THE AUSTRALIAN HYDROMEDUSÆ.

By R. von Lendenfeld, Ph.D.

Part I.—The Classification of the Hydromedusæ.

The Hydromedusæ are here taken in the sense, which Claus (1) attaches to his order Hydroidea. They are characterized by Claus (l.c.) in the following manner:—

"Kleine Polypen und ramificierte, festsitzende Polypenstöcke mit medusoiden Geschlechtsgemmen oder mit kleinen Medusen als zugehörige Geschlechtsgeneration, sowie kleine mit Randsaum versehene (craspedote) Medusen, ohne polypoide Ammengeneration."

It must be noted, that all Hydroid Zoophytes, "whether they" have Medusoide Geschlechtsgemmen "or" produce generative elements without the aid of medusoid buds, are placed in the order Hydroidea by Claus. The same course will be adopted in this paper.

Accordingly the Hydromedusæ comprise the Hydroid Zoophytes (Hincks), and the craspedote Medusen (Haeckel), together with the Hydrocorallinæ (Moseley.)

Although, perhaps only few groups of animals have been the subject of so many papers, as the Hydromedusæ, still our knowledge, particularly of the Australian representatives of this group, is very limited.

Most of the Hydromedusæ undergo a change of generation, which is very different in the different Families. The adult animal with sexual products is in many cases a Medusa, and of course it is this stage of the whole cycle of changing generations, which must be considered most in describing, naming and classifying our animals.

(1.) *C. Claus* Grundzüge der Zoologie vierte Auflage. Seite, 248.

The relation between the adult Medusa and the Hydroid Zoophyte, on which it grows is similar to the relation between an adult Proglottis of a Taenia and the non-sexual head of the tape-worm.

It is an accepted custom in every branch of Zoology to classify a series of changing generations, according to that stage in which mature ova and Spermatozoa are found, and it is as expedient to do this here as in any other group of animals.

However clear and self-evident this may appear, it has nevertheless not been done in the case of our Hydromedusæ.

Here the non-sexual stages, the colonies of nutritive Zooids, on which the sexual stages bud, are described and classified, whilst the adult Medusa is unknown or ignored. This practice has been followed by most of the authors on Hydroid Zoophytes, although both Haeckel and Claus have shown the fallacy of such a practice. And so the value of papers on this subject, which are written without the consideration of the adult Medusa, is very small. Besides this, in most cases, not even the nutritive Zooids but only their skeletons have been accurately described.

Of course this is much easier and more convenient, than to describe the soft Medusæ, which are difficult to obtain and preserve, and which have no skeleton at all—but it is not scientific.

What would an Entomologist say if the dried skins of the larvæ of Cecidomya were used to classify these flies, and they were accordingly placed under the annelid worms, instead of placing them according to the structure of the adult Insect in the group of the nemocerous flies. It would appear monstrous, but it is only the same thing that has been done in the case of many Hydroid Zoophites.

Besides describing the new forms I have found, the main object of this paper is, to give a list of all the known Australian species, with references.

Before entering on the subject it may be worth while to recall to the recollection of the reader a few of the most interesting points concerning the morphology and physiology of our animals.

The recent researches of Kleinenberg (1), F. E. Schulze (2), Hertwig (3), Weismann (4), Hamann (5), Jickeli (6), myself (7), and others on the structure of the Hydromedusæ, have thrown quite a new light on these animals. With the aid of these authors results and with the help of Haeckel's (8), Monagraph, I hope to be able to extend our knowledge on this subject a little.

The great scientific interest which attaches to the study of the Hydromedusæ and the nearly related Siphonophora, lies in the Polymorphism of the individuals which belong to one colony. All possible stages in the differentiation of the persons are met with, and it is a thing of particular interest to follow the development of this Polymorphism through its different stages.

This Polymorphism is attained in the following manner :—The Hydroids multiply by budding, and all persons or individuals, with the exception of the free Medusa-stages, which bud from the original Polype, remain in continuity, their stomachs are united by a tube. Now a division of labour takes place among the different persons and consequently they change their shape and structure by natural selection, differing finally very much from each other.

(1.) *N. Kleinenberg.* Hydra, 1872.

(2.) *F. E. Schulze.* Cordylophora lacustris, 1871. Syncoryne Sarsii, 1873.

(3.) *O. und R. Hertwig.* Das Nervensystem und die Sinnesorgane der Medusen, 1878. Der Organismus der Medusen, 1878.

(4.) *Weismann.* Die Entstehung der Geschlechtszellen bei den Hydroiden, 1883.

(5.) *O. Hamann.* Der Organismus der Hydroidpolypen Jenaische Zeitschrift. Band, XV. Seite. 545.

(6.) *C. Jickeli.* Der Bau der Hydroidpolypen. I., II., Morphologisches Jahrbuch. Band, VIII Seite, 373, 580.

(7.) *R. von Lendenfeld.* Ueber das Nervensystem der Hydroidpolypen· Zoologischer Anzeiger Nr. 131. Ueber eine eigenthümliche Art der Sprossenbildung bei den Campanulariden. Zoologischer Anzeiger Nr. 130. Ueber Wehrthiere und Nesselzellen Zeitschrift fûr wiss. Zool. Band, XXXVIII. Seite, 355. (Translated into English Annales and Magazine of Natural History. 5 Series. Nr. 71.) Eucopella Campanularia Zeitschrift für Wissenschaft. Zool. Band, XXXVIII. Seite, 497.

(8.) *E. Haeckel.* Das System der Medusen. Jena, 1879-1880. Die Medusen der Challenger Expedition. Jena, 1881 (Translated into English. Report of the Zoology of the voyage of the " Challenger.")

In the simplest case of Protohydra we have a Polype, which multiplies by fission and is propagated by generative elements, produced in the wall of the body. Hydra multiplies by budding and also produces ova and Spermatozoa in the wall of the gastral cavity.

Both these Hydroids always remain single and never form colonies: the budding persons are always completely isolated from the parent. The same thing happens in the case of Myriothela.

In the stock-forming Hydroida, most of the buds do not attain personal liberty but remain in connection with the primary Polype, their common parent, by tubes through which the nutritive chymus flows freely. In the simplest case all the Polypes belonging to one colony are alike: Clava is to be compared to a colony of Hydra's. Whilst in Clava and Tabiclava the generative elements are produced by all the Zooids, in other Hydroids the production of generative elements devolves on certain Zoids only, which change their shapes and became Blastostyles; whilst the other Zooids remain pretty much unchanged in appearance, losing only the reproductive faculty. Division of labour causes some persons belonging to the stock—a simple political unity—to become alimentary, and others to attain reproductive functions.

To this group belong the Cordylophorinæ, Bimerinæ, Campanlarinæ, Sertularinæ, and perhaps also the fossil Graptolithes. Also, the Plumularidæ are placed in it.

The Plumularidæ are characterized by the tranformation of some of the Zooids into Machopolypes. These are persons whose main duty is to defend the stock against outer enemies, and to attack, slay, and bring home, food for the nutritive Zooids. They are the soldiers and fishers of the colony; often as many as 80% of the Zooids of a colony are thus transformed into soldiers, a state of affairs not even reached by the Continental powers. These Machopolyps, or rather the cups in which they live, were formally called Nematothecæ or Sarcothecæ.

