

J. W. GREGORY.

---

THE GEOLOGY AND FOSSIL CORALS AND  
ECHINIDS OF SOMALILAND.

---

[Quart. Journ. Geol. Soc., vol. lvi, 1900,  
pp. 26-45 & pls. i-ii.]

[*From the QUARTERLY JOURNAL of the GEOLOGICAL SOCIETY for  
February 1900, Vol. lvi.*]

---

ON THE GEOLOGY AND FOSSIL CORALS  
AND ECHINIDS OF SOMALILAND.

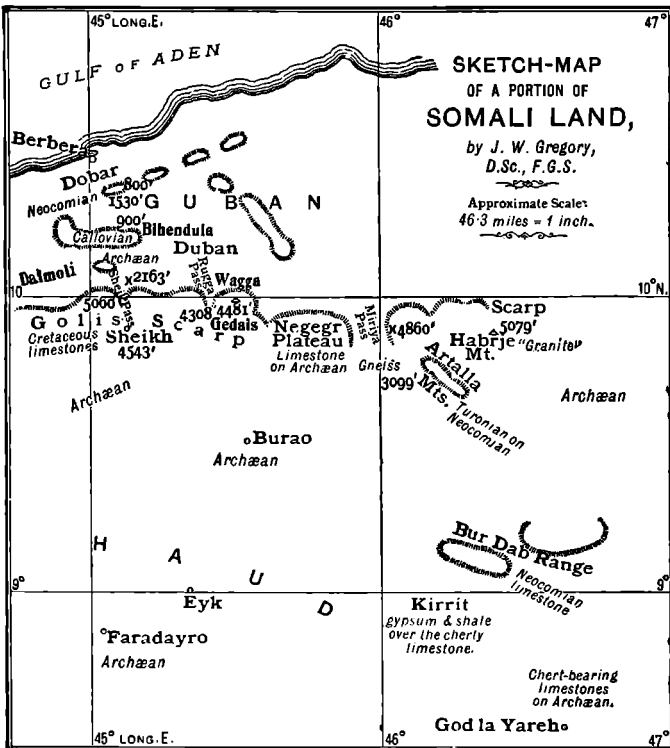
On the GEOLOGY and FOSSIL CORALS and ECHINIDS of SOMALILAND.

By J. W. GREGORY, D.Sc., F.G.S.

[PLATES I & II.]

CONTENTS.		Page
I. Introduction .....		26
II. The Archæan Series .....		28
III. The Somaliland Limestones .....		29
IV. The Fossil Corals of Somaliland .....		30
V. The Fossil Echinoidea of Somaliland .....		41
VI. The Limestone Sequence and the Date of the Foundering of the Aden Gulf		42

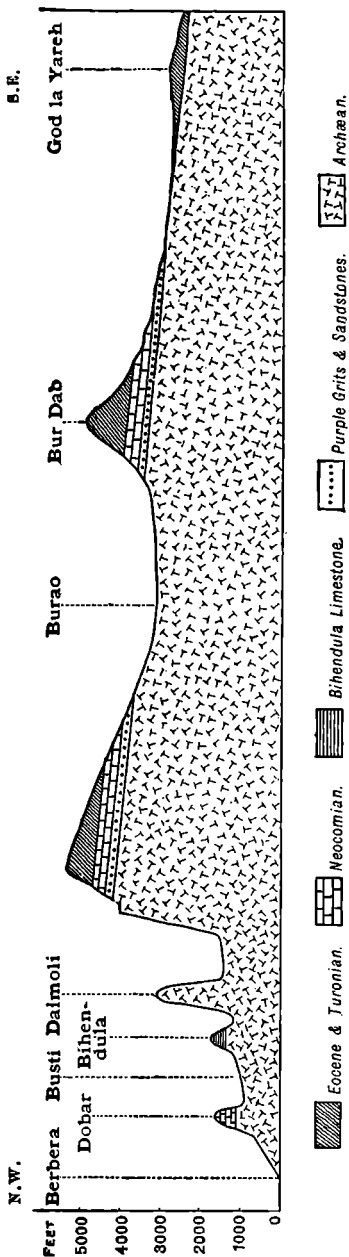
Fig. 1.



I. INTRODUCTION.

BRITISH Somaliland consists of a high plateau, of which the northern scarp is separated from the Gulf of Aden by a belt of low hills and plains, known as the Guban. The southern plateau consists of a vast block of Archæan rocks, mainly gneiss and amphibolites, with intrusive pegmatite-dykes, and it is

Fig. 2.—Section across a portion of Somaliland, from the coast at Berbera to God-la-Yareh.



capped by purple grits, red sandstones, and conglomerates. The more rugged peaks of the coastal belt are outliers of the Archæan plateau; but the main geological interest of this area is due to the occurrence in it of a series of limestones. That the limestones belong to more than one period was obvious from the earliest accounts of them. Thus M. de Rochebrune,<sup>1</sup> who in 1882 first described the Somali limestones, identified the fossils collected by Révoil in the Singeli country (lat. 11° N. & long. 49° E.) as Neocomian; and Miss Raisin,<sup>2</sup> who six years later gave an account of the specimens collected by Capt. King at Mount Eilo, south of Zeila (lat. 10° 30' N. & long. 43° 35' E.), suggested, on the evidence of the foraminifera, that the limestone at that locality was late Cretaceous or more probably Kainozoic.<sup>3</sup> The fossils described by M. de Rochebrune were obtained in Eastern Somaliland; the limestone described by Miss Raisin came from the western part of the Guban; while the Neocomian fossils described by Prof. Mayer-Eymar<sup>3</sup>

<sup>1</sup> A. T. de Rochebrune, 'Obs. géol. & pal. Région Comalis' Mission Révoil, Faune & Flore des Pays Comalis, 1882 (pt. vii), 39 pp. & 4 pls.

<sup>2</sup> C. A. Raisin, 'Rock-specimens fr. Somaliland' Geol. Mag. 1888, p. 418.

<sup>3</sup> C. Mayer-Eymar, 'Neocom. Verst. Somali-Lands,' Viertel-jahraschr. naturf. Gesellsch. Zürich, vol. xxxviii (1893) pp. 249-65.

were 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.

A geological collection made in the winter of 1894-95 by Mr. and Mrs. Lort Phillips, Miss Edith Cole, and Mr. G. P. V. Aylmer demonstrated the occurrence of two distinct limestones in the central area of the Guban, south of Berbera.<sup>1</sup> In the paper describing this collection, some suggestions were made as to points on which information would be especially useful; and in reply I have received some further collections which practically settle the three problems then mentioned as unsolved. The largest collection was made by Mr. and Mrs. Lort Phillips, Miss Gillett, and Mr. G. P. V. Aylmer in the Golis Mountains and in the coastal belt between the foot of the Golis scarp and the sea. Capt. E. T. Marshall has kindly sent me a supplementary collection of rocks from the Haud and of fossils from the raised beaches of the Maritime Plain. A collection of fossils from the limestones east of the Berbera district and some fossils from the high-level limestones has been made by Mr. F. B. Parkinson. To Mr. Aylmer I am greatly indebted for a carefully-prepared map of the Guban and of the watershed along part of the northern margin of the central plateau.

To all these travellers I must express my best thanks for their interesting collections, which throw light on three problems:—the distribution of the Archæan rocks; the age and sequence of the limestones; and the date of the foundering of the Aden Gulf.

