

2. NOTES on some UPPER JURASSIC ASTORRHIZIDÆ and LITUOLIDÆ.

By Dr. RUDOLF HÄUSLER, F.G.S. &c. (Read November 1, 1882.)

[PLATES II. & III.]

THE latest researches on the arenaceous types of the Reticularian Rhizopoda from the Swiss Jurassic formation, especially from the zones of *Ammonites transversarius* and *A. bimammatus*, have yielded so many unexpected results concerning the relationship of certain species and varieties with recent forms, that a few preliminary notes on some important species may be of interest, as adding to the knowledge of the arenaceous Foraminifera in general, and giving new proofs of their wide geological range.

If we examine the various works on Swiss Jurassic Foraminifera, the small number of arenaceous forms recorded must surprise us. It may to some extent be attributed to the little attention which was formerly paid to many sandy species, and the imperfect knowledge of the simpler forms, but probably still more to the great difficulties attending a careful examination of the hard marls and limestones.

Most of the species are of comparatively small size and very fragile, whereby they easily escape observation.

The total number of determined arenaceous species is about 60 for the whole Swiss Jurassic formation, if we include the *Textulariidae*; but, to judge from doubtful specimens and fragments, their number must become considerably greater by further researches.

These species, with an almost unlimited number of varieties, belong to the following genera:—

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|-----------------|-------------------------|
| Psammosphæra. | Placopsilina. |
| Astorrhiza. | Trochammina. |
| Rhabdammina. | Ammodiscus. |
| Marsipella. | Hormosina. |
| Hyperammina. | Webbina. |
| Lituola. | Thurammina. |
| Reophax. | Textularia (Plecanium). |
| Haplophragmium. | Bigenerina. |
| Haplostiche. | Valvulina. |

By far the greatest number have been found in the lowest beds of the zone of *Ammonites transversarius*, from which all the specimens figured in this paper are taken.

While a few species are identical with Carboniferous or Permian forms (*Troch. (Am.) incerta, gordialis, pusilla, filum*), most of the others most nearly approach recent deep-sea varieties, from which they often differ but very little. The resemblance of the Rhizopodal fauna of the Jurassic "sponge-beds" to that of the deep sea is the more surprising, as many of the species have not been found in the younger formations.

As a more complete memoir on the Foraminifera of the zone of *Amm. transversarius* will appear next year, only a few species and

interesting varieties will be described and illustrated in this short paper.

PSAMMOSPHÆRA FUSCA, Schultze. Plate II. fig. 1.

There occur in the oldest beds of the Argovian stage, and again in the zone of *A. bimammatus**, minute spherical bodies of a coarsely arenaceous nature, without any large pseudopodial apertures, which agree in their principal characters with *Ps. fusca*, Schultze.

The cement is generally hyaline; but in a few cases a light yellow colour has been preserved. These spheres are very small, never exceeding 0·6 mm., and composed of large grains of quartz-sand. In the specimen figured, Pl. II. fig. 1, a part of the cement has been removed with dilute hydrochloric acid.

Before treatment with acids many arenaceous Foraminifera (*Psammosphæra*, *Reophax*, *Trochammina*, &c.) are very difficult to distinguish from grains of sand or fragments of other organic remains, as they are usually covered with a thin deposit of carbonate of lime.

HYPERAMMINA VAGANS, Brady. Plate II. figs. 2-6.

In the whole Middle and Upper Jurassic formation we meet frequently with the large, tubular, finely arenaceous tests of this species. Some free and attached forms have been erroneously described by me as purely siliceous and externally corroded organic remains †. The species is very variable as regards its external appearance, being entirely free, fixed, or partly free, straight, irregularly bent or twisted, sometimes spiral. The latter forms are always fixed. The simplest specimens form a large bulbous chamber drawn out in a long conical tube. *H. vagans* is the largest Jurassic Foraminifer, as it reaches a total length of several millimetres when attached to the stems of Crinoids, valves of Brachiopoda, &c.

From the recent forms described by Brady ‡ they differ very little.

Though generally of pure white colour, specimens of a brownish colour are often met with.

REOPHAX MULTILOCULARIS, sp. nov.

Test long, slender, fragile, straight or irregularly bent, consisting of 22-25 small segments separated by slight constrictions. Oldest chambers broad, youngest oblong, rounded; test built up of comparatively large grains of sand, firmly cemented by a colourless calcareous cement. Surface very rough. Length 1 mm.