According to Metschnikoff (1) some of these, which possess no thread-cells have also the function of devouring the trophosomes of the colony when they get sick. With great acuteness Metschnikoff (l.c.) follows up the similarity between this process and the action of amoeboid wandering cells or white blood corpuscles and festering cells, which perform the same duties in higher animals. By the action of these analogous organs similar work is performed.

These Machapolypes appear in three different forms which are sometimes met with in the same colony. They may possess thread-cells or adhesive cells, similar to those found in the Ctenophoræ, or both. I have described the Morphology and Physiology of these Machopolypes elsewhere. (2.)

An intermediate stage between the members of this latter group and the Clavidæ, is met with in Eudendrium, where there are Blastostyles and Polypes, but where both may contain ripe ova, and where the Polypes which mature the generative elements afterwards, in many cases lose their tentacles, and so become Blastostyles as it were under the eyes of the observer.

I propose to place all Hydroids mentioned above with the exception of those which produce free Medusæ, or which are descended from Hydromedusæ which once produced free Zooids, in the first Suborder the Hydropolypinæ. The great difficulty in executing this task and classifying the Hydromedusæ according to whether their Gonophores are medusoid or not, lies in the great similarity between Polypostyles, that is Gonophores derived from a generative Polype direct, and Medusoid Gonophores, that is rudimentary Medusæ.

I have attempted a classification, comprising all the Hydromedusæ in the Zoologischer Anzeiger, (3) but I fear, as I pointed

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(1.) *E. Metschnikoff.* Ueber die intracelluläre Verdauung bei wirbellosen Thieren. Arbeiten aus dem Zool. Inst. der Universität Wien Band V. (Translated into English, Quarterly Journal of Mik. Science, Nr. 93.)

(2.) *R. von Lendenfeld.* Ueber Wehrthiere und Nesselzellen. Zeitschrift für wiss. Zool. Band, XXXVIII Seite, 355 (Translated into English Annales and Magazine of Natural History, 5th Series. Nr. 71.)

(3.) *R. von Lendenfeld.* Das System der Hydromedusen. Zoologischer Anzeiger 1884.

out in that paper, that many of the statements contained in this first attempt of the kind, are erroneous. Since then a work (1) on the generative elements of the Hydromedusæ, has appeared which is equally excellent for the correctness of the observations contained therein as for the ingenious conclusions drawn therefrom. Although I did not receive this work until after this paper had been read before the Linnean Society of N. S. Wales, I shall still endeavour to make as much use of it as as possible.

The observations contained in this book are given in a table (l.c. p. 214, f.f.), and show, that many of the genera which I had placed in my former (l.c.) paper, among the Hydropolypinæ, show in the Gonophores no traces of a medusoid structure. There are a few however, in the Gonophores of which such traces have been discovered by Weismann ; genera which I had placed under the Hydropolypinæ. These are Sertularia and Plumularia.

Weismann (l.c.), states that two genera, namely Autennularia and Campanularia are peculiar, for the extraordinary difference between the male and female Gonophores. In both these genera the male Gonophores show no trace of the Medusoid structure, whilst such a structure—several layers of cells outside the generative elements—is met with in the female.

Now of course it is quite out of the question to suppose, that the ancestors of these two genera possessed female Medusæ, whilst the male Gonophores were always sessil Polypostyles. We must therefore, conclude that both male and female Gonophores descended from free Medusæ or from sessile Polypostyles, Weismann considers it probable—any such conclusion of course can only be the more or less probable and never certain—that both descended from free Medusæ. Now the male, not Medusoid Gonaphores, of these, are quite similar to those of other Hydroids, and so Weismann concludes further, that also these (Aglaophenia Sertularella. Opercularella) have descended from free Mudusæ.

(1.) *A. Weismann.* Die Entstehung der Sexnolzellen bei den Hydromedusen. Jena, 1883.

In this manner he brings all but five of those genera which were investigated by him into the group with Medusoid Gonophores, my Hydromedusinæ. But even these five, with the exception of Hydra (l.c. pag. 245 ff.), he finally considers to be Hydromedusae with medusoid buds. These conclusions are mainly based on the observations made by Weismann on the wandering of the generative cells, one of the most important discoveries concerning our animals, which were ever made, statements which also I had occasion to confirm in my paper on Eucopella.

The medusæ certainly are more recent than the Hydroid colonies, and there can be no doubt, that the Hydroid colonies must have been propagated sexually before Medusæ were formed. It would appear very strange if no such ancestral forms should have come down to us as it is clear that *now* the free Medusæ are in many cases worse than useless and have therefore again become rudimentary. The cases of Gonophores which show traces of a Medusoid structure doubtlessly belong partly to the Hydromedusinæ as they have really descended from Hydromedusæ with free Zooids. On the other hand it is certainly possible that some of these are not rudimentary Medusæ but real Polypostyles. It is only a case of greater or smaller probability, and probability always is a subjective feeling. Weismann thinks it probable that these Gonophores are rudimentary Medusæ, and his opinion is of great weight if we consider the excellency of his work on the subject, and I dare say he is quite right.

I for my own part have not been convinced by his publication, and consider it as probable that Gonophores, which are not rudimentary Medusæ, do exist. Whether all the forms, which according to my idea, have other Gonophores, and therefore are placed among the Hydropolypinæ really belong there, is another question. In doubtful cases I decided according to the position of the Gonophore for the reasons given in my former paper (Zoologischer Anzeiger) on this subject.

The Hydroid colonies are often overgrown by tufts of Diatoms and other Protista, and a Medusa produced near the base of the

colony would in consequence not be able to swim away whilst the small embryo escaping the Gonongium could easily penetrate the marine undergrowth, which, of course, in this case, is of advantage to the colony, hiding and sheltering the Gonophore.

I have, therefore, in doubtful cases, placed those Hydromedusinæ, which have Gonophores at the base of the colony under the Hydropolypinæ, those on the other hand, which bear exposed Gonophores under the Hydromedusinæ.

The first suborder of the Hydromedusæ, the Hydropolypinæ, comprises accordingly Hydra, the Clavidæ, Eudendridæ, Cordylophorinæ, Bimerinæ, Campanularinæ, Sertularinæ, the Plumularidæ, and Dicorynidæ. I have also placed the Graptolithidæ under this heading.

We meet with quite a different kind of Polymorphisne in another series of Hydromedusæ. Here Medusæ are formed, that is Hydroid persons, which lead a free life and are provided with an apparatus for free locomotion. This apparatus is in most cases a bell-shaped Umbrella, an extremely clumsy and unsuitable propelling organ. Only very few Medusæ are destitute of an Umbrella and crawl on their marginal tentacles like Clavatella (Eleutheria.)

These Medusæ, which had originally the function of distributing the species like the winged Imagines of Insects, with which they are to be compared, are small when born and often grow to a large size afterwards. In such cases the nourishment assimilated by the Medusa greatly exceeds that, which the Polyp colony needs. Such Hydromedusæ however (Zygodoctyla) are rare. In most cases they remain small, losing more and more the function of taking up nourishment which in such cases devolves on the Polyp colonies.

