22. CONTRIBUTIONS to the PALÆONTOLOGY and PHYSICAL GEOLOGY of
the WEST INDIES. By J. W. GREGORY, D.Sc., F.G.S. (Read
February 20th, 1895.)

[PLATE XI.]

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I. INTRODUCTION.

SHORTLY after Mr. Jukes-Browne's return from Barbados in 1889, he asked me to identify a collection of fossil corals which he had made on that island. A very cursory examination showed that the synonymy of the coral fauna of the West Indies was in such confusion that it would be impossible properly to execute this task, and work out the relations of these Barbadian fossils, with the material then available to me. The causes of the difficulty were as follows:—In the West Indies there are two coral faunas, one recent and the other fossil. The former has been described by the neontologists, the latter by the palæontologists; and neither school has devoted adequate attention to the work of the other. If the two faunas had been wholly distinct, this would not have mattered so much; but unfortunately they overlap, and thus the same species have been twice described. The extent to which this has been carried has been greatly increased by the fact that many late Pleistocene species have been mixed in collections with those of the older Kainozoic deposits. The synonymy has been still further complicated by the imperfection of the original figures and descriptions upon which most of the species are based. The West Indian corals were favourite objects in the collections of the early naturalists, and thus the great majority of the species date back to the works of the museographers of the last century. The illustrations given by these authors show the mode of growth and general appearance of the corals, but the generic characters are often unrecognizable. It is, therefore, not surprising that very different interpretations have been placed upon them.

To overcome these difficulties it was necessary to obtain a collection of specimens from the reefs of the district whence the fossils had come, and to cut sections of these so as to be able to institute a comparison on equal terms. It was also necessary to examine the types of the recent species described by the neonto-

logists. The chief of these were those of Duchassaing and Michelotti now preserved in the Museum of the Royal University of Turin, of Milne-Edwards and Haime in Paris, of Verrill in New Haven (Connecticut), of Pourtalès in the Museum of Comparative Zoology in Cambridge (Mass.), and of various West Indian expeditions in the Museums at Washington (D. C.). The study of these types was rendered possible by the kindness of the Trustees of the British Museum, who, on the recommendation of Dr. H. Woodward, F.R.S., granted me an extra leave of absence in 1891, in order to visit the principal American collections. To the officials of these Museums I am most grateful for their kind help, especially to Prof. A. Agassiz, who allowed me free access to the rich collections of the Museum of Comparative Zoology, in spite of the inconveniences entailed by a visit during the summer vacation. I am also greatly indebted to Prof. Sacco for his assistance during an examination of Duchassaing and Michelotti's types; these authors so seldom figured, and so briefly described, the numerous species which they founded, that without a study of their types it would have been impossible to include their names in the synonymy.

The most important collection of the fossil corals is that described by the late Prof. P. M. Duncan in five valuable papers on 'the Fossil Corals of the West Indies.' Most of the specimens he described are now preserved in the Museum of the Geological Society, and the rest are mainly in the British Museum. The collection is therefore readily accessible: by permission of the Council of this Society several of the types have been cut, and thus some doubtful structures determined. I desire to express my thanks to the Assistant Librarian, Mr. W. Rupert Jones, for the help which he has so readily given me during the examination of this collection. Unfortunately the specimens were not collected with as much care as that devoted to their description; mixed up with Miocene and Oligocene species, there are many derived from late Pleistocene reefs. That this circumstance escaped Duncan's notice, although he remarked their association with Pleistocene mollusca, is doubtless due to the intense alteration which they have often undergone. Many of the corals are more changed and less recognizable than ordinary Silurian specimens; this therefore gives them an aspect of great age, which is strengthened by their affinity to the extinct species of the Mediterranean Miocene. But it often happens that one half of a specimen from the recent reefs of the West Indies may be altered into chalcedony without any trace of coral-structure left, while the other shows every detail in perfect preservation.

Little, therefore, could have been done without further collections from Barbados. The greatest thanks are due to Mr. G. Firth Franks, F.G.S., then of the Harrison College, Barbados, who, at the request of Mr. Jukes-Browne, devoted much time and expense to the formation of collections from the recent and fossil reefs of the island. This collection he has generously presented to the British Museum (Natural History), and it forms the main basis of the present paper. Mr. Jukes-Browne has also presented his collection,

which is of value, as it contains many specimens in excellent preservation from the High-level Reefs. Col. H. W. Feilden also grasped the importance of the study of the fauna of the oldest raised reefs, and collected some specimens from the highest available points; these are unfortunately in imperfect preservation, but are of value from the care with which the altitudes have been recorded. C. E. Easton, Esq., C.E., has also presented to the British Museum a large series of specimens from various shafts and tunnels made by him for the Barbados Waterworks Co. Finally the Rt. Rev. Bishop Mitchinson has given to the British Museum a collection of over a thousand specimens of mollusca from the Low-level Reefs near Bridgetown. These are recorded in the third part of the present paper.

I must apologize, to those who have so generously helped with material, for the long delay in the completion of this paper. The part dealing with the corals was finished in the autumn of 1892, and was then ready for publication. The manuscript was, however, stolen a few months later when my luggage was looted on the eastern coast of Africa. As the notes on the Paris types were lost at the same time, it has been necessary to leave out references to many of the species—especially of *Mæandrina*—founded by Milne-Edwards and Haime, which I believe to be only synonyms.

II. THE CORALS OF THE RAISED REEFS OF BARBADOS.

Considering the confusion in the synonymy of the West Indian Corals, a mere list of species would be useless. The synonymy of the species is therefore given in some detail, in order that the value assigned to each may be easily recognized.

The classification adopted is that of Duncan's 'Revision of the Madreporaria,'¹ as this is still the most convenient for systematists. The later schemes of Ortmann² may have a more scientific basis, but at present they are not in a form that can be recommended for general adoption. A classification that unites *Lithophyllia*, *Mussa*, *Symphyllia*, and *Diploria* into one family and then places *Mussa Harti*, *Eusmilia*, and *Euphyllia* in a different order; which places *Oculina* and *Heliastrea* in one family and separates *Pectinia* and *Manicina* into different orders, is too revolutionary to be accepted without much further evidence in its support. At present it seems very like a *reductio ad absurdum* of the principles on which it is based.

¹ Journ. Linn. Soc., Zool. vol. xviii. (1884) pp. 1-204.

² 'Beobachtungen an Steinkorallen von der Südküste Ceylons,' Zool. Jahrb. vol. iv. (1889), Abt. f. Syst. pp. 548-554, and 'Die Morphologie des Skelettes der Steinkorallen in Beziehung zur Koloniebildung,' Zeitschr. f. wiss. Zool. vol. i. (1890) pp. 314, 315.

Order MADREPORARIA. Suborder APOROSA.

Family OCULINIDÆ.

Genus MADRACIS, M.-Ed. & H., 1849.

Syn. *Reussia*, Duch. & Mich.; *Pentalophora*, Sav. Kent; *Axohelia*, M.-Ed. & H.
Species MADRACIS DECACTIS (Lyman).

Synonymy :—

Astræa decactis, Lyman, 1859, 'New Sp. Coral.' Proc. Bost. Soc. Nat. Hist.
vol. vi. pp. 260-263.

Madracis decactis, Verrill, 1864, 'List of Corals sent etc.' Bull. Mus. Comp.
Zool. vol. i. p. 45; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool.
no. iv. pp. 28 & 67; id. 1874, 'Hassler Corals,' *ibid.* no. viii. p. 41; Lindström, 1877,
'Actin. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 15; Quelch, 1886,
'Reef Corals,' Zool. 'Chall.' Exp. pt. xvi. p. 53.

Reussia lamellosa, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R.
Accad. Sci. Tor. ser. 2, t. xix. p. 339, pl. ix. fig. 8; *ibid.* 1866, 'Suppl. Cor. Ant.'
ibid. ser. 2, t. xxiii. p. 164; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 26.

Stephanocenia dendroidea, non M.-Edw. & H., Duncan, 1863, 'W. Ind. Cor.' pt. i.
Quart. Journ. Geol. Soc. vol. xix. p. 432.

? *Stylophora minuta*, Duncan, 1868, 'W. Ind. Cor.' pt. iv. *ibid.* vol. xxiv. p. 14.

Distribution. Recent: St. Thomas, Barbados, Florida (6-17 faths.), Bermuda.
Fossil: Pleistocene, Bermuda (Coll. Geol. Soc.); Barbados: Low-level Reefs
(B.M. Coll. Presented by G. F. Franks, Esq.); San Domingo: Nivajé & Cerro Gordo
Shales (Coll. Geol. Soc.).

Notes on the Species.—The genus is said by Duncan to have
no costæ, while both he and Milne-Edwards & Haime in their
original diagnosis state
that the septa are all of
uniform size. This was
one of its differences from
the nearly allied *Stylo-*
phora. Some sections,
however, cut from the
specimens from Barbados,
show that a rudimentary
set of septa and also costæ
may be sometimes present
(see fig. 1). Quelch in-
cludes Duchassaing &
Michelotti's species *Stylo-*
phora incrustans as a
synonym of this; but
the figure is useless, and
I did not see the type
at Turin. The type of
Duncan's *S. minuta* was
lost, and so the value
of this species cannot be
determined; the two spe-
cimens identified by that
author as *Stephanocenia dendroidea* are both in the Society's
Museum; they certainly belong to *Madracis*, and appear to be
only a form of *M. decactis*, which grows out into low, cylindrical,
massive branches.

Fig. 1.—Section of *Madracis decactis* (Lym.). (×12 diam.)

To show rudimentary septum (S).

Family ASTRÆIDÆ.

Subfamily ASTRÆIDÆ SIMPLICES.

Genus LITHOPHYLLIA, M.-Ed. & H., 1857.

Species 1. LITHOPHYLLIA LACERA (Pallas), 1766.

Synonymy :—

Madrepora lacera, Pallas, 1766, 'Elench. Zooph.' pp. 298-299; Esper, 1789, 'Pflanzenh.' Bd. i. pp. 148-150, pl. xxv. fig. 2.

Caryophyllia lacera, var. *a*, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 316; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 237; *ibid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 72.

Lithophyllia lacera, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 291; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 343; *ibid.* 1866, 'Suppl. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 170; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlvii. p. 12; Ortmann, 1890, 'Morph. Skel. Steinkor.' Zeit. wiss. Zool. Bd. 1. p. 291.

Caryophyllia cardus pars, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 229; *id.* 1836, 'Hist. Nat.' ed. 2, t. ii. p. 357.

Lithophyllia Argemone, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 344, pl. ix. fig. 12, pl. x. fig. 15; *ibid.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 171; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28.

Lithophyllia cylindrica, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 344, pl. ix. figs. 17, 18; *ibid.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* t. xxiii. p. 171; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28; Quelch, 1886, Zool. 'Chall.' Exped. pt. xlvii. p. 12.

Lithophyllia radians, Duchassaing & Michelotti, 1866, *op. jam cit.* p. 171, pl. vii. figs. 3, 4; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28; Quelch, 1886, *op. cit.* p. 12.

Distribution. Recent: West Indies; Florida. *Fossil*: Barbados: Low-level Reefs.

Species 2. LITHOPHYLLIA CUBENSIS (M.-Ed. & H.).

Synonymy :—

Caryophyllia cubensis, M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 238.

Lithophyllia cubensis, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 292; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 343, pl. v. fig. 10; *ibid.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 170; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 70; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlvii. p. 12.

Lithophyllia dubia, Duchassaing & Michelotti, 1861, *op. jam cit.* p. 344, pl. ix. fig. 15; *ibid.* 1866, *op. jam cit.* p. 171; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 70; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlvii. p. 12.

Lithophyllia multilamellosa, Duchassaing & Michelotti, 1866, *Suppl., op. jam cit.* p. 171, pl. viii. fig. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 28.

Montlivaltia ponderosa, non M.-Edw. & Haime, Duncan, 1863, 'West Ind. Cor.' pt. i., Quart. Journ. Geol. Soc. vol. xix. pp. 441, 442, pl. xvi. fig. 6.

Antillia ponderosa, non M.-Edw. & Haime, Duncan, 1864, 'West Ind. Cor.' pt. ii. *ibid.* vol. xx. p. 28, pl. v. fig. 5; *id.* 1868, 'West Ind. Cor.' pt. iv. *ibid.* vol. xxiv. p. 23.

Antillia explanata, Pourtalès, 1874, 'Hassler Corals,' Ill. Cat. Mus. Comp. Zool. no. viii. p. 42, pl. vii. figs. 4-6; A. Agassiz, 1888, 'Three Cruises of the 'Blake',' Bull. Mus. Comp. Zool. vol. xv. p. 154, fig. 478.

Distribution. Recent: West Indies; Florida. *Fossil*: Barbados: Low-level Reefs; Jamaica.

Notes on the Species.—The *Lithophyllia multilamellosa* of Duchassaing & Michelotti is shown by the figure which they give to be very closely allied to the type-form. The figure of their *L. dubia*

appears more divergent owing to the thinness of the septa. The type of this species is, however, in Turin, and shows that the septa of the first two cycles are of the normal thickness; the examination of the type left no doubt as to the species being the same as that of Milne-Edwards & Haime.

The inclusion in the list of synonyms of a species which Duncan assigned to *Antillia* renders necessary a remark on this genus, and on the value of the epitheca in this group. The genus was founded by Duncan in 1864; he included in it a series of species agreeing in having an essential columella and a membraniform epitheca. The septa and costæ are of two types: in some species, as in his type-species *A. ponderosa*, the septa are not lobed and the costæ are coarsely dentate; in other species, such as *A. Lonsdaleia*, the septa are lobed and the costæ finely granulate. In his 'Revision' (p. 60) he reduces the genus to a subgenus of *Circophyllia*, and still bases its value on the epitheca.

The examination of a considerable series of specimens shows, however, that the epitheca is so very variable in this group that it does not appear worthy of even subgeneric value; the characters of the septa and costæ seem much more important. In some specimens the epitheca is present and in others quite rudimentary, and all stages can be seen between the two conditions. In this case the genus has to be split up into two. Duncan's type goes into *Lithophyllia*, and the *A. Lonsdaleia* and some others into *Circophyllia*.

Milne-Edwards & Haime's *M. ponderosa* seems to me a different species from that which Duncan has assigned to it. It is well figured in the atlas to the 'Histoire Naturelle des Coralliaires,' pl. n. iii. fig. 2. It appears to me that Duncan's *A. bilobata* is the same as the true *M. ponderosa*, Ed. & H., and the *M. Guesdesi*, Duch. & Mich. In the specimens figured by Duncan and by Duchassaing & Michelotti the shape of the corals is bilobed; but this is only an individual character, for in the series of specimens in the British Museum collection several are regularly elliptical.

Species 3. LITHOPHYLLIA WALLI (Duncan).

Synonymy :—

Antillia Walli, Duncan, 1865, 'Foss. Corals Jamaica,' Quart. Journ. Geol. Soc. vol. xxi. p. 11, pl. ii. fig. 4.

Distribution. *Fossil*: Pleistocene? Bowden, Jamaica (type in Geol. Soc. Mus.). Barbados: Low-level Reefs (B. M. R 1284).

Subfamily ASTRÆIDÆ CÆSPITOSÆ.

Genus EUSMILIA, M.-Edwards & Haime, 1848, em. 1857.

Species 1. EUSMILIA FASTIGIATA (Pallas), 1766.

Synonymy :—

Madrepora fastigiata, Pallas, 1766, 'Elench. Zooph.' p. 301; Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1280.

* *Madrepora fastigiata*, Ellis & Solander, 1786, 'Hist. Nat. Zooph.' p. 152, pl. xxxiii.; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3777.

Mussa fastigiata, Oken, 1815, 'Lehrb. Naturg.' Zool. Bd. i. p. 73; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. pp. 175, 720.

**Caryophyllia fastigiata*, Lamarck, 1816, 'Hist. Anim. s. Vert.' t. ii. pp. 228, 229; Lamouroux, 1821, 'Exp. Méth. Polyp.' p. 50, pl. xxxiii.; *id.* 1824, 'Encycl. Méth. Zooph.' p. 172.

Caryophyllia fastigiata, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berl. 1832, p. 316.

**Caryophyllia fastigiata*, Lamarck, 1836, 'Hist. Anim. s. Vert.' ed. 2, t. ii. p. 355.

Caryophyllia fastigiata, Schomburgk, 1847, 'Hist. Barbados,' p. 562.

Lithodendron fastigiatum, Schweigger, 1820, 'Handb. Naturg.' p. 416.

**Lobophyllia fastigiata*, Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. lx. p. 321; *id.* 1834, 'Man. Act.' p. 356; Duchassaing, 1850, 'Anim. rad. Ant.' p. 15; *id.* 1855, 'Form. Mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. p. 756.

Eusmilia fastigiata, M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat., Zool. sér. 3, t. x. p. 264, pl. v. fig. 1; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 52; *id.* 1857, 'Hist. Nat. Cor.' t. ii. p. 187; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 340; *id.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 165; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 67; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 167.

**Madrepora capitata*, var., Esper, 1795, 'Pflanzenh.' Fortsetz. Bd. i. p. 102, pl. Madrep. lxxxii.

**Lithodendron capitatum*, Schweigger, 1820, 'Handb. Naturg.' p. 416.

Eusmilia Silene, Duchassaing & Michelotti, 1861, *op. supra cit.* ser. 2, t. x. pp. 340, 341, pl. x. figs. 11, 12; *id.* 1866, *Suppl. op. supra cit.* ser. 2, t. xxiii. p. 165; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Quelch, 1886, *op. supra cit.* pt. xlv. p. 12.

Eusmilia alticostata, non M.-Ed. & H., Pourtales, 1871, *op. supra cit.* p. 68.

Distribution. Recent: West Indies, Florida. *Fossil:* Barbados: Low-level Reefs, Bridgetown; High-level Reefs, Castle Grant, 1050 feet (Jukes-Browne Coll.); Guadeloupe: Tuf blanc.

Species 2. *EUSMILIA KNORRI*, M.-Edwards & Haime, 1848.

Synonymy:—

Eusmilia Knorri, M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 265, pl. v. fig. 2.

Madrepora capitata, Esper, 1795, 'Pflanzenh.' Fortsetz. Bd. i. p. 102, pl. Madrep. lxxxi. (non var. pl. lxxxii.).

Euphyllia aspera, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. pp. 164, 720, pl. ix. fig. 7.

Eusmilia aspera, M.-Edwards & Haime, 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 52; *id.* 1857, 'Hist. Nat. Cor.' t. ii. pp. 187, 188; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 340; *id.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 165; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 167.

Eusmilia alticostata, M.-Edwards & Haime, 1848, *op. supra cit.* Ann. Sci. Nat. Zool. sér. 3, t. x. p. 265; *id.* 1857, 'Hist. Nat. Cor.' t. ii. p. 188.

Distribution. Recent: West Indies. *Fossil:* Pleistocene, Low-level Reefs, Bridgetown, Barbados (Franks Coll. & Old Coll. B.M.).

Notes on Synonymy.—The synonymy of these two species of *Eusmilia* has been very confused, as they have been separated at different times on two different and discordant characters. Their distinction is here based on the structure of the columella. This is well developed in *E. Knorri* (see figures of Milne-Edwards & Haime and of Esper), and very imperfectly so in *E. fastigiata*. This character has, however, often been ignored, and the distinction has then been based on the development of the epitheca, which seems to me to be useless.

Unfortunately we do not definitely know the nature of the columella in Pallas's type, but he describes his species as with 'centrum immersum, exiguum, cellulosum.' This would seem to

indicate an imperfect development of the columella. If it is not so, then Pallas's species is not the *fastigiata* of all later authors, but is the *E. Knorri* of Milne-Edwards & Haime, and the *E. aspera* of Dana. Milne-Edwards & Haime separate the *fastigiata* of Ellis & Solander from that of Pallas, and make it a synonym of *E. Knorri*. If this be the case, then all those references in the synonymy of *E. fastigiata* marked by an asterisk must be transferred to *E. Knorri*; but there seems to me no reason why this should be done, for they are all based on a figure in which the columella is not shown; so far as the evidence of the figure goes, one would infer from the aspect of the calices that the columella was most imperfect. The reason that apparently led Milne-Edwards & Haime to suggest this confusion of the synonymy was the character of the costæ and epitheca.

In regard to the name for the second species, I think that the safest course is to take that of Milne-Edwards & Haime, which was accurately diagnosed and figured, instead of the earlier ones of Esper and Dana. Esper included under *capitata* two species; it is impossible to remove all doubt as to whether his typical form is *fastigiata* or *Knorri*. Dana's species was also so inadequately diagnosed that there can be no certainty regarding it. He makes it a synonym of both the *C. fastigiata* of Lamarck and the *M. capitata* of Esper (pl. lxxxi.); one of these must be incorrect. Milne-Edwards & Haime regard Dana's *Mussa fastigiata* and his *Euphyllia aspera* as the same species.

Milne-Edwards & Haime diagnosed both species very well, and it seems best to accept them as thus defined, but not to follow these authors in their synonymy.

Genus *MUSSA*, Oken, 1815, em. Dana 1846.

Species *MUSSA ANGULOSA* (Pallas), 1766.

Synonymy :—

Madrepora angulosa, Pallas, 1766, 'Elench. Zooph.' pp. 299-300; Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 152, pl. xxxiv.; Esper, 1788, 'Pflanzenth.' Bd. i. pp. 92-95, pl. Madrep. vii.; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3781.

Mussa angulosa, Oken, 1815, 'Lehrb. Naturg.' Zool. Bd. i. p. 73; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. pp. 176-177, pl. viii. fig. 4; M.-Edwards & Haime, 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 78; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. pp. 329-330; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 345; *ibid.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. pp. 158, 172; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 72; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 168.

Caryophyllia angulosa, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 229; Lamouroux, 1824, 'Encycl. Méth. Zooph.' p. 173; (pars) Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berl. 1832, p. 315; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, p. 355.

Lithodendron angulosum, Schweigger, 1820, 'Handb. Naturg.' p. 416.

Lobophyllia angulosa, Blainville, 1830, Dict. Sci. Nat. t. ix. p. 321; *ibid.* 1834, 'Man. Act.' p. 355, non pl. liii. fig. 3; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 245.

Caryophyllia dubia, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 335, pl. v. fig. 2.

Distribution. Recent: West Indies. Fossil: Barbados: Low-level Reefs (Franks Coll.).

Subfamily ASTRÆIDÆ CONFLUENTES.

Genus DENDROGYRA, Ehrenberg, 1834.

Species DENDROGYRA CYLINDRUS, Ehrenberg.

Synonymy :—

(*Mæandrina*) *Dendrogyra cylindrus*, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 324.

