band; a second, indistinct band from the discocellular spot to the inner margin: secondaries with the inner black line close to the discocellular spot and placed upon a brownish diffused streak or band: abdomen with indications of brown spots in pairs upon each segment. Wings below white, the markings of the upper surface for the most part obsolete; discocellular spots black and prominent; a marginal series of black dots and a dentate-sinuate brown postmedian line; primaries with a brown subapical patch or belt enclosing a quadrate apical white spot. Expanse of wings 2 inches 3 lines.

[To be continued.]

XLII.—*On the Nutritive and Reproductive Processes of Sponges.* By H. J. Carter, F.R.S. &c.*

Conflicting statements have been made respecting the nourishment of sponges, which need but a little explanation to become reconcilable.

The subject has only just now presented itself separately, because it has hitherto been implied rather than stated that the nourishment of sponges was derived from foreign bodies observed in their interior.

* *Publications to which reference is made in the following Communication.*

1. 1826. Grant, R. "Observations on the Structure and Functions of the Sponge." (Concluded.) *Edinburgh New Philosophical Journal*, vol. ii. p. 121, pl. ii.
2. 1848. Carter, H. J. "Notes on the Species, Structure, and Animality of the Freshwater Sponges in the Tanks of Bombay." *Ann. & Mag. Nat. Hist.* ser. 2, vol. i. p. 303.
3. 1849. ——. "A Descriptive Account of the Freshwater Sponges in the Island of Bombay, with Observations on their Structure and Development." *Ib.* vol. iv. p. 81, pls. iii.–v.
4. 1854. ——. "Zoosperms in *Spongilla*." *Ib.* vol. xiv. p. 334, pl. xi.
5. 1856. Lieberkühn, N. "Beiträge zur Entwicklungsgeschichte der Spongillen." *Archiv für Anat. Physiol. und wissenschaftliche Medicin*, pp. 1, 399 & 496, Taf. xv. und xviii.
6. 1857. Carter, H. J. "On the Ultimate Structure of *Spongilla*, and Additional Notes on the Infusoria." *Journal Bombay Asiatic Society*, vol. v. p. 574, April 9th, reprinted in *Ann. & Mag. Nat. Hist.* ser. 2, vol. xx. p. 21, pl. i.
7. 1857. Lieberkühn, N. "Beiträge zur Anatomie der Spongien." *Archiv für Anat. Physiol. und wissenschaftliche Medicin*, p. 376, Taf. xv. Juni (*der Gesellschaft naturforschender Freunde mitgetheilt in den Sitz.* v. 6. Sept. u. 2. Dec. 1856).
8. 1859. Carter, H. J. "On Fecundation in the Two *Volvoces* and their Specific Differences; on *Eudorina*, *Spongilla*, *Astasia*, *Euglena*, and *Cryptoglena*." *Ann. & Mag. Nat. Hist.* ser. 3, vol. iii. p. 1, pl. i.

Still, while attempting this reconciliation, it is necessary to bear in mind that the sponge-cell is unceasingly polymorphic except under the resting-form, which is spherical, and that this polymorphism enables it to assume a monadic monociliated form at one time and immediately afterwards almost any unciliated amœboid one that can be conceived—apparently amalgamating with its neighbours into a homogeneous mass, yet at any moment ready to separate and resume any of its wonted forms under favourable circumstances.

In 1849 I noticed that the "sponge-cell *itself* frequently contained pieces of *Confervæ* within duplicatures of its cell-wall, and other matters" similar to what might be seen in the "proteus" = *Amœba* (no. 3, p. 94); also that the "living sponge" presents "*ejecta*" on its surface, which "consist

