XXXIV.—The Coral-fauna of Ceylon, with Descriptions of new Species. By STUART O. RIDLEY, M.A., F.L.S.

THE distribution of the Anthozoa and Hydroid Corals in the Indian Ocean is very imperfectly known; those of Ceylon have been almost wholly neglected. Blyth and Kelaart, who have devoted special attention to the animals of Ceylon, do not deal with the corals. Among the few specific references in modern times to the subject, which I have been able to find, is the identification of a stray species from there in Milne-Edwards and Haime's 'Histoire Naturelle des Coralliaires.' Pallas and Esper, who have probably done more for the zoology of the Indian Ocean than any others of the older writers, and of whom the latter exhibits a special acquaintance with Southern India and Ceylon, give the localities of their Indian-Ocean species of corals, for the most part, as "Indian Ocean" or "East-Indian seas;" I have found no specific allusion to Ceylon in connexion with corals in the writings of these authors. Verrill mentions three species with certainty, one with doubt, from Ceylon (Proc. Essex Institute, vols. v. & vi.). Mr. H. J. Carter describes (Ann. & Mag. Nat. Hist. (5) v. pp. 442, 454, vi. p. 152) from the Gulf of Manaar, on the north of the island, under the name Hydradendrium, a species obtained by Capt. Cawne Warren with Sponges, Foraminifera, &c., also a species which he assigns to Tubipora, also a Rhizoxenia and Spongodes without specific names.

General remarks on the coral-reefs and corals are found in Prof. E. Häckel's letters to the 'Deutsche Rundschau' for 1882 (translated in part in 'Nature,' 1882), and in a separate work by the same author, entitled 'Indische Reise-Briefe' (Berlin, 8vo, 1883). Prof. Häckel, as is well known, made large collections in Ceylon; and a scientific account of his investigations there is to be anticipated with much interest. Dr. W. C. Ondaatje, F.L.S., Colonial Surgeon of Ceylon, has called my attention to some plates representing Ceylon corals, contained in a work entitled "Ceylon: Skizzen seiner Bewohner, seines Thier- und Pflanzenlebens, by Baron von Ransonnet-Villez," which describes the reefs and enumerates ten species, probably all included in the list below, except two Turbinariæ. Darwin describes the reefs generally in his ' Coral Islands.' Sir Emerson Tennent makes a few allusions to corals in his work on Ceylon.

It is to Dr. Ondaatje that we owe this opportunity of becoming acquainted with the precise characters of the Ceylon coralfauna. His permanent sojourn and his journeys in the island have afforded him special facilities for accumulating facts and material for the study of this subject; and his interesting collections show how well his energies have been directed. He has liberally presented examples of many of the species below enumerated to the British Museum, and has written an important note on the reefs, which is printed below.

All the specimens collected by Dr. Ondaatje were obtained on the southern coast, in the neighbourhood of Galle, except where otherwise stated; and they were obtained from the shore or from shallow water, with the exception of the Antipatharia, and the *Echinogorgia* and *Menacella*, which were obtained by fishermen in their nets at depths said to amount to from 100 to 150 fathoms.

Although, as might have been expected, the coral-fauna of Ceylon has the same general aspect as that of the other parts of the Indian Ocean so far as it is known, and of the Red Sea, having most of its known species in common with these regions, yet it has peculiarities of its own—viz. one peculiar (so far as is known at present) species of *Cæloria* and a species of *Pavonia*, and one of *Alcyonium*; in the latter two cases the nearest known allies seem to be found in the Pacific. These species are described for the first time in this paper. A *Stephanoseris* described by Verrill is also not known except from Ceylon, so far as I am aware. To sum up, in all we have forty-eight or forty-nine species of corals known to occur in Ceylon, of which four are at present not recorded from elsewhere.

The following is a list of all species which I know to have been obtained at Ceylon; those not obtained by Dr. Ondaatje are marked with a *.

Subclass ZOANTHARIA.

Order ALCYONARIA.

Family Alcyoniidæ.

Alcyonium polydactylum, Ehrenberg, var. mamillifera, Klunzinger.

Alcyonium polydactylum, Ehrenberg, Cor. Roth. Meer. p. 58; Klunzinger, Korallenthiere Roth. Meer. p. 26, pl. i. fig. 6, b.

Also found in the Red Sea (Klunzinger).

Alcyonium submurale, n. sp.

