The specimens exhibit the more or less conical shape of this species with a spiral region which although depressed is well exposed above the posterior margin of the body-whorl. The nucleus is obtuse and surrounded by about two-and-half smooth volutions, while the surface of the penultimate whorl and the succeeding body-whorl are furnished with the closely spiral ornamentation of this species, consisting of minutely banded lines often with irregular or serrated margins, the intervening grooves being furnished with still more delicate and finer spiral striations, the whole being crossed by numerous more or less obscure longitudinal striations. Evidently the shell is closely related to the well known European species, although probably possessing a more exposed spiral region and being, perhaps, of a generally less depressed form. The largest specimen has an altitude of 20, width 17, depth 10 millimetres. The species differs from typical forms of *Sinum* by its conical and depresso-globose contour, and its possession of a more elevated spire. In ornamentation and general contour lines there is great resemblance to *Natica striata* of Lea (Contributions to Geology, 1833, pl. 4, fig. 88, p. 105) as interpreted by Gregorio (Ann. Géol. Pal. 1890, part. 7, pl. 15, figs. 9–15, p. 154), from the Alabama Eocene beds.

DISTRIBUTION.—Middle and Upper Eocene of Britain and Europe.

OCCURRENCE.—Cuttings No. 5, 6, 10, 11, 12.

COLLECTOR.—Mr. Kitson.

Sinum africanum, sp. nov.

PLATE 4, fig. 12, 13.

DESCRIPTION.—Shell oval, very slightly arched, depresso-convex, auriform; spire small, lateral, depressed, with smooth protoconchal region consisting of three volutions furnished with a minutely canaliculated suture, and an obtuse apex; aperture shallow, ovately elongate, oblique, with excavated columella lip and a nearly vertically margined labrum; umbilicus present, but only exposed when the thin callosity covering has been removed; sculpture of minute texture, consisting of numerous, moderately distant, spiral ridges with irregularly serrated margins, divided by smooth furrows and crossed at intervals by strong concentric growth periods.

DIMENSIONS.—

Alt.	... ...	15 millimetres
Lat.	... ...	10 „
Depth	... ...	5 „

REMARKS.—This Gastropod belongs to the very depressed forms of Naticoid shells which Bolten [1] recognised under the genus *Sinum* in 1798, Lamarck [2] as *Sigaretus* in 1799, and de Blainville [3] as *Cryptostomus* in 1818. This species is much flatter than any members of the genus found in Eocene rocks, such as *S. clathratus*, &c., which are more or less conically shaped, of rounder periphery and bearing an elevated spiral region. It exhibits characters which connect it more with shells of the Miocene, Pliocene and Recent seas, in which the earliest volutions are generally on the same plane as the body-whorl. This species is represented by four specimens of very similar size, although, unfortunately, one of the better examples illustrated in the plate has been recently broken beyond repair, and only its fragments deposited in a glass test-tube, are now available for study.

OCCURRENCE.—Cuttings Nos. 6, 10.

COLLECTOR.—Mr. Kitson.

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[1] Museum Boltenianum, 1798, p. 14. *Type* = *Helix haliotoideus*, Linnaeus.

[2] Mém Soc. Hist. Nat. Paris, 1799, p. 77. *Type* = *H. haliotoideus*, Linnaeus.

[3] Bull. Sci. Soc. Philom. Paris, 1818, pp. 120-122, and Manuel de Malacologie, 1827, p. 467, pl. 42, fig. 3. *Type* = *Cryptostomus leachi*, de Blainville. This type is stated in the 1818 memoir to be among the spirit specimens at the British Museum.

Family CAPULIDÆ.

Crepidula falconeri, sp. nov.

PLATE 2, figs. 13, 13a.

DESCRIPTION.—Shell sub-oval, convex, labial side depressed and sub-vertical, opposing side inflated ; nucleus forming a minute postero-lateral spiral composed of two volutions well divided from the peritreme ; surface striated concentrically and periodically ridged, obscurely and microscopically tessellated, and possessing indistinct radial striations ; aperture oval, extensive, concave, porcellanous, provided with a thin, continuous and rather undulating peritreme, a prominently arched and well sunken septum, having beneath its lateral terminations a pair of oval and concentrically marked muscular scars which are united by a rounded or horse-shoe shaped connexus hidden by the septum.

DIMENSIONS.—

	Adult	Young
Alt.	43 ...	9 millimetres
Lat.	27 ...	5 „

REMARKS.—The foregoing characters have been drawn up from an adult example, although the majority of the specimens are only about half its size, whilst others are of considerably smaller dimensions. This adult form shows a remarkable scar-line on the internal floor of the aperture, pursuing a diagonal course from beneath the septum to the right ventral side, with obscure evidence of a bifurcation about half way. No muscular impressions of this nature have been observed in recent examples like *C. fornicata* (Linnaeus), the type of Lamarck's *Crepidula*, nor does there appear to be any reference in literature pointing out the origin of such markings in this genus. It is therefore considered that they must indicate a connection with part of the mantle attachment. A small horizontal slit-like cavity exists behind the central upper surface of the septum, which is probably of umbilical value, although having apparently no opening to the spire, and thus representing a pseudo-umbilicus. The horse-shoe shaped adductor scar with its latero-oval muscular impressions, are very typical of the Family Capulidae, being well marked in *Capulus ungaricus* (Linnaeus) of Recent seas, the type of De Montfort's genus *Capulus*. Our new species, however, is a true *Crepidula* and not to be mistaken for *Capulus* which possesses no internal septum. The following references to other described forms

of *Crepidula* may be made, although there are no species exhibiting very close affinities with the Nigerian shell. There is Mayer-Eymar's *Crepidula indigena* (Journ. Conchyl., 1903, pl. 13, fig. 1, p. 318) from the Lutetian of Egypt, which was founded on a natural cast, but being without internal characters it might just as well belong to *Capulus* as *Crepidula*, or even *Hipponyx* as suggested by Oppenheim (*Palaeontographica*, 1906, Vol. 30, part 3, pl. 22, figs. 36, 37, pp. 261, 262). The only *Crepidula* mentioned by M. Cossmann (*Ann. Soc. R. Mal. Belgique*, 1888, Vol. 23, p. 192, pl. 7, figs. 29-31) from the Parisian Eocenes is his *C. parisiensis*, an extremely small shell and without any observant muscular impressions. More resemblances, perhaps, may be observed with Conrad's *Crepidula lirata* from the Alabama Eocene (*see* de Gregorio: *Ann. Géol. Paléont.*, 1890, part 7, pl. 13, figs. 49-58, p. 146), although the diaphragm in that species occupies a greater area of the aperture, while the sculpture includes numerous radial costae, the Nigerian shell being more or less polished and smooth, the obscure radial striations being almost obsolete. The new species is named after Dr. J. D. Falconer, Director of the Geological Survey of Nigeria.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Family CALYPTRÆIDÆ.

Calyptraea crepidularis (Lamarck).

PLATE 4, figs. 18, 19.

Calyptraea crepidularis.

Lamarck: Ann. Mus. (Paris), 1802, Vol. 1, p. 385; Deshayes: Desc. Coq. Foss., Paris, 1824, Vol. 2, p. 32, pl. 4, figs. 16-18; Cossmann: Ann. Soc. R. Mal. Belgique, 1888, Vol. 23, p. 194.

REMARKS.—This species is interesting as occupying a more or less intermediate position between *Calyptraea* and *Crepidula*; following M. Cossmann at the present day, it is here regarded under the first named genus. The original description is as follows:—"Testa subovata, convexo-gibbosa, obsolete echinata; spira submarginali." Deshayes first referred to it as related to both *Calyptraea* and *Crepidula*, a view since supported by M. Cossmann. The Nigerian shell exhibits a similar sunken septum as is present in the European form, being besides prominently umbilicated at the

right posterior corner, whereas the septum in true forms of *Calyptraea* is more an attachment of the periphery and consequently occupying a fairly shallow area of the aperture. Again, the present shell shows a sub-marginal spiral region which in *Calyptraea* is more central. Its ornamentation, consisting of distant spiral rows of perforated tubercles and numerous oblique striations, resembles very much the sculpture of Solander's *Trochus apertus* from the Barton beds of Hampshire, a form, however, which is regarded as a separate species chiefly on account of the more central spire and the septum's attachment to the periphery. Only two examples of this shell were found in the Nigerian deposits, the larger one measuring 13 × 11 mm. possessing good spiral and sculpture characters, while the smaller illustrates the position of the internal diaphragm and umbilicus. The species appears to be restricted to the Lutetian portion of the Eocene series.

DISTRIBUTION.—Lutetian of Europe.

OCCURRENCE.—Cutting (No. not stated).

COLLECTOR.—Mr. Kitson.

Pelecypoda.

Family OSTREIDÆ.

Ostrea cf. marginidentata, S. V. Wood.

PLATE 6, Figs. 2-5.

Ostrea marginidentata.
S. V. Wood: Eocene Mollusca, England, Mon. Pal. Soc., 1861, pl. 5, fig. 2, p. 27.

REMARKS.—The largest of the specimens represented under this category, consists of an imperfect upper valve of an oyster possessing an elongate contour with an undulating surface, a crenulated margin, and exhibiting a length of 33 and an approximate height of 60 millimetres. The adductor scar marking is posterior, large and ovately lunate, while the crenulations are composed of numerous equi-distant short plications which are represented as well on the external margin, the remaining shell structure consisting of extremely fine concentric laminae of growth; the ligament region is not preserved in this particular specimen but is well seen in some much smaller

examples. These younger forms are numerously represented, the one of least dimensions being an upper valve with a length and height respectively of five and seven millimetres; it exhibits a finely crenulated margin. In the original account of this species, S. V. Wood overlooked an important element of sculpture in the upper valve, in connection with the presence of closely arranged radial costae, such as ornament the other valve, although considerably depressed and rendered much less obvious on account of the great prominence of the concentric laminae; this structure is well seen on Wood's figured specimen (Fig. 2a, of Pl. 5) which gives, however, only an internal view of the upper valve. It is difficult to accept Wood's species as synonomous with *O. extensa* of Deshayes[1] from the Upper Eocene (Bartonian) of France as recommended by M. Cossmann,[2] who assumes that the original figures of the interior of that species probably represented *O. gigantica* on account of the absence of crenulated margins. The smooth character of the margins of *O. extensa* was, however, well emphasised in the first description, as *marginibus integris*, and again referred to in the later work of Deshayes,[3] who regarded the species as distinct from *O. elegans* which possessed crenulations. The presence of radial ribs on the upper valve, now pointed out for the first time, will further support the contention that *O. marginidentata* is a perfectly good species and not to be amalgamated with *O. extensa*. The present specimens chiefly differ from the type in their narrower and more oblong contour.

DISTRIBUTION.—Eocene (Lutetian-Bracklesham Beds) England.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 15.

COLLECTORS.—Sir F. Lugard; Mr. Kitson.

Ostrea cf. ludensis (Deshayes).

PLATE 8, figs. 2, 3.

Ostrea ludensis.

Deshayes: Desc. Anim. Sans Vert. Coq. Foss. Paris, 1861–64, Vol. 2, pl. 85, figs. 1–4, p. 107.

REMARKS.—In the collection is an isolated upper valve of an *Ostrea* which appears to share the characters of this species. It possesses a smooth, minute, subacute, rounded prodissoconch, furnished with distant concentric

[1] Description des Coquilles Fossiles des Environs de Paris, 1832, Vol. 1, p. 358, pl. 56, figs. 1, 2.

[2] Catalogue Illustré des Coquilles Fossiles de l'Éocène des Environs de Paris: *Ann. Soc. R. Mal. Belgique*, 1887, Vol. 22, p. 194.

[3] Description des Animaux sans Vertebres, &c., 1861, Vol. 2, p. 117.

ridges (as seen microscopically), which are continued over the surface of the immediately surrounding region. The remaining sculpture consists of more or less equi-distant, compressed, concentrically laminate structure, crossed by numerous, close, microscopically fine, radial costae, which are irregular in their descent to the ventral margin. The valve is thin (probably a young form), rather longer than high, and is supplied with a narrowly oblong and horizontal ligament compressedly triangulate, and basally wide at the 'resilium' centre; there is present, also, a prominent semilunate adductor scar which is posteriorly attenuated or produced above, whilst the margins exhibit some obscure evidence of crenulations, especially on the anterior side. The valve shows a much less elongate contour than characterises the true *O. ludensis*.

DIMENSIONS.—

Length	25	millimetres.
Height	30	„

It would be premature to base the specific determination of an oyster on only one valve, although the type of sculpture referred to is so unusual among Ostreiform shells that if not *O. ludensis* it certainly belongs to a closely related species. Deshayes described this shell from the *Sables Moyens* of the Paris Basin, which belongs to the Bartonian Eocene.

DISTRIBUTION.—Eocene (Barton or Ludian Beds).

OCCURRENCE.—Cutting No. 1.

COLLECTOR.—Mr. Kitson.

Crassostrea lugardi, sp. nov.

PLATE 6, fig. 1; PLATE 7, fig. 1; PLATE 8, fig. 1.

DESCRIPTION.—*Shell* inequivalve, concavo-convex, oblong, thick, strong, tapering above, margins crenulate near hinge, with slightly curved and more or less parallel sides, height about twice the length. *Lower valve* interiorly excavated, undulating, furnished with an elongate, triangular, tripartite, frequently curved ligament region bearing equi-distant growth-lines with intermittent finer lines crossed by innumerable microscopical perpendicular striations; the 'canal' or central part of ligament area has a widened base and is much excavated, lateral platforms depresso-convex with outer margins composed of the closely arranged terminal laminations of shell structure;

adductor scar marking very large, rounded, ventral, covered with concentric growth-lines and finer interlineations and more or less obsolete radial striations; sculpture irregularly concentric, finely laminate, furnished with numerous slightly elevated, radial and obscure rounded costae, superficial layer of the adherent surface, consisting of delicate concentric laminae and close microscopically small radial plications; radial costae with colour markings sometimes preserved. *Upper valve* oblong, nearly horizontal above, large rounded cavity at each corner below ligament region; ligament area broad, projecting in front, marked with equi-distant concentric and longitudinal striations as in larger valve; external sculpture resembling that of other valve, *i.e.*, bearing obscure evidence of radial costae.

DIMENSIONS.—

Lower valve (largest example, with slightly imperfect ventral margin)	Length	90	millimetres.	
	Height	165	„	
	Depth	53	„	
Upper valve (another individual, with imperfect antero-lateral margin)	Length	70	„	
	Height	120	„	
	Depth	37	„	
Upper valve (probable) (of a much larger example, but imperfect)	Length	125	„	approximate.
	Height	240	„	
	Depth	40	„	

REMARKS.—This species belongs to the 'longirostriform' oysters—or those with a much produced ligament region, which are of frequent occurrence in Tertiary deposits and of much assistance in determining the stratigraphical value of the beds containing them. One of the oldest forms is *Ostrea angusta*, Deshayes, peculiar to the French Eocenes (Ypresian Sables de Cuise), although the more typical include: *O. longirostris*, Lamarck from the Oligocene (Stampian), *O. aginensis*, Tournouer (= *O. crispata*, Goldfuss *pars*) from the Miocene (Aquitanian), besides *O. gingensis*, Schlotheim and *O. gryphoides*, Schlotheim (= *O. crassissima*, Lamarck) of Miocene (Vindobonian) age, the latter species occurring, as well, in Recent seas [1]. The more elongate of these species is *O. gryphoides*, which sometimes attains a perpendicular measurement of 54 centimetres, including a ligament region of 23 centimetres, or about nine inches, and which was described and figured by Hoernes [2] from the Vindobonian beds of the Vienna Basin. The species from Southern

[1] R. B. Newton and E. A. Smith.—On the Survival of a Miocene Oyster in Recent Seas: Records Geol. Surv. India, 1912, Vol. 42, pp. 15, pls. 1–8.

[2] Abhandl. K.K. Geol. Reichs. 1870, Vol. 4, p. 455, pls. 81–84.

Nigeria, however, is considerably smaller than such giant forms, and appears to be more closely related to *O. aginensis*,[1] with which it agrees partially in size, shape and sculpture, as figured by Goldfuss[2] under the name of *O. crispata (pars)*, but differing in possessing a greater width of ligament region and in the ventral position of the much larger and rounder adductor scar marking, which is higher up and very posteriorly situated in *O. aginensis*. Moreover, if M. Cossmann and Peyrot's[3] interpretation is correct, the valves of *O. aginensis* are distinctly narrower, the height being nearly three times the length, and with no indication of radial costae on the upper valve. These very elongate oysters have been recognised by Dr. Sacco under his genus *Crassostrea*, founded on Gmelin's *Ostrea virginica* (Moll. Terz. Piemonte, &c., 1897. Vol. 23, p. 15).

Represented, also, in the collection, are the remains of a very large, presumably upper valve of this oyster, which have been united, thus exhibiting a fair proportion of the anterior side of the shell, including a massive, thick, and broad laminate margin, with parts of a nacreous, moderately shallow inner surface, which shows an upward curvature on the dorso-posterior side and therefore indicating the probable extent of the shell in that region. The ligament end and most of the posterior parts are wanting, whilst the shell-structure in the direction of the dorsal area is of immense thickness (nearly 35 mm.). The specimen is plano-convex, besides being much denuded of sculpture characters, although appearing to correspond with what is present on the smaller forms of this species—even some radial costae can be obscurely traced in places. It is interesting to note that De Lapparent[4] recognised a large oyster in the Lutetian beds of the African Soudan (Tamaske, between the Niger and the Tchad), resembling *O. longirostris* or *O. aginensis*, but gave no important details of structure. It is possible, however, that that form may represent the new species now described, although the evidence in that direction is at present incomplete. As a matter of fact, Prof. H. Douvillé[5] has recently described an oyster, *Crassostrea soudanensis*, of large

[1] Tournouer: Bull. Soc. Géol. France, 1881, Ser. 3, Vol. 8, p. 294.

[2] Goldfuss: Petrefacta Germaniae, 1833, Vol. 2, pl. 77, figs. 1e, 1f, p. 15; see also Raulin and Delbos: Bull. Soc. Géol. France, 1855, Ser. 2, Vol. 12, part 2, p. 1157.

[3] *Act. Soc. Linn. Bordeaux*, 1914, Vol. 68, pl. 21, figs. 5–8, p. 190.

[4] Sur de Nouvelles trouvailles géologiques au Soudan: *Compt. Rend.* 1904, Vol. 139, p. 1189.

[5] L'Eocene au Soudan et au Senegal: *Bull. Com. Étud. Hist. Sci. Afrique Occid. Française*, 1920. No. 2, p. 164, pl. 4, fig. 14.

size from the Eocene of Tamaske, which is probably similar to that referred to by De Lapparent, possessing a ligament area nearly 100 millimetres long, as well as a series of radial plications, the total height of the shell being about 240 millimetres.

COLLECTORS.—Sir F. Lugard, after whom the species is named; and Sir J. Eaglesome.

Family PLICATULIDÆ.

Plicatula polymorpha, Bellardi.

PLATE 6, figs. 6-9.

Ostrea symmetrica.

Bellardi: Bull. Soc. Géol. France, 1851, Ser. 2, Vol. 8, p. 261 (list name only, with no description or figure). (Egypt.)

Plicatula polymorpha.

Bellardi: Mem. R. Acad. Sci. Torino, 1854, Ser. 2, Vol. 15, pl. 3, figs. 8-10 (*non* fig. 11, = *P. bellardii*, Mayer-Eymar), pp. 197, 198. (Egypt.)

Terebratella pyramidarum.

O. Fraas: Württembergische Nat. Jahresh, 1867, Vol. 23, pl. 6, fig. 4, p. 280. (Egypt.)

Plicatula abundans.

Mayer-Eymar: Viertelj. Nat. Ges. Zürich, 1889, Vol. 34, p. 392. (Egypt.)

Plicatula bovensis.

De Gregorio: Ann. Geol. Pal. (Turin—Palermo), 1894, 13th Livr., pl. 4, figs. 81, 82, p. 24. (Italy.) Oppenheim—"Die Priabonaschichten und ihre Fauna"; Palaeontographica, 1901, Vol. 47, pp. 142, 143, pl. 5, figs. 1-5.

Plicatula pyramidarum.

Oppenheim: Zur Kenntnis alttertiärer Faunen in Agypten; Palaeontographica, 1903, Vol. 30, part 3, p. 59.

(*?*) *Plicatula? malembaensis.*

Em. Vincent: "La Faune Paléocene de Landana ; Ann. Mus. Congo Belge, 1913, Ser. 3, Vol. 1, p. 28, pl. 3, figs. 1-4.

REMARKS.—This species is characterised by both valves being in the possession of three or four swollen radial costae which widen considerably to the base, and which are divided by equally broad and prominent furrows. The shell structure consists of extremely fine, close, concentric laminae of growth which are crossed by numerous microscopically small radial costae, the latter being less apparent and almost absent in very worn examples. This radial sculpture is traceable over both valves, although it is more often seen in the furrows only, where erosion would be less likely to obliterate them. The presence or otherwise of radial ornamentation has created a rather long synonomy for this

species. Bellardi's first name, *O. symmetrica*, being without figure or description, is clearly not acceptable, but there is every reason for adopting the later *P. polymorpha* which Bellardi fully described and figured but with no reference to the radial markings, although his Figure 11, representing a shell with a greater number of ribs, has been separated by Mayer-Eymar as *P. bellardii*. Fraas next described the shell as *Terebratella pyramidarum*, and first detected the radial costae but wrongly ascribed them to Brachiopod sculpture. *P. polymorpha* was afterwards changed to *P. abundans* by Mayer-Eymar, because Bellardi's fig. 11 of his plate 3 represented another species (*P. bellardii*, Mayer-Eymar). In an amended diagnosis Mayer-Eymar recognised the radial striations entering into the sculpture of this shell. Again, De Gregorio's *P. bovensis* from the Italian Priabonian rocks has been proved by Dr. Oppenheim to be the same shell, the latter author, however, adopting the specific name of *pyramidarum* introduced by Fraas. As there is no rule of Zoological nomenclature preventing the use of Bellardi's *P. polymorpha*, there is every reason for adopting it on the present occasion, as it claims priority over all others. Another very probable synonym of the species is *Plicatula (?) malembaensis*, described and figured by M. E. Vincent from the Paleocene deposits of the Belgian Congo Territory of Africa, in which shell the same contours and structures are to be observed, including even the radial striations among its sculpture characters. Generally speaking, *P. polymorpha* need not be confused with any other species of the genus, especially those of the African Tertiary deposits. It is, however, strangely like in form to *P. marginata* of Say,[1] the type of which is in the Geological Department of the British Museum (No. L. 13199), and which came from the Chesapeake group of the Miocene as developed in Maryland, United States. This American species exhibits important differences such as a bifurcation on the posterior side of one of the costae, as well as possessing a series of minute elongate, equi-distant granulations on the inner margin of the left valve which fit into corresponding sockets of the opposing valve; there are also no radial striations, the shell being coarse and squamose. The African shell shows similar nodulations within the valve although coarser and larger, and there is no evidence of a bifid growth to any of the costae. The Nigerian

[1] An account of some of the Fossil Shells of Maryland: *Journ. Acad. Nat. Sci., Philadelphia* 1824, Vol. 4, part 1, p. 136, pl. 9, fig. 4, and R. B. Newton, "List of Thomas Say's Types of Maryland U.S.) Tertiary Mollusca in the British Museum," *Geol. Mag.*, 1902, pp. 303-305.

examples are in a good state of preservation, the radial striations being generally present on both valves or at any rate on the grooval surfaces between the costae.

DISTRIBUTION.—The Upper Mokattam beds of Egypt, and the Priabonian rocks of Italy.

OCCURRENCE.—Cuttings, Nos. 5 and 12.

COLLECTOR.—Mr. Kitson.

Family PINNIDÆ.

Pinna, sp.

REMARKS.—Some thin fragmentary layers of shell structure are the only relics available to indicate the presence of the genus *Pinna* in the Nigerian rocks. These are friable and very delicate although of interest from their markings which exhibit more or less regular, nearly equi-distant, longitudinal costae, together with obscure evidence of distant and obliquely concentric growth-lines; parts of the shell surface show also small irregularities of sculpture which assume a malleated appearance. Although it is difficult to restrict such ornamentation to any particular species without the study of complete specimens, there is a suggestion among these fragments that they may have belonged to an elongate-trigonal form resembling *P. margaritacea* of Lamarck[1] from the British and European Eocene (Barton and Bracklesham Beds), more especially as the longitudinal costae and the obliquely-curved striations agree with Searles Wood's[2] figure of that species as well as with some well-preserved examples from the Paris Basin. It is to be regretted that these remains should be somewhat inadequate for purposes of exact specific determination.

OCCURRENCE.—Cutting No. 10.

COLLECTOR.—Mr. Kitson.

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[1] Ann. Mus. Hist. Nat. (Paris), 1805, Vol. 6, p. 218; *ibid.*, 1807, Vol. 9, pl. 15, fig. 8.

[2] Mon. Pal. Soc., 1861, pl. 11, fig. 9, p. 56.

Family ARCIDÆ.

Fossularca africana, sp. nov.

PLATE 8, figs. 14-17.

