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A review of the siphonophore species mentioned in Haeckel's (1888b) *Challenger* Monograph

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Abstract

In his *Challenger* Monograph Haeckel (1888b) listed a total of 204 species of siphonophores and 36 species of Porpitidae (Disconectae, according to Haeckel), which are now known not to belong to the Siphonophorae. In this paper the siphonophore species have been divided into four categories: a). species that had been described previously by an acknowledged authority other than Haeckel; b). species where Haeckel changed the generic or specific name of a previously described species by another authority, and then ascribed the authority to himself; c). species that Haeckel actually described and illustrated as what he believed to be new; and d). species that Haeckel mentioned in the text as a new species, but with the description deferred to a later publication or simply not given. The validity of the forty-three species that Haeckel actually described is then discussed. A full list of all these species is given in an Appendix.

Key words: Siphonophorae, Haeckel species, Cystonectae, Physonectae, Auronectae, Calycophorae

Introduction

Love him or loath him, Haeckel has inspired some lengthy discussions on his work, particularly with regard to his unshakeable belief in Darwin's *Origin of the Species*. As Gould (2000, p. 43) said: "Men of vision often display outsized foibles as well. No character in the early days of Darwinism can match Haeckel for enigmatic contrast of the admirable and the dubious. No one could equal his energy or the extent of his output ... Yet no major figure took so much consistent liberty in impressing his theoretical beliefs upon nature's observable factuality." Gould (*ibid*.) also remarked: "Yet Haeckel's critics recognized from the start that this master naturalist, this more than competent artist, took systematic license in "improving" his specimens to make them more symmetrical or more beautiful. In particular, the gorgeous plates for his technical monograph on the taxonomy of radiolarians (intricate and delicate skeletons of single-celled planktonic organisms) often "enhanced" the actual appearances (already stunningly complex and remarkably symmetrical) by inventing structures with perfect geometric regularity." This is equally so for his beautiful, but not necessarily accurate, illustrations of siphonophores. Some of Haeckel's embryological drawings also drew the attention, as Gould noted, of Sedgwick (1894 pp. 36–37) who in a footnote rather litotically said: "I do not feel called upon to characterize the accuracy of the drawings of embryos of different classes of Vertebrata given by Haeckel in his popular works. … As a sample of their accuracy, I may refer the reader to the varied position of the auditory sac in the drawings of the younger embryos." The fact that Haeckel appeared to have been falsifying his evidence surfaced again quite recently when an article by Pennisi (1977), as Gould (2000, p. 34) said, caused: "a tempest in a teapot" and was followed by another by Richardson & Keuck (2002).

Most of his biographers, however, have tended to give short shrift to his studies on siphonophores. For those who work on siphonophores such publications are fortunately few, although just one of them was enough to cause so many problems that they have long out-lived him. In fact, there are only five publications that are of relevance, and one of these was published three times. Haeckel started with a study of the embryological development of several siphonophore species (Haeckel 1869a), and immediately instigated a trait that so typified his later work; namely the description of an already described and well-known species, under a completely different name for which he claimed the authority. For instance, although Haeckel (1869a) recognised the validity of *Agalma okenii* Eschscholtz, 1829, he considered that there was a new species, *Crystallodes rigida* Haeckel, that differed solely on the fact that

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Eschscholtz had considered that, since the bracts were so tightly packed on the rigid siphosomal stem, the tentacles of the gastrozooids had to emerge from the posterior end of the stem whereas for Haeckel's specimens they immediately passed between the bracts. Although Haeckel was correct in his observation, the mistaken view of Eschscholtz should not have been considered as the basis for the establishment of a new species, let alone a new genus. Indeed, Haeckel used a totally specious argument to justify his new generic name.

Haeckel (1869a) also illustrated a new species of *Physophora*, *P. magnifica* Haeckel, without making any detailed comparisons with the extant species. All he said (*ibid*., p. 36)[1] was: "The Atlantic *Physophora*, the development of which I have described above, and which I have depicted at natural size in Fig. 26, Plate III, does not agree with any of the species described so far, especially with the two most closely examined Mediterranean species (*P. hydrostatica* Forskal; *P. Philippi* Kölliker). It differs from these and other known species by its greater size, and by the construction of the tentilla (Plate IV, Fig. 28, 29), also by the shape of the swimming bells, and by other subordinate characters, which I will describe in another place." However, all that Haeckel (1888b, p. 263) had to say on the matter was: "At present it is not possible to distinguish exactly the different species of *Physophora* described by numerous authors [including himself]; a far more accurate anatomical description of the various parts and their arrangement, and a comparison of good ures drawn from nature, is indispensable to render specific distinction possible. Since the genus is not rare and widely distributed over all seas, it is probably represented by numerous "geographical species"." Likewise, it appears that Haeckel (1969a) also named a new species of *Athorybia*, *A. ocellatus* Haeckel, without mentioning the specific name at all in that text. We only learn that name from a later publication (Haeckel, 1888b)

Most of Haeckel (1869a) is devoted to his studies on the development of the aforementioned species. It appears that he was a dab hand at producing monstrosities after manipulating the developing embryos in various ways. But his embryological studies for all three physonect species are fundamentally wrong, as he believed that the pneumatophore connected with the central gastrovascular system, which opened through the mouth of the protozooid. In actuality, the pneumatophore, which is an organ not a zooid, is developed by invagination (e.g. Carré, 1969, 1971), so that its cavity is lined by ectoderm. Haeckel had submitted his work anonymously, as was required, to the Utrecht Society of Art and Science and, rather surprisingly, was awarded its gold medal. In the same year, Haeckel (1869b) also published, in Gothic German script, an extensive (38 pages), and populist essay on entitled *Ueber Arbeitstheilung in Natur– und Menschenleben* [On the division of labour in natural and human life]. Siphonophores were, of course, a good example of the division of labour and Haeckel used his description of what he considered to be a new species, *Anthemodes canariensis* Haeckel, as an example.

