10. *THE TERTIARY FOSSILS of SOMALILAND, as represented in the BRITISH MUSEUM (NATURAL HISTORY).* By RICHARD BULLEN NEWTON, F.G.S. (Read June 22nd, 1904.)

[PLATES XVII-XXI.]

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I. INTRODUCTION.

SINCE the publication in the fifty-sixth volume of this Journal (1900) of Prof. J. W. Gregory's paper on the Geology of Somaliland, which was founded upon specimens in the British Museum (Natural History) mostly collected and presented by Mrs. Lort-Phillips, the National Collections have been enriched by two further series of fossils from the same country—that obtained by Dr. Donaldson Smith from the neighbourhood of Berbera, and presented by His Highness the Gaekwar of Baroda; the other presented by Major R. G. Edwards Leckie (of the Canadian Mounted Rifles), and collected by him during an exploration-tour, from Upper Sheikh and Garrasgooi in the Golis-Range district, and also from the Eilo Range of mountains.

In the course of my official duties at the British Museum, I have been entrusted with the examination of these new collections, with the view of describing the individual specimens, as well as of ascertaining their importance with regard to the stratigraphy of the country.

In carrying out this work, a large amount of comparison with species already known from Somaliland and elsewhere has been imperative, while the limestone-matrices surrounding the different specimens have been microscopically examined in several cases, in order that the best confirmatory evidence should be obtained as to geological horizons. This examination has rendered necessary a revision of some of the geological and palæontological conclusions referred to in Prof. Gregory's memoir, for which I am largely responsible in connection with the determination of certain molluscan remains therein mentioned. The new material before us is, generally speaking, better preserved than that dealt with previously, and especially does this remark apply to the mollusca. There are good

Topographical map of British Somaliland, by Major R. G. Edwards Leckie.

fragmentary casts of large turriculate shells belonging to the genus *Campanile* of the family Cerithiidae, which, on account of certain plications on the columella, were erroneously considered as *Nerinea* and consequently of Cretaceous age; there are also large casts of Luciniform shells, as well as other lamellibranchs and gastropods to which special reference need not now be made. It is sufficient, for the present, to state that the forms of mollusca here indicated are characteristic of Eocene rocks generally, and that with regard to the specimens from Somaliland further evidence is afforded of their Eocene age by the presence of certain foraminifera which enter into the minute structure of the limestone-matrices.

The new collections embrace no older fossils than may safely be ascribed to an Eocene age, excepting some remains of ammonites and belemnites found by Major Leckie in the Eilo Range of Western Somaliland, which belong to Mesozoic rocks, and are therefore not considered in this paper.

The corals described by Prof. Gregory came from the 'Urdu' and 'Dobar' Limestones, these formations being regarded as Turonian and Neocomian respectively, although he thought that the upper part of the Urdu Limestone might be of Eocene age, on account of the discovery in its structure by Messrs. Sherborn & Chapman of *Nummulites*, *Amphistegina*, and *Orbitoides dispansa*, all of which were found associated with a large *Conoclypeus* (?) sp. described in the same memoir. No nummulites have been detected in the present material, but *Operculina complanata*¹ has been determined, together with *Amphistegina* and *Orbitoides dispansa*. This particular form of Orbitoid, exhibiting rectangular chambers in the median plane, is acknowledged by most authorities on the Foraminifera to be indicative of an Eocene age.

It is evident, from an examination of the specimens in these different collections, that there are two limestones represented—an upper one, which is a massive cherty rock, frequently reddish-brown externally; and a lower, of less cherty character, and generally of a lighter colour, although sometimes red-stained. According to Major Leckie, these two sets of limestones are conformable to each other, and therefore without any great difference in age to account for. Further, they may be regarded as the equivalents of the so-called 'Urdu' and 'Dobar' Limestones, previously diagnosed as Cretaceous but which now appear to belong to Tertiary times.

These Somaliland limestones are probably capable of correlation with those of South-Eastern Arabia, as well as with those of Scind and Cutch in India; for, according to the researches of H. J. Carter, *Orbitoides dispansa*, *Operculina*, etc., occur in all three regions of Asia. Carter² also referred to the occurrence of molluscan casts in the

¹ As understood by W. B. Carpenter, W. K. Parker, & T. R. Jones, 'Introduction to the Study of the Foraminifera' Ray Soc. (1862) pp. 247-62 & pl. xvii.

² 'Memoir on the Geology of the South-East Coast of Arabia' [reprinted, with alterations and additions, from the Journ. Bombay Branch R. Asiat. Soc. 1852, vol. iv], Geological Papers on Western India, etc. (1857) pp. 551-627.

Arabian deposits, especially large Naticoid shells, a small *Gryphæa*, and Spatangoid echinoderms. A collection of Tertiary fossils from Ras Ghissa (Arabia) was made a few years ago by Lieut.-Col. Dr. A. S. G. Jayakar, and presented to the British Museum, containing yellowish limestone-casts of Naticoid shells and a *Campanile* resembling those from Somaliland, while the matrix of these specimens exhibited foraminiferal organisms, particularly an abundance of *Operculina* and *Amphistegina*.

But, as well as this correlation of the Somaliland Tertiary limestones with those of Arabia and India, somewhat similar palæontological resemblances may be traced in the Eocene rocks of Egypt and other countries of Northern Africa (Nigeria,¹ the Cameroons,² etc.), through Southern Europe to the Paris Basin, and so on to the Bracklesham Beds of England.

II. LITERATURE.

A brief review of the various papers on the entire palæontology of Somaliland will now be given in chronological order.

The earliest record of fossils from Somaliland was made by H. J. Carter³ in 1857, who determined the following specimens, but without descriptions or illustrations, obtained by Capt. (afterwards Sir Richard) Burton from the neighbourhood of Berbera, and correlated them with the Jurassic fauna of Cutch in India:—

Belemnites canaliculatus, Schlotheim.

Terebratula intermedia, J. Sowerby.

Terebratula microhyncha, J. de C. Sowerby.

Arca (sp. ?).

Exogyra auricularia, Goldfuss.

A number of specimens from Ouarsangueli (= Warsangeli) were described and partly figured by Dr. A. T. de Rochebrune⁴ as of Neocomian age, the horizontal fossil being *Ostrea Couloni*, DeFrance. New names were given to the other species, the whole series comprising three gastropods, seventeen lamellibranchs, one echinoid, and one coral.

Miss C. A. Raisin,⁵ in a petrographical paper, referred to some limestones containing foraminifera (*Amphistegina*, *Globigerina*, etc.), polyzoa, etc., which she considered might be late Cretaceous or

¹ A. de Lapparent [Northern Nigerian Eocene], *Comptes Rendus Acad. Sci. Paris*, vol. cxxxvi (1903) p. 1118; R. B. Newton, *Geogr. Journ.* vol. xxiv (1904) pp. 522-24, & *Ann. & Mag. Nat. Hist.* ser. 7, vol. xv (1905) pp. 83-91 & pl. v; and F. A. Bather, *Geol. Mag.* 1904, pp. 292-304 & pl. xi.

² P. Oppenheim [Eocene Fossils from the Cameroons], *Centralblatt für Min. Geol. Pal.* (Stuttgart) 1903, pp. 373-74; and 'Beiträge zur Geologie von Kamerun' 1904, pt. iii, pp. 243-85, pls. vi-ix.

³ [Jurassic Fossils from near Berbera], 'Memoir on the Geology of the South-East Coast of Arabia' in *Geological Papers on Western India*, etc. (1857) p. 622.

⁴ 'Observations Géologiques & Paléontologiques sur la Région habitée par les Çomalis & plus spécialement sur les Montagnes des Ouarsanguélis'; in Georges Révoil's 'Faune & Flore des Pays Çomalis' 1882, pp. 39 & pls. i-iv.

⁵ 'Rock-Specimens from Somaliland' *Geol. Mag.* 1888, pp. 417-18.

Tertiary—possibly Miocene age. This material was obtained by Capt. King at Mount Eilo, south of Zeila (lat. $10^{\circ} 30' N.$, and long. $43^{\circ} 35' E.$).

A series of Neocomian fossils were described and figured by Prof. C. Mayer-Eymar¹ during 1893, which had been collected by Prof. Keller on the south-western slopes of the Somali plateau, along the valley of the Faf, a tributary of the Webi Shebéli. It consisted of cephalopods, gastropods, lamellibranchs, and echinoids, which in the aggregate were referred to four already-known species and eleven new forms.