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9. 1867. James-Clark, H. "Spongiæ ciliatæ as Infusoria flagellata." *Boston Soc. Nat. Hist. Mem.* vol. i. pt. 3, pls. ix. and x.
10. 1869. Carter, H. J. "On *Greyella cyathophora*, a new Genus of Sponges." *Ann. & Mag. Nat. Hist.* ser. 4, vol. iv. p. 189, pl. vii.
11. 1872. Häckel, E. 'Die Kalkschwämme.' 3 vols. (Two text, one Atlas.)
12. 1874. Carter, H. J. "On the Nature of the Seed-like Body of *Spongilla*; on the Origin of the Mother-cell of the Spicule; and on the Presence of Spermatozoa in the Spongida." *Ann. & Mag. Nat. Hist.* ser. 4, vol. xiv. p. 97, pl. x.
13. 1874. ——. "Development of the Marine Sponges from the earliest recognizable Appearance of the Ovum to the Perfected Individual." *Ib.* vol. xiv. p. 321, pls. xx.–xxii.
14. 1875. Schulze, F. E. "Ueber den Bau und die Entwicklung von *Sycandra raphanus*, Häckel." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxv. Suppl. Taf. xviii.–xxi.
15. 1876. Barrois, Ch. "Embryologie de quelques Éponges de la Manche." [Inaugural Thesis.] *Annales des Sci. Nat. Zoologie*, sér. 6, t. iii.
16. 1876. Keller, C. 'Untersuchungen über die Anatomie und Entwicklungsgeschichte einiger Spongien des Mittelmeeres. Ein Beitrag zur Lösung der Spongienfrage.' 4to. Basel, 1876. Taf. i. u. ii.
17. 1877. Schulze, F. E. "Untersuchungen über den Bau und die Entwicklung der Spongien.—Die Gattung *Halisarca*." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxviii. Taf. i.–v.
18. 1878. ——. Untersuchungen über den Bau und die Entwicklung der Spongien.—Die Metamorphose von *Sycandra raphanus*." *Ib.* Bd. xxxi. p. 262, Taf. xviii. und xix.
19. 1879. Balfour, F. M. "The Morphology and Systematic Position of the Spongida." *Quarterly Journal Microscopical Science*, no. 73, p. 103.
20. 1879. Metschnikoff, E. "Spongiologische Studien." *Zeitschrift für wissenschaftliche Zoologie*, Bd. xxxii. p. 349, Taf. xx.–xxiii.
21. 1879. Carter, H. J. "Contributions to our Knowledge of the Spongida." *Ann. & Mag. Nat. Hist.* ser. 5, vol. iii. p. 284, pls. xxv.–xxix.

of the cast-off parts of organisms from which the nutrient parts have been abstracted (*ib.* p. 98).

In 1857 (while still at Bombay, and totally ignorant of what Lieberkühn subsequently published at Berlin in the month of June of that year, from his communications to the "Gesellschaft naturforschender Freunde," on the 6th Sept. and 2nd Dec. 1856) I stated, among numerous other observations on the development of *Spongilla* from the seed-like body, that, on watching the feeding of it with carmine under the microscope (with immersed object-glass, of course), the particles may be seen to pass into the ampullaceous sacs ("Wimperkörbe"), where they are "instantly enclosed by the sponge-cell (spongozoon) on which they inpinge" (no. 6, p. 28); that the colouring-matter then is "wholly confined" to the ampullaceous sacs, and that when the latter are torn to pieces it is found to be contained in their cells (spongozoa), some of which are mono- and others unciliated; further, that after a little time the circulatory system of the young *Spongilla* becomes suspended synchronously with the closure of its *now* single osculum and the retraction of the tubular process which supports it; this lasts for about a "quarter of an hour," when the circulation is resumed the proboscidian process reproduced, the osculum at its extremity reopened, and that portion of the particles of carmine which may be assumed to have been deprived of their nutritive parts may be seen to leave the ampullaceous sacs, one after another, and, passing along the canals of the excretory system, finally to rush out at the osculum (no. 6)*. Here, then, it was naturally implied, rather than stated, that this was at least one of the ways in which nourishment got into the sponge.

