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## XXXV.—On the Jurassic varieties of *Thurammina papillata*, Brady

Dr. Rudolf Häusler

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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*, *Cœloria*, and *Mæandrina*, 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 *Thurammina* were discovered in the so-called Spathalke of the Upper Bathonian zone of *Rhynchonella varians*;

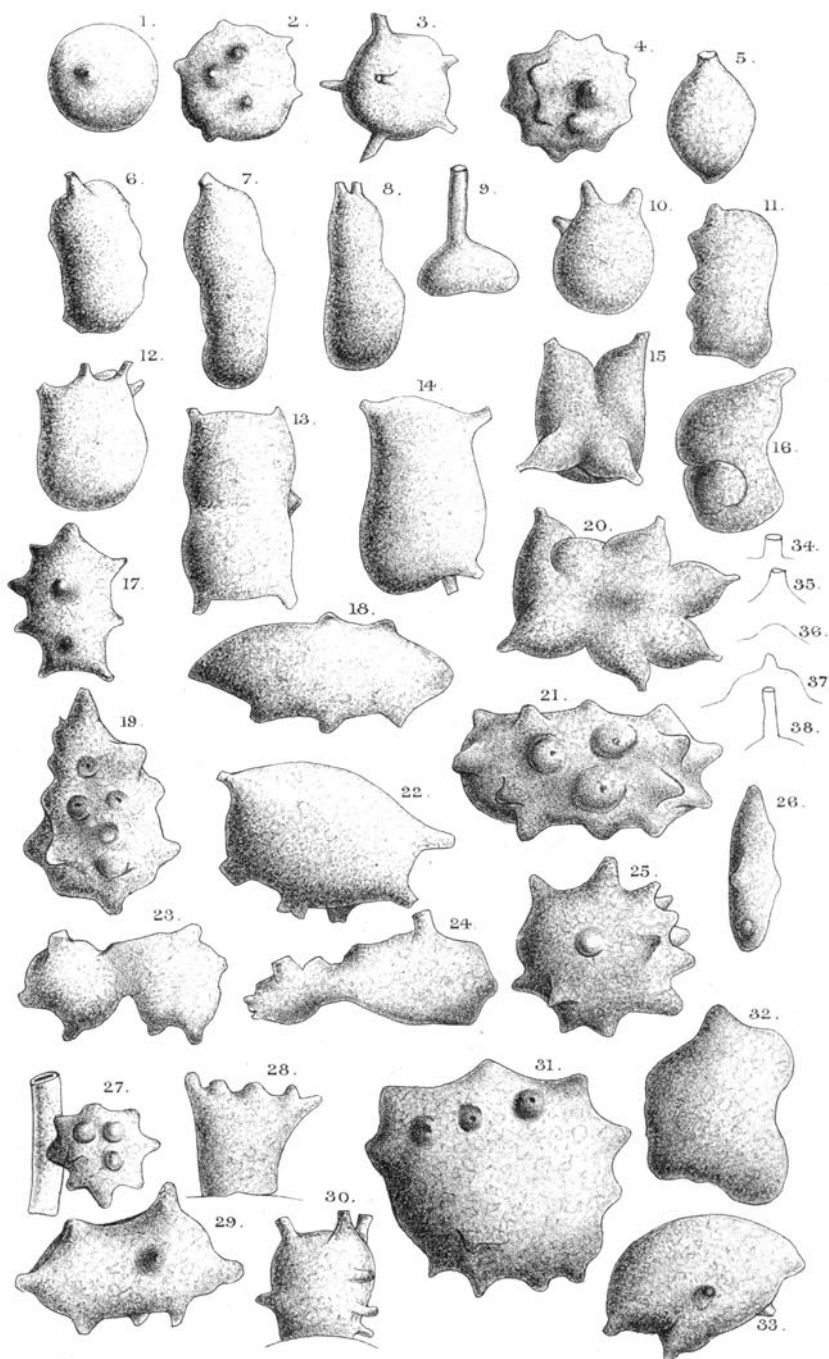
\* BRADY. "Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition," *Micr. Journ.* vol. xix. n. s. p. 26, tab. v. figs. 4-8.