Finally Medusæ are produced which only live a short time (Globiceps), and which already bear ripe sexual products at the time of their liberation. The stomach of such Medusæ may even be obliterated (Eucopella) and an organism is produced, which like the Ephemera is in fact only an apparatus for carrying the sexual product to a greater distance like the Hectokotylus.

These rudimentary Medusæ, produced, of course, in the ordinary course of natural selection, show that it is in many cases advantageous for the species *not* to have free swimming stages. In consequence of this the Medusæ may even become more rudimentary, and finally remain attached to the Hydroid colony, where they mature the sexual products within them (Tabularia.) When they have once become so far rudimentary, their parts, particularly the locomotive organ, the Umbrella will be obliterated, unless it is utilised for some other purpose (Weismann, Dohrn), and we shall finally have a Medusoid Gonophor before us. According to Weismann *all* Gonophores are rudimentary Medusæ as stated above. I, however, do not wholly agree with Weismann on this point, although I gladly admit that this is quite possible.

I place all Hydroid colonies which produce Medusæ, and also those which possess Gonophores of a doubtless medusoid origin in this group, which I designate as the second Suborder of the Hydromedusæ, the Hydromedusinæ. I accordingly place the Anthomedusidæ (Anthomedusæ Haeckel), the Tubularidæ (comprising Coryne, Myriothela, Stylactis, Tubularia, Pennaria and related genera), the Leptomedusidæ (Leptomedusæ Haeckel), and those Campanularidæ which possess decidedly medusoid Gonophores as Gonothyrea and Halecium in this suborder.

In the first of these families, the Medusæ bud on *all* the Zoids and become free, in the second they also bud on all Polypes of the stock, but are more or less rudimentary. In the third and fourth family the Medusæ bud on differentiated Polypes, Blastostyls becoming free in the one and rudimentary in the other.

Some Hydroid colonies producing Medusæ, which belong to Haeckel's Margelidæ, are so different from the others that I place them in accordance with *Claus* in a separate family the Hydractinidæ, which evidently connects the calcareous Hydrocorollinæ with the chitinous Hydromedusinæ.

The Hydrocorallinæ themselves, which I reckon as the third suborder, also produce Medusæ, or at least some of them do, but the calcareous skeleton seems to me to be so important a characteristic, because it points to fundamental chemical differences

in the Protoplasme, that I separate them in accordance with *Claus* from the other Hydromedusæ.

The process described above, by which the Medusæ became more and more rudimentary, was apparently advantageous only for one series of Hydromedusæ, whilst in another series we find the Hydroid colony becoming more and more rudimentary inasmuch as the nourishment is more and more assimilated by the Medusa stage and less by the Polypes.

This process which is indicated in Zygodactyla may go so far that the Polype stages are finally done away with altogether, and a Medusa is produced direct from the ovum without the intermediate stage of a Polype. In this manner the change of generation is done away with altogether and we have Medusæ before us, which, although probably descended from Hydroid ancestors, show no trace of such a descendance, and now only the comparative anatomy of these forms proves that they belong to our Hydromedusæ. Such Medusæ are very numerous. *Claus* combines all these forms in his suborder Trachomedusæ, which corresponds with our fourth suborder Trachomedusinæ.

The Trachomedusinæ comprise Haeckel's Trachomedusæ and Narkomedusæ, which correspond to our families Trachomedusidæ and Narkomedusidæ.

It appears to me that the total neglect of those Hydromedusæ, which do not produce free Medusæ, in Haeckel's System der Medusen is not true to nature. If Haeckel considers the Lucernaridæ as part of the Acraspædæ which they doubtlessly are, one would also expect that he would include the Hydroid Polypes in his Craspedotæ. And I think I shall follow out Haeckel's ideas better by placing them there than by separating them from those Hydromedusæ which produce free zoids.

The difference between Craspedotæ and Acraspedæ is so great that it seems advantageous to separate these two groups entirely. In this point I agree with *Claus*. The great similarity between the two is only analogy and not homology. At all events the Hydroid Zoophytes are much more nearly related to the Craspedote Medusæ than the latter to the Acraspedæ.

The Polypomedusæ form in my classification the second classis of the subtype Cnidaria (1), *(Claus)* of the Cœlenterata, and comprise all polypiform and Medusiform animals. I have selected this name for the Hydromedusæ of *Claus* (2), and given the reasons for doing so in my preliminary report (3). Since then I have received *Claus's* Lehrbuch of Zoology (4), and I find that *Claus* also has adopted in the latter publication this term, which I had found independently to be the most expressive.

The Polypomedusæ as a classis are devided into the three ordines Hydromedusæ (Hydroidea *Claus*, Hydromedusæ *Weismann*), Syphonophora and Scyphomedusal *(Ray Lankaster*, Acraspaedæ Gegenbaur, Haeckel.)

Our Ordo Hydromedusæ is, as mentioned above, to be divided into four suborders. The relative value of these classificatory terms is elucidated in the following table :—

Type Coelenterata.

1. Subtype Spongiæ.
2. Subtype Cuidaria.

Subtype Cuidaria.

1. Classis Anthozoa.
2. Classis Polypomedusæ.
3. Classis Ctenophoræ.

Classis Polypomedusæ.

Aphacellæ	1. Ordo Hydromedusæ.
	2. Ordo Syphonophora.
Phacellotæ	3. Ordo Scyphomedusæ.

(1.) *Marshall* has objected in a recent publication (Die Ontogenie von Reniera filigrana, Zeitschrift für wiss. Zool. Band XXXVII.) to this term on the ground that it "den Begriff nicht deckt" (l.c. Seite 243 Anmerkung), I don't see what advantage would be gained in altering *Claus's* generally adopted term in this case.

(2.) *C. Claus.* Grundzüge der Zoologie, 4te Auflage, Seite 243.

(3.) *R. v. Lendenfeld.* Das System der Hydromedusen. Zoologischer Anzeiger, Band VI., 1884.

(4.) *C. Claus.* Lehrbuch der Zoologie 1883, Seite 306.

Ordo Hydromedusæ.

1. Subordo Hydropolypinæ.
2. ,, Hydromedusinæ.
3. ,, Hydrocorallinæ.
4. ,, Trachomedusinæ.

If we now classify the Hydromedusæ according to the principles set forth above we shall arrive at the following classificatory system :—

Schemas are attached to the diagnoses. The italics represent stages which do not take up nourishment, the stages given in ordinary print represent such which do. The schema's also show the way in which the budding process alternates with the sexual propagation. As the change of generation is caused by this alternation on the one hand and influenced mainly by the phase in which nourishment is taken up, these schema's will elucidate the differences which are met with among the Hydromedusæ in this respect.

The most important genera are mentioned. Genera which are imperfectly known have been omitted.

ORDO, HYDROMEDUSÆ. Carus, 1863.

HYDROPHORAE. Huxley, 1856.
HYDROIDEA. Agassiz, 1862.
HYDROIDÆ. Claus, 1876.

THE POLYPCOLONIES.

HYDROID ZOOPHITES. Hinks, 1868. (Old term.)

THE MEDUSÆ.

CRASPEDOTÆ. Gegenbaur, 1856.
CYCLONEURÆ. Eimer, 1878.
APHACELLÆ. Haeckel, 1878.
CRASPEDOTÆ. Haeckel, 1879. (1.)