Dendrogyra cylindrus, M.-Edwards & Hahné, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 280, pl. vi. figs. 9, 9 a; *ibid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 55; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 202; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 341; *ibid.* 1866, 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 165; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 69.

Mæandrina cylindrus, Dana, 1848, 'Zooph. Expl. Exped. Wilkes,' vol. viii. p. 265.

Dendrogyra Sancti-Hilarii, Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' *op. jam cit.* p. 168; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27.

Distribution. Recent: West Indies. Fossil: Low-level Reefs, Barbados (Franks Coll.).

Genus PECTINIA, Oken, 1815 (em. M.-Edwards & Haime, 1851).

Species PECTINIA MÆANDRITES (Pallas), 1766.

Synonymy :—

Madrepora mæandrites, Pallas, 1766, 'Elench. Zooph.' pp. 292-294; Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1274; Maratti, 1776, 'De Plant. Zooph. et Lithoph.' p. 47; Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 161, pl. xlvi. fig. 1.

Madrepora mæandrites (pars), Esper, 1788, 'Pflanzenth.' pp. 76-84, pl. iv. A, *non* pl. iv.; Gmelin, 1790, 'Linn. Syst. Nat.' ed. xiii. p. 3761.

Madrepora mæandrites, var., Esper, 1795, 'Pflanzenth.' Fortsetz. p. 101, pl. lxxx. fig. 2.

Mæandra mæandrites, Oken, 1815, 'Lehrb. Naturg. Zool.' Bd. i. p. 70.

Ctenophyllia mæandrites, M.-Edwards & Haime, 1848, 'Mouogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 277.

Pectinia mæandrites, M.-Edwards & Haime, 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 57; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 207; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 342; *ibid.* 1866, 'Suppl. *ibid.* ser. 2, t. xxiii. p. 168; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 68; Lindström, 1877, 'Cont. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 22.

Manicina mæandrites, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 326.

Mæandrina pectinata, Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 372; *ibid.* 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 247.

Mæandrina pectinata (pars), Lamouroux, 1821, 'Exp. Méth.' p. 55, pl. xlvi. fig. 1 (*non* pl. li. fig. 1).

Mæandrina pectinata, Blainville, 1823, 'Méandrine,' Dict. Sci. Nat. t. xxix. p. 376; Deslongchamps, 1824, 'Encycl. Méth. Zooph.' p. 503, pl. 485. fig. 1; Eichwald, 1829, 'Zool. Spec.' pars i. p. 185; Blainville, 1830, 'Zoophytes,' Dict. Sci. Nat. t. lx. p. 322; *ibid.* 1834, 'Man. Act.' p. 357; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 387; Duchassaing, 1850, 'Anim. rad. Ant.' p. 18.

Pectinia pectinata, Oken, 1815, 'Lehrb. Naturg. Zool.' t. i. p. 68.

Manicina pectinata, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 326.

Ctenophyllia pectinata, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 170, pl. xiv. fig. 13.

Madrepora labyrinthica (pars), Pallas, 1766, 'Elench. Zooph.' pp. 297-298.

Ctenophyllia quadrata, Dana, 1848, *op. supra cit.* p. 171, pl. xiv. fig. 14; M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 278.

Pectinia quadrata, M.-Edwards & Haime, 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 57; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 209; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 342; *ibid.* 1866, 'Suppl. etc.' *ibid.* ser. 2, t. xxiii. p. 168; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27.

Pectinia disticha, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' *op. cit.* p. 342, pl. ix. fig. 16; *iid.* 1866, 'Suppl. etc.' *op. cit.* p. 168; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27.

Pectinia elegans, Duchassaing & Michelotti, 1861, *op. cit.* p. 342; *iid.* 1866, p. 168; Duchassaing, 1870, p. 27.

Pectinia caribæa, Duchassaing & Michelotti, 1861, *op. cit.* p. 343; *iid.* 1866, p. 168; Duchassaing, 1870, p. 27.

Manicina areolata (non auct.), A. Agassiz, 1890, 'Growth of Corals,' Bull. Mus. Comp. Zool. vol. xx. no. 2, p. 62, pl. iii.

Distribution. Recent: West Indies. *Fossil*: Low-level Reefs, near Bridgetown, Barbados (Franks Coll.).

Notes.—*Pectinia quadrata* seems to be clearly only a young form; *P. elegans* must go with *P. quadrata*. A certain amount of confusion has been caused by Esper having included in his *M. mæandrites* two different species: one (pl. iv. A) is clearly the type-form, but the other (pl. iv.) has been generally regarded as a *Manicina areolata*; several later authors have taken the wrong form as the type, while recently the converse error has been made.

Genus DIPLORIA, M.-Edwards & Haime, 1848.

Species DIPLORIA CEREBRIFORMIS (Lamarck), 1816.

Synonymy.—

Mæandrina cerebriformis, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 246; Blainville, 1823, 'Méandrine,' Dict. Sci. Nat. t. xxix. p. 376; Deslongchamps, 1824, Encycl. Méth., 'Zooph.' p. 508; Blainville, 1830, 'Zoophyte,' Dict. Sci. Nat. t. ix. p. 323; *id.* 1834, 'Man. Act.' p. 357; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 386; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 263, pl. xiv. fig. 2; Duchassaing, 1850, 'Anim. rad. Ant.' p. 16.

Mæandrina (Platysgra) cerebriformis, var. *α*, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 324.

Diploria cerebriformis, M.-Edwards & Haime, 1848, 'Classif. deux. tribu Astr.' Compt. Rend. t. xxvii. p. 493; *iid.* 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 289; *iid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 92; *iid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 402; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 351; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. t. i. p. 48; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xxiii. p. 176; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 75; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet. Akad. Bd. xiv. no. 6, p. 22; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlvii. pp. 12, 90; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii., Syst. p. 171; *id.* 1890, 'Morph. Skel. Steinkor.' Zeit. wiss. Zool. Bd. I. p. 301; Heilprin, 1890, 'Cor. W. Gulf Mex.' Proc. Acad. Nat. Sci. Phil. 1890, p. 307.

Madrepora mæandrites, var. *γ*, Pallas, 1766, 'Elench. Zooph.' p. 293.

Madrepora labyrinthiformis (pars), Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1274.

Distribution. Recent: West Indies, Bermuda, Florida. *Fossil*: Barbados: Low-level Reefs, near Bridgetown; High-level Reefs, Castle Grant, alt. 1070 feet (Jukes-Browne Coll.); Mt. Misery, 1053 feet (Col. Feilden Coll.); Orange Hill Plantation, St. Peter's (approx. 600 feet); Scotland, St. Andrews.

Genus MANICINA, Ehrenberg, 1834.

Species MANICINA ARBOLATA (Pallas), 1766.

Synonymy.—

Madrepora areolata, Linnæus, 1760, 'Syst. Nat.' ed. x. p. 795; Pallas, 1766, 'Elench. Zooph.' pp. 295-296.

Madrepora areolata (pars), Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 161, pl. xlvii. fig. 5, non fig. 4.

Madrepora areola, Esper, 1788, 'Pflanzenh.' Bd. i. pp. 84-87, pl. Madrep. v.

Mæandra areola, Oken, 1815, 'Lehrb. Naturg. Zool.' Abt. i. p. 70.

Mæandrina areolata, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 247; Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. pp. 283-284, pl. xvi. fig. 11; Lamouroux, 1821, 'Expos. Méth.' p. 55, pl. xlvii. figs. 4, 5; Blainville, 1823, 'Méandrine,' Dict. Sci. Nat. t. xxix. p. 376; Deslongchamps, 1824, 'Encycl. Méth., Zooph.' p. 508; Blainville, 1834, 'Man. Act.' p. 357; Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. p. 1095; Duchassaing, 1855, 'Form. mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. p. 756.

Manicina areolata, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 327; Leuckart, 1841, 'Zooph. Corall. speciatim Fungia,' p. 61, pl. iii. figs. 3, 4; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 191, pl. ix. fig. 3; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 286; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 91; *id.* 1857, 'Hist. Nat. Cor.' t. ii. p. 397; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 350; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 48; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 176; Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., Quart. Journ. Geol. Soc. vol. xxiv. p. 16; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 72; Duncan, 1873, 'Old Tert. W. Ind.' Quart. Journ. Geol. Soc. vol. xxix. p. 555; Pourtales, 1880, 'Flor. Reefs,' Mem. Mus. Comp. Zool. vol. vii. no. 1, pls. v., vi. figs. 1-6; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. pp. 90-91; Wilson, 1888, 'Development, etc.' Journ. Morph. vol. ii. pp. 191-252, pls. i.-vii.; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii., Syst. p. 171; *non* A. Agassiz, 1890, 'Rate of Growth,' Bull. Mus. Comp. Zool. vol. xx. p. 62, pl. iii.

Madrepora mæandrites (pars), Esper, 1788, 'Pflanzenh.' pp. 76-84, pl. iv., *not* pl. iv. a.

Manicina mæandrites, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 193.

Manicina prærupta, Ehrenberg, 1834, 'Cor. roth. Meer.' p. 327.

Mæandrina pectinata (pars), Schweigger, 1820, 'Handb. Naturg.' p. 420.

Distribution. Recent: West Indies, Florida, Cape of Good Hope (*vide* Quelch), Indian Ocean and Australia (*vide* Ortmann). *Fossil*: Barbados: Low-level Reefs, near Bridgetown (Mitchinson Coll.); San Domingo, Nivajé Shale; St. Bartholomew (horizon?); Guadeloupe (newer and older reefs).

Genus *MÆANDRINA*, Lamarck, 1801.

Species *MÆANDRINA FILOGRANA* (Esper).

Synonymy:—

Madrepora filograna, Esper, 1789, 'Pflanzenh.' Bd. i. pp. 139-140, pl. xxii. figs. 1, 2.

Mæandrina filograna, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 248; Blainville, 1823, 'Méandrine,' Dict. Sci. Nat. t. xxix. p. 377; Deslongchamps, 1824, 'Encycl. Méth., Zooph.' p. 509; Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. ix. p. 323; *id.* 1834, 'Man. Act.' p. 358; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 389; Michelin, 1842, 'Icon. Zooph.' p. 56, pl. xi. fig. 7; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 262; M.-Edwards & Haime, 1848, 'Classif. deux tribus Astr.' Compt. Rend. t. xxvii. p. 493; *id.* 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. pp. 280-281; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 90; *id.* 1857, 'Hist. Nat. Cor.' t. ii. pp. 390-391; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 350; Duncan, 1863, 'West Ind. Cor.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 433; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 175; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 22.

Madrepora clivosa, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 163.

Mæandrina clivosa, Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 48; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 74; Lindström, 1877, 'Contrib. Act. Atl.' p. 22; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii., Syst. p. 170.

Mæandrina strigosa, Dana, 1848, *op. jam cit.* p. 257, pl. xiv. fig. 4; Verrill, 1864, *op. jam cit.* p. 48; Pourtales, 1871, *op. jam cit.* p. 74; *id.* 1880, 'Florida Reefs,' Mem. Mus. Comp. Zool. vol. vii. no. 1, pl. ix. figs. 6-9; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. pp. 92-94; Heilprin, 1890, 'Coral. W. Gulf Mex.' Proc. Acad. Nat. Sci. Phil. p. 306; *non* Bassett-Smith, 1890, 'Corals Tizard & Maccl. Bks.' Ann. Mag. Nat. Hist. ser. 6, vol. vi. p. 370.

Mæandrina sinuosissima, M.-Edwards & Haime, 1849, 'Monogr. Astr.' pt. 2, Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 281; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 393; Duncan, 1864, 'W. Ind. Cor.' pt. ii., Quart. Journ. Geol. Soc. vol. xx. p. 36; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 175; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29; Lindström, 1877, 'Contrib. Act. Atl.' p. 22; Quelch, 1886, 'Reef Corals,' pp. 91-92.

Mæandrina sinuosa (non Ellis), Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. pp. 278-281, pl. xv. figs. 4-7; Verrill, 1864, 'List of Corals,' p. 49.

? *Mæandrina dedalea*, Michelotti, 1838, 'Specim. Zooph.' p. 155, pl. v. fig. 5.

Mæandrina labyrinthica, Lesueur, 1820, *op. supra cit.* p. 282, pl. xvi. fig. 10; Ortmann, 1888, 'Staud. Verbr. Steinkor.' p. 170.

Mæandrina labyrinthiformis, Verrill, 1864, *op. supra cit.* p. 49; Ortmann, 1890, 'Morph. Skel. Steinkor.' Zeit. wiss. Zool. Bd. I. p. 301.

Distribution. Recent: West Indies, Florida, Bermuda. *Fossil*: Barbados: Low-level Reefs, Bridgetown; High-level Reefs, Welsh Town Gully (600 feet); San Domingo, Nivajé Shale.

Notes on Synonymy.—The synonymy of this species is very confusing, representatives of different genera having been included in the same species and many other species founded on mere individual variations. Quelch has considered the synonymy with care; he reduces many of M.-Edwards & Haime's species to synonyms, including *M. heterogyra*, *M. serrata*, *M. crassa*, and *M. labyrinthica*. The last of these, however, appears to me to be a *Cœloria*, while M.-Edwards & Haime include in *Cœloria* the *M. strigosa* of Dana, a step which does not seem to me justifiable. M.-Edwards & Haime's types are in the Paris Museum, but my notes on them having been lost, I do not care to express any positive opinion on the value of the series of species.

The species is restricted to the shores of the West Indies and the adjoining districts. It has been recently quoted from the Tizard Bank; the specimen on which the record is based is preserved in the British Museum. So far as I can determine it without a section, it appears to be a *Leptoria tenuis*, Dana.

Genus MYCETOPHYLLIA, M.-Edwards & Haime, 1848.

Species MYCETOPHYLLIA LAMARCKI, M.-Edwards & Haime.

Synonymy:—

Mycetophyllia Lamarckana, M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. pl. viii. fig. 6; *ibid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat.' t. v. p. 80; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 376; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 350; *ibid.* 1866, 'Suppl., etc.' *ibid.* ser. 2, t. xxiii. p. 173; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29.

Mycetophyllia Lamarcki, Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12.

Distribution. Recent: West Indies. *Fossil*: Bermuda, Pleistocene (Coll. Geol. Soc.); Barbados: Low-level Reefs (Franks Coll.).

Subfamily ASTRÆIDÆ CONFLUENTES.

Genus COLPOPHYLLIA, 1848, M.-Edwards & Haime.

Species COLPOPHYLLIA GYROSA (Ellis & Sol.), 1786.

Synonymy:—

Madrepora gyrosa, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 163, pl. li. fig. 2; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3763; Esper, 1795, 'Pflanzenh.' Fortsetz. pp. 100-101, pl. xxx.

Méandrina gyrosa, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 247; Lamouroux, 1821, 'Exp. Méth.', p. 55, pl. li. fig. 2; Blainville, 1823, 'Méandrine, Dict. Sci. Nat. t. xxix. p. 376; Deslongchamps, 1824, 'Encycl. Méth., Zooph.' p. 508; Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. lx. p. 323; *id.* 1834, 'Man. Act.' p. 357; Lamarck, 1836, 'Hist. Nat.' ed. 2, t. ii. p. 388; Schomburgk, 1847, 'Hist. Barbados, p. 562; Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. p. 1095; *id.* 1850, 'Anim. rad. Ant.' p. 16; *id.* 1855, 'Form. mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. pp. 754, 756.

Mussa gyrosa, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 186.

Manicina gyrosa, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 326.

Colpophyllia gyrosa, M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 266; *iid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 84; *iid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 384; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. sér. 2, t. xix. p. 349; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 49; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. sér. 2, t. xxiii. p. 174; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 74; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 22; Pourtales, 1880, 'Flor. Reefs,' Mem. Mus. Comp. Zool. vol. vii. no. 1, pl. ix. figs. 13-16; Queleh, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12; Ortmann, 1890, 'Morph. Skel. Steinkor.' Zeit. wiss. Zool. Bd. 1. p. 305.

Mussa fragilis, Dana, 1848, *op. supra cit.* p. 185, pl. viii. fig. 7.

Colpophyllia fragilis, M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xi. p. 267; *iid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 84, p. 267; *iid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 385; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 349; *iid.* 1866, 'Suppl. etc.' p. 174; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29.

Manicina meandrites, non Esper, Ehrenberg, 1834, 'Cor. roth. Meer.' p. 326.

Colpophyllia tenuis, M.-Edwards & Haime, 1849, 'Monogr. Astr.' p. 267; *iid.* 1857, 'Hist. Nat. Cor.' p. 386; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 349; *iid.* 1866, 'Suppl. etc.' p. 174; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 29.

Distribution. Recent: West Indies, Bermuda. *Fossil*: Barbados: High-level Reefs, Castle Grant; Low-level Reefs, Bridgetown, Guadeloupe, Newer and older Reefs.

Notes on Synonymy.—The type of *C. tenuis* is in Paris, and seems to be only a young form of this species. The *C. fragilis* is probably a variation due to growth at a somewhat greater depth than the normal form. *C. breviserialis* appears to be definitely distinct.

Genus HYDNOPHORA, Fischer de Waldheim.

Species HYDNOPHORA LATEFUNDATA, sp. n.

Diagnosis. Coral encrusting. Thin common plateau.

Monticules large, blunt, serial. Bases broad (whence specific name). High, conical or subcolumnar, often elongated transversely to the calicinal valleys. Irregularly distributed; usually in dichotomizing rows.

Septa thick, uniform; strongly dentate. Calicinal centres indistinct.

Dimensions. Height of monticules=3 mm.; breadth=3.4 mm.

Distribution. Fossil: Barbados: High-level Reefs, Castle Grant, 1070 feet (Jukes-Browne Coll.), Spring Estate, St. Andrews; Trinidad, St. Croix (Geol. Soc. Coll.).

Figures. Pl. XI. fig. 1 a. Specimen from Castle Grant (B. M. R.), nat. size. Pl. XI. fig. 1 b. Monticules enlarged.

Affinities. The genus *Hydnophora* has not been previously recorded

from the West Indies. Mr. R. Etheridge, Jun., has referred to it a fossil specimen now in the British Museum (Natural History), from Madeira. The only specimens from the West Indies, with the exception of those now received from Barbados, are some from Trinidad in the Museum of the Geological Society. One was identified by Duncan as *Agaricia agaricites* (Pall.) and the other as *Agaricia undata* (Ell. & Sol.); they were recorded as such in the 'Fossil Corals of the West Indies,' pt. iv.¹ They appear to be fairly typical representatives of this species.

H. latefundata is a very well-marked species. Its nearest ally is *H. exesa* (Ell. & Sol.)²—the *H. microconos* of Lamarck. This has been especially well figured by Klunzinger.³ *H. exesa* differs, however, by growing in hemispherical masses; it has finer monticules, which are more crowded, so that the valleys are not so continuous. The calicinal centres are more distinct. *H. contignatio*, Forsk., which has also been well described by Klunzinger,⁴ has not such regularly-arranged serial monticules, which in places almost unite into 'collines.' *H. tenella*, Quelch,⁵ is another species that must be compared with the new one; *H. tenella* differs not only in its thin contorted sheets, but by having the calicinal centres more distinct; this species appears more Astræiform than any other in the genus.

Genus DICHOCENIA, M.-Edwards & Haime, 1848.

Species DICHOCENIA STOKESI, M.-Edwards & Haime.

Synonymy :—

Dichocenia Stokesi, M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 307, pl. vii. figs. 3, 3 a; *ibid.* 1857, 'Hist. Nat. Cor.' t. ii. p. 200; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 341; *ibid.* 1866, 'Suppl. etc.' *ibid.* p. 166; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 68; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 22.

Dichocenia Cassiopæa, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 341; *ibid.* 1866, 'Suppl. etc.' p. 166; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27.

Dichocenia pulcherrima, Duchassaing & Michelotti, 1861, *op. cit.* pp. 341-342; *ibid.* 1866, *op. cit.* p. 167; Duchassaing, 1870, *op. cit.* p. 27.

Dichocenia æquinoxialis, Duchassaing & Michelotti, 1866, *op. cit.* p. 167; Duchassaing, 1870, *op. cit.* p. 27.

Dichocenia elliptica, Duchassaing & Michelotti, 1866, *op. cit.* p. 167, pl. ix. figs. 11, 12; Duchassaing, 1870, *op. cit.* p. 27.

Dichocenia pauciflora, Duchassaing & Michelotti, 1866, *op. cit.* p. 167, pl. ix. figs. 9, 10; Duchassaing, 1870, *op. cit.* p. 27; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12.

Dichocenia tuberosa, Duncan, 1863, 'W. Ind. Cor.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 432, pl. xv. figs. 5 a, 5 b.

Dichocenia tuberosa, var., Duncan, 1864, *do.*, pt. ii., *ibid.* vol. xx. p. 27; Duchassaing & Michelotti, 1866, *op. supra cit.* p. 168; Duchassaing, 1870, *op. supra cit.* p. 27.

¹ Quart. Journ. Geol. Soc. vol. xxiv. (1868) p. 12.

² 'Hist. Nat. Zooph.' p. 161, pl. xlix. fig. 3.

³ 'Die Korallthiere des rothen Meeres,' pt. ii. Abt. ii. (1879) pp. 21-22, pl. iii. fig. 1, pl. ix. fig. 12 d.

⁴ *Ibid.* pp. 22-23, pl. iii. figs. 2-3, pl. ix. figs. 12 a-c.

⁵ 'Reef Corals collected by H.M.S. 'Challenger,' Zool. 'Chall.' Exped. pt. xlv. p. 96, pl. v. figs. 8-8 a.

Dichocenia porcata (non auct.), Pourtalès, 1880, 'Flor. Reefs,' Mem. Mus. Comp. Zool. vol. vii. no. 1, pl. x.

Barysmilia intermedia, Duncan, 1863, 'W. Ind. Cor.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 431, pl. xv. fig. 4; *id.* 1868, do. pt. iv., *ibid.* vol. xxiv. p. 23; Duchassaing & Michelotti, 1866, 'Suppl. etc.' p. 165; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27.

Distribution. Recent: West Indies. *Fossil*: Barbados: Low-level Reefs, near Bridgetown (Franks Coll.); San Domingo: Esperanza Shale, Nivajé Shale, and Tufaceous Limestone.

Notes on Synonymy.—This species has given rise to great difficulty; its earliest history I have not been able to unravel. It was confused with *Dichocenia uva* (Esper), and many of the early records of this East Indian species are no doubt based on *D. Stokesi*. Duchassaing & Michelotti had a fine series of specimens, all now in the Museum at Turin; their new species seem to be based on individual variations. *D. pauciflora* is a form with scattered calices. *D. elliptica* is a form that has grown quickly, so that the calices are crowded, and they have undergone repeated fission. *D. æquinoxialis* is a variety also with crowded calices; these average 6 mm. in length by 3 mm. in breadth, and are separated by cœnenchyma only 1 mm. broad; it appears, however, to have grown slowly, as fission is much rarer than in the previous form. *D. guadalupensis* is a small undergrown variety of *æquinoxialis*. The *D. porcata* of Pourtalès is a variety in which the formation of long series of confluent calices has reached its extreme limit for this species. Duncan's *Barysmilia intermedia* appears to be a young form of this; it looks much like a *Barysmilia* externally, but, as the specimen has a well-marked columella, it cannot belong to that genus.

