with oblong, distant, indistinct punctures, the intervals very minutely punctured; body beneath and legs black, glabrous, shining; antennæ black, slightly thicker outwards. Length 4½–5 lines.

XIII.—*On the Organization of Sponges, and their Relationship to the Corals.* By Ernst Häckel.

[Continued from p. 13.]

What raises our deduction as to the common origin and genealogical relationship of the sponges and corals to a perfect certainty is the hitherto entirely overlooked *fundamental agreement of the sponges and corals* (*and, indeed, of all the Cœlenterata*) *in the ontogenetic building-up of their body from two different layers of cells or germ-lamellæ—the entoderm and ectoderm.* In all Sponges (just as in all Acalephs, Corals, Hydromedusæ, and Ctenophora) all the parts of the body are developed by the differentiation of two distinct cellular layers —an inner formative membrane, the *entoderm*, and an outer formative membrane, the *ectoderm. In all Sponges, as in all Acalephs*, the inner germ-lamella (or entoderm) forms the epithelial lining of the nutrient canal-system, as well as the spores or sexual products (ova and zoospermia), which are nothing more than sexually differentiated cells of this canal-epithelium; the outer germ-lamella (or ectoderm), on the other hand, forms the entire external wall of the canal-system and the principal mass of the body in general, which is differentiated in the higher Sponges and Acalephs into epidermis, connective tissue, skeletal parts, muscles, &c. *The cells produced from the entoderm or inner formative membrane perform the vegetative functions of nutrition and reproduction both in the Sponges and in the Acalephs. The cells which originate from the ectoderm or outer formative membrane, on the other hand, perform the animal functions of movement and sensation*, and serve also as a *protective covering* and as *supporting skeletal parts* for the whole body. It will therefore seem to be not inappropriate if in *all Cœlenterata* (i. e. *in all Sponges and Acalephs*) we designate the *entoderm* (or inner formative cell-layer) *as the vegetative germ-lamella*, and the *ectoderm* (or outer formative cell-layer) *as the animal germ-lamella.* The wide view which is presented to us by this conception, and by its comparison with the corresponding relations of the germ-lamellæ in the higher animals, and which is well adapted to elucidate the primitive relationship of all the stems of the animal kingdom, *i. e.* the common derivation of all animal *phyla*, will be explained more fully in my Monograph of the Calcispongiæ.

I will admit that this law, which appears to me to be of high importance, is subject to certain modifications in many individual cases, and that perhaps here and there, in both the Sponges and Acalephs, the two germ-lamellæ or formative membranes (the entoderm and ectoderm) may replace each other by *local substitution*. Not unfrequently the entoderm is lost over large spaces, and is replaced by the ectoderm. In some, perhaps in many cases (both in Sponges and Acalephs), the different signification of the two divergent germ-lamellæ is, in particular parts of the body, not clearly recognizable, or even actually changed. Thus, for instance, *perhaps* in both groups of animals, sexual products may sometimes be developed from the ectoderm and muscles from the entoderm. But then, probably, these deviations and local substitutions of the two lamellæ are to be regarded as *secondary modifications, only produced at a late period by adaptation. The original primary relation inherited by all Sponges and Acalephs from the common trunk-form* (Protascus) *is probably that described above*: the *entoderm*, as the *inner*, *vegetative germ-lamella*, forms the nutrient cells of the canal-epithelium, and the cells produced from these, by division of labour, serving for the purpose of reproduction (germ-cells or spores, ova and zoospermia); whilst the *ectoderm*, as the *outer*, *animal germ-lamella*, forms the muscles, nerves, skeletal parts, outer covering, &c.