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.



they belong to two species, *Th. papillata*, Brady, and *Th. hemisphærica*, Häusl. Both make their appearance again in the compact limestones of the Callovian zones, where, however, they are very rare. The finest and most numerous shells of *Th. papillata* have been collected in the sponge-beds of the Lower Malin, especially in the zone of *Ammonites transversarius* (Argovian I.), where the whole family Lituolidæ reaches its maximum development in the Jurassic formation. In a paper on the *Trochamminæ* of this zone\* I proposed to divide the alternating layers of soft marls and harder marly limestones into three subdivisions in the Canton Aargau. In accordance with the different lithological and palæontological characters, we observe certain striking differences in the distribution and the composition of the arenaceous Foraminifera †. The oldest calcareous beds, full of siliceous sponges, Brachipoda, Cephalopoda, &c., contain a rich fauna of arenaceous types, among which the *Thuramminæ* are conspicuous by their comparatively large size and certain peculiarities in the disposition and shape of the papillæ and the texture of their thin walls. While these beds yielded the largest and most irregular forms of a characteristic yellowish colour, the younger layers contain particularly the more regular colourless varieties, and the youngest argillaceous beds, C, the minute more or less spherical specimens.

These small varieties, somewhat resembling *Th. albicans*, Brady, are unfortunately so cemented into the matrix that it is almost impossible to extract perfect specimens. In the younger zone of *Terebratula impressa* (Argovian II.) the whole genus is represented by a similar very scarce variety of *Th. papillata*. In the compact limestones of the following zones, especially in the sponge-beds of the Lower Sequanian stage, the *Thuramminæ* are moderately plentiful. Towards the Kimmeridge group of the Swiss Jura they disappear gradually; and, so far as I could observe, only one doubtful variety passes into the Lower Cretaceous beds (Neocomian I.) of the Cantons Vaud and Neuchâtel.

Further researches in other Jurassic countries will no doubt enable us to give in a short time a more complete account of the distribution of this interesting species.

As a rule, *Thurammina papillata* is found in greatest number and finest specimens in the beds with abundant *Hyperamminæ* (*H. vagans*, Brady).

In comparing a great number of specimens of different ages

\* Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 49.

† These differences and the characteristic varieties will be described in my Monograph of the Foraminifera of the zone of *Am. transversarius*.

and localities, we find that the species can be divided into a number of groups, each of which contains some characteristic, and often remarkably constant, varieties. But, owing to their great variability, most of them can be connected through intermediate forms, forming thus a single series from the simple spheroidal to the most complicated types.

As regards bathymetrical range, the Jurassic *Thurammia papillata* is found in greatest number in the deposits with true deep-sea character, much more rarely and in less typical specimens in those formed at moderate depths. As the distribution of the recent *T. papillata* is world-wide\*, its oldest fossil representatives seem to be present in the deep-sea sediments all over Europe in countless modifications, many of which have not been found in a recent state. On the other hand the globular large varieties with small papillæ and very finely arenaceous tests of our existing seas are not known in a fossil condition.

The tests of all the Jurassic specimens of *T. papillata* are very thin, composed of small grains of quartz-sand, neatly fitted together, and united by a colourless, brownish, or yellow cement.

In describing briefly the various groups, I hope to add to the knowledge of the *Thurammia*, as well as to that of the Foraminifera in general, in connexion with the great variability of certain forms and the wide geological range of species characteristic of the deeper parts of the present sea.

1. Test free, small (0.1 millim.), more or less spheroidal. Papillæ disposed regularly or irregularly all over the surface. Test finely arenaceous, generally colourless, or of a light brownish colour. A single specimen from the *Bimammatus*-beds of the Portuguese Jurassic formation showed a very dark brown colour. These forms sometimes resemble *Thurammia albicans*, Brady, with which they are found associated in the Upper Jurassic zones, especially in the sponge-beds of the Argovian and Sequanian stage, all over the continent.

Figs. 1-4 represent the more characteristic varieties, and fig. 25 a larger specimen with numerous papillæ. A typical specimen from the *Bimammatus*-beds of Baden (Cant. Aargau) is figured in N. Jahrb. f. Min. 1883, Bd. i. tab. iv. fig. 10.

2. Test free, compressed, generally symmetrical, large (0.5-1 millim.). Papillæ numerous, disposed all over the surface. Colour yellow. The finest specimens from the sponge-beds of the Lower Malm (zone of *Ammonites transversarius*) are almost transparent and of a characteristic yellowish colour (fig. 21).

\* Brady, l. c. p. 27.