Then, in 1887 Haeckel published, privately, a paper entitled System der Siphonophoren auf phylogenetischer Grundlage entworfen [System of siphonophores designed on a phylogenetic basis], which was published again the following year in a journal (Haeckel, 1888a). These papers briefly discussed the various theories regarding the origin of siphonophores, such as the poly-organ and poly-person and medusa theories, although by this time it was well established that siphonophores were colonial animals (e.g. Leuckart, 1851; Vogt, 1851; see accompanying paper (Pugh, 2019a). Haeckel himself rejected the polypoid origin of the siphonophores but, as was so typical of him, modified the Medusa theory into his own Medusome theory. Although none of this is relevant to the present purpose of this paper it is worth quoting Claus (1889b), pp. 190–191, which is a translation of Claus (1889a), who gave a damning critique of Haeckel's theory when he stated: "It was, however, consistent that Haeckel, in consequence of a representation made to him by Metschnikoff relating to the interpretation of the Siphonophoran larva as a Medusa, was converted from the theory of Vogt and Leuckart, of which he had previously been a zealous adherent, to the Medusa theory and transferred to this the polymorphism of the former. Nevertheless we might have expected from him at least a statement of the reasons why a swimming polyp–stock could not have been the phylogenetic origin of the Siphonophora, more especially as of late several arguments in favour of this view and in contradiction to the Medusa–theory have been brought forward. Instead of clearing away the difficulties raised by R. Leuckart and afterwards by myself and others, which are offered to this theory by the supposed dislocation of many parts of

1 Original quote: "Die atlantische *Physophora*, deren Entwickelung ich im Vorstehenden geschildert habe, und welche ich in natürlicher Grösse in Fig. 26, Taf. III, abgebildet habe, stimmt mit keiner der bisher beschriebenen Arten vollkommen überein, insbesondere nicht mit den beiden, am genauesten untersuchten mediterranen Species [*P. hydrostatica* Forskal; *P. Philippi* Kölliker). Sie unterscheidet sich von diesen und den anderen bekannten Arten durch bedeutendere Grösse und durch den Bau der Nesselknöpfe (Taf. IV, Fig. 28, 29), auch durch die Form der Schwimmglocken und durch andere untergeordnete Charaktere, welche ich an einem anderen Orte genau beschreiben werde."

Medusae, and confuting the objections raised by me to the assumption that the sexual form of the Hydroid polype [sic] in its perfected form as a Medusa furnished the starting-point for the production of the Siphonophora, a series of assertions are posited as axioms and adopted as established propositions in the schematization of the new Medusome theory". The present author has no intention of further discussing this theory as it has already been mentioned in the accompanying paper (Pugh, 2019a) and, as has just been mentioned, thoroughly debunked by Claus (1889 a, b) and others apart, apparently, from Richards (2008) (see Pugh (2019a).

Haeckel (1887, 1888a) then continued to give a description of all the various "organs" possessed by siphonophores, and how they were arranged on the stem or truncus, all of which was repeated in his *Challenger* Monograph (1888b). For the siphosomal region he considered how the cormidia, iterating groups of zooids, were arranged along the stem; whether each bore one or more gastrozooids, and whether they were ordinate or dissolute.

Haeckel (1888b, p. 7) defined *Ordinate Cormidia* as: "In most polygastric Siphonanths (and therefore in the great majority of now existing genera of Siphonophoræ) the cormidia are ordinate, that is, regularly arranged as the metameres of the jointed stem or corm axis; the internodes, or regular intervals of the stem between each two cormidia, are often quite free, especially in much elongated corms, as for instance in almost all polygastric Calyconectae, in a number of the Physonectæ (Apolemidæ, many Agalmidæ) and of the Cystonectæ (Salacidæ, many Rhizophysidæ). Not infrequently in these stocks the elongated stem is so strikingly jointed by the annular strictures separating the internodes at equal intervals, that the uniform and all-pervading metameric structure of the Articulata is quite equalled. This comparison is the more permissible, since the apical portion of the stem (representing the head) is distinguished by the higher morphological differentiation of its group of persons. The poly-organ theory might conceive these regularly jointed forms as *Siphonophoræ articulatæ* in contrast to the others or *Siphonophoræ inarticulatæ*. But even when the stem is much shortened and the cormidia so closely compressed that the internodes are hardly distinguishable, the cormidia are often arranged with great regularity in a compressed spiral row, as in the Discolabidæ and Rhodalidæ. In others, and often in nearly related forms, the regular arrangement disappears, and gradually passes into the scattered disposition of *Cormidia dissoluta*."