Upper surface horizontal, level, with the exception of low ridges, which rise between the centre and the edge, gradually increasing in height towards the latter, but not attaining an altitude of more than an inch or two. Ridges about 6 millim. thick at free edge. Margin of zooid-bearing lamina plicate ; surface of this region even, zooids crowded. Pedicel (in medium-sized specimen) almost as broad as the zooidbearing plate. Colour, in dry state, dark reddish brown, that of sterile pedicel paler. Spicules :--(1) Large doubleheads, consisting of a usually extremely short narrower smooth cylindrical median portion, and of two large strongly tuberculated ends, each bearing four or five large broad tubercles covered with minute, sharp-pointed, secondary tubercles; length of spicule '25, diameter of heads '18 millim., of smooth median portion '1 millim. (2) Slender, tuberculate, subclavate, straight, one end tapering to point, the other usually rather blunt and more strongly tuberculate than the former : spicule beset with low tubercles covered with small secondary tubercles; most of the tubercles are arranged into four or five more or less distinct whorls, which surround the spicule and are separated by spaces usually free from tubercles, the remainder are scattered near the ends; spicule about '25 to '35 millim. long by .07 millim. thick. A few stout few-whorled forms also occur in the cortex, perhaps representing intermediate stages between nos. 1 and 2. No. 1 forms the lower side of the frond and the greater part, at any rate, of the stem; no. 2 forms the surface of the zooid-bearing plate, and extends some way beneath it. The entire specimen, of which I have seen a photograph, measured about 8 inches in diameter across the disk.

This in its external form is quite unlike the species A. pachycladus, described so fully by Klunzinger from the Red Sea; but the large double-headed spicules ally it to that form. A. murale of Dana, of which only the external form is known, seems to differ mainly in the great height of the radiating ridges which there, as here, crown the disk; here, however, they are quite small, even in large specimens.

Sarcophytum pauciflorum, Ehrenberg.

Lobularia pauciflora, Ehrenberg, Corallenthiere Roth. Meeres, p. 58.

Appears to be common on the Galle coast; found in Red Sea (*Ehrenberg*).

Spongodes, sp.

Spongodes, Carter, l. c.

Rhizoxenia, sp.

Rhizoxenia, Carter, l. c.

Family Primnoidæ.

Menacella reticularis, Gray, var.

I have already added a few details of the characters of this

Mr. S. O. Ridley on the Coral-fauna of Ceylon. 253

species in this Journal (ser. 5, vol. ix. p. 191). In the specimen brought by Dr. Ondaatje, and presented by him to the national collection, the largest spicules are rather longer and less thick than those described by me (l. c.) from the type specimens, and do not exhibit the dark axial coloration which I have mentioned. The Ceylon specimen is the largest which I have seen, and attains the remarkable dimensions of—height 970 millim. (39 inches), greatest diameter 500 millim. (20 inches).

Echinogorgia pseudosasappo, Kölliker.

Gorgonia sasappo, var. reticulata, Esper, Pflanzenthiere, ii. p. 48, pl. ix.A.

Echinogorgia pseudosasappo, Kölliker, Icones Histiologicæ, p. 136, pl. xviii. fig. 10.

" East-Indian seas" (Esper).

Family Euniceidæ.

Plexaura flabellum, Esper.

Antipathes flabellum, Esper, l. c. ii. p. 109, pl. i.

Esper's figure represents the axis of what appears to be this *Plexaura*; the localities given by him are the East Indies, and especially the Moluccas. Several specimens were obtained by Dr. Ondaatje.

Family Gorgonellidæ.

*Juncella juncea, Pallas.

Gorgonia juncea, Pallas, Elenchus Zoophytorum, p. 180. Obtained by Mr. Holdsworth (coll. Mus. Brit.).

Subfamily Sclerogorgiacer.

Suberogorgia verriculata, Esper.

Gorgonia verriculata, Esper, l. c. ii. p. 124, pl. xxxv.

* Suberogorgia suberosa, Pallas.

Gorgonia suberosa, Pallas, Elench. Zooph. p. 191.

A common Indian-Ocean species; it extends to the north of Australia. A specimen is in the British Museum, presented by E. W. H. Holdsworth, Esq.

Family Coralliidæ.

Corallium nobile, Pallas.

Isis nobilis, Pallas, Elenchus Zoophytorum, p. 223.

