16. LIMNOGONUS (?) LUBRICUS, n. sp. *Limnogono* (?) *loto* simillimus sed minor, pronoto vix constricto, lateribus corporis haud vel obsoletissime nigro notatis, femoribus anticis linea longitudinali postica vice maculæ fuscæ ornatis. Long. 5, lat. 1½ millim.

Hab. Brasiliam borealem. (Manaos, August 1875, "at light," *J. W. H. Trail.*)

NAUCORIDÆ.

17. PELOCORIS PROCURRENS, n. sp. Pallide brunneo-testaceus, capitis postici et pronoti maculis nonnullis irregularibus, connexivi signaturis, femorum anticorum supra macula irregulari et posterius basin versus vittula brunneo-fuscis; capite pronotoque obsolete, hujus disco distinctius et transversim rugosis; pronoti marginibus lateralibus angustissime reflexis; hemelytris minutissime punctulatis. ♂ long. 5, lat. 3½ millim.

Hab. Brasiliam borealem. (Montealegre, 1873, *J. W. H. Trail.*)

Belongs to the same section of the genus as *binotulatus*, Stål; but is very much smaller and otherwise different.

THE ANNIVERSARY ADDRESS OF THE PRESIDENT, Professor ALLMAN, M.D., LL.D., F.R.S.

Recent Progress in our Knowledge of the Structure and Development of the Phylactolæmatous Polyzoa.

[Read May 24, 1878.]

CONTINUING to adopt the practice which I have hitherto regarded as the most useful—that of making the Addresses delivered at the Anniversary Meetings of the Society reports of the progress of discovery in certain departments of zoological research—I have this year chosen for my subject the structure and development of the Phylactolæmatous Polyzoa, making the report extend over a period which dates from the publication of my own early researches on this group *.

Unless we include among them the genus *Rhabdopleura* †, all the Phylactolæmata are inhabitants of fresh water. One of their

* A Monograph of the Freshwater Polyzoa. Published by the Ray Society, 1856.

† I do not believe that *Rhabdopleura* has any real claims for admission into the group of the Phylactolæmata. The characters which at first sight

most obvious peculiarities is the possession of an epistome, an organ somewhat resembling the epiglottis of a mammal, which springs from the lophophore or support of the tentacular crown at the anal side of the mouth, whose entrance it defends much in the same way that the epiglottis defends the glottis. With one exception—that afforded by *Fredericella*—the lophophore is in the form of a crescent.

Structure.

We owe to Hyatt a very valuable and well-illustrated memoir on the structure of the Phylactolæmatous Polyzoa*. The genera which form the subject of his observations include, with the exception of *Lophopus*, all those hitherto found in Europe†, as well as a new genus *Pectinatella*, which, so far as we yet know, is confined to the United States. He has studied the histological structure of the endocyst and of the alimentary canal, the distribution of the muscles and of the nervous system; and on all these points has added much to our previous knowledge of the group.

Nitsche has also published the results of a series of very careful and valuable researches on *Alcyonella fungosa*‡, which he takes as a representative of the Phylactolæmata. He does not appear

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would appear to justify these claims are its crescentic lophophore and the possession of a shield-like organ extended over the mouth, and having some resemblance to the epistome of a Phylactolæmatous polyzoon.

The crescentic lophophore, however, of *Rhabdopleura* is very different from that of the Phylactolæmata, the tentacles which it carries forming an interrupted series instead of a continuous row round the edges of the lophophore. The shield-like organ, moreover, as shown by its development, has a significance entirely different from that of a Phylactolæmatous epistome. It is in fact an independent zooid (person) intercalated into the life series of the animal.

The characters of *Rhabdopleura* are altogether so anomalous as to place it in a great primary section of the Polyzoa, at least equal in rank to those of Ectoprocta and Endoprocta—a section for which one of its most striking features, the possession of the great supraoral shield, would suggest the name of Aspidophora.

* Alpheus Hyatt. "Observations on Polyzoa, Suborder Phylactolæmata," Proceedings of the Essex Institute (United States), 1865, vol. iv.

† *Alcyonella* is referred to merely as a form of *Plumatella*.