In its general outlines, *R. multilocularis* bears some resemblance

* In a paper "Die Astrorhiziden und Lituoliden der Zone des *Ammonites bimammatus*," Neues Jahrb. f. Min. &c. 1883, vol. i., several species have been briefly described and figured, to show their identity with the forms from the older zone of *Amm. transversarius*.

† Häusler, Untersuch. über die micr. Struct. d. Aarg. Jurakalke, p. 25, pl. i. figs. 16, 20, 52-54.

‡ Brady, "Notes on some of the Reticularian Rhizopoda of the 'Challenger' Exp.," Micr. Journ. vol. xix. p. 14, pl. v. fig. 3.

to *R. nodulosa*, Brady, but the texture is sometimes like that of *R. scorpiurus*, Montf.

R. multilocularis appears to be characteristic of the Lower Malm of the Canton Aargau, where several specimens were obtained from a bed with numerous Cephalopoda.

REOPHAX HELVETICA, Häusl. Plate II. figs. 8-10.

This species was described by me as *Dentalina helvetica* * from the zone of *Amm. transversarius*. It has since been found in the younger sponge-beds of the Swiss Malm †, but is nowhere common, and generally in small fragments.

REOPHAX SCORPIURUS, Montf. Plate II. fig. 7.

The figure represents a unilocular *Lituola*, which is probably identical with *R. scorpiurus*. The tests are generally of small size, seldom exceeding 0·8 mm., flask-like, somewhat pyriform, or long, cylindrical, often slightly constricted, or bent, of a coarsely arenaceous nature, and not rare in the sponge-beds of the lower Argovian étage. Small fragments of this or a nearly related species are common, but difficult to distinguish before treatment with acids.

There occur in the same beds other coarsely sandy tests of doubtful nature, which, owing to their bad state of preservation, often with chemical changes, could not be determined.

PLACOPSILINA CENOMANA, d'Orb. Plate III. fig. 1.

P. cenomana is one of the commonest arenaceous species of the whole Jurassic formation.

In certain banks of the Lower Malm it is almost impossible to find shells of Brachiopoda without traces of *Placopsilina* and *Hyperamminea*. Typical specimens differ in no way from those of other formations.

THURAMMINA PAPILLATA, Brady. Plate III. figs. 2-6.

The Jurassic *Thuramminea* differ but little from the recent forms described by Brady ‡. Some of the specimens still show the peculiar yellowish colour.

As the recent *Th. papillata* is very variable, we meet also in the *transversarius*-beds with a large number of varieties, passing from small, almost smooth, *Orbulina*-like forms to the large (1 mm.) papillated types.

In a few instances polythalamous specimens similar to that mentioned in Brady's paper were observed. As Uhlig § discovered the same species in the zone of *Amm. transversarius* in the neighbourhood of Brunn, *Th. papillata* must be a widely distributed species, mounting up into the zone of *Amm. bimammatus*.

* Häusler, *l. c.* p. 34, pl. ii. fig. 45.

† Häusler, "Die Astorrhiziden &c.," Neues Jahrbuch f. Min. 1883, vol. i. p. 59, pl. iii. fig. 11.

‡ Brady, *l. c.* p. 26, pl. v. figs. 4-8.

§ Uhlig, "Ueber einige oberjurass. For. mit agglut. Sch.," Neues Jahrb. f. Min. 1882, vol. i. p. 152.

THURAMMINA HEMISPHERICA, Häusl. Plate III. figs. 7-9.

Test invariably fixed, nearly hemispherical, monothalamous, with few indistinct papillæ placed round the margin.

Test finely arenaceous, very thin, transparent. Diam. 0.5 mm. By its simple, more or less hemispherical chamber, the smallness and arrangement of the few papillæ, and the very thin, hyaline test this species is easily distinguished from the fixed varieties of *Th. papillata*.

T. hemisphærica is not common, but widely distributed in the zones of *Amm. transversarius* and *A. bimammatus*.

From these few notes we may conclude that probably most of the recent genera of Astrorhizidæ and Lituolidæ were already represented in Mesozoic sediments, either by the same or nearly allied species.

Though the zone of *Amm. transversarius* and chiefly its sponge-beds are the richest in arenaceous Foraminifera amongst the Upper Jurassic sediments, yet a careful study of the microscopic remains of the younger beds is sure to yield better results in time. Amongst these the zone of *Amm. bimammatus* (étage Séquanien I.) with a well-developed fauna of hexactinellid sponges is undoubtedly the richest; but the collecting offers great difficulties. A good many Astrorhizidæ and Lituolidæ were, however, collected about six years ago at Auenstein, Remigen, and the Rhyfluh.