It is also desirable to note that, among the carmine-bearing cells torn out from the ampullaceous sacs, there were unciliated as well as monociliated cells, and to connect this with the fact that shortly after a monociliated sponge-cell is eliminated from the sponge it loses its active, living, monadic form, and, retracting its cilium (which is but a hair-like extension of its own polymorphic body), assumes the more passive, amœboid one, which is really the only visible characteristic distinction between the monociliated cell of the ampullaceous sac and the cell of the parenchyma. Hence, whether the foreign material be in one or the other, the nutritive process may be assumed to be the same in both.

In 1857, also, Lieberkühn stated that on feeding *Spon-*

* This paper, in importance and amount of fact, is, to me, the best I have ever published on sponges.

gilla with carmine the particles entering by the pores were conveyed to and stuck in ("stecken") the ampullaceous sacs ("Wimperorgane") (no. 7, p. 384); also that Infusoria passing through the "canal-system" were taken into the parenchyma ("Körperparenchym"), and there falling to pieces, after some time disappeared without leaving a trace behind, after the manner of an infusorium which had been devoured by an *Actinophrys* (*ib.* p. 388).

Although nothing is said here, again, about "nourishment," no one can doubt what was passing in Lieberkühn's sagacious mind at the time, viz. that the Infusoria thus afforded nutrient matter to the *Spongilla*.

We now come to Häckel's views in 1872, viz. that the flagellate cells of the endoderm ("Geisselzellen des Endoderms") are exclusively the organs of reception for the digestion of the food (no. 11, vol. i. p. 372); and these we may pass by with Metschnikoff's observation, viz. that they are theoretical and not founded on matter of fact (no. 20, p. 372). This brings us to the following statements of Metschnikoff himself in 1879, made under the heading "Ueber die Nahrungsaufnahme bei Spongien" (no. 20, p. 371).

Beginning with Lieberkühn's observations, Metschnikoff observes that they were made more than twenty years ago, and that their result has of late been "lost sight of." If it had not been for Lieberkühn's observations, my own, which were made seven years previously, would have shared the same fate (no. 5, p. 400).

With Metschnikoff undue prominence seems to be given to the cells of the parenchyma (mesoderm) in the nourishment of the sponge. It is true that he says the ampullaceous sacs ("Wimperkörbe") were "usually" empty, and that in some sponges nourishment is carried on by the mesodermal element. But why, with the facts above stated, should he give illustrations (no. 20, Taf. xxii. figs. 16, 17) wherein the mesodermal cells are represented as charged with particles of carmine and the ampullaceous sacs ("Wimperkörbe") empty, without in the text alluding to the opposite results of other experimenters, and conclude his observations with the statement that it was clear that the mesodermal cells could take in the material and were more or less able to digest it (no. 20, p. 374)?—which implies that they alone are the nutrient organs, as the ampullaceous sac ("Wimperkorb") is not mentioned.

It is possible, and I should think probable, that Metschnikoff has never seen my paper "On the Ultimate Structure of *Spongilla*" (no. 6), and therefore is not aware of the

reflection which his observations cast on the statement that, in *my* experiments, the carmine or "colouring-matter was wholly confined to the ampullaceous sacs." But then he ought to have been acquainted with that of Lieberkühn to which I have alluded, and which is in the page preceding that to which he has called attention (no. 20, p. 371, footnote), and again in 1857, viz. "in Wasser befindliche Karminkörnchen sieht man hier aus dem grossen Hohlraum unmittelbar in jene Wimperapparate gelangen" (no. 7, p. 385). That I should have made the statement in 1857 that the carmine was "wholly confined to the ampullaceous sacs" is no excuse for an observer in 1879 *exclusively* mentioning the cells of the parenchyma as engaged in this process.

Besides, in feeding the calcareous sponges with carmine and indigo respectively, the colouring-matter has always appeared to me to be so confined to the sponge-cells (spongozoa) of the ampullaceous sacs, that I have not sought for it anywhere else; while I have sometimes seen the green germ of an *Alga*, *together with the colour-particles*, in the body of a spongozoon.