DESCRIPTION.—Shell strong, small, subrhomboidal, trigoniform, ventricose, slightly inaequivalve, inaequilateral, length nearly 1½ times the altitude; anterior margin rounded, posterior region slightly excavated, abruptly truncated, deep, ventral border straight and produced to meet the posterior angle; ligament furrow short, narrow and tapering in front, widest and sagittate behind (*i.e.*, with closed valves), not chevroned, perpendicularly striated, succeeded by smooth terminations; without triangular fossette beneath the beaks; umbones anterior, incurved, moderately remote; sculpture unequal, composed of innumerable, elevated, rounded, radial costae of irregular strength crossed by microscopically fine, close, concentric lines, radial costae of left valve fewer being more distant and thicker anteriorly than those of the opposing valve; hinge line straight, short, slightly arched within, bearing about 40 closely arranged, continuous denticles, the central and smallest being vertical, the terminal divergent; inner margins crenulate.

DIMENSIONS.—

	Young.	Adult.	
Height	5 ...	12	millimetres.
Length	7½ ...	17	„
Diameter (closed valves)	4 ...	14	„

REMARKS.—The species here described approaches in general characters *Arca lactea*, Linnaeus, from the Atlantic, which represents the type of Cossmann's *Galactella*;[1] it differs, however, in its more ventricose umbonal region, in its stronger and more abrupt carination, the wider and more acuminate postero-ventral end, its unequal valves, pairs of which show a difference in their individual ornamentation, the left being rather longer than the right and possessing slightly fewer radial costae. Some small European Arciform shells of Eocene age have been referred by Cossmann to his genus *Fossularca*,[2] the type of which is *Arca quadrilatera* of Deshayes, from the Lutetian beds of the Paris Basin, which is characterised by the presence of

[1] Act. Soc. Linn. Bordeaux, 1912, Vol. 66, p. 312.

[2] Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, p. 138.

a minute triangular fossette under the beaks, besides possessing a larger trellised ornamentation on the left valve than on the right. These Eocene forms, however, differ from the present shell in their more oblong contours, much smaller dimensions, and being furnished with the central fossette. There is another Eocene shell that has been distinguished by M. Cossmann as *Scapularca*,[1] the type of which is *Arca scapulina*, Lamarck, which presents similar ligamental features to the Nigerian shell, but it differs in being much more inaequilateral, in its modioliform shape, and smaller size. With such distinctions to consider, it is difficult to accurately place the Nigerian shell, although as its general conformation and ligament features resemble *Fossularca* and, in part, the two sections of *Galactella* and *Scapularca*, it is proposed that it be recognised under the first-named genus which was established many years before the others. It should be also mentioned that the ligament region of this shell is similar in structure to that of *Anadara nigeriensis* described in this paper. The shell is of abundant occurrence in the Nigerian deposits, while its valves are frequently perforated, as in *Striarca africana*, and chiefly in the umbonal region where certain organisms have probably attacked it for the extraction of the soft parts of the mollusc.

Occurrence.—Cuttings Nos. 1, 2, 5, 6, 10, 11, 12, 13, 14, 15.

Collector.—Mr. Kitson.

Striarca africana, sp. nov.

Plate 8, figs. 11–13.

Description.—Shell thin, subcylindrical, without mesial depression, slightly inequivalve, subequilateral, length twice the height; dorsal and ventral margins parallel, anterior rounded, posterior truncated, widely and obtusely carinated; ligament region entirely covered by the lozenge being narrowly lanceolate, horizontally lineate and perpendicularly striated; surface sculpture similar in both valves, microscopically reticulate, consisting of closely set, strong, concentric costae, crossed by innumerable minutely granulated radial striations of which the more prominent are equi-distant, inner margins smooth; umbones prosogyrous, acute, incurved, moderately distant; hinge line horizontal,

[1] Act. Soc. Linn. Bordeaux, 1912, Vol. 66, p. 312.

furnished with about fifty minute slightly divergent denticles, terminal largest and most oblique, obsolete beneath the umbo, rather fewer anteriorly than posteriorly ; inner margin smooth.

DIMENSIONS.—

	Small form.	Adult form.	
Height	4 ...	10	millimetres.
Length	8 ...	20	,,
Diameter (united valves) ...	4 ...	8	,,

REMARKS.—The chief features of this shell concern its more or less cylindrical contour, the nearly central umbones, and the occupation by the striated ligament lozenge of the entire ligament furrow, the latter character having been referred to by Dr. Dall[1] as typifying Conrad's *Striarca* of the United States Miocene, under which this new species is here recognised ; being therefore distinguishable from *Fossularca*, which ranges from Eocene to recent times, that shell having a shorter ligament lozenge with a bare space at both ends of the ligament cavity. This form apparently exhibits little relationship to any of the Arciform species from the European Tertiaries which, generally speaking, possess much more inaequilateral valves, besides being relatively wider. The species is quite well represented, although the examples are not numerous. The valves are observed to be frequently perforated at the umbonal arch, suggestive of an attack by a *Serpula* or other organism in an attempt to reach the soft parts of the mollusc for purposes of food.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 12, 14.

COLLECTOR.—Mr. Kitson.

Anadara nigeriensis, sp. nov.

PLATE 8, figs. 4–7.

DESCRIPTION.—Shell subquadrate, posteriorly oblique, convex, equivalve, inaequilateral, length about one-tenth in excess of the altitude ; anterior margin rounded, posterior region obtusely carinated, abruptly deep, oblique, ventral border slightly curved ; ligament furrow narrowly lanceolate, chiefly anterior, shorter, broader and more saggitate posteriorly, perpendicularly striated, not chevroned ; umbones anterior, incurved, moderately distant ;

[1] Trans. Wagner Free Inst. Sci. Philadelphia, 1898, Vol. 3, part 4, p. 615.

sculpture exhibiting thirty distant radial costae and equal furrows, costal summits more or less depressed, especially ventro-laterally, covered with close concentric striations which are thick in the earlier growth of the shell but which afterwards become thinner, closer and distinctly scalloped, the postero-umbonal grooves frequently furnished with delicate radial striae composed of minute elongate tubercles ; hinge line straight or slightly arched bearing about forty-five denticles nearly equally divided on each side ; denticles small and verticle in the centre, laterally divergent, sometimes bent at the middle, very coarse in aged specimens and often grooved or bifurcated above, especially posteriorly ; adductor scars well defined, posterior the largest, subquadrate ; margins closed and dentated.

DIMENSIONS.—

	Young.	Adult.	
Length	12½ ...	42	millimetres.
Height	10 ...	35	„
Diameter (closed valves) ...	8½ ...	32	„

REMARKS.—This shell is associated with Gray's [1] genus *Anadara*, the type of which is *Arca antiquata* of Linnaeus of existing seas, on account of its squarish contour, the possession of equi-sized valves, and the general details of sculpture. Similarly, it also resembles *Scapharca* of Gray [1] founded on Bruguière's *Arca inaequivalvis*, a recent species although clearly distinguishable, from the fact that the valves of the latter are of unequal dimensions. The features of the ligament furrow, however, connect the Nigerian shell more closely with Cossmann's *Fossularca* [2] and its sections *Galactella* and *Scapularca*, rather than with *Anadara*, because of its perpendicularly striated surface and the total absence of chevrons, the latter being nearly always present on both *Anadara* and *Scapharca*. In general appearance this type of shell belongs to Miocene and Recent seas rather than to an older period of time, although small forms of *Anadara* have been recognised by Cossmann in Eocene rocks. The valves vary much in size and are abundantly represented in the collection.

OCCURRENCE.—Cutting Nos. 1, 2, 5, 6, 10, 11, 12, 13, 15.

COLLECTOR.—Mr. Kitson.

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[1] Proc. Zool. Soc. 1847, p. 198

[2] Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, p. 138, and Act. Soc. Linn, Bordeaux, 1912, Vol. 66, p. 312.

Family GLYCYMERIDÆ.

Glycymeris nigeriensis, sp. nov

PLATE 8, figs. 8–10.

DESCRIPTION.—Shell elongately quadrangular, length one-fifth more than the height, inaequilateral, compresso-convex, margins dentated, both sides obliquely truncated, posterior shortest with postero-ventral angulation; ligament region about half the length of shell, narrow, without divergent grooves, vertically and equally costated; hinge line horizontal, not arched, half the length of shell, with a terminal curvature bearing about twenty-five denticles on each side, which are small and nearly obsolete in the centre; adductor scars unequal, anterior largest and most oval; outer surface with numerous equal, radial costae minutely annulated by the close concentric striations covering the valves.

DIMENSIONS.—

	Young.	Adult.	
Height	10 ...	16	millimetres.
Length	13 ...	20	,,
Diameter (closed valves)	6 ...	12	,,

REMARKS.—In general contour and appearance this form resembles *Pectunculus decussatus* of J. Sowerby,[1] from the Lower Eocene (London Clay) of Highgate. There are, however, some important differences. The Nigerian shell is more elongate; its ligament region is linear, not triangular; the hinge line is horizontal, not arched; the radial costae are less numerous, without intermediate riblets, delicately annulated by the close concentric striations which cover the valve, but not nodulated; margins dentated, not smooth. Such distinctions are deemed of sufficient importance to separate this shell from the British form.

OCCURRENCE.—Cuttings Nos. 5, 6, 10, 11, 12, 13, 15.

COLLECTOR.—Mr. Kitson.

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[1] Mineral Conchology, 1813, Vol. 1, pl. 27, fig. 1, p. 71.

Family NUCULIDÆ.

Nucula costæimbricatis, sp. nov.

PLATE 6, figs. 10, 11.

DESCRIPTION.—Shell ovately sub-trigonal, small, rather tumid, very inaequilateral, sharply truncated posteriorly; lunule well defined, cordate, extending to angulation, confluent with ventral margin; escutcheon well developed, terminating at ventral angle; denticles strong, slightly angulate and oblique, parallel, about twenty in front and eight behind, enlarging from the umbonal region on the anterior side where they are of minute size; internal surface nacreous, margins finely crenulated; sculpture consisting of numerous, equal, sometimes irregular, narrow, closely arranged, imbricating concentric bands crossed by extremely fine, innumerable, radial striations; umbones rather compressed.

DIMENSIONS.—

Height	5	millimetres.
Length	7	„
Diameter (closed valves)	4	„

REMARKS.—This small shell is chiefly distinguished by its sculpture, the narrowly-banded imbricating costae forming a somewhat rare ornamentation in the surface structure of *Nucula*, which is more often smooth or furnished with only concentric lineations. Similarly composed costae are, however, observable in *N. sulcata* of A. Adams[1] from New Zealand seas, although that species differs in having a rounded posterior margin, a smaller and less defined lunule, fuller umbones, and is besides of larger dimensions. In contour it may be compared with some older Tertiary species such as *N. lunulata* of Nyst[2] from the Belgian Lutetian desposits (Laekenian), which also possesses a large lunule, a lengthy escutcheon, and a similar postero-ventral angulation; the denticles are, however, more angulate and more numerous, while there is not the same banded character in the structure of the costae which is so prominent a feature of the Nigerian shell. The species is represented by two specimens, one with both valves in the closed condition, and a single valve exhibiting internal characters.

OCCURRENCE.—Cutting No. 1.

COLLECTOR.—Mr. Kitson.

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[1] Proc. Zool. Soc. London, 1856, p. 53.

[2] Desc. Coq. Terr. Tert. Belgique: *Mém. Cour.* 1843-1845, Vol. 17, pl. 7, fig. 4, p. 231.

Family CARDIIDÆ.

Cardium cf. obliquum, Lamarck.

PLATE 7, figs. 6-9.

Cardium obliquum.

Lamarck: Ann. Mus. Nat. Hist. (Paris), 1805, Vol. 6, p. 344, and 1807, Vol. 9, pl. 18 (20), fig. 1; Deshayes: Desc. Coq. Foss. Paris, 1829, Vol. 1, pl. 30, figs. 7, 8, 11, 12, p. 171; *ibid.*, Suppl. 1858, Vol. 1, p. 568.

Cardium (*Loxocardium*) *obliquum.*

Cossmann: Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 173.

Cardium obliquum.

R. B. Newton: Syst. List, British Eocene Mollusca (Edward's Coll.), &c., 1891, p. 52.

Cardium (*Loxocardium*) *obliquum.*

Oppenheim: Palaeontographica, 1903, Vol. 30, part 3, p. 156.

REMARKS.—In general appearance, a number of small valves show a relationship to this species having a well rounded anterior margin and a steep posterior declivity. Some differences may be noted in the sculpture, such as the fewer and consequently rather more distant costae, which moreover do not possess the minute, triangular scale-like tubercles so often possessed by well preserved examples of the European species and which was the chief character of M. Cossmann's[1] section, *Loxocardium*. In the present specimens, however, this scaly feature is absent, only some small granulations being observable on the anterior costae, otherwise they are smooth, with the exception of bearing closely-set transverse striations which are also, but more strongly, developed in the furrows where they would be less subjected to erosive agencies. Like the European species, the Nigerian valves are furnished with costae having flattened summits, while both forms are similarly striated as described. The larger sized valves have a height and length respectively of 13 × 15 millimetres, whereas those from Europe measure 26 × 28, as stated by Deshayes. The species has been recognised by Dr. Oppenheim, from the Mokattam Beds of Egypt, while M. Cossmann regards it as extending throughout the Eocene Series of Europe (Anglo-Parisian Basin); it may therefore be restricted to Eocene times, although it is worthy of comment that specimens are in the Edwards Collection of the British Museum from the Roydon Beds of Hampshire, which belong to the Headon Hill Series,

[1] Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 172.

such deposits having been variously assigned to the topmost Bartonian, although more commonly placed in the Lower Oligocene (Tongrian).

DISTRIBUTION.—British : Oligocene (Headon Beds), Upper Eocene (Bartonian). Europe : Eocene (throughout). Egypt : Mokattam Beds (Eocene).

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 15.

COLLECTOR.—Mr. Kitson.

Family LUCINIDÆ.

Phacoides eaglesomei, sp. nov.

PLATE 8, figs. 18-20.

DESCRIPTION.—Shell thin, subquadrangular, compresso-convex, inaequilateral ; anterior side short, dorsally horizontal, in the centre bluntly acuminate, excavated, inner margin obliquely carinated, posterior side longest, obliquely curved ; lunule small, narrow, well impressed ; escutcheon depresso-concave, wide, obscurely angulated within, and at the centre ; ligament groove narrowly linear, elongate ; surface covered with distant concentric more or less serrated lamellae, intervening grooves finely and concentrically striated and crossed by innumerable microscopical radial striations, lateral margins squamate ; umbones prosogyrous, compressed, acute ; hinge plate moderately wide, depressed, with a cardinal tooth, in each valve, an elongate, compressed, erect lateral on each side of the right valve, posterior lateral distant, with corresponding sockets in the left valve ; adductor scars elongate, anterior much produced, narrow, with sometimes serrated margins, close to and nearly parallel with the pallial line ; surface within pallial line roughened, irregular, punctated, beyond the pallial line to outer margin the surface is radially costated, especially in older or thicker specimens.

DIMENSIONS.—

	Young.	Adult.
Height	11 ...	25 millimetres.
Length	14 ...	28 „
Diameter (closed valves)...	4 ...	8·5 „

REMARKS.—This shell is of frequent occurence in the Nigerian deposits and although the valves are generally in a good state of preservation, they

have undoubtedly been subjected to different phases of erosion which has considerably diminished certain details of sculpture, such as the marginal serrations of the concentric laminae and the squamose growths of the dorso lateral borders. It is probably one of the flattest forms of the genus yet described, in which respect it comes nearest to the recent species from the Red Sea, *Lucina dentifera*, Jonas[1] but differing from it in possessing more remote concentric lamellae in its more compressed valves and being furnished with only one cardinal tooth instead of two. Among fossil forms, from the European Mio-Pliocene strata *Lucina orbicularis*, Deshayes[2] shows some general affinities although having more convex valves and less remote concentric laminae of growth. The same widely distant laminate sculpture and flattened valves characterise *Lucina callipteryx* of Tournouer[3] from the French Miocene (Burdigalian), although that species exhibits no squamate extensions on the dorso-lateral margins, no serrated margins to the lamellae, nor is the presence of minute radial striations covering the valves referred to in the original description. Among Eocene forms of this genus, which are mostly furnished with numerous concentric striations and more convex valves, there is *Lucina squamula* of Deshayes[4] which bears rather distant lamellae, though they are not dentated, nor are there any spines issuing from the dorso-lateral margins. Again, M. Cossmann's *Lucina bouryi*[5] from the French Eocene shows squamose projections on the dorso-lateral margins, but in other respects is easily distinguishable from the Nigerian shell. Reference may also be made to *Lucina camerunensis* of Oppenheim[6] from the older Tertiary deposits of Camerun, West Coast of Africa, which is related to our species as also to *L. jamaicensis* of Recent seas, although chiefly differing in its much smaller size, rather closer concentric sculpture and the absence of an antero-lateral angulation. Everything points to the fact that the new form here described presents features connecting it rather with Miocene and Recent species than with those described from Eocene Seas. This shell is included in De Blainville's[7] *Phacoides* of which the type is *Lucina jamaicensis*, Lamarck

[1] R. A. Philippi : Abbildungen Conchylien, 1847, Vol. 2, pl. 1, fig. 4, pp. 206, 207.
[2] Expédition de Morée, 1833, Vol. 3, part 1, pl. 22, figs. 6-8, pp. 95, 96.
[3] *Journ. Conchyl.*, 1874, Vol. 22, pl. 10, fig. 4, p. 306.
[4] Desc. Coq. Foss., Paris, 1825, Vol. 1, pl. 17, figs. 17, 18, p. 105.
[5] Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, pl. 2, figs. 13, 14, p. 38.
[6] Beitrage Geol. Kamerun (E. Esch.), 1904, pl. 6, figs. 10-14, pp. 260, 261.
[7] Manuel de Malacologie, 1825, Vol. 1, p. 550.

from the North Atlantic. The species is named after Sir John Eaglesome, one of the collectors and donors of these Nigerian fossils now in the British Museum.

Occurrence.—Cuttings Nos. 2, 5, 6, 10, 11, 12, 15.

Collector.—Mr. Kitson.

Phacoides subrhomboidalis, sp. nov.

Plate 7, figs. 4, 5.

Description.—Shell subrhomboidal, inaequilateral, plano-convex, length in excess of height, anterior side smallest; dorsal margins sloping posteriorly, short and horizontal in front, dorsal-lateral areas compressed, slightly flexuous, obtusely angulate; ligament furrow deep, elongate, narrow; lunule forming a narrow sulcation to the dorso-lateral obtuse angle; lateral borders more or less vertical, notched in the centre, ventral margins elongately curved, nearly horizontal; valves covered with closely-set elongate, concentric lamellar striations with a few distant radial grooves on the dorsal areas.

Dimensions.—

Height	37	millimetres.
Length	45	„
Diameter (closed valves)	17	„

Remarks.—Unfortunately this species is represented by only one specimen which has closed valves so that internal characters are not observable. The fossil is, however, in good preservation and may undoubtedly be referred to De Blainville's *Phacoides* (type = *Lucina jamaicensis*, Lamarck, North Atlantic), which includes those Luciniform shells having a more or less lentiform shape, strong dorsal areas, and a generally concentric sculpture. The relations of the present shell are closest to Bellardi's *Lucina pharaonis*[1] from the Eocene of Egypt, which according to Oppenheim[2] embraces *L. bialata* and *L. aegyptiaca* both of Bellardi, and both, also, from the Egyptian Eocene deposits. There are, however, certain distinctions which tend to separate the new shell from the Egyptian form. The Nigerian specimen has considerably

[1] Mem. R. Accad. Sci. (Torino), 1854, Ser. 2, Vol. 15, pl. 2, fig. 12, pp. 190, 191.

[2] Paleontographica, 1903, Vol. 30, part 3, pl. 13, figs. 1, 2, pl. 15, fig. 6, pp. 124-128.

more compressed valves, smaller and rather depressed umbones instead of being swollen; it has besides a straighter ventral border, more vertical sides, and a nearly rhomboidal contour which is a marked feature of the shell. Again, the notched character at the base of the dorsal areas appears to be obsolete in the Egyptian species, that form presenting an almost even outline. Either under *Phacoides* or Fischer's[1] *Dentilucina*, which is its synonym as first pointed out by Dr. Dall,[2] several species of this genus have been recognised by M. Cossmann[3] from the Eocene and Miocene rocks of France, as also by Dr. Sacco[4] from the Oligocene and later Tertiaries of Italy; many species have also been reported from the United States and West Indian Tertiaries by Dall,[5] but these are all of much rounder contour and very often possessing deeper and more bombiform valves. The Nigerian shell differs, also, from *Phacoides eaglesomei* found in the same deposits, on account of its less compressed valves being of different contour, and the strong differences existing in connection with the sculpture characters.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Divaricella oppenheimi, sp. nov.

PLATE 7, figs. 2, 3.

DESCRIPTION.—Shell (left valves) small, sub-globose, robust, equilateral, convex, postero-dorsal margin obliquely curved, antero-dorsal truncated, lateral and ventral hemi-spherical; ligament cavity narrowly elongate; lunule small, wide, well excavated; umbones median, small, obtuse; hinge line arched posteriorly and obliquely curved anteriorly, strong, with two short, divergent cardinal teeth, anterior thickest, separated by a small triangular socket to receive the single tooth of the other valve, a prominent socket on each side for the reception of the lateral teeth of the opposing valve, posterior furthest from the umbo; anterior adductor scar narrowly lingulate, obliquely directed down-

[1] Manuel de Conchyliologie, 1887, p. 1143.

[2] Proc. United States Nat. Mus., 1901, Vol. 23, p. 805.

[3] Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, p. 36; Inconog. Coq. Foss. Éocène Paris, 1904, Vol. 1, Fasc. 2, pls. 23-26; Act. Soc. Linn. Bordeaux, 1911, Vol 65, pp. 304, 309-327.

[4] Molluschi Terz. Piemonte, 1901, Vol. 29, pp. 78-89.

[5] Trans. Wagner Free Inst. Sci., Philadelphia, 1903, Vol. 3, pp. 1359-1385.

wards and diverging from the pallial line ; sculpture at first concentric, then divaricate, consisting of numerous, strong, divergent, erect, equi-distant costae, costal apices commencing from just below the umbonal region, and continuing to the ventral margin, surface of valve closely, concentrically and radially striated, the latter more or less obsolete ; the angulations of the costae become thicker, depressed, less prominent, and more or less imbricating with age ; the growth periods are well marked and nearly equi-distant ; margins serrated.

DIMENSIONS.—

	Small example.	Larger example
Height	8 ...	10
Length	8 ...	10
Diameter (valves closed)	8 ...	10

REMARKS.—There are only two left valves in the collection to represent this form, which fortunately exhibit well-defined characters. It is distinguished by having thick and very sub-globose valves, an irregular and more or less arched hinge line, a small, wide, and deeply impressed lunule, while the earlier angulate costae are erect and not imbricating, such distinctions separating this shell from other species either recent or fossil. Most species appear to have depressed imbricating costae throughout the valve, whereas the Nigerian shell in its earlier stages has at first fine concentric striations, then a series of erect, angulate costae separated by well-marked furrows, which as age advances become more depressed and assume the imbricating character. A general feature also, for most species is the nearly straight hinge line, which in the present form curves upwards from the posterior margin into a small arch, then descends in a slight curvature anteriorly beneath the lunular cavity. Perhaps among all the known species of this genus, our shell shows closest affinity to *Lucina (Strigilla) rigaultiana,* Deshayes,[1] from the " Sables Moyens " of France, which belongs to the Bartonian stage of the Eocene series, although according to M. Cossmann [2] it flourished throughout Eocene times. That, however, has slightly more equilateral, more spreading and less convex valves, the hinge line is much more delicate, quite narrow and nearly horizontal, whilst the angulate costae are continuous from the summits of the shell, whereas the earliest sculpture of the Nigerian valves consists of fine concentric striations. A few Egyptian Eocene

[1] Suppl. Desc. Coq. Foss. Paris, 1858, Vol. 1, pl. 47, figs. 28-30, p. 661.
[2] Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, p. 43.

forms have been described by Dr. Oppenheim,[1] but those also differ in their nearly circular contour and less acutely angled costae. The genus *Divaricella* of E. von Martens,[2] under which the new Luciniform shell is included, has existed from older Tertiary times to the present day, although its origin may apparently be traced from Stoliczka's,[3] *Lucina (Cyclas) taeniolata*, an extremely rare form, found in the later Cretaceous deposits (Ariyalur Group) of India, known as the Ninnyoor limestones of the Trichinopoly District, which chiefly on account of the absence of Ammonites are regarded as of transitional age between the Cretaceous and Tertiary epochs. The living species are chiefly Atlantic. The specific name is in honour of Dr. Paul Oppenheim, a well known authority on African Tertiary Mollusca, especially in connection with faunas from Egypt, Togoland, and the Cameroons.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Family CARDITIDÆ.

Cardita cf. planicosta (Lamarck).

Venericardia planicosta.

Lamarck : Ann. Mus. Hist. Nat. (Paris), 1806, Vol. 7, p. 55 ; *ibid.*, 1807, Vol. 9, pl. 19 (31), fig. 10 ; J. Sowerby : Mineral Conchology, 1814, Vol. 1, pl. 50, p. 107 ; Deshayes : Desc. Coq. Foss. Paris, 1825, Vol. 1, pl. 24, figs. 1-3, p. 149 ; Conrad : Journ. Acad. Nat. Sci. Philadelphia, 1830, Vol. 6, pp. 213-215.

Cardita planicosta.