During the year 1896, Prof. J. W. Gregory² published a list of Jurassic fossils from Bihin collected by Mrs. Lort-Phillips, which were determined by Messrs. G. C. Crick,³ R. Bullen Newton,⁴ and F. A. Bather as *Belemnites subhastatus*, Zieten, *Parallelodon Egertonianus*, Stoliczka, *Rhynchonella Edwardsi*, Chapuis & Dewalque, and *Rh. subtetrahedra*, Davidson. In the same paper Prof. Gregory described a new species of coral, under the name of *Cryptocenia Lort-Phillipsii*, found in the Duba Limestone, which he doubtfully referred to the Neocomian age.

Prof. Gregory⁵ noted the value of a single specimen of *Rhynchonella subtetrahedra*, determined by Dr. F. A. Bather, which was found by Dr. Donaldson Smith in Somaliland, as indicating the presence of Jurassic rocks in that region.

Four forms of *Perisphinctes* collected by Dr. Donaldson Smith from the rocks of Tug Turfa, were described by Mr. G. C. Crick⁶ and regarded as characteristic of an Upper Jurassic horizon.

Prof. Gregory's⁷ most comprehensive paper on the Somaliland fossils was published in 1900. It contained descriptions of the corals and echinoids found in the raised-reef and plateau-limestones of that country, together with certain molluscan determinations made by the present writer, as well as forms of foraminifera identified by Messrs. C. D. Sherborn & F. Chapman, and some brachiopods determined by Dr. F. A. Bather. The horizons recognized were post-Pliocene, Eocene (?), Turonian (or Cenomanian?), Neocomian, and Jurassic.

¹ 'Neocomian-Versteinerungen aus dem Somaliland' Vierteljahrsschr. naturf. Gesellsch. Zürich, vol. xxxviii (1893) pp. 249-65 & pls. i-ii.

² 'A Note on the Geology of Somaliland, based on Collections made by Mrs. E. Lort-Phillips, Miss Edith Cole, & Mr. G. P. V. Aylmer' Geol. Mag. 1896, pp. 289-94.

³ 'Note on some Fragments of *Belemnites* from Somaliland' Geol. Mag. 1896, pp. 296-98.

⁴ 'On the Occurrence of an Indian Jurassic Shell, *Parallelodon Egertonianus*, in Somaliland, Eastern Africa' Geol. Mag. 1896, pp. 294-96.

⁵ 'Note on Dr. A. Donaldson Smith's Geological Collection' [from Somaliland]; Appendix E to Donaldson Smith's 'Through Unknown African Countries' 1897, pp. 423-25.

⁶ 'On the Fossil Cephalopoda from Somaliland collected by Dr. Donaldson Smith'; Appendix F, *op. cit.* pp. 426-29.

⁷ 'On the Geology & Fossil Corals & Echinids of Somaliland' Quart. Journ. Geol. Soc. vol. lvi (1900) pp. 26-45 & pls. i-ii (with sketch-map & sects. in the text).

A new form of *Heliopora* collected by Mrs. Lort-Phillips from the Uradu Limestone near the Rugga Pass, was described and figured by Prof. Gregory¹ as *Heliopora somaliensis*, and regarded as of Turonian age.

In 1901, Herr Oscar Neumann² announced the discovery of Jurassic and early Cretaceous fossils at various localities in Galla-Land, material which is under description by Dr. Edgar Dacqué,³ a first fasciculus having been issued in 1904 on the 'Untere Kreide,' containing figures and descriptions of mollusca—*Exogyra Couloni*, Defrance, *Cucullea Gabrielis*, Leymerie, *Pholadomya Picteti*, Mayer-Eymar, etc., from the Neocomian; and *Trigonia Picteti*, Coquand, etc., from the so-called Aptian(?). *Astroccenia subornata*, d'Orb. var. *africana*, Weissermel, is also described by Dr. Dacqué from Neocomian strata of this part of Africa.

III. DESCRIPTION OF THE FOSSILS.

(a) Gastropoda.

Remarks on the Genus *Campanile* as found in Somaliland.

Among the specimens mentioned in Prof. Gregory's memoir of 1900, were some more or less silicified limestone-casts of large gastropodan shells which, on account of possessing the plaited columella, were identified by the present writer as *Nerinea*, and consequently classed as Cretaceous in age. They were referred to as fossils of the '*Nerinea*-Limestone' from Dongorreh and Bur-Dab, and regarded as Neocomian, under the following identifications—*Nerinea*, sp. nov., and *Nerinea* allied to *Rencuviana*, d'Orb.

The further material from Somaliland that has now been studied embraces some better specimens than were formerly available, so that these shells can be recognized as belonging to the family of the Cerithiidae and to the genus *Campanile*,⁴ the type of which is *Cerithium giganteum* of Lamarck, a species characterizing the Lutetian or Middle Eocene rocks of England, the Continent of Europe, Northern Africa, Asia Minor, etc. It is to this type that the different forms from Somaliland are undoubtedly related. There is always considerable difficulty in dealing with casts at any time, but careful comparison of them on the present occasion with many

¹ '*Polytremacis* & the Ancestry of Helioporidæ' Proc. Roy. Soc. vol. lxi (1900) p. 298 & pl. ii, figs. 8 a-c.

² 'Ueber jurassische & die ersten cretaceischen Versteinerungen aus den Galla-Ländern' Zeitschr. Deutsch. Geol. Gesellsch. vol. liii (1901) Verhandl. pp. 100-102.

³ 'Beiträge zur Geologie des Somalilandes: I. Untere Kreide' Beitr. zur Paläont. & Geol. (Österreich-Ungarns & des Orients, vol. xvii (1904) pp. 7-20 & pls. ii-iii.

⁴ *Campanile* of Bayle, in Paul Fischer's 'Manuel de Conchyliologie' fasc. vii (1884) p. 680.

specimens from other localities, has enabled me to prepare the following notes on the examples from Somaliland now preserved in the British Museum.

Before entering upon these descriptions, it may be interesting to point out that casts of *Campanile* have been previously mistaken for *Nerinea*. A notable case was that of Bellardi's *Nerinea Serapidis*,¹ founded on the cast of a fragmentary whorl from the Nummulitic formation of Egypt, showing internal characters, with the markings of three prominent plications which were originally produced by the columella. Similar fragments from Egypt are in the British Museum, as well as more perfect specimens, all of which exhibit this strongly-plicated columella extending through the entire axis of the shell, which, as a cast either in limestone or as an impression taken in ordinary modelling-wax, will produce a result exactly similar to that figured by Bellardi. That is, it would appear that, in all these natural casts, the original solid columella has been dissolved away during the process of fossilization, but not before leaving its plicated character fully impressed on the internal walls of the volutions. Moreover, in all true specimens of *Nerinea*, the outer lip is plicated as well as the columella; but, in members of the Cerithiidae, such a character is wanting. With regard to another form of *Nerinea* described as *N. supracretacea*, Bellardi, from the Nummulitic rocks of Nice, it is possible, as suggested by Stoliczka,² that the absence of plications on the outer lip of that specimen may be due to its worn condition; and that, instead of coming from the Nummulitic rocks, it probably came from the Cretaceous deposits which also occur in the neighbourhood of Nice. So far, therefore, as can be ascertained, no authentic *Nerinea* is known in the Tertiary Period, and it appears to be a genus absolutely restricted to Secondary rocks.

All these large forms of *Campanile* appear to be characteristic of Middle Eocene times. F. Bayan has described and figured *C. Bedechei*, with a basal diameter of 61 millimetres, from the Paris Basin, as well as *C. Lachesis*, measuring from 65 to 90 mm., from the 'Nerita Schmiedeli-beds' of Ronca.³ From Asia Minor, A. d'Archiac figured and described *C. Tchihatcheffi*, which has a basal measurement of 90 mm., and is found associated with *Nummulites Ramondi* and *N. scabra*; also *C. Leymeriei*, with a basal width of 140 mm., from the same horizon.⁴

CAMPANILE cf. GIGANTEUS (Lamarck) Var. A. (Pl. XVII, fig. 1.)

Cerithium giganteum, Lamarck, Ann. Mus. Hist. Nat. Paris, vol. iii (1803) p. 439;
J. Sowerby, 'Mineral Conchology' vol. ii (1818) p. 199 & pl. clxxxviii, fig. 2;

¹ 'Mem. R. Accad. Sci. Torino, ser. 2, vol. xv (1855) p. 178 & pl. i, fig. 9.