The two species *D. uva* and *D. Stokesi* are closely allied. The distinctions that separate them from *D. porcata* are so well marked as to be probably of subgeneric value.

Genus LAMELLASTRÆA, Duncan, 1868.

Species LAMELLASTRÆA SMYTHI, Duncan.

Synonymy:—

Lamellastræa Smythi, Duncan, 1868, 'W. Ind. Foss. Cor.' Quart. Journ. Geol. Soc. vol. xxiv. p. 20, pl. i. figs. 2 a, 2 b.

Distribution. Fossil: Antigua Marl (type Brit. Mus.); Barbados: High-level Reefs, Castle Graut (Jukes-Browne Coll.).

Genus FAVIA, Oken, 1815.

Species FAVIA ANANAS (Pallas), 1766.

Synonymy:—

Madrepora ananas, Pallas, 1766, 'Elench. Zooph.' p. 321; Ellis & Solander, 1786, 'Hist. Nat. Zooph.' p. 168, pl. xlvii. fig. 6; *non* Linnæus, 1787, 'Syst. Nat.' ed. xii. p. 1275; *non* Esper, 1789, 'Pflanzenh.' pp. 128-131, pl. Madrep. xix.

Favia ananas (pars), Oken, 1815, 'Lehrb. Naturg. Zool.' Abth. i. p. 67.

Favia ananas, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 435; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 352; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 48; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 177; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 75.

Astræa ananas (pars), Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 260.

Astræa ananas, Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. p. 285, pl. xvi. fig. 12; Schweigger, 1820, 'Handb. Naturg.' p. 419.

Astræa ananas (pars), Lamouroux, 1821, 'Expos. Méth.' p. 59, pl. xlvii. fig. 6; *id.* 1824, 'Encycl. Zooph.' p. 127.

Non *Astræa ananas*, Eichwald, 1829, 'Zool. Spec.' pars i. p. 183.

Astræa ananas (pars), Blainville, 1834, 'Man. Act.' p. 369.

Non *Astræa ananas*, Quoy & Gaimard, 1834, 'Voy. Astrolabe,' Zool. t. iv. p. 207, pl. xvi. figs. 6, 7.

Astræa ananas, pars, Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 406.

Astræa ananas, Schomburgk, 1874, 'Hist. Barbados,' p. 562; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 222; Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. p. 1095; *id.* 1850, 'Anim. rad. Ant.' p. 16; *id.* 1855, 'Form. mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. pp. 754, 756; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlvii. pp. 12, 98.

Explanaria ananas, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 307.

Parastræa ananas, M.-Edwards & Haime, 1850, Ann. Sci. Nat. Zool. sér. 3, t. xii. p. 172.

Distribution. Recent: West Indies, Florida, Bermuda. *Fossil:* Barbados: Low-level Reefs, near Bridgetown (Mitchinson Coll.); Guadeloupe, newer and older reefs.

Notes on Synonymy.—The great confusion with this species is due to Linnæus and Esper, who applied the name to an East-Indian coral, which is no doubt *Dichocenia porcata*. Schweigger, in 1820, clearly recognized this; but many later authors have continued to use the name either for the East Indian species only or for both. The collection at the Museum of Comparative Zoology at Harvard contains some typical specimens from Barbados which agree exactly with one from the raised reefs.

Subfamily ASTRÆIDÆ GEMMANTES.

Genus ORBICELLA, Dana, 1848.

Species 1. ORBICELLA RADIATA (Ellis & Solander), 1786.

Synonymy:—

Madrepora radiata, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 169, pl. xlvii. fig. 8; Gmelin, 1790, Syst. Nat. ed. xiii. p. 3765; Esper, 1795, 'Pflanzenth.' Fortsetz. Bd. i. pp. 74–75, Madrep. pl. lxi.

Astræa radiata, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 258; Lamouroux, 1821, 'Expos. Méth.' p. 57, pl. xlvii. fig. 8; *id.* 1824, 'Encycl. Méth., Zooph.' p. 132; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 404; Schomburgk, 1847, 'Hist. Barbados,' p. 562; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xii. p. 101.

Astræa radiata, var. *intermedia*, Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 421.

Astræa (Tubastræa) radiata, Blainville, 1830, Dict. Sci. Nat. t. lx. p. 334, pl. xxxv. fig. 8; *id.* 1834, 'Man. Act.' p. 368, pl. lv. fig. 8.

Explanaria radiata, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 307.

Orbicella radiata, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 206.

Heliastræa radiata, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 470; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 352; *ibid.* 1866, 'Suppl. etc.' *ibid.* ser. 2, t. xxiii. p. 179; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Madrepora cavernosa, Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1276; Gmelin, 1790, *op. cit.* ed. xiii. p. 3767; Esper, 1794, 'Pflanzenth.' Fortsetz. Bd. i. pp. 18–21, pl. Madrep. xxxvii.

Non *Madrepora cavernosa*, Schlotheim, 1820, 'Petrefactenkunde,' p. 358.

Favia cavernosa seu astroites, Oken, 1815, 'Lehrb. Naturg. Zool.' Abt. i. p. 67.

Astræa cavernosa, Schweigger, 1820, 'Handb. Naturg.' p. 419; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. pl. ix. fig. 1, t. xii. p. 97; *ibid.* 1851, 'Polyp. Palæoz.' Arch. Mus. Hist. Nat. t. v. p. 97.

Non *Astræa cavernosa*, Quenstedt, 1852, 'Handb. Petref.' p. 647, pl. lvii. fig. 22; *id.* 1883, *op. cit.* ed. iii. p. 1000, pl. lxxx. fig. 11; Faurot, 1888, 'Miss. Mer Rouge,' Arch. Zool. Expér. sér. 2, t. vi. p. 119.

Astræa (Tubastræa) cavernosa, Blainville, 1830, Dict. Sci. Nat. t. lx. p. 334; *id.* 1834, 'Man. Act.' p. 368.

Heliastrea cavernosa, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 463.

Heliastrea cavernosa, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 352; *id.* 1866, 'Suppl. etc.' p. 179; Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., Quart. Journ. Geol. Soc. vol. xxiv. p. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Orbicella cavernosa, Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 47; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 76; Lindström, 1877, 'Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 23; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. pp. 12, 106; Heilprin, 1890, 'Cor. W. Gulf Mex.' Proc. Acad. Nat. Sci. Phil. 1890, p. 306.

Astræa Argus, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 259; Lamouroux, 1824, Encycl. Méth., 'Zooph.' p. 131; Eichwald, 1829, 'Zool. Spec.' t. i. p. 183; Schomburgk, 1847, 'Hist. Barbados,' p. 562; Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. pp. 1095, 1097; M.-Edwards & Haime, 1848, 'Classif. deux. tribu Astr.' Compt. Rend. t. xxvii. p. 494; Duchassaing, 1850, 'Anim. rad. Ant.' p. 15; *id.* 1855, 'Form. mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. pp. 754, 756.

Orbicella Argus, Dana, 1843, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 207, pl. x. fig. 1, p. 75, fig. 34.

Explanaria Argus, Ehrenberg, 1834, 'Cor. roth. Meer.' p. 307.

Astræa endothecata, Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 434, pl. xv. fig. 7.

Heliastrea endothecata, *id.* 1868, *op. cit.* pt. iv., *ibid.* vol. xxiv. p. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Astræa cylindrica, Duncan, 1863, *op. supra cit.* vol. xix. p. 434, pl. xv. fig. 8.

Heliastrea cylindrica, *id.* 1868, *op. cit.* vol. xxiv. p. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Heliastrea aperta, Verrill, 1868, 'Notes on Radiata,' Trans. Conn. Acad. vol. i. pt. 2, p. 356.

Distribution. Recent: West Indies, Florida, Vera Cruz, Brazil. *Fossil*: Barbados: Low-level Reefs near Bridgetown (Franks Coll.); Ceres (Jukes-Browne Coll.); High-level Reefs, Spring Estate, St. Andrews; Bissex Hill, near foot of crest; Gully by Farmer's Shaft No. 3; Welsh Town Gully (600 feet); Mt. Hillaby (780 feet). Trinidad, St. Croix; Antigua, Marl; Guadeloupe, newer and older reefs; San Domingo, Tufaceous Limestone, Nivajé Shale; Bermuda, raised reefs (Coll. Geol. Soc.)

Notes on the Species.—The group of Astræan corals of the alliance *Orbicelloida* is the most difficult in the West Indian fauna. The first species, however, is fairly well marked. I have adopted for it the name *radiata*, though *cavernosa* is earlier. But Linnæus's diagnosis of this is so imperfect and inadequate that it is absolutely useless. Ellis and Solander, on the other hand, gave a figure; this, unfortunately, was based on a worm broken specimen, but is nevertheless clearly recognizable. It appears, however, at first so different from Esper's admirable figure of *M. cavernosa* that the two species were regarded as distinct.

The *O. aperta* of Verrill seems to me to be only a specimen of this species, in which the fourth cycle of septa is incomplete. It looks somewhat different, as the cœnenchyma is more cellular and the septa are thinner; in all fundamental points it agrees with *O. radiata*. The specimen probably grew under less favourable conditions than those of the West Indian seas, and thus is less massive. Verrill's type is preserved in the Museum of Yale College, to the authorities of which I am indebted for the opportunity of studying it.

Species 2. *ORBICELLA ACROPORA* (Linnæus), 1767.

Synonymy :—

Madrepora acropora, Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1276; Gmelin, 1790, *ibid.* ed. xiii. p. 3767; Esper, 1794, 'Pflanzenth.' Fortsetz. Bd. i. pp. 21–23, pl. Madrep. xxxviii.

Heliastrea acropora, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 477; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mém. R. Accad. Sci. Torino, ser. 2, t. xix. p. 179; *ibid.* 1866, 'Suppl. etc.' *ibid.* ser. 2, t. xxiii. p. 352; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Madrepora annularis, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 169, pl. liii. figs. 1–2.

Astræa annularis, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 259; *id.* 1816, 'Encycl. Méth. Atlas,' pl. 486. figs. 1–2; Lamouroux, 1821, 'Expos. Méth.' p. 58, pl. liii. figs. 1–2; *id.* 1824, 'Encycl. Méth.,' 'Zooph.' p. 131; Lamarck, 1836, 'Hist. Nat.' ed. 2, t. ii. p. 406; Schomburgk, 1847, 'Hist. Barbados,' p. 562; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xii. p. 104.

Astræa (Tubastræa) annularis, Blainville, 1830, Dict. Sci. Nat. t. lx. p. 334; *id.* 1834, 'Man. Act.' p. 368.

Explanaria annularis, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 308.

Orbicella annularis, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 214, pl. x. fig. 6; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 48; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 77; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 23; Pourtales, 1880, 'Flor. Reefs,' Mem. Mus. Comp. Zool. vol. vii. no. 1, pl. iv; A. Agassiz, 1890, 'Rate of Growth,' Bull. Mus. Comp. Zool. vol. xx. p. 61, pls. i., ii.; Heilprin, 1890, 'Cor. W. Gulf Mexico,' Proc. Acad. Nat. Sci. Phil. 1890, p. 305.

Heliastrea annularis, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 473; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 352; *ibid.* 1866, 'Suppl. etc.' p. 179; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30; Ortmann, 1888, 'Stud. Syst. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 174; *id.* 1889, 'Steinkor. Ceylons,' *ibid.* Bd. iv. Syst. p. 529; *id.* 1890, 'Morph. Skel. Steinkor.' Zeitschr. Wiss. Zool. Bd. i. p. 307.

Madrepora faeolata, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 166, pl. liii. figs. 5–6; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3769.

Orbicella Hyades, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 212, pl. x. fig. 15.

Heliastrea? Hyades, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 478. *Solenastrea Hyades*, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 353; *id.* 1866, 'Suppl. etc.' p. 179; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Heliastrea abdita, Duchassaing & Michelotti, 1861, *op. supra cit.* p. 352; *id.* 1866, *op. supra cit.* p. 179; Duchassaing, 1870, *op. supra cit.* p. 30.

Heliastrea rotulosa, Duchassaing & Michelotti, 1861, *op. supra cit.* p. 352; *id.* 1866, *op. supra cit.* p. 179; Duchassaing, 1870, *op. supra cit.* p. 30.

Astræa barbadensis, Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. pp. 421, 444–445, pl. xv. fig. 6 a, b.

Heliastrea barbadensis, Duchassaing & Michelotti, 1866, 'Mém. Cor. Ant.' p. 180; Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., Quart. Journ. Geol. Soc. vol. xxiv. p. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Heliastrea altissima, Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., vol. xxiv. pp. 12–13, pl. ii. fig. 3.

Distribution. Recent : West Indies, Florida, Yucatan, ? Samoa (*vide* Ortmann). *Fossil* : Barbados : Low-level Reefs near Bridgetown (Franks Coll.); Ceres (Jukes-Browne Coll.); High-level Reefs, Castle Grant, 1050 feet (Jukes-Browne Coll.); summit of Mt. Misery, 1053 feet (Col. Feilden Coll.). Trinidad, St. Croix (Geol. Soc. Coll.); Antigua, Marl.

Notes on Synonymy.—The main point in the synonymy of this species is the determination as to whether *O. annularis* should be kept distinct. At first I thought that this could be done, owing to the fact that in *O. annularis* the costæ are subequal, though the septa of the third cycle are very small. In *O. acropora*, on the other hand, there is a rudimentary costa between those corresponding to the third cycle of septa; these rudimentary costæ do not themselves correspond to septa. This point seemed a satis-

factory means of establishing the distinctness of the two species, until an additional section showed that in some corallites one half is on the *acropora*-type and the other on that of *annularis*.

Fig. 2.—Section of *Orbicella acropora* (Linn.). $\times 10$ diam.

Genus *SOLENASTRÆA*, M.-Edwards & Haime.

Species *SOLENASTRÆA STELLULATA* (Ellis & Solander), 1786.

Synonymy.—

Madrepora stellulata, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 165, pl. liii. figs. 3-4; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3767.

Astræa stellulata, Lamouroux, 1821, 'Expos. Méth.' p. 58, pl. liii. figs. 3-4; *id.* 1824, Encycl. Méth., 'Zooph.' p. 131, pl. 484. figs. 3-4; Blainville, 1830, Dict. Sci. Nat. t. ix. p. 334; M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xii. p. 105.

Orbicella stellulata, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 215, pl. x. fig. 7.

Heliastræa stellulata, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 473; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Torino, ser. 2, t. xix. p. 352; *id.* 1866, 'Suppl. etc.' *ibid.* ser. 2, t. xxiii. p. 179; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Solenastræa Verheltsi (non M.-Ed. & H.), Duncan, 1864, 'Foss. Cor. W. Ind.' pt. ii, Quart. Journ. Geol. Soc. vol. xx. p. 40.

Solenastræa Verheltsi, Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

? *Solenastræa Bournoni*, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 497.

Distribution. Recent: West Indies. Fossil: Barbados: High-level Reefs, Castle Grant, 1070 feet (Jukes-Browne Coll.). San Domingo, Tufaceous Limestone; Jamaica (Coll. Geol. Soc.).

Notes on the Species.—Duncan referred to the Eocene species, *S. Verheltsi*, a worn fragment from San Domingo preserved in the Museum of the Geological Society. I have been allowed to have a microscopic preparation cut from this, which shows a well-marked columella. It cannot therefore be included in the French species.

Some of the specimens collected by Mr. Jukes-Browne at Castle Grant are extremely well preserved. Others, however, are much worn; the septa in these having been removed, the corals look like *Cyphastræa*, in which genus I was at first inclined to include them. More careful study of vertical sections shows that the septa are not cribriform, though very brittle. The corallites present two different aspects: in one the thecal wall and costæ are thin; in another group from the same slab both these elements are coarse and thick. Pl. XI. figs. 4 *a*, 4 *b*, show the very different appearance which these present.

Genus *CYPHASTRÆA*, M.-Edwards & Haime, 1848.

Species *CYPHASTRÆA COSTATA*, Duncan.

Synonymy :—

Cyphastræa costata, Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. pp. 436, 441, 443; *id.* 1865, 'Foss. Cor. Jam.' *ibid.* vol. xxi. p. 7; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xxiii. p. 180; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30.

Cyphastræa oblita, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 353; *id.* 1866, 'Suppl. etc.' p. 180; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 30; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. p. 12.

Distribution. Recent: St. Thomas, West Indies. Fossil: Barbados: High-level Reefs; Castle Grant, 1070 feet; Groves, 650 feet; Low-level Reefs, near Bridgetown. San Domingo, Nivajé Shale; Jamaica; Barbuda.

Notes on Synonymy.—This species has been well described by Duncan from a specimen from Barbuda. It was named by Duchassaing & Michelotti two years previously; but they gave so inadequate a diagnosis that their name has no claim to precedence. The coral looks at first sight much like *Orbicella acropora* (L.), from which it may be distinguished at once by its thicker thecal walls and more cellular exotheca. The whole aspect of the coral is coarser and looser. The cribriform nature of the septa is extremely well marked. Following Duncan, but differing from Klunzinger and Quelch, I prefer to keep *Cyphastræa* and *Solenastræa* distinct.

Genus *ECHINOPORA*, Lamarck, 1816.

Species *ECHINOPORA FRANKSI*, sp. n.

Diagnosis. The coral has a broad base; from this pass outward short, thick, rapidly tapering expansions.

Corallites long: often an inch in length. Their distance one from the other varies from half their diameter to the whole.

Septa strongly dentate; inner teeth paliform, in three cycles. Those of the first cycle always unite to the columella; those of the second cycle often do so, but may join the primary septa; those of the third cycle are much smaller and independent, but a few may unite with the septa of the other orders.

Columella of very loose tissue; half the diameter of the corallite.

Endotheca scanty. Cœnenchyma thinner than in other species of the genus. Echinulation of the surface coarse. Epithecæ thick and well developed.

Dimensions. Diameter of an average corallite, 3 mm.; height of corallite varies from 10 to 25 mm.; thickness of wall varies from $1\frac{1}{2}$ to 3 mm.

Distribution. *Recent:* West Indies. *Fossil:* Barbados: Low-level Reefs, near Bridgetown (Franks Coll.).

Figures. Pl. XI. fig. 2 *a*, the coral reduced to $\frac{1}{3}$; fig. 2 *b*, corallites from the surface of a flat area; fig. 2 *c*, corallites on a boss on the same specimen (B.M. R 2514); fig. 3, section of a corallite, enlarged from another specimen (B.M. R 2513).

Affinities. This species is most closely allied to *Echinopora rosularia*, Lamk., of which a good figure has been given by Blainville ('Man. Act.' pl. lvi. fig. 2). The old species may, however, be easily distinguished by the greater irregularity in the distribution of the corallites, which are much farther apart. *E. aspera* (Ell. & Sol.) agrees in the general form, but differs by the great development of spines and denticles on the upper surface; the thinness of the branches, and the rudimentary character of the epithecæ, also separate the species. *E. Ehrenbergi*, M.-Ed. & H.,¹ sometimes approaches *E. Franksi* in the thickness of the expanding lobes, but these never attain the strength of the West Indian species; the cœnenchyma in the latter is, moreover, radially echinulate and not irregularly spinous.

This species is, in fact, exceptionally well marked off from those species of which adequate illustrations and descriptions have been given. The genus, moreover, has not been previously definitely recorded from the West Indies. Lamarck² described a species, *E. ringens*, of which he says 'je la crois des mers d'Amérique.' Dana ('Zoophytes,' p. 279) has quoted Lamarck's diagnosis, and puts it as 'West Indies?' Two points in this scanty diagnosis suggested at first that the Barbados specimens really belong to this species; these are the general form of the coral and the closeness of the corallites. The former character is, however, of little value; and doubt is thrown on the last by the corallites being also described as sub-confluent and sinuous. In this species they certainly are not, and this is really the only definite character in Lamarck's diagnosis. The corallites, moreover, instead of being irregular, are more regular than in most species of the genus. It would therefore be unwise to resuscitate Lamarck's practically unrecognized name. I have much pleasure in naming the species after Mr. G. F. Franks, by whose energy in forming a collection of recent and fossil species from Barbados it has been possible to work out the relations of the two faunas.

¹ Ann. Sci. Nat. Zool. sér. 3, t. xii. (1850) p. 187.

² 'Hist. Nat.' 1816, vol. ii. p. 256.

GENUS *STEPHANOCÆNIA*, M.-Edwards & Haime, 1848.

SPECIES *STEPHANOCÆNIA INTERSEPTA* (Esper), 1797.

Synonymy.—

Madrepora intersepta, Esper, 1795, 'Pflanzenth.' Fortsetz. Bd. i. p. 99, pl. Madrep. lxxix.

Astræa intersepta, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 266; Lamouroux, 1824, Encycl. Méth., 'Zooph.' p. 127; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 417.

Non *Astræa intersepta*, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 246.

Astræa intersepta, Duchassaing, 1850, 'Anim. rad. Ant.' p. 16.

Astræa (Cellastræa) intersepta, Blainville, 1830, Dict. Sci. Nat. t. ix. p. 342; *id.* 1834, 'Man. Act.' p. 377.

Stephanocœnia intersepta, M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 300, pl. vii. figs. 1-1 b; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 66; *id.* 1857, 'Hist. Nat. Cor.' t. ii. p. 265; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xix. p. 343.

Stephanocœnia intersepta, var., Duncan, 1864, 'Foss. Cor. West Ind.' pt. ii., Quart. Journ. Geol. Soc. vol. xx. p. 27.

Stephanocœnia intersepta, Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 168; Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., Quart. Journ. Geol. Soc. vol. xxiv. p. 12; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12.

Stephanocœnia Michelini, M.-Edwards & Haime, 1848, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. x. p. 301; *id.* 1857, 'Hist. Nat. Cor.' t. ii. p. 266; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 343; *id.* 1866, 'Suppl. etc.' p. 169; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 27; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 12.

Plesiastrea spongiformis, Duncan, 1864, 'Foss. Cor. W. Ind.' pt. ii., Quart. Journ. Geol. Soc. vol. xx. p. 39, pl. iv. fig. 6, a, b.

Antillastrea spongiformis, Duncan, 1884, 'Revis. Madr.' Journ. Linn. Soc., Zool. vol. xviii. p. 108.

Distribution. Recent: West Indies. *Fossil*: Barbados: Low-level Reefs, Ceres, and near Bridgetown; Guadeloupe, White Limestone (*vide* Duchassaing); Trinidad, St. Croix; San Domingo, silt.