J. de C. Sowerby : Dixon's "Sussex," 1850, pl. 2, figs. 14, 18, p. 169 ; Deshayes : Suppl. Desc. Coq. Foss. Paris, 1860, Vol. 1, p. 756 ; S. V. Wood : Mon. Pal. Soc., 1871, pl. 21, fig. 5, p. 150.

Venericardia planicosta.

Cossmann : Ann. Soc. R. Mal. Belgique, 1887, Vol. 22, p. 86.

Cardita planicosta.

R. B. Newton : Syst. List, British Eocene Mollusca, &c., 1891, p. 39.

Venericardia planicosta.

C. J. Maury : Paleontology of Trinidad-Journ. Acad. Nat. Sci. Philadelphia, 1912, Vol. 15, 2nd Ser., pl. 8, figs 15, 16, p. 51.

REMARKS.—A single specimen of small size representing a right valve, appears to show relationship to this species. The radial costae, numbering about 25, are of similar squarish design, and with depressed summits, their width

[1] Palaeontographica, 1903, Vol. 30, part 3, pl. 15., figs. 10-13, pp. 146, 147.

[2] Beitr. Meerest. Mauritius Seychellen-Mollusken (Möbius & Richter), 1880, pl. 22, fig. 14, p. 321.

[3] The Pelecypoda : Mem. Geol. Surv. India, *Palaeontologia Indica*, 1871, pl. 13, fig. 9, p. 257.

being equal to that of the divisional furrows, except immediately below the lunuloid area, where they become almost contiguous. Numerous close and rather coarse concentric striations cover the whole surface, the costae being thus furnished with annulations, especially on the anterior and ventral regions, where they are strongest. This ringed appearance of the costae is not so apparent in the true *C. planicosta* because the concentric striae are somewhat finer, moreover the radial ribs of that species are more numerous than in the present shell.

DIMENSIONS.—

Height	13 millimetres.
Length	15 „
Diameter (of single valve)	5 „

The valve is moderately convex and of rhomboidal contour, while the hinge, which is small and narrow, contains a prominent triangular cardinal tooth with a socket on each side for the reception of the teeth in the opposing valve; the crenulations of the inner margins are well displayed. It appears to be a young example, but until further evidence is available its true determination must remain in abeyance. Dr. Carlotta Maury has identified *C. planicosta* in the Antillian Eocene of Trinidad.

DISTRIBUTION.—Eocene of Britain, Europe, N. America and Trinidad.

OCCURRENCE.—Cutting No. 10.

COLLECTOR.—Mr. Kitson.

Cardita costæirregularis, sp. nov.

PLATE 9, figs. 30, 31.

DESCRIPTION.—Shell strong, sub-triangular, closed, inequilateral, depresso-convex, length about 1/5th in excess of altitude; anterior region short, oblique, depressed with small lunule, posterior end produced, depressed, bearing a short and narrow ligament furrow; cardinal area small, dentition as in *C. costae-nodulosis*; sculpture exhibiting from 10-12 contiguous radial costae at each end, much depressed posteriorly, but anteriorly broad and well rounded, sides of the valves with two isolated, radial and rounded ribs divided by unequally wide furrows, surface of valves strongly and concentrically striated throughout, ventral margin widely plicated, anterior and posterior margins closely pectinated; internal surface radially swollen and furrowed.

DIMENSIONS.—

Height	13 millimetres.
Length	18 „
Diameter (closed valves)	14 „

REMARKS.—The sculpture of this species is its chief distinguishing feature, the lateral face of the valves possessing two widely divergent costae, of which the anterior is largest, bordered by unequally wide furrows, whereas the terminal regions bear a crowded series of costae, all touching, the anterior preserving a well rounded character, while those in rear are considerably flattened. These are details unknown to me among described forms of *Cardita* from either Tertiary or recent seas, and hence the present shell is described as a new species. It must also be comparatively rare, as very few valves have been found in the collection.

OCCURRENCE.—Cuttings Nos. 5, 6, 11, 12.

COLLECTOR.—Mr. Kitson.

Cardita costænodulosis, sp. nov.

PLATE 9, figs. 22-25.

DESCRIPTION.—Shell strong, trigono-cuneiform, closed, inaequilateral, moderately ventricose, length rather more than a quarter the altitude; anterior region short, excavated, with smooth, small, cordiform lunule surrounded by finely nodulated costae; posterior end oblique, produced, depresso-convex, elongately and smoothly ribbed, ligament furrow narrow and short; umbones anterior, approximate; cardinal area with a thick, central triangular tooth in right valve bordered by an oblique cavity on each side to receive two strong divergent teeth of the opposite valve of which the anterior is shortest and thickest; sculpture consisting of 20 elevated, equi-distant, radial costae, alternating at margin with those of the other valve, minutely and closely nodulated at the summits, nodulations absent posteriorly, costae divided by well excavated, broad and concentrically striated furrows; adductor scars unequal; margins thick and widely pectinate within.

DIMENSIONS.—

	Young.	Adult.
Height	4 ...	14 millimetres.
Length	5 ...	20 „
Diameter (closed valves)	4 ...	12 „

REMARKS.—This shell is characterised by its cuneiform contour, its equi-distant, elevated and thin radial costae which anteriorly have their summits ornamented with minute, closely set nodulations, the costae being simple and never showing a divided structure. At first sight this mollusc appears to resemble *Cardita aegyptiaca* (Fraas)[1] from the Lower Eocene (Libyan Beds) of Egypt, as well as *C. fayumensis* and *C. mokattamensis*, both of Oppenheim[2] from the Middle Eocene (Lutetian) of the same country. From the first it differs in its more cuneiform contour, the possession of a longer and more oblique posterior margin a slightly larger number of radial costae which are simple and of non tripartite structure. It agrees more closely in contour with the second and third species mentioned, both of which, however, are characterised by their possession of more or less tripartite costae. A resemblance in contour is also noticeable with two limestone casts described by J. Chautard[3] from the Middle Eocene (Lutetian) of Senegal determined as *C. sererina* and *C. baoli*, n. spp., although the latter is sufficiently distinct on account of its fewer ribs and being much more inequilateral. I am not familiar with this type of *Cardita* from European or Indian deposits and it may perhaps be restricted to African localities. This shell is abundantly represented in the collection.

OCCURRENCE.—Cuttings Nos. 1, 2, 5, 6, 10, 11, 12, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Cardita triparticostata, sp. nov.

PLATE 9, figs. 26–29.

DESCRIPTION.—Shell strong, trigono-cuneiform, inaequilateral, ventricose, length about a quarter in excess of the height, feebly gaping postero-ventrally; anterior region short, depresso-inflated, with a small smooth cordate lunule surrounded by nodulated costae, posterior end oblique, depressed, lanceolate, smoothly and closely costated, bearing a short and narrow ligament groove; umbones anterior, approximate; cardinal elements as in *C. costænodulosis*; sculpture consisting of about 26 broad, radial, tripartite costae, central ray

[1] Aus dem Orient: Württembergis, Nat. Jahres, 1867, Vol. 23, pl. 3, fig. 6, p. 286.

[2] Palaeontographica, 1903, Vol. 30, part 3, pl. 8, figs. 7–11, 13–18, 22–27, pp. 102–105.

[3] Bull. Soc. Géol., France, 1905, Ser. 4, Vol. 5, pl. 5, figs. 4, 5, p. 149.

being elevated, rounded, nodulated above, and bordered by a smooth, rounded ray on each side; costae divided by narrow interstices, and alternating at margin with those of the other valve; surface of valves furnished with close, concentric, and fine striations; margins thick, with tripartite serrations, and pectinate within.

DIMENSIONS.—

	Adult.
Height	11 millimetres.
Length	15 „
Diameter (closed valves)	8 „

REMARKS.—In a general way this shell is related to *C. costænodulosis*, although differing widely from that form in the possession of tripartite costae and a small byssal aperture. The nodulose or central part of the ribs is elevated and equidistantly separated from each other by a wide furrow, in the floor of which runs a thin interstitial groove; each side of the nodulated section and on a lower plane, is furnished with a smooth, rounded rib. This tripartite structure of the costae is quite well known among Eocene forms of *Cardita*, such as *C. carinata* (J. Sowerby)[1] from British Lutetian deposits, *C. acuticosta* (Lamarck)[2] from similar beds of Europe and Egypt, as also *C. viquesneli*,[3] Archiac and Haime (which includes Cossmann's *Venericardia tripartita*)[4] from beds of the same age occurring in India and Egypt, all of which species, however, differ from the present shell in contour being either rhombic or rounded as distinct from a trigoniform outline, besides possessing more slenderly constructed costae. Forms of *Cardita* bearing trigonoid shapes and furnished as well with tripartite costae are of frequent occurrence in the Egyptian Eocene, being represented particularly by *C. mokattamensis* and *C. fajumensis* described by Oppenheim,[5] which have similarly wide costae although more divided in structure and lacking generally the nodulose ornamentation. This species is apparently of rare occurrence only six specimens having been obtained.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

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[1] Mineral Conchology, 1820, Vol. 3, pl. 259, fig. 2, p. 106.
[2] Ann. Mus. Hist. Nat. (Paris), 1806, Vol. 7, p. 57, *ibid.*, 1807, Vol. 9, pl. 32, figs. 2.
[3] Desc. Anim. Foss. Nummulit. l'Inde, 1854, part 2, pl. 21, fig. 7, p. 255.
[4] Bull. Inst. Egyptien, 1901, Ser. 4, No. 1, p. 193. Separate copy with pl. 3, figs. 9, 10.
[5] Palaeontographica, 1903, Vol. 30, part 3, pl. 8, figs. 7–11, 22–27, pp. 103, 105.

Family VENERIDÆ.

Cordiopsis incrassata (J. Sowerby).

PLATE 9, figs. 15–17.

Venus Meröe.
Solander: Brander's "Fossilia Hantoniensia," 1766, pl. 8, figs. 104, 105, p. 41, *non* Linnaeus.

Venus (*Cytherea*) *incrassata.*
J. Sowerby: Mineral Conchology, 1817, Vol. 2, pl. 155, figs. 1, 2, p. 126, *non V. incrassata* Brocchi, 1814.

Cytherea incrassata.
Deshayes: Descr. Coq. Foss, Paris, 1825, Vol. 1, pl. 22, figs. 1–3, p. 136.

Venus incrassata.
Nyst: Mém. Cour. Acad., Belgique, 1845, Vol. 17, pp. 181, 640 (Belgium).

Cytherea incrassata.
Deshayes: Suppl. Descr. Coq. Foss., Paris, 1858, Vol. 1, p. 454.

Meretrix incrassata and bartonensis.
Edwards (Ms.): R. B. Newton's Syst. List F. E. Edwards Coll. British Oligocene and Eocene Moll. British Mus., 1891, pp. 63, 64.

Cytherea incrassata.
Koenen: Abhandl, geol. specialkarte Preussen, 1894, Vol. 10, part 6, pl. 87, figs. 1–3, p. 1259 (Germany); Oppenheim: Palaeontographica, 1906, Vol. 30, part 3, pl. 19, fig. 24, p. 173 (Egypt).

Dosinia (*Sinodia*) *incrassata.*
Jukes-Browne: Proc. Mal. Soc., London, 1908, Vol. 8, pl. 6, fig. 2, pp. 151–154 (British).

Cordiopsis incrassata.
Cossmann: Act. Soc. Linn., Bordeaux, 1910, Vol. 64, p. 387 (France).

REMARKS.—Several valves in the collection can be referred to this well known species. The younger or smaller examples (Height = 28, Length = 30 mm.) exhibit a globulose and subtrigonal shape whereas the more adult forms (Height = 35, Length = 38 mm.) assume a somewhat oval contour. The small and more or less conical isolated tooth in front of the left valve which fits into a socket of the opposing valve is quite well displayed together with the prominently marked ascending pallial sinus with its obtusely pointed apex. As in European examples the lunule is not excavated although distinctly circumscribed, thus differing from *Dosinia* in which the lunule is sunken.

It was first suggested by Nyst that Solander's *Venus meröe* from the British Barton Beds, which however was not the Linnaen recent shell of the same name, was in all probability the equivalent of Sowerby's *V. incrassata*

from the Brockenhurst Beds (Headon-Hill Series) of Hampshire belonging to the Lower Oligocene (Tongrian). Specimens from the British Barton and Bracklesham Beds, with sub-trigonal and well inflated valves, have long lain in the Edwards Collection at the British Museum under the manuscript name of *Meretrix bartonensis;* these it is now considered should be regarded as *C. incrassata.*

This species forms the type of M. Cossmann's sub-genus *Cordiopsis,* established in 1910, which appears to be closely related to *Sinodia* of Jukes-Browne, 1908, founded on Reeve's recent shell, *Dosinia trigona.* Without discussing the points of difference raised by the two authors it may be mentioned that *Sinodia* was grouped by Jukes-Browne with *Dosinia,* while *Cordiopsis* is regarded by M. Cossmann under *Meretrix,* the views of the latter being, however, adopted on this occasion more especially as Sowerby's *V. incrassata* has so commonly been associated in the past with the genus *Meretrix* (= *Cytherea),* whilst the new species of *Sinodia* from Southern Nigeria would favour a like result.

DISTRIBUTION.—British: Middle (Lutetian) and Upper (Bartonian) Eocene, Lower Oligocene (Tongrian). (Headon and Bembridge Series). Europe: Oligocene (Tongrian); Miocène (Aquitanian). Egypt: Upper Mokattam (Bartonian); related forms.

OCCURRENCE.—Cuttings Nos. 5, 6, 10, 12, 15.

COLLECTOR.—Mr. Kitson.

Sinodia heward-belli, sp. nov.

PLATE 9, figs. 18–21.

DESCRIPTION.—Shell ovately trigonal, inaequilateral, height in excess of length, thick, ventricose; dorso-anterior margin straight, oblique, posterior margin long, compressed and nearly vertical in the centre, ventral margin rounded; umbones acute, laterally approximate, strongly anterior (prosogyrous); lunule widely cordiform, well circumscribed, not impressed; ligament groove narrowly elongate, situated within a shallow escutcheon area margined by an obtuse angulation which is succeeded by a distant and more obscure angulation; pallial inflection broadly lingulate, antero-laterally ascending, obtusely

terminal. Left valve with a strongly conical tooth in front moderately distant from anterior cardinal; cardinal teeth divergent, coalescent above, lamelliform, the central thick and robust, postero-lateral tooth lamelliform, obliquely curved and quite near to the middle cardinal. Right valve with a front socket to receive anterior tooth of opposing valve, a pair of closely situated, unequal cardinal teeth with flattened parallel inner surfaces, anterior smallest, postero-lateral tooth thick, obliquely lamelliform, and elongately furrowed.

DIMENSIONS.—

Height	38	millimetres.
Length	36	,,
Diameter (closed valves)	28	,,

REMARKS.—This species is related to *Cytherea incrassata* of James Sowerby, the type of Cossmann's *Cordiopsis*, although it undoubtedly belongs to *Sinodia* of the late Jukes-Browne,[1] which was founded on Reeve's *Dosinia trigona* from Recent Seas (Indian Ocean). Some perceptible differences separate our shell from the Sowerbian species. In form it possesses the trigonal and ventricose aspect of the recent shell as opposed to the more oval contour of *C. incrassata*, whose valves are moreover relatively less deep, more narrowly lunuled, and with only a single obtuse angulation to the posterior region. The double angulation of the posterior region of the Nigerian shell is important from the specific point of view especially, as it forms a good distinguishing feature in support of recognising it as a new form. The dentition generally agrees with that of *Sinodia*, *Cordiopsis*, and *Dosinia*. From the latter genus, it differs in contour, as also in its superficial lunule, and in possessing a shorter, less ascending, and less acuminate pallial sinus. From *Cordiopsis*, the shape, again, separates it as well as the more ventricose valves; while the possession of an obtusely angulate posterior region enclosing the elongately-shallow escutcheon distinguishes it from *Sinodia*. The shell, however, so closely approximates in other characters to the last named genus, that there can be no hesitation in regarding the new species as one of its members. The obtusely carinated character of the posterior region is so important that it must be regarded as an additional feature in the diagnosis of *Sinodia*, its presence connecting it with the *Meretrix* shells of the

[1] On the Genera of Veneridae represented in the Cretaceous and Older Tertiary Deposits: Proc. Mal. Soc., London, 1908, Vol. 8, pl. 6, p. 151.

Veneridae, as advocated by M. Cossmann, rather than with *Dosinia*, where Jukes-Browne had placed it. The species is named in honour of W. Heward Bell, Esq., F.G.S., who is associated with Mr. Kitson as one of the donors of this Nigerian collection to the Geological Department of the British Museum.

OCCURRENCE.—Cutting No. 6.

COLLECTOR.—Mr. Kitson.

Callista elongatotrigona, sp. nov.

PLATE 9, figs. 1–5.

DESCRIPTION. — Shell small, thin, sub-oval, elongately sub-triangular, inaequilateral, compressed; anterior side oblique, ovally confluent with ventral margin, posterior side produced, oblique, truncated, obtusely acuminate at ventral angle, ventral margin elongately curved, lunule lanceolate, superficial, ligament groove elongate, very narrow; surface covered with more or less regular, depressed, smooth, imbricating, concentric costae obtusely angulate in rear, with finer intermittent concentric striations; hinge small, dental formula in accordance with *Callista*; pallial sinus short, broad, obtusely angled; umbones small, acute, prosogyrous.

DIMENSIONS.—

	Young.	Adult.
Height	11 ...	14 millimetres.
Length	8 ...	21 „
Diameter (valves united) ...	6 ...	10 „

REMARKS.—The few valves representing this species are related to *Cytherea laevigata* of Lamarck [1] and *C. proxima* of Deshayes,[2] both European shells, the former from the Middle and Upper Eocene, the latter being of Lower Eocene age. From *C. laevigata* the present species differs in having more cuneate and compressed valves, which are, moreover, less smooth and without any evidence of the fine microscopical radial striations seen in the shelly texture of that species. It differs also from *C. proxima* in its more cuneate

[1] Ann. Mus. Hist. Nat. (Paris), 1806, Vol. 7, p. 134; *ibid.*, 1808, Vol. 12, pl. 21 (40), fig. 5.

[2] Suppl. Desc. Coq. Foss., Paris, 1858, Vol. 1, pl. 30, figs. 31–34, p. 435.

contour being less ovate, in the possession of a steeper obliquity to the posterior side, and in its less regular concentric sculpture.

It should be mentioned that the late A. J. Jukes-Browne regarded the European species referred to, together with *C. suberycinoides* of Deshayes, as belonging to Meek's section, *Macrocallista*[1] (Type—*Venus gigantea*, Gmelin), being alike in general shape and hinge characters. For the same reason, therefore, the present new species would be also included in the same section.

Occurrence.—Cuttings Nos. 10, 5, 6.

Collector.—Mr. Kitson.

Callista kitsoni, sp. nov.

Plate 9, figs. 11–14.

Description.—Shell thin, ovato-transverse, inaequilateral, posteriorly elongate and oblique, moderately inflated; lunule lanceolate, distinct, *not* impressed; surface bearing numerous fine, close, concentric, often irregular, striations, together with obscure microscopical radial striae; umbonal regions tumid; hinge plate narrow; left valve with a strong, compresso-triangular tooth in front, a pair of cardinals diverging from the dorsal arch, and a short oblique laminar tooth in rear; right valve with an elongate anterior socket for the front tooth of opposing valve, a pair of closely parallel cardinals with flattened opposing faces, followed by a thick posterior cardinal obliquely sulcated above; pallial sinus wide, ovate, obtusely acuminate, and nearly horizontal.

Dimensions.—

	Young.	Adult.
Height...	12	20 millimetres.
Length	17	27 „
Diameter (united valves) ...	9	14 „

Remarks.—This species is closely related in its internal characters to *Cytherea laevigata*, Lamarck[2] from the Anglo-Parisian Middle and Upper Eocene deposits. It differs, however, in having thinner valves, being less elongate and rather more convex, in possessing a shorter and more abruptly

[1] F. B. Meek: Invertebrate Cretaceous and Tertiary Fossils, Upper Missouri Country—Rept. United States Geol. Surv. Territories, 1876, Vol. 9, p. 179.

[2] Ann. Mus. Hist. Nat. (Paris), 1806, Vol. 7, p. 134; *ibid.* 1808, Vol. 12, pl. 21 (40), fig. 5.

sloping posterior side, and in being furnished with a crowded series of thread-like striations instead of the flattened lines of growth as in Lamarck's shell. It agrees with the French species in exhibiting obscure microscopical radial striations, a structure seen also in recent forms of this genus, and particularly mentioned in modern years by the late Jukes-Browne[1] in connection with his studies on the "Veneridae." Another point of difference between these two species may be observed in the structure of the pallial sinus which is rounded or obtusely acuminate in the form from Nigeria, while in the European shell it has frequently a squarish termination with angulate corners. The dental elements are the same in both species and agree with those present in the genus *Callista*, under which M. Cossmann[2] includes *C. laevigata*. This is an abundant shell in the Nigerian deposits and is generally well preserved.

OCCURRENCE.—Cuttings Nos. 2, 6, 10, 12, 13.

COLLECTOR.—Mr. Kitson.

Tivelina cf. sphenarium (Bayan).

PLATE 9, figs. 7-10.

Cytherea cuneata.
Deshayes: Desc. Coq. Foss., Paris, 1825, Vol. 1, pl. 22, figs. 6, 7, p. 131; *ibid.*, Suppl., 1858, Vol. 1, p. 465, *non* Lamarck.

Cytherea sphenarium.
Bayan: Études Coll. École. Mines Foss., 1873, Fasc. 2, p. 121.

Tivelina sphenarium.
Cossmann: Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 122.

Meretrix (Tivelina) sphenarium.
Cossmann & Pissarro: Iconog. Coq. Foss. Éocène, Paris, 1904, Vol. 1, pl. 11, fig. 35.

REMARKS.—This is another of the very abundant Pelecypods which occur in the Nigerian deposits, the valves exhibiting every possible size and varying in length and height respectively of from 7 × 5 up to 20 × 17 mm., their diameters with both valves in the closed condition ranging from 4 to 12 mm. The valves are slightly higher than those of European examples although preserving the characteristic subtrigonal contour, the posterior side being the most produced, as it is also truncated, and obtusely angled, whilst

[1] Proc. Mal. Soc., London, 1908, Vol. 8, p. 154.
[2] Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 113 (101).

the anterior margin is vertical, oblique and ventrally rounded. An obscure and almost obsolete shallow depression runs obliquely from the umbonal region to the postero-ventral corner causing a slight insinuation at the margin, a character usually found in species of *Tivelina* although apparently not present in *T. sphenarium*, but which is quite obvious in *Cytherea rustica*, Deshayes and *C. tellinaria*, Lamarck, both referred by Cossmann to *Tivelina* from the French Eocenes, species which, nevertheless, differ from the present Nigerian shell in the possession of more elongately oval contours. The original figures of *C. cuneata*, Deshayes, a name altered by Bayan to *C. sphenarium* on account of Lamarck's pre-occupation of the former for another shell, are by no means good, a better conception of the outline being available in MM. Cossmann and Pissarro's work referred to above. The type specimen was most probably very eroded as the concentric striations appear to be confined to the posterior margin instead of being continued across the valve whilst an exaggerated curvature is given to the ventral region which is not maintained in actual specimens. *Tivelina* was founded by M. Cossmann, in 1886, on Lamarck's *Cytherea tellinaria*, a number of other species being also included in it; it is regarded as being restricted to Eocene times and occurs throughout beds of that age in Europe, undescribed species occurring also in the Barton Beds of England. The present specimens are much better preserved than most European examples of *Tivelina* available for study in the British Museum, so that the more or less regular concentric sculpture, the large lanceolate lunule, the short pallial sinus, and the dental elements, are all remarkably clear and well defined.

DISTRIBUTION.—Upper Eocene: Europe.

OCCURRENCE.—Cuttings Nos. 1, 2, 5, 6, 10, 15.

COLLECTOR.—Mr. Kitson.

Family TELLINIDÆ.

Peronaea nigeriensis, sp. nov.

PLATE 11, figs. 1-3.

DESCRIPTION.—Shell trigoniform, broad and ovately oblong, nearly equilateral, more or less smooth, plano-convex, obtusely angulate posteriorly, anterior border the most produced and pursuing an obliquely linear direction

to the ovatiform marginal curvature, ventral margin elongately curved; teeth consisting of two divergent cardinals each provided with a groove at the summit, the anterior tooth thickening with age and becoming coalescent with the strong cardinal fulcrum, lateral teeth obsolete; the adductor scars are unequal, the anterior being elongate while the other is much rounder, both are concentrically and radially striated; an obscure and, more or less swollen rib proceeds obliquely along each side of the floor of the valve from beneath the cardinal arch to the inner margins of both the adductor scars; pallial line with an extensive elliptical indentation extending nearly horizontally beyond the middle of the valve and more or less parallel with the ventral margin, sometimes the upper line of the sinus or indentation gradually and obliquely ascends to the margin of the posterior adductor scar; sculpture exhibits fine concentric lineations grouped into regular periods of growth, crossed by innumerable delicate radial striations, whilst the posterior angulation is furnished with two or three nearly obsolete radial ribs; close vertical striations cover the wide, internal marginal surface of the ventral region.