## II. THE ARCHÆAN SERIES.

The Archæan rocks from the Haud and its northern outliers include gneiss, amphibolites, mica- and chlorite-schists, coarse quartz-orthoclase-pegmatites, etc. They belong to types familiar from the descriptions of the similar rocks from Socotra by Prof. Bonney<sup>2</sup> and from Western Somaliland by Miss Raisin.<sup>3</sup>

The principal varieties have been recorded from the area south of Berbera in my note of 1896 (*op. jam cit.*). It is therefore only necessary to give the following list of localities where the present collections have proved the occurrence of the Archæan Series:—

<i>Localities.</i>	<i>N. Lat.</i>	<i>E. Long.</i>	<i>District.</i>	<i>Altitudes in feet.</i>	
East of Gellakur ...	10° 5'	45° 15'	Urada		Syenitic gneiss.
Foot of Rugga Pass	10 0	45 20	"	...	Gneiss.
Top of Rugga Pass	10 0	45 20	Golis	4300	Gneiss and quartzite.
Upper Sheikh	9 55	45 10		4543	Gneiss and chloritic schist.
Sok Soddah	9 47	45 20		4308	Saussuritic gneiss and chloritic schist.

<sup>1</sup> See my 'Note on the Geol. of Somaliland,' *Geol. Mag.* 1896, pp. 289-94.

<sup>2</sup> T. G. Bonney, 'Oolite Rock-specimens fr. I. of Socotra,' *Phil. Trans. Roy. Soc.* vol. clxxiv (1883) pp. 273-94 & pls. vi-vii.

<sup>3</sup> C. A. Raisin, 'Rock-specimens fr. Somaliland' *Geol. Mag.* 1888, pp. 414-18.

<i>Localities.</i>	<i>N. Lat.</i>	<i>E. Long.</i>	<i>District.</i>	<i>Altitudes in feet.</i>	
Dobar .....	10° 20'	45° 5'	Guban	appr. 800	Coarse syenitic gneiss.
Busti .....	10 16	45 4	"	" 900	Gneiss.
Bihendula .....	10 10	45 5	"	" 1000	Amphibolite-schist.
Wagga Mt. ....	10 2	45 25	Golis	" 4000	Gneiss, mica-schist, chloritic schist, and amphibolite.
Duban .....	10 10	45 25	Guban		Gneiss and pegmatite.
'Hau Kideali' .....			Wagga		Gneiss (coll. by Miss F. Gillett).
Daimoli .....	10 7	45 3	Guban	3094	Gneiss and amphibolite.
Between Bihin and Daimoli .....	10 9	45 4	"		Gneiss.

### III. THE SOMALILAND LIMESTONES.

In 1896 it was uncertain whether the limestones were restricted to the Guban or whether any member of the series occurred on the northern part of the plateau. This point was important, as upon it depended the question whether the Haud had been below sea-level in Kainozoic times, or whether it was part of a very ancient land-area, round the flanks of which the limestones had been deposited.

The collections now prove conclusively that marine limestones of Cretaceous and early Kainozoic date do occur on the summit of the Haud. This view appeared probable, on account of the abundance of irregular chert-fragments scattered over the surface of the plateau; but this evidence was not conclusive, as the cherts might have been carried up by the makers of the Palæolithic stone-implements found upon the plateau. The existence of the high-level limestones is demonstrated indirectly by the occurrence of thick deposits of calcareous tufa at various points on the edge of the Haud, as at Wagga, where some beds of tufa with leaf-remains are exposed, at Gedais and at the Upper Sheikh Pass, where there are encrustations of compact stalagmitic limestone. These deposits show that there must have been some considerable amount of calcareous rock at higher levels than that at which the tufa now occurs. Fortunately there is also direct evidence, as Mr. Aylmer has collected specimens of limestone *in situ* at the following localities:—

<i>Localities.</i>	<i>Altitudes in feet.</i>	<i>Position.</i>
Sok Soddah.....	4300	South of the Rugga Pass.
Wagga .....	4000	A spur of the Golis, north-east of the Rugga Pass.
By highest point of Abdullah Ismail...	about 5300	South of the Golis, west of Sheikh.
Between Burao and Bur Dab .....	.. 3000	The Haud, approximately 9° 20' lat. N. & 45° 50' long. E.
Derkamli Libah, south of Burao ...	.. 3000	The Haud.

At Burao and Derkamli Libah the rocks are banded cherts and foraminiferal limestones. Limestones have also been recorded by

Mr. Parkinson<sup>1</sup> from the sides of the Miriya Pass, above Dongorreh, in the ranges of Artalla and Bur Dab, and as far south as God-la-Yareh.

Hence it is clear that the marine limestones are widely distributed in Somaliland on the summit of the plateau. As some limestones of the same age also occur in the low-lying Guban at the foot of the plateau-scarp, the formation of the Aden depression was later than the deposition of the high-level limestones, for the age of which we must turn to the palæontological evidence.

#### IV. THE FOSSIL CORALS OF SOMALILAND.

##### Description of the Species.

##### GENUS STYLOPHORA, Schweigger, 1820.

###### 1. STYLOPHORA PISTILLATA (Esper).

1797. *Madrepora pistillata*, Esper, 'Pflanzenh.' Fortsetz. vol. i, p. 73, Madrep. pl. lx.

1820. *Stylophora pistillaris*, Schweigger, 'Handb. Naturg.' p. 414; 1879. *St. pistillata*, Klunzinger, 'Korallth. roth. Meer.' pt. ii, p. 62.

Distribution.—Raised Reefs, Guban near Berbera. Coll. Capt. E. T. Marshall.

###### 2. STYLOPHORA PALMATA (de Blainville).

1830. *Sideropora palmata*, de Blainville, Zooph. in Dict. Sci. Nat. vol. lx, p. 350.  
1857. *Stylophora palmata*, Milne-Edwards & Haime 'Hist. Nat. Cor.' vol. ii, p. 137;  
1879. Klunzinger, 'Korallth. roth. Meer.' pt. ii, p. 63.

Distribution.—Raised Reefs: Guban, near Berbera. Coll. Capt. E. T. Marshall. This 'species,' which may be only a form of *St. pistillata* with more compressed branches, is represented by a small specimen.

###### 3. STYLOPHORA FRONDOSA, sp. nov. (Pl. I, figs. 1 a-1 c.)

Diagnosis.—Corallum large and caespitose; with thick, strongly compressed, twisted branches. Corallites small, about 1 mm. in diameter, very crowded; the calices are deep and the lower margins raised. Columella prominent.

Septa in one cycle; all six septa equal in size and united to the columella. Endotheca in distant, tabuliform lamellæ.

Distribution.—Duban: low-level alkali plain, north of the foot of the Rugga Pass. Coll. Mrs. Lort Phillips.

Affinities.—This coral occurs as a series of branches ramifying through a large block of limestone. In many places the coral has been removed, leaving the interspaces as confluent sheets of limestone ornamented by minute granulations or tubercles which are the casts of the calices. These bands of limestone stand out as branched expanded sheets, resembling in appearance a crateriform sponge. The branches of the coral occur as depressions between the raised limestone-bands; and it was only by breaking away the latter that

<sup>1</sup> F. B. Parkinson, 'Two recent Journeys in Northern Somaliland' Geogr. Journ. vol. xi (1898) pp. 17, 19, 25 & 28.

the real fossil was displayed, and proved to be a *Stylophora* instead of a Latusastræan coral as had been at first suspected.

The main characters of the species are the narrowness of the cœnenchyma and the crowded arrangement of the corallites.

#### Genus STYLINA, Lamarek, 1816.

##### 1. STYLINA SUBTABULATA, sp. nov. (Pl. I, figs. 2 a & 2 b.)

**Diagnosis.**—Form of corallum unknown. The corallites are of medium size and crowded. They are circular or elliptical in transverse section.