‡ Nitsche. "Beiträge zur Anat. und Entwick. der Phylactolæmen, insbesondere von *Alcyonella fungosa*," Archiv für Anat., 1868.

to have been aware of the researches of Hyatt, made a short time previously; and though he has, to a certain extent, been anticipated by these, his memoir has all the value of independent investigation.

Nitsche's observations agree, on the whole, with those of Hyatt, but in some important points supplement them; and we thus, from the combined labours of the American and German zoologists, have attained to a very accurate and complete knowledge of the structure of the Phylactolæmatous Polyzoa. The following may be regarded as the most important results of these researches.

Structure of Endocyst.—In the endocyst three distinct layers may be demonstrated. These are (in succession from without inwards):—1, an outer cellular layer; 2, a muscular tunic; 3, a ciliated epithelium.

The outer cellular layer is composed of two different forms of cells. The cells composing the principal mass of this layer are prismatic where they enter into the proper body-walls, while in the tentacular sheath or invaginable portion of the body-wall they have become diminished in height and increased in width so as to assume the form of flat polygonal cells. In every case they show a manifest cell-membrane, and possess a large and distinct nucleolated nucleus. Hyatt makes the interesting observation that in the tentacular sheath these cells are eminently contractile, occasionally dilating to twice or thrice their normal size, and then suddenly contracting.

Imbedded among the polygonal cells we find those referable to the second form. These are roundish or oval, also with manifest membrane and with small parietal oval nucleus. Their contents, which in the living animal are clear and strongly refringent, become quickly and intensely coloured by carmine solution, while the polygonal cells are scarcely affected by the colouring-matter.

In the muscular tunic two distinct sets of fibres may be detected, an outer circular or transverse set, and an inner longitudinal set, both supported by a common delicate homogeneous foundation membrane. Both circular and longitudinal fibres are smooth, more or less flattened, contain a nucleus, and lie with their pointed ends wedged between each other.

The third and most internal layer of the endocyst is the ciliated epithelium. Nitsche has noticed that the cilia do not uniformly cover this layer. On the tentacular sheath and on the under part of the body-wall they are disposed in separate groups, each of which is seated on a small elevation determined by the presence of a nucleus.

Structure of Alimentary Canal.—The histological structure of the alimentary canal is very similar to that of the endocyst. Its walls, for the greater part of their extent, are here also composed of three layers. The outer is an epithelial layer continuous with the epithelial or inner layer of the body-wall. It is, however, destitute of cilia, and is composed of flattened fusiform cells, containing a nucleus, but without any cell-membrane. At the blind end of the stomach it increases in thickness, and is here continued over the funiculus.

Next to the epithelium is a muscular layer composed of fibres supported by a transparent homogeneous foundation membrane. The fibres are flat bands pointed at each end, and having for the most part a longish nucleus in the middle. They run transversely round the alimentary canal, with the pointed ends of each wedged into the intervals of others. Nitsche has noticed in them a kind of striation, but has not satisfied himself that this depends on an essential structure of the fibre. The muscular fibres are absent on the extreme point of the stomach where this passes into the funiculus.

The most internal stratum of the alimentary canal consists in the stomach of a single layer of cells. Here this layer is thrown into longitudinal ridges, whose cells contain brown granules, which possibly indicate a hepatic function. The ridges have been shown by Nitsche to consist of certain cells of this layer which have become elongated, and are sometimes enlarged at their free extremities so as to present a club-shaped form*.

The inner layer of the rectum appears also to consist of a simple layer of cells. These are prismatic, and sit vertically on the muscular layer. Each is provided with a nucleus at its base; and as they are all of equal length, the longitudinal ridges of the stomach are here wanting.

In the œsophagus the cells which correspond to this layer present, according to Nitsche, a very remarkable condition. He describes them as being of long prismatic shape with the long

This view is apparently the right one, and is a rectification of a somewhat different description of the longitudinal ridges given formerly by myself ('Monograph of the Freshwater Polyzoa').

axis perpendicular to the walls of the œsophagus. They have in their middle a large oval nucleus with clear strongly refringent nucleolus. The nucleus divides the cell into an inner half and a peripheral half. The peripheral half is clear, and has the appearance of being empty and closed at its inner end by the nucleus, while the inner half is filled with granular contents. The inner half, moreover, is provided with a special cell-membrane, while the peripheral half has no proper membrane. The peripheral portions thus appear to constitute a system of lacunæ in which the wall of one forms a part of the wall of that abutting on it, and which may be thus best compared with a honey-comb.