POLYPES WITHOUT GASTRAL FILAMENTS OFTEN IN COLONIES, SOMETIMES WITH GREATLY TRANSFORMED GENERATIVE OR DEFENSIVE PERSONS, AND CYCLONEUROUS MEDUSÆ, WITHOUT GASTRAL FILAMENTS.

I.—SUBORDO HYDROPOLYPINÆ. Von Lendenfeld, 1884.

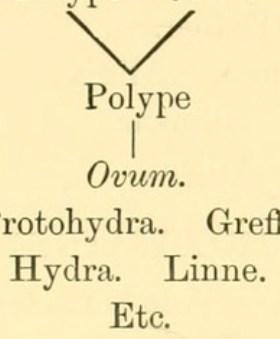
HYDROMEDUSÆ GENERALLY FORMING COLONIES OF ALIMENTARY AND GENERATIVE PERSONS. THE TWOFUNCTIONS MAY DEVOLVE ON ALL PERSONS ALIKE, OR BE EXECUTED BY DIFFERENT ZOOIDS. RARELY SOLITARY. NOT PRODUCING MEDUSÆ. THE BLASTOSTYLS OF THE HYDROPOLYPINÆ ARE TRANSFORMED POLYPES AND NOT RUDIMENTARY MEDUSÆ.

(1.) Other synonyms in the works referred to.

I. FAMILY HYDRIDÆ. Huxley, 1856.

Multiplying by budding or fission, and by sexual cells produced in every Polype (1) Solitary.

SCHEMA.

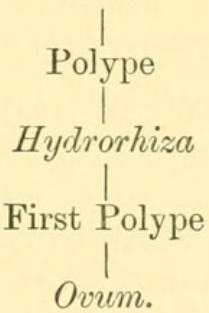


Protohydra. Greff.
Hydra. Linne.
Etc.

2. FAMILY CLAVIDÆ. Von Lendenfeld, 1884. non Allman !

Forming colonies, all persons alike and all maturing (2) sexual cells on hollow tentacular processes.

SCHEMA :



(1.) In this and in other similar cases it is very likely, and has indeed been observed, that although the Polypes which produce ova are similar to others which may not appear adult ; budding and sexual propagation are not carried on by the same individual at the same period. It appears likely, that here, as in the Infusoria, periods of sexually multiplying and budding generations alternate, and so a division of labour in time exists, which may lead to a division of labour in space, if the budding persons remain attached to one another.

(2.) "Maturing" in this and the following definitions, because the generative elements in many cases are *produced* elsewhere, and wander into the place, where they finally reach maturity at a comparatively late period.

1. SUB-FAMILY CLAVINÆ,

With scattered filiforme tentacles.

Clava. Gmelin.
Tubiclava. Allman.
Rhyzogeton. Agassiz.

2. SUB-FAMILY CORYNINÆ.

With scattered capitate tentacles.

Coryne. Gärtner.
Actinogonium. Allman.
Wrightia. Allman.
Stylactis. Allman.

3. FAMILY MYRIOTHELIDÆ. Allman, 1872.

Solitary with scattered capitate tentacles. Some of the tentacles are transformed and bear the sexual products.

SCHEMA.

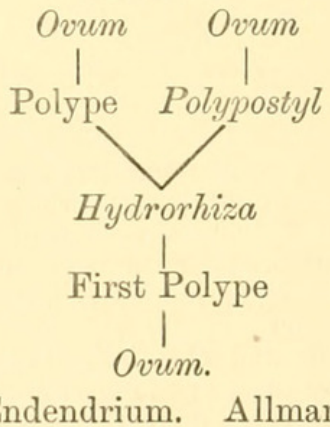
Polype
|
Ovum
|
Polype.

Myriothela. Sars.

4. FAMILY EUDENDRIDÆ. Allman, 1872.

Forming colonies, all Polypes may mature sexual product whereby they are often changed into Polypostyles without mouth or tentacles.

SCHEMA.

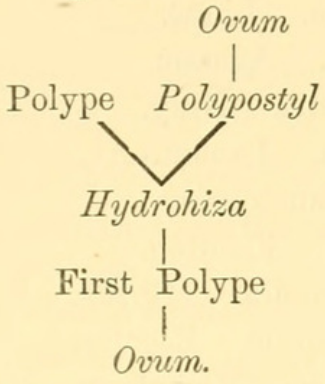


Endendrium. Allman.

5. FAMILY BLASTOPOLYPIDÆ. Von Lendenfeld, 1884.

Forming colonies with differentiated Alimentary and Generative Zooids. The latter are Polypostyles and mature the sexual products. The Alimentary Zooids do not take part in the sexual reproduction.

SCHEMA.



I. SUB-FAMILY. CORDYLOPHORINÆ.

Alimentary Zooids of the Colony, with scattered filiform, tentacles not protected by a chitinous cup.

Cordylophora. Allman.
Merona. Norman.

II. SUB-FAMILY. BIMERINÆ.

Alimentary Zooids with one verticil of filiform tentacles, not protected by a chitinous cup.

Heterocordyle. Allman.
Pachycordyle. Weismann.
Garveia. St. Wright.
Bimeria. St. Wright.
Coinistes. St. Wright.
Etc.

III. SUB-FAMILY. CAMPANULARINÆ.

Alimentary Zooids, with one verticil of filiform tentacles in chitinous cups which are connected with the Hydrorhiza by more or less developed stalks, and never adnate to the stem.

Campanularia. Lamarck.
Opercularella. Hincks.
Calycella. Hincks.
Etc.

IV. SUB-FAMILY. SERTULARINÆ.

SERTULARIDÆ. Hincks.

Alimentary Zooids, invested by chitinous cups, which are more or less adnate to the stem, and never possess separate Hydrocauli.

Lineolaria. Hincks.
Sertularia. Linné.
Diphasia. Agassiz.
Sertularella. Gray.
Pasythea. Lamouroux.
Idia. Laumouroux.
Thuiaria Fleming.
Hydrallmania. Hincks.
Triplograptus. Richter.
Corynoides. Nicholson.
Dendrograptus. Hall.
Callograptus. Hall.
Dictyonema. Hall.
Ptilograptus. Hall.
Thomnograptus. Hall.
Buthograptus. Hall.
Inocaulis. Hall.

6. FAMILY. GRAPTHOLITHIDÆ.

Possessing a chitinous Endo- and Exo-skeleton. The former rod-shaped. Colonies free swimming, probably extinct. From the Cambrian to the lower Devonian.

I. GROUP. GRAPTOLIDEA. Lapworth.

Hydrosom developed from a Sicula, every canal containing Coenosarc, bears only one row of cells. Axis (Virgula) on the dorsal side in a furrow of the inner lamina.

A. MONOPRIONIDÆ.

Hydrothecæ in one row opposite the axis.

1. SUB-FAMILY. MONOGROPTINÆ.

MONOGROPTIDÆ. Lapworth.

Developed one-sided; pointed ends of the Sicula pointing upwards, united with the dorsal margin of the proximal end of a single or composite Hydrosome.