And *Dissolute Cormidia* (*ibid*., pp. 7–8) as: "While in the majority of polygastric Siphonanths the corms are distinctly articulate, and the cormidia are arranged in regular succession, this original arrangement is more or less lost in one portion of this group and in some entirely. The dissolution usually begins in this way, that the siphons and gonophores belonging to one cormidium separate; the latter bud off directly from the stem, often regularly alternating with the first, as in *Polyphyes* [family Hippopodiidae] among the Calyconectæ, in *Linophysa*, *Nectophysa*, *Rhizophysa*, among the Cystonectæ, and in many Agalmidæ among the Physonectæ. In consequence of further dissolution of the stem arrangement, the palpons and the bracts also lose connection with the cormidia, and bud out directly from the stem, as in several Agalmidæ and Forskalidæ. Finally the ordinate arrangement is quite lost, and the entire stem exhibits hundreds or thousands of different appendages (siphons, palpons, gonophores, bracts, &e.) in irregular grouping, so that it is impossible to distinguish the various connected components of the broken up cormidia (*Physalia*, *Agalmopsis*, and other Agalmidæ). This appearance is of the greatest interest, because, within one and the same family (e.g., Agalmidæ, Rhizophysidæ), most nearly related genera exist, of which one possesses perfectly ordinate cormidia, another completely scattered, and a third an exact transition between these two. In this fact lies the direct morphological evidence of the multiplication and dislocation of the portions of the Siphonophoral stock."

These subtle differences between *ordinate* and *dissolute* cormidia do not appear to have any taxonomic relevance and, nowadays, are not used in any way to distinguish siphonophores at any taxonomic level. However, there appears to be one family, the Apolemiidae, where there are distinct differences in the construction of the cormidia that may come to have relevance on this subject. As quoted above, Haeckel (1888b) had considered that the family Apolemiidae possessed *ordinate cormidia*, possibly based on a plate drawn by Lesueur (see Plate III in Blainville 1834). However, anyone who has studied an apolemiid would probably not agree. Indeed, recently, Siebert *et al*. 2013, while describing two new species of *Apolemia*, found that one species had what they referred to as *dispersed* cormidia, in that all the zooids were attached directly to the siphosomal stem; while in other had *pedunculate* cormidia, where only the peduncle of the gastrozooid was attached to the siphosomal stem, and the other zooids branched off from it. The latter arrangement was also found be present in *A. uvaria* and previously had been reported by Stepanjants (1967) for her species *A. vitiazi*. Earlier, Dunn (2005), who had studied in detail the budding of the siphosomal zooids of another physonect, *Bargmannia elongata* Totton, showed that the "horn", his term for the zone of proliferation or blastocrene of the siphosome, gave rise to pro-buds on which all the zooids of each cormidium were

developed before they ultimately moved down on to the siphosomal stem. Firstly, the pro-bud budded off what Dunn referred to as the footbud, while the remainder ultimately developed into the gastrozooid, with its tentacle. From the footbud all the other cormidial zooids were developed and, once they had moved down onto the siphosomal stem, the base of the original pro-bud became the more or less developed peduncle of the gastrozooid. Dunn noted that this mechanism of zooid formation was consistent with what Chun (1885) had described for a calycophoran species, *Sphaeronectes koellikeri*, and thus conjectured that the development of cormidia in all codonophoran siphonophores started with a pro-bud. In the Apolemiidae, which is sister to all other codonophorans, it seems likely that one group, possibly evolving first, retained all the cormidial zooids on the pro-bud, i.e. with pedunculate cormidia, while the other then developed further to allow for the dispersal of the zooids along the siphosomal stem, i.e. with dispersed cormidia.

After Haeckel (1887, 1888a) had discussed the *System der Siphonophoren*, he then gave a comparatively brief systematic synopsis of the families and genera of siphonophores, defining all the genera and listing all the species and indicating those that were new. Haeckel (1888b) also included the *System der Siphonophoren* in his *Challenger* Monograph. The remainder, consisting of 388 pages and 50 plates, was taken up with his descriptions, or not, of various siphonophore and disconectid (Porpitdae) species, which until quite recently were considered to be siphonophores. Finally, on pages 357–372 he gave a list of families, genera and 240 species noting (p. 357): "This list is a complete catalogue of all the genera and species of Siphonophoræ hitherto described with sufficient evidence (from 1775 to 1888); the doubtful or insufficiently characterised species are marked by a query. Those new species, which are followed by the words "Morph. Siphon.," will be described afterwards in my *Morphologie der Siphonophoren*". That publication, if it was even begun, was never published. It is not clear why Haeckel chose 1775, the year that the first of Forsskål's posthumous papers was published, instead of Linnaeus (1758), but the latter date had yet to be established by the International Commission for Zoological Nomenclature, which first convened in 1895.

Haeckel's siphonophore species

Haeckel's (1888b) list of species is given in the Appendix. There are certain differences between this list and that given in Haeckel (1879, 1888a) and these are indicated in footnotes. In order to understand the origin of these species names they have been colour coded according to whether:

a. The species had been described previously by an acknowledged authority other than Haeckel (**Purple**);
b. Haeckel changed the generic or specific name of a species previously described by another authority, and ascribed the authorship to himself (**Green**);
c. Haeckel described and illustrated what he believed to be a new (**Blue**) species; or
d. Haeckel mentioned a new species with description deferred to a later publication or simply not given (**Red**).

Among the 240 species mentioned and listed in the Appendix, 36 were "Disconectae" or Porpitidae of which **13** had been described by other authorities, and their original name retained; **9** had had their names changed; **8** were described by Haeckel; and **6** were simply named, but not described. Only three porpitid species are currently recognised of which just one of Haeckel species, *Porpita prunella* (Haeckel), is included. As these porpitid species are no longer considered as siphonophores they will not be considered further herein.