Lying on the free end of each of these œsophageal cells may be seen a small transparent vesicle, which at one time swells out into a sphere, at another contracts into a short ovoid. These vesicles seem to represent an internal epithelial layer of the œsophagus. Where the œsophagus slightly dilates towards the mouth, they are replaced by cells bearing long cilia, and here also the honeycomb-like lacunæ are absent.

Tentacles.—The walls of the tentacles are composed of three layers—an outer cellular layer, an inner epithelium, and an intermediate homogeneous membrane. Muscular fibres also enter into the composition of the tentacle; but these do not form, as in the body-walls and alimentary canals, a continuous layer. The homogeneous membrane forms the proper foundation-layer of the whole tentacular crown. It is in direct continuation with the homogeneous membrane of the muscular layer of the œsophagus and body-wall, and, like this, is easily coloured by carmine solution. It forms also the foundation-layer of the intertentacular membrane, and is continued beyond the free margin of this membrane along the opposed sides of the tentacles in the form of a ridge, which, however, in the living animal, is concealed beneath the outer cellular layer, beyond which it does not project.

The outer cellular layer of the tentacles is divided by this ridge into two distinct portions. That which lies behind the ridge is directly continued from the outer cellular layer of the body-wall which passes uninterruptedly from the tentacular sheath upon the back of the tentacles, where it presents the two elements already described, the polygonal cells and the round cells. This part of the cellular layer carries no cilia ; but, on the other hand, fine, long, stiff bristles have been described by Nitsche as occurring here along the middle line of the tentacle; these are arranged in groups of two or three at tolerably regular intervals.

While the outer cellular layer of the body-wall is thus carried over the back of the tentacles, their opposite or oral side is clothed by a continuation of the ciliated epithelium of the mouth. Besides the cilia thus continued from the mouth along the middle line of the oral side of the tentacles, there is a dense line of vibratile cilia along each of the opposed sides of the tentacles. On each side of the ciliated tract which runs along the middle of the oral face of the tentacle and between this tract and the lateral line of cilia is a non-ciliated area which, according to Nitsche, carries a series of long stiff bristles. These stand singly at regular distances from one another and tolerably close, thus differing from the bristles on the back of the tentacles, which are disposed in groups of two or three.

The inner epithelium extends from the cavity of the lophophore into that of the tentacle, and presents two strong ridges, one along each of the lateral sides of the tentacular lumen.

Special Muscles.—The investigation of specimens hardened in chromic acid shows in the interior of the tentacles two fasciculi composed each of two or three long fibres. These had been already noticed by Hyatt, and their existence is now confirmed by Nitsche. They run, one along the oral side, the other along the opposite side of the tentacle. Their fibres contain nuclei and are apparently muscular.

The same homogeneous membrane already so frequently referred to has been followed by Nitsche into the epistome, where it forms the foundation-layer of this organ. Hyatt describes three muscle-bands as entering into the structure of the epistome. I had already described the musculature of the epistome as consisting of a single strong fasciculus which acts as an elevator*. With this view the observations of Nitsche are entirely in accordance.

Under the name of "brachial contractors," Hyatt describes a series of previously unnoticed muscular bands situated within the arms of the lophophore, where they run transversely in their walls. These, by their contraction, act on the floor of the arms, drawing it up into folds.

He also, under the name of "lophophoric flexors," describes

* 'Monograph of the Freshwater Polyzoa.'

a pair of large muscles, one in each arm. These run from the oral region to the extremities of the arms, and serve to elevate their tips.

The two groups of muscles hitherto known as the " great retractors of the polypide " and the " rotators of the lophophore " are brought together by Nitsche under the designation of the " great motor muscles of the polypide." He so names them from a belief that when the polypide is completely retracted its extrusion may be initiated by the action of these muscles, though when it is only partially retracted the contraction of the body-wall may, by its pressure on the contained fluid, be of itself sufficient to bring about the evagination of the tentacular sheath and the protrusion of the polypide.