Monograptus. Geinitz.
Rostrites. Barrande.
Cryptograptus. Carruthers.
Azygograptus. Nicholson.
Dimorphograptus. Lapworth.

2. SUB-FAMILY. LEPTOGRAPTINÆ.

LEPTOGRAPTIDÆ. Lapworth.

Hydrosom bilateral, with irregular branches. Cells apart, just touching. Sicula persistent in the axilar. The broad part forming the proximal end of the Hydrosome.

Leptograptus. Lapworth.
Amphigraptus. Lapworth.
Pleurograptus. Nicholson.
Nemograptus. Emmons.
Coenograptus. Hall.

3. SUB-FAMILY. DICHOGRAPTINÆ.

DICHOGRAPTIDÆ. Lapworth.

Bilateral. Branches of regular cells, very dense, rectangular Sicula persistent. Its point at the proximal end of the Hydrosome.

Didymograptus. McCoy.
Trichograptus. Nicholson.
Tetrograptus. Salter.
Goniograptus. McCoy.
Schizograptus. Nicholson.
Temnograptus. Nicholson.
Ctenograptus. Nicholson.
Dichograptus. Salter.
Lagonograptus. Hall.
Clonograptus. Hall.
Clematograptus. Hopkins.
Cladograpsus. McCoy

MARINE BIOLOGICAL LABORATORY WOODS HOLE LIBRARY MASS.

4. SUB-FAMILY. DICRANOGRAPTINÆ.

DICRANOGRAPTIDÆ. Lapworth.

Hydrosom consists of two originally dorsally united axes. Cells overlapping. Exterior part indented. Broad end of the Sicula on the proximal end of the Hydrosoma.

Dicellograptus. Hopkins.
Dicranograptus. Hall.

B. DIPRIONIDÆ.

Cells in two rows, axis central.

5. SUB-FAMILY. DIPLOGRAPTINÆ.

DIPLOGRAPTIDÆ. Lapworth.

Hydrosom consists of two branches dorsally joined. Sicula imbedded. The broad part forming the proximal end of the Hydrosom.

Climacograptus. Hall.
Diplograptus. McCoy.
Glyptograptus. Lapworth.
Petalograptus. Suess.
Cephalograptus. Hopkins.

6. SUB-FAMILY. PHYLLOGRAPTINÆ.

PHYLLOGRAPTIDÆ. Lapworth.

Hydrosom consists of four biserial axes, which coalesce with their dorsal sides. Sicula imbedded. The broader ends close to the proximal terminations of the Hydrosoms.

Phyllograptus. Hall.

II. GROUP. RETIOLOIDÆ. Lapworth.

No Sicula. The Coeaosark of the common canal developes a double row of cells. Epidermis supported by chitnious fibers.

7. SUB-FAMILY. GLASSOGRAPTINÆ.

GLASSOGRAPTIDÆ. Lapworth.

Both axes united in the middle of the body.

Retiograptus. Hall.
Sasiograptus. Lapworth.

8. SUB-FAMILY. GLADIOGRAPTIÆ.

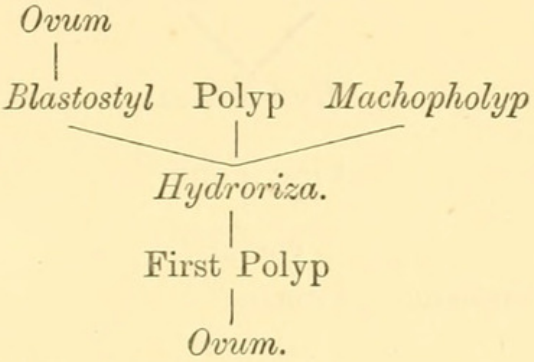
GLADIOGRAPTIDÆ. Lapworth.

Both axes separate. Perfect exoskeleton of chitinous fibres.

Clathrograptus. Lapworth.
Trigonograptus. Nicholson.
Retiolithes. Barrande.

7. FAMILY PLUMULARIDÆ. Hincks, 1868.

Forming a colony. Alimentary and Generative Zooids, and Machopolyps. Alimentary Zooids with one verticil of filiform Tentacles.



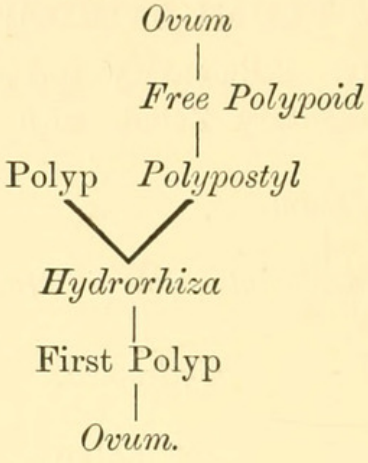
Ophiodes. Hincks.
Plumularia. McCrady.
Antennularia. Lamarck.
Aglaophemia. McCrady.
Halicornaria. Busk.
Halicornopsis. Bale.
Sciarella. Allman.
Acanthella. Allman.
Schizatricha. Allman.
Polyplumaria. Sars.
Heteroplana. Allman.
Acanthochladium. Allman.
Lithocarpus. Kirchenpauer.
Kirchenpaueria. Jickeli.
Streptocaulus. Allman.
Diplochilus. Allman.
Cladocarpus. Allman.
Azigoplana. Allman.
Etc.

8. FAMILY DICORYNIDÆ. Allman.

Generative Zooids free swimming Polypes with two tentacles and without a mouth, carrying two ova each.

These Zooids bud only on Polypostyles, and never on the Alimentary Zooids which have one verticil of filiforme tentacles.

SCHEMA.



Dicoryne. Allman.

II. SUBORDER HYDROMEDUSINÆ. Von Lendenfeld, 1884.

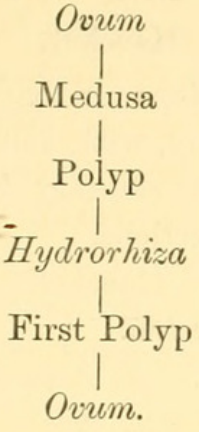
COLONIES OF POLYMORPHIC ZOOIDS. THE ALIMENTARY ZOOIDS RETAIN THE SHAPE OF POLYPES, WHILST THOSE IN WHICH THE SEXUAL PRODUCTS REACH MATURITY ARE MEDUSÆ, WHICH MAY BECOME FREE OR REMAIN ATTACHED TO THE COLONY AND BECOME RUDIMENTARY.

9. FAMILY ANTHOMEDUSIDAÆ. Von Lendenfeld, 1884.

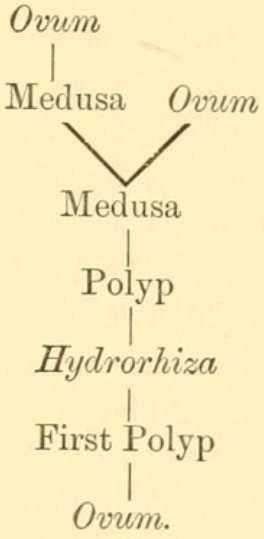
Anthomedusæ. Haeckel, without the Cytaeidæ of Haeckel.