For the remaining 204 siphonophore species, Haeckel (1888b) distributed them among four orders, Calyconectae, Physonectae, Auronectae and Cystonectae; the names of all of which he claimed to be the authority (Table 1). As discussed in the accompanying paper (Pugh, 2019a), Haeckel (1888b) classified the species of the cystonect genus *Bathyphysa* with the physonect family Forskaliidae, because he thought that they possessed a nectosome. In Table 1 the numbers in brackets represent the re-distribution of the species of that genus if the species had been correctly included in the Cystonectae. Table 1 also shows a breakdown of the species according to the categories mentioned above, except that the species described by Haeckel (1888b) have been divided into two categories according to whether they are presently considered valid or not.

Thus, as Table 1 shows, 127 of the species mentioned by Haeckel (1888b) had previously been described, many of which Haeckel placed into different genera and, named himself as their authority. Claus (1889 a, b) who, as mentioned above, had written a scathing review of Haeckel's *Challenger* Report, particularly with reference to

Haeckel's Medusome Theory, also commented on the trait of changing names and claiming authority for them. Thus, Claus (1889b, pp. 195–196) stated: "That Haeckel makes a very extensive, indeed almost unlimited, use of his skill in making new and suitable names, is certainly intelligible from the fact that he possesses this faculty in a very high degree and has developed it, by many years' practice, into a speciality, in which at present no other naturalist can hope to equal him. But, although it cannot be denied that the introduction of new and appropriate names has many advantages, and is especially indispensable for the sake of conformity in the schematization of theory and system, it is, however, indisputable that by the continual accumulation of synonyms it leads to a nearly unlimited complication of nomenclature, causes much confusion, and instead of facilitating investigation renders it more difficult. It is therefore only in place when moderately exercised where the conditions absolutely require it, but when immoderately done without absolute necessity decidedly mischievous, and to be rejected at once when by it old, equally good names, which have become historical by the personality of meritorious authors, are displaced and removed from science."

TABLE 1. The distribution of siphonophore species in the various Orders, according to Haeckel (1888b).

	Calyconectae	Physonectae	Auronectae	Cystonectae	Totals
Haeckel (1888b)					
Families	6	8	2	5	21
Genera	29	29	4	14	76
No. of species	94	75 (72)	5	30 (33)	204
Species described previously by other authors	**38**	**26 (25)**	**1**	**11 (12)**	**76**
Species or generic names changed by Haeckel	**24**	**21 (20)**	**0**	**6 (7)**	**51**
Valid species described by Haeckel (1888b)	**2**	**2**	**3**	**0**	**7**
Invalid species described by Haeckel (1888b)	**16**	**13**	**0**	**7**	**36**
Nomina nuda	**14**	**13 (12)**	**1**	**6 (7)**	**34**

Claus (1889b, p. 198) further commented: "How far the changes relating to the nomenclature of the genera and families are justified shall not be further discussed here, only a deviation from the old-established practice which Haeckel has permitted himself, as in previous writings, in his System of the Siphonophora, may be mentioned and rejected as inadmissible. This relates to the perfectly new proceeding of striking out the name of the author in the case of already known species established by previous authors on the ground of a change in the generic designation, placing in its stead the name of the author of the new genus. This is a licence which, so far as I know, no other naturalist allows himself, one of Haeckel's peculiarities which, in conjunction with the principle of splitting the genera into new ones upon unimportant differences previously used only for the distinction of species, opens to the "mihi" of the systematist a glimpse of a new and exceedingly fertile field".

Of the remaining species in Haeckel's list, a further 34 species names are considered to be *nomina nuda* as they were mentioned but not described (Table 1; Appendix), or their descriptions were deferred to his *Morphologie der Siphonophoren*. However, the situation was further complicated by the fact that Haeckel included both the polygastric and sexual eudoxid stages of some calycophoran species under separate specific names. The concept of the alternation of generations in hydrozoan cnidarians had been well established for well over 45 years (Steenstrup, 1842), and the fact that certain calycophoran species released, from their polygastric stages, the terminal cormidium of the siphosome as a free-living sexual stage for over 35 years (e.g. Leuckart, 1853). Once again Claus (1889b, p. 197–198) had something so say on this matter: "Another much heavier criticism relates to the classification of the Calycophorid (Calyconect), under which the Eudoxid and Ersæid with their genera and species figure as distinct families side by side with the Monophyid and Diphyid. It is, in fact, a fundamental offence against the idea of a natural system constructed upon a phylogenetic foundation to separate the sexual generations which have become independent from the generations which produce them and to treat them as distinct species of distinct genera and families, to be arranged and enumerated as equivalent to the corresponding categories of the nursing generations. No fewer than 25 species, 8 genera, and 2 families in consequence occur twice over and under two denominations. ... It is difficult to find a reasonable ground which can have induced the author to make so inconceivable a logical mistake. Was it conformity of arrangement that ruled the scheme of classification? The other orders commence with monogastric families, the Physonectæ with the Circalidæ and Athoridæ, the Cystonectæ with the Cystalidæ, the

Disconectæ are exclusively monogastric Siphonophorae, and so monogastric families must come at the head of the Calyconectæ. However, the unequal values of the monogastric families ought to have attracted attention, inasmuch as in those orders they represent the simplest and, in development, the oldest genera, whereas the Eudoxidæ and Ersæidæ, as metameric fragments equivalent to the so–called Prodoxiæ of the polygastric Apolemiadæ, represent the final terms of the evolution". Haeckel (1888b) was quite aware that he was duplicating species as on p. 102 (see Appendix) there is a section entitled *Metagenesis Calyconectarum* where he lists the names given to the monogastric generation and the equivalent name for the polygastric generation. So it is an even bigger mystery to try to understand why Haeckel chose to duplicate so many species names.