Nitsche further shows that the individual fibres of these muscles are each enveloped in a distinct sarcolemma, and are provided with a nucleolated nucleus, which lies between the proper muscle-substance and the sarcolemma. In quite young buds the muscle-fibres are found to be as yet short fusiform cells with parietal nucleus. Nitsche has never been able to see a true striation in the muscular fibre, but only a slight transverse wrinkling of the sarcolemma; while the breaking up of the fibrillæ into disks, which may be occasionally witnessed, takes place so irregularly, that he cannot regard it as indicating a normal structure.

The posterior parieto-vaginal muscles are described by Nitsche as continuous with the longitudinal fibres of the endocyst. They are not, like the other special longitudinal muscular bundles (such as the great motors of the polypide), simple structures consisting of a single histological element, but are composed (1) of a foundation-membrane formed by a prolongation of the homogeneous membrane of the tunica muscularis of the body-wall, (2) of muscular fibres which pass inwards in bundles from the longitudinal fibres of the body-wall, (3) of an epithelium by which each parieto-vaginal band is enveloped. The muscular fibres of these bands pass upwards on the tentacular sheath, and form its fine longitudinal musculature.

With this composite condition Nitsche contrasts the simple structure of the anterior parieto-vaginal muscles. These, moreover, are not, like the posterior, continued into the muscular layer of the body-wall. Each fibril of the anterior set is known to present a small swelling, which he has proved by treatment with chromic acid to be a true nucleus. He has also observed that, on the places where these nuclei lie, the muscular fibre and nucleus are enveloped by a fine sarcolemma.

Nervous System.—Both Hyatt and Nitsche have made the nervous system of the Phylactolæmata a subject of careful study, and have considerably advanced our knowledge of it. The central nerve-mass is described by Hyatt as presenting a longitudinal depression which indicates a division into two lateral masses, each of which would form a ganglionic centre for the nerves going to its own side of the body. Nitsche has made a similar observation, which thus tends to confirm Dumortier's original view of the existence of two lateral ganglia in the central nerve-mass of *Lophopus,* though Hyatt has not succeeded in demonstrating the existence of an œsophageal collar.

A very delicate œsophageal collar has, on the other hand, been described by Nitsche, who makes an apt comparison of the central nerve-mass to a signet-ring with two long horns affixed to the right and left of the stone. The stone represents the ganglionic centre, the remainder of the ring the œsophageal collar, and the two horns are thick chords which pass into the arms of the lophophore.

The two ends of the ganglion, whose double nature may be inferred from the presence of a deep furrow on the surface which rests on the œsophagus, are continued laterally round the œsophagus, thus forming the œsophageal ring just referred to. This ring, however, is very thin and difficult to detect. The two chords which are sent off from the opposite side into the arms of the lophophore are much thicker.

The central mass is, according to Nitsche, surrounded by a firm envelope, which appears to be identical with the homogeneous membrane already so often mentioned. By means of this the ganglion is attached to the œsophagus, and the horns to the arms of the lophophore. The contents of the envelope consist of a finely granular mass in which very numerous nuclei are scattered, the nuclei preponderating over the finely granular matter both in the ganglion and in the horns. The œsophageal ring, on the other hand, shows an indistinct fibrous structure, and a similar structure is seen in the very delicate peripheral nerves which proceed from the ganglion and horns.

From the sides of the horns and from their points run a number of fine chords, each of which passes towards the interspace between every two tentacles, then passes through the walls of the lophophore, and divides into branches on the intertentacular membrane beneath the cellular layer; but no closer connexion of the nerves with the tentacles could be traced. Nitsche also believes that he has seen a fine filament pass from the anterior margin of the ganglion into the epistome, but cannot speak of this with certainty.

The central mass is stated by Hyatt to be contractile, and, as a result, mutable in form. It is difficult to reconcile this character with the properties of a true nervous centre, and one can scarcely help believing that Hyatt's account of it rests on some deceptive appearance.