Dr. Lankester ('Uses of Animals to Man'), besides the Per-

254 Mr. S. O. Ridley on the Coral-fauna of Ceylon.

sian Gulf, gives Ceylon as a locality for this, the precious Red Coral of the Mediterranean and Cape-Verd Islands; and Dr. Ondaatje has shown me decorticated specimens from Ceylon which make the identity of the species probable. It is noteworthy that a fossil form is recorded from Indian deposits (*Duncan*) which (as I have given reasons for thinking, see Proc. Zool. Soc. 1882, p. 232) seems probably identical with this species, Seguenza having found it fossil in Italy, still bearing a slight red tint.

"An Officer," in a work entitled "Ceylon" (London, Svo, 1876, 2 vols.), ii. p. 274, mentions small fragments of red coral similar to that of the Mediterranean as having been found at the water's edge between Galle and Colombo, and states it to have been referred to by the Portuguese.

The specimens shown me by Dr. Ondaatje, one of which has been placed by him in the British Museum, have a decidedly *scarlet* colour, which penetrates to the centre; the texture of the corallum is dense; the longitudinal striæ are placed rather further apart in the smaller branches than is usual in the Mediterranean red coral, with which, however, the general habit seems to agree. An examination of the cortex appears to me necessary to the absolute determination of the species.

INCERTÆ SEDIS.

* Tubipora reptans, Carter.

Tubipora reptans, Carter, Ann. & Mag. Nat. Hist. (5) v. p. 442, pl. xviii. fig. 2.

Resembles *Callipodium* in its manner of growth. Only known from a small specimen.

Obtained in Gulf of Manaar (Carter).

Order ZOANTHARIA.

Suborder MADREPORARIA.

Family Astræidæ.

Galaxea musicalis, Linné.

Madrepora musicalis, Linné, Systema Naturæ, (12) p. 1278.

It is recorded from the Indian Ocean by Milne-Edwards and Haime. Galaxea Bougainvillei, Milne-Edwards & Haime. Sarcinula Bougainvillei, Milne-Edwards & Haime, Annales des Sciences Naturelles, (3) x. p. 312.

Mussa ringens, Milne-Edwards & Haime. Lobophyllia ringens, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xi. p. 247.

Prionastræa seychellensis, Milne-Edwards & Haime. Prionastræa seychellensis, M.-Edw. & H. Hist. Nat. Cor. ii. p. 517. Also from Seychelles and Red Sea (Milne-Edwards &

Haime); north-east of New Guinea (Studer).

Prionastræa magnifica, De Blainville.

Favastræa magnifica, De Blainville, Dict. Sciences Naturelles, lx. p. 340. Also from Batavia, Java (Milne-Edwards & Haime).

Prionastræa profundicella, Milne-Edwards & Haime. Prionastræa profundicella, M.-Edw. & H. Ann. Sci. Nat. (3) xii. p. 131. Also from New Ireland (Studer).

Prionastræa gibbosa, Klunzinger. Prionastræa gibbosa, Kl., Kor. Roth. Meer. p. 40, pl. iv. fig. 10. Found also in the Red Sea (Klunzinger).

Prionastræa halicora, Ehrenberg. Astræa halicora, Ehrenberg, Cor. Roth. Meer. p. 97. Also from the Red Sea (Ehrenberg).

Manicina Blainvillei?, M.-Edwards & Haime. Manicina Blainvillei, M.-Edw. & H. Hist. Nat. Cor. ii. p. 400.

A large explanate specimen; the gyri differ from the description given by the describers in being only 5-8 millim. across, instead of 8-10, and in the depth descending sharply into the calyx. The primary septum bears a paliform lobe in most cases; else I should have referred the species to Mæandrina, with which it agrees in other respects.

Cæloria Bottai, Milne-Edwards & Haime. Cæloria bottæ, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xi. p. 295.

Klunzinger (Kor. Roth. Meeres, iii. p. 17) unites this

species with several others under the name *arabica*; but I prefer, on the present occasion, to keep the original name, as it applies to what seems to be a more or less distinct form.

It occurs also in the Red Sea (Milne-Edwards & Haime).

Caloria ascensionis, Ridley, var. indica, nov.

Platygyra ascensionis, Ridley, Ann. & Mag. Nat. Hist. (5) viii. p. 438.

Calicles rapidly defined and seldom elongated; extreme diameter 2 to 4 millim.; a paliform, upwardly directed, thickened and roughened process rises in many calicles from the primary septum at the point at which it unites with the columella. This specimen is curiously variable as to the presence or absence of the paliform process referred to; a considerable variation in the size of the calicles appears due to the presence of perforating worm-tubes, causing condensation in parts. The typical form of the species, from which this variety differs in the points above noticed, was described from Ascension Island originally. Colony rising from a somewhat spreading base to form a hemispherical head about 50 millim. (2 inches) in diameter.