This law finds its strongest support in the structure of the young forms of the two groups of animals, which have been already referred to. The cup-shaped young state, produced from the ciliated larva, which possesses a simple stomachal cavity (or digestive body-cavity) with a single, simple aperture (or mouth), and which, in the living *Prosycum*, still recalls to us the long-lost picture of the *Protascus*, shows us its simple solid body-wall (or stomach-wall) composed throughout of the two distinctly differentiated formative membranes, the entoderm and the ectoderm, and, indeed, equally in the corresponding young states of the Spongiæ as in those of the corals and the Acalephs generally. Here, again, however, the Calcispongiæ serve as admirable elucidatory objects, because, on the one hand, of all Sponges they approach nearest to the corals, and, on the other, in the graduated evolution of their simple organization, from the very simple *Prosycum* and *Olynthus*, up to the highly developed *Dunstervillia* and *Cyathiscus*, they bring wonderfully before our eyes the continual separation of the two originally divergent formative membranes, the vegetative entoderm and the animal ectoderm, notwithstanding their further differentiation to various higher structures.

In all Calcispongiæ without exception (although in some more distinctly than in others), the fundamental and original difference of the two formative membranes stands out so distinctly, and may be so readily and clearly traced in their further divergence, even up to the most highly developed forms, that it may be at all times visibly demonstrated. Consequently it has not escaped those naturalists who have most carefully investigated the structure of the Calcispongiæ. Here and there they all speak of the different layers of the body-wall; but none of them has indicated their general and genetic significance, and no one has perceived that the entoderm produces exclusively the epithelium of the canal-system, which performs the function of nutrition, and the cells serving for reproduction, and the ectoderm all the other cells. For this reason I may be permitted here to adduce some special circumstances connected with the structure of the body in the Calcispongiæ, the detailed description of which, and their elucidation by figures, I reserve for my monograph.

The *entoderm*, or inner formative membrane of the Calcispongiæ, produced from the inner cell-layer or vegetative germ-lamella of the embryo, originally lines the whole inner surface of the nutrient canal-system or gastrovascular system in the form of a single continuous cell-layer of flagellated epithelium. By the expression *flagellated epithelium* (Geissel-Epithel, epithelium flagellatum) I understand an epithelial cell-layer, *each cell of which bears a single vibratile hair* (flagellum), in contradistinction to *ciliated epithelium* (Wimper-Epithel, epithelium ciliatum), *each cell of which bears two or more vibratile hairs* (Wimpern, cilia). Flagellated and ciliated epithelia are to be distinguished as two different modifications of *vibratile epithelium* (Flimmer-Epithel, epithelium vibratorium). *In all sponges the vibratile epithelium appears to occur exclusively in the form of flagellated epithelium, and never in that of ciliated epithelium.* This applies both to the vibratile cells which line the inner surface of the canal-system and to those which clothe the outer surface of the vibratile swimming larva. In both cases the epithelial cells are always monotrichal, flagellate cells, and never polytrichal, ciliate cells. The flagellate cells of the sponges are perfectly naked and membraneless; their protoplasm passes directly into the long flagellum, which is thicker at the base. In the flagellate cells I have never failed to find a distinct nucleus. It is usually of very considerable size, one-half or two-thirds as large as the cell. Generally the flagellate cells line the walls of the canal-system only in a single layer; rarely several layers are superimposed upon each other. Such stratified flagellate epithelium occurs, for example, in *Tarroma* and *Clathrina.*

Besides the flagellate cells, the entoderm of the sponges gives origin only to one product, the *ova.* Although here, following the example of all authors, I denominate the *germ-cells* or reproductive cells of the sponges *ova,* this is not without great hesitation. Thus, although I have most carefully examined with the microscope hundreds of Calcispongiæ, I have never succeeded, either in these or in the other sponges investigated by me, in detecting any trace of fecundating male elements or zoospermia. I have thus become very suspicious of the generally accepted *sexual differentiation of the sponges* in general. The only accounts of zoospermia in sponges which seem to merit confidence (although they still require confirmation) are those of Lieberkühn with regard to *Spongilla.* What Carter describes as the zoospermia of *Spongilla* are, as Lieberkühn perceived, Infusoria; and what Huxley figures as the zoospermia of *Thetya* are very probably vibratile cells. No less doubtful are the filaments which Kölliker describes as the zoospermia of *Esperia.* Scepticism as to the occurrence of zoospermia in sponges appears the more justifiable because, on the one hand, the detached flagella of the flagellate cells, which move briskly, may very easily be mistaken for motile seminal filaments, and, on the other, many of the most experienced observers, such as O. Schmidt and Bowerbank, who have examined microscopically thousands of sponges, have, like myself, sought in vain for male organs of any kind whatever. I regard it, therefore, as most prudent and advisable, for the present, to doubt the sexuality of the sponges. But then the cells subserving reproduction, the germ-cells (*gonocyta*), must be designated not as *sexual eggs* (ova), but as *asexual germ-cells* (sporæ).