From the zone of *Amm. tenuilobatus* about ten species are known from Baden and the Lägern. The English Upper Jurassic deposits seem to be much less rich in arenaceous Foraminifera.

The distribution within the limits of the zone of *Amm. transversarius* is very irregular, so that up to the present time certain species are known only from a small district or even a single locality, where the conditions for their preservation must have been specially favourable.

With the typical forms we meet in almost every zone with varieties or monstrosities from which many interesting facts concerning the relationship of widely different species may be obtained.

As a rule, we observe amongst the Jurassic Astrorhizidæ and Lituolidæ that all the hosts of varieties show a strongly marked tendency to fall back into the simplest typical forms, which, from their wide geological range, we are obliged to suppose possess the greatest chance of surviving in the struggle for existence.

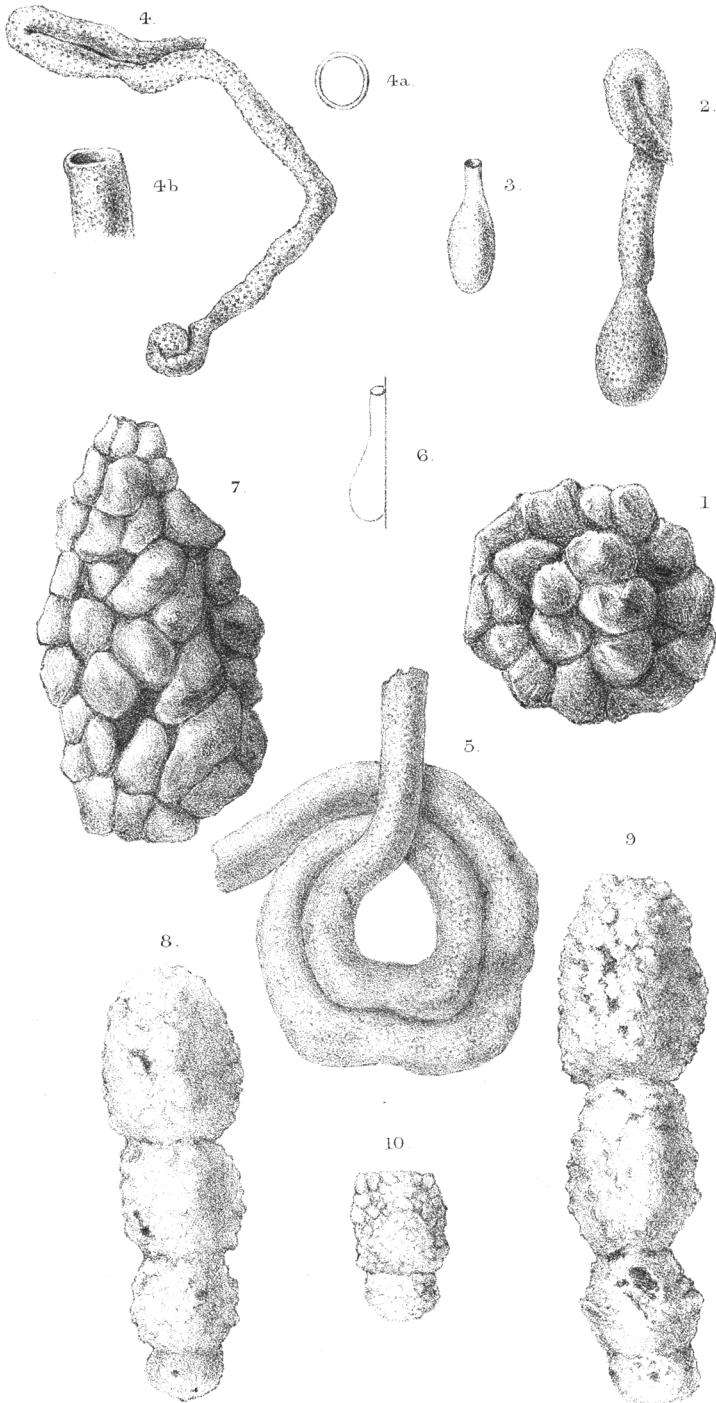
EXPLANATION OF THE PLATES.

PLATE II.

- Fig. 1. *Psammosphæra fusca*, Schultze.
2-6. *Hyperammmina vagans*, Brady (spiral var.).
7. *Reophax scorpiurus*, Montf. (?).
8-10. *Reophax helvetica*, Häusl.