² 'Palæont. Indica: Cretaceous Fauna of Southern India,' Mem. Geol. Surv. India, vol. ii (1867-68) p. 179.

³ 'Études faites dans la Collection de l'Ecole des Mines: Fossiles nouveaux ou mal connus' Fasc. i, Moll. Tertiaires, 1870, pp. 31-33.

⁴ In Tchihatcheff's 'Asie Mineure' Paléontologie (1866-69) pp. 126-29 & pl. i, figs. 1-2, pl. ix, figs. 2-3, & pl. ii, fig. 1.

Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. ii (1833) p. 300 & pl. xlii, figs. 1-2.

Campanile giganteum, Bayle, in Fischer's 'Manuel de Conchyliologie' fasc. vii (1884) p. 680.

This specimen consists of a large limestone-cast exhibiting the basal and penultimate whorls only, the remainder of the spire being absent. The whorls are shallow, infundibuliform, postero-horizontally depressed, obtusely angulate at and between the margins, and separated by a deep suture; the margin of the inner or columella-lip is smooth, rounded, thickened, and excavated; the aperture is filled with matrix and not definable, but, where this is rubbed down, columella-plications are observed to be present. The surface of the whorls shows indications of one or two obscure spiral bands, which give rise to obtuse angulations apart from that produced by the marginal carination.

DIMENSIONS IN MILLIMETRES.

Basal whorl { Diameter.....=100	Penultimate whorl { Diameter ...=8.5
Height.....= 70	

Although not quite so rounded in its whorls, this specimen is closely related to a large internal cast in the British Museum (Mantell Coll. 32578) labelled *Campanile* cf. *giganteus*, from the Eocene (Lutetian) strata of Verona, Italy, which exhibits three prominent columella-plications extending through its whole axis. The specimen now described was previously regarded as 'a *Nerinea* of Neocomian affinities';¹ but a further study of its characters removes all doubt as to its proper place being with the large Cerithiidae, so characteristic of the Eocene Period. That it belongs to this horizon is a fact further strengthened by the presence of *Amphistegina* and *Operculina* cf. *complanata* in the limestone-matrix (see § P in the Notes on the Foraminiferal Structures, etc., p. 177).

Locality.—Bur Dab (Somaliland).

Collector.—Mr. F. B. Parkinson. [G. 12053.]

Matrix.—Cream-coloured limestone, weathering a straw-colour.

CAMPANILE cf. GIGANTEUS (Lam.) Var. B. (Pl. XVII, figs. 2 & 3.)

This form is represented by a basal fragment possessing four whorls, which have been more or less distorted or compressed through the process of fossilization. The whorls are obtusely angulate on both margins, infundibuliform, deeply sutured, depressed and concave above; they are of uniform height, with the exception of the last, which is about double that of the others. The base shows two strong columella-plications, and there may be a third, but it is not exposed. The surface of the last whorl possesses distant concentric sulcations, about midway between the lower marginal angulation and the basal area.

¹ See R. B. Newton in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43.

DIMENSIONS IN MILLIMETRES.

Height of the specimen	=70	Height of the last whorl ...	=30
Basal diameter (maximum)...	=65		

The example here described was collected at Dongorreh by Mrs. Lort-Phillips, its matrix containing *Amphistegina*, *Operculina*, etc. (see § O in the Notes on the Foraminiferal Structures, p. 177). There is a second specimen of this variety, which was obtained by Mr. F. B. Parkinson at the same place, and was erroneously recognized as *Nerinea* allied to *Renauxiana*, d'Orb.¹ A further specimen was collected by Major R. G. Edwards Leckie about 4 miles south of Camp, Upper Sheikh, at an altitude of over 5000 feet, showing similar lithological characters to the others. It is, however, of smaller size, having a basal diameter of 55 millimetres, although the whorls are of precisely the same type of structure as that described.

Localities.—Dongorreh: 4 miles south of Camp, Upper Sheikh.

Collectors.—Mrs. Lort-Phillips, Mr. F. B. Parkinson, and Major R. G. Edwards Leckie.

Matrix.—Heavy cherty limestone, red-stained externally.

CAMPANILE SOMALIENSIS, sp. nov. (Pl. XVIII, figs. 1 & 2.)

There are two limestone-casts now to be noticed, of still larger proportions than those previously described, which apparently belong to one and the same species. The best-preserved and largest of these exhibits a conically-shaped body of oblong circumference with the four last whorls, all the earlier ones being absent. The latest whorl shows a maximum height of 72 millimetres, while the penultimate measures 40 mm. in the same direction, the next giving a height of 35 mm. The basal diameter of the specimen measures 165 by 145 mm. Its base is much covered with matrix, but concentric plications are observable round the columellar region, where a flattened area is noticed circumscribing the axis. The whorls of this specimen are not funnel-shaped anteriorly, nor is the suture so deep as in the forms previously described. Moreover, it is doubtless of much shorter spire also, and is probably a form not yet described. Indications of a short anterior canal are also present.

The smaller of these specimens (having a diameter of 135 by 120 millimetres) has been cut through longitudinally, for the exposition of internal characters. This exhibits a wide cylindrical axis showing columella-plications, having on each side large quadrate chambers with rounded outer margins, and curving obliquely and anteriorly inwards.

Locality.—Specimens collected by Dr. Donaldson Smith in the neighbourhood of Berbera, and presented to the British Museum (Natural History) by the Gaekwar of Baroda.

Matrix.—A cream-coloured cherty limestone, containing *Orbitoides*, *Operculina*, etc. (see § L in the Notes on the Foraminiferal Structures, p. 176).

¹ See R. B. Newton in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43, footnote.

EUSPIRA cf. *SCALARIFORMIS* (Deshayes). (Pl. XIX, figs. 1 & 2.)

Ampullaria scalariformis, Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. ii (1825) p. 138 & pl. xvi, figs. 8-9.

Euspira scalariformis, Cossmann, 'Catal. illustré Coq. Foss. Éocènes des Environs de Paris' Ann. Soc. Roy. Malacol. Belg. vol. xliii (1888) p. 175.

This form of gastropod is represented by a fragmentary limestone-cast, exhibiting the penultimate and last whorls of a large shell of ovately-conical shape. The last whorl is convex, long, and surmounted by a somewhat flattened area, bordered by an angulated margin. The umbilical region is excavated, although partly filled with matrix; and the aperture is of distinctly-oval contour, vertically elongate, narrow, with nearly-parallel sides, and showing a measurement of 63 by 35 millimetres.

The specimen has all the appearance of a close relationship to *Euspira scalariformis*, having been probably furnished with just as prominent a spire as that which characterizes that species when in a more perfect condition. The species was originally recorded from the Middle Eocene of France.

Locality.—Near Berbera.

Collector.—Dr. Donaldson Smith. Presented to the British Museum (Natural History) by the Gackwar of Baroda.

Matrix.—Greyish cherty limestone.

EUSPIRA cf. *HYBRIDA* (Lamarck). (Pl. XIX, figs. 3 & 4.)

Ampullaria hybrida, Lamarck, Ann. Mus. Hist. Nat. Paris, vol. v (1804) p. 33.

Natica hybrida, Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. ii (1829) p. 172 & pl. xix, figs. 17-18.

Euspira hybrida, Cossmann, 'Catalogue illustré des Coquilles Fossiles Éocènes des Environs de Paris' Ann. Soc. Roy. Malacol. Belg. vol. xliii (1888) p. 175.

Natica allied to *Hugardiana*, R. B. Newton, in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43 (footnote), *non* d'Orb.

This specimen was originally recognized as Cretaceous, under the name of *Natica* allied to *Hugardiana*, but it is apparently a form not far removed from *Euspira hybrida*, so characteristic of most Eocene localities. It shows a graduated and conical spire with the prominent 'rampe' or platform constituting the summit-area of each whorl. The last whorl is inflated, and excavated at the base, where there are indications of a large rounded callosity. The aperture is semi-oval. Parts of four whorls are traceable in this cast, the more delicate earlier ones not, of course, being present.

DIMENSIONS IN MILLIMETRES.

Height of the specimen ...=65		Height of the last whorl=37
Diameter (dorsal view) ...=63		

There is also a smaller cast, which may be referred to this species.

Localities.—Bur Dab (Parkinson); and Garrasgooi, 3 miles south-west of Upper Sheikh (Leckie).

Collectors.—Mr. F. B. Parkinson and Major R. G. E. Leckie.

Matrix.—Cream-coloured limestone.