I have found the spores or so-called ova, in all sponges investigated by me, to be perfectly naked and destitute of membrane, like the flagellate cells from which they proceed. *Throughout I have never found in the sponges examined by me any trace of a membrane or true cell-membrane on the cells. All sponge-cells are naked cells without envelopes* (gymnocyta). The spores of the Calcispongiæ have hitherto been seen only by Lieberkühn in *Sycum ciliatum,* and by Kölliker in *Tarrus* and *Dunstervillia.* I have never missed them in any of the *mature* Calcispongiæ investigated by me. They are very easily recognized, as they are distinguished at once from the flagellate cells by their very considerable size and the absence of the flagellum, whilst no other independently persistent cells (except these two cell-forms of the entoderm) occur in the body of the Calcispongiæ.

The *mode of production of the spores* or so-called ova of the sponges has hitherto been unknown. In my monograph I shall demonstrate that they proceed directly from the flagellate cells, and consequently are *products of differentiation of the entoderm, or metamorphosed flagellate cells.* The simple and extremely significant fact that the reproductive cells are produced, by division of labour, from the nutrient vibratile cells of the entoderm or vegetative germ-lamella applies also to the sponges equally with the Acalephs. According to Kölliker, the spores of *Dunstervillia* and *Tarrus* lie outside the vibratile epithelium in the ectoderm. But they only get there when, from the increase of their bulk, they can no longer find room among the surrounding flagellate cells of the entoderm. They then project sometimes into the ectoderm and sometimes into the lumen of the canals. I have never found special spore-capsules in the Calcispongiæ, but the spores may develope themselves from the flagellate cells on the most different spots in the entoderm. What Lieberkühn describes in *Sycum* as a special "receptacle for the ova, without demonstrable structure," I have never seen, and I suppose that these asserted spore-capsules are transversely cut canals.

As Kölliker has already pointed out, the spores of the sponges have a remarkable resemblance to large ganglionic cells. This is due to the fact that the protoplasm of the cells emits from the periphery polymorphic branched processes. *The spores of the Calcispongiæ resemble large* Amœbæ, *and perform amœboid movements*, by extending and retracting such branched processes. In a state of repose, they are spherical or polyhedral. Each spore possesses a very large, usually spherical, and limpid nucleus. This encloses a large, round, dark, nucleolus, and this, again, a distinct nucleolinus.

The Spongiæ are in part sporiparous and in part viviparous. In the sporiparous sponges (e. g. *Leucosolenia*, *Clistolynthus*) the mature spores drop out of the entoderm into the stomachal cavity or into the parietal canals issuing from the latter, and are then cast forth through the mouth in the forms which are provided with a mouth, whilst in astomatous sponges they creep out through the cutaneous pores. In the latter case their amœboid movements will be of essential assistance to them.

In the viviparous sponges (e. g. *Olynthus*, *Clathrina*) a spherical body (embryo), composed entirely of similar naked nucleated cells, is produced from the simple spore-cell by continued division ("segmentation") within the body of the sponge (either in the stomach or in the parietal canals issuing from it. Each of the cells situated on its surface emits a filamentous process, and thus becomes a flagellate cell. Then there is produced in the interior of this vibratile embryo a central cavity (stomach), which, sooner or later breaking through to the outside, acquires an orifice (mouth). As has already been remarked, the wall of this simple stomachal cavity (body-cavity) then becomes differentiated into two different cellular layers. After the vibratile larva has issued from the parent body, and come to rest after swimming about for a time, the cells of the outer surface retract their flagella, become fused together, and thus form the ectoderm. On the contrary, those cells which surround the stomachal cavity emit each a filiform process, and thus become flagellate cells and form the entoderm. It is only much later, when the sponge has attained its true maturity, that the spores are produced from individual cells of the entoderm.