DIMENSIONS.—

	Adult.
Height	52 millimetres.
Length	70 „
Diameter (united valves)	30 „

REMARKS.—This large Tellinoid shell is well represented in the collection; the valves being generally in an isolated condition although some of them are capable of being accurately paired. The specimens agree with the contour lines of *Tellina pellucida*, *T. zitteli*, *T. grandis*, and *T. latissima*, from the Egyptian Eocenes, as delineated by figures and descriptions published by Mayer-Eymar,[1] and continued by Oppenheim,[2] the latter regarding such species as one form of shell under the specific name of *zitteli*. In other important respects, however, the Nigerian valves differ from the Egyptian shell. They are of much deeper construction measuring more than double the diameter of the Egyptian valves, an adult form of which, as quoted by Oppenheim, yielding a height and length respectively of 56 and 75 millimetres shows a diameter of only 13 millimetres for their united

[1] Palaeontographica, 1883, Vol. 30, pl. 23, figs. 14, 15, p. 71; and Journ. Conchyl., 1898, Vol. 46, pl. 3, fig. 6, pl. 13, figs. 1, 3, pp. 28, 230, 231.

[2] Palaeontographica, 1906, Vol. 30, part 3, pl. 18, fig. 19, pl. 19, fig. 12, Text-figs. 14, pp. 179, 180.

valves. There are, besides, no lateral teeth which, according to Mayer-Eymar, characterise the Egyptian shell. So far as sculpture is concerned both shells exhibit a more or less zonal arrangement in the structure of the concentric striations; the closely-set radial striations are, however, absent in Egyptian valves, although some distant obscure radial ribs are noticeable on the posterior area of a valve as represented by Oppenheim's largest figure of *Tellina zitteli*. The Nigerian valves are thick and strong, being mostly mineralised and consisting of a siliceo-calcareous structure. Relics of a periostracum are frequently preserved. This form is regarded as belonging to Poli's genus *Peronaea* on account of its non-rostrate character, its more or less trigonal shape, and its possession of a nearly horizontal pallial sinus, this latter character being much rounder and more expansive in *Arcopagia*, with which Oppenheim associated Mayer-Eymar's Egyptian shell of *Tellina zitteli*.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10, 15.

COLLECTOR.—Mr. Kitson.

Family MACTRIDÆ.

Mactra semisulcata, Lamarck.

PLATE 7, figs. 10-13.

Mactra semisulcata.

Lamarck: Ann. Mus. Hist. Nat. (Paris), 1805, Vol. 6, p. 412, and 1807, Vol. 9, pl. 18 (20), fig. 3; Deshayes: Desc. Coq. Foss., Paris, 1824, Vol 1, pl. 4, figs. 7-10, p. 31, *ibid.*, Suppl. 1857, Vol. 1, p. 288; Dixon's "Sussex," 1850, pl. 3, fig. 10, p. 88; Cossmann: Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 60: and R. B. Newton: Syst. List, &c., 1891, p. 84.

REMARKS.—Several moderately sized and smaller shells, forming part of this collection, are easily referred to this European species. The valves are deeper than in *M. compressa* of Deshayes (= *M. depressa*, Deshayes *non* Lamarck), besides exhibiting the equally strong striated character of the lunule and escutcheon regions which is so marked a feature of the species. Variations in size show a length and height respectively of from, 19 × 13 to 30 × 21 millimetres, whilst one of the largest European examples in the British Museum measures 50 × 40 millimetres.

DISTRIBUTION.—Eocene: according to M. Cossmann this species is found throughout the Eocenes of France; it is also recorded from the Lutetian beds of England (Bracklesham Bay).

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10.

COLLECTOR.—Mr. Kitson.

Family RAETOMYIDÆ (R. B. Newton, 1919).

Genus Raetomya (R. B. Newton, 1919).[1]

Proc. Mal. Soc. London, 1919, Vol. 13 pl. 1, pp. 80–82.

DESCRIPTION.—Shell inequilateral, obliquely gibbose, thin, concentrically and irregularly plicate, striated and wrinkled; dorsal areas not defined; anterior side deep, long, oblique, depresso-concave, posterior region short,[2] marginally compressed, reflected, slightly gaping; umbonal areas arched, summits opisthogyrous, incurved, oblique, laterally approximate but distant with age, the right elevated above the left; left valve with strong hinge-plate furnished with a horizontally projecting triangular chondrophore marginally grooved each side, deeply excavated anteriorly and striate within, succeeded by an antero-marginal sulcus, the posterior side having a wider marginal sulcus to receive the laminar tooth of the other valve; right valve provided with a shallow oval chrondrophore set back in the sub-umbonal cavity, obliquely ridged posteriorly to connect with the postero-lateral groove of the left chrondrophore, followed by a narrow sulcus, a posterior laminar tooth, and a widely depressed dorsal furrow; cardinal teeth absent in both valves; pallial impression widely indented by a nearly circular sinus; adductor scars unequal, posterior more or less normal, anterior narrow and elongate.

TYPE.—*Lovellia schweinfurthi*, Mayer-Eymar, from the Eocene (Upper Mokattam Beds) of Egypt.

REMARKS.—This shell agrees with the mactroid genus *Raeta*,[3] in most external characters, but differs internally by possessing: (1) dissimilar chondrophores, the left being triangular and projecting outwards, while the right is triangularly ovate, vertical, and well within the sub-umbonal region; (2) no cardinal teeth; (3) a large rounded pallial sinus. The chief external distinction concerns the summits or umbones, which instead of being opposite each other and nearly touching as in *Raeta* are laterally approximate but becoming more or less distant with age, that of the right valve being always

[1] This descriptive account of *Raetomya* and of its species, *R. schweinfurthi*, together with the plate of illustrations (Pl. 10),have been reproduced from the original, published in the Proceedings of the Malacological Society of London, 1919, Vol. 13, with the permission of the Council of that Society.

[2] In this respect resembling the genera *Raeta*, *Nucula*, *Pisidium*, etc.

[3] According to Dr. Dall the true systematic position of *Raeta* is still uncertain, since its soft parts are unknown: Trans. Wagner Free Inst. Sci. Philadelphia, Vol. 3, pt. 4, 1898, p. 907.

in front of the other and rather more elevated, such as is observable in *Corbula gallica*, *C. exarata*, etc., from the European Eocene deposits. In its projecting character the left chondrophore resembles that present in *Mya*, but instead of merging with the postero-dorsal margin as in that genus it radiates outwards, with the other extended elements of the hinge-plate, from a point immediately beneath the umbo. A similarly projecting chondrophore is also apparent in members of the Corbulidae, otherwise such shells as well as *Mya* are quite distinct from the present genus.

In *Raeta* the chondrophores are of similar construction and position in both valves; it has, moreover, cardinal teeth, and a siphonal inflection which is deep, angulate, and sloping downwards from the posterior adductor scar, being nearly parallel with the ventral margin. The adductor scar impressions are of the same design as those of the African shell, while the umbones occupy a more approximate position and are on the same plane.

The shell has similar dorso-marginal sulci as that of *Raeta*, which it is considered would be for the reception of ligament and therefore *amphidetic*, as expressed in Neumayr's[1] terminology, as opposed to *opisthodetic*, when the ligament is entirely behind the umbones.

Again, there are no paired laminae to receive the lateral teeth as in the genus *Mactra*; these are also absent in *Raeta*. These and the other distinctions already referred to have been considered of sufficient importance for regarding *Raetomya* under the new family designation of Raetomyidae. In like manner it has been suggested that *Raeta*, from its differences to *Mactra*, in contour, its unequal adductor scars, and the possession of a large angulate pallial sinus, should be placed under the family name of Raetidae instead of Mactridae.

This genus *Raetomya* appears to be restricted to African Eocene deposits, whereas *Raeta* ranges from Eocene times through the later tertiaries on to the seas of the present day, being known from the rocks of Peru, the United States, and Switzerland.

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[1] Denkschr. k. Akad. Wiss. Wien, Vol. 58, 1891, p. 711.

Raetomya schweinfurthi (Mayer-Eymar).

PLATE 10.

Lovellia schweinfurthi.
Mayer-Eymar : Journ. Conchyl. 1887, Ser. 3, Vol. 27, pp. 320–322, pl. 11, fig. 6.

Raeta schweinfurthi.
Oppenheim : Palaeontographica, 1906, Vol. 30, part 3, pp. 190, 191, pl. 19, fig. 1, text figure 17.

Raetomya schweinfurthi.
R. B. Newton : Proc. Mal. Soc. London, 1919, Vol. 13, pp. 79–84, pl. 1.

REMARKS.—The Nigerian specimens referred to this species, hitherto only known from the Egyptian Eocene, vary considerably in size, the smallest showing a length and height respectively of 25 and 20 mm., while one of maximum size, a natural cast with united and closed valves, measures 113 by 75 mm. ; the dimensions of the type being 65 by 54 mm.

The chief features of interest of this Pelecypod are the very inaequilateral and obliquely gibbose valves ; the thin test with its sculpture of more or less regular concentric ridges ; the narrow, elevated umbonal regions and their laterally approximate incurved beaks ; the possession of an elongate, depressed, anterior end region, slightly concave above and rounded at extremity, while the posterior side is short, wide, marginally compressed, reflected, and slightly gaping ; pallial sinus widely arcuate ; hinge-plate small with an anterior lamellar tooth parallel to the margin, as well as an oblique and strongly lamellar posterior tooth ; no cardinal teeth referred to. These characters, mostly mentioned in the original account, are mainly of external interest, very little apparently being known as to those affecting the interior of the valves. The new and better preserved material from Southern Nigeria fortunately supplies some important details of internal structure which contribute to the value of the species, as well as suggesting its recognition as the type of a new genus ; the emended specific characters may be set out as follows :—

Umbonal region well elevated and arched ; summits resting on the shell margin, opisthogyrous, laterally approximate but divided in age, that of the right valve always slightly raised above the other. Left valve with a strong hinge-plate, having all its elements coalescent and radiating from beneath the umbonal region, which embrace :—a horizontally projecting chondrophore of elongate triangular shape and slightly concave surface, bordered by a posterior groove, and followed by a steep, oblique, posterior side which forms part of a wide and deep

dorso-marginal sulcus, which probably received the ligament as well as the postero-lamellar tooth of the opposing valve. The chondrophore surface is covered with minute and closely-set concentric striations crossed by radial riblets, and bordering three-fourths of its anterior side (which is longest) is a narrowly elongate, rounded, funnel-shaped cavity marked with fine concentric and radial striations, which is regarded as the receptacle for the anterior part of the resilium. This cavity bears an antero-marginal ridge which may probably represent the so-called anterior lamellar tooth of the original description of the species; then follows the dorso-anterior marginal sulcus which holds the ligament. The basal or underneath surface of the hinge-plate is quite smooth, more or less bulbous, and furrowed. Right valve with a slightly excavated, triangularly-oval chondrophore, vertically situated, and merged in the sub-umbonal region, its surface similarly ornamented to that of the other chondrophore, although smoother and less obvious. The posterior border of this cavity is obliquely and roundly ridged to fit the postero-lateral groove of the left chondrophore, this being followed by an oblique sulcus and a prominently oblique, postero-laminar tooth, to which succeeds a wide and flattened internal dorsal margin. Neither of the valves exhibits any indication of cardinal teeth.

The pallial impression as seen on internal casts shows a large and nearly circular sinus, an adult specimen measuring 85 mm. in length giving the dimensions of this sinus as 25 by 28 mm. in vertical and longitudinal diameters respectively.

The adductor scar impressions are of very unequal position and shape, the posterior being of moderate size, oblong-pyriform, concentrically striated, and well above the middle of the shell margin, while the anterior is narrowly elongate, extending to nearly the antero-ventral curvature of the valves, as in *Raeta.*

The sculpture consists of rounded plications and furrows marked with extremely fine concentric interlineations, together with obscure microscopical radial striations which enter into the texture of the shell; the surface is also wrinkled, especially posteriorly, caused in all probability by a periostracum which must have originally covered the valves as in *Raeta.* Sometimes the plications are irregular, and occasionally they bifurcate midway across the valve, terminating singly in the posterior region, when they become more distant and consequently fewer.

DIMENSIONS.—

	Smallest example.	Largest example.
Length	25 ...	113 millimetres
Height	20 ...	75 „
Diameter (closed valves)	20 ...	60 „

DISTRIBUTION.—The Upper Mokattam deposits of Egypt (Bartonian), and the Nigerian deposits.

OCCURRENCE.—Cuttings Nos. 1, 5, 6, 10.

COLLECTORS.—Sir John Eaglesome and Mr. Kitson.

Family CORBULIDÆ.

Corbula rugosa, Lamarck.

PLATE 7, figs. 14-18,

Corbula rugosa.

Lamarck : Ann. Mus. Hist. Nat. (Paris), 1806, Vol. 8, p. 467 (not figured) ; Deshayes : Desc. Coq. Foss., Paris, 1824, Vol. 1, pl. 7, figs. 16, 17, 22, p. 51 ; J. de C. Sowerby in F. Dixon's "Geology of Sussex," 1850, p. 89 ; Deshayes : Suppl. Desc. Coq. Foss., Paris, 1857, Vol. 1, p. 226 ; Cossmann : Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, p. 48 ; R. B. Newton : "Syst. List, &c.," 1891, p. 89.

Corbula lyonsi.

Oppenheim : Palaeontographica, 1906, Vol. 30, part 3, pl. 18, fig. 1, p. 196.

REMARKS.—This form of *Corbula* occurs in great abundance in the Nigerian deposits. It is strongly globulose, both valves, especially the lower, being well excavated ; the umbonal regions are rounded and the summits much incurved. In the ridged ornamentation of the lower valve it somewhat resembles *C. ficus*, of Solander, from the Bartonian deposits of England, although differing in the absence of a prolonged posterior end, which is as stated in the original diagnosis, *brevissime rostrata.* The posterior area is marginally carinated within and has a strongly striated surface, features which are well seen in examples from the Anglo-Parisian Basin (Bracklesham Bay and near Paris). The upper or smaller valve is concentrically striated but much less prominently than the other, being generally smoother, it moreover is furnished with distant radial striations apparently only seen in well preserved specimens, those from Bracklesham Bay showing them rather obscurely, whereas Parisian examples, such as are available for study, appear to be destitute of such a structure. The Egyptian shell, *C. lyonsi,* of Oppenheim must, I think, be regarded as the European species,

there being no definite characters for a separation. Oppenheim's fig. 1a of plate 18 of that species shows the interior of a lower valve containing within it an upper valve that has become inverted or placed out of position during the process of fossilization, and which clearly indicates the presence of radial striations, suggesting the strong probability that it represents the opposing valve of the same individual shell with which it is associated. The Nigerian valves resemble very much in dimensions, those from Europe and Egypt, larger individuals exhibiting a height of 12, length 14, and diameter (with closed valves) of 10 millimetres.

DISTRIBUTION.—British: Middle Eocene (Lutetian); Europe: Eocene (throughout); Egypt: Upper Mokattam Beds (Bartonian).

OCCURRENCE.—Cuttings Nos. 1, 2, 5, 6, 13, 14, 15.

COLLECTOR.—Mr. Kitson.

Family CORALLIOPHAGIDÆ.[1]

Coralliophaga eocenica, sp. nov.

PLATE 11, figs. 4-5.

DESCRIPTION.—Shell extremely thin, narrow, elongately sub-cylindrical, equivalve, dorsally arched, ventral margin incurved, postero-obtusely acuminate, umbones very anterior, valves closed; length more than three times the height; left valve with a laminate tooth parallel with dorsal margin and directed posteriorly, right valve with a similar tooth but less prominent, succeeded immediately in rear by two additional obscure teeth, also postero-obliquely directed; ligament linear, external; pallial line angulately sinuated; anterior adductor scar prominent and rounded, posterior scar sub-central just beneath dorsal margin, elongately elliptical; surface concentrically ridged, finely interlineated, posterior half of the valves polished internally.

DIMENSIONS.—

Height	4 millimetres.
Length	14 „
Diameter (closed valves)	5 „

[1] M. Cossmann (Act. Soc. Linn. Bordeaux, 1911, Vol. 65, p. 83) has introduced the family name of Lithophagellidae for *Coralliophaga*, which is considered to be irregular, because Gray's genus, *Lithophagella*, being a synonym of the earlier *Coralliophaga*, of Blainville, should no longer be used either as a family or generic name.

REMARKS.—This shell is of frequent occurrence in the nodules containing the *Teredo* remains. It is most delicately thin and fragile, so much so that the one complete example which was released without any attendant matrix has been more or less broken during the process of handling for examination, although sufficient remains for characterisation. This particular specimen was found in a loose sandy matrix occupying one of the *Teredo* tubes, other examples appear to be located in similar tubes lined with siliceo-calcareous material of considerable hardness. In the details of its pallial indentation, it resembles *Gastrochaena*, although that is an edentulous Pelecypod besides having most prominently gaping valves, the present specimen differing as well in its closed valves and its peculiar dentition, the characters of the latter appearing to connect it with De Blainville's genus, *Coralliophaga*, which is known to exist in the tubes of perforating molluscs. In general external features and shape these Nigerian fossils show, likewise, a resemblance to *Lithophaga*, besides being somewhat like Gregorio's figures, of *Byssomya petricoloides*, Lea,[1] in contour and size, from the Claiborne Eocene of the United States, although according to Dr. Dall[2] that species may represent a *Lithophaga*, as first suggested by Gregorio ; its history is, however, not clear, and we seem to know none of its internal characters, *i.e.*, the features of the pallial line which, of course, in the true *Lithophaga* is entire and not sinuated as in *Coralliophaga.*

M. Cossmann[3] recognises several species described by Deshayes from the Paris Basin Eocene as belonging to *Coralliophaga*, but which are of very different contour to the present shell, being without a cylindrical axis and having a usually rounder sinus to the pallial line. Another species has been recognised from the German Oligocene by Von Koenen,[4] whilst Cossmann[5] has also determined certain forms of *Coralliophaga* from the older Miocene deposits of France, as also Dr. Sacco[6] from the Italian Pliocene.

OCCURRENCE.—No particular bed mentioned. Accompanying *Teredo* tubes, and *Tugurium nigeriense.*

COLLECTOR.—Sir John Eaglesome.

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[1] *Gregorio :* Ann. Géol. Pal. (Palermo), 1890, pl. 38, figs. 25, p. 236, and pl. 22, figs. 6, 7, p. 184.
[2] *Dall :* Trans. Wagner Free Inst. Sci. Philadelphia, 1898, Vol. 3, part 4, p. 801.
[3] Ann. Soc. R. Mal. Belgique, 1886, Vol. 21, pp. 146, 147.
[4] Abhandl. Geol. Spec. Preussen, 1893, Vol. 10, part 5, p. 1192.
[5] Act. Soc. Linn. Bordeaux, 1911, Vol. 65, part 2, pp. 83-87.
[6] Moll. Terz. Piemonte, 1900, Vol. 28, pp. 7-9, pl. 1, figs. 28-33.

Family TEREDINIDÆ.

Teredo, sp.

PLATE 11, figs. 6-8.

REMARKS.—Masses of closely arranged *Teredo* tubes in a woody material, occur in a hard, siliceo-calcareous, reddish brown, ferruginous-looking rock, forming nodules. The outer crust of these nodules consist of a heavy, compact, dark-greenish-grey sandstone although weathering a much lighter colour and becoming quite soft and pulverulent, this external softer material containing many fragmentary molluscan remains. The *Teredo* tubes vary from one to nearly ten millimetres in diameter, besides having a maximum length of more than 60 millimetres. They are often nearly straight, others exhibit a flexuosity, while all possess a more or less tapering growth; the rounded and bulbiform summits, where the valves are enclosed, being characteristic of this group of shells. The outer surface of the tubes is more or less annulated, and internally there is evidence of some horizontal septa, as well as two apertures, seen at the tapering ends, divided by a diaphragm, indicative of channels for the passage of the siphons. Most of the specimens are highly mineralised, the tubes being lined within by a calcitic layer which forms a remnant of the original shell structure. The valves are rarely preserved in good condition, although a few isolated examples are of interest in yielding generic characters. They possess the usual globular contour and structure of *Teredo*, being composed of three divisions or lobes, the central being narrowest and extending from the umbo to well below the ventral border of the laterals, besides being furnished with a posterior, narrow, and concentrically striated margin, otherwise its surface is smooth; the lateral lobes also present a concentric sculpture. A deeply angulate emargination exists in the anterior region, thus forming a most prominent gape, which is not bridged over by a callosity as in the allied genus *Teredina*. The valves, likewise, possess a well marked styloid myophore, which is curved, elongate, depresso-concave, and suspended from or apparently forming part of the inwardly curved umbo which initially is more or less tubercled and which in connection with a similarly rounded tubercle (the parietal tubercle) near the ventral border would suggest (as pointed out to me by Dr. Calman) a rotatory movement of the valves when being used by the animal for boring wood or other material; the cavity in front of the umbo is bordered by an enamelled callosity, whilst on the

dorso-posterior side is a widely elongate, thick, calcareous plate which would represent the attachment surface of the posterior adductor muscle. Unfortunately, the ventral margin of the valves available for examination is not sufficiently preserved to show the parietal tubercle, so important a structure in *Teredo*. Without, therefore, attempting to refer these remains to any individual species, it may be stated that they somewhat resemble such forms as *Teredo libyca*[1] from the older Eocene of Egypt, *T. tournali* of Leymerie[2] from the Eocene of France and Egypt, as also *T. cincta* and *T. vermicularis*, both of Deshayes[3], from the Parisian Eocene. The tube characters are, also, very similar to those prevailing in the well known *Teredina personata* from the older Eocenes of Britain and France, although the Nigerian valves show no indication of a callosity plate covering the great gape in front, which is among the distinguishing features of *Teredina*.

DIMENSIONS of a left valve :—

Height	7	millimetres.
Length	7	„
Diameter	3	„

Associated with these *Teredo* tubes is a small, narrow, cylindrical shell referred to *Coralliophaga eocenica* sp. nov. (see p. 99) and some cast-remains of a small Xenophoroid shell previously described as *Tugurium nigeriense* sp. nov.

OCCURRENCE.—No particular cutting referred to. In ironstone nodules weathering a grayish colour externally.

COLLECTORS.—Sir J. Eaglesome and Sir F. Lugard.

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[1] Oppenheim : Palaeontographica, 1906, Vol. 30, part 3, pl. 27, fig. 16, and Text-figures, p. 207.

[2] Mém. Soc. Gèol., France, 1846, Ser. 2, Vol. 1, pl. 14, figs. 1-4, p. 360, and Palaeontographica, 1906, Vol. 30, part 3, p. 207.

[3] Suppl. Desc. Coq. Foss., Paris, 1857, Vol. 1, pl. 3, figs. 5-9, pp. 115-117.

DISTRIBUTION CHART OF MOLLUSCA.

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent.	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Cephalopoda.												
Family BELOSEPIIDÆ.												
Belosepia sepioidea (Blainville)	...	*	*	...	...	...	...	*	*	...	...	First record of occurrence in African Eocene.
Gastropoda.												
Family STROMBIDÆ.												
Rostellaria bidigitata, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With alliances to *R. dentata*, Grateloup, European Miocene.
Rostellaria unidigitata, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Semiterebellum suturocostatum, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Semiterebellum elongatum, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Family CYPRÆIDÆ.												
Cypræa cf. bowerbanki, J. de C. Sowerby	...	*	...	...	...	...	...	*	...	...	...	A fractured specimen, but resembling this species from Bracklesham Bay.
Family AMPHIPERASIDÆ.												
Amphiperas nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Family TURRIDÆ.												
Surcula ingens (Mayer-Eymar) ...	...	...	*	...	...	...	...	...	...	*	...	The type is from the Upper Mokattam beds of Egypt.
Surcula africana, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	
Eopleurotoma nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Related to *Pleurotoma lajonkairii* and *P. multicostata* from the Paris Basin Eocene.
Family CONIDÆ.												
Conospirus cf. parisiensis (Deshayes)	...	*	*	...	...	...	...	...	*	...	...	
Family VOLUTIDÆ.												
Athleta lugardi, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	With affinities towards *Athleta selseiensis* from the Bracklesham beds.

DISTRIBUTION CHART OF MOLLUSCA—*contd.*

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent.	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Volutospina conicoturrita, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Volutospina multispinosa, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Family LOTORIIDÆ (=Tritoniidæ)												
Hilda turriculata, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	*Hilda* belongs to Miocene times and is apparently unknown as an Eocene fossil.
Family MURICIDÆ.												
Pteropurpura cf. tricarinata (Lamarck)	...	*	*	...	...	...	...	*	*	...	...	
Poirieria cf. calcitrapa (Lamarck)...	...	*	*	...	...	...	...	...	*	...	...	
Family FUSIDÆ.												
Rhopalithes africanus, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Related to *Murex noæ* from British and European Eocene deposits.
Family STREPTURIDÆ.												
Strepsidura spirata, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	Compared with Solander's *Murex turgidus* from British and European Eocenes.
Family TURBINELLIDÆ.												
Cornulina minax (Solander) ...	...	*	*	...	...	...	...	*	*	...	...	This species occurs rarely in later formations.
Bulbifusus nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With alliances to *Fusus inauratus* from the Alabama Eocene.
Family PSEUDOLIVIDÆ.												
Buccinorbis kitsoni, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	This species is more closely related to forms from the Alabama Eocene than to those from Europe.
Family BUCCINIDÆ.												
Liomesus africanus, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	With resemblances to *Buccinum dalei* from Pliocene and Recent seas.
Cominella douvillei, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	
Janiopsis nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With alliances to Brocchi's *Murex angulosus* from the Upper Tertiaries of Italy, the type of *Rovereto's Janiopsis*.

