gland are identical nephridia than that they represent those of different segments.

VII. Lastly, I wish briefly to point out that Professor Edouard Van Beneden of Liège was the first naturalist since Straus-Dürckheim to insist upon the necessity of regarding *Limulus* as an Arachnid. In 1871 (Société Entomologique de Belgique) he briefly expressed this view as the result of an examination of the embryos of *Limulus*; but he did not attempt to support it by any detailed comparison of the organization of the Xiphosura, Eurypterina, and Arachnida.

Had Professor Claus done justice to his predecessors in the discussion of the classification of the Arthropoda, he would have cited the views of the professor of Liège as well as my own detailed observations and speculations, which, I am glad to acknowledge, owe their existence to the brief but suggestive publication of my friend Edouard Van Beneden.

XXXII.—*Contributions towards the Knowledge of the Nervous and Muscular Systems of the Horny Sponges.* By Dr. R. von Lendenfeld*.

One of the Australian species of *Euspongia*, which is identical with *Euspongia anfractuosa*, Carter †, shows in many respects remarkable differences from the known structure‡ of the common bath-sponge, *Euspongia officinalis*. The sponge is massive, and has short, rounded, finger-like processes. Each of the latter contains a wide cylindrical cavity running in the direction of its length, and which externally looks very like a wide oscular tube. These wide tubes open below into a system of anastomosing lacunæ. The whole dermis is rich in pores. A very elegant sand-net is diffused between the regularly distributed pore-sieves. On closer examination it is seen that the tubes in the digitiform processes are lined with a membrane of exactly the same structure. This applies also to the lining of the lacunose cavities in the interior of the sponge. The tubes and lacunæ are not oscular tubes, and do not belong to the true sponge-body, but form a vestibular

* Translated by W. S. Dallas, F.L.S., from the 'Sitzungsberichte der königl. preussischen Akademie der Wissenschaften zu Berlin,' 1885, pp. 1015–1020.

† Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 316.

‡ F. E. Schulze, "Untersuchungen über den Bau und die Entwickelung der Spongien.—VII. Mittheilung. Die Familie der Spongidæ" (Zeitschr. f. wiss. Zool. Bd. xxxii. pp. 591 *et seqq.*).

space, which is connected only with the afferent canal-system. On the inner surface of the tubes and in the walls of the lacunæ no oscula are to be found. This vestibular structure consequently differs considerably from that which I have described in the case of the Aulenidæ *. It resembles that occurring in the *Nardorus* forms.

The oscula are small and are always arranged in rows. These rows traverse the finger-like processes in a longitudinal direction. The finger-like processes are 10–20 millim. thick, and of about the same length. The oscula are 1–2 millim. broad, circular, and placed at pretty regular distances of 10–15 millim. apart.

In the skeletons we see no trace of oscula. In place of the rows of oscula there are in them deep furrows, which sometimes extend down into the central pseudo-oscular tube. In the living sponge nothing can be seen of these furrows, which are completely filled with sponge-tissue. It is true that this tissue has no skeletal support, and in dried specimens this part appears much depressed and as having fallen in.

In transverse sections we see that the tissue which forms this part is very loose and lacunar. The groups of flagellate chambers between the broad and irregular, generally longitudinally-directed canals are small and not very numerous, in fact far less numerous than those of the much denser skeletiferous part, which is furnished only with small canals. These large canals and lacunæ coalesce to form the short oscular tube; they all belong to the efferent system.

While even in this furrow and its structure we have a remarkable peculiarity presented to us, we find much more interesting characters on careful microscopic examination.

The skeleton is a very finely reticulate *Euspongia* skeleton. The main radial fibres are but little branched and bear sand. The uniting fibres, on the contrary, are free from foreign bodies and much ramified. They form numerous anastomoses. Their average thickness differs in the different varieties, and varies between 0·01 and 0·02 millim. At the margin of the furrow all these uniting fibres terminate in very sharp ensiform points, which stand so close together that the wall of the furrow appears densely spinose. There can be no doubt that this spinosity is a defensive arrangement against such foreign intruders as may attempt to penetrate into the sponge-body from the wide oscular tubes and lacunæ of the efferent system.