So let us look at the species that Haeckel (1869a, b, 1888b) actually described. These are shown in Table 2, together with those species that are currently considered to be valid. Those in red represent the only ones of Haeckel that are currently recognised as valid.

TABLE 2. Species described by Haeckel (1869a, b or 1888b)

Species No.[2]	Haeckel's Species name	Present status	Stage
Order Calyconectæ			
1. 39.	*Eudoxella galea*	*Rosacea cymbiformis*	cormidium[3]
2. 51.	*Cuboides crystallus*	*Enneagonum hyalinum*	eudoxid
3. 55.	*Amphiroa carina*	*Abyla* sp.	eudoxid[4]
4. 59.	*Sphenoides obeliscus*	*Bassia bassensis*	eudoxid
5. 63.	*Aglaisma gegenbauri*	*Abylopsis tetragona*	eudoxid
6. 66.	*Ersaea compressa*	*Diphyes dispar*	eudoxid
7. 69.	*Monophyes princeps*[5]	larval nectophore of ?	
8. 75.	*Mitrophyes peltifera*	*Amphicaryon peltifera*	polyg
9. 76.	*Cymbonectes huxleyi*	*Diphyes chamissonis*	polyg
10 83.	*Cymba crystallus*	*Enneagonum hyalinum*	polyg
11. 88.	*Praya galea*	*Rosacea cymbiformis*	polyg
12. 107	*Diphyopsis compressa*	*Diphyes dispar*	polyg
13. 111.	*Abyla carina*	*Abyla trigona*	polyg
14. 115.	*Bassia obeliscus*	*Bassia bassensis*	polyg
15. 119.	*Calpe gegenbauri*	*Abylopsis tetragona*	polyg
16. 122.	*Desmophyes annectens*	*Desmophyes annectens*	polyg
17. 127.	*Polyphyes ungulata*	*Hippopodius hippopus*	polyg
18. 130.	*Vogtia köllikeri*	*Vogtia spinosa*	polyg
Order Physonectæ			
19. 131.	*Circalia stephanoma*	*Nomen dubium*[6]	
20. 134.	*Athoria larvalis*	*Nomen dubium*	
21. 137.	*Dicyma Diphyopsis*	*Apolemia* sp.	
22. 143.	*Crystallodes rigida*	*Agalma okenii*	
23. 144	*Crystallodes vitrea*	*Agalma okenii*	
24. 151	*Agalma eschscholtzi*	*species inquierenda*	
25. 154.	*Anthemodes ordinata*	*Cordagalma ordinatum*	
26. 162.	*Cupulita canariensis*[7]	*Nanomia bijuga*	
27. 171.	*Lychnagalma vesicularia*	*Lychnagalma utricularia*	
28. 177.	*Forskalia tholoides*	*Forskalia tholoides*	

2 As shown in Appendix.
3 Prayine calycophoran siphonophores do not release eudoxids.
4 The eudoxid stages of *Abyla* species presently cannot be distinguished from each other.
5 See Pugh (2009).
6 This species appears to be a figment of Haeckel's imagination. The single specimen was monogastric, yet had a corona of nectophores surrounding a large pneumatophore
7 Originally described as *Anthemodes canariensis*.

29.	84.	*Nectalia loligo*	*Halistemma sp.*[8]
30.	188.	*Physophora magnifica*	*Physophora hydrostatica*
31.	194.	*Discolabe quadrigata*	*Physophora hydrostatica*
32.	201.	*Athorybia ocellatus*	*Athorybia rosacea*
33.	205.	*Anthophysa darwinii*	*Athorybia rosacea*
Order Auronectae			
34.	206 .	*Stephalia corona*	*Stephalia corona*
35.	207.	*Stephonalia bathyphysa*	*Stephalia bathyphysa*
36.	210.	*Rhodalia miranda*	*Rhodalia miranda*
Order Cystonectæ			
37.	211.	*Cystalia monogastrica*	See Pugh (2019b)
38.	212.	*Cannophysa murrayana*	*Rhizophysa filiformis*
39.	218.	*Nectophysa wyvillei*	*Rhizophysa eysenhardtii*
40.	224.	*Salacia polygastrica*	See Pugh (2019b)
41.	226.	*Epibulia ritteriana*	See Pugh (2019b)
42.	230.	*Alophota giltschiana*	*Physalia physalis*
43.	233.	*Arethusa challengeri*	*Physalia physalis*

So, as Table 2 indicates, only seven of the 43 species described by Haeckel (1888b) are currently recognised as valid, but the validity of one of these can also be called into question, as is discussed below. Three of these valid species belong to what Haeckel classified in a separate Order, the Auronectidae. But even here Claus (1889b. p.197) has something to say: "Further, it seems to me quite unjustifiable to establish a special order of Siphonophora for the remarkable deep-sea genera *Stephalia* (*Stephonalia*), *Auralia*, and *Rhodalia*, as these forms possess the pneumatophore of the Physophorid (Physonect) and have only acquired the character peculiar to them and by which they take their place as a special group of Physophorid by the union of the proximal section of the pneumatophore with an air-discharging apparatus (aurophore). That the peculiar apparatus designated an aurophore has been produced by the transformation of a nectocalyx is not only not proved, but is even very improbable, as we cannot very well see how a nectocalyx could have got upon the dorsal line of the stem, which is always destitute of buds".

