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Tail longer than the head and body, brown above, pencilled with black terminally, orange-rufous on the sides and below. Palms and soles with the essential characters of those of *G. gracilis*, *leucogaster*, &c., i. e. naked, with five anterior and four posterior pads, but distinguished from all the species of this group by the fact that a band (about 4 millim. broad) of fine hairs passes across the soles at about the level of the base of the hallux. Skin of soles black.

Skull very much as in *G. gracilis*. Bullæ small, egg-shaped, their posterior part scarcely swollen.

Teeth: upper incisors much bevelled, each with one deep groove. Molars with the low, distinct, directly transverse laminæ characteristic of this group of Gerbilles.

Dimensions of the type (an adult specimen in skin):—Head and body 140 millim.; tail 155; hind foot 29.

Skull: basal length 30; greatest length 35; tympanic breadth 16·5; nasals, length 14, breadth 3·7; interorbital breadth 6; interparietal, length 4, breadth 8·5; palate, length 18·5, diastema 10, palatal foramen 6·1; length of upper molar series 5·2; greatest diameter of bullæ 10·4; vertical height of brain-case and bullæ combined 13·5.

Hab. Wadelai.

Type (87. 12. 1. 50) collected and presented by Dr. Emin Pasha.

A second specimen, collected at the same time and place, agrees in every respect with the type.

These two specimens were presented to the Museum with Emin Pasha's first collection (see P. Z. S. 1888, p. 10, no. 24). Turning out now to be new, it is only just that they should receive the name of their distinguished discoverer.

XII.—*The Mesozoon Salinella*.

By JOHANNES FRENZEL*.

It is a well-known fact that between unicellular and multicellular animals there hitherto stretched a gulf which was wider than that between the vegetable and animal kingdoms, for indeed the two latter, in spite of the advances which we have made in knowledge, are even to-day hardly separable from one another. The unicellular animals, usually comprised under the name Protozoa, and embracing besides many doubtful forms of the Protista, not only consist, as their name

* Translated from the 'Biologisches Centralblatt,' xi. Bd. no. 19 (October 15, 1891), pp. 577–581.

already implies, of a *single cell* which unites in itself all the various functions of an animal organism, but also assume quite a peculiar position in many other respects, especially with regard to development. In the systematic arrangement of the group we are even obliged, hard though it will be for every modern zoologist, to allow ourselves to be swayed by *physiological* considerations, since here the purely *morphological* and *embryological* foundations are insufficient; and we are even forced to exclude them, at any rate in general, from Hæckel's fundamental principle of biogenesis, which is equally unsatisfactory.

The multicellular animals, on the other hand, are not mere aggregates of cells, such as, moreover, are not unknown among the Protista, but they permit us to distinguish, albeit frequently with difficulty, a structure consisting of *three layers*, in that in the simplest case they possess an *external* layer of cells, which provides for sensory perceptions &c., next a *median* supporting tissue, and finally an *internal* one, which discharges the function of nutrition, since it clothes a cavity which is known as the gastral chamber, alimentary canal, &c.

There is yet another by no means unimportant difference between unicellular and multicellular animals to which unfortunately far too little attention is paid, perhaps in consequence of the fact that it arises in the first place from physiological conditions only.

For if we disregard forms which exhibit holophytic nutrition, and therefore live like a lower form of plant, and further neglect the intestinal parasites, which in many cases, but not always, are able to absorb that which has already been digested by other animals, we find that the Protozoon cell receives its food *into itself*, digests it in its *interior*, and absorbs what is suitable. This is a so-called *intra-cellular* digestion, which in Metazoa, on the contrary, is only met with in isolated and exceptional cases; for in the latter *extra-cellular* digestion prevails, which is accomplished on the principle of "one for all and all for one," since all the participating cells to a certain extent throw their digestive ferments into a common pot, in which digestion proceeds, exactly as cooking is done in a kitchen for a large number of persons. It follows that *solid*, in part absolutely indigestible bodies, are no longer taken up by the cells, as we found to be the case in Protozoa, but only *fluid* substances in the shape of peptone, sugar, fat, &c. In consequence of this, those morphologically specially constructed organs for the acquisition of food, such as we meet with in the Protozoa in the form of pseudopodia, flagella, cilia, &c., are no longer necessary. We may

rather regard absorption in the Metazoa as a purely *chemical* process, emanating from the living cells.