DISTRIBUTION CHART OF MOLLUSCA—*contd.*

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent.	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Family CANCELLARIIDÆ.												
Cancellaria multiplicis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	An intermediate form between *Cancellaria* and *Trigonostoma.*
Trigonostoma decorata, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Affinity with *Trigonostoma propegemmata* from the Eocene of Alabama.
Bonellitia cf. evulsa (Solander)	...	*	*	...	...	...	...	*	*	...	...	
Family CERITHIIDÆ.												
Exechestoma cossmanni, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Related to Lamarck's *Cerithium angulosum* from the European Eocene.
Terebralia, sp. A	...	...	...	...	...	...	...	...	...	...	...	
Terebralia, sp. B	...	...	...	...	...	...	...	...	...	...	...	
Family TURRITELLIDÆ.												
Turritella mauryana, sp. nov....	...	...	...	...	...	...	...	...	...	...	...	Related to *T. transitoria* from the Lutetian of Egypt and *T. mortoni* from the United States Eocene.
Turritella cf. sulcifera, Deshayes	...	*	*	...	...	...	...	...	*	...	...	
Family EPITONIIDÆ.												
Acrilla cf. affinis (Deshayes) ...	...	...	*	...	...	...	...	...	*	...	...	
Family XENOPHORIDÆ.												
Tugurium nigeriense, sp. nov....	...	...	...	...	...	...	...	...	...	...	...	
Family ARCHITECTONICIDÆ.												
Stellaxis bicingulata, sp. nov....	...	...	...	...	...	...	...	...	...	...	...	
Solariaxis cf. spectabilis (J. de C. Sowerby)	...	*	...	...	...	...	...	*	...	...	...	
Solariaxis cf. canaliculata (Lamarck)	...	*	*	...	...	...	...	*	*	*	...	
Family NATICIDÆ.												
Neverita cf. calvimontana (Deshayes)	...	*	...	...	...	...	...	...	*	...	...	
Sinum cf. olathratum (Gmelin)	...	*	*	...	...	...	...	*	*	...	...	

DISTRIBUTION CHART OF MOLLUSCA—*contd.*

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent.	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Sinum africanum, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	This species is more nearly related to those from Miocene, Pliocene and Recent seas, than with Eocene shells.
Family CAPULIDÆ.												
Crepidula falconeri, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	With alliances to *C. lirata* from the Alabama Eocene.
Family CALYPTRÆIDÆ.												
Calyptræa crepidularis (Lamarck)...	...	*	...	...	...	...	...	...	*	...	...	
Pelecypoda.												
Family OSTREIDÆ.												
Ostrea cf. marginidentata, S. V. Wood	...	*	...	...	...	...	...	*	...	...	...	
Ostrea cf. ludensis (Deshayes) ...	...	...	*	...	...	...	...	...	*	...	...	
Crassostrea lugardi, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	One of the longirostriform oysters which range from Lower Eocene to recent times, and closely related, if not the same shell, as *Crassostreasoudanensis*, Douvillé from the Soudan (Tamaske) Eocene.
Family PLICATULIDÆ.												
Plicatula polymorpha, Bellardi ...	*	*	...	...	...	...	...	...	*	*	...	Occurs in the Upper Mokattam beds of Egypt and in the Priabonian of Italy.
Family PINNIDÆ.												
Pinna, sp.	...	...	...	...	...	...	...	...	...	...	...	
Family ARCIDÆ.												
Fossularca africana, sp. nov. ...	...	...	..	...	...	...	...	...	...	...	...	Allied to the Atlantic shell, *Arca lactea.*
Striarca africana, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	Related to Conrad's type of *Striarca* (*Arca centenaria* Say), from the United States Miocene rocks.

DISTRIBUTION CHART OF MOLLUSCA—*contd.*

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent.	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Anadara nigeriensis, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	This type of shell belongs to Miocene and recent forms rather than to those of an older period.
Family GLYCYMERIDÆ.												
Glycymeris nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With resemblances to Sowerby's *Pectunculus decussatus* from British Lower Eocene.
Family NUCULIDÆ.												
Nucula costæimbricatis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	In contour comparable with *N. lunulata* from the Lutetian of Belgium.
Family CARDIIDÆ.												
Cardium cf. obliquum, Lamarck	*	*	*	*	...	...	...	*	*	*	...	This European species has been identified by Oppenheim in the Mokattam beds of Egypt.
Family LUCINIDÆ.												
Phacoides eaglesomei, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	A form with Miocene affinities, although slightly resembling Oppenheim's *Lucina camerunensis* from the older Tertiaries of Camerun, West Africa.
Phacoides subrhomboidalis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With resemblances to Bellardi's *Lucina pharaonis* from the Egyptian Eocene.
Divaricella oppenheimi, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Alliances with *Lucina rigaultiana* from the French Eocenes (Bartonian).
Family CARDITIDÆ.												
Cardita cf. planicosta (Lamarck)	...	*	*	...	...	...	...	*	*	...	*	North American and Trinidad Eocene.
Cardita costaeirregularis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	
Cardita costaenodulosis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	

DISTRIBUTION CHART OF MOLLUSCA—*contd.*

Determinations.	Geological.							Geographical.				Remarks.
	Eocene (older).	Eocene (Lutetian).	Eocene (Bartonian).	Oligocene.	Miocene.	Pliocene.	Recent	Britain.	Europe.	Africa.	United States. (Alabama Beds.)	
Cardita triparticostata, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	With resemblances to *C. mokattamensis* and *C. fajumensis* from the Egyptian Eocene.
Family VENERIDÆ.												
Cordiopsis incrassata (J. Sowerby)	...	*	*	*	...	...	...	*	*	*	...	Upper Mokattam beds of Egypt.
Sinodia heward-belli, sp. nov....	...	...	...	...	...	...	...	...	...	...	...	Related to *Cytherea incrassata*, J. Sowerby, from the Oligocene of Britain and Europe.
Callista elongatotrigona, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Alliances with *Cytherea lævigata* and *C. proxima* from the European Eocene deposits.
Callista kitsoni, sp. nov. ...	...	...	...	...	...	...	...	...	...	...	...	
Tivelina cf. sphenarium (Bayan)	...	...	*	...	...	...	...	...	*	...	...	
Family TELLINIDÆ.												
Peronaea nigeriensis, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	Related to *Tellina zitteli* and other forms of this genus from the Egyptian Eocenes.
Family MACTRIDÆ.												
Mactra semisulcata, Lamarck ...	*	*	*	...	...	...	...	*	*	...	...	
Family RAETOMYIDÆ.												
Raetomya schweinfurthi (Mayer-Eymar)	...	*	...	...	...	...	...	...	...	*	...	Type from the Upper Mokattam deposits of Egypt.
Family CORBULIDÆ.												
Corbula rugosa, Lamarck ...	...	*	*	...	...	...	...	*	*	*	...	Species occurs in the Upper Mokattam beds of Egypt (= Bartonian)
Family CORALLIOPHAGIDÆ.												
Coralliophaga eocenica, sp. nov.	...	...	...	...	...	...	...	...	...	...	...	This delicate shell accompanies *Teredo* tubes. *Coralliophaga* ranges from Eocene to Recent seas (Mediterranean).
Family TEREDINIDÆ.												
Teredo, sp.	...	...	...	...	...	...	...	...	...	...	...	

CONCLUSIONS.

A final study of the Mollusca from these Nigerian deposits, which consist of rather more than 70 species, is in favour of their Middle Eocene or Lutetian origin, and probably its later part on account of the prevalence of Bartonian forms. Many of the species are prolifically represented. The only Cephalopod collected, *Belosepia sepioidea*, although occurring throughout the Eocenes is more characteristic of Lutetian than of any other part of the series. Among the Gastropods, of which some 40 forms have been recognised, the large *Surcula* is important as agreeing in every way with *S. ingens* from the Upper Mokattam Beds of Egypt which are of Bartonian age.[1] A form of *Pteropurpura* allied to *tricarinata* suggests likewise its Lutetian horizon, while such species as *Cornulina minax*, *Bonellitia cf. evulsa*, *Neverita cf. calvimontana*, *Sinum cf. clathratum*, *Calyptraea crepidularis*, all support a similar geological age. The occurrence of *Bulbifusus*, hitherto known only as an American Eocene Gastropod, is also of great interest since it tends to prove a stratigraphical relationship between the Middle Eocene deposits of Alabama, which has yielded that mollusc, and those of Southern Nigeria. Most of the new Gastropods described exhibit affinities with species that are more or less characteristic of Lutetian times, among which may be mentioned particularly *Turritella mauryana*, a form with resemblances to *T. mortoni*, also, from the Alabama Eocene.

The Pelecypoda of these beds of which there are 30 different species show similar horizonal results, as for instance the discovery of *Raetomya schweinfurthi*, which until recently was only known in the Upper Mokattam deposits (Bartonian) of Egypt. There are also the remains of an oyster closely allied to *O. marginidentata*, a species confined to the Bracklesham beds of England and therefore of Middle Eocene age, as well as a large rostriform oyster, *Crassostrea lugardi*, which is closely related to *C. soudanensis* recently

[1] The Mokattam deposits of Egypt are divided into two groups, an upper and a lower. The older or lower beds are recognised as Lutetian, whereas the upper beds have been referred to as Bartonian in De Lapparent s "Traite de Geologie," 1906, Ed. 5, p. 1542, and as Bartonian and Priabonian by Dr. W. F. Hume in his "Explanatory Notes to accompany the Geological Map of Egypt" published by the Geological Survey of Egypt in 1912 (p. 18), although previously the whole of the Mokattam limestones had been determined as of Lutetian age.

described by Prof. H. Douvillé from the Upper Eocene deposits of the Soudan (Tamaske). Examples of *Plicatula polymorpha* indicate a late Lutetian or Bartonian horizon as that species occurs in the Upper Mokattam Beds of Egypt as also in the Priabonian rocks of Italy. In a similar way some small valves of *Cardium cf. obliquum* have been identified, a species recorded from the Lutetian of Egypt by Dr. Oppenheim. Among the Lucinidae, *Phacoides eaglesomei*, a new species, shows certain resemblances to *Lucina camerunensis* of Oppenheim from the Eocene of the Cameroon country; it also exhibits features which connect it with Miocene, Pliocene, and Recent species. A well sculptured shell *Divaricella oppenheimi*, sp. nov., presents affinities to *Lucina rigaultiana* from the Bartonian of Europe. An interesting valve of a probable *Cardita planicosta* indicates a very characteristic Lutetian species although extending to the Bartonian. Its occurrence in the United States Eocene has long been known, while Dr. Carlotta Maury has discovered it, within recent years, in the so-called Midway Eocene beds of the Island of Trinidad. The well known *Cordiopsis incrassata*, one of the Veneridae, is also represented in the collection; it ranges in Britain and Europe from Lutetian to older Miocene, the latter period including more or less related forms, while Bartonian examples are found in the Upper Mokattam Beds of Egypt. Some large Tellinoid shells determined as *Peronaea nigeriensis* show relationships to *Tellina zitteli* from the Egyptian Eocene; while specimens of *Mactra semisulcata* indicates a shell known in the British Lutetian and throughout the Eocenes of France. *Corbula rugosa* is also a familiar Lutetian shell of Britain, although found in the Eocenes of Europe and likewise in the Upper Mokattam deposits of Egypt.

The fossils of this collection having been discovered in a clayey deposit are remarkably well preserved, better in fact than most African specimens which as a rule occur in limestone rocks being frequently mere natural casts with very limited sculpture details, and imperfect contours. It is of interest to note, however, that Eocene faunas have been described from contiguous territories of Western Africa. Papers by Dr. F. A. Bather[1] and myself[2] on some Echinoids and Mollusca from the Sokoto region of Northern Nigeria, their age being considered Lutetian although the later criticisms of Lemoine

[1] Eocene Echinoids from Sokoto: *Geol. Mag.*, 1904, plate 11, pp. 292–304.

[2] Eocene Shells from Nigeria: *Ann. Mag. Nat. Hist.*, 1905, Ser. 7, Vol. 15, pl. 5, pp. 83–91.

and others are in favour of a Cretaceous horizon. Dr. Oppenheim[1] has described older Tertiary shells, generally of small size, from the Cameroons, while the same author[2] has fairly recently published a monograph on an invertebrate fauna from the Togo limestones which he regards as resembling that characterising the Ranikot Series of India and therefore of older Eocene age.

The late Prof. A. de Lapparent[3] was among the first authorities to recognise the presence of Lutetian rocks in the Soudan area of Africa, while Vasseur[4] was an early writer on Eocene Foraminifera from borings in the kingdom of Senegal. Another monograph[5] of importance published in 1913, deals with a series of Paleocene fossils from the Landana country of the Belgian Congo, the Mollusca having been described by Dr. Em. Vincent, the Chelonians by Prof. L. Dollo, and the Fish-remains by Prof. M. Leriche. A later work on the Eocene of the Soudan and Senegal has been recently issued by Prof. H. Douvillé[6]; it is descriptive of the Mollusca and Foraminifera which the author acknowledges as representing horizons ranging from Paleocene to Upper Eocene times.

Much information on the geology of the country between the Niger and Lake Tchad is given in a work by Dr. G. Garde,[7] which should be consulted by the student in connection with the discussions on the geological age of the rocks forming the structure of that region, the author regarding Eocene determinations of other palaeontologists as Upper Cretaceous. Prof. H. Douvillé, however, has given an analytical review of this subject, and

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[1] Über Tertiärfossilien, wahrscheinlich eozänen Alters, von Kamerun: *Beitr. Geol. Kamerun* (Esch), 1904, pls. 6–9, pp. 245–285.

[2] Die Eocäne Invertebraten-Fauna des Kalksteins in Togo: *Beitr. geol. Erfor. Deutsch. Schutzgeb.*, 1915, part 12, pls. 1–5, p. 126.

[3] "Sur les traces de la Mer Lutétienne au Soudan," and "Sur de Nouveaux fossils du Soudan" *Compt. Rend.*, 1903, Vol. 136, pp. 1118 and 1297.

[4] Sur la découverte du terrain nummulitique dans un sondage exécuté ā Saint-Louis du Sénégal: *Compt. Rend.*, 1892, Vol. 134, pp. 60–63.

[5] Materiaux pour la Paléontologie du Bas-et du Moyen-Congo: *Ann. Mus. Congo Belge*, 1913, Ser. 3, Vol. 1, Fasc. 1, p. 92, pls. 1–10.

[6] L'Éocene au Soudan et au Sénégal: *Bull. Com. Étud. Hist. Afrique Occid. Française*, 1920, pp. 113–171, pls. 1–5.

[7] Description Géologique des Régions situées entre Le Niger et le Tchad (Paris), 1911, pp. 284, maps, and one plate of fossil shells from the Adar-Doutchi Beds, which are referred to the Maestrichtian zone of the Upper Cretaceous series.

questions Garde's recognition of *Cardita beaumonti*, a well-known Cretaceous fossil from India, in the Soudan deposits. Further Molluscan forms are also mentioned by Douvillé, such as the occurrence of longirostriform Ostreas of the genus *Crassostrea*, at Tamaske associated with Chelonians and *Halitherium*, and he is of opinion that the character of the fauna generally admits of no doubt as to its Eocene age.

But without further remarks on the important question of West African stratigraphy, it is thought that the very brief reference here given to a few of the principal papers on the subject will be all sufficient for the purposes of this report. In any case, however, the Molluscan fauna now described, finds little or no analogy with any other peculiar to the immediately surrounding regions, its relationships being restricted to the Lutetian-Bartonian areas of Northern Africa, especially Egypt, the same facies extending to European and British rocks, and in a probably slighter manner to the Alabama Eocene beds of the United States. The same faunistic facies does not apparently extend to the Indian Eocene deposits.

INDEX OF GENERA AND SPECIES.

Plates and Explanations (Map and Shells).

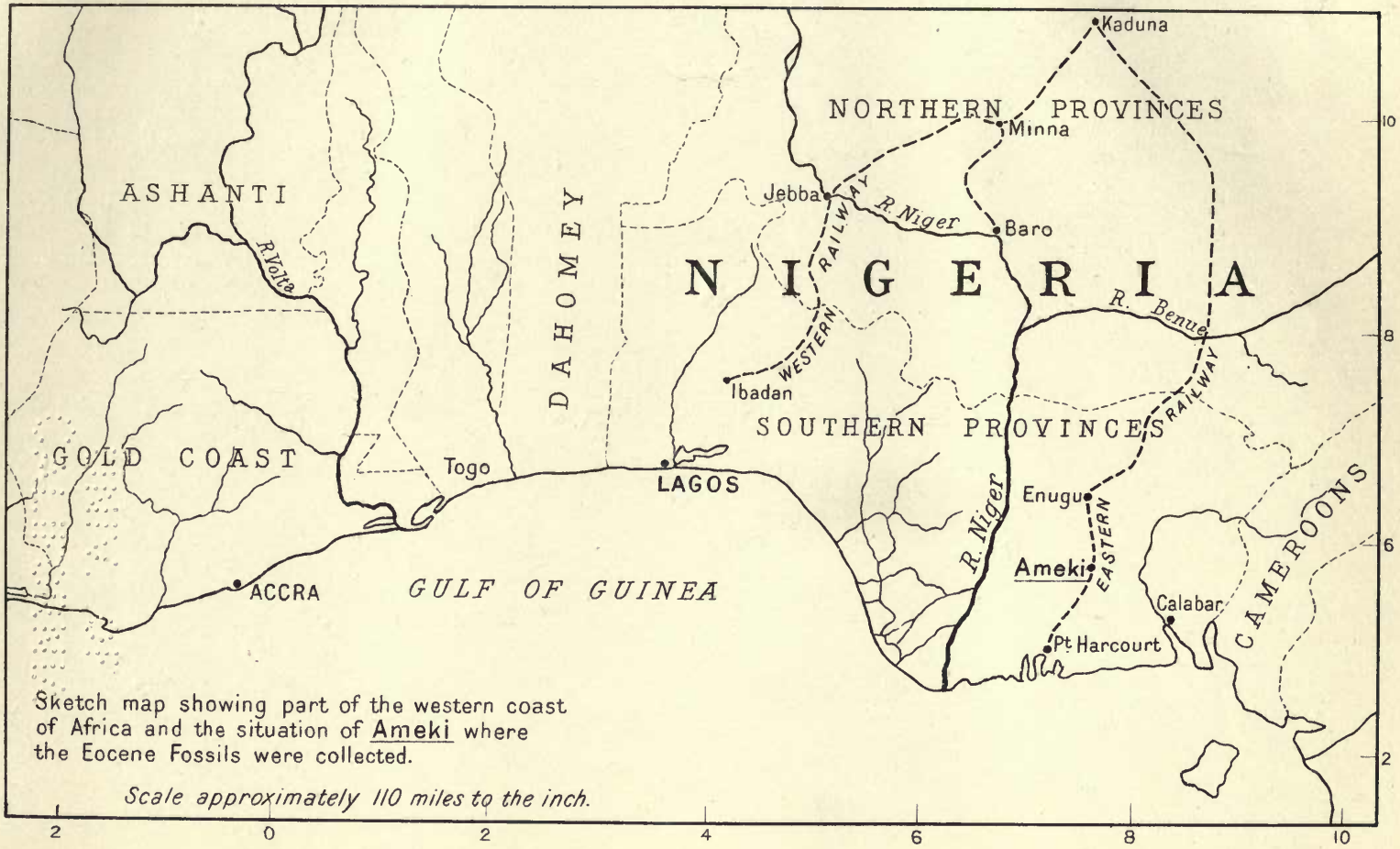
Except when otherwise marked, the figures are of natural size or nearly so.

PLATE 1.

Sketch-map of part of the Western coast of Africa showing the position of Ameki, Nigeria, where the Eocene Fossils were discovered.

Scale.—Approximately 110 miles to the inch.

Plate I.



Sketch map showing part of the western coast of Africa and the situation of Ameki where the Eocene Fossils were collected.

Scale approximately 110 miles to the inch.

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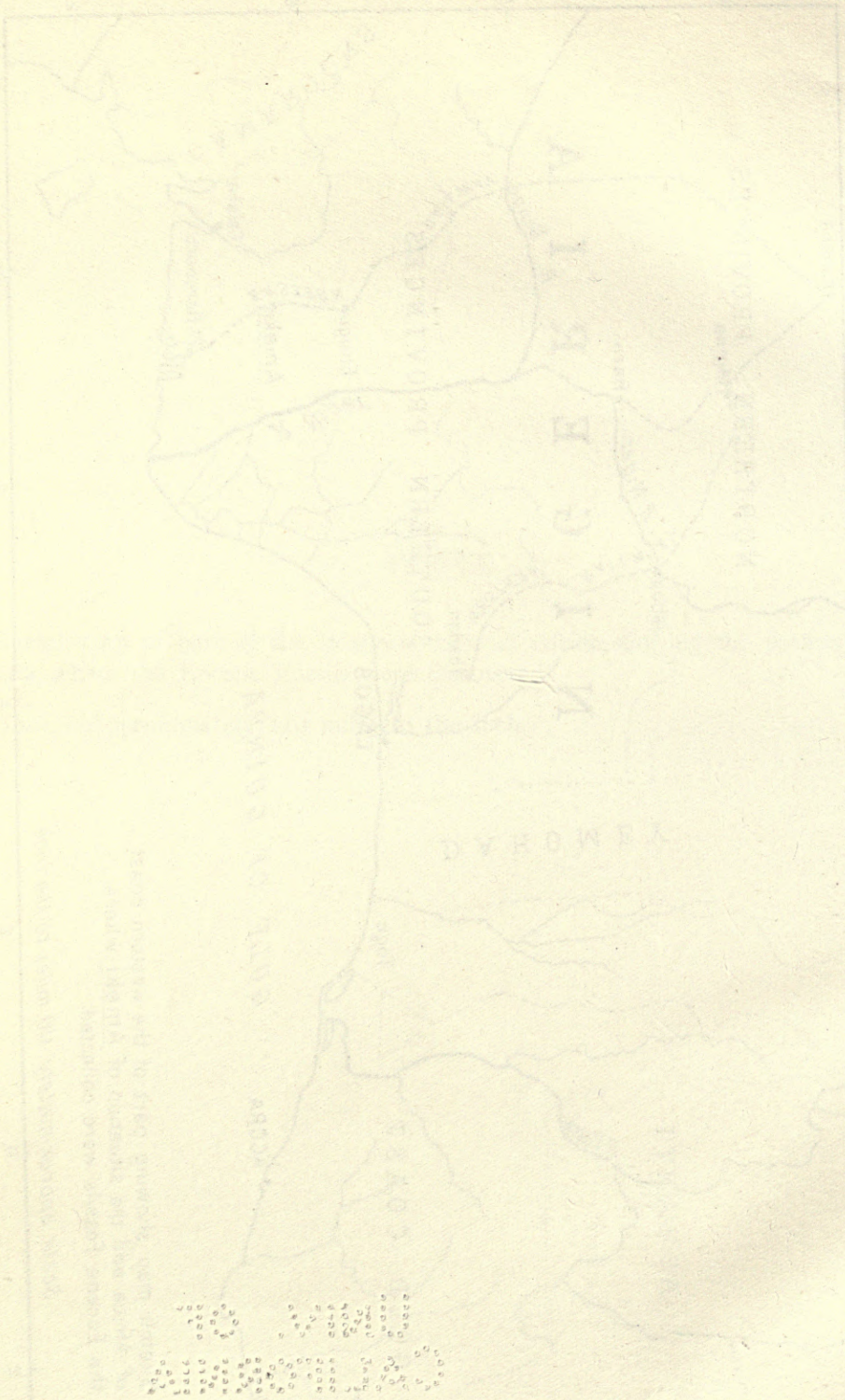


PLATE 2.

Belosepia sepioidea (Blainville).

FIG. 1.—Profile of the rostrum showing its curvature, and robust base.

FIG. 2.—Ventral view of same specimen showing the radiately channelled, semicircular plate, and the alveolar cavity beneath.

Surcula ingens (Mayer-Eymar).

FIG. 3.—Dorsal view of large example showing the deeply sinuated lines between the periphery and the suture.

FIG. 4.—Apertural aspect of same fossil.

FIG. 5.—Dorsal view of a younger specimen in which the peripheral tubercles and finely reticulate structure, are well preserved.

Surcula africana, sp. nov.

FIGS. 6 and 7.—Dorsal view of different examples showing the complicated ornamentation and the sinuated region between the periphery and the suture.

FIG. 8.—Apertural view of a small specimen.

Rhopalithes africanus, sp. nov.

FIG. 9.—Dorsal aspect showing the extremely fine spiral sculpture, and the swollen, longitudinal costae on the earlier whorls of the spire.

FIG. 10.—View of another specimen showing the narrow aperture and long vertical canal.

Eopleurotoma nigeriensis, sp. nov.

FIG. 11.—Profile of an example showing the outwardly curved margin of the aperture and the excavated sinus at the shoulder.

FIG. 12.—A smaller form showing the narrow aperture, and the closely costate sculpture.

Crepidula falconeri, sp. nov.

FIG. 13.—Profile of an adult example exhibiting the postero-lateral spiral region and the capacious body chamber.

FIG. 13A.—Interior of same individual with the sunken diaphragm, lateral muscular scars, and the probable mantle attachment markings on the inner surface.