One species in the list, *Monophyes princeps* Haeckel (Figure 1), has rarely been discussed since its original description. As Bigelow (1911, p. 184) noted: "*Monophyes princeps* has not been discussed either by Chun or by Schneider. Its subumbral canals resemble those of [*Sphaeronectes*] *irregularis*, but the nectosac is proportionately even higher, and the hydroecium is a mere groove, much as in certain Prayids. Should it prove that these characters are constant, and that the specimen was in fact a Monophyid, princeps would deserve recognition. But to determine whether this is the case will require renewed examination of material agreeing with Haeckel's account. Knowledge of its appendages would be particularly valuable". There was little detail in Haeckel's (1888b) account of a single specimen caught in the Indian Ocean, between the Maldives and Socotra, a Yemeni island off the Gulf of Aden. The specimen consisted of a single nectophore, 6 mm long and 3 mm wide, without ridges but with a deep hydroecium enclosed by its overlapping lateral folds, which were somewhat expanded basally. An extensive nectosac, with simple radial canals stretched up to about the same level as the top of the hydroecium, and the anterior portion of the nectophore was occupied by a large, ovoid somatocyst. As we will see for other species, Bigelow was reluctant to do away with many of Haeckel's more dubious species and retained it in the genus *Sphaeronectes* Huxley.

Chun (1892) mentioned *Monophyes princeps*, stating that it did not belong in the genus *Sphaeronectes*, and retaining it under its original name. Moser (1925) also briefly mentioned it, but made no further comment, and Daniel (1976, 1985) placed it as a very dubious species in the genus *Sphaeronectes*. Pugh (2009), however, considered that this was another of Haeckel's beloved intermediate species, representing a transition between a diphyid posterior nectophore, without a somatocyst, and *Sphaeronectes* species, with a somatocyst, as the nectophore of *M. princeps* certainly resembles a diphyid posterior nectophore, but with the addition of a somatocyst. It might be considered as a *nomen dubium*, but is best just ignored as another of Haeckel's imaginary species.

Two physonects are presently considered as a *nomina dubia* (see Figure 2). They are both monogastric that means they must be a post-larval stage as there are no monogastric adult physonects. *Circalia stephanoma* (Figure 2A) was collected by Haeckel off the west coast of Norway. He likened it to Quoy & Gaimard's (1833 (1834))

8 Post-larval stage. See Pugh & Baxter (2014).

species *Physophora alba*, which Bigelow (1911) considered to be a doubtful species but, looking at the palpon shown by Quoy & Gaimard's (1834) Plate 1, figure 6, it seems very likely that they had described the species *P. hydrostatica* Forsskål. Haeckel (1888b, p. 197–8) suggested: "Comparing the entire corm of Circalia with a single Medusa, which has produced a cormidium by budding from the base of the manubrium, we get a further support for our medusome theory (p. 3). The transformed umbrella of the original Medusa person is the apical pneumatophore; its manubrium is the prolonged central siphon. The distal and lower part of the siphon only has preserved the function of a feeding and digesting stomach, whilst the proximal and upper part represents the axial trunk of the corm, from which the buds arise. These buds may have been originally simple Medusae, but afterwards transformed into loose medusomes; the umbrella of the secondary Medusa has been developed into a nectophore, the dislocated manubrium into a palpon, and its single tentacle into a palpacle. Beyond these sterile medusomes have been developed the fertile ones, in the form of gonostyles, which have produced by budding the gonodendra composed of numerous Medusoid gonophores".