* Lendenfeld, "Ueber den Bau der Hornschwämme," Zool. Anzeiger, 1885.

From the pointed ends of the horny fibres descends a membrane which completely separates the lacunar tissue of the groove from the rest of the sponge-body. Below this membrane is repeatedly interrupted, and here the efferent canals come through. We find a membrane of this kind on each side of the lacunar groove, and these membranes line the side-walls of the groove throughout their whole length.

On close examination of thin transverse sections it is seen that this membrane is composed of parallel fusiform cells, which stand perpendicularly to the outer surface of the sponge, all of them descending radially towards its interior. They form several layers in the above-mentioned membrane—generally three. The membrane itself is of uniform thickness throughout. These cells run out at both ends into extremely fine points. They are 0·1 millim. in length and 0·003 millim. in breadth at the middle. The oval nucleus is placed about the middle of the length; it is, however, not placed axially, but more or less laterally. In the neighbourhood of the nucleus there is a very small quantity of ordinary protoplasm, while all the rest of the cell consists of a substance which differs essentially from the contents of ordinary fusiform cells. Thus it contains distinct, small, but strongly and *doubly* refractive, rounded granules, imbedded in a homogeneous transparent substance which is but slightly and simply refractive. The granules are in part very regularly arranged, so that a sort of *transverse striation* of the fibres is produced. The granules do not combine to form doubly refractive disks, and the regularity of their arrangement is not always equal in degree. In examining material in spirit one easily sees that these membranes of the walls of the groove are strongly contractile, and, indeed, that they always contract in a *radial* direction. By this means the outer surface of the tissue occupying the groove is more or less lowered; and in the very considerable variation of depth to which the surface of the tissue occupying the groove sinks in different specimens, we have the expression of the action of the radial contractions of these membranes.

I think we may conclude from the above-cited observations that these membranes are muscles and the cells composing them muscle cells; and, further, that these muscle-cells in their peculiar structure make the transition from the smooth to the transversely-striated fibres.

In transverse sections through the margins of the groove we see that a peculiar organ is seated upon the upper outer margin of this muscular membrane. We then find the membrane suddenly increased to twice or three times its diameter

elsewhere. This line of thickening can be accurately studied in thin sections, when we find that it does not consist of fusiform cells. Large globular nuclei are very distinct here, and these appear to be imbedded in a granular substance. This substance no doubt belongs to cells the boundaries of which are not distinct. From this marginal thickening granular threads issue laterally, which run tangentially in the exterior dermis of the sponge, and may sometimes be traced to considerable distances. Above, on these distal thickenings of the muscular lamella, there stand fusiform sense-cells. The basal extremities of all these cells, which are diffused over a tolerably broad zone, are curved towards the above-mentioned thickening, and stand in direct connexion therewith. No ramification of the basal process was observed. The cell-body itself has the ordinary form. The cells are about 0·03 millim. long, and 0·002 millim. broad in the middle at the nuclear dilatation. In the cell-body, after treatment with osmium, we find those characteristic dark granules which have been discovered by Jickeli* in the sense-cells of the Hydroida, and which also occur in the sense-cells of the Sponges, and here furnish a particularly distinct and valuable criterion.

I believe that the above-described structures on the distal margin of the muscular membrane are to be interpreted as follows :—

The whole thickening, which is interrupted only here and there, consists of ganglion-cells, the nuclei of which are distinct in preparations, although their contours do not appear distinctly. The granular threads which are given off from these ganglia in a tangential direction are nerves which establish the connexion of the ganglia with more distant and at present still unknown structures.

From the above description it appears that the zone of sense-cells runs along the upper margin of the muscular membrane, so that two bands of sense-cells are formed, bordering the tissue filling the groove at the surface.

I believe that this structure of our sponge may be directly compared with the *annular nerve* of the Cycloneural Medusæ (Eimer), and indicates that the Sponges, being capable of a development similar to that of those Cnidaria, were probably not so very different from them as we commonly suppose. It must indeed be admitted that, by *convergent* development, a resemblance may here have been produced which does not justify any phylogenetic conclusions, especially as these structures in the Sponges are mesodermal and not subepithe-

* "Ueber den Bau der Hydroidpolypen," in Morphol. Jahrbuch, Bd. viii.

lial as in the Hydromedusæ. To enter into more detail upon this subject, however, would lead us further than seems to be permissible in a preliminary communication.