Semiterebellum elongatum, sp. nov.

FIG. 14.—Dorsal view showing remains of spiral sculpture at the base, the recurved posterior canal, and obscure sutural carination.

FIG. 15.—Apertural view of another specimen, showing the forward curvature of the labrum, and the callosity covering the columella.

Sinum cf. clathratum (Gmelin).

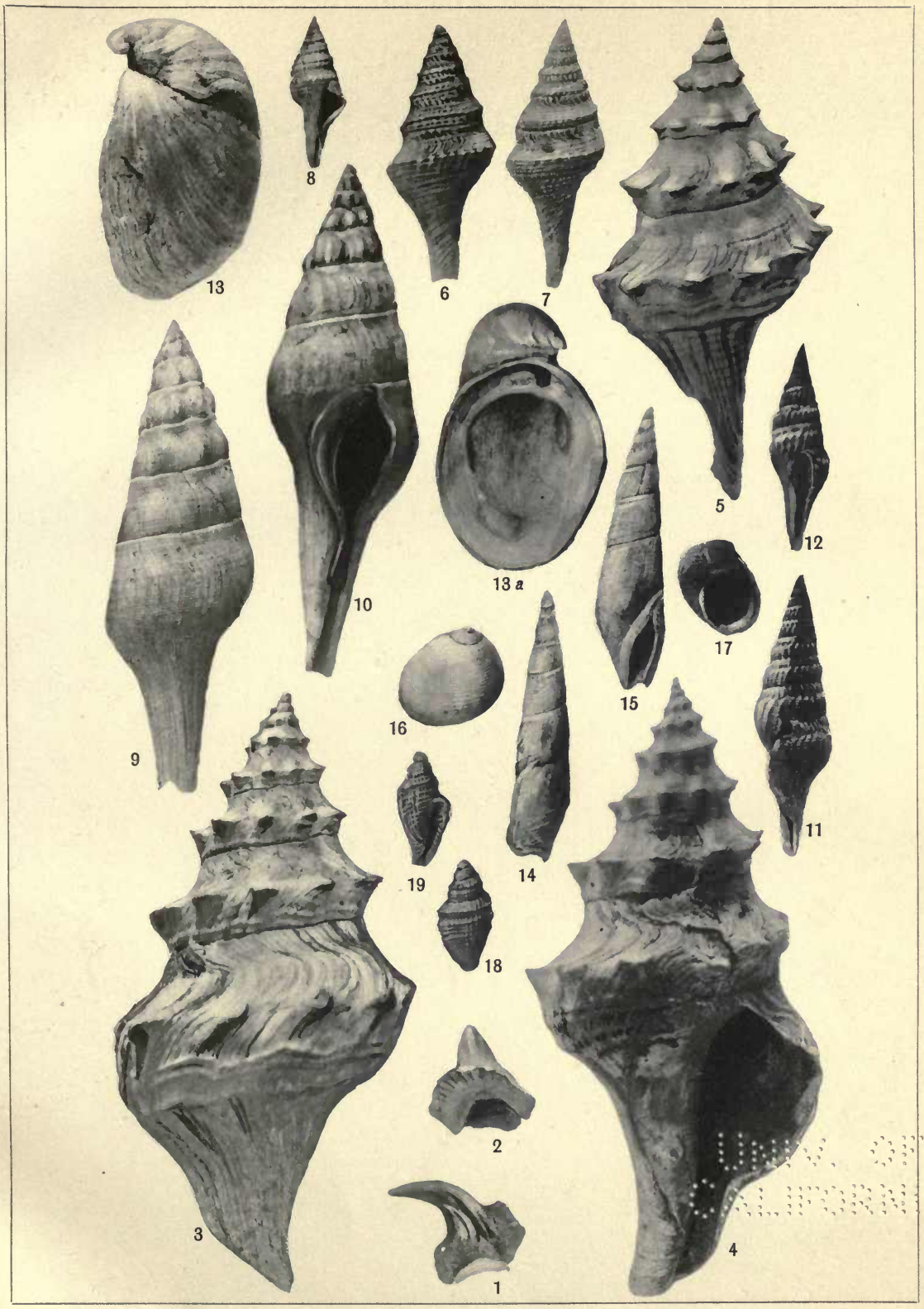
FIG. 16.—Dorsal view showing a well exposed depressed spire and the closely spiral sculpture.

FIG. 17.—Apertural view of a smaller specimen exhibiting the narrow, umbilical cavity, and the slightly reflected inner lip.

Cominella douvillei, sp. nov.

FIG. 18.—Dorsal view of example showing the complicated ornamentation.

FIG. 19.—View showing narrow, elongate aperture with the interno-marginal ridges of the outer lip.



P. Dollman, phot. *R. B. Newton, direx.*

EOCENE CEPHALOPODA AND GASTROPODA (NIGERIA).

PLATE 3.

Volutospina conicoturrita, sp. nov.

FIG. 1.—Dorsal view showing the conically built spire and hook-shaped marginal spines.

FIG. 2.—Ventral aspect of another example with a thin spreading callosity on the posterior surface of the body-whorl.

Volutospina multispinosa, sp. nov.

FIG. 3.—Ventral aspect showing elongate aperture and the spiniform-tubercle character of the sculpture.

FIG. 4.—Dorsal view of another specimen showing the closely ridged ornamentation of the anterior half of the shell.

FIG. 5.—Dorsal view of a young example.

Cornulina minax (Solander).

FIG 6.—Ventral aspect of specimen showing the peripheral spines and the widely depressed whorls.

FIG. 7.—Dorsal view of same showing the two distant and parallel rows of spines on the body-whorl, typical of the species.

Conispirus cf. parisiensis (Deshayes).

FIG. 8.—Dorsal view showing the excavated longitudinal striations on the periphero-sutural surface of the whorls.

FIG. 9.—Apertural view of another example exhibiting a minutely tubercled margin at the basal whorls of the spire.

Acrilla cf. affinis (Deshayes).

FIG. 10.—Fractured specimen showing the convexity and sutural depth of the whorls.

FIG. 11.—A disconnected base probably belonging to specimen represented by Fig. 10.

FIG. 12.—Magnified view of Fig. 11 showing sculpture characters. × 4.

Cypraea cf. bowerbanki, J. de C. Sowerby.

Fig. 13.—Apertural view showing the ridge-like teeth of both the inner and the outer lips, the contour lines being more or less approximate on account of the fractured condition of the specimen.

Amphiperas nigeriensis, sp. nov.

FIG. 14.—Dorsal view showing reticulate sculpture.

FIG. 15.—Another example showing the curvature of the mouth and the broad terminal channel openings.

Buccinorbis kitsoni, sp. nov.

FIG. 16.—Ventral view, exhibiting an elongate umbilical excavation and smooth columella.

FIG. 17.—Dorsal view of another specimen showing a well elevated spire, and a furrowed and funiculate base.

FIG. 18.—The upper part of specimen represented by Fig. 17, to show broad sutural platform.

FIG. 19.—Dorsal view of a young example with a metallic lustre, being naturally stained a brownish colour, covered with spiral ornamentation and longitudinal striations.

Liomesus africanus, sp. nov.

FIG. 20.—Dorsal aspect of example showing the spiral ornamentation at the base.

FIG. 21.—Ventral view of another form showing the uniplication near the base of the columella.

Poirieria cf. calcitrapa (Lamarck).

FIG. 22.—Dorsal view showing the equidistant peripheral spines.

FIG. 23.—Apertural view of a smaller specimen with posterior canaliculated spine and denticles within the inner margin of labrum.

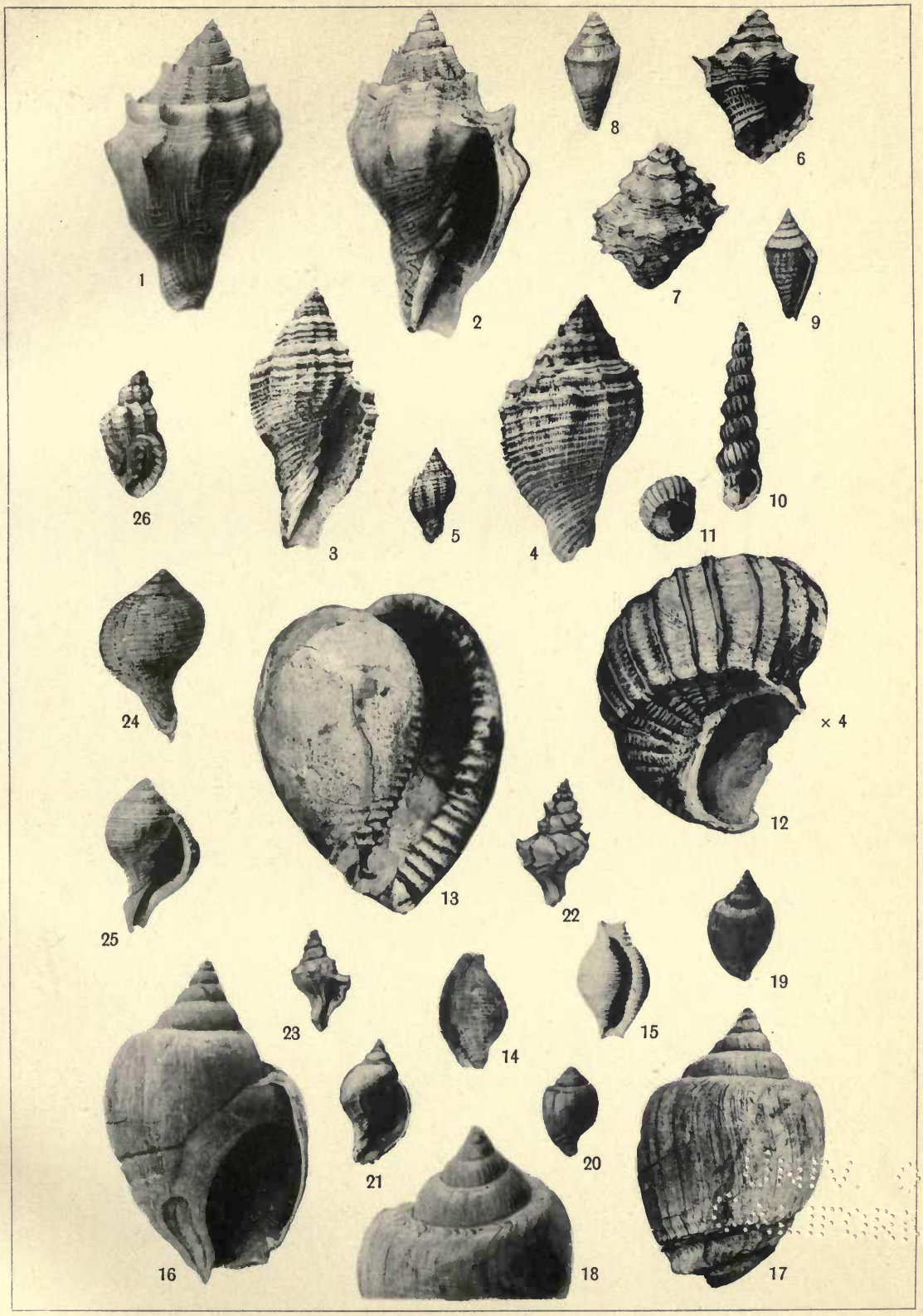
Strepsidura multispirata, sp. nov.

FIG. 24.—Dorsal aspect showing the closely arranged spiral sculpture.

FIG. 25.—Ventral view of another example showing the plicated columella.

Cancellaria multiplicis, sp. nov.

FIG. 26.—Ventral view of specimen with the plicated columella and the interno-marginal dentated labrum.



P. Dollman, phot. *R. B. Newton, direx.*

EOCENE GASTROPODA (NIGERIA).

PLATE 4.

Bulbifusus nigeriensis, sp. nov.

FIG. 1.—Dorsal view of adult form obscurely showing the sutural platform.

FIG. 2.—Ventral view of a younger example with an extremely thin labrum, and smooth columella.

Rostellaria unidigitata, sp. nov.

FIG. 3.—Ventral view of example showing the narrow canal and prominent callosity of the posterior region.

FIG. 4.—Dorsal aspect of another specimen showing elevated spire and its sculpture, and the wide basal notch.

FIG. 5.—Ventral view of a younger form with scarcely any sutural platform.

FIG. 6.—Another young specimen showing posteriorly the callosity and recurved canal, and the sinuous margin and reflective lip of the labrum with its digitation.

FIG. 7.—Young example with a perfect anterior canaliculate prolongation.

Rostellaria bidigitata, sp. nov.

FIG. 8.—Ventral view showing the earlier plicated whorls, and the double digitation of the labrum.

FIG. 9.—Another specimen, in profile, showing the marginal details of the labrum and the recurved character of the posterior canal.

Terebralia, sp. A.

FIG. 10.—An imperfect example showing columella region of fractured aperture, and the rather distant oblique costae.

Terebralia, sp. B.

FIG. 11.—A probable variety of the same species with numerous and closer costae.

Sinum africanum, sp. nov.

FIG. 12.—External view showing small and depressed spiral region and expansive body-whorl, with the straight margin to the labrum.

FIG. 13.—Ventral aspect exhibiting aperture and the strong concentric ridges on the columella side of the shell, the dark narrow cavity above represents a fracture.

Semiterebellum suturocostatum, sp. nov.

FIG. 14.—Apertural view in which the sutural ornamentation is only seen in the earlier volutions.

FIG. 15.—Profile of another example showing the margined labrum and the recurved posterior canal.

FIG. 16.—Dorsal aspect of another example showing the backward extent of the posterior canal.

FIG. 17.—Ventral view of a further specimen showing the posterior callosity of the inner lip.

Calyptraea crepidularis (Lamarck).

FIG. 18.—Spiral aspect of specimen with concentric rows of small spinose tubercles.

FIG. 19.—Interior of a smaller example showing the perforated and much sunken diaphragm.

Tugurium nigeriense, sp. nov.

FIG. 20.—Spiral view showing agglutinated surfaces near the suture, and peripheral irregularity.

FIG. 21.—Apertural view of another specimen with an obscure and partially covered umbilicus.

Janiopsis nigeriensis, sp. nov.

FIG. 22.—Ventral view of specimen showing a uniplicate columella and an internally ridged labrum.

FIG. 23.—Dorsal aspect of another example exhibiting the perpendicular plications.

Hilda turriculata, sp. nov.

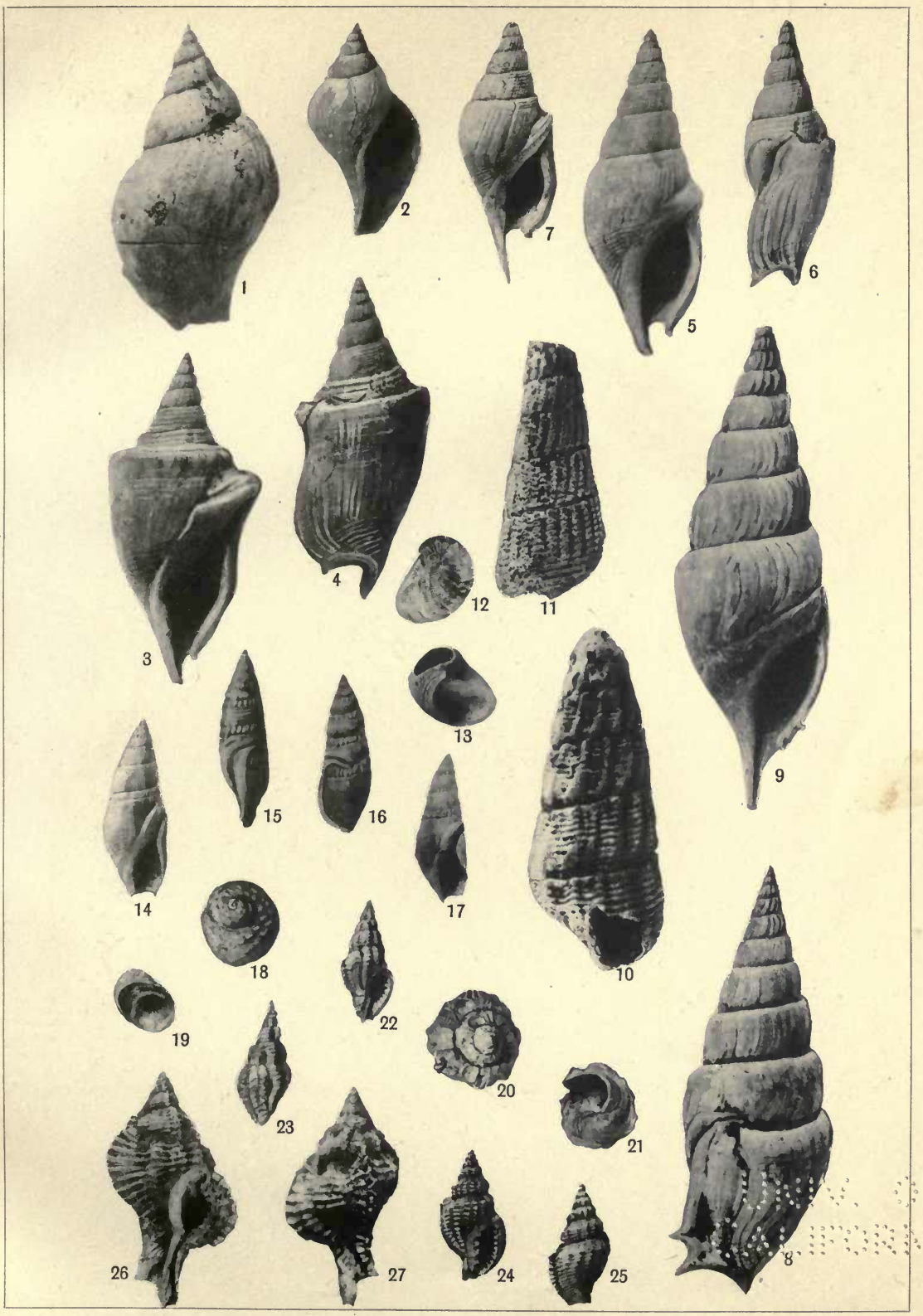
FIG. 24.—Apertural aspect showing columella plications and denticulated labrum.

FIG. 25.—Dorsal view of another specimen with imperfect basal termination.

Pteropurpura cf. tricarinata (Lamarck).

FIG. 26.—Specimen showing the rounded character of the varices, the denticulated labrum, a posterior plication on the smooth columella, and the narrowly elongate anterior canal with a short tubular accessory extension on the left side.

FIG. 27.—Dorsal view of same example in which a polyzoan (*Membranipora*) growth covers a large part of the spire.



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EOCENE GASTROPODA (NIGERIA).

PLATE 5.

Athleta lugardi, sp. nov.

FIG. 1.—An adult example showing the long, narrow aperture with the marginally thin labrum, the prominent rounded posterior callosity, and the twisted "bourrelet" at the base.

FIG. 2.—Summit view of the volutions of the same specimen showing periodical growth ridges.

FIG. 3.—An apertural view of a smaller specimen with a less depressed spire.

Turritella mauryana, sp. nov.

FIG. 4.—View showing sub-quadrangular aperture, and the sub-horizontal shelf-like structure of the volutions.

FIG. 5.—The earlier part of the spire of another specimen.

FIG. 6.—Fragment of an adult form showing the well excavated striations between the suture and peripheral carination.

Turritella cf. sulcifera, Deshayes.

FIG. 7.—A profile view of example showing the closely spiral sculpture.

Exechestoma cossmanni, sp. nov.

FIG. 8.—Dorsal aspect of example in which the upper part of the spire is absent, showing the equidistant tubercles and the pair of spiral ridges at the base.

FIG. 9.—Ventral aspect of a smaller specimen showing the sub-quadrangular aperture.

Stellaxis bicingulata, sp. nov.

FIG. 10.—Spiral view of example.

FIG. 11.—Base of another specimen showing marginal tubercles to the whorls in the umbilical cavity and the bicingulation near the margin.

Solariaxis cf. spectabilis (J. de C. Sowerby).

FIG. 12.—Spiral view exhibiting close concentric striations bearing minute tubercles.

FIG. 13.—The base of another specimen with deep umbilical cavity and marginal tubercles to the whorls.

Bonellitia cf. evulsa (Solander).

FIG. 14.—Ventral view showing aperture and the triplicate columella.

FIG. 15.—Dorsal view of another example showing the elevated plications.

Neverita cf. calvimontana (Deshayes).

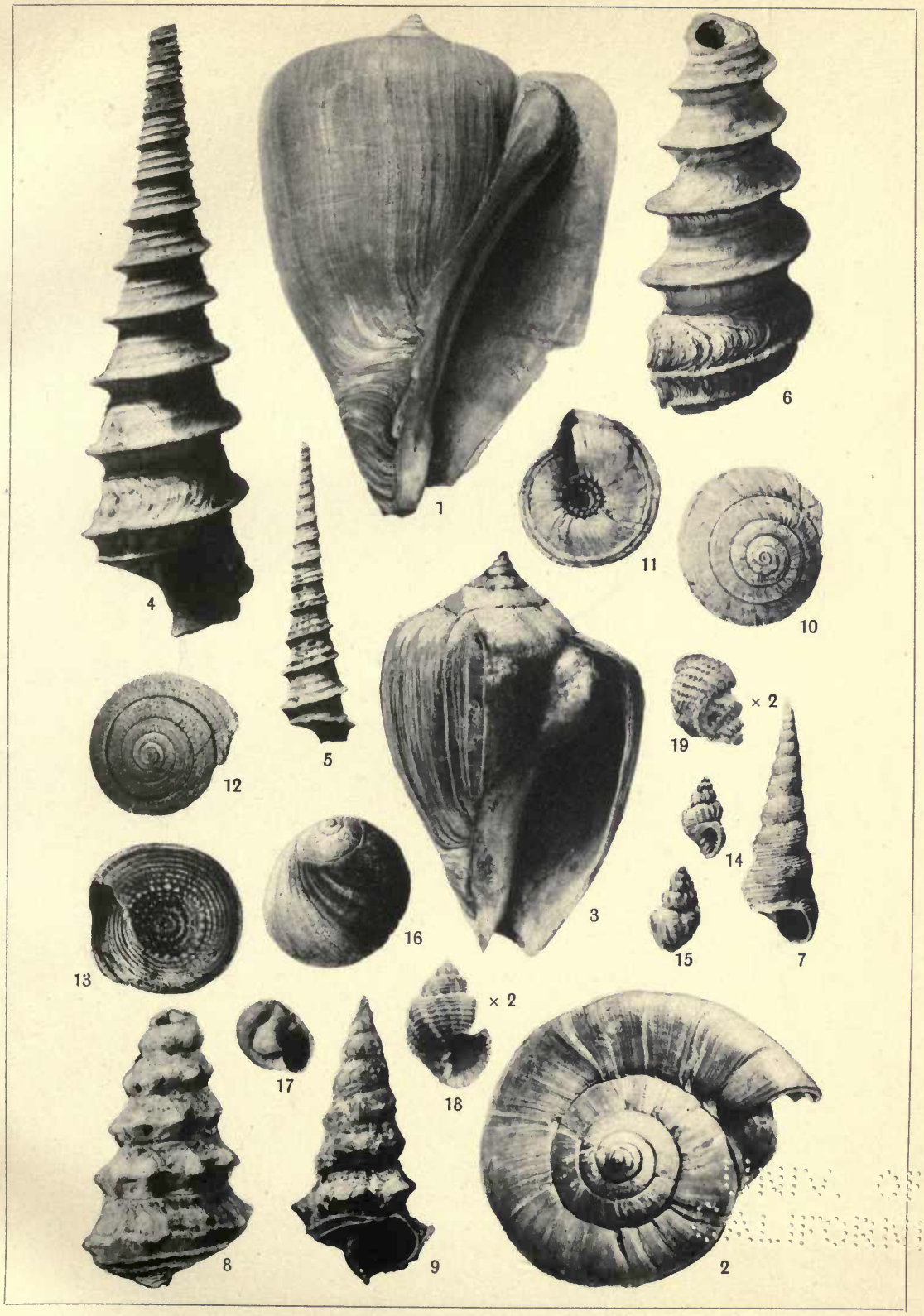
FIG. 16.—Dorsal view showing depressed spiral region, with minutely canaliculated suture, and extensive body whorl.

FIG. 17.—A younger specimen exhibiting the semilunate aperture, with a prominent funiculate callosity occupying the umbilicus.

Trigonostoma decorata, sp. nov.

FIG. 18.—Apertural view showing spinose sutural margins and the interno-marginal ridges of the labrum. × 2.

FIG. 19.—Dorso-lateral view of another example showing the sutural sulcation furnished with radial ridges. × 2.



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EOCENE GASTROPODA (NIGERIA).

PLATE 6.

Crassostrea lugardi, sp. nov.

FIG. 1.—Interior of lower valve, with striated ligament region, and large radially ribbed muscular scar. For external view of same specimen *see* Plate 7, fig. 1.

Ostrea cf. marginidentata, S. V. Wood.

FIG. 2.—Outer view of a regularly contoured upper valve, with obscure radial striations.

FIG. 3.—Interior of same specimen exhibiting the dentated margin.

FIG. 4.—External aspect of an upper valve with deeply cut plicated margin.

FIG. 5.—Interior of same showing marginal dentations.

Plicatula polymorpha, Bellardi.

FIG. 6.—Exterior of a right valve of example with closed valves showing obscure striations in the furrows.

