No. IV.—ON *GYPSINA PLANA*, CARTER, AND THE RELATIONS OF
THE GENUS.

By MARJORIE LINDSEY, B.Sc., *The University, Manchester.*

(Text-figures 1—6.)

(COMMUNICATED BY PROF. J. STANLEY GARDINER, M.A., F.R.S., F.L.S.)

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IN the collections made by Prof. J. Stanley Gardiner in the Indian Ocean in 1905 specimens of a Foraminifer were obtained from Mauritius* (>100 fathoms), Amirante (25 fathoms) and Providence (50—78 fathoms) which have acquired a fixed mode of existence to an extraordinary degree.

They form irregular spreading masses over any object on which they happen to grow, generally old coral detritus, *Polytrema*, sponges and polyzoa—in short, on pretty nearly any kind of decayed calcareous matter.

The most striking feature of this foraminifer, in addition to its encrusting habit, is its extraordinary size, not only of the mass as a whole, but to a certain extent also of the individual chambers. The specimens reach in some cases (e.g. those from Mauritius) three or four inches diameter in their widest parts and they may spread until they completely surround the decayed matter on which they are growing.

This incrustation is not simply a uniformly thin layer, but grows out into projections forming an irregular series of knobs all over the surface.

The spirit material is of a pink colour, but it goes white on drying.

When magnified the surface† is seen to consist of numbers of chambers arranged more or less regularly with well defined walls separating them, giving it the appearance of being divided into areolæ, each roughly circular in shape and each perforated by a few large foramina. These areolæ vary in size in the specimens from different localities, but are largest in those from Mauritius, and these specimens, on account also of the larger size to which the mass as a whole grows, have been mainly used for working on. Here the areolæ vary from 90—233 μ , but an average chamber is somewhere about 120 μ in diameter.

The areolæ are separated by grooves about 5 μ wide, which represent the walls.

The perforations are not very numerous and are from 10—20 in each areolæ, each being 5—7 μ in diameter.

* See "Description of the Expedition," Trans. Linn. Soc. Ser. 2, Zool., xii. (1907), p. 122.

† For a figure of a similar surface see Challenger Report, ix. plate 102.

The walls and foramina are of about the same size in the other specimens, but the chambers as above stated are smaller, those from Providence varying between 80 and 150 μ , with an average of 105 μ and from Amirante 49—115 μ with an average of 89 μ .

Fig. 1. Specimen of *Gypsina plana*, Carter, from 100—200 fathoms, off Mauritius, nat. size.

A vertical section through the incrustation shows the chambers arranged in rows parallel to the surface, the chambers of one row alternating more or less regularly with those of the row above.

The typical form of the chambers as seen in such a section is more or less oblong, the upper and lower walls being slightly convex outwards; the surface walls do not differ from the others in any noticeable features, though on the whole they are somewhat flatter.

The chambers are seen communicating with one another by gaps in the wall representing the foramina.

Fig. 2. Vertical section, magnified about 120 diameters.

On account of the presence of the irregular projections of more or less spherical nature, such a true vertical section is rather difficult to obtain, and the most usual one is a transverse section through one of these knobs.

In such a transverse section the cells are seen more or less concentrically arranged round a common centre, especially in the outer layers, the inner ones being frequently

irregular in arrangement, shape and size, and while those chambers towards the outside of the knob are very similar in shape to those seen in a vertical section, the inner ones are irregularly polygonal.

Fig. 3. Section through the centre of a knob, showing the irregular arrangement, shape and size of the chambers, also the perforated plates. $\times 96$.

Fig. 4. Section showing the arrangement in the outer layers of a knob or in a section at right angles to the surface in the ordinary thin part of the layer. $\times 75$.

The foramina occur not only in the walls seen in section, but also in those in the plane of the section, in which case the walls are seen as perforated plates.

Fig. 5. Enlargement of portion of Fig. 4 to show the gaps in the walls of the chambers as well as the perforated plates. $\times 212$.

These perforations occur right up to the centre of the foraminifer, and not merely in the superficial layers as in *Homotrema* and *Sporadotrema*, and they are all of the same

kind, there being no evidence of the so-called pillar pores of *Polytrema* nor any other large spaces or passages of any kind.