Notes on Synonymy.—This species has three different varieties, all of which may occur on the same block. In the typical form, as shown in M.-Edwards & Haime's figure (Ann. Sci. Nat. sér. 3, vol. x. pl. vii. fig. 1) and some of the specimens from the Barbados reefs (for example, B.M. R 2533), the calices are polygonal and crowded, and separated by thin raised ridges. An extreme type of this is shown in Pl. XI. fig. 5 a, taken from a specimen from the Low-level Reefs (B.M. R 2533). On another portion of this specimen the calices are separated by low flat areas formed by the separation of the thecal walls (see Pl. XI. fig. 5 b). The third type appears very different. The corallites are circular, and are separated from one another by depressed bands; the septa, moreover, are exsert. This type is shown in Pl. XI. fig. 6; this is the variety described by M.-Edwards & Haime as *S. Michelini*. The instructive series of specimens sent from Barbados by Messrs. G. F. Franks and A. J. Jukes-Browne clearly show that all these are phases of the same species.

Duncan has described two species from Antigua (*S. Reussi* and *S. tenuis*) which are quite distinct.

The inclusion of the species made by Duncan in the type of a new genus, *Antillastrea*, necessitates the consideration of the four species originally placed by Duncan in *Plesiastrea*. The types are all in the Museum of the Geological Society; I have been kindly permitted to have sections prepared from these. Without such sections I could not have come to any conclusion as to the affinities

of the species. In his 'Revision' Duncan seems to have been puzzled by this group of species, and left three of them in *Plesiastræa*, apparently with considerable hesitation. For the fourth he proposed the genus *Antillastræa*. I can see no difference whatever between this and *Stephanocœnia*, and feel no doubt that had Prof. Duncan compared the two he would have recognized their identity; but, as he placed them in different alliances, he probably did not compare them.

Plesiastræa globosa, Duncan, is a *Leptastræa*, and is probably *L. caribæa*, Duch. & Mich.; *P. ramea*, Duncan, appears to me to be an *Orbicella*, as the structures regarded by Duncan as pali are probably only paliform lobes.

Family PLESIOFUNGIDÆ.

Genus ASTRÆA, Lamarck, 1801.

Species 1. ASTRÆA RADIANS (Pallas), 1766.

Synonymy.—

Madrepora radians, Pallas, 1766, 'Elench. Zooph.' pp. 322-323.
Astræa radians, Fischer de Waldheim, 1807, 'Mus. Demid.' t. iii. p. 295; Oken, 1815, 'Lehrb. Naturg.' Zool. Bd. i. p. 65; M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. pp. 506-507; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mém. R. Acad. Sci. Nat. Torino, ser. 2, t. xix. p. 354; *ibid.* 1866, 'Suppl. etc.' *ibid.* ser. 2, t. xxiii. p. 182; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Siderastræa radians, Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 55; Lindström, 1877, 'Contr. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 23; Ortmann, 1888, 'Syst. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 181; *id.* 1890, 'Morph. Skel. Steinkor.' Zeitschr. wiss. Zool. Bd. l. p. 298.

Madrepora astroites, Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1276; Gmelin, 1790, *ibid.* ed. xiii. p. 3767; Esper, 1794, 'Pflanzenzth.' Forsetz. Bd. i. pp. 12-16, pl. Madrep. xxxv.

Astræa astroites, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 319.

Madrepora galaxea, Ellis & Solander, 1786, 'Hist. Nat. Zooph.' p. 168, pl. xlvii. fig. 7; Gmelin, 1790, *op. cit.* p. 3765.

Astræa galaxea, Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 371; *id.* 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 267; Lesueur, 1820, 'Polyp. Lamell.' Mém. Mus. Hist. Nat. t. vi. p. 285, pl. xvi. fig. 13; Lamouroux, 1821, 'Expos. Méth.' p. 60, pl. xlvii. fig. 7; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 418; Duchassaing, 1860, 'Anim. rad. Ant.' p. 15; *id.* 1855, 'Form. mod. Guad.' Bull. Soc. géol. France, sér. 2, t. xii. p. 754.

Siderastræa galaxea, Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. lx. p. 335; *id.* 1834, 'Man. Act.' p. 370; M.-Edwards & Haime, 1848, 'Classif. deux tribu Astr.' Compt. Rend. t. xxvii. p. 495; *id.* 1849, 'Monogr. Astr.' Ann. Sci. Nat. Zool. sér. 3, t. xii. p. 139; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 105; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 81; *id.* 1880, 'Flor. Reefs,' Mém. Mus. Comp. Zool. vol. vii. no. 1, pl. xi. figs. 14-21, pl. xv. figs. 1-12; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. pp. 12, 113; Heilprin, 1890, 'Cor. W. Gulf Mex.' Proc. Ac. Nat. Sci. Phil. 1890, p. 305.

Explanaria galaxea, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832 p. 306.

Siderina galaxea, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 218, pl. x. figs. 12, 12 b, c (non figs. 12 a, d).

? *Astræa punctifera*, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 260; Lamouroux, 1824, Encycl. Méth., 'Zooph.' p. 132; Lamarck, 1836, 'Hist. etc.' ed. 2, t. ii. p. 407.

Astræopora punctifera, Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. lx. p. 349; *id.* 1834, 'Man. Act.' p. 383.

Distribution. Recent: West Indies, Florida, Vera Cruz. *Fossil*: Barbados, Low-level Reefs; Bahamas, Pleistocene Reefs (Coll. Geol. Soc.).

Notes on Synonymy.—As this is the type-species of its genus, it is convenient to consider in connexion with it the correct name of the genus—a subject which has given rise to much difference of opinion. Lamarck, in 1801, used the term *Astræa* for two species, *rotulosa* and *galaxea*, but does not definitely name either as the type. Fischer de Waldheim came next; he quoted Lamarck's diagnosis, with only unimportant verbal additions. He does not mention *rotulosa*, but includes *radians* in *Astræa*. The diagnosis used both by him and Lamarck certainly applies better to *radians* than to *rotulosa*.

The genus was first properly subdivided by Oken in 1817. He restricted *Astræa* to *galaxea*, and proposed the genus *Favia* for the other. According to the rule—that when an author includes two or more species in a genus which is subsequently dismembered, and does not definitely choose one species as his type, the author who subdivides the genus has the right to select any species as the type—M.-Edwards & Haime were quite right in taking *radians* as the type of *Astræa*. This leads, however, to the unfortunate position that *Astræa* is not one of the Astræan corals. To obviate this difficulty, Blainville renamed *Astræa*, *Siderastræa*. Duncan follows the same course, by which *Astræa* would fall out of use. Quelch, however, goes back beyond Oken, uses *Astræa* for the *rotulosa*-group of species, makes *Favia* a synonym of *Astræa*, and accepts *Siderastræa* for the *radians*-group.

But this course is opposed to the rule already quoted. The only chance of escape from the solution adopted by M.-Edwards & Haime is a prior use of the name *Astræa*. Before Lamarck, Gmelin used it for *Madrepora astroïtes* (p. 3767), but his diagnosis is so uncertain that one cannot base anything upon it. Brown¹ used *Astræa* for a coral, but his description is so ill-defined that it is impossible to recognize what was intended. Bolten used the term for a mollusc in 1798; but it is not used in conchology, and I cannot find what he meant by it. We seem, therefore, bound to follow the course taken by Milne-Edwards & Haime.

Species 2. *ASTRÆA SIDEREA* (Ell. & Sol.), 1786.

Synonymy :—

Madrepora sideræa, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 168, pl. xlix. fig. 2; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3765.

Astræa sideræa, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 267; Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. p. 286, pl. xvi. fig. 14; Lamouroux, 1821, 'Exp. Méth.' p. 60, pl. xlix. fig. 2; *id.* 1824, Encycl. Méth., 'Zooph.' p. 126; Lamarck, 1836, 'Hist. Nat. etc.' ed. 2, t. ii. p. 417; M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 509; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mém. R. Acad. Sci. Tor. ser. 2, t. xix. p. 354; *id.* 1866, 'Suppl. etc.' *ibid.* sér. 2, t. xxiii. p. 183; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Astræa (Siderastræa) sideræa, Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. lx. p. 335; *id.* 1834, 'Man. Act.' p. 370.

Siderastræa sideræa, M.-Edwards & Haime, 1849, 'Monogr. Astr.' Ann. Sci. Nat., Zool. sér. 3, t. xii. p. 141; *id.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 105; Verrill, 1884, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 55; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 81.

¹ Patrick Brown, 'Civil & Natural History of Jamaica,' 1789, p. 392.

- Pavonia siderea*, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 331.
Astræa trichophylla, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 319.
? *Siderastræa globosa*, M.-Edwards & Haime, 1849, 'Monogr. Astr.' p. 141.
? *Astræa globosa*, M.-Edwards & Haime, 1857, 'Hist. Nat. Cor.' t. ii. p. 510.
Siderastræa grandis, Duncan, 1863, 'Wt. Ind. Cor.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 441, pl. xvi. fig. 5; *id.* 1864, *op. cit.* pt. ii., *ibid.* vol. xx. p. 40.
Astræa grandis, Duncan, 1868, *op. cit.* pt. iv., *ibid.* vol. xxiv. pp. 18, 20; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.
Siderastræa crenulata, Blv., var. *Antillarum*, Duncan, 1863, *op. cit.*, Quart. Journ. Geol. Soc. vol. xix. p. 435; *id.* 1865, 'Cor. Jam.' *ibid.* vol. xxi. p. 11.
Astræa crenulata (non Blainv.), Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.
Siderastræa stellata, Verrill, 1868, 'Notes on Radiata,' pt. iv., Trans. Connect. Acad. vol. i. p. 352.

Distribution. Recent : West Indies ; Florida ; Abrolhos Banks, Brazil. *Fossil* : Barbados : Low-level Reefs, Ceres (Jukes-Browne Coll.), near Bridgetown (Franks Coll.) ; High-level Reefs, Castle Grant, 1070 feet (Jukes-Browne Coll.) ; Spring Estate, St. Andrews ; Two Mile Hill, St. Michael's. San Domingo, Nivajé Shale ; Jamaica.

Notes on Synonymy.—The only point requiring notice in the synonymy of this species is in reference to Duncan's species *A. grandis* and his identification of some specimens as a variety of the common Italian Miocene form, *A. crenulata* (Blv.). Duncan's type of the former is preserved in the British Museum ; sections of it agree exactly with those of *A. siderea* from Barbados. The specimen on which he based his record of *A. crenulata* is a small one, and appears to be only a young form of this species.

Family LOPHOSERIDÆ.

Genus AGARICIA, Lamarck, 1801.

Species 1. AGARICIA AGARICITES (Pallas), 1766.

Synonymy :—

Madrepora agaricites, Pallas, 1766, 'Elench. Zooph.' pp. 287-289 ; Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1274 ; Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 159, pl. lxiii. ; Esper, 1789, 'Pflanzenzeth.' Bd. i. pp. 132-135, pl. Madr. xx. ; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3759.

Undaria agaricites, Oken, 1815, 'Lehrb. Naturg. Zool.' Bd. i. p. 69.

Pavonia agaricites, Lamarck, 1816, 'Hist. Anim. s. Vert.' t. ii. p. 239 ; Lamouroux, 1821, 'Exp. Méth.' p. 53, pl. lxiii. ; Deslongchamps, 1824, 'Encycl. Méth.' 'Zooph.' p. 604 ; Blainville, 1825, *Pavonia*, Dict. Sci. Nat. t. xxxviii. p. 167 ; Eichwald, 1829, 'Zool. Spec.' pars i. p. 185 ; Blainville, 1830, 'Zoophyte,' Dict. Sci. Nat. t. lx. p. 330 ; *id.* 1834, 'Man. Act.' p. 365.

Mycetia agaricites, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 342.

Agaricia agaricites, M.-Edwards & Haime, 1851, 'Monogr. Foug.' Ann. Sci. Nat. Zool. sér. 3, t. xv. p. 127 ; *id.* 1860, 'Hist. Nat. Cor.' t. iii. p. 81 ; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mém. R. Acad. Sci. Tor. sér. 2, t. xix. p. 356 ; Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 437 ; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 55 ; *id.* 1868, 'Notes on Rad.' pt. iv., Trans. Conn. Acad. vol. i. p. 352.

Non *Agaricia agaricites*, Duncan, 1868, 'Foss. Cor. W. Ind.' pt. iv., Quart. Journ. Geol. Soc. vol. xxiv. p. 12.

Agaricia agaricites, Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31 ; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 82 ; Lindström, 1877, 'Contrib. Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 23 ; Pourtalès, 1880, 'Flor. Rfs.' Mém. Mus. Comp. Zool. vol. vii. no. i. pl. xi. figs. 11-13, pl. xii. figs. 1-3 ; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. pp. 12, 117 ; Ortman, 1888, 'Syst. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 181.

Pavonia cristata, Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 372.

Pavonia cristata, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 328.

Non *Pavonia cristata*, Lamarck, 1816, *et auct.*; ? Deslongchamps, 1824, Encycl. Méth. p. 604.

Agaricia cristata, Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. p. 1097.

? *Agaricia arthrophylla*, Horn, 1860, Proc. Acad. Nat. Sci. Phil. 1860, p. 435.

Madrepora undata, Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 157, pl. xl.; Esper, 1796, 'Pflanzenth.' Fortsetz. Bd. i. p. 98, pl. Madr. lxxviii.

Agaricia undata, Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 373; *id.* 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 242; Lamouroux, 1821, 'Exp. Méth.' p. 54, pl. xl.; *id.* 1824, Encycl. Méth., 'Zooph.' p. 13; Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. ix. p. 326; *id.* 1834, 'Man. Act.' p. 361; Lamarck, 1836, 'Hist. Nat. etc.' ed. 2, t. ii. p. 381; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 336; Duchassaing, 1850, 'Anim. rad. Ant.' p. 17; M.-Edwards & Haime, 1851, 'Monogr. Fong.' Ann. Sci. Nat. Zool. sér. 3, t. xv. p. 129; *iid.* 1851, 'Polyp. Paléoz.' Arch. Mus. Hist. Nat. t. v. p. 129; *id.* 1860, 'Hist. Nat. Cor.' t. iii. p. 83; Duchassaing & Michelotti 1861, 'Mém. Cor. Ant.' Mém. R. Accad. Sci. Tor. sér. 2, t. xix. p. 357.

Agaricia undata, var., Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 437.

Non *Agaricia undata*, Duncan, 1868, *op. cit.* pt. iv., *ibid.* vol. xxi. p. 12.

Agaricia undata, Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Undaria undata, Oken, 1815, 'Lehrb. Naturg.' Zool. Bd. i. p. 69.

Pavonia undata, Blainville, 1830, 'Zooph.' Dict. Sci. Nat. t. ix. p. 331; *id.* 1834, *op. cit.* p. 365; Duchassaing, 1847, 'Const. géol. Guad.' Bull. Soc. géol. France, sér. 2, t. iv. p. 1097.

Agaricia purpurea, Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. p. 276, pl. xv. fig. 3; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 55; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 82; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. p. 12.

Mycedia purpurea, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 340.

Mycedium purpureum, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 357.

Mycedia gibbosa, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 341.

Mycedium gibbosum, Duchassaing & Michelotti, 1861, *op. supra cit.* p. 357.

Agaricia ? *gibbosa*, M.-Edwards & Haime, 1860, 'Hist. Nat. Cor.' t. iii. p. 84.

Mycedium Lessoni, Duchassaing & Michelotti, 1861, *op. cit.* p. 357; *id.* 1866, 'Suppl. etc.' Mém. R. Accad. Sci. Tor. sér. 2, t. xxiii. p. 186; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Mycedium vesparium, Duchassaing & Michelotti, 1861, *op. supra cit.* p. 357; *id.* 1866, *op. supra cit.* p. 186; Duchassaing, 1870, *op. supra cit.* p. 31.

Agaricia vesparium, Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xvi. p. 12.

Distribution. Recent: West Indies; North America and Bermuda; South America. *Fossil:* Barbados: Low-level Reefs. San Domingo: Nivajé Shale. Guadeloupe: Older or White Limestone.

Notes on Synonymy.—The *M. Lessoni* is a specimen with crowded collines. The decision to merge the species *A. undata* with *A. agaricites* seems at first of very doubtful value. The two types of calicular structure appear very distinct. A specimen from the Franks Collection (B.M. R 2482) has, however, both types on different sides of the coral; the two areas are of corresponding age and appear to have grown under the same conditions. The striking difference in appearance is therefore remarkable. Pl. XI. fig. 7 *a* shows a part of the coral with the characters of the typical *Agaricia agaricites*, and fig. 7 *b* shows a part which, if found separately, would have been referred to *A. undata*. This specimen not only unites the two species, but shows that the distinctions between the two genera *Agaricia* and *Mycedium* are valueless; for the one side of the specimen is an *Agaricia* and the other a *Mycedium*.

Species 2. AGARICIA ELEPHANTOTUS (Pallas), 1766.

Synonymy:—

Madrepora elephantotus, Pallas, 1766, 'Elench. Zooph.' p. 290; Esper, 1789, 'Pflanzenth.' Bd. i. pp. 126-128, pl. Madr. xviii.; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3759.

Mycedium elephantotus, Oken, 1815, 'Lehrb. Naturg.' Zool Bd. i. p. 69; M.-Edwards & Haime, 1851, 'Monogr. Fong.' Ann. Sci. Nat. Zool. sér. 3, t. xv. pp. 131-132; *id.* 1860, 'Hist. Nat. Cor.' t. iii. p. 74; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xxiii. p. 186; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Agaricia elephantotus, Schweigger, 1820, 'Handb. Naturg.' p. 415; Ehrenberg, 1834, 'Cor. roth. Meer.' Abb. k. Akad. Wiss. Berlin, 1832, p. 329.

Pavonia elephantotus, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. pp. 323-324.

Madrepora cucullata, Solander & Ellis, 1786, 'Nat. Hist. Zooph.' p. 157, pl. xlii. figs. 1, 2; Esper, 1795, 'Pflanzenh.' Fortsetz. Bd. i. p. 83, pl. Madr. lxvii.

Agaricia cucullata, Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 373; *id.* 1816, 'Hist. Anim. s. Vert.' t. ii. 242; Lamouroux, 1821, 'Exp. Méth.' p. 54, pl. xlii. figs. 1, 2; *id.* 1824, 'Encycl. Méth., 'Zooph.' p. 12, pl. 484; Blainville, 1834, 'Man. Act.' p. 360, pl. 56, fig. 3; Lamarck, 1836, 'Hist. Nat. Anim. s. Vert.' ed. 2, t. ii. p. 380.

Mycedium cucullatum, Oken, 1815, 'Lehrb. Naturg.' Zool. Bd. p. i. 69.

Mycedia cucullata, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 339.

Mycedia fragilis, Dana, 1848, *ibid.* p. 341.

Mycedium fragile, Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 55; Pourtales, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 82; (—a —is), Pourtales, 1880, 'Flor. Reefs,' Mem. Mus. Comp. Zool. vol. vii. pt. 1, pl. xi. figs. 1-10, pl. xiii. figs. 1-5, pl. xiv. figs. 1-9; Ortmann, 1888, 'Stud. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 181; *id.* 1890, 'Morph. Steinkor.' Zeitschr. wiss. Zool. Bd. i. p. 288.

Agaricia fragilis, Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xli. pp. 11, 12.

Mycedium Danai, Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mem. R. Acad. Sci. Tor. ser. 2, t. xix. p. 367; *id.* 'Suppl. Mém. Cor. Ant.' *ibid.* ser. 2, t. xxiii. p. 186; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 31.

Mycedium Sancti-Johannis, Duchassaing & Michelotti, 1866, *op. supra cit.* p. 187, pl. x, fig. 11; Duchassaing, 1870, *op. supra cit.* p. 31.

? *Mycedium Cailleti*, Duchassaing & Michelotti, 1866, *op. supra cit.* p. 187; Duchassaing, 1870, *op. supra cit.* p. 31; Pourtales, 1874, 'Hassler Corals,' Ill. Cat. Mus. Comp. Zool. no. viii. p. 44, pl. ix. fig. 12.

Agaricia frondosa, Duchassaing & Michelotti, 1866, *op. supra cit.* pl. x. figs. 5, 6; Duchassaing, 1870, *op. supra cit.* pp. 31-32; Quelch, 1886, 'Reef Corals,' p. 118.

Distribution. Recent: West Indies; Abrolhos Banks, Brazil; Florida. *Fossil*: Barbados: Low-level Reefs, near Bridgetown (Coll. Bishop Mitchinson & Franks); San Domingo, Nivajé Shale; Guadeloupe, Older Reefs.

Notes on Synonymy.—This species is the most typical of the genus *Mycedium*; but, for reasons given in discussing the last species, the generic value of this form is regarded as quite inadmissible. The *M. cucullatum* has long been recognized as a synonym of the type-species. *M. fragile* and *M. Cailleti* appear to be both varieties based on specimens growing at a greater depth than the normal form.

Suborder PERFORATA.

Family MADREPORIDÆ.

Genus MADREPORA, Linn., 1767.

Subgenus EUMADREPORA, Brook, 1893.

Species MADREPORA MURICATA, Linn., 1767.

Distribution. Recent: West Indies, Vera Cruz, Florida; Australia; Pacific. *Fossil*: Barbados: Low-level Reefs, Two Mile Hill, St. Michael's; near Bridgetown; Ceres; Woodstock; High-level Reefs, Welsh Town Gully (600 feet); Guadeloupe, Newer Reefs.

Notes on Synonymy.—This species was founded by Linnæus for the recent West Indian form. Its great variability was soon noticed,

but the earliest workers on the group did not perceive the necessity of subdividing it. This was done by Lamarck in 1816: he founded three species, *M. cervicornis*, *M. palmata*, and *M. prolifera*. These have been adopted by all later authors. In 1890 Heilprin and Ives¹ first suggested that the several species were probably only one. Brook in 1893 went back to the pre-Lamarckian view and merged the three best-known names of recent corals in Linnæus's original name. The examination of the collection sent by Mr. Franks from Barbados had led me previously to conclude that this course would have to be adopted. Brook has given the detailed synonymy with care,² and there is no need to repeat it. Duchassaing & Michelotti's type of *M. ethica* is in Turin, and is clearly only a young encrusting form of the variety *prolifera*. The types of *M. cornuta* and *M. Thomasiana* of the same authors could not be found in Turin, but the descriptions given suggest that one may safely follow Brook in reducing them to synonyms.

In regard to the recent distribution of the species, it is to be noted that Brook has recently widened it by identifying as this some specimens from Singapore, Australia, Tahiti, and Thursday Island. I have examined most of these and cannot see any point by which they could be separated from the West Indian species. In such a genus as *Madrepora* it appears, however, probable that the Pacific and Malaysian species has been developed independently. Phylogenetically it probably ought not to be included in the West Indian species, though the two are now indistinguishable one from the other.