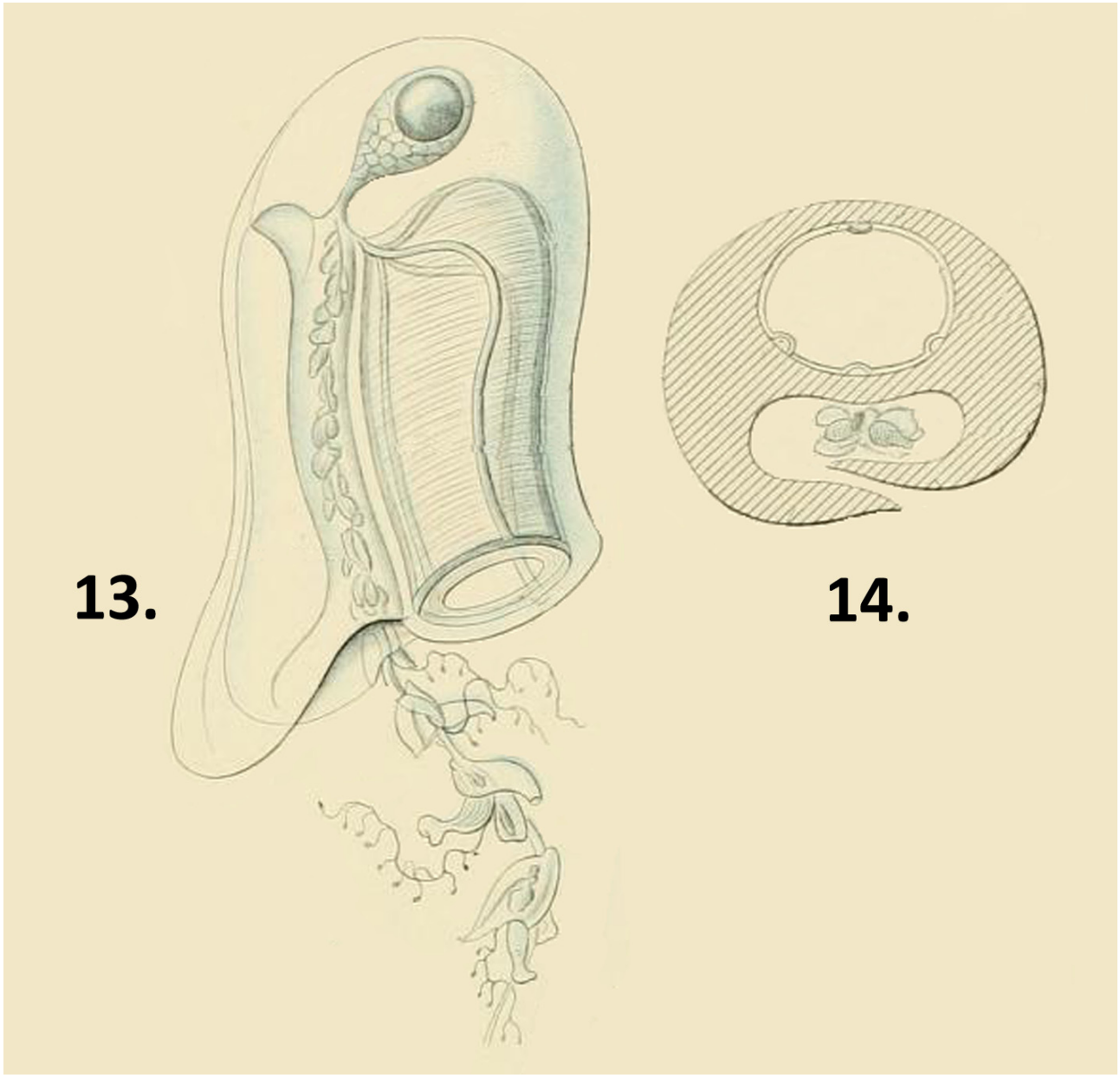

FIGURE 1. *Monophyes princeps* Haeckel, 1888b. Plate XXVIII, figs. 13 & 14.

Such an interpretation is not acceptable nowadays. Later he likened the corona of eight nectophores to the situation in *Stephalia*, which is a rhodaliid or auronectid, according to Haeckel, species; except that it lacks an aurophore. In addition the specimen was monoecious, while rhodaliids are dioecious. Nonetheless, Totton (1965), who said that

the species must be regarded with great caution, again suggested that it might be a larval rhodaliid. In conclusion, as the specimen is clearly a post-larva, then it either belongs to an extant species or, more likely, it was another figment of Haeckel's imagination in order to prove a close link between siphonophores and medusae.

For the second species, the name *Athoria larvalis* (Figure 2B) suggests that Haeckel (1888b) considered it to be a larval form, and he likened it to members of the Family Anthophysidae (Athorybiidae) whose species are now placed within the family Agalmatidae (Dunn *et al*., 2005), and also noted a similarity with the post-larval of *Agalma* species. However, the big difference from *Athorybia*, which also lack nectophores, was that there was said to be a rudimentary subumbrella or nectosac at the distal end of the bracts (Figure 2B, insert); a totally unique character, if it were true. Garstang (1945, p. 139), referring to Haeckel's (1888b) genera *Athoria* and *Rhodophysa*, which is a *nomen nudum*, said: "Unfortunately the single specimens of these forms, which had been seen by Haeckel only, have been lost, and his idealized pictures of the former (Pl. xxi, 5 and 6) can scarcely be regarded as evidence; for the tip of a larval bract is so frequently provided with a nest of large nematocysts, sometimes four in number, set up side by side in a little terminal pocket, that a lively imagination could easily convert this into a minute vesicle segmented by four little radial canals (cf. Haeckel's P1. xxi, figs. 10 and 12, with Metschnikoff's figures of larval Agalma, 1874, or Schneider's special drawings of them, 1896, P1. xliii, 1–3). Moreover it should be noted that in his original description Haeckel's words were less emphatic than his figures, for all he said was that "our very small radial canals seem to arise from it (i.e. the bracteal canal)" (l.c., p. 202). If to Haeckel's keen eye they only "seemed", we may certainly discount the hard strokes of his pencil, as well as his subsequent overstatement that these "seeming" nectosacs are a "proof that the bracts in these cases are reduced nectophores"". Totton (1965) also regarded *A. larvalis* as a species to regard with caution, and made no further mention of it. The fact that the bracts formed a corona around the pneumatophore again suggests a post-larval form, but the suggestion that they had a rudimentary nectosac at their distal ends is too far–fetched. At best we can maintain these two species as *nomina dubia*, although in reality they deserve to be forgotten altogether.