Now, should we desire to construct a multicellular animal from a number of Protozoa, *e. g.* from Ciliate Infusoria, we should consequently soon be confronted with a great physiological difficulty. We could indeed easily imitate the simplest Metazoon type, and so arrange the cells that they should surround a cavity possessing an incurrent opening. But how would nutrition proceed? The group of Protozoa would at all events obtain their food from the common cavity, but it would be directly introduced into the interior of the separate individuals, there digested, and so forth. It follows that in this construction of ours we should not get beyond a simple Protozoon colony, and should still be a long way from obtaining a typical Metazoon. For although among the Metazoa there are forms which possess intracellular digestion, we must nevertheless not forget that it is only the *endoderm* cells which can be concerned therein. But yet all the other tissues must be similarly nourished, and this is effected by their receiving already digested matters from the intestinal cells. Were we able therefore still to regard the latter at all events as Protozoon cells, this view would be absolutely inadmissible for the former, the cells of the mesoderm and ectoderm, and they must absorb in a manner similar to that of the intestinal cells which possess the power of extracellular digestion.

From the foregoing considerations it is not difficult to see that the multilamellar character of the Metazoa in itself entails the decisive difference which separates them from the Protozoa, and, further, that the multicellular character, as such, is insufficient to bridge over the deep gulf between the two principal groups of the animal kingdom.

It is well known that the title Mesozoa has already been bestowed upon organisms which it must be confessed are strange enough, and which rendered the justification of the term not improbable. But the position of the Orthonectids and Dicyemids is nevertheless an extremely doubtful one, and points more to an affinity with the worms. The genus *Trichoplax*, moreover, has been with good reason assigned to the Metazoa by Fr. Schulze; for although its conditions of nutrition may be regarded as being still very obscure, nevertheless it has not been possible to determine that its digestive processes are intracellular.

It thus came to pass that the group Mesozoa once more disappeared from the scene. I therefore consider that I am entitled to regard the chance as a lucky one which enabled me

to discover, in a solution of salt obtained from a salt-pit in the province of Cordova, in the Argentine Republic, a microscopic animal, which, being a combination of a number of cells to form a single organism, cannot be regarded as a Protozoon; while, on the other hand, since it exhibits only a single layer of cells, it cannot be termed a Metazoon, although the digestive processes follow the Metazoon type.

It follows that we are here confronted with the first and only example of a connecting-link between Protozoa and Metazoa.

Salinella, as I have named this new animal, is a multicellular organism in which the elementary organisms of which it is composed have so completely renounced their independence, that there has been developed an animal possessing a mid-gut as it were, an animal the intestinal epithelium of which is composed of typical mid-gut cells. Whether, nevertheless, there was in this case originally a colony of Infusoria, which have gradually become transformed, is a question which it is absolutely impossible to decide in any way whatever; for unfortunately one of the most material aids to demonstration, *i. e.* a knowledge of the development, is so far wanting. I have so far only met with larvæ, which are certainly *unicellular*, and moreover have an *intracellular* digestion, exactly like a true Ciliate. The external structure of these larvæ is, however, of so peculiar a character, in the possession of ventral cilia, dorsal setæ, &c., that we are bound at once to recognize their connexion with *Salinella*, and are inclined to conclude that development is thoroughly direct. This nevertheless leaves a difficulty of considerable importance to be surmounted, in that the transition from the *single cell with intracellular* digestion to the *adult animal with extracellular digestion* is enigmatical and completely unexplained.

Were we to attempt to construct our *Salinella* from an aggregate of Ciliate Infusoria, we should obtain, as we already know, merely a *Protozoon colony*. It would then be further necessary to induce the individual elementary organisms to close their mouths, empty their digestive ferments into the common cavity of the intestine, and absorb the digested matter. This would, however, constitute a highly complicated developmental process, to which there scarcely exists anything analogous.