Medusæ become free, without Otoliths, with Ocelli at the base of the tentacles. Gonads in the outer or oral wall of the gastral cavity. Mostly four Radial Canals. The Polype colonies on which these Medusæ bud, contain alimentary Zooids, which are not invested by chitinous cups. The Medusæ bud mostly on the ordinary alimentary Polypes, exceptionally they are also born on peduncles and bud direct from the Hydrorhiza. A division of labour between alimentary Polypes and Polypes, which produce Medusæ, Polypostyles does not occur.

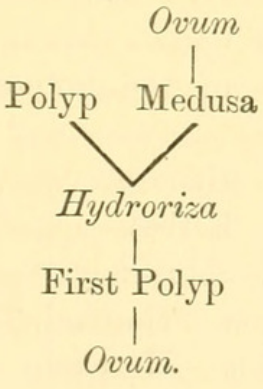
SCHEMA.


Ovum
Medusa
Polyp
Hydrorhiza
First Polyp
Ovum.

or :


Ovum
Medusa
Ovum
Medusa
Polyp
Hydrorhiza
First Polyp
Ovum.

or :


Ovum
Polyp
Medusa
Hydroriza
First Polyp
Ovum.

I. SUB-FAMILY. CODONINÆ.

CODONIDÆ. Haeckel.

Mouth simple, with flaps or barbels. Gonade simple tube shaped, not divided radially, with four simple Radial Canals and unbranched tentacles. Alimentary Zooids, with tentacles, which are scattered, or in two verticils.

Codonium. Haeckel.
Sarsia. Lesson.
Syndictyon. A. Agassiz.
Ectopleura. L. Agassiz.
Dipurena. MacCrady.
Bathycodon. Haeckel.
Dicodonium. Haeckel.
Dinema Van. Beneden.
Steenstrupia. Forbes.
Euphysa. Forbes.
Hybocodon. L. Agassiz.
Amphicodon. Haeckel.
Amalthaea. O. Schmidt.
Globiceps. Ayres.
Gymnocoryne. Hincks?
Vorticlava. Alder.
Acharadria Strethill. Wright.
Dendroclava. Weismann.

II. SUB-FAMILY. TIARINÆ.

TIARIDÆ. Haeckel.

Anthomedusidæ with four broad Moutharms, with four or four pair of gonads, four simple Radial Canals and unbranched tentacles. The alimentary Zooids of the Polypecolonies with scattered capitate tentacles.

Protiara. Haeckel.
Moderia. Forbes.
Corynites. McCrady.
Amphinema. Haeckel.
Codonorchis. Haeckel.

Stomodoca. L. Agassiz.
Panthaea. Lesson.
Conis. Brandt.
Tiara. Lesson.
Turris. Lesson.
Catablema. Haeckel.
Turritopsis. McCrady.
Callitiara. Haeckel
Corydendrium Van. Beneden?

III. SUB-FAMILY. MARGELINÆ.

Margelidæ. Haeckel, with the exceptian of Haeckel's Genera Cytaeis, Cubogaster, Dysmorphosa, Cytæandra.)

Anthomedusæ, with simple or branched moutharms. Gonade divided into four or eight marginal flaps. The Medusæ bud on Colonies of Polypes, which contain alimentary Zooids, with a verticil of filiform tentacles.

Lizusa. Haeckel.
Lizzia. Forbes.
Lizzella. Haeckel.
Thamnitis Haeckel.
Thamnostylus. Haeckel.
Thamnostoma. Haeckel.
Limnorea. Peron.
Margelis. Steenstrup.
Hippocrene. Mertens.
Nemopsis. L. Agassiz?
Margelium. Haeckel.
Rathkea. Brandt.

IV. SUB-FAMILY. CLADONEMINÆ.

CLADONEMIDÆ. Gegenbaur.

Anthomedusæ, with branched tentacles, with 4—8 simple or branched Radial Canals, and four or four pair of gastral Gonads. The Medusæ bud on Polypecolonies which contain alimentary Zooids, with scattered capitate tentacles.

Pteronema. Haeckel.
Zanclea. Gegenbaur.

Gemmaria. McCrady.
Eleutheria. Quatrefages.
Ctenaria. Haeckel.
Cladonema. Diyardin.
Dendronema. Haeckel.
Heterostephanus. Allman?

10. FAMILY TUBULARIDÆ. Von Lendenfeld, 1884.

The Medusæ in this family become more or less rudimentary, and remain attached to the Polypes.

All Zooids are alike and all bear Medusæ.

SCHEMA.

Ovum
|
Medusoid bud
|
Polyp
|
Hydrorhiza
|
First Polyp
|
Ovum

I. SUB-FAMILY. PENNARINÆ.

The Polypes possess a distal set of capitate and a proximal set of filiform tentacles.

Pennaria. Goldfuss.
Halocordyle. Allman.
Monocaulus Sars?

II. SUB-FAMILY. TUBULARINÆ.

The Polypes possess two verticils of filiform tentacles.

Tubularia. Allman.

III. SUB-FAMILY. ATRACTYLINÆ.

The Polypes possess a single verticil of filiform tentacles. The medusoid buds are produced on the Hydrocaulus.

Atractylis. Hincks.

11. FAMILY LEPTOMEDUSIDÆ. Von Lendenfeld, 1884.

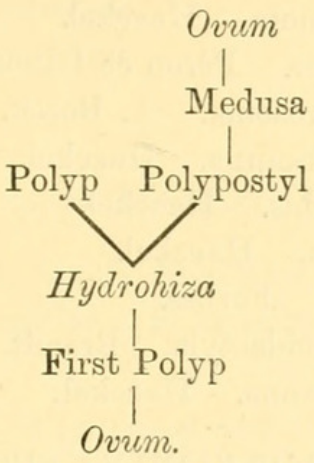
LEPTOMEDUSÆ. Haeckel.

Medusea with Ocelli or Ectodermal Otolithes and Gonads, developed in the walls of the Radial Canals.

Medusæ always budding on transformed Polypes, Polypostyls and never on the alimentary Zooids.

Alimentary Zooids and Polypostyles invested by a chitinous Perisarc.

SCHEMA :



I. SUB-FAMILY THAUMANTINA.

THAUMUANTIDÆ. Gegenbaur.

Leptomedusæ without marginal vesicles, simple Radial Canals.

Tetranema. Haeckel.
Dissonema. Haeckel.
Octonema. Haeckel.
Thaumtias. Eschscholtz.
Staurostoma. Haeckel.
Laodice. Lesson.
Melicertella. Haeckel.
Melicertissa. Haeckel.
Melicertum. A. Agassiz.
Melicertidium. Haeckel.
Orchistoma. Haeckel.

II. SUB-FAMILY. CANNOTINÆ.

ANNOTIDÆ. Haeckel.

Leptomedusæ, without marginal vesicles, with branched Radial Canals.

Staurodiscus. Haeckel.
Ganinema. A. Agassiz.
Ptychogena. A. Agassiz.
Staurophora. Brandt.
Polyorchis. A. Agassiz.
Cannota. Haeckel.
Discannota. Haeckel.
Berenice. Péron et Leseur.
Dipleurosoma. A. Boeck.
Dicronocanna. Haeckel.
Toxorchis. Haeckel.
Veletta. Haeckel.
Willia. Forbes.
Proboscidactyla. Brandt.
Cladocanna. Haeckel.