Nevertheless our thanks are due to Metschnikoff for having *especially* pointed out that the mesodermal cells are capable of taking in nutritive material and digesting it, because, together with what had gone before, it is now shown that whether ciliated and in the ampullaceous sac, or unciliated and in the parenchyma, the sponge-cell generally is at least an alimentary organ; and thus the "conflicting statements" to which I have alluded become reconcilable.

Should the reader be inclined to recur to my paper in the 'Annals' of 1849, he will there find the following paragraphs:—

"If a seed-like body which has arrived at maturity be placed in water, a white substance will, after a few days, be observed to have issued from its interior, through the infundibular depression on its surface, and to have glued it to the glass; and if this be examined with the microscope, its circumference will be found to consist of a semitransparent substance, the extreme edge of which is irregularly notched or extended into digital or tentacular prolongations, precisely similar to those of the protean [*Amœba*], which, in progression or in polymorphism, throws out parts of its cell in this way (pl. iv. fig. 2, *c*). In the semitransparent substance may be observed hyaline vesicles of different sizes, contracting and dilating themselves as in the protean (fig. 2, *d*), and a little within it the green granules so grouped together (fig. 2, *e*) as almost to enable the practised eye to distinguish *in situ* the passing

forms of the cells to which they belong; we may also see in the latter their hyaline vesicles with their contained molecules in great commotion, and between the cells themselves the intercellular mucilage (fig. 2, *f*).

"If this newly formed sponge be torn up, its isolated cells assume their globular or passive form, or become polymorphous, changing their position and their locality, by emitting expansions similar to the proteans or polymorphic cells developed after a forcible expulsion of the contents of the seed-like body, and differing only from them in being more indolent in their movements" (no. 3, p. 91, pl. iv. fig. 2).

With this statement, at that comparatively early period, how was it possible to come to any other conclusion than that every part of the sponge-parenchyma is capable of enclosing nutritious material and digesting it like the *Amœba* ("protean"), even if we had not had the observations of Lieberkühn, confirmed by Metschnikoff (no. 20, p. 374), to establish the fact?

In the first paragraph above quoted I have mentioned the extreme edge of the young *Spongilla* as composed of semi-transparent substance charged with hyaline vesicles, as if this were a distinct portion; but from what I have stated at the commencement of this paper respecting the homogeneity of amœboid cells after amalgamation, defying all attempt to detect their individuality, although capable at a moment's notice of separating themselves from each other (as in the conjugation of two *Difflugiæ*), it is quite possible that this "semitransparent substance" may be composed of sponge-cells thus combined, and the "hyaline" their "contracting" vesicles respectively, since, as I have heretofore shown, the apparently homogeneous investing membrane or cuticle of the young *Spongilla* is so composed (no. 6, pp. 24, 25, pl. i. fig. 7).

Connected with this is the *curious fact* that the whole of the spongozoa of an ampullaceous sac ("Wimperkorb") may, under isolation, become thus amalgamated, and assume the form and habits of an *Amœba*, while the cilia of the spongozoa may be seen still playing in its interior, and the exterior enclosing particles of carmine which come into contact with it (no. 6, p. 26)—finally losing all appearance of cilia internally, and presenting an actinophorous form (*ib.* p. 33, pl. i. fig. 9).

Since, then, we find Balfour (no. 19, p. 108) stating, "It has not, so far as I know, been definitely made out where the digestion is carried on. Lieberkühn would appear to hold the view that the amœboid lining-cells of the passages are mainly concerned with digestion, while Carter holds that

digestion is carried on by the collared cells of the ciliated chambers," the above must be my reply.

Although at one time the foreign material may be chiefly taken in by the sponge-cells (spongozoa) of the ampullaceous sac, and at another by the sponge-cells of the parenchyma, it cannot be inferred that there are two systems of alimentation, but rather that they are both the same, only that they are respectively more or less used according to circumstances.