Statoblasts.—Hyatt describes the statoblasts of *Pectinatella* as armed, like those of *Cristatella*, with spines; but he has not succeeded in detecting in the statoblasts of *Pectinatella* the ciliated membranous envelope which in *Cristatella* surrounds these bodies before their liberation. In *Pectinatella* they are detached from the funiculus before the appearance of the spines, and then lie loose in the body-cavity, where they remain until the death of the polypide and the decay of the upper part of the zoœcium affords them exit. They are then floated off, and remain during the winter in a quiescent state, and often imbedded in ice. The young polyzoon, which on the approach of spring protrudes from between the separating valves of the statoblast, has the whole of its free surface covered with vibratile cilia. By the aid of these it enjoys for some time a free-swimming existence, and finally disencumbers itself of the old valves of the statoblast, loses its cilia, and becomes fixed.

The peculiar statoblasts which are known to occur in several freshwater species, and which, instead of being free, are always found closely adherent to the walls of the zoœcium, are regarded by Hyatt as originating in these walls instead of being formed, like the free statoblasts, in the funiculus. He also states that the free statoblasts of *Fredericella,* though primarily formed, like those of other genera, in the funiculus, become subsequently attached to the walls of the zoœcium, where they resemble in all respects the true fixed statoblasts.

Development.

Development of the Bud.—Some very valuable contributions to our knowledge of the development of the Phylactolæmata have been made by Metschnikoff and by Nitsche.

Metschnikoff, in a short communication to the St. Petersburg Academy *, describes the eggs of *Alcyonella* as formed in the inner epithelial layer of the body-cavity, where they occur as simple cells combined into a mass so as to form an ovary. From this are detached the mature eggs with the germinal vesicle still apparent. These float about for a time in the body-cavity, and then enter into relation with a peculiar bud, which appears, in the form of an ordinary Polyzoon bud, on the walls of the body-cavity, into which it projects. He could not discover how the egg becomes first attached to this bud; but he has determined that it ultimately becomes included within it, the bud enveloping it in a duplicature which he compares to a decidua reflexa. In the sort of brood-capsule thus formed the egg undergoes total cleavage, and becomes changed into a heap of cells, which, after enlarging, forms a central cavity surrounded by a double layer of cells. This constitutes the cyst of the well-known *Alcyonella*-larva, within which two polypides subsequently make their appearance by budding. In this budding both laminæ of the cyst-walls participate. The outer lamina serves for the formation of the outer epithelium of the tentacles and the inner epithelium of the alimentary canal; while the central nervous system, which in the larva is very large, is also most probably derived from it. The inner lamina, on the other hand, forms all the muscles of the body, as well as the genitalia and the inner epithelium of the body-cavity.

Nitsche had arrived at nearly the same conclusion regarding the part taken by the two germinal laminæ in the formation of the tissues of the polypide in the marine polyzoon *Flustra membranacea* †; and he further ‡ confirms Metschnikoff's remarkable observation regarding the reception of the eggs of *Alcyonella* into a brood-capsule formed as a bud from the walls of the body-cavity. He sees in this last observation a solution of the question regarding the escape of the larvæ from the body-cavity of the parent, though no orifice which could serve as exit had been hitherto detected. He has convinced himself that the brood-sac of *Alcyonella*, which, quite like the polypide-buds, arises near the invagination-orifice of the parent zoœcium, finally opens at its anterior end, where it is connected with the endocyst in the same way as the tentacular sheath of a young polypide. The larva

* Bull. de l'Acad. de St. Pétersbourg, xv. 1871, p. 507.

† Zeitschr. f. wiss. Zool. Bd. xxi. p. 457. ‡ *Ibid.* Bd. xxii.

which had been included within it is thus liberated, and enters on its free life in the surrounding water.

Nitsche compares this brood-capsule to the oœcium or ovicell of the marine Polyzoa, which is formed as an external bud on the body-wall, and into which the fecundated egg passes in order to escape finally into the sea.

It appeared to me some years ago, when engaged in examining the larvæ of *Alcyonella*, that these were set free into the body-cavity of the parent, whence they subsequently gained exit by the destruction of the tissues. Nitsche believes that in this case they obtained access to the body-cavity by accidental rupture of the brood-capsule. It is possible that Nitsche may be right in this; at all events, without an opportunity of controlling, by further examination, my original observation, I do not desire to insist on its accuracy.