III. SUB-FAMILY. EUCOPINÆ.

EUCOPIDÆ. Gegenbaur.

Leptomedusæ, with marginal vesicles and four simple unbranched radial canals.

Eucopium. Haeckel.
Saphenella. Haeckel.
Eucope. Gegenbaur.
Obelia. Péron et Leseur.
Tiaropsis. L. Agassiz.
Euchilota. McCrady.
Phialium. Haeckel.
Phialis. Haeckel.
Mitrocomium. Haeckel.
Epeuthesis. McCrady.
Mitrocomella. Haeckel.
Phialidium. Lemkart.

Mitrocoma. Haeckel.
Eutimimu. Haeckel.
Eutima. McCrady.
Saphenia. Eschscholtz.
Eutimeta. Haeckel.
Eutimalphes. Haeckel.
Octorchidium. Haeckel.
Octorchis. Haeckel.
Octorchandra. Haeckel.
Irenium. Haeckel.
Irene. Eschscholtz.
Tima. Eschscholtz.

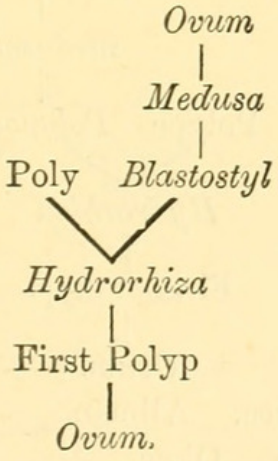
IV. SUB-FAMILY. EUCOPELLINÆ. Von Lendenfeld.

Medusa without stomach, highly developed organs of sense, no tentacles, eight marginal vesicles. Four radial canals, which send branches into the Gonads.

Alimentary Zooid, with 32 tentacles and a Perisarc. Blastostyl consisting of four radial tubes, between which the Medusæ bud.

Ova formed as in the Companularinæ in the Hydrorhiza.

SCHEMA :



Eucopella. Von Lendenfeld.

V. SUB-FAMILY AEQUORINÆ.

Aequoridæ. Eschscholtz.

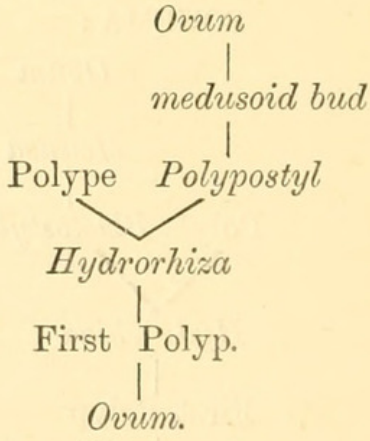
With marginal vesicles and numerous (at least 8), often branched Radial Canals.

Octacanna. Haeckel.
Zygocanna. Haeckel.
Zygocannota. Haeckel.
Zygocannula. Haeckel.
Halopsis. A. Agassiz.
Aequorea. Péron et Leseur.
Rhegmatodes A. Agassiz.
Stomobrachium. Brandt.
Staurobrachium. Haeckel.
Mesonema. Eschscholtz.
Polycanna. Haeckel.

12. FAMILY CAMPANULINIDÆ. Von Lendenfeld, 1884.

Colonies of Polypes which are differentiated into alimentary Zooids with one verticil of filiform tentacles and generative Polypes, Polypostyles without mouth or tentacles. Both kinds of Zooids are invested by chitinous capsules. The Polypostyles only produce by budding sexual Zooids, which are rudimentary Medusæ and never become free.

SCHEMA :



Gonothyrea. Allman.
Halecium. Oken.

(According to Weismann all the genera placed under the heading Campanularidæ, should be placed here.)

13. FAMILY HYDRACTINIDÆ. Von Lendenfeld, 1884.

Hydractinidæ. Claus (?).

Polypecolonies with free or rudimentary Medusæ. The free Medusæ belong to Haeckels Sub-family Cytæidæ, and possess Ocelli at the base of the tentacles, and no Otolithes. The tentacles are scattered and equally distributed. With simple Moutharms.

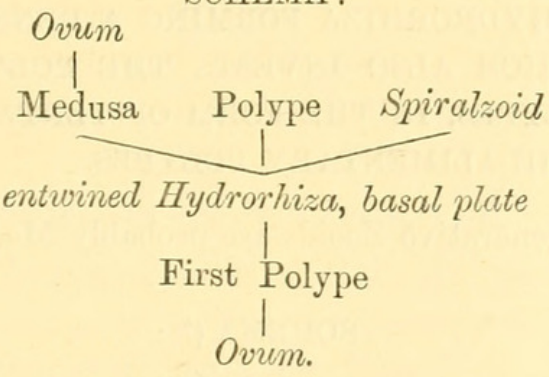
The Polype colonies consist of a dense mass of entwined Hydrorhizæ from which the Hydrocauli, simple or slightly branched grow forth. The alimentary Zooids possess one verticil of filiform tentacles. The Medusæ bud from the Hydrorhiza, or on mouthless Polyps, Polypostyles, rarely on the alimentary Polypes. Besides the alimentary and Generative Zooids we meet with defensive Spiral Zooids. (P. Wright.)

I. SUB-FAMILY CYTÆINÆ.

Cytæidæ. Haeckel.

Producing free Medusæ, which bud from the Hydrorhiza.

SCHEMA:

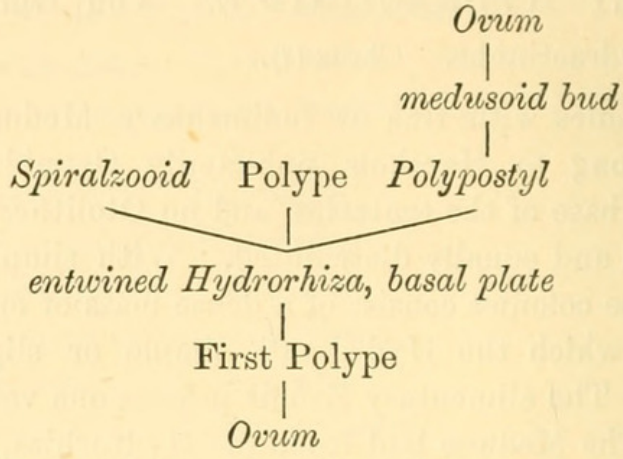


Cytæis. Eschscholtz.
Cubogaster. Haeckel.
Dysmorphosa. Philippi.
Cyteandra. Haeckel.
Corynopsis. Allman.

II. SUB-FAMILY HYDRACTININÆ.

Medusæ bud on Polypostyls, remain sessile and become rudimentary (or immersed in the basal plate ?)

SCHEMA :



Hydractinia. Van Bemeden.
Coppinia. Hincks ?

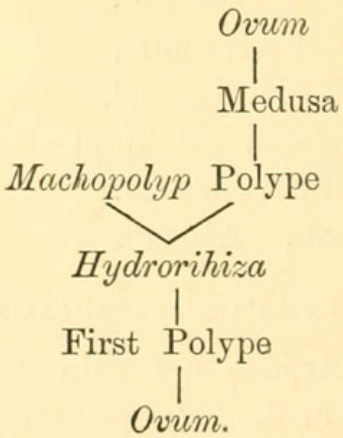
III. SUBORDER HYDROCORALLINÆ.