As a matter of fact moreover Nature appears to have followed a different path; for an observation, which unfortunately could not be further continued in consequence of an unlucky accident, points to the fact that within the larval cell, by means of a kind of endogenous cell-formation upon

the body-wall, new and much smaller cells arise, leaving a cavity in the interior which probably subsequently becomes the intestinal canal. This process is ushered in by a splitting of the nucleus into two, which is indeed to be regarded as an indirect division, but which differs materially from mitosis. Further segments are subsequently produced, which then pass to the periphery of the larval cell. What afterwards happens I was unfortunately unable to observe. Probably, however, as already stated, a cell is formed round each of those nuclei—ventral cells on the ciliated ventral side of the larva, dorsal cells on the dorsal side, which is beset with setæ, and so on. Simultaneously an oral opening must be developed at the anterior pole and an anal opening posteriorly, and likewise a coating of cilia on the inner side of the young cells. With this the fully-developed animal would then be constituted, and the original digestive cavity of the unicellular larva, which, indeed, is filled with endoplasm and is not hollow, would have passed into the alimentary canal, which for its part is now free from such contents.

It appears to me that this last circumstance becomes of quite critical importance; for were the intestine also to contain a (digestive) plasma, this must be of a cellular nature, and must, since particles of food are taken in, digest by the *intra-cellular* method. But then a multilamellar structure also would be already in existence.

I have already published a preliminary communication upon the structure of *Salinella**, and have recently sent to the press a detailed paper upon the subject. I may be permitted to refer the reader to the latter for particulars, since here it was only intended specially to indicate the closeness of the relations between *Salinella* and the Metazoa from the point of view of physiology, and to show that it must not be regarded offhand as having arisen from a Protozoon colony, although its larval form indeed looks just like a Ciliated Infusorian; for it is precisely the further development of this larva, incomplete though my study of it was, which proves that it does not develop into the perfect animal by means of ordinary division, much as a colony is formed from a single Choanoflagellate, but by a far more complicated process, which we may most fitly term endogenous cell-formation.

In conclusion, it is for the present pretty much a matter of indifference whether we assign *Salinella* to the Protozoa or to the Metazoa, or introduce it between the two as a Mesozoon, where its position will be quite as disconnected as that

* Zool. Anzeiger, 1891, no. 367, p. 230 *et seqq.* See p. 109.

of *Amphioxus* in the series of higher animals. Nevertheless, that it constitutes an actual transition between the two great groups of the animal kingdom can be asserted of it equally as little as of an Orthonectid or of *Trichoplax*; for indeed we have here isolated links before us for which we cannot find a place in our system, beautifully and ingeniously constructed though it is, and which tend to prove how little Nature is amenable to a dogmatic treatment on our part, a treatment which unfortunately appears to take the upper hand too much in the biological sciences, and which would gladly exclude everything which does not fit into its narrow frames.

XIII.—*Descriptions of Seven new Species of Terrestrial Mollusca from South Africa.* By JAMES COSMO MELVILL, M.A., F.L.S., and JOHN HENRY PONSONBY, F.Z.S.

[Plates IV. & VI.]

1. *Helix (Pella) trichosteiroma*, sp. n.
(Pl. IV. fig. 9.)

H. testa angustissime sed profunde umbilicata, corneo-fusca, convexiuscula, sublævi, longitudinaliter oblique tenuistriata, undique lirulis spiralibus minutissime decussata; anfractibus quinque, ultimo in medio carinato, carina capillis brevibus accincta; apertura lunari-ovata; peristomate simplici ad marginem columellarem reflexo.

Long. 5·50, lat. 7·50 mill.

Hab. Port Elizabeth, S. Africa.

Judging from the description of *Helix petrobia* (Benson), recorded from High Constantia, Cape of Good Hope, but of which we have not been able to examine the type, the species under discussion would seem to differ chiefly in the acutely angled keel, fringed with regular, short, epidermal hairs, also in the form being more convex, colour dull brown, with no fulvous tinge, and other minor distinctions.

2. *Helix (Pella) epetrima*, sp. n. (Pl. IV. fig. 3.)

H. testa anguste umbilicata, depressa, tenui, cornea, subpellucida, undique confertim striatula, striis obliquis regularibus, spira depresso-convexa; anfractibus quatuor, convexiusculis, ad suturas impressis, ultimo anfractu rapide accrescente; apertura lunari;