In a subsequent memoir * Nitsche traces the formation of the bud in *Alcyonella* and points out in detail the parts which the endoderm and ectoderm (the two germinal layers) take in the formation of the tissues and organs. He had already shown that the wall of the cystid or zoœcium of *Alcyonella* consists of three different layers besides the externally excreted ectocyst or cuticula. These are an outer epithelium, an inner epithelium, and a tunica muscularis lying between the two and consisting of a structureless supporting membrane on which lie transverse and longitudinal muscular fibres.

The first indication of the polypide-bud shows itself as a sac-like bulging inwards of the cystid wall. In this bulging the tunica muscularis, however, takes no part, but seems to be absorbed at the spot where the bud occurs. The polypide-bud consists therefore at this stage of a two-layered cellular sac, whose inner layer, bounding its central cavity, passes continuously into the outer epithelium of the cystid wall, while the outer layer is continuous with the inner epithelium of the cystid.

Nitsche follows Metschnikoff in regarding the outer epithelium of the cystid as the outer germinal layer or ectoderm, the inner epithelium as the inner germinal layer or endoderm; and if we further regard the tunica muscularis as a middle germinal layer or mesoderm, we may view the young polypide-bud as com-

* "Untersuchungen über die Knospung der Süsswasserbryozoen, insbesondere der *Alcyonella*," Sitzungsberichte der naturforschenden Gesellschaft zu Leipzig, 1874.

posed of two concentric cellular layers—the internal derived from the ectoderm, the external from the endoderm of the cystid, while the mesoderm of the cystid takes no part in the formation of the bud. The point where the cystid walls have become invaginated to form the bud corresponds in the completed polypide to the spot at which the tentacular sheath passes into the wall of the cystid; while the blind end of the sac corresponds to the blind end of the future polypide stomach, that from which at a later period the funiculus proceeds—an organ, however, whose genesis Nitsche has not succeeded in tracing.

Folds and secondary introversions of this two-layered cellular sac give to the young polypide its definitive form. First, two lateral introversions of the posterior part of the sac grow towards one another, and finally meeting convert this part into a bent tube, each of whose arms opens into the still unchanged anterior part. The bent tube becomes the alimentary canal, and the two openings by which its lumen communicates with that of the anterior part of the sac are the oral and anal orifices of the future polypide; while the anterior unchanged portion of the sac is to become the tentacular sheath.

The alimentary canal and tentacular sheath thus sketched out consist each of two cellular layers. The inner epithelium of the alimentary canal is derived from the ectoderm of the cystid, while the outer is derived from the endoderm. The two layers of the tentacular sheath have a precisely similar derivation.

There next occurs, right and left of the oral orifice, a conical introversion of the walls of the alimentary canal. There are thus formed two hollow cones, whose lumen is in each accessible from the body-cavity of the cystid by a wide opening. These are the foundation of the two arms of the crescentic lophophore. In the further course of the development they become united by a ridge, which runs round the abanal margin of the mouth. This ridge is formed by an infolding of the two layers of the bud, and constitutes the foundation of the abanal or middle portion of the lophophore. The lophophore is thus in its essential features sketched out, and from this the tentacles arise as hollow protrusions of the lophophore walls. Each tentacle thus represents a short cæcal tube which projects free into the cavity of the original cellular sac of the bud, and has its lumen in connexion with the cavity of the cystid, never with that of the polypide. The tentacles arise nearly simultaneously from the entire margin of the lophophore, with the exception of the two opposed margins of the arms, where they sprout first after the polypide can protrude itself from its cystid. Nitsche compares the arms of the lophophore to two great primary tentacles, from which the secondary (or definitive) tentacles sprout. From this account of the orifice of the tentacles it is obvious that their outer epithelium, which afterwards becomes ciliated, is derived from the ectoderm of the cystid, which corresponds to the inner layer of the bud; while their inner epithelium is derived from the endoderm of the cystid, the outer layer of the bud.