Compared with the foramina of the *Polytrema* group these are of relatively large size (5μ in this form and 1μ in *Polytrema*) and relatively few in number.

The walls are seen in thin sections to consist of fibrous crystalline calcite; each chamber has not its own individual wall, but is built up, so to speak, on the layer below (Figs. 4 and 5).

No coiled initial chambers have been observed, but this is possibly due to the large size of the specimens making search very difficult, and it is more than probable that the mass did arise from some such coiled chambers as are found in other sedentary foraminifera. Once started on its encrusting mode of life it simply enveloped everything it came across, as is well seen in some sections (unfortunately too thick to photograph) where the foraminifer is seen surrounding *Polytrema*. Here the chambers immediately round the

Fig. 6. Section showing a shell of *Polytrema* in the centre surrounded by the chambers of *Gypsina*.

Polytrema are smaller and flatter than the ordinary ones, but do not differ otherwise, and gradually merge into quite typical perforate chambers.

Some of the spirit material was decalcified and sections of the remaining soft parts were obtained. These, however, were not very successful, as the material shrank considerably on being embedded in wax, and they showed no further details except that in one series there was a suggestion of an initial chamber, but this was unfortunately not clear enough to make a definite statement about.

Briefly, then, the foraminifer may be described as follows: Sedentary, of large size, the surface marked into clearly defined areolæ about 120μ in diameter and with the walls of each chamber perforated by a few large foramina— 5μ in diameter. Below the surface are seen rows of chambers communicating by perforations in the walls and *not* by large open passages. There is no general aperture and no supplemental skeleton of spines and tubercles as in *Tinoporus*.

A point worthy of notice in connection with this foraminifer is the occurrence of large

numbers of sponge spicules embedded in it and penetrating it in all directions in exactly the same manner as in *Polytrema*.

That these are foreign bodies incorporated in some way by the foraminifer and are not part of its structure seems reasonably certain, as both the foraminifer and the spicules are so typical of their kind. But it is nevertheless singular that these tetraxonid spicules seem about the only kind of foreign matter picked up by the foraminifer, and they may therefore be of some importance to the animal in the living condition; for it seems probable that the spicules were picked up during growth, as they are too large and firmly imbedded to have penetrated later by the foraminifer being overwhelmed by the sponge.

As to the affinities of this foraminifer, there are four genera all among the Rotaliidae to which by its general appearance it might belong; these are *Planorbulina*, *Cymbalopora*, *Tinoporus* and *Gypsina*. *Planorbulina* consists typically of a single layer of chambers, spiral in the early stages but more irregular later, the chambers of successive whorls alternating with one another and each having an opening at each end close to the line of union with the previous whorl. In certain forms there are a number of small chambers not arranged in any particular order which cover the surface, but as in the form under discussion there are no specialised openings of any kind or any additional chambers on the surface, its inclusion in this genus is not possible.

In *Cymbalopora* the successive chambers are not closely contiguous and are separated by intervals which appear on the under surface as fissures, and each chamber opens directly into a central cavity on this underside. Here again the presence of these specialised openings renders it impossible to connect the two.

The original *Tinoporus* of Carpenter was characterised by the acervuline massing of the chambers and by the absence of any specialised mouth or general aperture; in some forms there was a supplemental skeleton of spines, &c., in others this was absent.

It was these latter which Carter in 1877 split off as his new genus *Gypsina* on account of their greater simplicity of form, and it is to this genus that the foraminifer under discussion really belongs, as shown by its general appearance, the relative size of the foramina and cell walls, together with the absence of any supplemental skeleton.

But it must be confessed that the original description of this genus was rather an unsatisfactory one; it was, however, amended by Brady in the Challenger Reports, and now reads as follows:

“Test free or attached, spheroidal or spreading, structure acervuline radiating or laminated, chambers rounded or polyhedral; coarsely perforated. No supplemental skeleton, no canal system and no general aperture.”