The body-wall, or stomachal wall of the freely swimming, ovate, vibratile larvæ, the entire canal-system of which consists of a simple stomachal cavity with a mouth-orifice, is composed, in the smaller Calcispongiæ (e. g. *Olynthus*, *Nardoa*), only of two layers of cells, the ectoderm and the entoderm each forming only a single layer of cells. In the larger Calcispongiæ, on the contrary (e. g. *Dunstervillia*, *Clathrina*), each of the two sets of cells may divide into several layers.

The *ectoderm* or outer formative membrane *of the Calcispongiæ*, produced from the outer cell-layer or animal germ-lamella of the embryo, always forms more than half the volume of the body, as it is always thicker (often several times) than the entoderm. *The ectoderm consists of intimately amalgamated naked cells*, the nuclei of which are always at first, and usually even at later periods, distinctly visible in the united protoplasm, which is frequently differentiated in various ways. The nuclei are generally of an elongate-rounded form, and frequently surrounded by an aggregation of fine granules, which not rarely radiate from the nucleus and extend in various directions into the protoplasm. Although in the ectoderm of the mature Calcispongiæ, the apparently almost homogeneous, nearly structureless, fundamental substance, charged with nuclei and skeletal spicules, no longer allows any trace of the amalgamated cells of which it is composed to be recognized, it has nevertheless been *actually produced from originally separated cells by their subsequent fusion*, as is clearly proved by the ontogeny of the embryos and larvæ. The ectoderm therefore does not merit the name of true *sarcode*, if under this notion we understand free and *primitive protoplasm not yet differentiated into cells*. The denomination *syncytium* or *sarcodine* might perhaps seem more suitable for it.

The ectoderm of the Calcispongiæ, which becomes converted by the *fusion of the originally separate cells* of the outer or animal germ-lamella into the in some respects *retromorphosed* tissue of the *sarcodine* or *syncytium*, represents, physiologically considered, a tissue which performs the whole of the animal functions of the sponge-body—*movement*, *sensation*, *support*, and *covering*. The amalgamated protoplasm of the sarcodine is *contractile* and *sensitive*, *forms the skeleton*, and *covers* the surface of the body. It therefore, as it were, unites *in one person* the four functions which, in the higher animals, are separated and distributed over the four tissue-systems of the muscles, nerves, skeletogenetic connective substances, and epidermoidal covering.

In a morphological point of view, of all the functions of the ectoderm its *skeletogenetic* activity indisputably produces the most important results. The *skeleton* of the Calcispongiæ, as indeed of all other sponges, is *purely the product of the ectoderm*—and, indeed, never a simple exudation, an "external plasma-product," as I have expressed this idea in my 'General Morphology,' but always an *internal plasma-product*. The *quæstio vexata*, so often ventilated, whether the skeletal parts of the sponges are or are not produced in the interior of cells, is solved by the developmental history. When the skeletogenetic protoplasm still persists in the form of a distinct cell provided with a nucleus, the spicules are produced in the interior of this cell. But when the skeletogenetic cells have already become fused together to form *sarcodine*, the skeletal parts are produced in the interior of this syncytium. *The skeletal parts of the sponges are never produced at the free surface of the ectoderm, but always in its interior.*

In the calcareous skeleton of the Calcispongiæ, by which these sponges are distinguished from all others, we may with comparative ease convince ourselves of this fact. The spicules of the calcareous skeleton are in them either entirely concealed in the modified protoplasm of the ectoderm, or, when they project freely from its surface, they are still coated, as if with a sheath, by a thin layer of the protoplasm. This character, first indicated by Kölliker in *Tarrus spongiosus* (his *Nardoa spongiosa*), has occurred to me more or less distinctly throughout the Calcispongiæ. Moreover *in certain cases* the calcareous spicules contain a central canal filled with protoplasm, such as occurs almost universally in the siliceous spicules of the siliceous sponges. Lastly, in many (perhaps in all?) Calcispongiæ the carbonate of lime of the skeleton appears not to be deposited quite pure, but to be intimately combined with a more or less considerable quantity of organic substance (modified protoplasm). In many Calcispongiæ the carbon-compound takes so considerable a share in the formation of the skeletal parts, that the latter, after the extraction of the carbonate of lime by muriatic acid, remain quite unchanged in form and size, whilst only a slight residue of molecular calcareous dust is left after calcination.