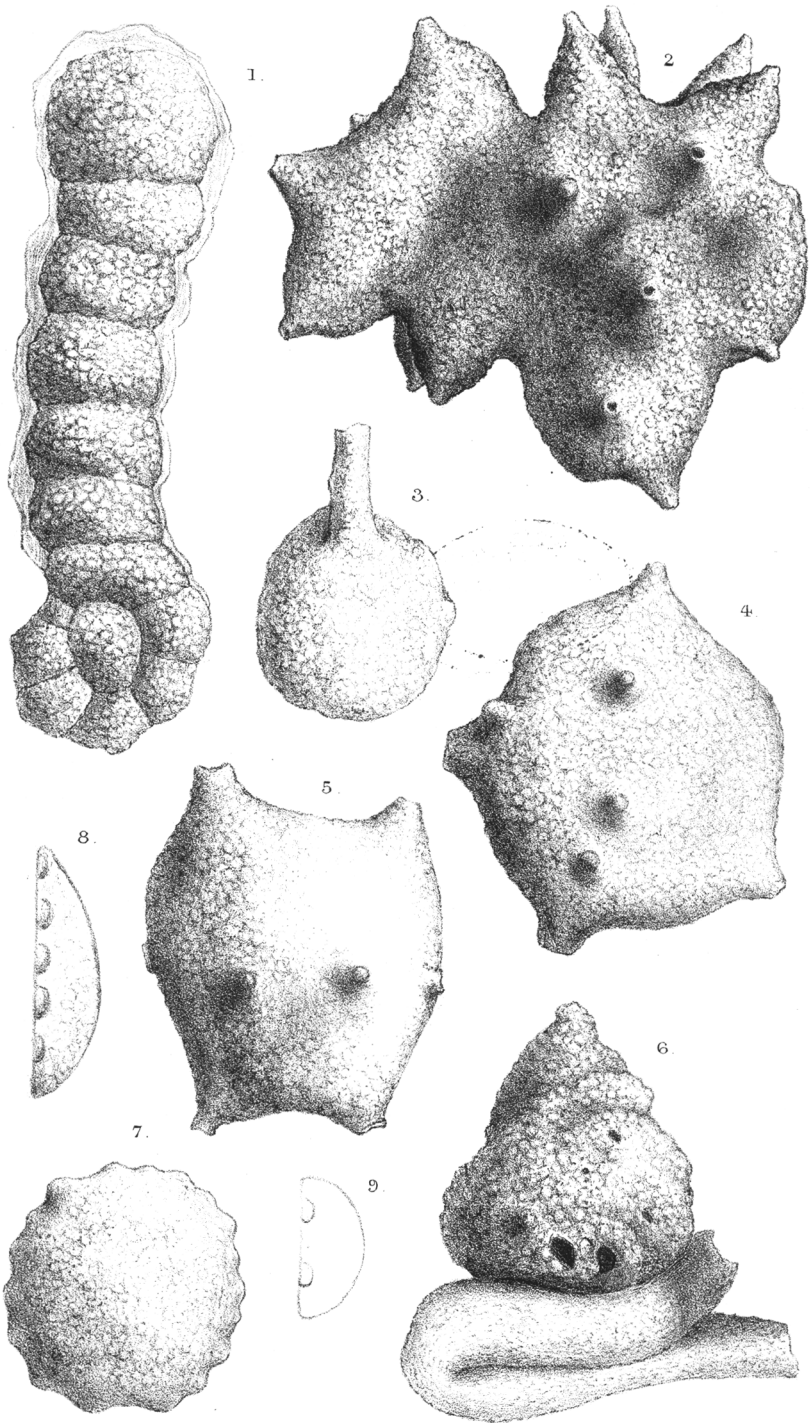
PLATE III.

- Fig. 1. *Placopsilina cenomana*, d'Orb.
2-5. *Thurammmina papillata*, Brady.
6. *Thurammmina papillata* upon *Hyperammmina vagans*.
7-9. *Thurammmina hemisphærica*, sp. nov.



A. S. Foord, lith.

Mintern Bros. imp.



A. S. Foord. lith.

Mintern Bros imp.

SWISS JURASSIC FORAMINIFERA.

DISCUSSION.

Prof. RUPERT JONES said that these deposits seemed to be of much interest. The difference of shape in Foraminifera was so great that it was not an easy task to settle the limits of a species. He described the mode of formation of the tests of arenaceous Foraminifera. The author had doubtless spent great pains in working out these Foraminifera. Arenaceous Foraminifera (Nodosarians) occur as far back as the Permian. The Society was indebted to Dr. Häusler for his important addition to our knowledge of the Swiss Foraminifera.