The septal symmetry is pentagonal or hexagonal, rarely heptagonal. The septa belong to two complete cycles, with one or two small septa representing the third cycle in a few of the primary loculi. The primary septa are thick and conspicuous, whereas the secondary septa are short and thin. Costæ short, thick, and prominent.

The columella is very small.

The dissepiments are stout, and in longitudinal sections may resemble tabulæ.

**Dimensions.**—Diameter of corallites = 3 to 5 mm.; distance of calicinal centres = 4 to 7 mm.

**Distribution.**—Dobar Limestone: Dobar, south of Berbera. Coll. Mrs. Lort Phillips.

**Affinities.**—In general aspect, this coral closely resembles *Cryptocœnia Picteti*, Koby, from the Swiss Urgonian; but in the Somaliland coral there is a distinct columella in many corallites, and the diameter of the corallites is, on the average, nearly twice as great. In septal characters the species agrees with the Upper Senonian *Stylina geminata* (Goldf.), from Maastricht; but the corallites are larger and the columella is smaller.

An interesting feature in this species is the strong development and subtabulate arrangement of the dissepiments; the presence of definite tabulæ in the closely-allied genus *Cyathophora* may be thus explained as merely exaggerated dissepiments.<sup>1</sup>

##### 2. STYLINA LORT-PHILLIPSI, Gregory.

1896. *Cryptocœnia Lort-Phillipsi*, Gregory, Geol. Mag. p. 291.

**Distribution.**—Dobar Limestone, Dobar. 'Coll. Mrs. Lort-Phillips.

#### Genus CALAMOPHYLLIA, de Blainville, 1830.

##### CALAMOPHYLLIA AYLMERI, sp. nov. (Pl. I, fig. 3.)

**Diagnosis.**—Corallum with the corallites widely separated, the interspaces being usually wider than the diameter of the corallites. The corallites are circular or elliptical in transverse section, and are slightly sinuous. They are connected by occasional collerettes, which are somewhat thick and lamellar.

<sup>1</sup> Koby, Mém. Soc. Pal. suisse, vol. xxiii, 'Mon. Polyp. Crét. Suisse' pt. ii (1897) p. 32 & pl. ii, fig. 11.



The septa are very thin, and belong to three cycles. There is no columella, and the endotheca is very scanty.

Dimensions.—Diameter of corallites = 1.5 to 2 mm.; average distance of calicinal centres = 5 mm.

Distribution.—Uradu Limestone, near Uradu; north of the foot of the Rugga Pass. Coll. Mrs. Lort Phillips.

Affinities.—This species resembles *C. radiata* (Lamx.),<sup>1</sup> from the Bathonian, in the small size of its corallites; but it differs from that coral by the more open growth of the corallum, the greater number of septa, and less sinuous corallites. The general characters of the corallum are more like those of *Stylosmilia* than of *Calamophyllia*; but owing to the absence of the columella it is included in the latter genus. In the description of the Kach corals I have expressed doubt as to the continued separation of these two genera;<sup>2</sup> the presence of the well developed columella is the distinctive feature of *Stylosmilia*.

#### Genus GALAXEA, Oken, 1815.

##### GALAXEA IRREGULARIS (Milne-Edwards & Haime).

1848. *Sarcinula irregularis*, Milne-Edwards & Haime, 'Monogr. des Astréides' Ann. Sci. Nat. ser. 3, vol. x, p. 316.

1851. *Galaxea irregularis*, Milne-Edwards & Haime, 'Polyp. Foss. des Terr. Paléoz.' Arch. Mus. Hist. Nat. vol. v, p. 71; 1857. 'Hist. Nat. Cor.' vol. ii, p. 229 & pl. D 2, fig. 2; 1879. Klunzinger, 'Korallth. roth. Meer.' pt. ii, p. 78 & pl. vii, fig. 11

Distribution.—Raised reefs. In the Guban, near Berbera. Coll. Capt. E. T. Marshall.

#### Genus ORBICELLA, Dana, 1848.

##### ORBICELLA MAMMILLOSA, Klunzinger.

1879. *Orbicella mammillosa*, Klunzinger, 'Korallth. roth. Meer.' pt. iii, p. 49 & pl. v, fig. 6, pl. x, figs. 10 a-10 c.

Distribution.—Raised Reefs. In the Guban, near Berbera. Coll. Capt. E. T. Marshall.

#### Genus COLUMNASTRÆA,<sup>3</sup> d'Orbigny, 1849.

The inclusion of the following fossils in this genus necessitates a slight alteration in its accepted definition, which we owe to Milne-Edwards & Haime; for in one species, if not in more, there are two crowns of pali instead of only one, as in the type-species. The genus is nearly allied to *Cyathomorpha*, which has more numerous septa.

##### 1. COLUMNASTRÆA BICORONATA,<sup>4</sup> sp. nov. (Pl. II, figs. 7-9.)

Diagnosis.—Corallum massive, apparently in nodular or hemispherical masses.

The corallites are of medium size; the average diameter is

<sup>1</sup> *Eunomia radiata*, Lamouroux, Exp. Méth. p. 83 & pl. lxxi, figs. 10-11.

<sup>2</sup> Gregory, 'Jur. Fauna Cutch' Pal. Ind. ser. 9, vol. ii, pt. ii, pp. 49-50.

<sup>3</sup> This name was originally spelt *olumustræa* by d'Orbigny.

<sup>4</sup> Having two crowns of pali.

about 4 mm. The corallites are separated by distinct but narrow spaces, with comparatively little exotheca. The walls are thick.

Septa in three complete cycles; they are thick at the base and taper rapidly.

The columella is small and inconspicuous.

Pali: one crown of six strong cylindrical pali, alternating with which are six thin, inconspicuous lamellar pali.

Dimensions (of three specimens).—

	No. 31.	No. 32. <sup>1</sup>	No. 16.
	mm.	mm.	mm.
Diameter of the corallites .....	3 to 5	4 to 5	4 to 6
Distance of calicinal centres.....	4.5 to 5.5	5 to 5.5	5 to 7
Corallum: diameter .....	broken fragment	...	75 by 65
„ height.....	70 by 50	85	40

Distribution.—Urada Limestone: near Urada, south of Dobar, and in the Duban. Coll. Mrs. Lort Phillips.

Affinities.—*Columnastræa bicoronata* differs from previously-described species of the genus by its double crown of pali and the greater size of the corallites. The spaces between the corallites are sometimes completely filled by calcareous material, in such wise that the corallites appear united by solid walls.

## 2. COLUMNASTRÆA PHILLIPSÆ, sp. nov. (Pl. II, fig. 10.)

Diagnosis.—Corallum massive.

Corallites very small: the average diameter being about 2 mm. The corallites are closely crowded, but internally appear definitely separated by narrow intermediate spaces. Exotheca very scanty. The corallites in section are usually circular or elliptical, but are sometimes subtrigonal. Distance of the calicinal centres = 2.5 mm.

Septa very thin; the primary are decidedly more distinct than the secondary. There are three complete cycles and some representatives of a fourth cycle.

Columella small, and often appearing trabecular, owing to its union with the pali.

Pali in one complete crown, and in some corallites irregular representatives of a second crown occur.

Distribution.—Urada Limestone: Urada, near the foot of the Rugga Pass. Coll. Mrs. Lort Phillips.