The *forms of the skeletal parts* or spicules in the Calcispongiæ are, as is well known, by no means so multifarious as in the Silicispongiæ. Only the four following fundamental forms occur, with various modifications:—1. Simple spicules (linear, cylindrical, or fusiform), frequent. 2. Two-limbed spicules (forked or hooked), very rare. 3. Three-limbed or triradiate spicules (with equal or unequal limbs and with equal or unequal angles), by far the most frequent, and at the same time the form most characteristic of the Calcispongiæ. 4. Four-limbed or quadriradiate spicules (the fourth ray of which usually projects freely into the canal-system). The different modifications of these four fundamental forms, which have hitherto occupied the attention of the observers of the Calcispongiæ more than all the rest of their organization, will be completely described in my monograph.

That the Calcispongiæ of all living sponges are most nearly allied to the corals, may be inferred in the first place even from the calcareous nature of the skeleton in the two groups. But to this may be added very interesting homologies in the special differentiation of the canal-system in the most highly developed forms of the Calcispongiæ, which in part directly approach the simpler forms of corals even by the formation of antimera*. We may therefore be allowed, in conclusion, to glance at *the steps in the evolution of the canal-system* in the Calcispongiæ.

At the root of the whole system (or, what is the same thing, of the genealogical tree) of the Calcispongiæ stands the remarkable *Prosycum*, the little calcareous sponge whose canal-system consists merely of a stomachal cavity with a mouth-opening. Next to this comes *Olynthus*, a simple " person " with stomach and mouth-opening, but the stomachal wall or body-wall of which is permeated by perfectly simple pores. These cutaneous pores are simple breaches in the parenchyma, which perforate

* Häckel applies the term "*antimera*" to the " homotypic organs " of Bronn—that is to say, to those segments of the body, placed side by side, of which each contains " all or nearly all the essential parts of the body of the species." The segments of the Radiate animals, as indicated in the text, furnish the most striking examples of this mode of formation. Where the repetition of parts occurs in consecutive segments (as in the Annulosa), these are called "*metamera*" by Häckel.—W. S. D.

both layers of the body-wall (ectoderm and entoderm) and are produced by the mutual separation of the cells at changeable points. There is no special canal-wall. *The situation and number of the cutaneous pores are not constant, but changeable,* in *Olynthus* and the most nearly allied Calcispongiæ (*Leucosolenia, Clistolynthus*). New ones form themselves, whilst the previously formed pores are again obliterated by the union of the cells which have moved asunder. The pores behave in this manner also in *Leucosolenia* (a stock-forming *Olynthus*) and in *Clistolynthus* (an *Olynthus* with the mouth closed up).

In the larger and more highly developed Calcispongiæ the simple and inconstant cutaneous pores gradually become converted into permanent and constant canals, which acquire a proper wall by the extension of the flagellate epithelium of the stomachal cavity upon their inner surface throughout the whole of the ectoderm (as in the family Sycaridæ). Among these the genera *Sycum* and *Dunstervillia* have hitherto been most accurately examined; and in these the cutaneous pores have become developed into very considerable canals, which are quite regularly arranged, and traverse the wall of the body in a radiating direction. All previous observers, however, have overlooked the fact that these *radiating canals* not only open inwardly into the stomach and outwardly at the surface of the body, but also all stand in direct communication with each other. The walls between the individual closely contiguous radiating canals are, in fact, perforated in all parts like a sieve, and interrupted by numerous apertures of communication, or *conjunctive pores*, through which each canal communicates with all its neighbours. In some genera the regular radiating canals ramify outwards in the same way as the irregular parietal canals in the walls of the Dyssycidæ.