Already, long before these last-mentioned occurrences take place, the nervous ganglion has made its appearance. At the margin of the mouth, between the bases of the arms of the lophophore, there may be seen an introversion of the two cellular layers. This is so situated that its shallow lumen communicates with the cavity of the tentacular sheath. Its direction is thus the reverse of that of every introversion hitherto described as occurring in the development of the bud ; for none of these open into any part of the cavity of the bud, but, on the contrary, have their lumen always in communication with the cavity of the cystid. The margins of the shallow introversion thus formed now grow together, in quite the same way as the margins of the medullary groove in the vertebrate embryo. In this way a button-like vesicle, composed of the two cellular layers of the bud, is pushed out from the walls of that part of the bud which is to become the pharynx of the polypid. It is the first sketch of the nervous ganglion, and at this stage is relatively very large. From its mode of formation, it is obvious that its internal proper nervous substance proceeds from the internal layer of the bud, which is derived from the ectoderm of the cystid ; while its envelope is a continuation of the external layer of the bud, the endoderm of the cystid.

The phenomena here described are in accordance with the general law that the central nervous system is always derived from the ectoderm of the embryo ; but, as Nitsche suggests, we must not in the present instance lose sight of the fact that the inner layer of the bud, though arising from the ectoderm of the cystid, has fundamentally different relations from those of an ordinary ectoderm, for there proceeds from it, at the same time with the nervous substance of the ganglion, the entire epithelial lining of the intestinal tract.

As yet no trace of muscular fibres can be detected in any part of the tentacular sheath or of the alimentary canal. These are formed at a later period; but Nitsche has not been able to determine from which of the two layers they are derived. The fibres of the retractors and of the parieto-vaginal muscles arise each out of a single cell of the endoderm—that is, of the outer layer of the polypide-bud close to the spot where this is connected with the wall of the cystid.

Formation of the Statoblast.—Nitsche has further paid great attention to the statoblasts of *Alcyonella*, and has given a very complete account of their mode of formation, which he shows to be a curious and complicated process*.

These bodies, as is well known, consist of two parts,—a lenticular disk enclosed in a chitinous envelope, and composed of the material from which a young individual is to be developed; and a chitinous ring running round the edges of the disk, composed of air-filled chambers and acting as a float.

The statoblasts arise from a sausage-shaped body, which is formed immediately below the outer epithelium of the funiculus, and is composed of nucleolated nuclei with a small quantity of intervening protoplasm. From this are constricted off one after another small heaps of nuclei. These heaps continue to lie between the body of the funiculus and its epithelial layer. Each of them represents a statoblast, and soon shows a division into two halves by means of an equatorial furrow, so that it assumes an appearance very like that of the vitellus of an ovum after its first segmentation. In the next place that half which lies furthest from the funiculus becomes excavated by a central cavity, the nuclei which compose it arranging themselves in a single layer on its periphery. This excavated half is destined for the formation of the chitinous envelope with the float-ring, while the other affords the material out of which the young animal is to be developed. The former is termed by Nitsche the cystogenous layer, the latter the formative mass.

Protoplasm now collects round the nuclei, forming the walls of the cystogenous layer, and converts them into true cells, which become elongated prismatic, and assume the form of a cylinder epithelium. An increase of protoplasm also occurs round the nuclei of the formative mass.

* Archiv für Anat. 1868.

The young statoblast now assumes an oval lenticular form, while the cavity of the cystogenous layer disappears by the approximation of its walls; and this layer now lies on the free surface of the formative mass in the form of an oval plate composed of two cellular layers, which pass into one another at their margins.

The cystogenous layer next extends itself at its margins, and gradually grows round the formative mass nearly in the same way that the fold of the amnion grows round the embryo.

At the same time there appears, between the two cellular layers of the cystogenous portion, a strongly refringent membrane. This is the foundation of the chitinous envelope of the disk, and is apparently a secretion from the cells of the outer layer.

The formative mass has in the mean time become differentiated into long fusiform cells, filled with strongly refringent granules and without any apparent nucleus.

The cystogenous layer now continues to grow round the disk, depositing as it proceeds the chitinous secretion between its two layers, and its margins have begun to approach one another at the opposite side of the disk. The inner layer has, however, become less distinct, a condition which is only a precursor of its complete disappearance; while the cells composing the outer layer at that part where it bends round the sharp edge of the disk have become very much elongated, and the outermost ones, here gliding away from the disk, have arranged themselves in two series, an upper corresponding to the upper side of the disk, and a lower corresponding to its lower side. The cells of each of these series impinge by their bases on the bases of those of the other in a plane which corresponds to an extension of the sharp edge of the disk.