Another Naticoid shell, of far larger dimensions than that just described, but probably related to *Euspira hybrida*, is among the specimens obtained by Dr. Donaldson Smith. It consists of a limestone-cast with four whorls, the last being of considerable size and showing a well-defined 'ramped' area. The basal region appears to have been removed by longitudinal splitting or weathering, so that a flat surface only is seen, representing a section with a large central umbilical space. The spiral diameter of this specimen measures 125 by 95 millimetres.

In a microscope-slide of the matrix, *Operculina*, *Amphistegina*, etc. are seen to enter largely into its minute structure (see § M in the Notes on the Foraminiferal Structures, p. 176).

Locality.—Near Berbera.

Collector.—Dr. Donaldson Smith. Presented to the British Museum (Natural History) by the Gackwar of Baroda.

Matrix.—Cream-coloured limestone.

SOLARIUM cf. CANALICULATUM, Lamarek. (Pl. XIX, figs. 5 & 6.)

Solarium canaliculatum, Lamarek, Ann. Mus. Hist. Nat. Paris, vol. iv (1804) p. 53; Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. ii (1832) p. 220 & pl. xxiv, figs. 19-21; J. de C. Sowerby, 'Mineral Conchology' vol. vi (1826) p. 43 & pl. dxxiv, fig. 1.

Represented by two weathered limestone-specimens, in the collection formed by Major Leckie, which mostly agree in shape, sculpture, and size with this well-known European Eocene shell. The granulose spiral lines of the upper surface, as well as those of the basal region, are well defined, although probably more regular than in the type.

DIMENSIONS IN MILLIMETRES.

Height (probable)=8 | Diameter of the base=10

One of the specimens is associated in the same matrix with *Liotina somaliensis* and a coral, probably *Calamophyllia Aylmeri* of Gregory; while the other example occurs with an Astartiform shell of doubtful determination.

Locality.—Top of Garrasgoi Mountain, 5200 feet above sea-level, south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Heavy, compact, cherty limestone, of reddish colour externally.

LIOTINA SOMALIENSIS, sp. nov. (Pl. XIX, fig. 7.)

Shell small, turbinate, summit depressed; whorls convex, deeply sutured, and ornamented with an elevated trellised sculpture, composed of numerous longitudinal and spiral costæ, forming regular quadrangular spaces. Margin of aperture thickened, varixed, and reflected. Basal characters not seen.

DIMENSIONS IN MILLIMETRES.

Height=12 | Diameter=12

Represented by a beautifully-weathered example on the limestone-matrix, associated with *Solarium* cf. *canaliculatum* and a coral, probably *Calamophyllia Aylmeri*, Gregory.

This form differs from *Liotina* (*Delphinula*) *fimbriata*, Deshayes, from the Paris-Basin Eocene, which it somewhat resembles in sculpture, by its much smaller trellised ornamentation, caused by the greater number of spiral and longitudinal costæ. A minute tuberculation is also apparent in the ornamentation, which is caused by a thickening at the junctions of the two sets of costæ. The spire consists of five or six whorls, the last of which has a height at the aperture of 8 millimetres, or nearly three times that of the succeeding one.

Locality.—Top of Garrasgoi Mountain, 5200 feet above sea-level, south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Heavy cherty limestone, reddish-brown externally.

Indeterminable Gastropoda.

Among Major Leckie's fossils from the limestones of Garrasgoi are some further forms of gastropods which, although possessing a certain Eocene facies, are unfortunately not capable of identification. These include natural casts of a *Trophon* (?); *Turritella*, showing two elongate whorls of a large species; and a *Conus* resembling somewhat *C. depraditus* of Bruguière, or *C. diversiformis* of Deshayes, from the English and Continental Eocene deposits, or the Indian (Cutch) species *C. militaris*, figured and described by J. de C. Sowerby,¹ from beds of similar age.

Locality.—Garrasgoi, 3 miles south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—A light-coloured limestone, and found below the more cherty rock containing *Liotina somaliensis* and other fossils.

(b) Lamellibranchia.

ALECTRYONIA cf. MARTINSI (d'Archiac). (Pl. XX, figs. 1 & 2.)

Ostrea orbicularis, J. de C. Sowerby, Trans. Geol. Soc. ser. 2, vol. v (1840) pl. xxiv, fig. 8; non Linnaeus.

Ostrea Martinsii, A. d'Archiac, 'Deser. Foss. Groupe Nummul.' Mém. Soc. Géol. France, ser. 2, vol. iii, pt. ii (1850) p. 438 & pl. xiii, fig. 25.

Ostrea Alectryonia Martinsii, Frauscher, Denkschr. d. k. Akad. Wissensch. Wien, vol. li (1886) pt. ii, p. 68 & pl. iii, figs. 4-6.

Alectryonia rectangularis, R. B. Newton in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43; non Römer.

Ostrea (Alectryonia) semipectinata, Schathaupt in Oppenheim, Palaeontographica, vol. xxx, pt. iii (1903) p. 43.

This specimen was previously regarded by me as a Cretaceous shell, under the name of *A. rectangularis* of Römer, but re-examination shows that its true place is in close association with *Alectryonia Martinsii*, originally described by J. de C. Sowerby from the Nummulitic formation of India under the pre-occupied name

¹ Trans. Geol. Soc. ser. 2, vol. v (1840) pl. xxvi, fig. 34.

of *Ostrea orbicularis*. It represents a fragment of a slightly-convex valve, showing a shallow ligamental area with a straight horizontal inner margin. The ribs are prominent and bifurcating, the channels between them being deeply excavated, and so producing a plicated margin. The surface is much worn, consequently there are no traces of an imbricated structure. It resembles very closely J. de C. Sowerby's original figure, as well as Dr. Frauscher's illustrations of examples from districts of the Northern Alps. Dr. Oppenheim regards this species as equivalent to Schafhäutl's *Ostrea semipectinata*, *suborbiculata*, and *abscissa*, and unites all three under the first-named species; but Schafhäutl's figures are so obscure for such a determination, that it is far better to retain *Martinsi* of A. d'Archiac. It is, however, interesting to know from Dr. Oppenheim's memoir that this shell is recognized in the Egyptian Eocene: and the present Somaliland example appears to offer characters of such close relationship as to make it almost certain that it is a second instance of its occurrence in Northern Africa.

Locality.—Dobar, south of Berbera.

Collector.—Mrs. Lort-Phillips.

Matrix.—The so-called 'Dobar Limestone.' [B.M.—L. 14927.]

GRYPHÆA GREGORYI, sp. nov. (Pl. XVII, fig. 4 & Pl. XXI, figs. 1 & 2.)

Gryphæa vesiculosa, R. B. Newton in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43; non J. de C. Sowerby.

Shell small, thin, strongly arched, sides abrupt, subrhomboidal, summit depressed; growth-lamellæ irregular and sinuated at the lateral lobe; umbonal area incurved; anterior margin extended at the hinge, and forming a small auricle; posterior lobe well-defined, expansive and moderately concave externally.

DIMENSIONS IN MILLIMETRES.

Umbono-ventral	=27	} Convexity of the left valve ... =25
Antero-posterior	=25	

This species is founded on external characters of the lower or left valve only, of which there are several examples more or less fragmentary, both in Major Leckie's collection and in that formed by Mr. Parkinson, referred to in Dr. Gregory's paper as a Cenomanian fossil with the name of *Gryphæa vesiculosa*. The specimen described and figured belongs to this latter collection, being preserved in the British Museum under the registered number L. 12666.

The present species is related to several Eocene forms of this genus, such as *Gr. eversa*, Melleville, from France, *Gr. laticeps*, Schafhäutl, from Kressenberg, and *Gr. Escheri* of Mayer-Eymar, which includes *Gr. gryphovicina*, S. V. Wood, and *Gr. pseudovesicularis*, Gümbel, from England, the Northern Alps, and Kressenberg; but it is well separated by its subrhomboidal form, its strongly-arched central region, the somewhat steep sides, and rather wide but not produced lobe of the posterior area. For synonymy and further particulars of these species reference should be made to an important

memoir by Dr. K. F. Frauscher, 'Das Unter-Eocän der Nordalpen & seine Fauna' Denkschr. d. k. Akad. d. Wissensch. Wien, vol. li (1886) pt. ii, pp. 49-55.

The specific name is given in honour of Prof. J. W. Gregory, my former colleague in the Geological Department of the British Museum (Natural History), who at the time of the reading of this paper was Professor of Geology in the University of Melbourne, but now occupies a similar position in the University of Glasgow.