Family PORITIDÆ.

Genus PORITES, Lamarck, 1816.

Species 1. PORITES CLAVARIA, Lamarck, 1816.

Synonymy :—

Madrepora porites, Pallas, 1766, 'Elench. Zooph.' pp. 324-326; Linnæus, 1767, 'Syst. Nat.' ed. xii. p. 1279; Ellis & Solander, 1786, 'Nat. Hist. Zooph.' p. 172, pl. xlvii. figs. 1, 2; Esper, 1789, 'Pflanzenh.' Bd. i. pp. 135-139, pl. Madrep. xxi., xxi. a; Gmelin, 1790, 'Syst. Nat.' ed. xiii. p. 3774; Lamarck, 1801, 'Syst. Anim. s. Vert.' p. 371; Schweigger, 1820, 'Handb. Naturg.' p. 413.

Porites clavaría, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 270; Lesueur, 1820, 'Polyp. Lamell.' Mém. Mus. Hist. Nat. t. vi. pp. 289-290, pl. xvii. fig. 17; Lamouroux, 1821, 'Exp. Méth.' p. 61, pl. xlvii. figs. 1, 2; Deslongchamps, 1824, Encyl. Méth., 'Zooph.' p. 652; Blainville, 1826, Dict. Sci. Nat. t. xliii. p. 50; *id.* 1830, *ibid.* t. ix. p. 361; *id.* 1834, 'Man. Act.' p. 396.

Porites clavaría, var. γ, Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 341.

Porites clavaría, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' vol. viii. p. 554; Duchassaing, 1850, 'Anim. rad. Ant.' p. 17; M.-Edwards & Haime, 1851, 'Monogr. Porit.' Ann. Sci. Nat. Zool. sér. 3, t. xvi. p. 26; *id.* 1860, 'Hist. Nat. Cor.' t. iii. p. 174; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' Mém. R. Accad. Sci. Tor. ser. 2, t. xix. p. 358; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 42; Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mém. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 189; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 32; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 84; Lindström, 1877, 'Act. Atl.' Handl. k. Svensk. Vet.-Akad. Bd. xiv. no. 6, p. 24; Pourtalès, 1880, 'Flor. Reefs,' Mém.

¹ Proc. Acad. Nat. Sci. Phil. 1890, p. 304.

² G. Brook, 'Catalogue of the Madreporarian Corals in the British Museum, vol. i. 'The Genus *Madrepora*,' 1893, pp. 23-25.

Mus. Comp. Zool. vol. vii. pt. 1, pl. xii. figs. 4-6; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. p. 179; Rathbun, 1898, 'Cat. Porites,' Proc. U.S. Nat. Mus. vol. x. (1887) pp. 356-361, pl. xvii., pl. xvii. fig. 2, pl. xviii., pl. xix. fig. 1; Rehberg, 1892, 'Abh. Geb. Nat.' Nat. Ver. Hamburg, Bd. xii. pt. i. p. 47.

Porites flexuosa, Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 554, pl. liii. fig. 6; M.-Edwards & Haime, 1851, 'Monogr. Porites,' p. 31; *iid.* 1860, 'Hist. Nat. Cor.' t. iii. p. 176; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 358; *iid.* 1866, 'Suppl. etc.' p. 191; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 32.

Porites flabelliformis, Lesueur, 1820, 'Polyp. Lamell.' Mém. Mus. Hist. Nat. t. vi. p. 289; Deslongchamps, 1824, Encycl. Méth., 'Zooph.' p. 652; M.-Edwards & Haime, 1851, *op. supra cit.* p. 31; *iid.* 1860, *op. supra cit.* t. iii. p. 178; Duchassaing & Michelotti, 1866, *op. supra cit.* p. 190; Duchassaing, 1870, *op. supra cit.* p. 32.

Porites Solanderi, Duchassaing & Michelotti, 1861, *op. supra cit.* p. 359; *iid.* 1866, *op. supra cit.* p. 189; Duchassaing, 1870, *op. supra cit.* p. 32; Quelch, 1886, 'Reef Corals,' p. 13.

Porites Plumieri, Duchassaing & Michelotti, 1866, *op. supra cit.* p. 190, pl. x. fig. 14; Duchassaing, 1870, *op. supra cit.* p. 32; Quelch, 1886, *op. supra cit.* p. 13.

Porites macrocephala, Duchassaing & Michelotti, 1866, *op. supra cit.* p. 189, pl. x. fig. 15; Duchassaing, 1870, *op. supra cit.* p. 32.

Porites conglomerata (pars), Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 269; *id.* 1836, *ibid.* ed. 2, t. ii. p. 434.

Porites furcata, Lamarck, 1816, *op. supra cit.* t. ii. p. 271; Deslongchamps, 1824, Encycl. Méth., 'Zooph.' p. 653; Blainville, 1826, Dict. Sci. Nat. t. xliii. p. 51; Lamarck, 1836, *op. supra cit.* ed. 2, t. ii. p. 437; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 555; M.-Edwards, 1849, 'Règne Animal, Zoophytes,' Atlas, pl. 84 bis; *id.* & Haime, 1851, 'Monogr. Porites,' p. 25, pl. i. figs. 1-1^c; *iid.* 1851, 'Polyp. Paléoz.' Arch. Hist. Nat. t. v. p. 143; *iid.* 1860, 'Hist. Nat. Cor.' t. iii. p. 174; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 358; Verrill, 1864, 'List of Corals,' p. 42; Duchassaing & Michelotti, 1866, 'Suppl. etc.' p. 189; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 32; Pourtales, 1871, Ill. Cat. Mus. Comp. Zool. no. iv. p. 85; *id.* 1880, 'Flor. Reefs,' Mém. Mus. Comp. Zool. vol. vii. pt. 1, pl. xii. fig. 7, pl. xvi. figs. 13-20; Quelch, 1886, 'Reef Corals,' p. 13; Rathbun, 1898, 'Cat. Porites,' pp. 361-364, pl. xv., pl. xvii. fig. 1; Ortmann, 1888, 'Syst. Verbr. Steinkor.' Zool. Jahrb. Bd. iii. Syst. p. 157; Heilprin, 1890, 'Corals W. Gulf Mexico,' Proc. Acad. Nat. Sci. Phil. 1890, p. 305.

Heliopora furcata, Blainville, 1830, Dict. Sci. Nat. t. lx. p. 357; *id.* 1834, 'Man. Act.' p. 392.

Porites divaricata, Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. p. 288; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 556; M.-Edwards & Haime, 1851, 'Monogr. Porit.' Ann. Sci. Nat. Zool. sér. 2, t. xvi. p. 30; *iid.* 1860, 'Hist. Nat. Cor.' t. iii. p. 178; Duchassaing & Michelotti, 1861, 'Mém. Cor. Ant.' p. 358; *iid.* 1866, 'Suppl. etc.' p. 191; Duchassaing, 1870, 'Rev. Zooph. Ant.' p. 32.

Porites recta, Lesueur, 1820, *op. supra cit.* p. 288, pl. xvii. fig. 16; Deslongchamps, 1824, Encycl. Méth., 'Zooph.' p. 651; Dana, 1848, 'Zooph. Explor. Exped. Wilkes,' p. 556.

Distribution. Recent: West Indies: Bermudas; Bahamas; Florida; Vera Cruz; Red Sea & Indian seas. *Fossil*: Barbados: Low-level Reefs near Bridgetown (Franks & Mitchinson Coll.).

Notes on Synonymy.—According to the British Association rule that the same word is not to be used as the generic and specific names of the same animal, this species cannot be called *Porites porites* (Linn.). The specific name has therefore to be dropped, and the next one taken. *P. clavaria* and *P. furcata* were proposed at the same time, but, as *P. clavaria* comes first and has been generally regarded as the most typical, it is best to accept that.

There has been an universal consensus of opinion since the days of Lamarck that *P. clavaria* and *P. furcata* are distinct. Nevertheless, I cannot but feel that it is necessary to merge them. Their distinction has been based on three characters: firstly, the height of the epitheca; secondly, the shape of the ends of the branches; thirdly, the structure of the calices. There is a fine series of specimens of both forms in the Museum of Comparative Zoology at Cambridge, Mass., many of which were labelled by Pourtales. An examination of these shows that the three characters are each of them

useless. Thus in the case of the epitheca, in a specimen labelled *P. furcata* which is 134 mm. high, in one branch the epitheca runs up to within 29 mm. of the top on one side, while on the other it ends off 62 mm. from the same point. The shape of the ends of the branches appears at first sight more distinctive, and it is by this character that the specimens have been generally determined; but in a large branching specimen at Cambridge the variation in the compression of the branches varies as follows:—

$$\begin{array}{l} \text{Longer diameter} = \frac{9}{15}, \frac{8}{15}, \frac{6}{13}, \frac{7}{7.5}, \frac{8}{13}, \frac{8}{10}. \\ \text{Wider diameter} \end{array}$$

The third of these shows the compression of *P. furcata*, but the fourth is practically circular in section. This one specimen has typical representatives of both the supposed species.

The last character is the supposed absence of a tubercular columella in *P. furcata* and its presence in *P. clavaria*. But there are specimens at Cambridge, Mass., labelled *P. furcata*, with a well-marked columella. In some the columella can be seen in the older parts of the colony, while it is absent in the newer calices. If this character be of any use, then Pourtalès and Quelch have reversed the correct names of the species. Rathbun had previously remarked that the calicinal characters are useless, though he keeps the species distinct: he says that Pourtalès's figures of the calicinal structures of *clavaria* and *furcata* in the 'Mém. on the Florida Reefs' (pl. xvi. fig. 14, & pl. xii. fig. 5) would do indifferently for either species. There seems, therefore, no valid distinction between them. In one large mass labelled *P. furcata* by Pourtalès, in some calices there is no trace of a columella, and a circle of pali surround a central space; in others there is a small columella; in yet others there is a columella as large as one of the pali.

Species 2. PORITES ASTRÆOIDES, Lamarck, 1816.

Synonymy:—

Porites astræoides, Lamarck, 1816, 'Hist. Nat. Anim. s. Vert.' t. ii. p. 269; Lesueur, 1820, 'Polyp. Lam.' Mém. Mus. Hist. Nat. t. vi. p. 287, pl. xvi. fig. 15; Blainville, 1834, 'Man. Act.' p. 395, pl. lxi. fig. 5; Ehrenberg, 1834, 'Cor. roth. Meer.' Abh. k. Akad. Wiss. Berlin, 1832, p. 343; Lamarck, 1836, *op. cit.* ed. 2, t. ii. p. 435; Dana, 1848, 'Zooth. Explor. Exped. Wilkes,' vol. viii. p. 561; Duchassaing, 1850, 'Anim. rad. Ant.' p. 17; M.-Edwards & Haime, 1860, 'Hist. Nat. Cor.' t. iii. p. 178; Verrill, 1864, 'List of Corals,' Bull. Mus. Comp. Zool. vol. i. p. 42; Duncan, 1868, 'Foss. Cor. W. Ind.' Quart. Journ. Geol. Soc. vol. xxiv. p. 12; Pourtalès, 1871, 'Deep-Sea Corals,' Ill. Cat. Mus. Comp. Zool. no. iv. p. 85; *id.* 1880, 'Flor. Reefs,' Mém. Mus. Comp. Zool. vol. vii. pt. i. pl. xvi. figs. 1-12, 21-22; Quelch, 1886, 'Reef Corals,' Zool. 'Chall.' Exped. pt. xlv. pp. 11, 13, 182; Rathbun, 1888, 'Cat. Species *Porites* U.S. Nat. Mus.' Proc. U.S. Nat. Mus. vol. x. (1887) pp. 354-355; Heilprin, 1890, 'Cor. W. Gulf Mex.' Proc. Acad. Nat. Sci. Phil. 1890, p. 305.

Neoporites astræoides, Duchassaing & Michelotti, 1866, 'Suppl. Mém. Cor. Ant.' Mém. R. Accad. Sci. Tor. ser. 2, t. xxiii. p. 192; Duchassaing, 1870, 'Rev. Zooth. Ant.' p. 32.

Neoporites incerta, Duchassaing & Michelotti, 1866, 'Suppl. etc.' p. 193; Duchassaing, 1870, 'Rev. Zooth. Ant.' p. 32.

Porites Collegniana (non Michelin), Duncan, 1863, 'Foss. Cor. W. Ind.' pt. i., Quart. Journ. Geol. Soc. vol. xix. p. 437.

Distribution. Recent: West Indies; Florida; Vera Cruz. *Fossil:* Barbados: Low-level Reefs near Bridgetown; High-level Reefs, Castle Grant (1070 feet); Trinidad, St. Croix; San Domingo, Nivajé Shale.

TABLE OF DISTRIBUTION OF CORALS.

	PERCENT.				ROCKS.						
	Atlantic Coasts.		Indo-Pacific.	Barbados.		San Domingo.		Anti-guan Marl.	Guadeloupe.		Miscellaneous.
	West Indies.	N. Amer. & Bermuda.		Low Level.	High Level.	Tri-natal.	Tufa-ceous Limest.		Newer Keels.	Older or White Limest.	
1. <i>Madracis decussata</i> (Linn.)	*	*	...	*	...	*	...	...	...	...	*
2. <i>Lithophyllia cubensis</i> (Ed. & H.) ..	*	*	...	*	...	...	...	...	...	...	Jamaica.
3. " <i>lacera</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
4. " <i>Walli</i> (Dunc.)	...	...	...	*	...	...	...	...	...	...	Jamaica.
5. <i>Eusmilia fastigiata</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
6. " <i>Knorr</i> , Ed. & H.	*	*	...	*	...	...	...	...	...	...	Jamaica.
7. <i>Massa angulosa</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
8. <i>Dendrogyra cylindrus</i> , Ehr.	*	*	...	*	...	...	...	...	...	...	Jamaica.
9. <i>Pectinia melanorhiza</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
10. <i>Diploria cervicornis</i> (Linn.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
11. <i>Manicina areolata</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
12. <i>Meandrina floerena</i> (Esper)	*	*	...	*	...	...	...	...	...	...	Jamaica.
13. <i>Mycetophyllia lanarcti</i> , Ed. & H.	*	*	...	*	...	...	...	...	...	...	Jamaica.
14. <i>Cyphophyllia quiposa</i> (Bill. & Sol.) ..	*	*	...	*	...	...	...	...	...	...	Jamaica.
15. <i>Hydnophora latifundata</i> , n. sp.	...	...	...	*	...	...	...	...	...	...	Jamaica.
16. <i>Dehocenia Stokesi</i> , Ed. & H.	*	*	...	*	...	...	...	...	...	...	Jamaica.
17. <i>Lamellastera Smythi</i> , Dunc.	*	*	...	*	...	...	...	...	...	...	Jamaica.
18. <i>Favia unguis</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
19. <i>Orbicella rodida</i> (Bill. & Sol.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
20. " <i>aeropora</i> (Linn.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
21. <i>Solenastrea stellata</i> , (Bill. & Sol.) ...	*	*	...	*	...	...	...	...	...	...	Jamaica.
22. <i>Cyphastrea costata</i> , Dunc.	*	*	...	*	...	...	...	...	...	...	Jamaica.
23. <i>Echinopora Frankesi</i> , n. sp.	?	...	...	*	...	...	...	...	...	...	Jamaica.
24. <i>Stephanocenia interspersa</i> (Esper) ..	*	*	...	*	...	...	...	...	...	...	Jamaica.
25. <i>Astræa radicans</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
26. " <i>sideræa</i> (Bill. & Sol.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
27. <i>Agaricia agaricites</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
28. " <i>elephantinus</i> (Pall.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
29. <i>Madrepora muricata</i> (Linn.)	*	*	...	*	...	...	...	...	...	...	Jamaica.
30. <i>Porites clavaria</i> , Linn.	*	*	...	*	...	...	...	...	...	...	Jamaica.
31. " <i>astræoides</i> , Linn.	*	*	...	*	...	...	...	...	...	...	Jamaica.

III. LIST OF MOLLUSCA FROM THE LOW-LEVEL REEFS OF BARBADOS.

In consideration of the differences between the corals of the raised reefs of Barbados and those still living in adjoining seas, it seemed advisable to examine the fossil mollusca. Mr. Jukes-Browne made a collection for this purpose from some reefs at Ceres, at the height of about 70 feet above the sea; a list of these was published in 1891.¹ The collection, however, was a comparatively small one, numbering only twenty-seven species. Since then the opportunity for a careful comparison between the recent and fossil molluscan faunas has been afforded by the kindness of the Rt. Rev. Bishop Mitchinson, who, during his residence in Barbados, made a large collection of shells from the raised reefs near Bridgetown. This collection, numbering over 1000 specimens belonging to over 140 species, he has generously presented to the British Museum (Nat. Hist.). That it has been possible to work out the collection is due to the kindness of Mr. E. A. Smith; he has himself named most of the species and checked every doubtful determination, often by comparison with D'Orbigny's types, which are now preserved in the Zoological Department of the Museum. For the amount of trouble which Mr. Smith has taken in this work I must express to him my best thanks.

The list is arranged in accordance with the classification adopted in Fischer's 'Manuel de Conchologie.' Many of the names are probably not of specific value; they have been given only to West Indian varieties of more widely distributed species. As the list is, however, mainly useful for the study of distribution, these slight differences are of value. The distribution is taken in the main from the works of Paetel and E. A. Smith. In deference to the opinion of the latter, Tryon's localities and some mistaken records in Paetel have been omitted.

A list of 53 species was published by Sir R. Schomburgk,² but the exact horizons from which these came are not stated.

¹ A. J. Jukes-Browne & J. B. Harrison, 'The Coral Rocks of Barbados and other West Indian Islands,' Quart. Journ. Geol. Soc. vol. xlvii. (1891) p. 225.

² R. H. Schomburgk, 'History of Barbados,' 1847, pp. 562-565.

Name.	Author of Species.	Fossil:		Recent.											
		Barba- dos.		Bridgetown.	Ceres.	West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
Class PTEROPODA.															
<i>Cavolinia longirostris</i>	Lesueur	—	...	—	—	—	—	—	—	—	—	—	—	—	
Class GASTROPODA.															
Order 1. PULMONATA.															
Fam. AURICULIDÆ.															
<i>Melampus flavus</i>	Gmel.	—	...	—	—	—	—	—	—	—	—	—	—	—	
" " var.		—	...	—	—	—	—	—	—	—	—	—	—	—	
Order 2. OPISTHOBRANCHIATA.															
Fam. BULLIDÆ.															
<i>Bulla striata</i>	Brug.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" <i>solida</i> (non Gmel.)	A. Ad.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Order 3. PROSOBRANCHIATA.															
A. TOXOGLOSSA.															
Fam. CONIDÆ.															
<i>Conus (Chelyconus) pygmaeus</i>	Reeve	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Stephanoconus</i>) <i>Ximenes</i>	Gray	—	—	—	—	—	—	—	—	—	—	—	—	—	
" { } <i>verrucosus</i> ..	Hwass.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" { } <i>nebulosus</i> ..	Sol.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Hermes</i>) <i>granulatus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Pleurotoma (Crassispira) fuscescens</i> ..	Gray	—	—	—	—	—	—	—	—	—	—	—	—	—	
" " <i>quadri-</i>		—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>fasciata</i>	" 	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. CANCELLARIIDÆ.															
<i>Cancellaria reticulata</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
B. RHACHIGLOSSA.															
Fam. OLIVIDÆ.															
<i>Oliva (Strophona) litterata</i>	Lam.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Olivella</i>) <i>jaspidea</i>	Gmel.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. MARGINELLIDÆ.															
<i>Volvaria avena</i>	Val.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. VOLUTIDÆ.															
<i>Voluta musica</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	

TABLE (continued).

Name.	Author of Species.	FOSSIL:		RECENT.									
		Barba- dos.		West Indiae.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
		Bridgetown.	Ceres.										
Fam. FASCIOLARIIDÆ.													
<i>Latirus spadiceus</i>	Reeve	—	..	—	—	—	—	—	—	—	—	—	—
<i>Leucozonia cingulifera</i>	Lam.	—	..	—	—	—	—	—	—	—	—	—	—
" " var. <i>angularis</i>	Reeve	—	—	—	—	—	—	—	—	—	—	—	—
Fam. TURBINELLIDÆ.													
<i>Vasum caesium</i>	Brod.	—	..	—	—	—	—	—	—	—	—	—	—
<i>Pyrula (Melongena) melongena</i>	Linn.	—	..	—	—	—	—	—	—	—	—	—	—
Fam. BUCCINIDÆ.													
<i>Polia (Tritonidea) coromandeliana</i> ..	Lam.	—	..	—	—	—	—	—	—	—	—	—	—
<i>Pisania pusio</i>	Linn.	—	..	—	—	—	—	—	—	—	—	—	—
<i>Phos (Strongylocera) pallida</i>	Powis	—	..	—	—	—	—	—	—	—	—	—	—
Fam. NASSIDÆ.													
<i>Nassa (Phrontes) ambigua</i>	Mont.	—	..	—	—	—	—	—	—	—	—	—	—
" " <i>vibex</i>	Say	—	..	—	—	—	—	—	—	—	—	—	—
Fam. COLUMBELLIDÆ.													
<i>Columbella (Pygmaea) mercatoria</i> ...	Linn.	—	—	—	—	—	—	—	—	—	—	—	—
" (<i>Engina</i>) <i>turbinella</i>	Kiener	—	..	—	—	—	—	—	—	—	—	—	—
" (<i>Conidea</i>) <i>ovuloides</i>	C. B. Ad. ...	—	..	—	—	—	—	—	—	—	—	—	—
Fam. MURICIDÆ.													
<i>Murex Toupiollei</i>	Born	—	..	—	—	—	—	—	—	—	—	—	—
" (<i>Haustellum</i>) <i>messorius</i>	Sow.	—	—	—	—	—	—	—	—	—	—	—	—
<i>Purpura (Thalessa) approx. speciosa</i> ..	Val.	—	..	—	—	—	—	—	—	—	—	—	—
" " (<i>Stramonita</i>) <i>fasciata</i>	Reeve	—	..	—	—	—	—	—	—	—	—	—	—
<i>Ricinuia (Sistrum) nodulosa</i>	C. B. Ad. ...	—	—	—	—	—	—	—	—	—	—	—	—
Fam. CORALLIOPHILIDÆ.													
<i>Coralliophila costata</i>	Blainv.	—	..	—	—	—	—	—	—	—	—	—	—
" <i>abbreviata</i>	Lam.	—	..	—	—	—	—	—	—	—	—	—	—
" <i>nivea</i>	C. B. Ad. ...	—	..	—	—	—	—	—	—	—	—	—	—
C. TENIOGLOSSA.													
Fam. TRITONIDÆ.													
<i>Triton Tritonis</i>	Linn.	—	..	—	—	—	—	—	—	—	—	—	—
" (<i>Simpulum</i>) <i>pilearis</i>	Linn.	—	..	—	—	—	—	—	—	—	—	—	—
" (<i>Colubraria</i>) <i>testaceus</i>	Mörch	—	..	—	—	—	—	—	—	—	—	—	—
" (<i>Lotorium</i>) <i>Antillarum</i>	D'Orb.	—	..	—	—	—	—	—	—	—	—	—	—
<i>Ranella (Lampas) Thome</i>	"	—	..	—	—	—	—	—	—	—	—	—	—
" " aff. <i>affinis</i>	Brod.	—	..	—	—	—	—	—	—	—	—	—	—

TABLE (continued).