Affinities.—This coral may be easily distinguished from the other Somaliland *Columnastrææ* by the small size of its corallites. In this character it approaches *C. striata* (Goldf.),<sup>2</sup> the type of the genus; and that Turonian species also has traces of a fourth cycle. *C. Phillipsiæ* differs, however, from *C. striata* by having the corallites more crowded, less uniform in shape, the pali less regular, and the septa of the different cycles less equal in size.

<sup>1</sup> This specimen, from south of Dobar, has a much altered corallum, the pali are obscurely indicated in a few calices only, and the determination is doubtful.

<sup>2</sup> *Astræa striata*, Goldfuss, 'Petref. Germ.' pt. i (1829) p. 111 & pl. xxxviii, fig. 11.

*C. similis*, M.-Ed. & H.<sup>1</sup> has corallites of a similar size, but has the septa less numerous and well developed than those of *C. Phillipsæ*.

### 3. COLUMNASTRÆA MAXIMA, sp. nov.

Diagnosis.—Corallum nodular; comparatively small.

Corallites very large; fused together by thick walls, which, in weathered specimens, stand out above the level of the corallum, separating the depressed calices.

Septa in three orders.

Dimensions.—Diameter of corallites = 10 to 12 mm.; distance of calicinal centres = 12 to 13 mm.

Distribution.—Uradu Limestone: Uradu. Coll. Mrs. Lort Phillips.

### Genus PRIONASTRÆA, Milne-Edwards & Haime, 1848.

#### PRIONASTRÆA CRASSISEPTA, sp. nov. (Pl. I, figs. 5 a, 5 b, & 6.)

Diagnosis.—Corallum in rounded masses; heavily calcified. The corallites are large, polygonal, closely crowded, and intimately united throughout by their walls.

Calices comparatively shallow.

Septa in four complete cycles; the primary and secondary septa are very thick, and reach the columella.

Columella broad, but not very conspicuous; it is about one-fifth of the diameter of the corallite, and composed of very spongy tissue.

Dissepiments abundant.

Dimensions.—Diameter of corallum = 90 by 70 mm.; of average corallite = 20 mm.; of columella of the same = 4 mm.

Distribution.—Dobar Limestone: Dobar, south of Berbera. Coll. Mrs. Lort Phillips.

Affinities.—This coral resembles *Dimorphocœnia crassisepta*, de From.<sup>2</sup> by the great thickness of its septa; but it differs by the presence of the columella, the absence of the concentric arrangement of the corallites, and other characters. The septa are thicker than in any other known species of *Prionastræa*, of which it is the earliest representative. The previous records of the genus from the Jurassic are based on species of *Isastræa*.

### Genus CÆLORIA, Milne-Edwards & Haime, 1848.

#### 1. CÆLORIA ARABICA, Klunzinger.

1879. *Cœloria arabica*, Klunzinger, 'Korallth. roth. Meer.' pt. iii, p. 17 & pl. ii, figs. 1, 3, 8; pl. ix, fig. 10.

Distribution.—Raised reefs. In the Guban, near Berbera. Coll. Capt. E. T. Marshall. Two small fragments.

<sup>1</sup> Milne-Edwards & Haime, 'Monogr. des Astréides' Ann. Sci. Nat. ser. 3, vol. xii (1849) p. 184.

<sup>2</sup> E. de Fromentel, 'Descr. Polyp. foss. Étage Néocom.' (1857) p. 55 & pl. viii, fig. 1.

Genus *FAVIA*, Oken, 1815.1. *FAVIA LOBATA* (Milne-Edwards & Haime).

1849. *Parastræa lobata*, M.-E. & H. 'Monogr. des Astréides' Ann Sci. Nat. ser. 3, vol. xii, p. 171.

1857. *Favia lobata*, M.-E. & H. 'Hist. Nat. Cor.' vol. ii, p. 434 & pl. D 8, fig. 3.

Distribution.—This coral is abundant in the existing reefs of the Red Sea, and occurs in the raised reefs of Egypt and Sinai. The specimen collected by Mrs. Lort Phillips is much altered; though it has larger calices than is usually the case in *F. lobata*, there is no doubt that it belongs to that species. It was found at Dobar, but was probably carried there as building-material from the raised limestones of the Somali coast, near Berbera. It is the only Pleistocene species that is represented in Mrs. Lort Phillips's collection.

2. *FAVIA SOMALIENSIS*, sp. nov. (Pl. I, figs. 4 a & 4 b.)

Diagnosis.—Corallum nodular; small.

Corallites of medium size, elliptical, quadrangular, or subtrigonal; in very short series. The walls are usually from 3 to 4 mm. thick, although the walls between newly-separated corallites may be only 1 mm. thick.

The septa belong to three complete cycles, with some representatives of a fourth. The septa of the primary and secondary cycles are subequal.

Dimensions.—Diameter of corallites = 5 to 8 mm.; distance of calicinal centres = 6 to 8 mm.; corallum: diameter = 55 by 70 mm.; height = 35 mm.

Distribution.—Urada Limestone: Urada. Coll. Mrs. Lort Phillips.

Affinities.—This coral may be regarded as a larger, coarser form of *F. Lorioli*, Koby,<sup>1</sup> from the Swiss Urgonian. Our coral may be only a geographical variety of that species, having corallites twice the width, owing to growth under more tropical conditions. As the only known corallum, however, is no larger than those of the Swiss species, this hypothesis must be regarded as merely a tentative suggestion.

Genus *METETHMOS*, Gregory, 1899.<sup>2</sup>

Diagnosis.—Ethmotidæ in which the corallum is simple and the calice shallow; some of the septa are perforated near their inner and upper ends, but the pores in the older septa and near the wall are closed by stereoplasm. Synapticulæ scarce. Columella well developed, papillary.

Affinities.—This genus was founded for some Bathonian corals from Kach, of which the type is *M. Blanfordi*, Greg.

<sup>1</sup> Koby, Mem. Soc. Pal. suisse, vol. xxiii 'Monogr. Polyp. Crét. Suisse' pt. ii (1897) p. 53 & pl. x, figs. 6-7.

<sup>2</sup> 'Jur. Fauna Cutch' Pal. Ind. ser. 9, vol. ii, pt. ii, p. 165.

**METETHMOS ASYMMETRICA**, sp. nov. (Pl. II, figs. 11 a & 11 b.)

**Diagnosis.**—Corallum large and cornutiform. The base is pointed, and the upper surface flat; the transverse section is elliptical.

Columella about one-tenth the diameter of the corallum. Ex-centric in position, being nearer the convex side.

Septa large and crowded, and unsymmetrically developed on the two sides of the columella. The septa are longer and more numerous on the concave side of the corallum, where they occur in six incomplete cycles. On the opposite side there are only four cycles.

The primary and secondary septa are thick, and appear imperforate; in the section on the concave side of the corallum the tertiary septa may be the same, but on the other side the tertiary septa and those of higher orders are thin and perforate.

**Dimensions.**—Height of corallum = 60 mm.; diameter, major = 40 mm., and minor = 29 mm.; diameter of columella = 4 by 3 mm.

**Distribution.**—Dobar Limestone: Dobar. Coll. Mrs. Lort Phillips.

**Affinities.**—Externally this coral strikingly resembles *Montivaltia cornutiformis*, Greg.<sup>1</sup> but may be distinguished from it in transverse sections. It is much larger than the two Indian Jurassic species of *Metethmos*, and the septa are more numerous.