The most remarkable development of the canal-system is attained, however, in *Cyathiscus*, which is nearly allied to *Sycarium* and *Sycum*, and in which the *horizontal* partitions between the *superimposed* radiating canals become absorbed, whilst the *vertical* partitions between the canals *lying side by side* persist. By this means is produced a *system of radial perigastric chambers*, which is exactly analogous to the corresponding system of perigastric cavities radially surrounding the stomach in the corals. The only distinction is, that the direct communication between the stomachal cavity and the chambers surrounding it takes place in the corals by the opening of the stomach and perigastric chambers below into the common basal space of the body-cavity situated beneath them, in *Cyathiscus*, on the contrary, by longitudinal rows of apertures (stomachal pores) which perforate the partition between the stomachal cavity and each perigastric radial chamber. *Thus the "person" of* Cyathiscus *divides into a radial system of antimera, just like each developed coral-person.*

That the *formation of antimera* occurs frequently in the sponges generally, and that thereby a still closer approximation to the corals is effected, has hitherto been entirely overlooked, Miklucho having only last year called attention to it (*l. c.* p. 230). In *Axinella polypoides*, *Osculina polystomella*, and many other sponges—among fossil forms, especially in *Cœloptychium lobatum*, *Siphonia costata*, &c., they strike one at once. These "radial" sponges are true "Radiata" no less than most corals. It is evident, however, that, from a tectological point of view, the sponges in which antimera are so distinctly differentiated rise no less than the more highly developed corals above the lower sponges, in which no formation of antimera occurs.

Consequently, except the higher degree of histological differentiation in most corals, there remains not a single character which completely separates the sponges from the corals. Even the tentacles surrounding the mouth, which have hitherto appeared to be the exclusive property of the corals, begin their development in certain sponges. At least I would regard as *incipient tentacles* the extremely remarkable curled and fringed "papillæ" which form a circlet surrounding the mouth-opening of *Osculina polystomella*, one of the most remarkable of sponges. Moreover less importance is to be ascribed to the tentacles of the corals, as secondarily developed appendages, because even corals occur in which they are almost wanting or developed only in the form of rudimentary buttons (e. g. *Antipathes*).

That the conditions of *stock-formation* or *cormogeny* are exactly the same in the corals and in the sponges scarcely needs to be particularly mentioned. It is precisely in this respect that the agreement between the two classes is so striking that it was this principally which led the older naturalists to unite the sponges and corals in their classifications. In the sponges we find no less multiplicity than in the corals in the combination of the "persons" to form stocks; and even the special modifications in the stock-formation which are produced by the multifarious forms of incomplete division and gemmation in the corals are reproduced in the sponges. Only one peculiarity pertaining here may be specially indicated, because it has repeatedly led to singular misinterpretations. This is the formation of peculiarly reduced stocks by the *growing together or concrescence of the branches*, i. e. "*persons*." Just as in the well-known fan-corals (e. g. *Rhipidogorgia flabellum*) the peculiar forms of the flatly dilated net-like stocks are produced by the repeated concrescence of the branches and anastomosis of their cavities, so in the sponges there are found stocks not only dilated and reticulated, but even twisted up into a coil, whilst at the same time their branches, *i. e.* "persons," grow together and anastomose at their points of contact. Among the Calcispongiæ these labyrinthic coils become so dense, especially in the *Nardopsidæ* and *Tarromidæ*, that the interspaces between the adult "persons" have been frequently taken for the internal cavities of their communicating canal-system. Thus, for example, Kölliker describes the interstices and fissures between the densely united branches of the stock of his *Nardoa spongiosa* (our *Tarrus spongiosus*) as "efferent canals," and the internal vibratile canal-system (the cavities of the branches) which occurs in this as in many other sponges, as "a network of ciliated canals, such as has hitherto been seen in no sponge."