Again, while it may be generally thought that there is no direct communication between the inhalant orifices (pores) of the surface and the exhalant or excretory canal-system of the interior except through the ampullaceous sacs ("Wimperkörbe"), facts now prove that branches of the excretory canal-system may commence directly under the pores (no. 10, pl. vii. fig. 5, and no. 21, pl. xxv. fig. 4, *e*, &c.); so that whatever nutritious material may be in the water which thus passes *directly* into the excretory canal, must be deflected from it to arrive where the sponge-cells of the ampullaceous sac and parenchyma respectively are *naked*—that is, uncovered by any membrane which would prevent the particles of food from coming into direct contact with them—indeed, where the canals are formed by the sponge-cells *alone*, as stated by Lieberkühn (no. 7, p. 388).

Bearing upon Nutrition is Starvation, under which, as I have long since stated (no. 2, p. 309, and no. 6, pp. 32, 33), the sponge-cells leave their "habitation" (that is, the skeleton) and creep about the watchglass wherein the young *Spongilla* might have been allowed to grow out from the seed-like body. Lieberkühn has recorded that the cells of *Spongilla* in the river Spree at Berlin are amœboid in the winter, but put forth a cilium in spring (no. 5, p. 2); and this is confirmed by Metschnikoff in *Spongilla* from the Dnieper in the months of October and November, together with the well-known fact that under "unfavourable" circumstances the retraction of the cilium may take place at any time (no. 20, p. 575).

But that the putting forth of the cilium in spring and its retraction in winter, when, as Metschnikoff states, the *Spongilla* had become charged with gemmules (seed-like bodies), seems to show that the active life of this sponge takes place during the warmer part of the year, like that of most organisms, when nourishment is chiefly required for the fulfilment of the reproductive process; and that the passive or amœboid state of the cells not only took place in the winter, when this activity was not required, but that the cilium at all times would be retracted under "unfavourable circumstances," according to Metschnikoff (no. 20, p. 375), may be inferred

from the simple fact that these unfavourable circumstances take place before one's eyes when the *Spongilla* or any other sponge is torn to pieces; while Metschnikoff states that, on the other hand, when the favourable circumstances were renewed ("erneuertem Wasserwechsel"), not only the cilium but the ampullaceous sac ("Wimperkorb") was *remade* in the parenchyma of a young *Spongilla*.

I cannot say, however, that the sponge-cells of *Spongilla* lose the cilium in the winter in the tanks of the island of Bombay, perhaps because the temperature then and there is about that of our midsummer, since the last mention of it in my 'Note-book,' together with an illustration in which the "ear-like processes" (collar) are represented, is dated "9th January, 1859," just after my paper on the subject had been published in England (no. 8, p. 14, pl. i. figs. 12–14).

Reproductive Process.

While on the subject of alimentation, it might be as well to briefly enumerate the facts known in connexion with reproduction, since the latter is chiefly dependent on the former process.

As early as 1826, my late kind and talented teacher Prof. Robert Grant described and illustrated (among his imperishable records of the Spongida) the embryo (swarm-spore) of his *Spongia panicea*=*Halichondria incrustans*, Johnston, beginning with the ovum "lying in the recesses of the parenchymatous matter," following its development into the ciliated embryo, its exit afterwards through the excretory cell-system and subsequent fixation, finally ending in the full development of the young sponge (no. 1, pp. 127–133, and p. 140, pl. ii. figs. 26–29).

In 1854 I described and figured minute monociliated bodies which were observed in *Spongilla* at Bombay in the month of July, and conjectured to be zoosperms (no. 4). Afterwards Lieberkühn described and figured undoubted spermatozoa in *Spongilla* in July, at Berlin (no. 5, pp. 17, 18, pl. xv. fig. 34, and pl. xviii. figs. 10–17), previously observed by Müller (no. 5, p. 19).