Cæloria ceylonica, n. sp.

Colony subhemispherical, massive. Calicles usually distinctly defined, occasionally forming short gyri, curved or undulating, 10 to 11 millim. in maximum length; the fully defined calicle polygonal, about 5 millim. in diameter; depth of calicles from summit of wall to surface of columella about 2.5 to 3.0 millim. Corallum dense and weighty.

Two cycles of septa; a rudimentary third not unfrequently occurring as a ridge about '5 millim. high and projecting from the wall into the calicle, commencing near the free margin of the wall; primary and secondary septa subequal, their margins sloping down obliquely from summit of wall about 1 millim., and then falling perpendicularly down towards the columella, the primaries reaching and uniting fully with the latter, the secondaries stopping short of its upper part, but uniting with it below. Septa thin; the primaries and secondaries with few very fine granulations on their surface, and with two or three blunt teeth on the lower part of their margin. Wall thin, barely '5 millim. thick at level of columella, sharp above and serrate with the septo-costal ridges. Columella distinct, formed of few contort laminæ connecting the septa. The colonies are chiefly small, not exceeding 100 millim. (4 inches) broad and 75 millim. (3 inches) high.

The species differs from the widely distributed Indian-Ocean species C. Esperi in the small, more angular calicles, less prominent septa, and the thinner wall. In these points it approaches C. (*Platygyra*) ascensionis, mihi, from the island of Ascension and of the present collection; but the wall is thinner and the calicles wider than is usual in that form, in which the difference in width between the primary and secondary septa is very marked and the septa are much more closely approximated to each other.

Baryastræa ----?

A subglobose colony of very dense texture; the calicles small, viz. 2.5 millim. in diameter. The walls are not thick, and exhibit no trace of grooves separating the calicles on their free margins.

Echinopora hirsutissima, Milne-Edwards & Haime.

Echinopora hirsutissima, M.-Edw. & H. Ann. Sci. Nat. (3) xii. p. 187.

Given by the above authors as from the Indian Ocean and as perhaps only varietally distinct from *E. horrida* of Dana, from the Pacific.

Family Fungiidæ.

Fungia repanda, Dana.

Fungia repanda, Dana, Zooph. U.S. Exploring Expedition, p. 295, pl. xix. figs. 1-3.

Occurs in Fiji Islands (Dana).

Family Eupsammiidæ.

Dendrophyllia Ehrenbergiana, Milne-Edwards & Haime.

Cænopsammia Ehrenbergiana, M.-Edw. & H. Ann. Sci. Nat. (3) x. p. 109, pl. i. fig. 12.

The late Dr. Brüggemann, who records it from the island of Rodriguez (Phil. Trans. clxviii. p. 574), referred the species to Dendrophyllia.

It occurs also at the Seychelles and in the Red Sea (Milne-Edwards & Haime), and at Mauritius (Möbius). Dr. Ondaatje informs me that it occurs occasionally on the reef on the Galle coast. The specimen which I have seen is quite normal, and shows the variability in the development of the columella to which Klunzinger (l. c.) has drawn attention.

18

Ann. & Mag. N. Hist. Ser. 5. Vol. xi.

Family Poritidæ.

Porites echinulata, Klunzinger. Porites echinulata, Klunzinger, Kor. Roth. Meer. ii. i. p. 43. Also from Red Sea (Klunzinger).

Porites punctata, Linné.

Madrepora punctata, Linné, Syst. Nat. (12) p. 1277.

Porites Gaimardi, Milne-Edwards & Haime.

Porites Gaimardi, Milne-Edwards & Haime, Ann. Sci. Nat. (3) xvi. p. 28.

Also from Fiji Islands, New Ireland, Australia (Milne-Edwards & Haime).

Pavonia percarinata, n. sp.

Growth partially incrusting. From an extensive base arise numerous subcylindrical lobes; lobes, when young, 4-5, when old 10-12 millim, in diameter at base, which is almost cylindrical, and on which the carinæ are very slightly marked, becoming irregular in outline towards apex, chiefly owing to the great development in number and size of the carinæ, which attain here a height of 1-2 millim. and are very sharp; they are chiefly longitudinal in direction; ends of lobes more or less rounded off, occasionally showing signs of division into secondary lobes; greatest height 30 millim. Surface of base more even than that of lobes, owing to the inferior frequency and prominence of the carinæ. Calices small, 1.5-2.0 millim. in extreme diameter, depressed; columella a single pointed papilla, often absent or obscure. Septa in three cycles, primaries and secondaries subequal, with strongly convex edge, thin; marginal teeth short, few; denticulations of surface numerous, prominent, sharp; tertiaries sloping obliquely downwards, scarcely half so wide at base as the secondaries; septa sloping more or less downwards from between calices. Corallum dense and massive.