Asymmetry in the septal sequence on either side of the axis of the corallum is not unusual in corals with a curved axis, and is well illustrated in this species. The septal sequence in two opposite sectors is as follows:—

1	10	6	4	8	11	3	9	5	7	2	7	5	9	3	8	4	6	1
1		4			3	5		2		5		3		4		1		

**Genus CYCLOLITES**, Lamarck, 1801.**1. CYCLOLITES HELIOPHANA**, de Rochebrune.

1882. *Cyclolites heliophana*, A. T. de Rochebrune, 'Obs. géol. & pal. Région Comalis' Mission Révoil, Faune & Flore des Pays Comalis, pt. vii, p. 38 & pl. iv, fig. 1.

**Diagnosis.**—Corallum orbiculate, subconvex above, concave below. Calicular fossa round. Septa equal, very thin and straight; laterally covered with alternately-arranged conical granules.

**Dimensions.**—Diameter = 43 mm.; height = 19 mm.

**Distribution.**—Neocomian (?); Amura, Singeli District.

**2. CYCLOLITES PHILLIPSÆ**, sp. nov.

**Diagnosis.**—Corallum large, elliptical, and thick. The base is uneven. The columellar fossa is short.

Septa very numerous, amounting to about seven cycles. The primary septa measure as much as 3 mm. in thickness. The septa occur as isolated trabeculæ in only the highest orders; in the lower orders the trabeculæ are united by stereoplasm.

<sup>1</sup> 'Jur. Fauna Cutch' Pal. Ind. ser. 9, vol. ii, pt. ii (1899) p. 85 & pl. iv, fig. 7.

Distribution.—Uradu Limestone: near the Rugga Pass. Coll. Mrs. LortPhillips.

Affinities.—This species is founded on a single coral from the Uradu Limestone, which is unfortunately so much weathered that its form is somewhat uncertain. The specimen measures 100 mm. in length, 80 mm. in breadth, and 33 mm. in height. There is no epitheca left on the base, but its absence may be due to erosion.

The coral is a close ally of the Turonian *C. crassisepta*, de From.<sup>1</sup> from which it differs by its shorter columellar fossa, also by having the thick septa equally developed in all directions, and not especially on the sides of the corallite. The new species agrees far more with the Turonian than with the Neocomian, Rhodanian, and Aptian species.

The four Indian Turonian species of *Cyclolites* are much smaller, and belong to a more primitive type of the genus.<sup>2</sup>

#### GENUS LITHARÆA, Milne-Edwards & Haime, 1849.

##### 1. LITHARÆA COLÆ, sp. nov. (Pl. II, figs. 12 a & 12 b.)

Diagnosis.—Corallum small, lamellar; probably growing in thin flat encrustations. Corallites small and crowded, and separated by thick walls.

Calices very deep. Columella small, and barely recognizable on the surface.

Septa in two cycles; irregular in thickness, and rather sinuous.

Dimensions.—Diameter of calices = 1.5 mm., and distance of calicinal centres = 2 mm.; corallum: thickness = 10 mm., and diameter = 28 mm.

Distribution.—Uradu Limestone: Uradu. Coll. Mrs. Lort Phillips.

Affinities.—This species is characterized by its small corallites, deep large calices, and thick walls or bands of cœnenchyma. The genus has hitherto been recorded no earlier than the Upper Cretaceous. The species of *Litharæa* which this coral most resembles is probably *L. Deshayesiana* (Mich.)<sup>3</sup> which agrees with it in the dimensions of the corallites and number of septa, but has thinner cœnenchymal bands. The new species differs from *L. epithecata*, Dunc.<sup>4</sup> from the Upper Cretaceous of Sind, by the smaller size of the corallites, the fewer septa, and the narrower wall.

##### 2. LITHARÆA PARKINSONI, sp. nov. (Pl. II, figs. 13 & 14.)

Diagnosis.—Corallum growing in cylindrical branches measuring from 10 to 20 mm. in diameter. The corallites are of medium

<sup>1</sup> E. de Fromental, 'Pal. franç. Terr. Crét.: Zooph.' vol. viii (1864) pl. lvi & *ibid.* (1867) p. 334.

<sup>2</sup> Stoliczka, 'Cret. Fauna S. Ind.' Pal. Ind. vol. iv, pt. iv (1873) pp. 48 & 49.

<sup>3</sup> Michelin, 'Iconogr. Zooph.' (1840-47) p. 164 & pl. xlv, fig. 4.

<sup>4</sup> P. M. Duncan, 'Sind Foss. Cor. & Aleyon.' Pal. Ind. ser. 14, vol. i, pt. ii (1880) p. 23 & pl. ii, figs. 1-9.

size, with broad, shallow calices, sometimes separated by raised walls 1 mm. thick.

The columella is distinct, and stands up as a blunt prominence, surrounded by six paliform lobes formed by the union of the primary and secondary septa.

Septa in three cycles; those of the first two cycles meet near the columella.

Dimensions (of two specimens).—

	mm.	mm.
Diameter of calices .....	3 to 4	3 to 4
Distance of calicinal centres .....	4 to 5	4 to 5
Diameter of branch of corallum ...	20	16

Distribution.—Cherty Limestone: Somali Plateau. Coll. Mr. F. B. Parkinson.

Affinities.—This interesting coral appears on first examination similar to a *Thamnastræa*, though the application of a hand-lens at once shows that it is a perforate species. The presence of six pali in some corallites raised doubts in my mind as to the generic position of the coral; from a study of the specimens collected by Mr. Parkinson it seems probable, however, that there are no true pali, but only paliform lobes. The species may thus enter *Litharæa*, where its nearest ally is *L. epithecata*, Dunc. from the Upper Cretaceous of Sind; Duncan's species has, however, a small hemispherical and not a branched corallum.

The specimen was collected from the cherty limestones which overlie the cave-forming *Nerinea*-limestone above the Miriya Pass, and around God-la-Yareh, south of Bur Dab (8° 30' lat. N. & 46° 30' long. E.).

#### Genus DENDRACIS, Milne-Edwards & Haime, 1849.

##### DENDRACIS sp.

Mr. Parkinson's collection includes a worn branch of a dendroid coral, which measures 9 mm. in diameter; the calices are slightly over 1 mm. in diameter, and the calicular margins are well raised. The species is closely allied to *D. nodosa*, Rss.<sup>1</sup> but the specimen is too small for definite determination.

The specimen came from the cherty limestone, which overlies the *Nerinea*-limestone.

#### Genus TURBINACIS, nov.

Diagnosis.—Corallum arborescent. Cœnenchyma in narrow bands, variable in width. Calices small, circular, usually crowded. Septa in adult calices numerous and subequal; six large primary septa in young calices. Columella large and parietal. No pali. Tabulæ present.

<sup>1</sup> A. E. von Reuss, 'Pal. Stud. über die älteren Tertiärschichten der Alpen pt. i, Anthozoen der Schichten von Castelgomberto' Denkschr. d. k. Akad. Wissensch. Wien, vol. xxviii (1868) pp. 172, 178 & pl. xv, figs. 2, 5.

Type-species.—*Turbinacis erythrænsis*, sp. nov. Pleistocene: Somaliland.

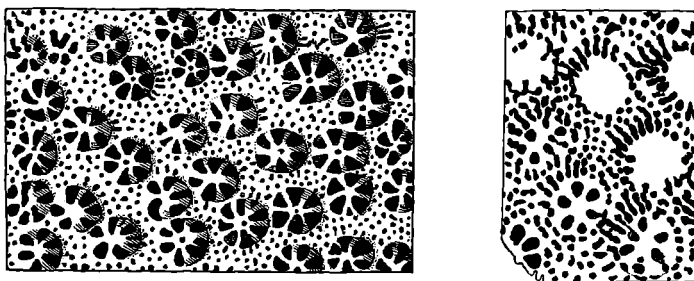
Affinities.—This genus has the habit of a *Stylophora*, the numerous subequal septa of a *Turbinaria*, and the calices of an *Actinacis*. It is most closely allied to the last-named genus, from which it differs by the absence of pali, the more scanty cœnenchyma, and the more numerous septa. It differs from *Astræopora*, which it resembles in the character of the cœnenchyma, by the presence of a prominent, well-developed columella. From *Turbinaria* it differs by its arborescent habit, the more scanty cœnenchyma and the prominence of the primary septa in younger calices.