That Lieberkühn should have identified my description and illustrations with *Trachelius trichophorus*, Ehr., I could never understand, because he must have known that the former carried the cilium *behind*, and *Trachelius* carries its cilium in front. Moreover, although I have hitherto been inclined to doubt if they really were spermatozoids or the common monociliated sponge-cell, I now observe, by the measurements of both (which have fortunately been published with their

descriptions respectively), together with my better acquaintance with the subject, that the *smallness* of the monociliated bodies which I figured as zoosperms, when compared with the "eared" (collared) monociliated sponge-cell, is so much in favour of what I had conjectured, that little doubt can be entertained by those familiar with such bodies that they really *were* the zoosperms of *Spongilla*. The time of their appearance in the *Spongilla*, their mode of progression, and their inferior size, if we do not admit the absence of the ear-like processes (collar) also, must satisfy the most fastidious mind that they could have been nothing more or less than "zoosperms."

About the same time also, viz. 1856, Lieberkühn discovered and described, with illustrations, the swarm-spore (embryo) of *Spongilla* and its development, which Grant, as above stated, did of *Halichondria incrustans* in 1826 (no. 5, pp. 9–14 and pp. 405–413, pl. xv. fig. 35).

Finally, F. E. Schulze, in 1877, pointed out the existence of spermatozoa in *Halisarca lobularis* in a much more satisfactory way than had hitherto been done, as testified by his descriptions and illustrations (no. 17, p. 24, Taf. iii.), together with some of his beautiful preparations, which, through his great kindness, are now in my possession.

They occur in the form of globular groups ("Spermaballen"), so like in size and appearance to the ampullaceous sacs ("Wimperkörbe") that, but for the smallness of the monociliated colourless head of the former, they would be almost undistinguishable from the larger monociliated and collared form of the latter, both being polymorphic and bearing the proportion of about 1 to 5 (compare Schulze's fig. 12, Taf. ii., with fig. 17, Taf. iii., both of which are magnified 800 times). In size the two look respectively very much like the so-called microspores and macrospores of Algæ; and at first one would be inclined to think that reproduction was similarly accomplished by their union. But another factor steps in here, viz. the unciliated sponge-cells of the parenchyma or mesoderm, which Metschnikoff has shown to take in nourishment equally with the monociliated cells of the ampullaceous sacs, or, at all events, to do so when the latter do not. And here (in the mesoderm) it is, that the ova appear (see Schulze's satisfactory figure of the eggs in *Sycandra raphanus*, H., no. 14, Taf. xviii. fig. 2)—a fact that all who have studied any of the calcareous sponges in spring (that is, during the reproductive period) must be well aware of, although Grant, who first mentioned this, observed it (*Halichondria incrustans*) during the autumn ("October and November") (no. 1,

p. 128). Then the time varies with the species, as Grant has observed (no. 1, p. 133).

The spermatozoa which I saw in 1854 bore the proportion of about 1 to 5 when compared with the average size of the common sponge-cell in *Spongilla*, as the latter is much the largest. Those which Lieberkühn figured in 1856 bear a similar ratio; and so do those figured by Schulze in *Halisarca lobularis*.

The smallest size at which I could recognize the egg in *Halisarca lobularis* was 1-3000th inch (no. 13, p. 31, pl. xx. fig. 3, *a*); while the monociliated sponge-cell of the ampullaceous sac was a little smaller, viz. about 1-3600th inch in diameter (*ib.* fig. 2, *a*); and Schulze's figures of the body of a monociliated collar-cell ("Kragenzell"), compared with that of the spermatozoid (no. 17, *l. c.*), give about 1-18000th of an inch for the latter. It might be thought that it would have been better to have been able to omit the indefinite word "about" (*circa*); but those who have studied the minute anatomy of sponges well know that all their soft parts afford, from polymorphism and actual difference in size, only approximate measurement.