Hab. Galle, Ceylon (Dr. Ondaatje).

The species which most closely resembles this externally is *P. prismatica*, Brüggemann (Journ. Mus. Godeffroy, xiv. p. 207), from Bonham Island (Marshall Islands); its lobes have not, however, the triangular form of those of that species; the calices seem to be much smaller, and are neither arranged in distinct transverse rows nor quite horizontal between the calices. *P. repens*, Brüggemann, is also nearly allied, but

wants the very sharp superior carinæ and the strong tendency to form lobose projections.

Pavonia explanulata, Lamarck.

Agaricia explanulata, Lamarck, Hist. Anim. s. Vert. (2) ii. p. 383.

Lamarck gives the species as probably from the Indian Ocean.

Pavonia, sp.

A species strongly resembling *P. repens*, Brüggemann, but with the different cycles of septa quite distinct in size from each other.

Family Madreporidæ.

Madrepora cytherea, Dana.

Madrepora cytherea, Dana, Zooph. U.S. Expl. Exp. p. 441, pl. xxxii. figs. 3 a, 3 b.

A large tabular specimen, rather elevated in the centre. Anastomosis of the branches has gone so far as to leave very few meshes between them; and their ends are but imperfectly distinct. Klunzinger records it from the Red Sea, Dana from Tahiti, Möbius from Mauritius.

Madrepora flabelliformis, Milne-Edwards & Haime.

Madrepora flabelliformis, M.-Edw. & H. Hist. Nat. des Coralliaires, iii. p. 156.

Recorded from the Indian Ocean by the above-named authors.

* Montipora foliosa, Milne-Edwards & Haime.

Montipora foliosa, Verrill, Proc. Essex Institute, vi. p. 51.

Recorded with doubt from Ceylon by Verrill.

* Stephanoseris sulcata, Verrill.

Stephanoseris sulcata, Verrill, Proc. Essex Institute, v. p. 48. Originally described from Ceylon by Verrill.

Group TABULATA.

Pocillopora grandis, Dana.

Pocillopora grandis, Dana, Zooph. U.S. Expl. Expedition, p. 533, pl. li. fig. 2.

This species is also found at the island of Rodriguez (Brüggemann), and at the Fiji Islands and Tahiti (Dana).

18*

Pocillopora brevicornis, Lamarck.

Pocillopora brevicornis, Lamarck, Hist. Anim. s. Vert. (2) ii. p. 443.

Appears to be common at Ceylon. It is also found at the Sandwich Islands and Fiji Islands according to Milne-Edwards and Haime, who also record it from Ceylon; Verrill also records it from Ceylon.

* Pocillopora elongata, Dana.

Pocillopora elongata, Verrill, Proc. Essex Institute, vi. p. 59.

Recorded by Verrill from Ceylon.

Suborder ANTIPATHARIA.

Cirrhipathes spiralis, Pallas.

Antipathes spiralis, Pallas, Elench. Zooph. p. 217.

This is a common Indian-Ocean species. Pallas's description is extremely accurate and renders identification easy. This is not the species so named by Pourtales (Bull. Mus. Comp. Zool. Cambridge, Massachusetts, vi. p. 114) from the West Indies; it probably does not occur in the Atlantic region.

Cirrhipathes anguina, Dana.

Antipathes anguina, Dana, Zooph. U.S. Expl. Exp. p. 576, pl. lvi. fig. 1.

A species quite distinct from the above, differing in the only slightly twisted condition of the axis and in the arrangement of the spines of the surface: these are longitudinally arranged in *A. spiralis*, with minute ones placed between the larger sharp ones; in *A. anguina* there is an obscure spiral arrangement and the smaller spines are wanting. Also from Red Sea (*Klunzinger*), Fiji Islands (*Dana*).

*Hydradendrium spinosum, Carter.

Hydradendrium spinosum, Carter, Ann. & Mag. Nat. Hist. (5) v. p. 454, pl. xix. fig. 8.