FIG. 7.—Ventro-marginal view of another specimen showing valvular folding.

FIG. 8.—Interior of a right valve showing nodular sockets between the margin and pallial line.

FIG. 9.—Interior of a left valve of another specimen, bearing nodulations.

Nucula costaeimbricatis, sp. nov.

FIG. 10,—Example with closed valves. × 2.

FIG. 10a.—Sculpture of same, magnified.

FIG. 11.—Interior of another specimen showing the hinge teeth and minute marginal dentations. × 2.

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EOCENE PELECYPODA (NIGERIA).

PLATE 7.

Crassostrea lugardi, sp. nov.

FIG. 1.—External view of lower valve bearing radial costae, the same example as depicted on Plate 6, fig. 1.

Divaricella oppenheimi, sp. nov.

FIG. 2.—Exterior of a left valve, with angulate costae. × $2\frac{1}{4}$.

FIG. 3.—Interior of another left valve showing hinge region and marginal dentations. × $2\frac{1}{4}$.

Phacoides subrhomboidalis, sp. nov.

FIG. 4.—External view of right valve of example with closed valves.

FIG. 5.—Dorsal aspect of same, showing its compressed valves and narrow, elongate ligament region.

Cardium cf. obliquum, Lamarck.

FIG. 6.—Umbonal aspect of specimen with closed valves.

FIGS. 7 and 8.—Interiors of opposing valves showing dentition and serrated margins.

FIG. 9.—External view of a valve showing costal structure. × 2.

Mactra semisulcata, Lamarck.

FIG. 10.—Exterior of a left valve.

FIG. 11.—Different view of same specimen, shortened in front to show the dorso-lateral compressions.

FIG. 12.—Interior of left valve of another example.

FIG. 13.—Interior of right valve of a different individual.

Corbula rugosa, Lamarck.

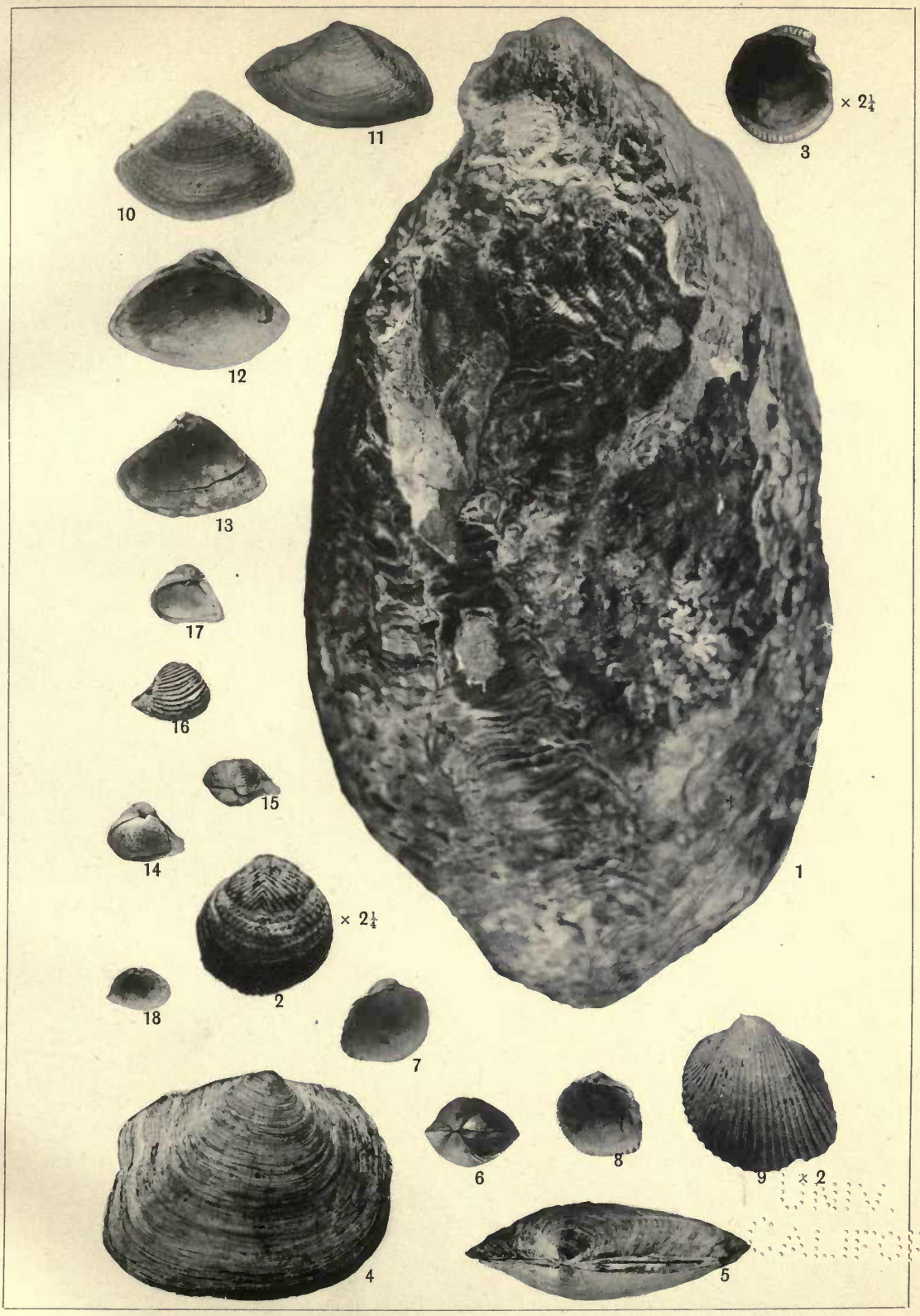
FIG. 14.—View of specimen with closed valves.

FIG. 15.—Another example with closed valves showing the inward umbonal curvature of the lower valve.

FIG. 16.—Outer view of another lower valve showing its strong concentric ridges.

FIG. 17.—Inner view of a lower valve.

FIG. 18.—Interior of an upper valve.



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EOCENE PELECYPODA (NIGERIA).

PLATE 8.

Crassostrea lugardi, sp. nov.

FIG. 1.—Interior of an upper valve.

Ostrea cf. ludensis (Deshayes).

FIG. 2.—Interior of an upper valve.

FIG. 3.—An enlarged external view of same valve to exhibit the radio-longitudinal striations. × $2\frac{1}{4}$.

Anadara nigeriensis, sp. nov.

FIG. 4.—Umbonal view of example with closed valves.

FIG. 5.—Ventral view of smaller specimen with closed valves showing the scalloped margins.

FIG. 6.—Internal aspect of a left valve of large size.

FIG. 7.—Interior of a medium sized right valve.

Glycymeris nigeriensis, sp. nov.

FIG. 8.—Outer view of a right valve showing closely costated surface.

FIG. 9.—Inner view of left valve of probably the same example.

FIG. 10.—Example with closed valves giving the umbonal aspect.

Striarca africana, sp. nov.

FIG. 11.—Dorsal view of example with closed valves.

FIG. 12.—Interior of a right valve.

FIG. 13.—External sculpture characters. × 3.

Fossularca africana, sp. nov.

FIG. 14.—Umbonal view of specimen with closed valves.

FIG. 15.—Exterior of a right valve.

FIG. 16.—Interior of a right valve of another specimen.

FIG. 17.—Interior of a left valve of another specimen.

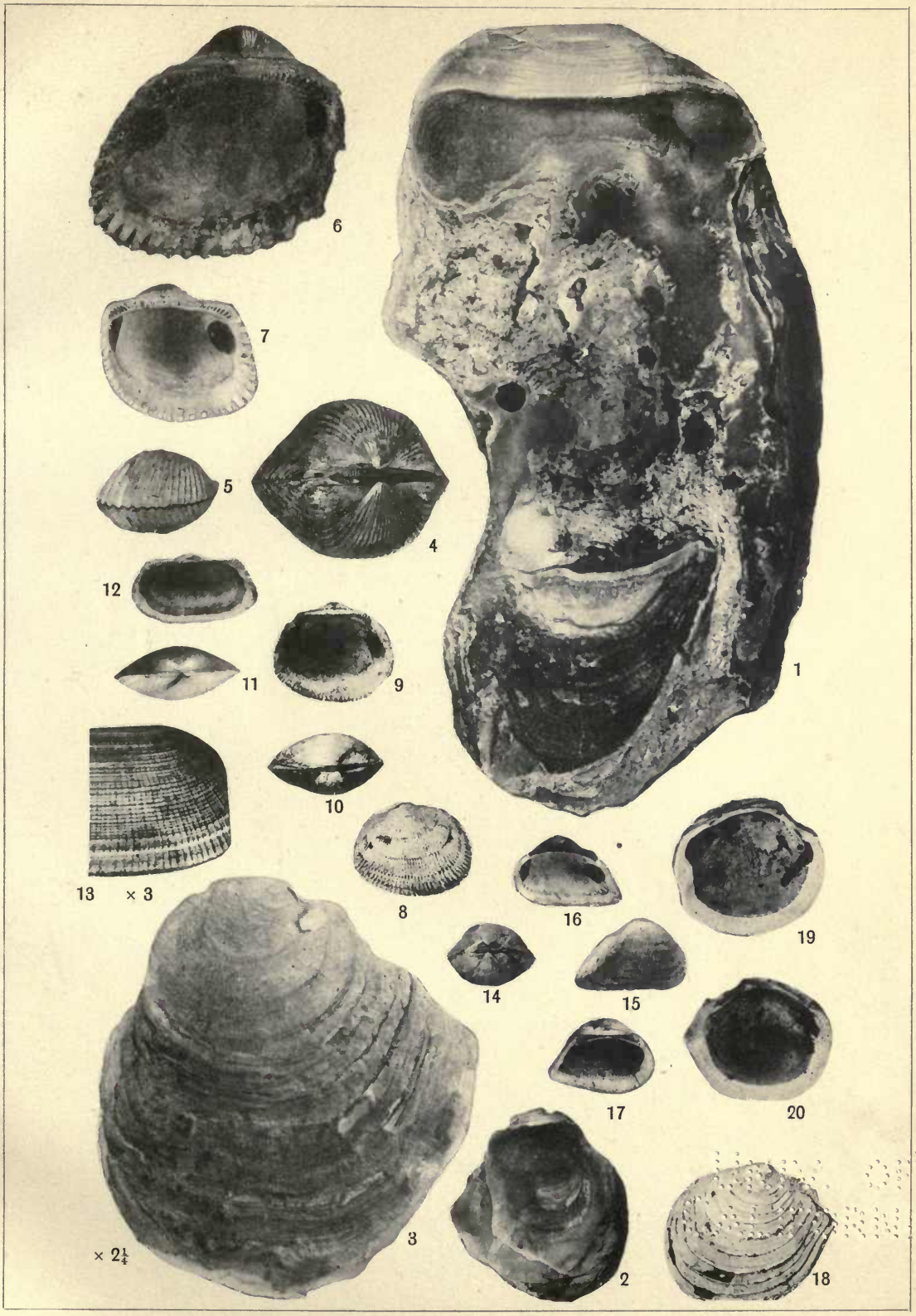
Phacoides eaglesomei, sp. nov.

FIG. 18.—External view of right valve.

FIG. 19.—Interior of a left valve of another specimen showing the narrowly elongate, anterior adductor scar.

FIG. 20.—Interior of right valve.

These three figures are slightly enlarged.



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EOCENE PELECYPODA (NIGERIA).

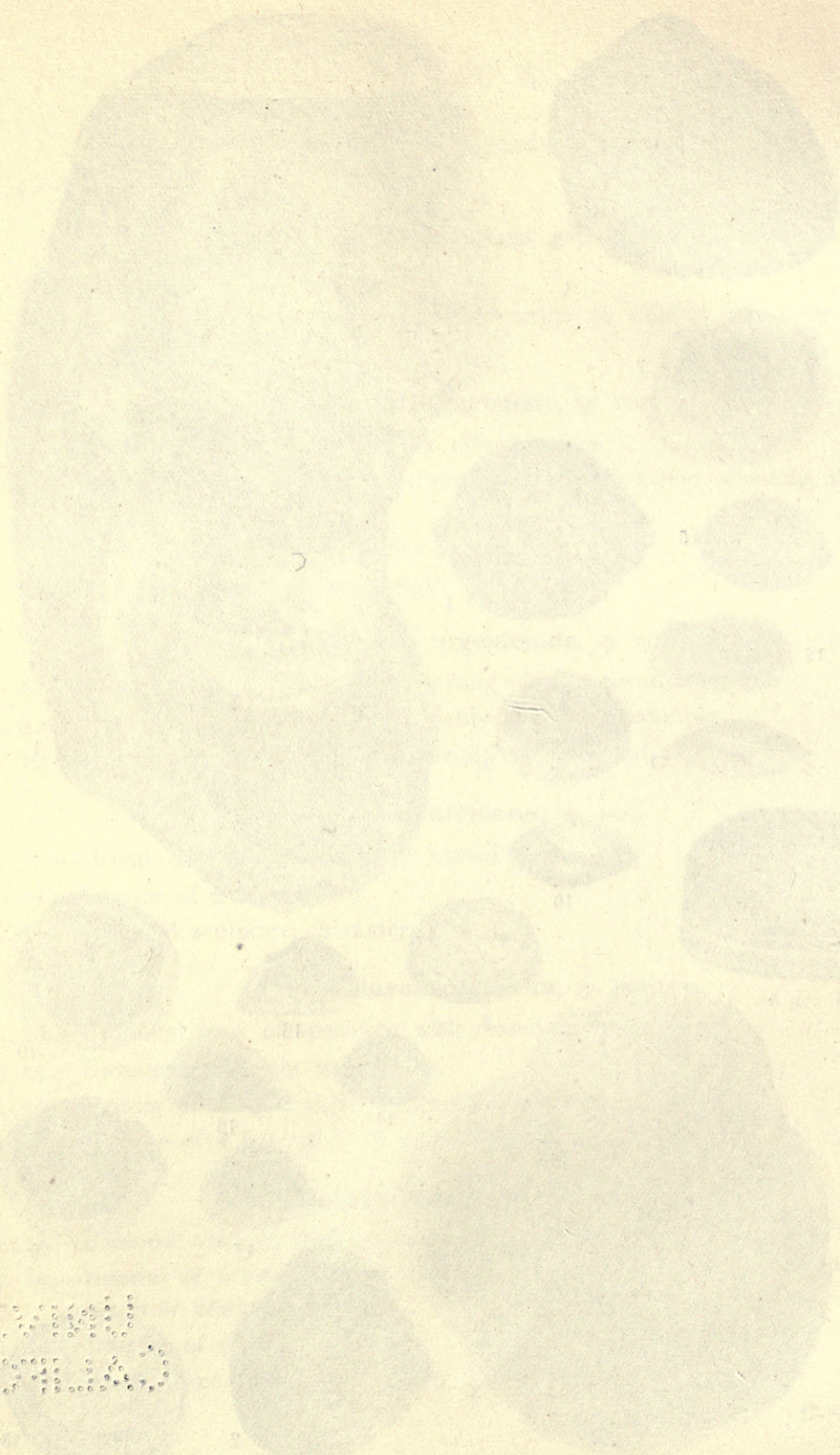


PLATE 9.

Callista elongatotrigona, sp. nov.

FIG. 1.—External aspect of a small right valve, showing strong concentrically banded sculpture and intermittent concentric striations. × $2\frac{1}{8}$.

FIG. 2.—Interior of same valve with its pallial markings. × $2\frac{1}{8}$.

FIG. 3.—Outer aspect of left valve of more adult age.

FIG. 4.—Interior of left valve of similar age.

FIG. 5.—Interior of a medium sized right valve.

Tivelina cf. sphenarium (Bayan).

FIG. 7.—Outer view of left valve, slightly enlarged.

FIG. 8.—Inner view of a right valve showing dentition and pallial markings, slightly enlarged.

FIG. 9.—Interior of a left valve, slightly enlarged.

FIG. 10.—Umbonal view of example showing closed valves, the interiors of which are represented by Figs. 8 & 9.

Callista kitsoni, sp. nov.

FIG. 11.—External view of a right valve (same individual as Fig. 13).

FIG. 12.—Inner view of a right valve.

FIG. 13.—Interior of a left valve (same individual as Fig. 11).

FIG. 14.—Umbonal view of example with closed valves.

FIG. 6.—Umbonal view of younger example with closed valves.

Cordiopsis incrassata (J. Sowerby).

FIG. 15.—Outer aspect of a right valve, slightly enlarged.

FIG. 16.—Internal view of another right valve, slightly enlarged.

FIG. 17.—Interior of a left valve, slightly enlarged.

Sinodia heward-belli, sp. nov.

FIG. 18.—Exterior of a left valve.

FIG. 19.—Interior of another left valve.

FIG. 20.—Interior of a right valve.

FIG. 21.—Umbonal view of example with closed valves.

Cardita costaenodulosis, sp. nov.

FIG. 22.—Outer view of a left valve.

FIG. 23.—Inner view of another left valve showing the wide marginal plications.

FIG. 24.—Interior of a right valve.

FIG. 25.—Dorsal view of an example with closed valves.

Cardita triparticostata, sp. nov.

FIG. 26.—Exterior of a left valve with tripartite costae.

FIG. 27.—Interior of another left valve.

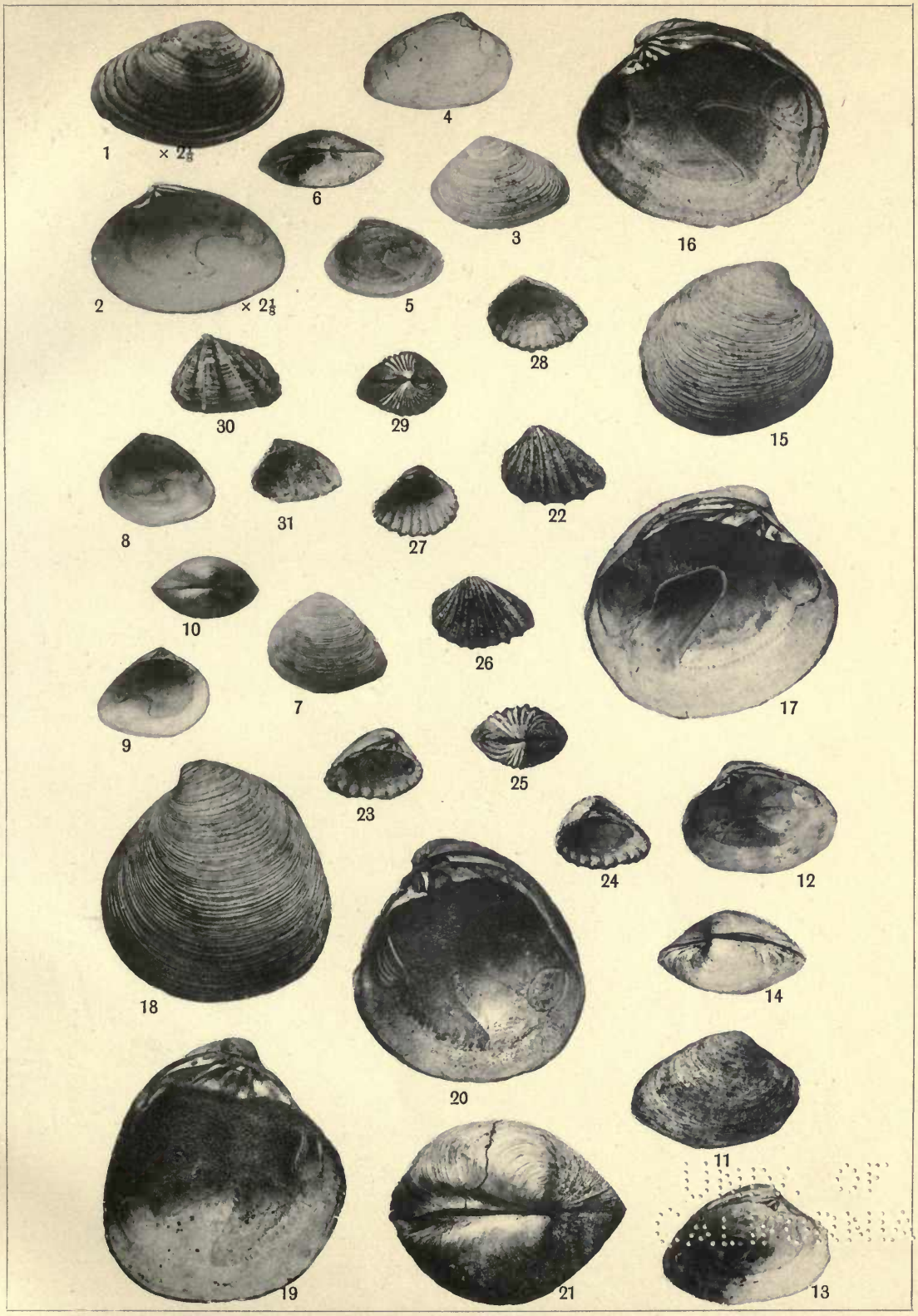
FIG. 28.—Interior of a right valve.

FIG. 29.—Dorsal view of an example with closed valves.

Cardita costaeirregularis, sp. nov.

FIG. 30.—Outer view of a left valve with wide and narrow costae.

FIG. 31.—Interior of right valve of another specimen.



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EOCENE PELECYPODA (NIGERIA).

PLATE 10.

Raetomya schweinfurthi (Mayer-Eymar).

FIG. 1.—Copy of Mayer-Eymar's original figure of the type from the Eocene of Egypt. The remaining figures represent specimens from Southern Nigeria which have been, also, previously published.

FIG. 2.—Left lateral view of a pair of closed valves of medium size.

FIG. 3.—Dorsal view of same specimen showing the depresso-concave anterior end, the laterally approximate umbones, and the posterior gape, enlarged one-fifth.

FIG. 4.—Right lateral aspect of specimen consisting of a pair of valves of larger size than Fig. 2, showing good testiferous structure and the bifurcation of the costae in the central part of the shell.

FIG. 5.—Dorsal portion of an adult example exhibiting the separation of the umbones. Note that the right-hand side of this figure is posterior.

FIG. 6.—Hinge aspect of the smallest example found, representing a left valve with the outwardly projecting chondrophore.

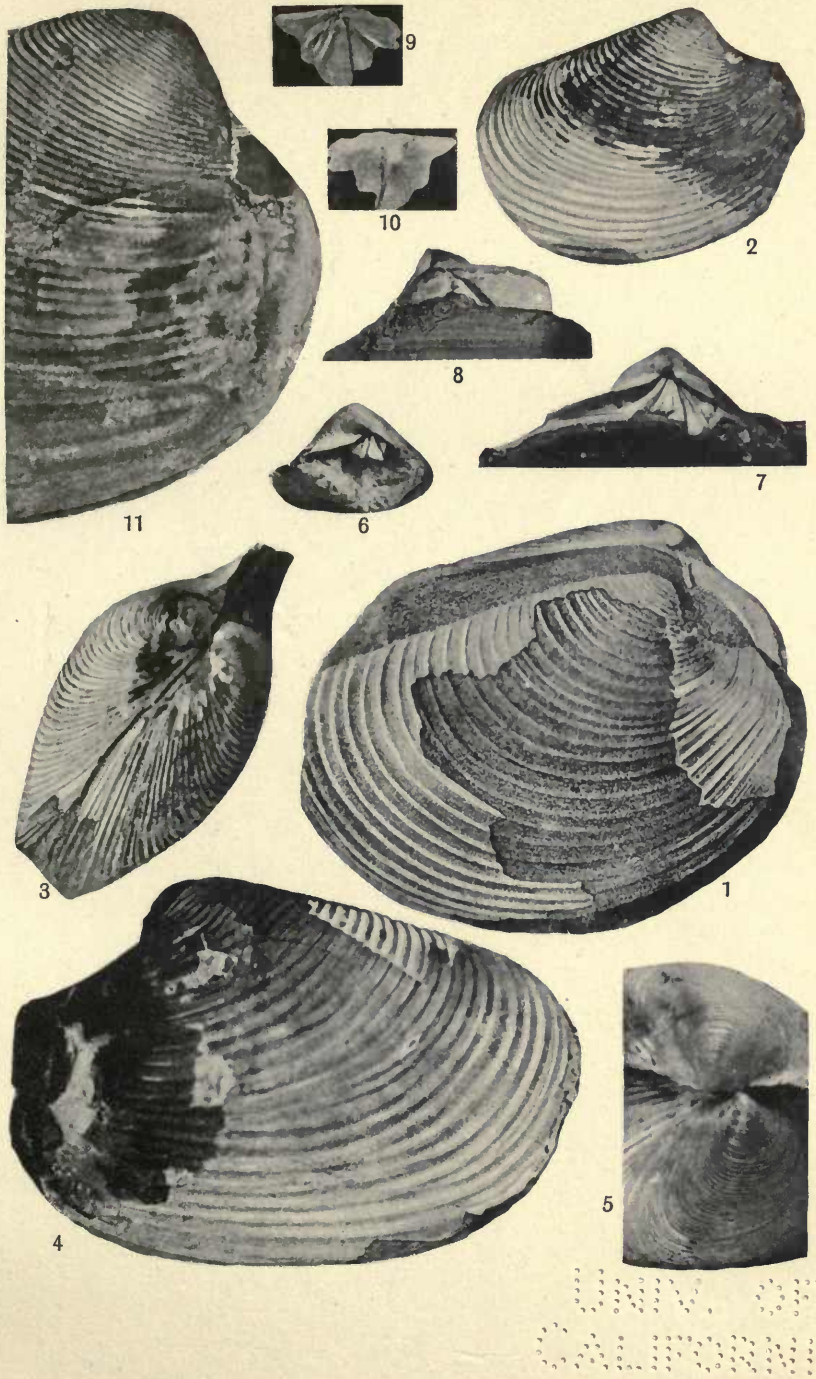
FIG. 7.—A disconnected hinge region of a left valve belonging to a moderately large specimen, showing the triangular chondrophore plate with the long funnel-shaped cavity in front, which is supposed to have held the anterior portion of the resilium. The black bases of Figs. 7 and 8 represent the hard flinty matrix which fills the remainder of the valves.