3. Test free, more or less cylindrical, large. Papillæ numerous, regularly disposed all over the surface in straight lines. Test generally very thin, cement brownish or colourless (figs. 17, 31). These forms seem to be characteristic of the sponge-beds of the Lower Malm.

4. Test free, compressed, often lenticular. Papillæ irregularly disposed, generally near the margins. Some of these varieties resemble *T. compressa*, Brady\*; but the texture is the same as in the typical *T. papillata*. Not common in the sponge-beds of the Lower Malm (figs. 11, 18, 22, 26).

5. Test free, more or less spheroidal or cylindrical. Papillæ small, tubular, few in number, placed at one or both ends of the shell. Cement brownish or colourless. Some of the most interesting modifications are represented by figs. 10, 12, 13, 14.

These rare forms were obtained from the marly limestones of the *Transversarius*-zone.

6. Test free, irregular, cylindrical, or flask-like, bearing a single aperture at the end of the chamber. Cement generally colourless (figs. 6, 7). Fig. 8 represents a specimen with two small orifices. A nearly globular specimen from the zone of *Ammonites transversarius*, bearing a long wide cylindrical neck, is figured Q. J. G. S. vol. xxxix. tab. iii. fig. 3, and another from the zone of *A. bimammatus* in N. Jahrb. f. Min. vol. i. 1883, tab. iv. fig. 11.

7. Test free, large (1 millim.), irregular. Papillæ large, conical, touching each other at the base. Cement of a peculiar light yellow or brass-like colour. These varieties appear to be characteristic of the Lower Malm. Figs. 15, 16, 20 represent the simpler forms. A typical specimen is figured Q. J. G. S. vol. xxxix. tab. iii. fig. 2.

8. Besides the above-mentioned forms, the various Jurassic zones from the Bathonian to the Upper Sequanian beds contain numerous quite irregular, sometimes monstrous specimens, as figs. 23, 24, 32, 33.

9. Test fixed, flask-like, without papillæ, ending in a long neck, bearing the large circular aperture. Cement generally hyaline; attached to the shells of mollusks, stems of crinoids, grains of sand, &c. (fig. 9, and N. Jahrb. f. Min. 1883, vol. i. tab. iv. fig. 9), in the Upper Jurassic sponge-beds.

10. Test fixed, irregularly shaped, spheroidal, cylindrical, or conical. Papillæ generally few in number, variously disposed all over the surface of the chamber. Cement usually hyaline. Attached to the tubes of *Hyperammia vagans*, Br., rarely to *Placopsilina* or other fossils (figs. 27, 30, and Q. J.

\* Brady, *l. c.* p. 27, tab. v. fig. 9.

G. S. xxxix. tab. iii. fig. 6). Not common in the Lower Argovian beds.

11. Test fixed, more or less cylindrical, small, bearing a small number of short papillæ regularly disposed round the margin of the chamber. Cement hyaline. Rare, in the Upper Jurassic sponge-beds (fig. 28, and Neues Jahrb. 1883, tab. iv. fig. 12).

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Brady mentions an interesting polythalamous form, two or three chambers being adherent to each other. I have not been able to find similar specimens in the Jurassic beds; but it is possible that they occur, especially in the sponge-beds, with numerous spherical varieties, but that the single chambers are broken off during the preparation. As an interesting fact, we must mention that several specimens were found with a second interior chamber, similar to those described by Brady.

Trusting that these few remarks on a very important but still little known arenaceous form may give new proofs of the continuity of certain species and of the great variety of Foraminifera, I must express my thanks to all the gentlemen who have assisted me by sending specimens for comparison, washings from Jurassic rocks, samples of limestones, and notes on the occurrence and different varieties of *T. papillata*.

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### XXXVI.—*Investigations upon some Protozoa.*

By Dr. AUGUST GRUBER\*.

[Plate XIII.]

THE present memoir consists of several sections which stand in no direct connexion with each other, and extend over various regions of Protozoology. The first part is devoted to the description of some new Rhizopods, which will be found interesting in several respects; in the second some Infusoria, partly new, partly not well known, will be described; and the last section will treat of some peculiar phenomena of union in Heliozoa.

Besides the observation of the living animal, I have availed myself of the mode of preparation described by Korschelt †,

\* Translated by W. S. Dallas, F.L.S., from the 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xxxviii. pp. 45-70.

† "Ueber eine neue Methode zur Konservirung von Infusorien und Amöben," Zool. Anzeig. no. 109.