The most remarkable results are produced by continued concrescence of the "persons" in the genera *Nardoa*, *Nardopsis*, and *Cœnostoma*, which I have therefore comprised in the distinct order of the Cœnosyca. In these, after the attainment of maturity, the stomachal cavities or "flues" of the different "persons" which compose a stock, and which have been produced by lateral gemmation from one "person," open together finally into a single cavity (a common "excurrent tube") which opens outwards by a single orifice (a common mouth). As the mature sponge in this case possesses only a single mouth-opening, *it is apparently only a single "person," but in reality a true stock*, i. e. a cormus composed of several "persons." In youth each "person" possesses a proper mouth-opening, until it subsequently becomes united with its neighbours, and forms, together with these, a common mouth-opening.

If we are to distinguish these wonderful animal-stocks the "persons" of which, by excessive centralization, have given up the most essential part of their individuality, the mouth, and in place of it have acquired a common stock-mouth (*cormostoma*), from the primitive polystomatous cormi, by a particular denomination, they might perhaps be fittingly named *Cœnobia*. The oldest form of starfish (*Tocastra*), which, according to my hypothesis as developed in the 'General Morphology,' is also the primitive stem-form of the Echinodermata, would have to be regarded as a cœnobium of this kind. If, in accordance with this phylogenetic hypothesis, the primitive form of starfish actually represented a stock of annulated worms (persons) which had formed for themselves a common mouth-opening, this apparently so wonderful process would not, in fact, be more wonderful than the production of the cœnobium of a *Nardoa* or *Nardopsis* from a stock of *Leucosolenia*, which may at any time be traced ontogenetically. Thus the lower cœnobia of the Cœnosyca appear actually well fitted to elucidate the production of the higher cœnobia of the much more perfect Echinodermata.

Peculiar as the *Nardopsidæ* and *Cœnostomidæ* with their single cormostome may appear, they (or at least the former) are united by transitive intermediate forms with the *Leucosoleniæ* from which they have proceeded. Such transitive forms are the *Tarromidæ*, in which the sponge-stock possesses not one, but several cormostomes, and in which, therefore, the mouth-openings of the "persons" are not all fused together into one, but in groups into several separate stock-mouths. On the other hand, however, the advancing amalgamation of the mouth-openings originally present may lead to their complete disappearance, as in the astomatous sponges already cited. Both the individual "persons" (*Clistolynthus*) and the stocks composed of several "persons" (*Auloplegma*) may lose their original mouth-openings by secondary fusion. Hence there are among the Calcispongiæ both individual forms with cutaneous pores, but without a mouth (*Clistolynthus*, *Auloplegma*), and also opposite forms with a mouth but without cutaneous pores (*Prosycum*).

The phenomenon here touched upon, namely, that the apparently opposite and extreme structures are united by the interposition of a chain of gradual transition-forms, and that consequently the unity of the type of organization, *i. e.* the unity of descent, displays itself throughout, notwithstanding the greatest multifariousness in the details, strikes the critical and unprejudiced naturalist everywhere among the Calcispongiæ, as, indeed, among the sponges generally; and this causes their study to appear so extremely instructive and so uncommonly fruitful, especially for the understanding of the *descendence theory*. *The entire natural history of the sponges is a coherent and striking argument "for Darwin."* Fritz Müller and Oscar Schmidt have already put forward many particular examples of this undeniable fact, and I have myself everywhere found it perfectly confirmed. The organism of the sponges has evidently kept itself, down to our time, so fluid, so mobile, and so flexible, that we may here most plainly trace step by step *the origin of the different species from a common stem-form.*

In this respect two forms of sponges may be indicated as quite peculiarly instructive and interesting. These are Miklucho's *Guancha blanca* and my *Sycometra compressa* : these two calcareous sponges occurring in such various forms that they seem to belong sometimes to one and sometimes to another systematic group, and place systematists in the greatest difficulty. In the following Prodromus of a system of the Calcispongiæ* I have been able to get over this difficulty only by founding for them a special order—that of the Metrosyca.