*TURBINACIS ERYTHRÆNSIS*,<sup>1</sup> sp. nov. (Text-figs. 3 a & 3 b.)

Diagnosis.—Corallum of slender, cylindrical, dichotomous branches. Cœnenchyma very variable in width, ranging from a thin band, nearly equal in width to the calices, till it is practically absent. Externally the cœnenchyma appears porous, as it is pierced by numerous circular punctations.

Septa in young calices six in number, and prominent; in older corallites the number of septa increases, and they fuse into groups

Fig. 3.—*Turbinacis erythrænsis*, gen. et sp. nov.



a.  $\times 6$  diam.

b.  $\times 7$  diam.

a = Part of the surface of the corallum.

b = Part of a transverse section of the same.

of six, which resemble six thick primary septa. In the mature corallites the number is about thirty, and they are all subequal.

Columella large, often hollow; sometimes it appears styliform.

Dimensions.—Diameter of branch = 10 mm.; of calices = 1 mm.; width of cœnenchyma = .2 to .8 mm.

Distribution.—Pleistocene; raised reefs, near Berbera, Somaliland. Coll. Capt. E. T. Marshall.

<sup>1</sup> From *Mare Erythræum*, the Red Sea.



## LIST OF SOMALILAND FOSSIL CORALS.

Species.		Pleistocene.	Duban.	Uradu Limestone.	Dobar Limestone.	Remarks.
<i>Stylophora pisitilata</i> .....	(Esper)	*				
" <i>palmeta</i> .....	(Blv.)	*				
" <i>frondosa</i> .....	nov.		*			
<i>Stylina subtabulata</i> .....	"				*	
" <i>Loert-Phillipsi</i> .....	"					
" <i>Calamophyllia Aylmersi</i> .....	"	*		*		
<i>Galaxea irregularis</i> .....	(M.-Ed. & H.)	*				
<i>Orbicella mammillosa</i> .....	Klz.	*	*	*		
<i>Colummastræa bicoronata</i> .....	nov.		*	*		And near Dobar.
" <i>Phillipsæ</i> .....	"			*		
" <i>maxima</i> .....	"			*		
<i>Prionastræa crassisepta</i> .....	"			*		
<i>Favia lobata</i> .....	(M.-Ed. & H.)	*				
" <i>somaliensis</i> .....	nov.			*		
<i>Cæloria arabica</i> .....	Klunz.	*				
<i>Metichmos asymmetrica</i> .....	nov.			*		
<i>Cyclolites heikophana</i> .....	Rochbr.			*		
" <i>Phillipsæ</i> .....	nov.			*		Neocomian (?) of Amura.
<i>Litharæa Cole</i> .....	"			*		
" <i>Parkinsoni</i> .....	"			*		'Cherty Limestone,' (32) Turonian.
<i>Helopora</i> .....	"			*		
<i>Dendracis</i> sp. ....	"			*		
<i>Turbinacis erythraensis</i> .....	nov.	*		*		'Cherty Limestone,' (32) Turonian.

## V. THE FOSSIL ECHINOIDEA OF SOMALILAND.

The collection includes specimens of two species of Echinids.

*PSEUDODIADEMA SOMALIENSE*, sp. nov. (Text-figs. 4 & 5.)

Diagnosis.—Test small, depressed, circular. Base flat, rounded above; ambitus tumid.

Ambulacra: the pairs of pores are biserial close to the peristome; elsewhere the pairs are straight and uniserial.

Fig. 4.—*Abactinal surface of Pseudodiadema somaliense, sp. nov. (×4 diam.)*

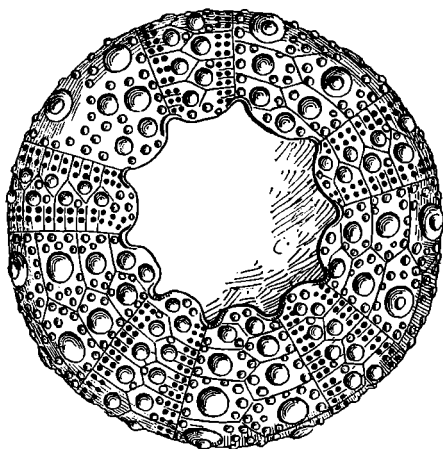
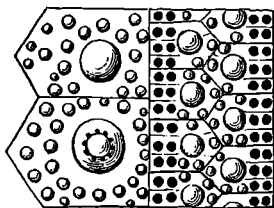


Fig. 5.—*Part of a specimen of Pseudodiadema somaliense. (×6 diam.)*



[To show the uppermost ambital interambulacral plate, the plate above it, and the adjacent ambulacral plates.]

Dimensions.—Diameter of test = 13 mm.; height of test = 6.5 mm.; width of interambulacrum at ambitus = 2 mm.; of ambulacrum at ambitus = 5.5 mm.; diameter of peristome = 6.55 mm.

Distribution.—Bihendula Limestone: Bihendula, south of Berbera.

There are no primary tubercles on the ambulacra; but in each area are four vertical rows of granules, with some scattered granules of an extra median series. The granules near the pores are larger than the internal series.

Interambulacra: about seven plates in each vertical series; the plates are of the cidaroid type, and have one primary tubercle each; the tubercles of the three uppermost plates are small, the size suddenly increases, and the tubercles of the ambital plates are large. The scrobicular circles are complete in the upper plates, but at the ambitus the scrobicular areas are confluent. Outside the scrobicular circles the plates are covered by numerous, crowded granules. Peristome large; roughly decagonal. Branchial incisions large.

**Affinities.**—The main characters of this species are the absence of tubercles in the ambulacra, and the occurrence there of four to five rows of granules. It belongs to the same group of species as the Bajocian *Ps. Jauberti*, Cott.<sup>1</sup> in which, however, the pore-pairs are not doubled near the peristome. *Ps. muelense*, P. de Lor.<sup>2</sup> from the Sinemurian of Portugal, agrees in the extensive ornamentation of the interambulacral plates; but though its ambulacral tubercles are small, they are much larger than in *Ps. somaliense*.

? CONOCLYPEUS, sp.

In Mr. F. B. Parkinson's collection there is a large flat echinid of which the base is all but lost. Its generic determination is therefore impossible, but it may be useful to record the specimen for reference, in case other imperfect specimens should be found. The specimen came from a massive limestone, which is no doubt Eocene, as Mr. C. D. Sherborn and Mr. F. Chapman have kindly identified some foraminifera in the matrix as *Nummulites* sp., *Amphistegina* sp., and *Orbitoides dispansa* (Sow.).

The specimen came from the beds of limestone associated with gypsum on the Somali plateau. The exact locality is apparently Kirrit (lat. 9° N. and long. 46° 10' E.), south of Bur Dab.

VI. THE LIMESTONE SEQUENCE AND THE DATE OF THE FOUNDERING OF THE ADEN GULF.

The palæontological evidence at present available shows that the limestones of Somaliland belong to five different ages—Lower Jurassic, Neocomian, Turonian (? Cenomanian), Eocene, and Pleistocene.