FIG. 8.—The opposing hinge of same specimen, showing a differently constituted chondrophore, and which is vertically disposed in the sub-umbonal cavity.

FIG. 9.—The upper surface of an isolated chondrophore plate, showing its coalescent elements, and which must have belonged to a very large example.

FIG. 10.—Basal surface of same specimen, more or less bulbous and furrowed, and quite smooth.

FIG. 11.—Portion of a large internal cast with united valves, showing the postero-lateral surface of the left valve with its extensive and rounded pallial sinus.



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EOCENE PELECYPODA (NIGERIA & EGYPT).

PLATE 11.

Peronaea nigeriensis, sp. nov.

FIG. 1.—External view of a left valve.

FIG. 2.—Interior of another left valve showing the divergent cardinal teeth and the nearly horizontal pallial sinus.

FIG. 3.—Interior of a right valve belonging to a different individual.

Coralliophaga eocenica, sp. nov.

FIG. 4.—External aspect of left valve showing anterior umbo and acuminate posterior end. × $2\frac{1}{2}$.

FIG. 5.—Interior of the right valve of same specimen with fractured ventral region. × $2\frac{1}{2}$.

Teredo, sp.

FIG. 6.—Outer view of left valve showing the obliquely concentric ornamentation. × $2\frac{1}{2}$.

FIG. 7.—Interior of same valve with a well marked styloid myophore. × $2\frac{1}{2}$.

FIG. 8.—Mass of *Teredo* tubes, one marked with a X containing remains of a pair of valves of this genus.

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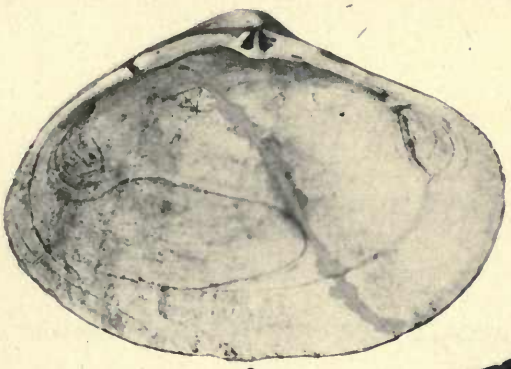

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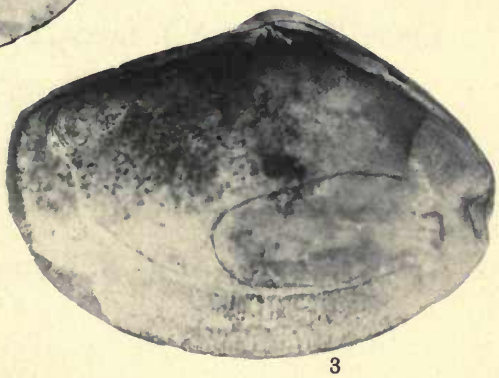

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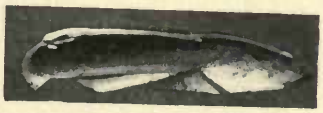

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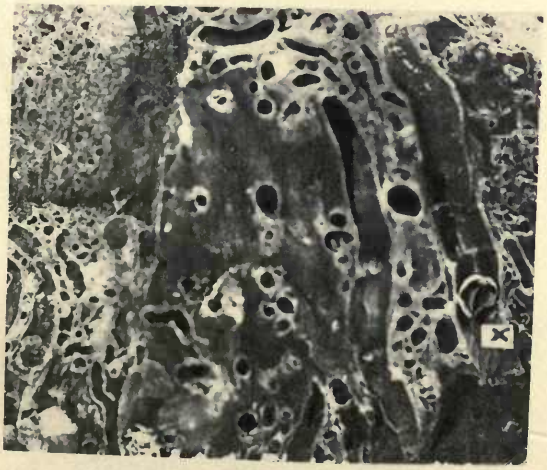

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8

7 × 2½

P. Dollman, phot. *R. B. Newton, direx.*

EOCENE PELECYPODA (NIGERIA).

APPENDIX.

Foraminifera from the Eocene Clay of Nigeria.

By

E. Heron-Allen, F.R.S., F.G.S.

and

A. Earland, F.R.M.S.

FORAMINIFERA FROM THE EOCENE CLAY OF NIGERIA.

PLATE 12.

The subjoined list of species must not be taken as in any way approaching completeness, or even as giving the representative forms to be found in the deposit, but it may be taken as a preliminary list of the typical and common forms. The sample of material submitted to us which had been collected by Sir Frederick Lugard, G.C.M.G., was very small, not more than 50 c.c. in all; and there is little doubt that the examination of a sufficient quantity of the clay would give very extended results. It was obtained from the same beds at Ameki in the district of Omobialla, situated in the Southern Provinces of Nigeria, which yielded the Mollusca described in this *Bulletin.*

At the same time, the sample, limited as it was, has furnished a few very distinctive and interesting forms, one of which, at least, *Virgulina schreibersiana* var. *marginata* may safely be described as new to science. The two Miliolids, *M. sulcifera* (Roemer) and *M. bicarinella* (Reuss) are interesting, as not having been recorded again since they were first described and figured by their authors. The occurrence of *Peneroplis carinatus*, d'Orbigny, which we recorded from the Eocene of Selsey Bill[1] is noteworthy, as also is the fact that the only representative of *Bulimina* is found in *B. fusiformis*, Williamson, which must be abundant in the deposit. We record also the typically cold-water species *Globigerina pachyderma* (Ehrenb.), which also occurred at Selsey. The Nonioninae are interesting but involved, the species running into one another and exhibiting an extraordinary tendency to limbation of the sutures; this tendency is noticeable also in other species, notably in *Pulvinulina brongniartii* (d'Orb.) and *Bolivina textilarioides*, d'Orb.

The facies indicates shallow water and a temperate climate. *Peneroplis*, alone, indicates tropical or semi-tropical conditions and the single specimen

[1] E. Heron-Allen & A. Earland: "The Recent and Fossil Foraminifera of the Shore Sands at Selsey Bill, Sussex": *Journ. R. Micr. Soc.*, 1909, Part 3, p. 320.

is small and starved. The other species are such as might be expected to-day in the latitude of the northern Mediterranean and at a depth probably not exceeding 50 fathoms.

Having made an exhaustive study of the Eocene clays of Selsey Bill, and of the Côte des Basques of Biarritz, the results of which have been published elsewhere,[1] we think it advisable, or, at any rate, of interest to compare these gatherings with the small sample under discussion. We have therefore appended the letter *S.* to species found at Selsey, and the letter *B.* to species found at Biarritz. It will be observed that of the 51 species recorded below, 33 have been recorded from Selsey, 35 from Biarritz and 25 from both localities. The complete absence of *Nummulites*, and, excepting in a few isolated "casts", of Glauconite, is a very unexpected feature in what purports to be an Eocene clay.

It is possible that a few of the specimens are derived from older strata, notably the cast of *Discorbina globularis* (d'Orb.) and another cast of an unidentified species of *Vaginulina*. Neither of these specimens have the characteristic appearance of the other fossils. Among the Nonioninae, the limbate individuals of *N. boueana*, d'Orb. are stained and eroded, whereas the others preserve their hyaline texture. On the other hand, the Miliolids are, in general, in a state of preservation quite remarkable for specimens of this genus.

[1] E. Halkyard: "The Fossil Foraminifera of the Blue Marl of the Côte des Basques Biarritz," 1919, 8vo., Manchester, Edited, with additions by E. Heron-Allen, & A. Earland, Mem. Proc. Manchester Lit. and Phil. Soc., 1917-18, Vol. 62, Pt. 2, No. 6.

LIST OF SPECIES.

NOTE.—Abbreviations used in this list :—

S. = Selsey Bill.
B. = Biarritz.

Further abbreviations used are explained in the list of works given on p. 146.

1. *Spiroloculina excavata*, d'Orbigny 1846, F.F.V., p. 271, pl. 16, figs. 19–21.

   One specimen, large but weak. S., B.

2. *Miliolina tricarinata* (d'Orbigny) 1839, F.C., p. 187, pl. 11, figs. 7–9 and 13.

   Small but typical. S., B.

3. *Miliolina pygmaea* (Reuss) 1849–50, F.O.T., p. 20, pl. 5, fig. 3.

   One typical specimen, pyritized ; and two others, longer, less sigmoid, and with the calcareous shell unaltered. S.

4. *Miliolina seminulum* (Linné) 1767, etc., S.N., 1788, p. 3739; Brady, 1884, F.C., p. 158, fig. 2.

   One worn specimen. S., B.

5. *Miliolina contorta* (d'Orbigny) 1846, F.F.V., p. 298, pl. 20, figs. 4–6.

   Two specimens, one being extremely compressed showing no less than five chambers in the side view. S., B.

6. *Miliolina ferussacii* (d'Orbigny) 1826, T.M.C., p. 301, No. 18, and Modèle, No. 32.

   Very thin walled. S., B.

7. *Miliolina boueana* (d'Orbigny) 1846, F.F.V., p. 293, pl. 19, figs. 7–9.

   Well-preserved specimens, characterised by large gaping apertures. One specimen has the striae more or less missing, probably from erosion, as another specimen in a clearly eroded condition has a nearly smooth test. S., B.

8. *Miliolina bicarinella* (Reuss) 1869, F.O.G., p. 456, pl. 1, fig. 6.

Pl. 12, fig. 2, a–c.

Three specimens of this pretty little form which does not appear to have been recorded since 1869. The specimens agree very well with Reuss's description, but are even more narrow and delicate than his figure suggests.

9. *Miliolina sulcifera* (Roemer) 1838, C.N.T.M., p. 393, pl. 3, fig. 76.

Pl. 12, fig. 3, a–c.

Roemer's figure is so small as to be very obscure, but the single specimen answers to his description, except that the costae to which he refers are regular instead of anastomosing.

10. *Miliolina* (*Adelosina*) *laevigata* (d'Orbigny) 1846, F.F.V., p. 302, pl. 20, figs. 22–24.

Small and pauperate.

11. *Miliolina* (*Adelosina*) *bicornis* var. *elegans* (d'Orbigny) 1826, T.M.C., p. 301, No. 12 ; Fornasini, 1902, F.L.R., p. 26, fig. 19. (*Adelosina bicornis*).

Pl. 12, fig. 1, a–c.

Four specimens, one perfect, the others more or less fragmentary. d'Orbigny's *nomen nudum* was established by Fornasini and figured *ut suprâ*. We have examined d'Orbigny's type specimens in Paris and noted them as a round-edged variety of *M. bicornis*, which agrees with Fornasini's diagnosis. The Nigerian specimens differ somewhat in the less produced oral extremity, and in a tendency to an extinction of the striation on the basal half of the ultimate and penultimate chambers. These compressed and finely striate variations of *M. bicornis* are comparatively rare, even in localities where the species is today abundant and extremely variable. We have met with closely similar forms in the Grand Harbour of Valetta (Malta), with every other conceivable variation of *M. bicornis*. Somewhat similar forms have been figured by other authors, notably by Costa 1856, P.R.N., p. 326, pl. 25, fig. 11 (*Quinqueloculina nussdorfensis*, d'Orb.), but differing considerably from d'Orbigny's original figure in d'O. 1846, F.F.V. p. 295, pl. 19, figs. 13-15, and *Q. affinis*, Costa, 1856, P.R.N., p. 329, pl. 25, fig. 13.

12. *Peneroplis carinatus*, d'Orbigny 1839, F.A.M., p. 33, pl. 3, figs. 7, 8.

Small but typical. S.

13. *Haplophragmium pseudospirale* (Williamson) 1858, R.F.G.B., p. 2, pl. 1, figs. 1, 2.
A fragment probably referable to this species. B.

14. *Haplophragmium fontinense*, Terquem 1867, etc., S.O., 1870, p. 337, (325 in Reprint), pl. 24, figs. 29, 30.
Three small immature individuals formed of coarse sand-grains.

15. *Textularia globulosa*, Ehrenberg 1838, Abh. K. Ak. Wiss., Berlin, p. 135, pl. 4, fig. 3.
Two specimens in good condition. S., B.

16. *Textularia gramen*, d'Orbigny 1846, F.F.V., p. 248, pl, 15, figs. 4–6.
One small but typical specimen. S., B.

17. *Bulimina fusiformis*, Williamson R.F.G.B., p. 63, pl. 5, figs. 129, 130.
Frequent, and well preserved. The specimens vary considerably in development, but are chiefly of the short, megalospheric type. S., B.

18. *Virgulina schreibersiana*, Czjzek, var. *marginata* nov.

Pl. 12, figs. 4 a–b.

This new variety is isomorphous with *Bulimina marginata* (d'Orbigny). The separate chambers are undercut or excavated at their upper edge, and furnished with minute cusps or spines at the angular upper edges of the chambers. It is probably a pauperate form, all the specimens being very thin-shelled.

19. *Bolivina textilarioides*, Reuss 1862, N.H.G., p. 81, pl. 10, fig. 1.
One specimen with heavily limbate sutures. S., B.

20. *Bolivina plicata*, d'Orbigny 1839, F.A.M., p. 62, pl. 8, figs. 4–7.
A single rather water-worn, thick-walled example. S., B.

21. *Bolivina nobilis*, Hantken 1875, C.S.S., p. 56, pl. 15, fig. 4.
A single thick-walled specimen. S.

22. *Cassidulina laevigata*, d'Orbigny 1826, T.M.C., p. 282, No. 1, pl. 15, figs. 4, 5.
A single typical specimen. B.

23. *Cassidulina subglobosa*, Brady 1879, etc., R.R.C., 1881, p. 60; 1884, F.C., p. 430, pl. 54, fig. 17.
A single typical specimen. B.

24. *Lagena apiculata*, Reuss 1862, N.H.G., p. 318, pl. 1, figs. 4–8, 10, 11.
One very large specimen. B.

25. *Lagena sulcata* (Walker & Boys) 1784, T.M.R., p. 2, pl. 1, fig. 6.
Two typical specimens. S., B.

26. *Nodosaria obliqua* (Linné) 1767, etc., S.N., 1788, p. 3372; Brady, 1884, F.C., p. 513, pl. 64, figs. 20–22.
Many fragments, and one small perfect specimen. All the examples are weakly marked. The number of species which have been described and figured for such pauperate varieties is infinite. There seems no object in adding to the number, or perpetuating the records. Some of the fragments suggest *N. capitata*, Boll, and other attributions might be suggested for others. B.

27. *Cristellaria rotulata* (Lamarck) 1804, A.M., vol. 5, p. 188, No. 3; vol. 8 (1806), pl. 62, fig. 11.

Pl. 12, figs. 5 a–b.

Four specimens ranging from minute to average size, and a further specimen representing all the marked characteristics of *C. macrodisca*, Reuss (1862, N.H.G., p. 78, pl. 9, fig. 5) which we figure. S., B.

28. *Uvigerina canariensis*, d'Orbigny 1839, F.I.C., p. 138, pl. 1, figs. 25–27.
Two specimens, one very short, the other long, probably representing the microspheric and megalospheric forms. B.

29. *Uvigerina pygmaea*, d'Orbigny 1826, T.M.C., p. 269, pl. 12, figs. 8, 9, Modèle No. 67.
A small, damaged specimen. B.

30. *Globigerina cretacea*, d'Orbigny 1840, C.B.P., p. 34, pl. 3, figs. 12–14.
Very rare, but typical. B.

31. *Globigerina dutertrei*, d'Orbigny 1839, F.C., p. 84, pl. 4, figs. 19–21.
Not infrequent, but small. S., B.

32. *Globigerina pachyderma* (Ehrenberg) 1861, p. 303, fig. 1,873, L.M.T., pl. 1, fig. 4.

Pl. 12, figs. 9 a–b.

Two quite typical specimens.

33. *Globigerina bulloides*, d'Orbigny 1826, T.M.C., p. 277, No. 1, Modèles Nos. 17 and 76.

Occurs frequently, ranging considerably in size, but all comparatively small. S., B.

34. ?*Pullenia obliquiloculata*, Parker and Jones 1865, N.A.A.F., p. 368, pl. 19, fig. 4.

A broken shell, apparently referable to this species.

35. *Discorbina globularis* (d'Orbigny) 1826, T.M.C., p. 271, No. 1, pl. 13, figs. 1–4.

A glauconitic cast. S., B.

36. *Discorbina orbicularis* (Terquem) 1876, A.P.D., p. 75, pl. 9, fig. 4.

A single typical specimen. S., B.

37. *Discorbina turbo* (d'Orbigny) 1826, T.M.C., p. 274, No. 39, Modèle, No. 73.

One small but typical specimen. S.

38. *Truncatulina lobatula* (Walker and Jacob) 1798, A.E.M. p. 642, pl. 14, fig. 36.

Common, and well developed. S., B.

39. *Truncatulina refulgens* (Montfort) 1808, C.S., p. 123, 31me. genre.

A single small specimen. B.

40. *Truncatulina ungeriana* (d'Orbigny) 1846, F.F.V., p. 157, pl. 8, figs. 16–18.

Fairly frequent. S., B.

41. *Truncatulina haidingerii* (d'Orbigny) 1846, F.F.V., p. 154, pl. 8, figs. 7–9.

One very small example. S., B.

42. *Truncatulina pygmaea*, Hantken 1875, C.S.S., p. 67, pl. 10, fig. 8.

One damaged specimen probably referable to this species. B.

43. *Pulvinulina brongniartii* (d'Orbigny) 1846, F.F.V., p. 158, pl. 8, figs. 22–24.

Pl. 12, figs. 6 a–c.

Abundant and strongly developed. Nearly all the specimens are characterised by limbation of the sutures which, in some instances, is extremely strong.

44. *Pulvinulina oblonga* (Williamson) 1858, R.F.G.B., p. 51, pl. 4, figs. 98–100.

Very small and pauperate. S.

45. *Pulvinulina hauerii* (d'Orbigny) 1846, F.F.V., p. 151, pl. 7, figs. 22–24.

A single, small, typical individual. S., B.

46. *Pulvinulina elegans* (d'Orbigny) 1826, T.M.C., p. 276, No. 54.

Two small specimens, typical. S., B.

47. *Nonionina depressula* (Walker and Jacob) 1798, A.E.M., p. 641, pl. 14, fig. 33.

Variable, running from *N. depressula* almost into *N. umbilicatula.* S., B.

48. *Nonionina asterizans* (Fichtel and Moll) 1798, T.M., p. 37, pl. 3, figs. e–h.

Fragment, with strongly limbate sutures. S.

49. *Nonionina boueana*, d'Orbigny 1846, F.F.V.. p, 108, pl. 5, figs. 11, 12.

Pl. 12, figs. 7 a–b.

Common. The specimens separate into two groups, the first in, which the shell is well preserved, characterised by the typical smooth sutures, a few specimens show a tendency to limbation; in the other group the shells are deeply stained, more or less eroded and the limbation is extraordinarily strong; they agree with Chapman's figure (Tertiary of California, Proc. Cal. Ac. Sci. Ser. 3, Geology, Vol. 1, No. 8, 1900, p. 255, pl. 30, fig. 14). S., B.

50. *Nonionina boueana* var. *janiformis*, Jones, Parker and Brady 1866, etc., M.F.C., 1896, p. 344, fig. 28.

Pl. 12, fig. 8.

A single typical specimen.

51. *Nonionina scapha* (Fichtel and Moll) 1803, T.M., p. 105, pl. 19, figs. d–f.

One pauperate individual. S., B.

WORKS, AND THEIR ABBREVIATIONS, REFERRED TO IN THE LIST OF SPECIES.

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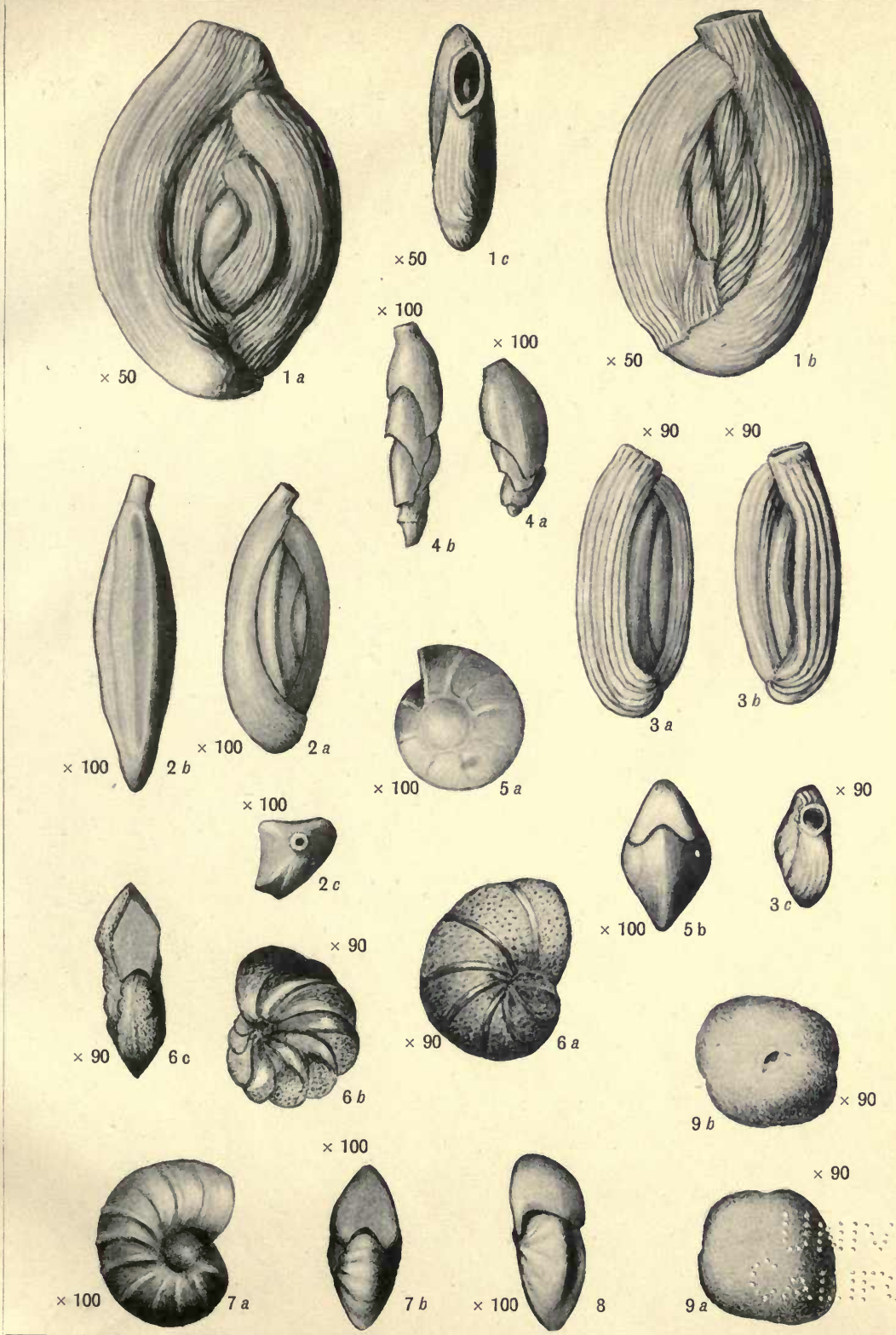
EXPLANATION OF PLATE 12.

FIG. 1 a.b. *Miliolina bicornis* vars. *elegans* d'Orbigny, side view. × 50.
„ 1 c. „ „ „ „ „ oral view. × 50.
„ 2 a. *Miliolina bicarinella* Reuss, side view. × 100.
„ 2 b. „ „ „ edge view, × 100.
„ 2 c. „ „ „ oral view. × 100.
„ 3 a.b. „ *sulcifera* (Roemer) side views. × 90.
„ 3 c. „ „ „ oral view. × 90.
„ 4 a.b. *Virgulina schreibersiana* Czjzek var. *marginata*, nov. × 100.
„ 5 a. *Cristellaria rotulata* var. *macrodisca* Reuss, side view. × 100.
„ 5 b. „ „ „ „ edge oral view. × 100.
„ 6 a. *Pulvinulina brongniartii* (d'Orbigny) superior view. × 90.
„ 6 b. „ „ „ inferior view. × 90.
„ 6 c. „ „ „ edge oral view. × 90.
„ 7 a. *Nonionina boueana* d'Orbigny, side view. × 100.
„ 7 b. „ „ „ edge oral view. × 100.
„ 8 „ „ var. *janiformis* Rupert Jones, edge oral view. × 100.
„ 9 a. *Globigerina pachyderma* (Ehrenberg) superior view. × 90.
„ 9 b. „ „ „ inferior oral view. × 90.



M. H. Brooks, del.

EOCENE FORAMINIFERA (NIGERIA).

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