This was described by Mr. Carter as allied to the Hydroid genus Hydractinia; it appears, however, to belong to the Antipatharia, a view to which Mr. Carter himself seems inclined in a paper written subsequently to the original one (op. cit. vi. p. 301), mentioning Antipathes ulex, Ellis, as apparently identical in form with Hydradendrium.

Obtained in 65 fathoms in the Gulf of Manaar (Carter). Possibly identical with the following.

Antipathes faniculacea?, Esper.

Antipathes faniculacea, Esper, Pflanzenthiere, ii. p. 152, pl. vii. (? Pallas, Elench. Zooph. p. 207).

Esper's species came from the East Indies; Pallas gives the Mediterranean as the locality; so it is doubtful whether he refers to the same species or not.

Class HYDROZOA.

Subclass HYDROCORALLINÆ (Moseley).

Millepora dichotoma, Klunzinger.

Millepora dichotoma, Klunzinger, Kor. Roth. Meer. iii. p. 86.

Seems to differ from the description of *M. Forskali*, Milne-Edwards & Haime, in having the branches in a large specimen subparallel and almost wholly fused into laminar vertical expansions. Gastropores at very short intervals, viz. 1-2 millim.; dactylopores scattered irregularly between them. In a younger specimen the ends of some of the branches are cuneiform and the branches themselves are more distinct than in the older specimen. I think it best to refer the specimens to the above species, so fully described by Klunzinger, from the Red Sea, and assigned by him with doubt to the same form as the *M. Forskali* of Milne-Edwards and Haime, although the texture of the centre of the branches is denser than that described by Klunzinger, the branches are not particularly brittle, and the distinction in size between the dactylopores and gastropores is well marked.

Note by W. C. ONDAATJE, F.L.S., Colonial Surgeon of Ceylon.

I may state roughly the chief features of the coral-reefs from which the corals were collected.

The position of the reefs is south-west of Ceylon, fringing the coast of Galle; they are wholly submerged at high tide.

The corals grow in shallow water, and were collected during ebb-tide in the latter end of 1881, a few months previous to my departure for England. The mean temperature of Galle is 79°9 F.

The predominating kinds which go to the formation of the reefs are as follows:-The family Madreporidæ abounds,

especially the branched species, one species (the Madrepora cytherea) forming large slabs. Of the family Poritidæ we have Porites; the numerous family of Astræidæ is chiefly represented by the beautiful Galaxea, Manicina, Cæloria, and Maandrina, which is much used in making lime; immense blocks are taken to Colombo by boats for the purpose. Of the Milleporidæ we have one foliaceous species growing in masses. Of the family of Favositidæ one species of Pocillopora (grandis) grows luxuriantly, forming extensive blocks. One block which I removed from the growing mass two men carried with difficulty. Among the Alcyonoids there are several species of sponge-like appearance under water (Alcyonium and Sarcophytum), and remarkable for the beauty of their spicules. Among the reefs are to be found Sponges, Polyzoa incrusting the bottom of many corals, Holothurians, &c., Melobesia growing in masses with the corals.

My time having been limited, I have not been able to make a thorough examination of the reefs.

XXXV.—On the Jurassic Varieties of Thurammina papillata, Brady*. By Dr. RUDOLF HÄUSLER.

[Plate VIII.]

Among the Jurassic Lituolidæ no species deserves our attention in such a degree as *Thurammina papillata*, Brady, on account of its wide range and especially its great variability. There is no positive evidence of the occurrence of the genus *Thurammina* in the Lias and the Lower Dogger, although small fragments of a similarly formed arenaceous type have been occasionally met with. The oldest known perfect specimens of *Thuramminæ* were discovered in the so-called Spathkalke of the Upper Bathonian zone of *Rhynchonella varians*;

- * BRADY. "Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition," Micr. Journ. vol. xix. n. s. p. 26, tab. v. figs. 4-8.
- CARPENTER. 'The Microscope and its Revelations,' fifth ed. p. 533, fig. 273, g, h.
- UHLIG. "Ueber einige oberjurassische Foraminiferen mit agglutinirender Schale," Neues Jahrb. f. Min. Jahrg. 1882, B. i. p. 152.

HÄUSLER. "Die Astrorhiziden und Lituoliden der Bimammatus-Zone," Neues Jahrb. f. Min. 1883, Bd. i. p. 60, Taf. iv. figs. 9-13.

HÄUSLER. "Notes on some Upper Jurassic Astrorhizidæ and Lituolidæ," Quart. Journ. Geol. Soc. vol. xxxix. p. 27, pl. iii. figs. 2-6.



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