Localities.—Northern Somaliland [B.M.—L. 12666]; and top of Garrasgooi Mountain, at an elevation of about 5200 feet, 3 miles south-west of Sheikh.

Collectors.—Mr. F. B. Parkinson and Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, coloured reddish-brown externally.

GRYPHÆA sp. (Pl. XXI, fig. 3.)

Major Leckie has collected three fragments of a large *Gryphæa* which, from want of better evidence, it is difficult to associate with any known form of this genus, although possibly they may be related to an Indian Nummulitic species described by J. de C. Sowerby as *Gryphæa globosa*.¹ The largest of the pieces represents the central portion of a lower valve, which gives an umbono-ventral measurement of 75 millimetres. It is considerably arched and incurved at the umbonal region, and the external surface, although in a worn condition, still shows some wide lamellæ of growth with occasional obscure concentric banding between them. This specimen also exhibits a shell-wall of great thickness (13 millimetres) at the umbonal arch, which gradually decreases, however, towards the ventral margin, where it is only about 6 mm. thick. No ligamental or other internal characters are definable.

Locality.—About 3½ miles south of Camp at Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, coloured reddish-brown externally, and containing *Discocyclina dispansa*, *Operculina*, and *Amphistegina* (see §§ B & C in the Notes on the Foraminiferal Structures, p. 176).

VULSELLA (?) sp. (Pl. XXI, fig. 4.)

This specimen consists of a narrow elongate valve, showing a convex and a somewhat acuminate umbonal region, the remainder of the surface being depressed. The lateral margins are imperfect, and consequently the original antero-posterior measurements are unknown. The principal feature of the specimen is its sculpture, exhibiting a regular series of concentric lamellæ, which are very thin, nearly equidistant, and smooth. In this ornamentation there is a certain agreement with some forms of *Vulsella*, recently described and figured by Dr. P. Oppenheim, from the older Tertiary strata of Egypt.² But it is hazardous to say more in regard to the

¹ Trans. Geol. Soc. ser. 2, vol. v (1840) pl. xxv, fig. 16.

² Palæontographica, vol. xxx, pt. iii (1903) pl. vi.

present imperfect material, especially as the specimen here figured is without hinge or internal characters. It might even represent the upper valve of a *Gryphæa*, similar to the larger form referred to in this paper.

DIMENSIONS IN MILLIMETRES.

Umbono-ventral = 58 | Antero-posterior (about) = 37

Locality.—Garrasgooi Mountain, about 5200 feet above sea-level, south-west of Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, coloured reddish-brown externally.

SPONDYLUS ÆGYPTIACUS, R. B. Newton.

Spondylus ægyptiacus, R. B. Newton, Geol. Mag. 1898, p. 536 & pl. xx, figs. 4-6; Cossmann, Bull. Inst. Egyptien, ser. 4, no. 1, fasc. vi (1901) p. 190 & pl. ii, fig. 21; P. Oppenheim, Palæontographica, vol. xxx, pt. iii (1903) p. 63 & pl. iii, figs. 1-2.

The examples referred to this species are very fragmentary, although showing typical sculpture-details, including the two orders of radial costæ, presenting a more or less zoned appearance caused by the occasional presence of finer costæ between the interstitial spaces. The costæ also exhibit minute spinous projections, an additional character pointed out by M. Cossmann since the publication of the original description.

This species was first described from the Eocene of Egypt, and it has since been identified from the same country by M. Cossmann and Dr. Paul Oppenheim, in rocks of similar age.

Localities.—Hill about 4 miles south of Upper Sheikh at a height of 5000 feet; top of Garrasgooi Mountain, about 5200 feet, south-west of Upper Sheikh; Bur Dab.¹

Collectors.—Major R. G. Edwards Leckie and Mr. F. B. Parkinson.

Matrix.—Cherty limestone, of reddish colour externally.

SPONDYLUS SOMALIENSIS, sp. nov. (Pl. XXI, figs. 5, 6, & 6 a.)

Species of variable size, sub-ovate, regularly convex, and nearly equivalve; external surfaces ornamented with numerous (probably about 60) well-defined, rounded, longitudinal costæ, all of one order, which are covered with frequent infundibuliform annulations having thin and elevated margins: these occasionally protrude beyond the others to form spinous projections, more especially on the lateral regions. The costæ are separated by extremely narrow and rather deep grooves; the hinge-line is short, with its umbono-lateral areas obliquely ribbed. No internal characters are seen.

DIMENSIONS IN MILLIMETRES.

(Imperfect specimen with contiguous valves.)	Antero-posterior (about) = 28
Umbono-ventral = 42	Maximum depth = 28

¹ Fragments referred to a Cenomanian age under the name of *Spondylus* sp., by R. B. Newton, in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43.

This species is represented by fragmentary specimens showing a variation in size, the most perfect of which possesses both valves and is of medium measurement (see dimensions as above); two fragments of considerably larger specimens exhibit the sculpture-characters in a good state of preservation. It differs from *Spondylus egyptiacus* in its surface-ornamentation, having ribs of only one order, that is, without secondary or intermediate ribs; in the closely-imbricated character of its costæ; and in its nearly-equivalve condition. The fragment from Bur Dab, referred to by me, in Prof. Gregory's paper, as belonging probably to a new species of *Pecten*, is, on comparison with the later improved material, found to be a fragment of the *Spondylus* now described.

Localities.—Top of Garraagoi Mountain, at an elevation of about 5200 feet; and Bur Dab.

Collectors.—Major R. G. Edwards Leckie and Mr. F. B. Parkinson.

Matrix.—Cherty limestone, red-stained externally.

LITHOPHAGA sp. (Pl. XXI, fig. 7.)

Modiola Ferreti, R. B. Newton in Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 43; non A. T. de Rochebrune.

These examples of a *Lithophaga* are represented by crypts, contained in a compound coral which Prof. Gregory has named *Prionastræa crassisepta*. The molluscan part of this fossil was erroneously identified by me in Prof. Gregory's paper as *Modiola Ferreti*, a species described by Dr. A. T. de Rochebrune¹ from the Antalo Limestones of Abyssinia, and supposed by that author to be of Neocomian age. Unfortunately, a very feeble description was given of the species, and unaccompanied by figures. It would appear, however, from the obscure nature of the Somaliland specimen, of which the crypts only are seen, that the cavities are more cylindrical than those from Abyssinia, their diameter measuring 12 millimetres. Beyond this there are no decided characters to speak of, although the lithological aspect of the specimens corresponds with other examples of the Lower Limestone fossils in the collections under description.

Locality.—Dobar, south of Berbera.

Collector.—Mrs. Lort-Phillips. [B.M.—L. 14928.]

Matrix.—Creamy-white limestone, equivalent to the 'Dobar Limestone' of Prof. Gregory.

LUCINA cf. GIGANTEA, Deshayes. (Pl. XX, fig. 3.)

Lucina gigantea, Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. i (1825) p. 91 & pl. xv, figs. 11-12.

Pseudomiltha gigantea, Fischer, 'Manuel de Conchyliologie' fasc. xi (1887) p. 1144.

Lucina (Miltha) gigantea, Gregorio, 'Monogr. Foss. Eocéniques (Parisien) de Mont Postale' Ann. Géol. Pal. Palerme, pt. xiv (1894) p. 35 & pl. vii, figs. 208-216.

¹ 'Mission G. Révoil aux Pays Comalis: Observations Géol. & Paléont.' 1882, p. 10 [*Lithodomus Ferreti*].

Lucina gigantea, Gregorio, 'Monogr. Faun. Eocenica Ronca' Ann. Géol. Pal. Palerme, pt. xxi (1896) pp. 94, 95 & pl. xvi, figs. 4-10; P. Oppenheim, Palaeontographica, vol. xliii (1896) p. 152 & *ibid.* vol. xxx, pt. iii (1903) p. 129.

This specimen consists of a large but rather rough limestone-cast with compressed valves, related probably to this species. The adductor-scar markings are well defined, and the pallial line can be seen for some distance in the ventral region accompanied by some fine vertical striations. There is also a strong indication of the long, ligulate, anterior adductor-scar on the lateral face of the right valve, which is of rather crescentic shape. Large forms of Lucinidae are very characteristic of the Eocene Period, being frequently found in the Paris-Basin area; in the neighbourhood of Ronca and Monte Postale (Italy); and in the Nummulitic rocks of Egypt and India. Another species, with which the specimen from Somaliland may be compared, attains an even larger size than *gigantea*: this is the *Lucina corbarica*, var. *regularis* of Leymerie,¹ which belongs to the Ypresian stage of the Eocene,² situated immediately below the Lutetian; but that species possesses much more convex valves, although somewhat similar in general contour. Limestone-casts of *L. corbarica*, var. *regularis* are found in the Lower Eocene deposits of Farafra, in the Libyan Desert of Egypt.