If I now glance back briefly over our knowledge of the nervous and muscular tissues of the Sponges, it may, on the one hand, be useful to my *collaborateurs* in this department; while, on the other hand, such a summary may serve as a foundation for general morphological investigations.

In the first place, F. E. Schulze, the founder of modern spongiology, demonstrated that in many sponges particular fibre-cells, and even combinations of fibre-cells, are contractile. This discovery that the long-known movements of adult sponges (larvæ, young *Spongillæ*, &c. move without contractions of fibre-cells) are caused, not by a contraction of the fundamental substance or of the epithelia, but by contraction of definite elements adapted to this purpose, has been repeatedly confirmed by myself and others.

In the year 1880 C. Stewart demonstrated "palpocils" in *Grantia compressa* before a meeting of the English Royal Microscopical Society. I am not in a position to offer any opinion upon this statement, which only came to my knowledge a few months ago. I indeed regard the existence of sense-hairs upon the sense-cells discovered by me as probable upon *à priori* grounds, but I have never seen palpocils.

I have investigated a number of Australian Calcispongiæ, Myxospongiæ, and Horny Sponges, and have found upon some, although only a few of them, cells which I regarded as nervous. Among the Horny Sponges I have hitherto tested in this respect only the Auleninæ and the genus *Euspongia* (the Australian species). The actual results in these groups are as follows:—

Sycandra arborea, Häckel. The sense-cells form a ring at the entrance of the afferent canals.

Grantessa sacca, R. v. L. The sense-cells stand in groups at the entrance to the afferent canals.

Vosmœria gracilis, R. v. L., and *Sycandra pila*, R. v. L. The sense-cells stand in groups at a greater distance around the incurrent apertures.

Leucandra saccharata, Häckel, and *Leucandra meandrina*, R. v. L. The sense-cells stand in groups which are scattered irregularly over the surface.

Leucetta microrhaphis and *Leucaltis helena*, R. v. L. The sense-cells are scattered singly over the surface, but appear to be more numerous in the vicinity of the incurrent orifices.

Aulena villosa, R. v. L. The sense-cells are placed in

small groups at the lines of union of the membranes, which are extended in the vestibular space.

Halme globosa, R. v. L. The sense-cells stand in groups at the edges of the membrane which are extended in the lacunar spaces of the afferent canal-system.

Euspongia canaliculata, R. v. L. The sense-cells form zones which surround at the surface the lacunar dilatation of the efferent canal-system.

These isolated observations do not enable us to draw any general conclusion, as the observations on the various species are so very different.

I have already indicated * that Schulze's denomination of the contractile elements as "contractile fibre-cells" is no longer necessary, and may now be replaced by the designation "muscle-cells," seeing that nervous elements have been found with them.

Both the muscle- and nerve-cells are *mesodermal*. The *epithelia* of the Sponges nowhere appear to be further developed after the fashion of the higher Cœlenterata. Both endoderm and ectoderm always remain simple †.

XXXIII.—*A few Remarks on Mr. Butler's Notes on the Genus* Terias. By W. L. Distant.

In the last number of this Magazine I have read with no inconsiderable interest a paper by my friend Mr. Butler, entitled "Notes on the Genus *Terias*." In this communication the author, after expressing the very sound opinion that "it is quite impossible for any one, in our present profound ignorance of the earlier stages of most of the species and our imperfect knowledge of those of all, to lay down the law as to which of these forms is worthy of a distinctive name and which not," has still been compelled to describe *twelve* new species, and also to again do me the kindness of not only reviewing some of my recent work, but also to contribute much readable criticism thereon, and to offer many alternative suggestions for my consideration. Under these circumstances I have felt it would be discourteous to any longer refrain from affording such explanation as is possible to one who has taken the trouble to read my remarks, and also I have considered it necessary to myself to show that the views I had the temerity

* Zoologischer Anzeiger, no. 186.

† Häckel has described some Calcisponges with locally plurilamellar endoderm, but hitherto this statement has not been confirmed. See also Vosmaer in Bronn's 'Klassen und Ordnungen des Thierreiches: Porifera.'