The oldest of the five limestones occurs at Bihendula, near the foot of the plateau-scarp, some 20 miles south of Berbera. Mrs. Lort Phillips collected four species of fossils from this locality in 1894-95. They were two species of brachiopoda, determined by Mr. F. A. Bather as *Rhynchonella Edwardsi*, Chapuis & Dewalque, and *Rh. subtetrahedra*, Dav.; a lamellibranch identified by Mr. R. B. Newton<sup>3</sup> as *Parallelodon Egertonianus*, Stoliczka; and a belemnite, recorded by Mr. G. C. Crick<sup>4</sup> as *B. subhastatus*, Zieten. The Bihendula Limestone was accordingly determined as of Lower Jurassic, and probably of Bathonian age. The belemnite is characteristic in India of the *macrocephalus*-zone, the lowest part of the Callovian; Mr. Crick distinguished it from *B. tanganensis*, Futterer, of the Lower Oxfordian of East Africa, and suggested that it might be identical with the fossil from Shoa, identified by H. Douvillé<sup>5</sup> as

<sup>1</sup> G. Cotteau, 'Echinides Réguliers,' Pal. franç. Terr. Jur. vol. x, pt. ii (1881) p. 238 & pl. ccxxiii, figs. 6-14.

<sup>2</sup> P. de Loriol, 'Descr. Faune Jur. Portugal, Embr. des Echinod.' pt. i (1890) p. 82 & pl. xv, figs. 1-5.

<sup>3</sup> R. B. Newton, 'Occurr. of an Indian Jur. Shell in Somaliland' Geol. Mag. 1896, pp. 294-96.

<sup>4</sup> G. C. Crick, 'Fragm. of Belemn. fr. Somaliland' *ibid.* pp. 296-98.

<sup>5</sup> H. Douvillé, 'Foss. rapp. du Choa par M. Aubry' Bull. Soc. géol. France, ser. 3, vol. xiv (1886) p. 223.

*Belemnopsis sulcata*. The *Parallelodon*, according to Mr. Newton, suggested a slightly older date, for he described it as identical with a specimen from the Niti Beds, where it is associated with *Parkinsonia Parkinsoni*. The Bihendula Limestones were accordingly suggested to be of Bathonian age; but with the larger collection now available it seems probable, from the cephalopoda, that some Callovian beds are represented at Bihendula, and possibly the whole fauna may be Callovian.

The Dobar<sup>1</sup> Limestone has yielded four species of corals and two Neocomian mollusca, which Mr. R. B. Newton has kindly identified as *Alectryonia rectangularis* (Röm.) and *Modiola Ferreti* (Rochebr.).<sup>2</sup> The evidence of the corals agrees with that of the mollusca, and the Dobar Limestone accordingly may be determined as Neocomian and approximately correlated with the Singeli limestone described by A. T. de Rochebrune, the Faf limestones discovered by Keller, and the cave-forming or *Nerinæa*-limestone of the Miriya Pass and Bur Dab. Mr. Parkinson has collected from Bur Dab a large *Nerinæa* and a *Natica* which Mr. R. B. Newton tells me are of Neocomian affinities, and from the cave-forming limestone at Dongorreh a specimen of a *Nerinæa*, also of the Neocomian type.<sup>3</sup>

Above the Neocomian beds occurs a thick series of limestones which include Turonian (or possibly Cenomanian) and Eocene representatives. The lowest part of this series is formed by a cherty limestone from which, in the neighbourhood of Bur Dab, Mr. Parkinson collected some broken mollusca; these specimens have been determined by Mr. Newton as *Gryphæa vesiculosa*, J. de C. Sow., *Pecten* sp. nov., and *Spondylus* sp., and he therefore suggests that the horizon is Cenomanian. A richer fauna has been obtained by Mrs. Lort Phillips in Uradu, near the Rugga Pass; she collected there eight species of corals, which are certainly Upper Cretaceous and correspond most nearly to Turonian species.

The upper part of this limestone series is no doubt Lower Kainozoic and probably Eocene. It has yielded an indeterminable species of *Conoclypeus* and some foraminifera, among which Mr. C. D. Sherborn and Mr. F. Chapman have identified species of *Nummulites* and *Amphistegina*, and *Orbitoides dispansa* (Sow.). The limestone of Mount Eilo, south of Zeila, may represent this horizon in Western Somaliland.

The last of the five limestones consists of the raised reefs south of Berbera, which are Pleistocene.

<sup>1</sup> Also spelt Duba and Dubbur.

<sup>2</sup> This species was founded on a specimen from Antalo, and its occurrence at Dobar supports M. de Rochebrune's contention as to the Cretaceous age of the Antalo limestone.

<sup>3</sup> The mollusca have been determined by Mr. Newton as *Nerinæa*, allied to *Renauxiana*, d'Orb., a *Nerinæa* sp. nov., and *Natica*, allied to *Hugardiana*, d'Orb., and as probably denoting a Barremian (that is, Urgonian or Upper Neocomian) age.

Our knowledge of the faunas of these five limestones is unfortunately scanty, and further collections would be welcomed from the limestones of Bur Dab, Artalla, Wagga, Abdullah Ismail, and especially from the highest beds above the Miriya Pass, also from the limestones associated with the gypsum-beds of Kirrit, Eyk, and the Duban. But the evidence of the present collections is sufficient to show that a Neocomian limestone occurs both on the summit of the Somali plateau and on the floor of the Guban, and that some marine limestones of probably Lower Tertiary (Eocene) age also occur on the plateau.

It seems therefore probable that the foundering of the Aden Gulf is post-Eocene in age.<sup>1</sup>

### EXPLANATION OF PLATES I & II.

#### PLATE I.

- Fig. 1. *Stylophora frondosa*, sp. nov. Duban, north of the foot of the Rugga Pass. Coll. Mrs. Lort Phillips. *a* = part of the surface of the corallum,  $\times 3$  diam.; *b* = a horizontal section through part of the same,  $\times 6$  diam.; *c* = a vertical section through part of the same,  $\times 6$  diam. (See p. 30.)
2. *Stylina subtabulata*, sp. nov. Dobar Limestone: Dobar, south of Berbera. Coll. Mrs. Lort-Phillips. *a* = part of a horizontal section,  $\times 2$  diam.; *b* = part of a vertical section through the same specimen,  $\times 2$  diam. (See p. 31.)
3. *Calamophyllia Aylmeri*, sp. nov. Uradu Limestone, near Uradu. Coll. Mrs. Lort Phillips. Part of a horizontal section,  $\times 3$  diam. (See p. 31.)
4. *Favia somaliensis*, sp. nov. Uradu Limestone, Uradu. Coll. Mrs. Lort Phillips. *a* = part of the corallum, showing some calices as seen from the surface, and others in section, nat. size; *b* = transverse section across one corallite,  $\times 4$  diam. (See p. 35.)
- Figs. 5 & 6. *Prionastræa crassisepta*, sp. nov. Dobar Limestone, Dobar, south of Berbera. Coll. Mrs. Lort Phillips. Fig. 5 *b* = transverse section of part of a corallum, nat. size; fig. 5 *a* = upper surface of a corallite from the same specimen, showing columella,  $\times 2$  diam.; fig. 6 = part of a vertical section through another specimen, showing columella, walls, and dissepiments; this figure is inverted. (See p. 34.)