DIMENSIONS IN MILLIMETRES.

Umbono-ventral	=85	Maximum convexity with closed	
Antero-posterior	=90	valves	=33

Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Limestone occurring below the more cherty beds.

LUCINA cf. THEBAICA (Zittel), Oppenheim. (Pl. XX, figs. 4 & 5.)

Lucina thebaica, Zittel, Palaeontographica, vol. xxx, pt. i (1883) pp. 100, 102, etc. (list-name only; species neither figured nor described); P. Oppenheim, *ibid.* pt. iii (1903) p. 128 & pl. xiii, figs. 3-3 *ν*.

This species of shell, although known under Zittel's list-name of *Lucina thebaica* since 1883, has only just been figured and described by Dr. Oppenheim. It is of common occurrence in Egypt, and characterizes the Middle Suessonian or the 'Libysche Stufe' of Zittel. The majority of the specimens that have come under my observation have a greater antero-posterior measurement than umbono-ventral, although Dr. Oppenheim's figures represent a shell having almost equal measurements.

The specimen from Somaliland is not so ventricose as those from Egypt, but it has much the form of this species, besides possessing similar subcentral beaks, and a sculpture showing indistinct concentric lines as well as straight longitudinal striations radiating from the summits, a character so frequently seen in members of the Lucinidae. Both valves (closed) are represented in the specimen

¹ 'Mém. sur le Terrain à Nummulites des Corbières, etc.' Mém. Soc. Géol. France, ser. 2, vol. i (1846) pt. ii, p. 361 & pl. xiv, fig. 5.

² A. de Lapparent, 'Traité de Géologie' 4th ed. (1900) p. 1435.

described; the right shows the sculpture and general configuration, while the other valve exhibits the cast with the muscular-scar impressions, pallial line, and radial striations spreading down from the umbonal area. It certainly bears a very close relationship to some forms from Thebes in Egypt, preserved in the British Museum.

There is a second specimen of this shell which is entirely a cast and also with closed valves, exhibiting the usual markings as previously observed.

DIMENSIONS IN MILLIMETRES.

Umbono-ventral	=60	Convexity (valves closed)	=25
Antero-posterior	=73		

Locality.—Garrasgooi, 3 miles south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Limestone occurring below the more cherty limestone-beds, containing foraminifera, such as *Operculina*, etc. (see § G in the Notes on the Foraminiferal Structures, p. 176).

LUCINA cf. *MENARDI*, Deshayes. (Pl. XXI, fig. 8.)

Lucina Menardi, Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. i (1825) p. 94 & pl. xvi, figs. 13-14.

Lucina Menardi (?), Bellardi, 'Catal. Foss. Nummulitici d'Egitto' Mem. R. Accad. Sci. Torino, ser. 2, vol. xv (1855) p. 188.

This specimen consists of a well-preserved fragment of a Lucini-form shell with large subventricose valves, showing fairly-regular concentric striations and a portion of the postero-lateral depressed area. Indications of the ligament are also present in the dorsal region, although beyond the summits in the anterior direction the shell is fractured and all further characters are wanting. Judging from Deshayes's figures of this species, the present specimen appears to resemble it very closely. It differs from *Lucina gigantea* in possessing the well-defined area of the posterior region.

DIMENSIONS IN MILLIMETRES.

Umbono-ventral	=65	Maximum convexity (valves closed)	=30

Bellardi has doubtfully recorded the occurrence of this species in the Eocene formation of Egypt; it was originally described from the Middle Eocene of France.

Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Sandy-limestone occurring below the more cherty limestone-beds, with a reddish tinge.

FIMBRIA cf. *LAMELLOSA* (Lamarck). (Pl. XXI, fig. 9.)

Lucina lamellosa, Lamarck, Ann. Mus. Hist. Nat. Paris, vol. vii (1806) p. 237, & vol. xii (1808) p. 458 & pl. xlii, fig. 3.

Corbis lamellosa, Deshayes, 'Description des Coquilles Fossiles des Environs de Paris' vol. i (1824) p. 88 & pl. xiv, figs. 1-3.

Fimbria lamellosa, Frauscher, Denkschr. d. k. Akad. d. Wissensch. Wien, vol. li (1886) pt. ii, p. 172.

This fossil consists of a fragmentary impression of a longi-

tudinally oval-shaped valve, belonging in all probability to the genus *Fimbria*. It exhibits a regular series of equidistant oval costæ with intervening broad sulcations, which are marked by closely-set and fine transverse striae. Only about half the valve is preserved, and this only as an impression in the limestone-matrix; yet its sculpture is of interest, as suggesting affinities with *Fimbria lamellosa* of Lamarck—a familiar Eocene shell found in Europe, Northern Africa (Egypt, etc.), Asia Minor, etc.

The original umbono-ventral measurement of the specimen must have been about 40 millimetres, and the antero-posterior about 60 mm. The posterior side appears to bear a slightly-excavated narrow and elongate area (as seen in a wax-squeeze), which recalls a character more suggestive of *Lucina* than *Fimbria*, and therefore the present identification of this specimen must be more or less provisional.

Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—The upper or more cherty limestone-beds, showing a reddish tinge. The rock contains *Operculina* and other foraminifera (see § F in the Notes on the Foraminiferal Structures, p. 176).

(c) Echinoidea.

SCHIZASTER sp.

A few remains of *Schizaster* are represented in these collections, one being an entire specimen, though much worn and without properly-detailed characters. Dr. F. A. Bather is inclined to refer them all to one species; he states that this

‘undoubted *Schizaster* is enough to prove the Tertiary age of this rock, but the ornament and contour of the specimens are scarcely preserved well enough to enable the species to be determined with certainty.’

Localities.—Top of Garrasgooi Mountain, at about 5200 feet above sea-level, 3 miles south-west of Upper Sheikh; Main Golis, 2 miles south-west from Sheikh Camp; and near Berbera.

Collectors.—Major R. G. Edwards Leckie and Dr. Donaldson Smith.

LINTHIA (?).

Another echinoid has been referred doubtfully to the genus *Linthia* by Dr. F. A. Bather, with the following remark:

‘It is so worn and crushed, and the actinal surface so obscured by hard matrix, which I have not succeeded in removing, that closer identification is not possible on the present evidence.’

A horizontal section of a small Rotaline is seen, on a fragment of matrix attached to the test of this specimen.

Locality.—Top of Garrasgooi Mountain, 5200 feet above sea-level, south-west of Sheikh.

Collector.—Major R. G. Edwards Leckie.

Matrix.—A cream-coloured limestone.

(d) Actinozoa (Corals).

CALAMOPHYLLIA AYLMERI, Gregory.

Calamophyllia Aylmeri, Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 31 & pl. i, fig. 3.

Major Leckie's collection contains a remarkably good example of this coral in the cherty limestone.

Localities.—Near Uradu, north of the foot of the Rugga Pass; about 4 miles south of Camp, Upper Sheikh, elevation over 5000 feet.

Collectors.—Mrs. Lort-Phillips and Major R. G. Edwards Leckie.

Matrix.—Cherty limestone (=the Uradu Limestone of Prof. Gregory), coloured externally a reddish-brown, containing *Operculina complanata* (see § A in the Notes on the Foraminiferal Structures, p. 175).

PRIONASTRÆA sp.

Among Dr. Donaldson Smith's specimens is a silicified coral resembling *Prionastrea crassisepta* of Gregory. The calicular details are somewhat obscure, but at the base individual corallites are seen to be longitudinally costated with closely-packed beaded lines, a character not mentioned in the original description, and therefore this specific name is not applicable to the present specimen.

Locality.—Near Berbera.

Collector.—Dr. Donaldson Smith.

Matrix.—Cherty limestone, with a reddish tinge.

GONIOPORA PARKINSONI (Gregory).

Litharæa Parkinsoni, Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 37 & pl. ii, figs. 13-14.

Goniopora somaliensis prima, H. M. Bernard, 'Catal. of the Madreporarian Corals in the British Museum (Natural History)' vol. iv (1903) pp. 154, 155, & 195.