Häckel is the only one who believes ("glaube") that he has seen the spermatozoids enter the ovum (no. 11, vol. i. p. 396, Atlas, Taf. 48. fig. 6) in *Sycortis lingua*=*Grantia ciliata*, Bowerbank.

Keller of Zurich also gives a figure of it in *Leucandra aspera*, H., with reasons for coming to the conclusion (no. 16, p. 21, Taf. 1. fig. 4, *c*).

But of all those who have so deeply studied the living calcareous sponges, it has been reserved for Häckel alone to see the *act*; and this, according to his statement (no. 11, vol. i. p. 396), he has done repeatedly ("wiederholten Malen"). Yet if his statements and figure are like those which he has given of my *Squamulina scopula* ('Jenaische Zeitschrift f. Naturwissen.' Bd. ix. 1877), I regret to be obliged to say that they are not trustworthy, as may be seen by Saville Kent's ample confirmation of my observations of 1870 in 1878 (Ann. vol. ii. p. 68, pls. iv. & v.); while it was not difficult to conjecture, with apparent certainty, that which the sagacious Lieberkühn had indicated sixteen years before by his descriptions and figures of the swarm-spore and spermatozoa respectively in *Spongilla* (*l. c.*).

Another difficulty here presents itself, viz. that, from the polymorphic condition of all the soft parts in the living sponge, even to the capsule of the ovum, it becomes doubtful, unless the spermatozoon is *seen* to enter the ovum, whether

the remaining projection of the still waving tail, such as those in Keller's instance, is confirmative of impregnation, simply because, when these polymorphic bodies become amalgamated, their water-like sarcode so flows together that their individuality becomes lost—although, where the body is not a spermatozoon, they can immediately individualize themselves again. Nothing is more like the "*melting away*" of a spermatozoon when it passes into the ovum than the union of two polymorphic amœboid Infusoria; so, unless the act itself is seen (that is, the spermatozoid and ovum are both observed before union), the case may only remain "probable," as Keller has observed.

Gemmule or Seed-like Body of Spongilla.

Turning our attention shortly to the seed-like body of *Spongilla* for our present purpose, as I have already given this in detail (no. 12), we find that it is more or less globular in form according to the species, variable in size, although generally nearly as large as a small pin-head, so that they can be easily seen by the unassisted eye, congregated towards the base or first-formed parts of the *Spongilla*, consisting of a cellular crust more or less charged with peculiar spicules, lined by a coriaceous membrane, and filled with a yellowish substance, something like the yelk of a hard-boiled egg, which is composed of transparent spherical sacs varying under 1-1000th inch in diameter, more or less filled with grain-like transparent compressed firm cells of different sizes varying under 1-3000th inch in diameter, bearing in one part of the crust a hilous aperture, through which the contents issue a few days after the seed-like body has been placed in water, in the form of the young *Spongilla* (no. 3, p. 87, pl. iii. fig. 6, *a–i*).

If this growth be made to take place in a watchglass under cover of a bell-glass, or something of the kind, replenishing the water as required, it can easily be transferred to the field of a microscope from time to time, where it can be viewed under $\frac{1}{4}$-inch object-glass, of course immersed; when the "transparent spherical sacs" with their "grain-like cells" appear to issue entire with the rest of the substance from the seed-like body, and so become developed in their entirety, respectively, in this substance, now assuming the form of a parenchyma (no. 6, pp. 21, 22).

On the other hand, the development of the swarm-spore or embryo leads to the same result, when some of its cell-contents also become developed into ampullaceous sacs (no. 13, p. 337, pl. xxi. fig. 21, *c*, &c., and pl. xxii. fig. 34, *d*).

In the future development of *Spongilla* the "transparent spherical sac" and its contents, which have become developed into an ampullaceous sac ("Wimperkorb"), appear to me to grow into a gemmule or seed-like body (no. 6, p. 34), and thus this increase or reproductive process to be successively effected.