A remarkable phenomenon now shows itself in these elongated cells. They begin to secrete chitin, not only from their bases as they have all along done, like all the cells of the outer layer, but from their sides, so that a chitinous secretion is thus deposited in the intercellular spaces.

The secretion from their bases forms a thin double lamella, which runs round the margin of the disk in the form of an extension of its sharp edge; while the secretion from the sides of the cells forms, both on the upper and lower sides of this lamella and on the adjacent parts of the disk, a series of short chitinous tubes, hexagonal in transverse section, and closely adherent to one another by their sides. These tubes form the foundation of the chitinous float-ring; they are, however, still open on their summits, and are each filled by the soft cell which acted as its matrix.

The chitinous envelope of the disk has now considerably increased in thickness, and along with the outer stratum of the cystogenous layer has extended still further towards the middle of the underside of the statoblast, while the inner stratum of the cystogenous layer has entirely disappeared.

The closure of the chitinous envelope, however, in the middle of the underside of the disk is not yet completed, and there still remains at this point a round hole through which part of the soft contents of the disk protrude. As the hole grows gradually smaller by the advancing chitin-deposit, the protruding mass becomes constricted off, and at last the disk becomes completely enclosed in its chitinous envelope.

Nearly up to the point of the complete closure of the chitinous envelope the chitin had been laid down by new cells which are being constantly formed on the advancing margin of the cystogenous layer. The final disappearance of the central aperture, however, is effected by the cells, which already lie round its circumference, bending over the aperture, cupola-like, and depositing the chitin from their bases.

The stage is now attained in the development of the statoblast when the disk is completely enclosed in its chitinous envelope and the chambers of the float-ring are laid down. These chambers, however, are still open on their summits, and are filled with their formative cells. The whole of these contents now withdraw towards the peripheric or open ends of the chambers, so that these are left empty, and the cells which had filled them now hang, in the form of small nucleated lumps of protoplasm, on the epithelial layer of the statoblast.

These little protoplasmic masses become gradually broader, press close to one another, and form with the remaining cells of the cystogenous layer a continuous stratum all round the statoblast. This stratum now begins to secrete chitin from its entire inner surface; and by the chitinous deposit thus uniformly laid down over the surface of the statoblast, the chambers of the float-ring are closed above and the chitinous envelope of the disk thickened. The fine tubercular sculpture which characterizes the completed statoblast is now distinctly visible on the surface of the disk, and exactly corresponds to the form of the secreting matrix.

It is thus evident that the cell-like chambers which compose the float-ring are not true cells, but a chitinous deposit moulded on the surface of cells. The statoblast is now complete, the soft cellular layer which had surrounded it gradually disappears, the epithelial layer which had held it to the funiculus also disappears, and the statoblast falls into the body-cavity of the animal, where it remains until the destruction of the latter sets it free.

New Forms.

Besides several new species belonging to genera already described, a new generic form from North America has been added by Hyatt to the Phylactolæmata. He names it *Pectinatella.* Its nearest ally would seem to be *Lophopus,* from which it differs by its gelatinous ectocyst being confined to the base, where it forms a broad disk, often several inches thick, and common to numerous colonies. The naked endocyst is divided into lobiform branches, in which the zoœcia with their polypides are immersed. The protrusion of the polypides is scarcely limited by any permanently invaginated fold of the endocyst, as in *Lophopus* and other genera, the tentacular sheath in *Pectinatella* rolling out nearly to its full length. This is described by Hyatt as resembling, in its completely evaginated state, "a column supported by a simple ovolo and fillet." The statoblasts are provided with marginal spines, as in *Cristatella.*

Only one species is known, *P. magnifica,* Hyatt. This occurs abundantly in shallow water during the months of July and August; but as autumn advances it is found attached to logs in deep cold water, at a depth which in some cases reaches 15 or 20 feet. "The tropical aspect and luxuriant growth of the clinging masses, frequently several feet in diameter, investing the summits of submerged stumps &c., are unequalled among the freshwater, or even among the marine, forms of our climate."—*Hyatt.*