There is a fairly well-preserved example of this coral in the Leckie collection, exhibiting portion of a subcylindrically-branched corallum, having a length of 40 millimetres and a maximum diameter of rather more than 30 mm. The corallites are broad and with shallow calices, and in every way they conform to the characters pointed out in the original description. Mr. Bernard, in the British Museum Catalogue above quoted, has called attention to this species, and regards it as belonging to the genus *Goniopora*, on account of that generic name having priority over *Litharæa*, a view which is adopted here. Prof. Gregory's specific name of *Parkinsoni* should, however, be retained, not only because it was the first used to designate this coral, but because it is not advisable to favour the trinomial system of nomenclature suggested by Mr. Bernard.

Localities.—Above the Miriya Pass and around God-la-Yareh, south of Bur Dab (type); top of Garrasgooi Mountain, at an elevation of 5200 feet, 3 miles south-west of Upper Sheikh.

Collectors.—Mr. F. B. Parkinson (type) and Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, with external reddish coloration.

DENDRACIS sp.

Dendracis sp., Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 38.

Among Major Leckie's specimens is a fragment of a *Dendracis* which agrees with the specimen described by Prof. Gregory, and it is interesting to note it from another locality in Somaliland.

Localities.—South of Bur Dab (type); Main Golis, 2 miles south-west of Sheikh camp.

Collectors.—Mr. F. B. Parkinson and Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, coloured a reddish-brown.

IV. NOTES ON THE FORAMINIFERAL STRUCTURES IN THE TERTIARY LIMESTONES OF SOMALILAND.

The prevailing organism in the Tertiary limestones of Somaliland is *Operculina*, most probably of the species *complanata*, as understood by W. B. Carpenter, W. K. Parker, & T. R. Jones.¹ Several vertical sections of this form show the bossed character of the margin, as well as the great thickness of the wall of the penultimate chamber, when compared with that of the outer volution.

There is an apparent absence of Nummulites in all the sections that have been examined, but other genera are observable, especially *Amphistegina*, trochoidal Rotalines, *Textularia*, *Biloculina*, *Miliolinæ*, and *Globigerina*. An Orbitoid is also present, possessing rectangular chambers in the median plane, which is recognized as *Discocyclina* cf. *dispana* of J. de C. Sowerby, a species originally described from the Nummulitic deposits of Cutch.² It is allowed by most authorities³ on the Foraminifera, that Orbitoids with rectangular chambers are characteristic of the Eocene Period; this organism is, therefore, of considerable importance in the determination of such an horizon among the Somaliland Limestones.

The following list includes the principal foraminifera seen in a series of microscope-slides of the Somaliland Limestones, Mr. Richard Holland having kindly assisted me in the various determinations. The slides are lettered from A to R.

A. *Operculina complanata* (Defrance) accompanying *Calamophyllia Aylmeri*, Gregory.

Locality.—Hill about 4 miles south of Camp, Upper Sheikh, at an elevation of over 5000 feet.

Collector.—Major R. G. Edwards Leckie.

Matrix.—Cherty limestone, stained externally a reddish-brown.

¹ 'Introduction to the Study of the Foraminifera' (Ray Soc.) 1862, p. 255. & pl. xvii, fig. 11.

² Trans. Geol. Soc. ser. 2, vol. v (1840) pl. xxiv, fig. 16 = *Lycophris dispanus*.

³ See Ch. Schlumberger, Bull. Soc. Géol. France, ser. 4, vol. iii (1903) p. 273.

- B. *Discocyclus*, possibly *dispana* (J. de C. Sowerby), accompanying the large *Gryphæa* sp.
Same locality, collector, and matrix as A.
- C. *Operculina* and *Amphistegina* associated with large *Gryphæa* sp.
Same locality, collector, and matrix as A and B.
- D. *Operculina complanata* (Defrance), showing examples of the bossed margins, etc., associated with an indeterminable lamellibranch.
Locality.—Top of Garrasgooi Mountain, south-west of Sheikh.
Collector.—Major R. G. Edwards Leckie.
Matrix.—Cream-coloured cherty limestone.
- E. *Operculina*, *Miliolina*, and possibly *Amphistegina*, accompanying a compound coralliferous organism showing obscure internal structure.
Locality.—Top of Garrasgooi Mountain, 5200 feet above sea-level, south-west of Sheikh.
Collector.—Major R. G. Edwards Leckie.
Matrix.—Cream-coloured cherty limestone, slightly tinged with red.
- F. *Operculina*, a trochoidal Rotaline, etc., associated with *Fimbria* cf. *lamellosa*.
Locality.—Garrasgooi, 3 miles south-west of Upper Sheikh ; same collector and matrix as E.
- G. *Textularia* and *Operculina*, found in the matrix of *Lucina* cf. *thebaica*.
Same locality, collector, and matrix as F.
- H. *Amphistegina*, *Operculina*, and *Globigerina*.
Locality.—Near Berbera.
Collector.—Dr. Donaldson Smith.
Matrix.—Cream-coloured cherty limestone.
- I. *Operculina*, *Amphistegina*, *Biloculina*, and other *Miliolinæ*.
Same locality, collector, and matrix as H.
- J. *Operculina* and other organisms ; indistinct and obscure, accompanying a large indeterminable shell-fragment.
Same locality, collector, and matrix as H & I.
- K. *Operculina*, *Miliolinæ*, *Textularia*, associated with a large indeterminable shell-fragment.
Same locality, collector, and matrix as H-J.
- L. Good examples of *Operculina* associated with *Campanile somaliensis*.
Same locality, collector, and matrix as H-K.
- M. *Operculina*, *Textularia*, *Miliolinæ*, and possibly *Amphistegina* ; in matrix accompanying the large Naticoid-looking shell.
Same locality, collector, and matrix as H-L.

- N. *Operculina* and *Amphistegina* associated with the large *Conoclypeus* (?) referred to by Prof. Gregory (Quart. Journ. Geol. Soc. vol. lvi (1900) p. 42): no Nummulites observed in this matrix, as previously determined by Messrs. C. D. Sherborn & F. Chapman in Prof. Gregory's paper just quoted.
 Locality.—? Kirrit, south of Bur Dab.
 Collector.—Mr. F. B. Parkinson.
 Matrix.—Cherty limestone, coloured reddish-brown externally.
- O. Possibly *Operculina*, *Amphistegina*, and *Globigerina*; forms rather obscure; in matrix accompanying casts of *Campanile* cf. *giganteus*, var. B.
 Locality.—Dongorreh.
 Collector.—Mrs. Lort-Phillips.
 Matrix.—Cherty limestone, exterior deeply iron-stained.
- P. *Textularia*, *Operculina*, probably *Orbitolites*, and some Rotalinæ, associated with *Campanile* cf. *giganteus*, var. A.
 Locality.—Bur Dab.
 Collector.—Mr. F. B. Parkinson.
 Matrix.—Cream-coloured limestone, weathering a fawn-colour.
- Q. *Discocyclina dispansa*, etc., from the type-specimen of *Columnastræa bicornata*, Gregory, Quart. Journ. Geol. Soc. vol. lvi (1900) p. 32 & pl. ii, figs. 7-9.
 Locality.—Duban District, south of Dobar.
 Collector.—Mrs. Lort-Phillips.
 Matrix.—Cream-coloured limestone.
- R. *Discocyclina*, etc., from the type-specimen of *Columnastræa bicornata*, Gregory.
 Same locality, collector, and matrix as Q.

V. LIST OF THE TERTIARY FOSSILS FROM SOMALILAND.

GASTROPODA.

<i>Campanile</i> cf. <i>giganteus</i> (Lamarck),
vars. A & B.	<i>Solarium</i> cf. <i>canaliculatum</i> , Lamarck.
<i>Campanile somaliensis</i> , sp. nov.	<i>Liotina somaliensis</i> , sp. nov.
<i>Euspira</i> cf. <i>scalariformis</i> (Deshayes).	<i>Conus</i> sp.
<i>Euspira</i> cf. <i>hybrida</i> (Lamarck).	<i>Trophon</i> (?)
	<i>Turritella</i> sp.

LAMELLIBRANCHIA.

<i>Alectryonia</i> cf. <i>Martinsi</i> (d'Archiac).	<i>Chama</i> cf. <i>calcarata</i> , Lamarck.
<i>Gryphæa</i> Gregoryi, sp. nov.	<i>Astarte</i> (?)
<i>Gryphæa</i> sp.	<i>Lucina</i> cf. <i>gigantea</i> , Deshayes.
<i>Vulsella</i> (?)	<i>Lucina</i> cf. <i>thebaica</i> , Oppenheim.
<i>Spondylus ægyptiacus</i> , R. B. Newton.	<i>Lucina</i> cf. <i>Menardi</i> , Deshayes.
<i>Spondylus somaliensis</i> , sp. nov.	<i>Fimbria</i> cf. <i>lamellosa</i> (Lamarck).
<i>Lithophaga</i> sp.	