That the "grain-like cells" of the transparent sacs do pass into monociliated sponge-cells may be proved by taking out some of the "yellow substance" on the point of a needle and placing it in a watchglass with distilled water, when, after a few days, the "grain-like cells" for the most part disappear and are followed by a development of active monociliated sponge-cells (no. 3, p. 91, and no. 12, pp. 97, 98).

Now comes the question whether the monociliated "sponge-cells" of the ampullaceous sacs ("Wimperkörbe") are impregnated by the spermatozoa for the formation of the seed-like body, and the cells of the parenchyma or mesoderm for the formation of the ovum respectively.

When we reflect on the almost identity that exists between the spongozoon or monociliated sponge-cell and the solitary flagellated infusorium called "*Salpingœca*" by the late H. James-Clark, who first pointed out the resemblance (no. 9), we can hardly help thinking that what the "solitary" form possesses in the way of organs is equally possessed by the social one or monociliated sponge-cell, and we can hardly doubt that the solitary *Salpingœca* and its like possess either an hermaphroditic, monœcious, or dicœcious system of reproduction respectively; while, assuming that of the sponges to be monœcious, the female organ or ovary must be looked for either in the monociliated sponge-cells of the ampullaceous sac ("Wimperkorb"), or in the unciliated sponge-cells of the parenchyma or mesoderm; and if this be the case, then we must consider the ampullaceous sacs in the marine sponges (wherein there are no seed-like bodies) abortive in this respect, and the ovum to be developed from the nutritive sponge-cells of the parenchyma. And as there are swarm-spores as well as seed-like bodies in *Spongilla*, both may become impregnated and developed in their respective cells, as already intimated, for the purpose of reproduction, in which case impregnation would take place in the *body* of the sponge-cell. How happens it, then, that Häckel has seen impregnation of the ovum to take place in the parenchyma or mesoderm? Perhaps the *ova* may be thrown off from the ovary of the parenchyma-sponge-cell in a very minute form, discharged, and then transported into the intercellular substance for increased growth previous to impregnation.

What Dr. Grant said of the sponge fifty-three years ago (no. 1, p. 138), equally applies to it at the present day, viz.:—"This animal still affords many curious and interesting subjects of inquiry to those who have leisure and opportunities of examining the more perfect species of tropical seas [? in temperate ones too!]; and, though probably the simplest of animal organizations, the investigation of its living habits, its structure and vital phenomena, and the distinguishing character of its innumerable polymorphous species, is peculiarly calculated to illuminate the most obscure part of zoology, to exercise and invigorate our intellectual and physical powers, and to gratify the mind with the discovery of new scenes of infinite wisdom in the economy of Nature."

XLIII.—*Preliminary Notice of a new Genus* (Parectatosoma) *of* Phasmidæ *from Madagascar, with brief Descriptions of its two Species.* By J. Wood-Mason*.

The interesting and remarkable animals briefly noticed below formed part of a large collection of insects, chiefly Coleoptera, recently received in London from Madagascar; and I was fortunate, while at home on furlough, to secure specimens of them from Mr. E. W. Janson, the well-known Natural-History agent.

They are unquestionably nearly related to *Ectatosoma*, an Australian genus, the three known members of which are three of the most curious and striking forms comprised in the whole class Insecta. This relationship I have indicated in the name of the new genus which the differences presented by these insects compel me to propose for their reception.

Parectatosoma †, gen. nov.

Closely allied to the Australian genus *Ectatosoma*, but differing therefrom in the following characters:—The prothorax is relatively longer and more spiny; the male is devoid of ocelli, and, like the female, brachypterous; the abbreviated tegmina in both sexes are shorter than the abbreviated wings; and the upper crest of each of the femora is produced into a sharp genual spine.

Of the species of the Australian genus, *Ectatosoma bufo-*

* From the 'Journal of the Asiatic Society of Bengal,' vol. xlviii. part ii. 1879, pp. 117, 118. Communicated by the Author.

† From παρὰ, by the side of, and *Ectatosoma*, generic name.