Guancha blanca (from the Canary Islands), in its most developed form, appears as *a sponge-stock which bears on one and the same cormus the mature forms of not fewer than four perfectly different genera*, namely, *Olynthus* among the Monosyca (form A of Miklucho), *Leucosolenia* (form B) and *Tarrus* (form D) among the Polysyca, and *Nardoa* among the Cœnosyca (Miklucho's form C). In the same way, the most developed form of the Norwegian *Sycometra compressa* appears as *a sponge-stock which bears on one and the same cormus the mature forms even of eight different genera*, namely :—*Sycarium* and *Artynas*, of the family Sycaridæ; *Sycidium* and *Artynium*, of the family Sycodendridæ ; *Sycocystis* and *Artynella*, of the order Clistosyca ; and *Sycophyllum* and *Artynophyllum*, of the order Cophosyca. But we must regard all these forms united upon one stock as generically different, and not as mere developmental stages of one species, inasmuch as each of them is capable of reproduction, and bears about it in its *developed spores* the convincing *testimony of perfect maturity*. *In these extremely remarkable and important sponges the organic species is to be observed as it were "in statu nascenti."*

The same is probably true of *Sycarium rhopalodes* from Norway and *Ute utriculus* from Greenland, the latter described by Oscar Schmidt, provided that the different forms of these which I have ranged under the genera *Sycarium*, *Artynas*, *Sycocystis*, and *Artynella* really manifest their specific maturity by the possession of developed spores.

If we return, in conclusion, to the relation between the sponges and corals, and endeavour to establish *artificially* the boundary between these two classes of animals, we find nothing essential except the higher degree of histological differentiation in the corals, and especially their possession of urticating cells. *No sponge forms urticating organs in the cells of its ectoderm, whilst these are present* to a greater or less extent *in all Acalephs* (in all *Corals*, *Hydromedusæ*, and *Ctenophora* without exception). It must be admitted that this histological character is in itself very unimportant, and, in respect of both its physiological and its morphological significance, is but little adapted for the establishment of a sharp boundary

* A translation of this will appear in our next Number.

between the sponges and the other Cœlenterata. This boundary appears to be very artificial, if we consider that both among the Vermes and among the Mollusca there are particular forms with urticating organs. It is, however, still further weakened when we take a general view of the whole of the conditions of histological differentiation in the sponges and corals, and become convinced that in both classes a wide scope is given to the degree of differentiation. Not a few of the more highly developed sponges, with regard to histological differentiation, perhaps occupy a higher grade than many corals, or at least than the *Hydræ* among the Acalephs. On the other hand, a very important and thoroughgoing difference between the Acalephs and Sponges would result from the confirmation of the supposition expressed by me above, that zoospermia and consequently sexual differentiation do not occur among the sponges, and that the supposed "ova" of the sponges are agamic spores.

The further explanation and establishment of all the particulars here brought forward I reserve for my detailed monograph of the Calcispongiæ, and, in conclusion, beg all readers of this preliminary communication who may be in possession of dried or spirit specimens of Calcispongiæ to be kind enough to transmit them to me for examination and comparison, in order to render the systematic part of that work as complete as possible. The Calcispongiæ have hitherto been so sparingly represented in zoological collections almost everywhere, and their classification is so imperfect, that the following Prodromus of a system of the Calcispongiæ must commence quite afresh. Moreover many Calcispongiæ are so very different in their internal structure, whilst their sober exterior appears almost the same, that the most accurate microscopic examination of all the forms hitherto discovered is quite indispensable for the establishment of their classification.

XIV.—*On a new Genus of the Madreporaria or Stony Corals* (Stenohelia). By Wm. S. Kent, F.Z.S., F.R.M.S., of the Geological Department, British Museum.

In the 'Proceedings of the Zoological Society for 1862,' p. 196, J. Y. Johnson described as a new species of *Allopora* a small branching coral, of the family Oculinidæ, taken by himself in the vicinity of Madeira. There are, however, several points of structure connected with it, seemingly overlooked by Mr. Johnson, which render it perfectly essential that a new genus should be created for its reception.