ECHINOIDEA.

<i>Conoclypeus</i> (?) sp.	<i>Linthia</i> (?)
<i>Schizaster</i> sp.	

ACTINOZOA (CORALS).

List of Prof. Gregory's new species of corals, described and figured in 1900 (Quart. Journ. Geol. Soc. vol. lvi & Proc. Roy. Soc. vol. lxvi) as of Cretaceous age, but which must now be recognized as Tertiary:—

<i>Calamophyllia Aylmeri.</i>	<i>Favia somaliensis.</i>
<i>Dendracis</i> sp.	<i>Cyclolites Phillipsiæ.</i>
<i>Stylina (Cryptocania) Lort-Phillipsi.</i>	<i>Litharæa Colæ.</i>
<i>Stylina subtabulata.</i>	<i>Litharæa Parkinsoni.</i>
<i>Stylophora frondosa.</i>	<i>Prionastræa crassisepta.</i>
<i>Columnastræa bicoronata.</i>	<i>Metethmos asymmetrica.</i>
<i>Columnastræa maxima.</i>	<i>Heliopora somaliensis.</i>
<i>Columnastræa Phillipsiæ.</i>	

FORAMINIFERA.

<i>Operculina complanata</i> (DeFrance).	<i>Amphistegina.</i>
<i>Nummulites</i> (according to Sherborn & Chapman).	<i>Textularia.</i>
<i>Discocyclina dispansa</i> (J. de C. Sowerby).	<i>Biloculina.</i>
	<i>Trochoidal Rotalines.</i>
	<i>Globigerina</i> , etc.

EXPLANATION OF PLATES XVII-XXI.

[All figures are of the natural size, except where otherwise stated.]

PLATE XVII.

Campanile cf. *giganteus*, var. A.

Fig. 1. Front view, with indications of the plicated columella on the rubbed-down surface of matrix filling the aperture.

Locality.—Bur Dab; collected by Mr. F. B. Parkinson. [B.M.—G. 12053.]

Campanile cf. *giganteus*, var. B.

2. Specimen showing the four later whorls, with plications and ornamental details at the base.

Locality.—Dongorreh; collected by Mrs. Lort-Phillips. [B.M.—G. 16071.]

3. Basal view of a smaller example of the same variety. [B.M.—G. 16072.]

Locality.—Four miles south of Camp, Upper Sheikh, at an altitude exceeding 5000 feet; collected by Major R. G. Edwards Leckie.

Gryphæa Gregoryi, sp. nov.

4. Dorsal view of a lower valve, showing the concave posterior area and small anterior auricle.

Locality.—Northern Somaliland; collected by Mr. F. B. Parkinson. [B.M.—L. 12666.]

PLATE XVIII.

Campanile somaliensis, sp. nov.

Fig. 1. Front view of specimen with short central canal. [$\frac{2}{3}$ nat. size.] [B.M.—G. 16073.]

2. Longitudinal section of another specimen, exhibiting the cylindrical axis with its plications, and the large quadrate chambers on each side. [B.M.—G. 16074.]

Locality.—Both specimens were collected near Berbera, by Dr. Donaldson Smith.

PLATE XIX.

Euspira cf. *scalariformis* (Deshayes).

- Fig. 1. Front view of limestone-cast, showing the umbilical area and the narrow elongate aperture with its nearly-parallel sides.
2. Dorsal view of the same specimen.
Locality.—Near Berbera; collected by Dr. Donaldson Smith. [B.M.—G. 16075.]

Euspira cf. *hybrida* (Lamarek).

3. Dorsal view of limestone-cast showing the 'ramped' character of the whorls. The curious pattern on the body-whorl represents rough cracks in the cast.
4. Basal aspect of the same specimen, showing the strong callosity.
Locality.—Bur Dab; collected by Mr. F. B. Parkinson. [B.M.—G. 12052.]

Solarium cf. *canaliculatum*, Lamarek.

5. Dorsal view, showing part of the spire. $\times 2$.
6. Basal view of the same specimen. $\times 2$.
Locality.—Top of Garrasgooi Mountain, 5200 feet above sea-level, south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—G. 16076.]

Liotina somaliensis, sp. nov.

7. Dorsal aspect of a specimen, showing the slightly-reflected margin of the aperture and the trellised sculpture of the shell. $\times 2$.
Locality.—Top of Garrasgooi Mountain, 5200 feet above sea-level, south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—G. 16077.]

PLATE XX.

Alectryonia cf. *Martinsi* (d'Archiac).

- Fig. 1. Internal view of valve, showing the ligamental region, etc.
2. External aspect of the same specimen, showing the bifurcating costæ.
Locality.—Dobar, south of Berbera; collected by Mrs. Lort-Phillips. [B.M.—L. 14927.]

Lucina cf. *gigantea*, Deshayes.

3. Limestone-cast, showing the internal surface of the right valve, with indications of the adductor-scars and pallial markings.
Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16883.]

Lucina cf. *thebaica*, Oppenheim.

4. Right valve, showing obscure concentric and radial sculpture.
5. Umbonal aspect of the same specimen, showing the convexity of the valves.
Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16884.]

PLATE XXI.

Gryphæa Gregoryi, sp. nov.

- Fig. 1. Dorsal view of a lower valve of this species, showing a more produced anterior auricle than that represented in Pl. XVII, fig. 4.
2. Dorsal aspect of a similar valve of another specimen, representing the smallest example of this species that is at present known.
Locality.—Top of Garrasgooi Mountain, 5200 feet above sea-level, south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16885.]

Gryphaea sp.

Fig. 3. Section of a fragmentary lower valve of a large species, showing the thickly-laminated shell-structure.

Locality.—Hill about $3\frac{1}{2}$ miles south-west of the Camp at Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16886.]

Vulsella (?)

4. Outer aspect of a valve, showing smooth, concentric, lamellate sculpture.

Locality.—Garrasgooi Mountain, 5200 feet above sea-level, south-west of Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16887.]

Spondylus somaliensis, sp. nov.

5. View of a specimen with closed valves.

6. Fragment of a larger specimen, with more distinct sculpture.

- 6a. Costæ enlarged 4 diameters, showing the annulated ornamentation.

Locality.—Top of Garrasgooi Mountain, about 5200 feet above sea-level; collected by Major R. G. Edwards Leckie. [B.M.—L. 16888.]

Lithophaga sp.

7. Specimen exhibiting the crypts of *Lithophaga* (= *Lithodomus*) in a small mass of *Prionastræa crassisepta* Gregory. [B.M.—L. 14928.]

Locality.—Dobar, south of Berbera; collected by Mrs. Lort-Phillips.

Lucina cf. *Menardi*, Deshayes.

8. Posterior lateral view of a fragmentary specimen, with both valves attached, showing the angulated area and concentric ornamentation.

Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16889.]

Fimbria cf. *lamellosa* (Lamarek).

9. View of a fragmentary valve, occurring as a limestone-impression, showing external sculpturing.

Locality.—Garrasgooi, 5 miles south-west of Upper Sheikh; collected by Major R. G. Edwards Leckie. [B.M.—L. 16890.]

DISCUSSION.

Major R. G. EDWARDS LECKIE said that the localities from which he made his collection of fossils were at Garrasgooi and at various points along the Golis Range, west of that mountain. The Golis Range had an elevation of 5000 feet above sea-level, and formed the northern edge of the great inland plateau of Somaliland. All this plateau was covered by a bed of fossiliferous limestone, averaging, so far as he could judge, about 250 feet in thickness. In the Guban, or Maritime Plain, between the plateau and the coast, the limestones which occurred at the Eilo Range and Bihendola were, in the opinion of those who had examined the fossils, of Jurassic age. He had not observed Tertiary limestones in the Maritime Plain.

The Author thanked Major Leckie for his remarks, and the Fellows present for their reception of his paper.

P. Highley del. et lith.

Mintern Bros. imp.

EOCENE SHELLS FROM SOMALILAND.

1.

$\frac{2}{3}$ nat.

2.

P. Highley del. et lith.

Mintern Bros. imp.

Eocene Shells from Somaliland.

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