In the same paper in which this new genus was instituted, Carter points out that a foraminifer previously described by him in a paper in 1876 as *Polytrema planum* must now be included in this new genus under the new name of *Gypsina melobesiodes*, as it was merely a small specimen of a foraminifer with a melobesia-like growth; and the fact that this specimen of Carter's comes from Mauritius and was found coating old coral detritus, &c., “like the white saccharine icing on bridecake,” to a very considerable extent renders it probable that the material collected by Prof. J. Stanley Gardiner is really

the same thing. But neither under its old name of *Polytrema plana* nor its new one of *Gypsina melobesiodes* is the description really clear.

As no figures were given in the later paper and those in the former were of specimens $\frac{1}{8}$ -inch in diameter, no real idea of the structure is obtainable, and further, as the series of canals shown in the original figure and described in the original description as the distinguishing feature of the foraminifera were in the later paper shown to be non-existent, the name *Gypsina plana* (or *melobesiodes*) seems to be nothing more definite than a name, and hence it is proposed to apply it to the specimens under discussion as being in all probability the correct identification of at any rate the Mauritius specimens. Of the two specific names, however, "*plana*" must take precedence over the more suitable "*melobesiodes*." Except that the difference in size of the chambers in the Amirante and Providence specimens makes them look more heavily built than the ones from Mauritius, and that in the material under observation these latter incrustations were much larger in size, there is no real difference in structure. Further, as both the size of the chambers and the size of the mass vary considerably in the material from the same districts, there seems no reason for making three species of them, and hence all must now be known as *Gypsina plana*.

It also seems probable that an unidentified specimen from the West Indies in the Halkyard Collection of Foraminifera in the Manchester Museum belongs to this species; the size of the chambers is rather smaller, being only 70—80 μ , but it grows to the extent of an inch or more over the surface of a shell of *Strombus gigas*, and is therefore considerably larger than any other known *Gypsina*. If this specimen does really belong to this species, it would seem to have a fairly wide distribution both in space and depth.

As reference has been made several times to the relatively large size of *Gypsina plana*, it is perhaps advisable to have a few measurements of other forms of *Gypsina* to compare with it. Carter gives no measurements at all of his type *Gypsina vesicularis*, and only outside measurements (2.3 inches) of *G. plana*, nor are any to be found elsewhere (except indirectly, as when the "Challenger" figures are said to be magnified 30—40 times), but all are of small size, not being more than a millimeter or so in outside diameter. No measurements of the areolæ are to be found, but in the specimens in the Halkyard Collection which were measured, the following seem to be about the average sizes. (For convenience in comparison the measurements of the present material are given also):

<i>G. plana</i> , Mauritius	...	...	...	90—230 μ
„ Providence	...	...	...	80—150 μ
„ Amirante	...	...	...	49—115 μ
„ W. Indies	...	...	...	70— 80 μ
<i>G. inhærens</i> , Guernsey	...	..	...	70— 90 μ
<i>G. vesicularis</i> , Naples	...	...	...	30— 48 μ
<i>G. globulus</i>	...	...	...	20— 28 μ

So that, though the difference in size of the areolæ between *G. globulus* and *G. plana* Mauritius is great, *G. inhærens* leads up to it through the Amirante and Providence specimens, the whole forming a gradual series.

With the exception of the above-mentioned gradual increase in the size of the chambers, there is very little difference of zoological importance on which to base the species, and, indeed, by some all are grouped under the one species of *G. globulus*, and even in those cases where the genus is sub-divided, the distinction lies mainly in the form and habit and not in any real difference of structure.

The name *Gypsina globulus* is then used in the restricted sense in which Reuss first used it—for the spherical forms, the subconical or convex forms constitute the species “vesicularis”—the original type species of Carter (formerly *Tinoporus vesicularis*), while the most usual encrusting forms of small size and fairly regular contour are grouped under the name “inhærens.”

But although these species are very artificial, it is perhaps the better way to let them stand as being the most convenient way of describing the form and habit of any particular specimen, and into this scheme of things *Gypsina plana* fits quite conveniently as being the encrusting forms of far greater size than are covered by the designation *Gypsina inhærens*.

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