Name.	Author of Species.	FOSSIL:		RECENT.											
		Barba- dos.		Bridgetown.	Ceres.	West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
Fam. CASSIDÆ.															
<i>Cassid (Cassidea) testiculus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ (<i>Semicassid</i>) <i>undulata</i> [<i>granulosa</i> , Brug.]	Gmel.	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Oniscia (Oniscidea) oniscus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. DOLIIDÆ.															
<i>Dolium perdix</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. CYPREIDÆ.															
<i>Cypræa cinerea</i>	Gmel.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ „ var. <i>clara</i>	Gask.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ <i>exanthema</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ (<i>Luponia</i>) <i>spurca</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Trivia vitrea</i>	Gask.	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Cyphoma (Urtinus) gibbosa</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ „ <i>intermedia</i>	Sow.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. STROMBIDÆ.															
<i>Strombus gigas</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ <i>pugilis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ (<i>Monodactylus</i>) <i>bituberculatus</i> [<i>lobatus</i> , Sow.]	Lam.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. CERITHIIDÆ.															
<i>Cerithium atratum</i>	Born	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ <i>litteratum</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
„ <i>eburneum</i>	Brug.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. MODULIDÆ.															
<i>Modulus (Modulus) lenticularis</i>	Chemn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. PLANAXIDÆ.															
<i>Planaxis succinctus</i>	A. Ad.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. LITTORINIDÆ.															
<i>Littorina (Melaraphe) ahenea</i>	Reeve	—	—	—	—	—	—	—	—	—	—	—	—	—	
<i>Tectarius muricatus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. SOLARIIDÆ.															
<i>Solarium (Torinia) cyclostomum</i>	Menke	—	—	—	—	—	—	—	—	—	—	—	—	—	
Fam. LITROPIDÆ.															
<i>Alaba tervaricosa</i>	C. B. Ad.	—	—	—	—	—	—	—	—	—	—	—	—	—	

TABLE (continued)

Name.	Author of Species.	FOSSIL:		RECENT.									
		Barba- dos.		West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
		Bridgetown.	Ceres.										
Fam. RISSOIDÆ.													
<i>Rissoina sagraiana</i>	D'Orb.	—	...	—									
Fam. HIPPONIDÆ.													
<i>Hipponyx antiquatus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—
<i>Calyptræa (Mitrularia) Dillwyni</i> ...	Gray	—	...	—	—	—	—	—	—	—	—	—	—
Fam. CAPULIDÆ.													
<i>Pileopsis (Capulus) intortus</i>	Meusch.	—	...	—	—	—	—	—	—	—	—	—	—
<i>Crepidula (Crepipatella) aculeata</i> ...	Gmel.	—	...	—	—	—	—	—	—	—	—	—	—
Fam. NATICIDÆ.													
<i>Natica marochiensis</i>	Gmel.	—	—	—	—	—	—	—	—	—	—	—	—
" (<i>Pollinices</i>) <i>uberina</i> ¹	D'Orb.	—	...	—	—	—	—	—	—	—	—	—	—
" " <i>porcellanea</i>	"	—	—	—	—	—	—	—	—	—	—	—	—
Fam. PYRAMIDELLIDÆ.													
<i>Obeliscus dolabratus</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—
D. RHIPIDIGLOSSA.													
Fam. NERITIDÆ.													
<i>Nerita (Peloronta) peloronta</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	—
" " <i>tessellata</i>	Gmel.	—	...	—	—	—	—	—	—	—	—	—	—
Fam. TURBINIDÆ.													
<i>Pachypoma (Astraliun) imbricata</i> ...	Gmel.	—	...	—	—	—	—	—	—	—	—	—	—
Fam. TROCHIDÆ.													
<i>Livona pica</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	—
Fam. FISSURELLIDÆ.													
<i>Fissurella (Crenides) barbadensis</i> ...	Gmel.	—	...	—	—	—	—	—	—	—	—	—	—
<i>Lucapina græca</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	—
" " var. <i>Listeri</i>	D'Orb.	—	...	—	—	—	—	—	—	—	—	—	—
" <i>cancellata</i>	{ Sow. (Sol. } MS.) ... }	—	...	—	—	—	—	—	—	—	—	—	—
<i>Emarginula imbricata</i>	A. Ad.	—	...	—	—	—	—	—	—	—	—	—	—

¹ The specimen is the *P. uberina* as usually interpreted; D'Orbigny's type-specimen, however, has not an especially straight callosity.

TABLE (continued).

Name.	Author of Species.	FOSSIL: Barba- dos.		RECENT.									
		Bridgetown.	Ceres.	West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
Class													
LAMELLIBRANCHIATA.													
Order 1. TETRABRANCHIA.													
Fam. OSTREIDÆ.													
<i>Ostrea canadensis</i>	Lam.	—	...	—	—	—	—	—	—	—	—	—	
„ <i>frons</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	
Fam. SPONDYLIDÆ.													
<i>Spondylus ictericus</i>	Reeve	—	...	—	—	—	—	—	—	—	—	—	
„ <i>electrum?</i>	„	—	...	—	—	—	—	—	—	—	—	—	
<i>Plicatula cristata</i>	Lam.	—	...	—	—	—	—	—	—	—	—	—	
Fam. LIMIDÆ.													
<i>Lima multicostata</i>	Sow.	—	...	—	—	—	—	—	—	—	—	—	
<i>Ctenoides scabra</i>	Born	—	...	—	—	—	—	—	—	—	—	—	
Fam. PECTINIDÆ.													
<i>Pecten exasperatus</i>	Sow.	—	...	—	—	—	—	—	—	—	—	—	
„ <i>vestalis</i>	Reeve	—	...	—	—	—	—	—	—	—	—	—	
<i>Vola (Janira) modesta</i>	Reeve	—	...	—	—	—	—	—	—	—	—	—	
„ „ <i>ziczac</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	
Fam. MYTILIDÆ.													
<i>Mytilus exustus</i>	Linn.	—	...	—	—	—	—	—	—	—	—	—	
<i>Modiola cinnamomina</i>	Chem.	—	...	—	—	—	—	—	—	—	—	—	
<i>Lithodomus corrugatus</i>	Phil.	—	...	—	—	—	—	—	—	—	—	—	
Fam. ARCIDÆ.													
<i>Arca imbricata</i>	Brug.	—	...	—	—	—	—	—	—	—	—	—	
<i>Barbatia (Acar) Adamsi</i>	Shuttl.	—	...	—	—	—	—	—	—	—	—	—	
„ „ <i>domingensis</i> [squa- mosa, Linn.]	Lam.	—	...	—	—	—	—	—	—	—	—	—	
„ <i>candida</i>	Chem.	—	...	—	—	—	—	—	—	—	—	—	
„ <i>fusca</i>	Brug.	—	...	—	—	—	—	—	—	—	—	—	
<i>Anomalocardia Deshayesi</i>	Hanl.	—	...	—	—	—	—	—	—	—	—	—	
<i>Pectunculus pectinatus</i>	Gmel.	—	...	—	—	—	—	—	—	—	—	—	
„ „ var. <i>pallium</i>	Reeve	—	...	—	—	—	—	—	—	—	—	—	
„ „ (<i>Arinæa</i>) <i>pennaceus</i>	Lam.	—	...	—	—	—	—	—	—	—	—	—	
var. <i>lineatus</i> „	Reeve	—	...	—	—	—	—	—	—	—	—	—	

TABLE (continued).

Name.	Author of Species.	Fossil:		Recent.									
		Bridgetown.	Barba- dos.	West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
Fam. CARDIIDÆ.													
<i>Cardium serratum</i>	Linn.	—	..	..	—								
" (<i>Bucardium</i>) <i>lima</i>	Gmel.	—	..	..	—								
<i>Ctenocardia</i> (<i>Fragum</i>) <i>medium</i>	Linn.	—	..	..	—								
" " aff. <i>graniferum</i>	Brod.	—	..	..	—							—	
Fam. CHAMIDÆ.													
<i>Chama macrophylla</i>	Chem.	—	..	..	—								
" <i>ruderalis</i>	Lam.	—	..	..	—								
Fam. CYPRINIDÆ.													
<i>Cypricardia coralliophaga</i>	Lam.	—	..	..	—								—
<i>Basterotia quadrata</i>	Hinds.	—	..	..	—								
Fam. VENERIDÆ.													
<i>Caryatis albidula</i>	Gmel.	—	..	..	—								
<i>Anatiss paphia</i>	Linn.	—	..	..	—								
<i>Chione multicostata</i>	Sow.	—	..	..	—								
" <i>cerina</i>	C. B. Ad. ...	—	..	..	—								
" (<i>Ventricola</i>) <i>rugosa</i>	Gmel.	—	..	..	—								
" (<i>Omphalocladrum</i>) <i>cancellata</i>	Linn.	—	..	..	—								
<i>Venerupis iris</i>	Linn.	—	..	..	—								
Fam. PETRICOLIDÆ.													
<i>Choristodon lapidum</i>	Chem.	—	..	..	—								
Fam. UNGULINIDÆ.													
<i>Diplodonta rotundata</i> (var. <i>subglobosa</i>)	Mont.	—	..	..	—								
Fam. PSAMMOBIIDÆ.													
<i>Asaphis defloratus</i>	Linn.	—	..	..	—								
" <i>coccinea</i>	Mart.	—	..	..	—								
Order 2. DIBRANCHIA.													
Fam. LUCINIDÆ.													
<i>Lucina columbella</i>	Lam.	—	..	..	—								
" <i>jamaicensis</i>	Lam.	—	..	..	—								
<i>Codakia exasperata</i>	Reeve.	—	..	..	—								
" <i>tigerina</i>	Linn.	—	..	..	—								
" (<i>Myrtea</i>) <i>imbricatula</i>	C. B. Ad. ...	—	..	..	—								
" <i>costata</i>	D'Orb.	—	..	..	—								
<i>Loripes chrysostomus</i>	Phl.	—	..	..	—								
<i>Divaricella dentata</i>	Wood	—	..	..	—								

TABLE (continued).

Name.	Author of Species.	Fossil:		Recent.											
		Barba- dos.		Bridgetown.	Ceres.	West Indies.	Atlantic coast of U.S.A.	St. Helena.	Canary Islands, Azores.	W. coast of Africa.	Mediterranean.	Brazil.	Panama.	Indo-Pacific.	
Fam. TELLINIDÆ.															
<i>Tellina (Musculus) radiata</i>	Linn.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" <i>brasiliiana</i>	Splgr.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Tellinella</i>) <i>decora</i>	Say	—	—	—	—	—	—	—	—	—	—	—	—	—	
" <i>interrupta</i>	Sol.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Peronæoderma</i>) <i>rubescens</i> ...	Hautl.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Arcopagia</i>) <i>fausta</i>	Pult.	—	—	—	—	—	—	—	—	—	—	—	—	—	
" (<i>Metis</i>) <i>ephippium</i>	Splgr.	—	—	—	—	—	—	—	—	—	—	—	—	—	

(Percentages of distribution have not been given: these can alone be use-
fully compiled by a specialist on the Mollusca, for the above species are
certainly not of equal value. The list is, however, conclusive as to the fauna
being practically identical with that of the present West Indian seas.)

IV. THE OCCURRENCE OF THE OCEANIC SERIES IN CUBA.

The fact that the Oceanic deposits were known only in Barbados,
and in a less typical form in Trinidad, to some extent detracted
from their significance. For, though Barbados is not itself a
volcanic island, it occurred near a great volcanic line, and thus great
local oscillations might easily have occurred. The absence of the
deep-sea deposits in the central West Indian Islands seemed to show
that their geographical range was but limited. The only known
bed approximating to this type in the central West Indies was the
Pteropod Marl of Jamaica, which, though clearly of deep-sea origin,
did not imply any such abyssal conditions as do the radiolarian
oozes.

I was, therefore, much interested when examining the collection
of coral rocks formed by Prof. Crosby in Cuba, and now preserved
in the Museum of the Boston Society of Natural History, to find
among them some specimens of radiolarian marls. The specimens
illustrated Prof. Crosby's well-known paper¹ on the raised reefs of
Cuba, but this contained no information as to the mode of occur-
rence of the marls. The author, however, kindly described to me
their position, which is at the base of the coral-rocks; the two
series seem to occur in exactly the same relative positions as the

¹ W. O. Crosby, 'On the elevated Coral Reefs of Cuba,' Proc. Boston Soc.
Nat. Hist. vol. xxii. (1883) pp. 124-130.

corresponding deposits in Barbados. Prof. Crosby, moreover, most generously gave me samples of the three principal varieties. Sections were subsequently prepared from these, and my guess as to their character was fully confirmed. They proved to be typical, pure oceanic oozes. This fact was announced in the discussion on Messrs. Jukes-Browne and Harrison's paper on Barbados.¹ At that time I had not succeeded in isolating the radiolaria so as to be able to identify the species. This, however, has now been kindly done by Mr. W. Murton Holmes, whose skill in mounting microscopic objects of this sort is well known. I must express to him my indebtedness for the time which he devoted to this task.

The accompanying list of radiolaria from these Cuban marls is very incomplete. It could easily be doubled by a more detailed examination of the slides. It is, however, sufficient for its purpose. All the species in the list are also found in Barbados. The common and conspicuous species are the same in both faunas. Some rarer forms have not apparently been recorded from Barbados, but every one agrees that the list of species from that island is still very imperfect. Until the Barbados fauna has been better worked out, the discovery of many species from Cuba, not recorded in it, would prove nothing.

The exact locality at which the Cuban radiolarian marls were collected is at Baraça, on the north side of the extreme eastern end of the island. Mr. R. T. Hill² has recently described the geology of this area. He describes a series of siliceous and argillaceous beds with radiolaria along the coast at Baraça, and says that they probably underlie the 'yellow beds';³ these latter contain many fossils, which enable him to identify them as Miocene. No doubt these siliceous beds are the radiolarian marls. Hill says that they are vertical and contorted, and are 500 feet in thickness. His description of the field-relations of these beds is not as detailed as one could wish, and leaves room for a little doubt as to their exact mode of occurrence. Mr. Hill's remark⁴ that there is no evidence of subsidence after the beginning of the Tertiary is also rather puzzling, unless it be a verbal misprint. Nevertheless it appears probable that the marls occur interstratified with Miocene limestones, and are in places overlain unconformably by the Pleistocene coral-reefs.

LIST OF THE RADIOLARIA.

The following list contains only a small proportion of the species in the collection. The 33 species determined are, however, sufficient to prove the practical identity of the faunas, for they belong to the five suborders Sphæroidea, Prunoidea, Discoidea, Spyroidea, and Cyrtioidea, and represent 17 families and 25 genera. The list there-

¹ Quart. Journ. Geol. Soc. vol. xlviii. (1892) p. 226.

² R. T. Hill, 'Notes on the Tertiary and later History of the Island of Cuba,' Amer. Journ. Sci. ser. 3, vol. xlviii. (1894) pp. 196-212.

³ *Ibid.* pp. 199-200.

⁴ *Ibid.* p. 210.

fore shows that the resemblance between the radiolarian faunas of Cuba and Barbados extends to a wide range of forms :

<i>Cerasosphaera entactinia</i> (Ehr.).	<i>Desmopyris anthocyrtoidea</i> (Bütschli).
<i>Stylosphaerella liostylus</i> , Ehr.	<i>Sphaerospyris sphaera</i> (Bütschli).
<i>Staurolonchiantha aperta</i> (Ehr.).	<i>Lychnocanissa hirundo</i> , Ehr.
<i>Haliometta oculatum</i> (Ehr.).	<i>Lychnocanoma crassipes</i> , Ehr.
<i>Xiphactractus spinulosum</i> (Ehr.).	<i>Anthocyrrella ventricosa</i> , Ehr.
<i>Xiphactractus radiosum</i> (Ehr.).	<i>Anthocyrtrissa grossularia</i> , Ehr.
" aff. <i>radiosum</i> (Ehr.).	<i>Podocyrtecium brevipes</i> , Ehr.
<i>Heliodiscella helianthus</i> (Ehr.).	<i>Podocyrteidium papale</i> , Ehr.
" <i>triactinus</i> ¹ (Ehr.).	" <i>mitra</i> , Ehr.
<i>Stylodictyon gracilis</i> , Ehr.	<i>Theopera luscina</i> (Ehr.).
" <i>multispina</i> , Haeck.	<i>Cyclampteryium spatiosum</i> , Ehr.
(syn. <i>Forbesi</i> , Ehr.).	<i>Clathrocyclia puella-sinensis</i> (Ehr.).
<i>Stylodictula setigera</i> , Ehr.	<i>Theocorypha cylindrica</i> (Ehr.).
<i>Stylospira echinastrium</i> , Ehr.	<i>Theocorythium persipeltis</i> (Ehr.).
<i>Stylotrichiscus rhabdostylus</i> (Ehr.).	<i>Cyrtostrobilus picus</i> (Ehr.).
<i>Petalospyrantha foveolata</i> , Ehr.	<i>Lithomitrella acephalum</i> (Ehr.).
<i>Lophospyris prox. echinus</i> , Ehr.	<i>Artocyrtris montiparum</i> (Ehr.).
<i>Gorgospyrium pentas</i> ² (Ehr.).	

V. ADDITIONS TO THE FOSSIL FAUNA OF ANTIGUA.

Two small but valuable collections from Antigua have recently been sent to me for examination. One consists of some mollusca and corals from the 'upper limestones' (of Purves); it has been forwarded by Mr. Jukes-Browne. The mollusca belong to the genera *Melanopsis* and *Turritella*. Mr. Edgar Smith has kindly examined these with great care, but is unable to identify them with any recent species. The best-preserved coral is a specimen of *Prionastrea diversiformis* (Mich.), a typical species of the Italian Miocene (Helvetian). It has been previously recorded from Antigua by M. Purves.³

I cannot name the other corals without more material for comparison from the Miocene of Piedmont.

The second collection was sent by J. Vincent Forrest, Esq., M.B. It is of much interest, as it contains two of the echinoids which are most typical of the West Indian Oligocene. They are *Echinanthus* (or *Diplotheicanthus* of Duncan) *concavus* (Cott.)⁴ and *E. Antillarum* (Cott.).⁵ No echinoids had been previously recorded from the island. These are of great value, as establishing the correlation of the beds in which they occur with those of St. Bartholomew and Anguilla.

The coral described by Duncan as *Alveopora dedalea* is also

¹ Haeckel (Zool. 'Chall.' Exped. vol. xviii. pt. 1, 1887; Radiolaria, vol. i. p. 432) has renamed this species *tripodiscus*; as the reason for the change is not apparent, I retain the earlier one.

² Haeckel, *op. cit.* p. 1070, has renamed this species *Ehrenbergii*.

³ J. C. Purves, 'Equisse géologique de l'île d'Antigua,' Bull. Mus. Hist. Nat. Belg. vol. iii. (1884) p. 289.

⁴ G. Cotteau, 'Description des Echinides tertiaires des îles St. Barthélemy et Anguilla,' K. Svensk. Vet.-Akad. Handl. vol. xiii. no. 6 (1875), p. 16, pl. ii. figs. 4-8.

⁵ *Ibid.* p. 15, pl. ii. figs. 1-3.

represented in the collection. There is moreover a *Lithophyllia cubensis* (M.-Ed. & H.); it is said to be derived from some recent raised reefs, but the exact locality is not stated.

These two collections conclusively prove that the Antigua series of cherts and limestones are neither Pleistocene nor Pliocene, as has recently been suggested. They are certainly either Oligocene or Miocene—probably the former.

VI. THE CORRELATION OF THE BARBADOS ROCKS AND ITS BEARING ON THE HISTORY OF THE CARIBBEAN AREA.

The Barbados Sequence.—The island of Barbados is composed of a series of rocks which may be classified as follows:—

Raised Coral Reefs.	{ Low-level Reefs.
	{ High " "
Oceanic Series.	{ <i>Archæopneustes abruptus</i> -Limestone.
Scotland Beds.	{ Thalassic Marls.

That these occur in the above sequence there can be now no doubt, thanks to the labours of Messrs. Jukes-Browne and Harrison¹ and Col. H. W. Feilden²; but in the first geological map and description of the island,³ the rocks now known as the Oceanic Series were said to overlie the coral-limestones, while Schomburgk⁴ described the deep-sea marls as interstratified with the Scotland Beds.

The Age of the Coral-Limestones.—The Low-level Reefs yield a rich molluscan fauna (see Part III. of this paper), which proves that these are of late Pleistocene age. The determination of the date of the other divisions of the sequence is a difficult task. Let us in the first place consider the correlation of the High-level Reefs. These are stratigraphically continuous with those of the lower levels, and it might at first sight appear unnecessary to separate them. There are, however, distinct differences in the fauna. Of the 31 species of corals found in the raised reefs of Barbados, 4 species and 3 genera are not known to occur at the present time in the West Indian seas. Nine of the recent species are recorded from the Nivajé Shale of San Domingo, which is assigned by Gabb⁵ to the Middle Miocene. This would therefore appear to suggest that the corals have so long a

¹ J. B. Harrison and A. J. Jukes-Browne, 'The Geology of Barbados, being an Explanation of the Geological Map,' etc. (1890), 8vo. 64 pp. and map; also 'The Geology of Barbados.—Part I. The Coral-Rocks of Barbados and other West Indian Islands,' Quart. Journ. Geol. Soc. vol. xlvii. (1891) pp. 197-250, and 'Pt. II. The Oceanic Deposits,' *ibid.* vol. xlviii. (1892) pp. 170-226.

² H. W. Feilden, 'On the Birds of Barbados,' *Ibis*, ser. 6, vol. i. (1889) pp. 478-479.

³ Jas. Dutt. Maycock, 'Flora Barbadosensis . . . to which is prefixed a Geological Description of the Island,' London, 1830, pp. 15-17, pls. i., ii.

⁴ R. H. Schomburgk, 'The History of Barbados,' 1847, pp. 546-557.