#### PLATE II.

- Figs. 7-9. *Columnastræa bicoronata*, sp. nov. Uradu Limestone, near Uradu, south of Dobar, and in the Duban. Coll. Mrs. Lort Phillips. Fig. 7 = part of the surface of a specimen from the Duban,  $\times 2$  diam.; fig. 8 = part of a horizontal section of a specimen from Uradu,  $\times 2$  diam.; fig. 9 = part of a horizontal section of a specimen from the Duban,  $\times 2$  diam. (See pp. 32-33.)
- Fig. 10. *Columnastræa Phillipsæ*, sp. nov. Uradu Limestone, Uradu. Coll. Mrs. Lort Phillips. Part of a horizontal section,  $\times 3$  diam. (See p. 33.)

<sup>1</sup> [This probability is based on three lines of evidence: the agreement in direction of the movements which have caused the Aden Gulf and the Somali Plateau; the absence of Lower Kainozoic deposits in the Red Sea, except towards the north, where, as in the Gulf of Akaba, their fauna is of Mediterranean affinities; and the recent date of the separation of Arabia and Africa, as indicated certainly by zoological evidence, and probably by the local traditions. For the last see my 'Great Rift Valley,' 1896, chaps. xii & xiii.—December 22nd, 1899.]

- Fig. 11. *Metethmos asymmetrica*, sp. nov. Dobar Limestone, Dobar. Coll. Mrs. Lort Phillips. *a* = side view; *b* = horizontal section, both nat. size. (See p. 36.)
12. *Litharæa Colæ*, sp. nov. Uradu Limestone, Uradu. Coll. Mrs. Lort Phillips. *a* = part of the upper surface,  $\times 2$  diam.; *b* = a horizontal section of the same,  $\times 6$  diam. (See p. 37.)
- Figs. 13 & 14. *Litharæa Parkinsoni*, sp. nov. Cherty Limestone, Somali Plateau. Coll. Mr. F. B. Parkinson. Fig. 13 = part of the surface,  $\times 2$  diam.; fig. 14 = section across one corallite of another specimen,  $\times 6$  diam. (See p. 37.)

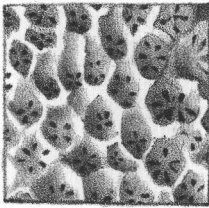
## DISCUSSION.

Dr. BLANFORD said that a slight acquaintance with the geology of a tract of country 500 miles away from Somaliland was scarcely sufficient to justify him in commenting on this paper, which was a valuable addition to our geological knowledge of North-eastern Africa. The Author was probably right in regarding the Gulf of Aden as of post-Eocene origin, but the evidence adduced of the post-Eocene elevation of the Somali plateau did not absolutely preclude the possibility that the depression forming the present Gulf of Aden existed earlier. The opening of the Straits of Babel-Mandeb appeared to be of very late geological date, perhaps Pleistocene.

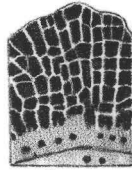
Mr. WALCOT GIBSON said he was sure that all interested in African geology would be indebted to the Author for bringing to our notice the existence of Lower Tertiary beds with a Tertiary fauna on the plateau of Somaliland. A few undoubted facts fixing the age of sediments in East Africa are exceedingly welcome.

Mr. G. C. CRICK asked the Author whether the *Pseudodiadema* from Bihin threw any light on the age of the Bihin limestone, as the cephalopoda from the same locality appeared to indicate the presence of an horizon somewhat younger than Bathonian.

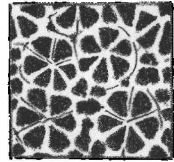
The AUTHOR, in reply, said that he thought the *Pseudodiadema* gave no more precise information as to the age of the Bihin limestone than that it was approximately Callovian or Bathonian. The only Tertiary marine fossils from the Erythræan Rift-valley of which he knew were a doubtful echinid from Nyasaland, and the Miocene fossils from the northern part of the Red Sea. The absence of Kainozoic marine deposits, except Pleistocene, in the southern part of the Red Sea, and the fact that those of the northern part of that area are of the Mediterranean, and not of the Indian Ocean type, rendered it probable that the Aden Gulf was formed by the same series of movements as those which formed the Somali scarp.



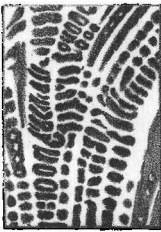
1a. x 3



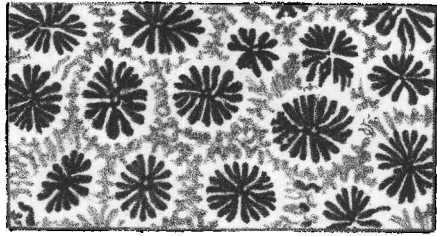
1c. x 6



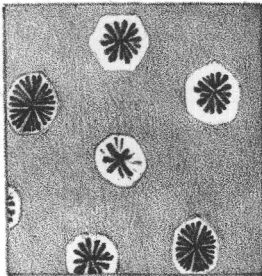
1b. x 6



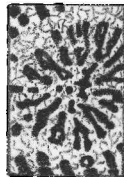
2b. x 2



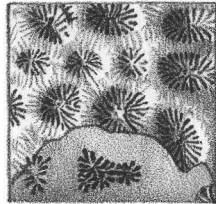
2a. x 2



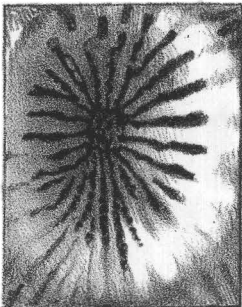
3. x 3



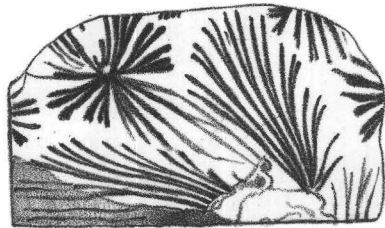
4b. x 4



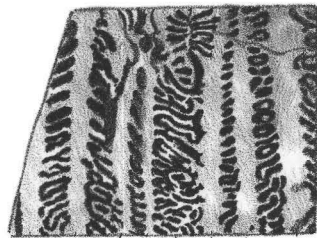
4a.



5a. x 2



5b.

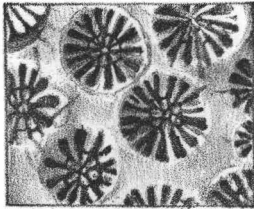


6  
x 2

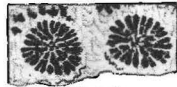
E. Drake del. et lith.

Corals from Somaliland.

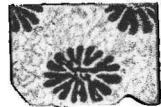
West, Newman imp.



7. x 2



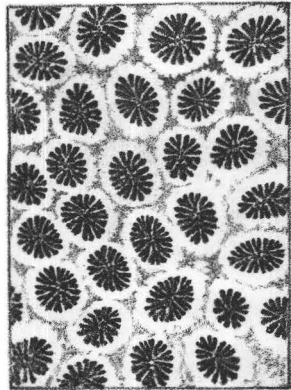
8. x 2



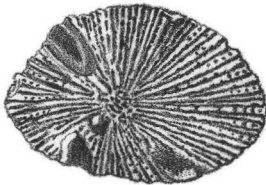
9. x 2



11a.



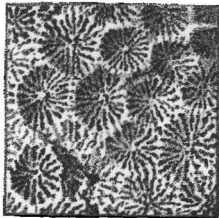
10. x 3



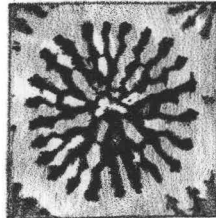
11b.



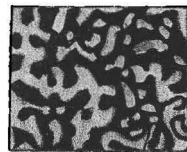
12a. x 2



13. x 2



14. x 6



12b. x 6

E. Drake del. et lith.

West, Newman imp.

Corals from Somaliland.