Moseley.

ALIMENTARY ZOOIDS WITH FEW VERTICILLATE, CAPITATE TENTACLES. HYDRORHIZA FORMING A DENSE CALCAREOUS SKELETON WHICH ALSO INVESTS THE POLYPES. GROUPS OF MACHAPOLYPES, IN THE FORM OF TENTACULAR ZOOIDS, SURROUND THE ALIMENTARY POLYPES.

Ultimately generative Zooids are probably Medusæ.

SCHEMA (?) :



14. FAMILY. STROMATOPORIDÆ. Murie and Nicholson.

Possessing undulating laminæ in the skeleton.

Stromatopora. Goldfuss.
Stylodictyon. Murie and Nicholson.
Clathrodictyon. Murie and Nicholson.
Pachystroma. Murie and Nicholson.
Dictyostroma. Murie and Nicholson.
Ellipsactinia. Steinmann.
Cannopora. Murie and Nicholson.
Stromatocerium. Murie and Nicholson.
Labechia. Lansdale.
Etc.

15. FAMILY. MILLIPORIDÆ. Moseley.

Alimentary Zooids, with from 4 to 6 tentacles. Polypary with many conic protuberances divided by Tabulæ. Coeneuchym with reticulating canals.

Millepora. Linne.
Pliabothrus. Pourtales.
Axopora. Edwards.
Porosphæra, Steinmann.
Cylindrohyphasma. Steinmann.
Etc.

16. FAMILY. STYLASTERIDÆ. Gray.

Alimentary Zooids with from 4 to 12 tentacles. Massive Hydrosom containing tubes which possess pseudosepta formed by the regular position of the tentacular Zooids.

Cryptohelia. E. H.
Stylaster. Gray.
Allopora. Ehrenberg.
Polypora.
Eudobelia. E. H.
Distichopora. Verill.
Lepidopora. Pourtales.
Errina. Gray.
Pentalophora. Kent.
Etc.

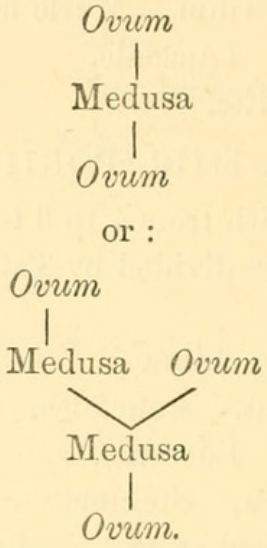
IV. SUBORDER TRACHOMEDUSINÆ.

Von Lendenfeld, 1884.

TRACHOMEDUSÆ *CLAUS.*

HYDROMEDUSÆ WHICH ARE MEDUSÆ, AND ARE PROPAGATED SEXUALLY WITHOUT A CHANGE OF GENERATION AND WITHOUT FORMING POLYPOID ZOOIDS. MEDUSÆ WITH ENTODERMAL ACUSTIC CLUBS.

SCHEMA:



17. FAMILY TRACHOMEDUSIDÆ. Von Lendenfeld, 1884.

Trachomedusae. Haeckel.

The Gonads are developed in the walls of the Radial Canals.

1. SUB-FAMILY PETASNIÆ.

Petasidæ. Haeckel.

With 4 Radial Canals, with long tube shaped stomach. Acustic clubs free or in vesicles on the margin of the Umbrella.

Petasus. Haeckel.
Dipetasus. Haeckel.
Petasata. Haeckel.
Petachnum. Haeckel.
Aglauropsis. F. Müller.
Gossea. L. Agassiz.
Olindias. F. Müller.

II. SUB-FAMILY. TRACHINEMINÆ.

TRACHINEMIDÆ. Gegenbaur.

With 8 Radial Canals, with long tube-shaped stomach.

Trachynema. Gegenbaur.
Marmanema. Haeckel.
Rhopalonema. Gegenbaur.
Pectillis. Haeckel.
Pectis. Haeckel.
Pectanthis. Haeckel.

III. SUB-FAMILY. AGLAURINÆ.

AGLAURIDÆ. L. Agassiz.

With 8 Radial Canals and with a pedicle to the stomach.

Aglantha. Haeckel.
Aglaura. Péron et Lesseur.
Stauraglaura. Haeckel.
Persa. McCrady.

IV. SUB-FAMILY. GERYONINÆ.

GERYONIDÆ. Haeckel.

Four or 6 radial tubes, leaf-shaped gonads. Long stomach pedicle, 8 or 12 marginal peroniæ, and as many acustic vesicles.

Liriantha. Haeckel.
Liriope. Lesson.
Glossoconus Haeckel.
Glossocodon. Haeckel.
Geryones. Haeckel.
Geryonia. Péron et Leseur.
Carmaris. Haeckel.
Carmarina. Haeckel.

18. FAMILY. NARKOMEDUSIDÆ. Von Lendenfeld, 1884.

NARKOMEDUSÆ. Haeckel.

Trachomedusæ, with gastral gonads.

I. SUB-FAMILY. CUNANTHINÆ.

CUNANTHIDÆ. Haeckel.

With broad pouch-shaped Radial Canals, with otoporpa.

Cunantha. Haeckel.
Cunarcha. Haeckel.
Cunoctantha. Haeckel.
Cunoctona. Haeckel.
Cunina. Eschscholtz.
Cunissa. Haeckel.

II. SUB-FAMILY. PEGANTHINÆ,

PEGANTHIDÆ. Haeckel.

Without Radial Canals and without gastral pouches in the sub-umbrella. With otoporpa.

Polycolpa. Haeckel.
Polyxenia, Eschscholtz.
Pegasia. Péron et Leseur.
Pegantha. Haeckel.

III. SUB-FAMILY. AGEININÆ.

AEGINIDÆ. Gegenbaur.

Circular canal in communication with the gastral cavity by double peranial tubes. With gastral pouches without otoporpa.

Aegina. Eschscholtz.
Aeginella. Haeckel.
Aegineta. Gegenbaur.
Aeginopsis. Brandt.
Aeginura. Haeckel.
Aeginodiscus. Haeckel.
Aeginodorus. Haeckel.
Aeginorhodus. Haeckel.

IV. SUB-FAMILY. SOLAMARINÆ.

SALMARIDÆ. Haeckel.

Without circular canal and without otoporpa, with or without Radial Canals.

Solmissus. Haeckel.

Solmundus. Haeckel.
Solmundella. Haeckel.
Solmoneta. Haeckel.
Solmaris. Haeckel.

In this list, of course, by no means *all* known genera are mentioned, but I have endeavoured not to omit any of the more recently established ones.

The older genera, for instance, of Lomouroux and Lamarck, and those recent ones, which appear too doubtful, have not been included.

This classification will, like all its predecessors, doubtlessly be full of errors, but I think the leading idea of it is the correct one, although the application of it in detail has in many cases very likely been a wrong one. And so I beg the reader to judge mildly of this attempt at a reasonable classification of the Hydromedusæ.

Lendenfeld, R. von. 1884. "The Australian Hydromedusae." *Proceedings of the Linnean Society of New South Wales* 9, 206–241.

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