⁵ W. M. Gabb, 'On the Topography and Geology of Santo Domingo,' Trans. Amer. Phil. Soc. new ser. vol. xv. (1881) pp. 88, 101. This author, however, includes in the Miocene deposits which yield a smaller proportion of extinct species than usually occurs in that system.

specific life that these changes indicate a considerable age for the High-level Reefs. Our faith, however, in that conclusion is disturbed by two facts. In the first place, it appears probable that the inclusion of the nine recent species in the Nivajé Shale is due to an intermixture of specimens from different horizons in Heneken's collection, before it was studied by Prof. Duncan. In the second place, two of the extinct species and one of the genera new to the West Indian fauna occur, not in the High-level, but in the Low-level Reefs, where they are associated with a molluscan fauna of late Pleistocene age.

Until a considerable collection of the mollusca of the High-level Reefs is available for comparison, it will not be possible to decide whether the whole of the raised limestones are Pleistocene, or whether part should be included in the Pliocene. That the latter will have to be done is most probable. The impossibility of separating the Pleistocene and the Pliocene in Tropical America has been shown by Prof. A. Heilprin¹ in the case of Yucatan, by Dr. A. C. Lawson² on the Western Coasts, and by M. Purves³ in Antigua. The two systems probably merge also in Barbados.

A maximum age for the High-level Reefs is given by the fact that they overlie the beds of the Oceanic Series. The age of these is, however, still uncertain. Neither of the two fossils of any value as time-tests, that occur in them, are known elsewhere. As was remarked at the time of their description, their evidence is insufficient to enable us to do more than simply call them Upper Kainozoic.⁴

The Age of the Scotland Beds.—A lower limit to the age of the Oceanic Series' could be determined if we could settle that of the 'Scotland Beds' upon which it rests. Deposits of similar character to the latter occur in other of the Lesser Antilles and are there part of a longer series than is exposed in Barbados. The palæontological evidence, however, by which to correlate the Scotland Beds with those of neighbouring islands is meagre in the extreme. It consists of only three species of mollusca, which were described by Forbes,⁵ and which were then peculiar to the island. These fossils gave no very definite evidence until Guppy⁶ discovered two of them in Trinidad. He disputed the correctness of Forbes's views as to the

¹ A. Heilprin, 'Geological Researches in Yucatan,' Proc. Acad. Nat. Sci. Phil. 1891, p. 141.

² A. C. Lawson, 'The Post-Pliocene Diastrophism of the Coast of Southern California,' Bull. Dep. Geol. Univ. Calif. vol. i. (1893) no. 4, p. 159.

³ J. C. Purves, 'Esquisse stratigraphique et Espèces fossiles de l'île d'Antigua,' Ann. Soc. Malac. Belg. vol. viii. (1873) Bull. p. xxviii; also 'Esquisse géologique de l'île d'Antigua,' Bull. Mus. Hist. Nat. Belg. vol. iii. (1884) p. 312.

⁴ J. W. Gregory, 'Cystechinus crassus, a new Species from the Radiolarian Marls of Barbados, and the evidence which it affords as to the age and origin of those deposits,' Quart. Journ. Geol. Soc. vol. xlv. (1889) pp. 647, 648; and 'Archæopneustes abruptus, a new Genus and Species of Echinoid from the Oceanic Series in Barbados,' *ibid.* vol. xlvii. (1892) p. 168.

⁵ E. Forbes in Schomburgk's 'History of Barbados,' pp. 565-567.

⁶ R. J. Lechmere Guppy, 'Remarks on the Cultivation of Scientific Knowledge in Trinidad,' Proc. Sci. Assoc. Trinidad, pt. ii. (1867) pp. 81, 82; 'The Tertiary Microzoic Formations of Trinidad,' Quart. Journ. Geol. Soc. vol. xlviii. (1892) p. 524.

affinities of the species, which he assigned to the Lower Miocene. Guppy introduced, however, a new element of uncertainty, by separating the fossiliferous horizon from the rest of the Scotland Beds. This he did apparently only on the strength of a remark of Sir R. Schomburgk's,¹ to which he attributes greater importance than it seems to deserve. It is therefore advisable at present to correlate the whole of the beds in Barbados below the Oceanic Series with the San Fernando or Naparima Marls of Trinidad. Guppy has recently referred these (and the lower part, at least, of the Scotland Beds, goes with them) to the Eocene.² They are, however, now generally assigned to the Oligocene, as, for example, by Heilprin.³ An additional argument in support of this view is now afforded by the record in an earlier part of this paper of the occurrence of two of the most typical of the West Indian Oligocene echinoids in Antigua. This tends to show that the various outcrops of shallow-water marine sediments in corresponding positions in different islands of the Lesser Antilles archipelago are all fragments of widespread Oligocene deposits. Unfortunately, the Antiguan fossil mollusca have not yet been worked out, so that we have only the evidence of the corals and the foraminifera to rely upon in the correlation of the Antiguan series. The reference of this to the Oligocene is, however, quite in accordance with the view advocated by Profs. Duncan⁴ and Rupert Jones⁵ in 1864; on the evidence respectively of these two groups of fossils they correlated the Antigua beds with the Lower Limestone of Malta, which is now known to be Tongrian or Lower Oligocene.⁶

As the Oceanic Series overlies the Scotland Beds it is intermediate in age between the Lower Oligocene and that of the High-level Coral Reefs. For determining its position within narrower limits we have to turn to indirect evidence.

The Age of the Oceanic Series.—The line of enquiry that at first sight promises most help is the correlation of the Oceanic Series with similar deep-sea deposits in other West Indian islands. This, however, is beset by two difficulties: the exact age of the other thalassic beds is equally uncertain, while one cannot be sure that they were all formed simultaneously. As is the case with the deep-

¹ 'Notes on West Indian Geology, with remarks on . . . Atlantis . . . and descriptions of new fossils.' . . . Geol. Mag. 1867, pp. 497, 500, fig. 5, 499.

² 'The Tertiary Microzoic Formations of Trinidad,' Quart. Journ. Geol. Soc. vol. xlviii. (1892) pp. 520, 521, 535, 538.

³ A. Heilprin, 'Explorations on the West Coast of Florida and in the Okeechobee Wilderness,' Philadelphia, 1887, pp. 127, 58-59.

⁴ P. M. Duncan, 'On the Correlation of the Miocene Beds of the West Indian Islands; and on the Synchronism of the Chert Formation of Antigua with the Lowest Limestone of Malta,' Geol. Mag. 1864, pp. 97-102.

⁵ T. R. Jones, 'The Relationship of certain West Indian and Maltese Strata as shown by some *Orbitoides* and other Foraminifera,' Geol. Mag. 1864, pp. 102-106.

⁶ J. W. Gregory, 'The Maltese Fossil Echinoidea and their Evidence on the Correlation of the Maltese Rocks,' Trans. Roy. Soc. Edinb. vol. xxxvi. (1891) pt. iii. pp. 634, 635,

sea deposits in the Mediterranean Miocenes, they may have been laid down in isolated basins formed at different times by the subsidence of various portions of the area to the required depth. A final decision upon this point cannot be arrived at until adequate collections have been made from the beds above and below the thalassic deposits, wherever these are found. So far as the evidence goes at present, it is clear that their relations to the shallow-water deposits are much the same wherever they occur, and that they occupy, at least approximatively, a corresponding position in the West Indian sequence. Thus, according to Prof. Harrison and Mr. Franks,¹ the radiolarian marls in Trinidad unconformably overlie the San Fernando or Naparima (and possibly also the Nariva Beds), just as the Oceanic Series in Barbados does the Scotland Beds. Prof. Crosby's verbal description of the position of the Baraoa marls in Cuba shows that they are there covered by the raised coral-reefs just as are those of Barbados. In Trinidad they are either Miocene or post-Miocene; in Cuba they appear to be interstratified, or closely associated, with Miocene deposits. These Cuban beds are probably on the same horizon as the 'Pteropod Marl,' which represents the deep-sea series in Jamaica. It is generally regarded as Pliocene or even Pleistocene,² but this view does not rest on precise or reliable observation.

The Submergence of Panama.—There is another line of argument which affords important help. The Caribbean Sea is separated from the Pacific by a ridge in places less than 50 miles broad, and the summit of which is in one locality 154 and in another 287 feet in height. A subsidence in this region of anything like the amount that happened in Barbados would have submerged the whole isthmus, and allowed the Atlantic and Pacific faunas to intermingle. Now the evidence of the fossil mammalia of the Western States of America conclusively demonstrates that in some part of the Kainozoic period, North and South America were separated one from the other in this way. As to the date of this separation opinions differ greatly. One school of glacial geologists have seen in it a chance of explaining the cause of the refrigeration of the climate of the North Atlantic in the 'Ice Age'; for, through the channel thus formed, the warm waters piled up in the Gulf of Mexico by the main 'Equatorial Current' could pass into the Pacific, instead of flowing north as the Gulf Stream. For the diversion of the ocean-currents of the Atlantic to be of any use for this purpose, it must have happened in Pleistocene times. That date has therefore been assigned to the submergence of the Isthmus of Panama.

The evidence quoted in support of this view is twofold :—1st, the

¹ Quart. Journ. Geol. Soc. vol. xlviii. (1892) p. 218.

² Jukes-Browne and Harrison, *ibid.* p. 221, discuss the question and conclude that 'the final opinion of the Surveyors with respect to both these [the White Limestone and the Pteropod Marls] seems to have been that they are post-Pliocene, or in other words Pleistocene.'

direct evidence of the geology of Central America; 2ndly, the indirect evidence yielded by the faunas of the two oceans. The former rests in the main on a collection made by Dr. G. A. Maack¹ during his survey of the Isthmus of Darien. It has been stated that he found numerous marine Pleistocene fossils on the very summit of the watershed. This does not, however, appear in his own account. According to this the summit of the ridge, which is crossed by the Napipi route at the height of 612 feet, is of old igneous or schistose rocks; the marine deposits on the lower slopes are Pliocene, and those at higher elevations early Tertiary. He assigns the connexion between the two seas in one passage to the Pliocene, and in another to the early Tertiary. Mr. Warren Upham first quoted Maack as proving the submergence of the isthmus to the summit of the main pass, at the height of 763 feet, in Pliocene and possibly Pleistocene times.² In a later note on the subject he claimed, from the work of the same observer, that a submergence of the whole isthmus had almost certainly taken place in Pleistocene time.³ Maack's collection was said to be in Washington, where I tried in vain to find it.

It was, however, seen by Gabb in Costa Rica in 1873, and he identified in it many Miocene species. Unfortunately, it is impossible now to tell to what subdivision of the Miocene the fossils belonged. Gabb has himself collected Miocene fossils from the summit of the central ridge of Costa Rica; he describes the deposits of this age as forming the whole of the Atlantic slope, and has little doubt that they extend thence uninterruptedly to the Pacific, though he did not trace them.³ But here again he gives no information as to what part of the Miocene the fossils indicate.

The abstract of Dr. Crawford's paper 'On the Geology of Nicaragua,'⁴ issued in 1891, also gives no support to the view of the occurrence of marine Pleistocene beds above the watershed.

We must, therefore, conclude that, though there is no doubt that marine Pleistocene deposits occur at the height of 150 feet up the Atlantic slope,⁵ there is not the slightest reliable geological evidence of any submergence of the isthmus in any period later than the Miocene of Gabb, and this Miocene may be Oligocene.

The Relations of the Caribbean and Panamaic Faunas.—The recent date of that event, however, has also been affirmed from a comparison of the marine faunas on either side of the isthmus.

¹ G. A. Maack, 'Reports of Exploration for a Ship Canal, Isthmus of Darien,' Public Doc. Navy Dept. no. 1144, vol. v. pp. 155-175; 'The Secret of the Strait,' Harper's New Monthly Mag. vol. xlvii. (1873) p. 812.

² Warren Upham, 'On the Cause of the Glacial Period,' Amer. Geol. vol. vi. (1890) p. 329; 'Pleistocene Submergence of the Isthmus of Panama,' *ibid.* p. 396.

³ W. M. Gabb, 'Notes on Costa Rica Geology,' Amer. Journ. Sci. ser. 3, vol. ix. (1875) pp. 198-204.

⁴ Rep. Brit. Assoc. 1890 (1891) pp. 812, 813.

⁵ W. M. Gabb, 'Miocene Fossils in Santo Domingo,' Proc. Amer. Phil. Soc. vol. xii. (1873) p. 572.

This view has been arrived at independently by students of the mollusca, the echinoids, and the fishes. In each of these groups we find a certain well-marked resemblance between the faunas of the two sides of Central America. This may consist either in the occurrence in both of identical species, or of closely allied or equivalent species of the same genera. Thus P. P. Carpenter¹ has given a list of 35 species of mollusca which live on both coasts of Central America; of 34 species which may do so; of 41 species which are separated from those of the other side by trivial differences, and of 26 species analogous to others on the western shores. With a caution, however, which those who have quoted these figures have not always shared, Carpenter merely asked whether these facts might not imply a connexion between the two oceans across Central America in Glacial times.

Prof. A. Agassiz² has been no less emphatic as to the resemblances between the echinoid faunas of the two seas, and even more cautious in his conclusions. In 1869 he published a list showing that all but three of the genera of echinoidea that live on the west coast have representative species in the east-coast fauna. This list has been used by Sir Wyville Thomson³ as a typical case of the 'law of representation,' with the natural inference that the two faunas must have had a common ancestor at no distant period. Prof. A. Agassiz has again called prominent attention to these facts in a chapter and elaborate table in his Report on the 'Blake' Echini.⁴ But though these facts have been used to support the case of the recent date of the Panama submergence, as we shall see later on, Prof. Agassiz went rather to the other extreme and made it older than is necessary.

The third main group of animals that has been used to prove the recent age of the connexion is that of the fishes. It was stated that 'with scarcely any exceptions the genera are identical, and of the species found on the Pacific side nearly half have proved to be the same as those of the Atlantic.' It was therefore contended that the fishes proved 'the existence of communications between the two oceans by channels and straits which must have been open till within a recent period.'⁵

With such conclusions vouched for by such authorities, it is no wonder that those who wished to deflect the Gulf Stream in order to account for the cold of the Glacial climate felt fully at liberty to

¹ P. P. Carpenter, 'Report on the present State of our Knowledge with regard to the Mollusca of the West Coast of North America,' Rep. Brit. Assoc. for 1856 (1857), pp. 363-364.

² A. Agassiz, 'Preliminary Report on the Echini and Starfishes dredged in deep water between Cuba and the Florida Reef, by L. F. de Pourtales,' Bull. Mus. Comp. Zool. vol. i. (1869) pp. 301, 302.

³ Wyville Thomson, 'The Depths of the Sea,' London 1873, pp. 13, 14.

⁴ A. Agassiz, 'Report on the Results of Dredging . . . by the . . . Blake,' vol. xxiv. pt. i.; 'Report on the Echini,' Mem. Mus. Comp. Zool. vol. x. (1883) no. 1, 'Origin of the West Indian (Caribbean) Echinid Fauna,' pp. 79-94.

⁵ A. Günther, 'Introduction to the Study of Fishes,' 1880, p. 280, and 'The Fishes of Central America,' Trans. Zool. Soc. vol. vi. (1868) pp. 397-402.

do so. Thus Dr. A. Russel Wallace,¹ relying mainly on the evidence of the fishes, maintains that the isthmus was certainly submerged more than once in Tertiary times, and that the last separation of the two Americas in this way may have helped the oncoming of the glacial conditions. Ricketts has twice expressed² the views of English glacialists who accept this explanation of the cause of the 'Ice Age,' but while he admits that there is no absolute proof of the submergence of the isthmus, he urges its probability owing to the lowness of the ridge, to the 'identity' of the fauna on both sides of it, and to the great earth-movements that have taken place in this region.

Still more recently the subject has been fully discussed by Jukes-Browne and Harrison.³ They conclude with a belief in a 'free communication between the Atlantic and Pacific at a late period in Tertiary time.' This 'late period' they distinctly refer on the same page to the Pleistocene.

Nevertheless, all recent zoological work has tended to show that though at one time the Caribbean Sea must have been in direct communication with the Pacific, this was at a very distant period, certainly prior to any part of the Pleistocene. There have always been advocates for this view. Thus Carrick Moore,⁴ who has been so often quoted as showing the connexion across Panama, pointed out the great differences in the faunas of the two sides. Similarly, Belt,⁵ in 1874, pointed out that the occurrence of less than 50 species common to the two faunas was really a proof that the isthmus could not have been submerged since Pliocene times; for the number is very small in proportion to the size of the faunas. Moreover, instead of P. P. Carpenter's list of species found on both sides of the isthmus having grown with further work, it has shrunk considerably. Fischer calls it 'une infime minorité (3 %),' and therefore carries back the close of the separation to the Miocene.⁶

The same change has come in the interpretation of the evidence of the fishes, thanks to the works of Jordan,⁷ and of Evermann and Jenkins. By the study of much larger collections than those available to Dr. Günther, Jordan reduced the number of species common to the two faunas to 6 per cent., and declared that they were so 'substantially distinct' that no recent connexion between the seas had existed. This estimate has been still further reduced by

¹ A. R. Wallace, 'Island Life,' 2nd ed. 1892, p. 151.

² C. Ricketts, 'The Cause of the Glacial Period with reference to the British Isles,' Geol. Mag. 1875, pp. 573-580, and 'Some Phenomena which occurred during the Glacial Epoch,' Proc. Liverpool Geol. Soc. vol. vi. (1891) pt. iii. pp. 244-247.

³ *Op. jam cit.* pt. ii. Quart. Journ. Geol. Soc. vol. xlviii. (1892) p. 224.

⁴ J. Carrick Moore, 'On some Tertiary Beds in the Island of San Domingo, from notes by J. S. Heniker, Esq., with remarks on the Fossils,' Quart. Jo. n. Geol. Soc. vol. vi. (1850) p. 43.

⁵ T. Belt, 'Naturalist in Nicaragua,' 1874, pp. 263, 264.

⁶ P. Fischer, 'Manuel de Conchologie,' 1887, p. 163.

⁷ Dav. S. Jordan, 'A List of Fishes known from the Pacific Coast of Tropical America, from the Tropic of Cancer to Panama,' Proc. U.S. Nat. Mus. vol. viii. (1885) pp. 361-394, especially pp. 393, 394.

the work of the latter authors,¹ who described the 'fish faunæ of the two coasts as being essentially distinct'; they conclude that 'there has not been, at any comparatively recent time, any water-way through the Isthmus of Panama.' They accept the fish fauna as composed of 1307 species, and, excluding 16 species of such wide distribution that their evidence does not count, they estimate that only 4·3 per cent. are common to the two shores. They add, moreover, that they think that the mollusca yield 'even stronger evidence of the remoteness of the time when the means of communication between the two oceans could have existed.'

With the corals the evidence is still more conclusive. Two more different coral faunas than those of the West Indies and Panama could hardly be found. There is not one species common to the two. Not only so, but the genera are nearly all different. Ortmann² has recently published a list of genera from the two coasts to emphasize this fact. Verrill has repeatedly called attention to the almost complete difference between the two faunas, not only with species and genera, but also with families. He has summarized the results as follows:—'No species are found to be identical, while even the genera and families show remarkable contrasts. Thus the numerous genera and families of reef-building corals, so abundant on the Atlantic side, are wholly wanting on the Pacific, with the exception of *Porites*, which is represented by three or four small species. Massive *Astræans*, *Mæandrina*, *Diploria*, *Manicina*, *Colpophyllia*, *Agaricia*, *Siderastræa* [*Astræa*], *Oculina*, *Madrepora*, *Millepora*, are wholly unknown in the Panama fauna. But *Pocillopora*, *Montipora*, and *Pavonia*, genera unknown on the Atlantic side, are represented, the last by two gigantic species. Among the Hæcyonoid Polyps we find an equal contrast, for *Eunicea*, *Plexaura*, *Plexaurella*, *Pterogorgia*, and many other very common Atlantic genera are unknown on the Pacific side, where they are replaced by numerous species of *Psammogorgia*, *Litigorgia*, and *Eugorgia*, which are eminently characteristic of that coast.'³ Elsewhere he concludes 'that there has been no connexion [between the oceans], or at least none sufficient to materially change the course of the Gulf Stream, since the commencement of the Tertiary period.'⁴

We may, therefore, conclude from the evidence of the recent

¹ B. W. Evermann and O. P. Jenkins, 'Report upon a Collection of Fishes made at Guaymas, Sonora, Mexico, with Descriptions of New Species,' Proc. U.S. Nat. Mus. vol. xiv. (1891) no. 846, p. 126.

² A. Ortmann, 'Beobachtungen an Steinkorallen von der Südküste Ceylons,' Zool. Jahrb. Bd. iv. Abt. f. Syst. (1889) p. 528.

³ A. E. Verrill, 'On the Comparison of the Coral Faunæ of the Atlantic and Pacific coasts of the Isthmus of Darien, as bearing on the supposed Former Connexion between the two Oceans,' Amer. Nat. vol. iii. (1869) p. 500.

⁴ A. E. Verrill, 'On the Polyps and Corals of Panama, with Descriptions of New Species,' Proc. Boston Soc. Nat. Hist. vol. x. (1866) p. 325. See also his 'Comparison of the Tropical Faunæ of the East and West Coasts of America,' in 'Notes on Radiata, No. 3,' Trans. Connect. Acad. vol. i. pt. ii. (1867) pp. 339, 340.

fishes, mollusca, corals, and echinoids that there has been no water-way across the isthmus in Pleistocene times, for this must have been closed prior to the development of the existing species. No doubt the physical conditions of the two seas are somewhat different, and hence variation may have gone on at an unusually rapid rate. Nevertheless, the connexion between the two seas cannot have lasted after the close of the Miocene. The two Agassiz, father and son, have proposed to date it much farther back than this. They referred the separation of the two oceans and the formation of the Gulf Stream to the period at the close of the Cretaceous.¹ As Prof. A. Agassiz stated it in 1883, 'soon after the end of the Cretaceous period, the separation of the great Atlantic and Indo-Pacific marine realms began.'² This is, however, probably considerably too early, as that author admits in a letter published by Jukes-Browne and Harrison.³ As we have already seen, the stratigraphical evidence advanced by Gabb and Belt renders a Miocene submergence highly probable, although the operations for the Panama Canal did not lead to the discovery of any Kainozoic deposits on the summit of the pass chosen for it. According to Dr. Dall—whose recently expressed opinion on this subject⁴ carries the greatest weight—the Kainozoic rocks of the higher levels are all either Miocene or Eocene, while the summit of the ridge is formed of 'Azoic' rocks of uncertain age.

The Connexion of North and South America.—The comparison of the faunas, though conclusively proving the former connexion and long-distant separation of the two oceans, does not, however, enable us to fix the date of these events with much precision: for we do not know the rate at which the faunas have varied. In order to restrict the date within narrower limits we must turn to the migrations of the land-fauna, and especially to the evidence of the fossil mammalia of the Western States. This has recently been considered by Prof. W. B. Scott,⁵ who points out the occurrence of a glyptodont (*Caryoderma*) of a South American type in the Loup Fork Beds. These must accordingly be later than the connexion between the two Americas. Prof. Scott therefore admits that, if the view of Dall and Harris that this was not established till the end of the Miocene

¹ Louis Agassiz, Report upon Deep-Sea Dredgings in the Gulf Stream during the third Cruise of the U.S. Steamer 'Bibb,' Bull. Mus. Comp. Zool. Harvard, vol. i. (1869) p. 377; Alex. Agassiz, 'Preliminary Report on the Echini and Starfishes dredged in deep water between Cuba and the Florida Reef, by L. F. de Pourtales,' Bull. Mus. Comp. Zool. Harvard, vol. i. (1869) p. 305; and 'Three Cruises of the 'Blake,'' *ibid.* vol. xiv. 1888, p. 116.

² Alexander Agassiz, Reports on the Results of Dredging . . . by the 'Blake,' no. xxiv. pt. 1; 'Report on the Echini,' Mem. Mus. Comp. Zool. Harvard, vol. x. no. 1 (1883), p. 83.

³ *Op. jam cit.* pt. ii. Quart. Journ. Geol. Soc. vol. xlviii. (1892) p. 223.

⁴ W. H. Dall and G. D. Harris, 'Correlation Papers: Neocene,' Bull. U.S. Geol. Surv. no. 84 (1892), p. 151.

⁵ W. B. Scott, 'The Mammalia of the Deep River Beds,' Trans. Amer. Phil. Soc. vol. xvii. (1894) p. 62.

be correct, then the Loup Fork Beds must be Pliocene. Its fauna however, has such Miocene affinities that Scott suggests that the isthmus must have emerged before the end of this period. There does not seem to be any reliable evidence to put against that of the Loup Fork mammalia. Neither Gabb nor Dall have recorded the names of the Miocene species from the higher levels of Panama, nor did they state what division of the Miocene the fossils indicated.

It is therefore probable that the waterway across Central America was finally closed in the Lower Miocene, or possibly even in the Upper Oligocene.

The Date of 'Antillia.'—A further complication remains to be considered. It is not at all certain that when the Isthmus of Panama was submerged there was a free communication between the Atlantic and the Pacific Oceans. The Caribbean Sea may then have been a gulf from the Pacific, separated from the Atlantic by the land area of the hypothetical 'Antillia.' That there was once a connexion between North and South America along the chain of the Windward Islands, Cuba, the Bahamas, and Florida is not improbable. Evidence for this, either in whole or part, has been advanced by De Castro, Cope, Leidy, and others, whose arguments have recently been well summarized by Sir Henry Howorth.¹ Further evidence could be adduced from the study of the land-shells,² and also from the remarkable distribution of the species or varieties—whichever they be—of *Peripatus*. That Cuba was once connected with Yucatan and Florida is almost certain: that this connexion was in existence in the Pliocene, and probably also in the Pleistocene, is shown by the evidence collected by De Castro.³ That the area of the Windward Islands was occupied by land in the Lower Kainozoic is also most probable. But this was all submerged at the period when the Oceanic Deposits of Barbados were laid down. There is no adequate evidence to show that at any time after this was there more land in this region than there is at present. The evidence of the *Archæopneustes*-limestone which overlies the Oceanic Deposits, and of the series of raised reefs, tends to show that Barbados has been undergoing a long, steady upheaval since the period of the great submergence. The rarity of mammals on these islands shows that they have not been part of a continuous tract of land since they rose above the sea: as contended by Prof. A. Agassiz,⁴ the islands probably have always been isolated, and

¹ 'The Mammoth and the Flood,' 1887, pp. 360-366.

² Thomas Bland, 'On the Geographical Distribution of the Genera and Species of Land Shells of the West Indian Islands: with a Catalogue of the Species of each Island,' Ann. Lyc. Nat. Hist. New York, vol. vii. (1862) pp. 335-361; 'Additional Notes on the Geographical Distribution of Land Shells in the West Indies,' *ibid.* vol. ix. (1870) pp. 238-241.

³ M. F. de Castro, 'Pruebas Paleontológicas de que la Isla de Cuba ha estado unida al continente Americano, y breve idea de su constitucion geológica,' Bol. Com. Mapa geol. España, vol. viii. (1881) pp. 357-372.

⁴ A. Agassiz, 'Three Cruises of the 'Blake',' Bull. Mus. Comp. Zool. Harvard, vol. xiv. (1888) p. 116.

have received their inhabitants in the same manner as true oceanic islets.

Affinities of the Fossil Coral Fauna.—One final argument against the view of the Pleistocene connexion between the Caribbean Sea and the Pacific is afforded by the evidence of the fossil corals of Barbados. When we remember that the High-level Reefs there contain two genera now extinct in the West Indies, and that the stratigraphical evidence indicates that the reefs have been gradually formed during a long, slow elevation, it is difficult to doubt that the oldest reefs must date back at least to early Pleistocene times. Nevertheless the coral fauna of the High-level Reefs does not present the slightest trace of any intermixture with Pacific types. In fact the forms found fossil in, but not known to be still living around, Barbados increase the differences between the Caribbean and Panamaic faunas. They strengthen the resemblance of the former to that of the Red Sea and Indian Ocean, and to the fossils of the Mediterranean basin. One cannot compare the West Indian corals with those of such deposits as the Miocene of the hills around Turin, or with those which are still living in the Red Sea, without recognizing that they are part of the same fauna.

The remarkable resemblances between the present fauna of the West Indian seas and that of the Miocene deposits of the Mediterranean basin have frequently been pointed out. Michelotti¹ identified many of the fossils from the hills of Turin with recent West-Indian species. Duncan² determined the presence of the same species of corals in the rocks of Antigua and Malta. Pourtales³ suggested that the Tertiary deep-sea fauna of Europe migrated westward and supplanted that of the West Indies. Cleve⁴ and Guppy,⁵ on the evidence of the mollusca, pointed out that the affinities of the West Indian Miocene faunas are with those of Europe instead of North America, and therefore conclude that they reached that region by migration across the Atlantic. The echinoidea yield similar and more conclusive evidence. As I have previously pointed out,⁶ the intimate affinity between those of the

¹ J. Michelotti, 'Specimen Zoophytologiæ diluvianæ,' Turin, 1838. Though most of the living West Indian genera of corals are represented by equivalent species in the North Italian Miocenes, I am not persuaded of the specific identity of the two series. Michelotti's records are therefore not included in the synonymy.

² P. M. Duncan, Geol. Mag. 1864, pp. 97-102.

³ L. F. de Pourtales, 'Zoological Results of the Hassler Expedition, Crinoids and Corals,' Ill. Cat. Mus. Comp. Zool. Harvard, no. viii. (1874) p. 49.

⁴ P. T. Cleve, 'On the Geology of the North-Eastern West India Islands,' Handl. k. Svensk. Vet.-Akad. vol. ix. no. 12 (1871) p. 48.

⁵ R. J. L. Guppy, 'On the Tertiary Mollusca of Jamaica,' Quart. Journ. Geol. Soc. vol. xxii. (1866) p. 285; 'On the Relations of the Tertiary Formations of the West Indies,' *ibid.* pp. 584-590; 'Notes on West Indian Geology, with Remarks on the Existence of an Atlantis in the Early Tertiary Period, and Descriptions of some New Fossils from the Caribbean Miocene,' Geol. Mag. 1867, pp. 496-501; 'On some New Tertiary Fossils from Jamaica,' Proc. Sci. Assoc. Trinidad, pt. x. vol. ii. (1873) p. 72.

⁶ J. W. Gregory, 'The Relations of the American and European Echinoid Faunas,' Bull. Geol. Soc. Amer. vol. iii. (1891) pp. 101-108.

West Indies and the Mediterranean can only be explained by the assumption of the existence of a shallow-water connexion across the Central Atlantic in—at latest—Miocene times. That the fauna did not follow along the shores of the North Atlantic basin is shown by its absence from the northern Miocenes of Europe and America. The evidence now adduced from the fossil corals of Barbados lends support to this view, as showing that the West Indian fauna is only a fragment of that of the Mediterranean Miocene, and has received nothing from the Pacific. This is in full agreement with Prof. Suess's theory that the Atlantic is of comparatively recent geological age, and arose by the gradual enlargement of two great bays which run north and south from a sea that once extended across the mid-Atlantic from Europe to America, including both the Mediterranean and the Caribbean seas.

The Permanence of Oceans and Continents.—The geological history of the West Indian area is therefore strongly opposed to the theory of the permanence of the great continental masses and of the ocean-basins. For, while on the one hand it supplies us with an example of the elevation of true abyssal oozes to the height of 1095 feet above the sea, on the other the origin of its shallow-water fauna can only be explained by the formation of the basin of the Central Atlantic in Middle Kainozoic times. It has been objected that the discovery of true deep-sea oozes in Barbados did not really seriously affect the question, as these occurred only on the extreme margin of a volcanic area, where great earth-movements were most likely to have taken place. The discovery, however, of exactly the same deposits in Cuba shows that this argument is invalid, as they there occur in the very centre of the West Indies. The submergence was therefore probably regional in extent, though it is possible that these two sets of oozes may have been formed in isolated areas of depression. It is not improbable that the subsidence which led to the deposition of the Oceanic Series of the West Indies was one of the earth-movements which, in Langhian or Helvetian (Lower or Middle Miocene) times, broke up the great Antilleo-Mediterranean Sea, by the formation across it of the main trough of the Atlantic. That the deep-sea oozes were subsequently raised in Barbados to a great height above the sea is doubtless due to the position of that island on the line connecting the eastern coasts of North and South America. The remarkable amplitude of the oscillations of level along this is not surprising, whether we simply regard it as one of the primitive lines of weakness in the crust of the earth, or, with Prof. Lapworth, explain its instability by its coincidence with a septum of the Atlantic fold.

VII. SUMMARY OF CONCLUSIONS.

A. *Correlation of the Barbados Sequence.*

Raised Coral Reefs,	Low Level	} Pleistocene. Pliocene.
	High Level	
Oceanic Series.		Miocene (and possibly partly Pliocene and partly Oligocene).
Scotland Beds,		Oligocene (probably Lower).

B. *History of the Caribbean Area in Kainozoic Times.*

1. In Eocene times the site of the Windward Islands was a land-area. There is no adequate evidence of the existence of this land in post-Tongrian (that is, post-Lower Oligocene) times.
2. North and South America were then separated by a waterway across the Isthmus of Darien, and probably also across much of the States of Costa Rica and Nicaragua.
3. In early Miocene, or possibly Oligocene, times the two oceans were separated by the final emergence of Central America and its union with a continuous land-area.
4. There is no evidence, afforded either by stratigraphy or zoology, to show that the Atlantic and Pacific Oceans have been united across Central America in post-Miocene times.
5. Approximately simultaneous with the rise of the west of the Caribbean Sea, subsidence was taking place to the east. This plunged part of the area, now occupied by land, into abyssal depths. True deep-sea oozes were then deposited in Barbados, Trinidad, and Cuba.
6. In some part of the late Miocene or Pliocene epoch re-elevation began. Deposits characteristic of shallower conditions (the *Archæopneustes abruptus*-limestones) were formed: these contain simple corals which, though too imperfect for description, indicate a depth of between 100 and 300 fathoms.
7. In Pliocene or early Pleistocene times (probably the former) the continued elevation of the Barbados area brought it within the zone of reef-coral growths. The first reefs formed were the High-level Reefs, now raised nearly 1000 feet above the sea. From these a continuous series forms a cap to the island, and extends down to reefs of late Pleistocene age at sea-level.

Synonymy of Corals.

1. The types of the numerous species founded by Duchassaing & Michelotti have been examined. Thirty-three are now placed as synonyms.
2. The following species, described as being from the West Indian Miocene, are reduced to the rank of synonyms. They have been founded on Pleistocene specimens, probably included by accident among the Miocene fossils:—

<i>Stephanocania dendroidea</i> , Dunc., p. 258.	<i>Astræa barbadensis</i> , Dunc., p. 272.
<i>Antillia bilobata</i> , Dunc., p. 260.	<i>Heliastrea altissima</i> , Dunc., p. 272.
<i>Dichocania tuberosa</i> , Dunc., p. 268.	<i>Antillastrea spongiformis</i> , Dunc., p. 276.
<i>Barysmilia intermedia</i> , Dunc., p. 269.	<i>Siderastrea grandis</i> , Dunc., p. 279.
<i>Astræa endothecata</i> , Dunc., p. 271.	— <i>crenulata</i> , var. <i>Antillarum</i> , Dunc., p. 279.
— <i>cylindrica</i> , Dunc., p. 271.	

3. The genus *Antillastrea* is regarded as a synonym of *Stephanocania*, and *Mycedium* of *Agaricia*. *Antillia* is also abandoned, as the epitheca is not regarded as a reliable diagnostic character in the *Astræidæ* simplices.
4. The genera *Hydnophora* and *Echinopora* are added to the West Indian fauna.

Affinities of the Fossil Corals.

1. Those of the raised reefs of Barbados give no trace of the influence of admixture with Pacific types.
2. The fauna is an offshoot of that of the Miocene of the Mediterranean basin.
3. Its nearest living ally is, therefore, that of the Red Sea and Indian Ocean.
4. The migration of this fauna westward across the tropical Atlantic supports the theory of the existence of a shallow-water ridge or coast-line across that ocean in Middle Kainozoic times. For the corals could not have crossed the cold abysses of the Atlantic, and, as they are absent from the Miocene deposits of Northern Europe and the United States, it is clear that they did not work their way around the shallow waters of the North Atlantic. As some echinoidea of similar range, which have no free-swimming larval stage, must have crossed at the same time, it is not probable that the fauna reached the West Indies by larvæ floating across the ocean.

The Theory of the Permanence of the Ocean-Basins.

1. The evidence of the geology and palæontology of the West Indies is therefore opposed to the theory of the permanence of the ocean-basins. For, on the one hand, it supplies a case of abyssal deposits raised more than 1000 feet above the sea: on the other, the origin of the faunas can only be explained by the subsidence of part of the Mid-Atlantic in Miocene times.
2. The occurrence of radiolarian oozes in Cuba shows that the submergence did not affect only the margin of the West Indian area. The great subsidence was probably part of that which formed the basin of the Mid-Atlantic.

NOTE ON ADDITIONAL MOLLUSCA FROM THE SCOTLAND BEDS.—I have received this morning (18th Feb.) from Mr. Jukes-Browne a small collection of mollusca from the Scotland Beds. They are too fragmentary for full determination, but so far as the evidence

which they furnish goes it is strongly in favour of the Oligocene age of the deposits. The fossils are as follows:—

Entaliopsis? aff. *rudis* (Gabb).
Cuphus aff. *incrassatus*, Gabb.
Cardita aff. *scabricostata*, Guppy.
Ostrea, sp.
Lampusia (= *Triton*), sp.

The best-preserved fossil has been kindly identified by Mr. G. F. Harris as a very close ally of *Surcula transversaria* (Lam.). This is a common Oligocene species; it occurs, for example, at Brockenhurst, and ranges down to the Middle Eocene. Mr. Harris states that the general aspect of the fossils resembles that of the Brockenhurst Beds and their equivalents in the Paris Basin.

Mr. R. B. Newton has kindly determined three mollusca from the Scotland Beds collected by Mr. Jukes-Browne. They are allied to

Clavilithes longævus (Sol.).
Neritina aperta, J. de C. Sow.
Potamides funatus, G. Sow.

Mr. R. B. Newton says that these 'are probably of Lower Oligocene age (Headon Beds).'

EXPLANATION OF PLATE XI.

- Fig. 1. *Hydnophora luteifundata*, sp. n.; High-level Reefs, Castle Grant. Fig. 1 a. Specimen, nat. size (R 2460). Fig. 1 b. Monticules of the same, $\times 4$ diam.
- Figs. 2 & 3. *Echinopora Franksi*, sp. n.; Low-level Reefs, Barbados. Fig. 2 a. Coral (R 2514), reduced to $\frac{1}{3}$. Fig. 2 b. Corallites from a flat area on the same specimen, $\times 3$ diam. Fig. 2 c. Corallites from a boss on the same specimen, $\times 3$ diam. Fig. 3. Section of a corallite, $\times 7$ diam.
- Figs. 4 a & 4 b. *Solenastræa stellulata* (Ell. & Sol.); High-level Reefs, Castle Grant. Two types of calyces from different parts of the same specimen (R 2469), $\times 3$ diam.
- Figs. 5 & 6. *Stephanocænia intersepta* (Esper); Low-level Reefs, Barbados. Fig. 5 a. The normal type of corallites, $\times 4$ diam. Fig. 5 b. Corallites, scattered and rounded, from the same specimen (R 2533), $\times 4$ diam. Fig. 6. Corallites of the *Michelini*-type from another specimen (R 2195), $\times 4$ diam.
- Fig. 7. *Agaricia agaricites* (Pallæe); Low-level Reefs, Barbados. Two figures of different parts of a funnel-shaped specimen (R 2482), $\times 3$ diam. Fig. 7 a shows the *Agaricia* and 7 b the *Mycedium* condition.

DISCUSSION.

The PRESIDENT alluded to the interest which the Fellows of the Society had for many years past taken in the geology of the West Indian area. He cited the papers published in the Geological Society's Journal by old West Indian workers such as De la Beche, R. Lechmere Guppy, Sawkins, Wall, Lucas Barrett, while our past President, Prof. P. Martin Duncan, had done much in the study of the corals; then, too, we had papers by Harrison, Jukes-Browne, Agassiz, and more than twenty other workers, who had laboured in this field of enquiry. Dr. Gregory had added new points of interest to the geology of this area, and in his paper had dealt

with three series of deposits—the Reefs, the Oceanic Series, and the Scotland Beds—which owe their origin to varying age and very different depth of deposits.

Mr. MARR, having obtained the President's permission, read the following remarks made by Mr. JUKES-BROWNE (who was prevented by ill-health from being present at the meeting):—

‘As Dr. Gregory's paper deals with the relative ages of the rocks in Barbados, I take the opportunity of communicating the results of some investigations made by Mr. G. F. Franks, F.G.S., in the neighbourhood of Bissex Hill. In the paper by Prof. Harrison and myself, we stated that the higher part of this hill consisted of granular *Globigerina*-marl capped by a limestone and marl containing foraminifera, shell-fragments, and included pieces of chalk. This we regarded as a separate formation, but classed the marl below with the Oceanic deposits. Mr. Franks, however, has discovered detrital limestones in the *Globigerina*-marls, as well as some evidence which suggests that the whole mass of *Globigerina*-rock lies unconformably upon the Oceanic Series, and is faulted down into the centre of the Bissex Hill area.

‘Mr. Franks has not yet been able to find a clear and unfaulted junction of the two formations, but, if his observations are correct, the group of beds which we classed as of intermediate date between the Oceanic Series and the Coral Rocks acquires a greater importance. Moreover, it seems to be more intimately connected with the Coral Reefs than with the Oceanic deposits, for Mr. Franks has found patches of reef-rock on the spurs of the hill, which seem to pass down into the upper shelly portion of the Foraminiferal Marls. He has also discovered the same succession in a well-shaft at Bowmanston.

‘In view of these facts, we are quite prepared to accept Dr. Gregory's conclusion that the Oceanic Series is of Miocene age, the more so as Dr. Spencer has come to the same conclusion with respect to the Radiolarian Earths of Cuba, after a personal study of the geology of that island. The Barbadian succession may therefore be provisionally stated as follows, and I hope that ere long I may be able to lay the evidence for it before the Society:—

Pleistocene	{	Low-level Reefs.
and		High-level Reefs.
Pliocene.		Foraminiferal Marls and Limestones.

Break.

Miocene = Oceanic Series.

Break.

Eocene = Scotland Beds.’

Mr. CLEMENT REID observed that, judging by the extent of post-Oligocene denudation in Europe, it is unsafe to take the present height of the Isthmus of Panama as any measure of its height in Tertiary times. If the mountains were formerly much higher, it is evident that great elevations and depressions might take place in

the West Indies without connecting the Atlantic and Pacific Oceans.

Mr. G. F. HARRIS remarked that this was a valuable contribution to our knowledge of the palæontology and physical geology of the West Indies. With reference to the few mollusca obtained from the Scotland Beds, he believed that they were of Lower Oligocene age, *Surcula belgica* being very characteristic of that horizon in Europe. The *Clavilithes* exhibited was, however, very similar to the stunted forms of *C. deformis* from the upper part of the Sables Moyens of the Paris Basin—a bed of Upper Eocene age. In addition to the Tertiary fossils from Panama alluded to by the Author, Dr. Dall of Washington had described *Glyptostyla panamensis* and several other mollusca given to him by Prof. Alex. Agassiz, and obtained along the line of the canal 12 miles south of Colon (at Vamos-Vamos) a few feet above the sea-level. These seemed to indicate the presence, in the Isthmus, of beds equivalent in age to the Martinez group of California, which was now merged in the Chico-Téjon—partly Eocene and partly Upper Cretaceous. The fossils referred to presented an Eocene facies. He quite agreed with the Author, but on different grounds, that there had been no land-connexion between Florida and South America by way of the larger islands, to form the supposed 'Antillean continent,' in recent Tertiary times. The distribution of the land-mollusca of Cuba, Hayti, Jamaica, Barbados, and Trinidad, amongst other islands, was directly opposed to such an hypothesis, each island possessing a number of forms peculiar to it and unlike those on the mainland. It was hard to believe that such marked differentiation could have resulted since Pliocene times as had been assumed by certain American writers. He thought it much more reasonable to suppose, with the Author, that the land-connexion had taken place at an earlier period.

The Author remarked that he had been much interested by Mr. Jukes-Browne's contribution to the Discussion, as Mr. Franks's observations confirmed the conclusion expressed at the end of his paper on *Archæopneustes* in 1892. He read the passage maintaining that the nodular limestones were formed on the rising dome of the deep-sea deposits, and were intermediate in age between these and the Coral Limestones. They would therefore be unconformable to the Radiolarian Marls. He preferred at present to call the Scotland Beds Lower Oligocene. He quite agreed with Mr. Reid that the Panama ridge was at one time higher; but this argument was not a valid reply to those who maintained the Pleistocene age of its elevation. He was glad Mr. Harris thought that the land-mollusca (the evidence of which is considered in the paper) opposed Dr. Spencer's views as to the recent existence of the continent of Antillia. He thought that the evidence of the faunas of the Windward Islands was conclusive against their ever having formed part of a great continent since their emergence from the sea.