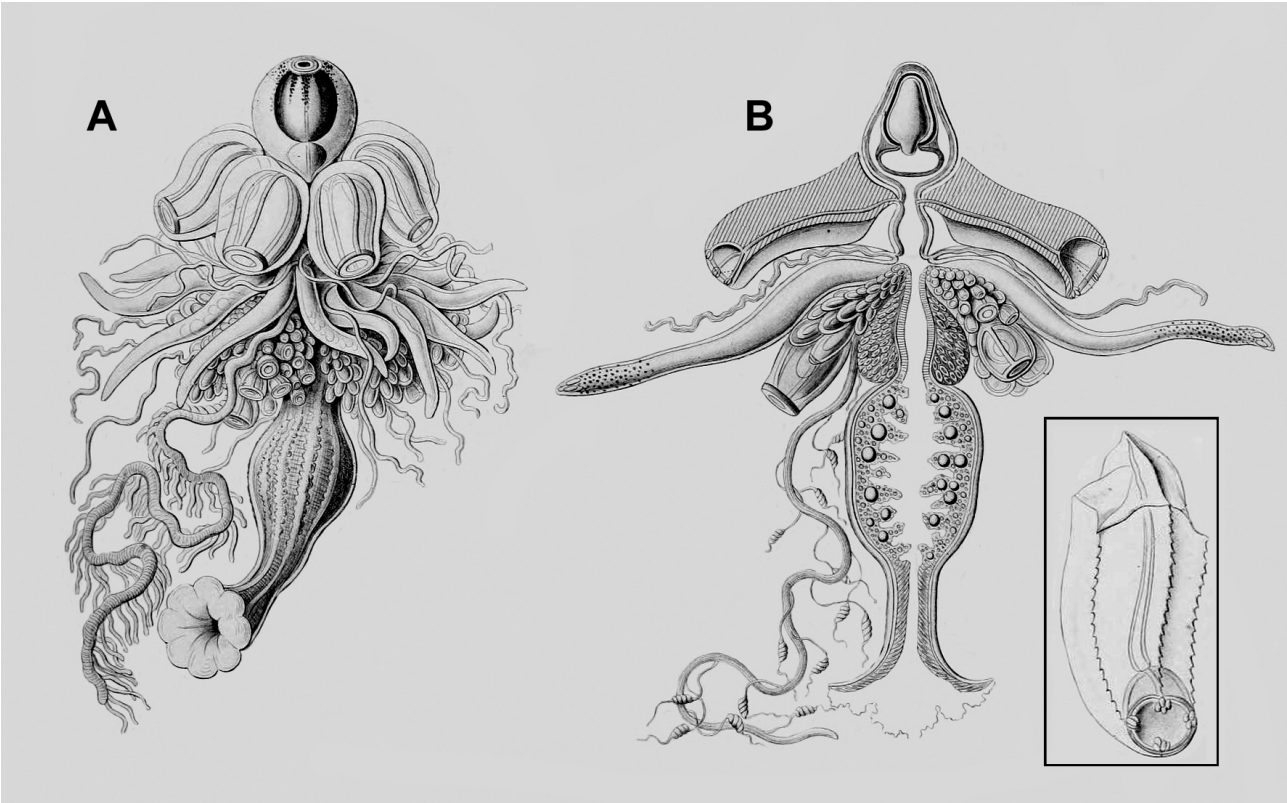

FIGURE 2. A. *Circalia stephanoma* Haeckel; **B**. *Athoria larvalis* Haeckel, with (insert) individual bract/nectophore. From Haeckel (1888b) Plate 21, figures 1, 6 & 7, respectively.

One other physonect, *Agalma haeckeli* Bigelow, 1911, which Haeckel (1888b) had original described under the name *A. eschscholtzii* but, as that specific name was pre-occupied, Bigelow named it after Haeckel himself, presently is retained as a *species inquirendum*. Totton (1965, p. 53) commented: "Described and figured from a single,

small specimen taken off Beligemma, Ceylon. Both description and figures are inadequate. As Bigelow (1911b) judged, this is not a well established species, but it is included here in the hope that someone will keep a look out for it." The species bears many similarities to *A. clausi* that had been described early the same year by Bedot (1888), but Haeckel's figures are so poor that it is difficult to make detailed comparisons with those of Bedot, which themselves are not that good. However, *A. clausi* has recently been re-described by Mańko & Pugh (2018), and they concluded that until further specimens resembling that described by Haeckel are caught in the Indian Ocean *A. haeckeli* could not properly be synonymised with *A. clausi* Bedot, 1888, and so they retained it as a *species inquirendum*.

Totton (1965) was dubious about several of Haeckel's (1888b) species. Under the heading "*Cystonectae: Species inquirendae*" he included Haeckel's family Epibulidae and his species *Epibulia ritteriana* together with *E. chamissonis* (Eysenhardt, 1821), both of which were supposed to have a ring of palpons surrounding the pneumatophore, which was of the cystonect type having hypocystic villi. But cystonects possess only gonopalpons, so that Haeckel (*ibid*., p. 333) was: "led … to the opinion that this genus represents a new family, intermediate between the latter [the Physalidæ] and the Rhizophysidæ". These species are discussed in the accompanying article (Pugh, 2019a) and it is concluded that the palpons are nothing more than young tentacleless gastrozooids, and that the great contraction of the siphosome leads to their ring-like arrangement.

Totton (1965) had every reason to include his species *Cordagalma cordiformis* Totton (1932) as, at that time, the species was known only from a few minute, heart-shaped nectophores that resembled nothing that had ever been described before. Even Carré (1968)[9], who re-described the species from complete specimens collected in the Bay of Villefranche, France: noted: "These bracts are, therefore, different from those of other known Agalm[at]idae, but close to those described by Haeckel (1888) for *Anthemodes ordinata*, an enigmatic species that has never been found again, and which cannot be confused with *Cordagalma cordiformis*". Indeed, there was a close resemblance between the bracts of the two species, while the nectophores were completely different. But Carré failed to mention that there was also a close similarity between the tentilla, not only in their unique larval nature, but also with the presence of large cnidocils and a terminal "rostre". Strangely Totton (1965) included *A. ordinata* as a synonym of what presently is called *Nanomia bijuga* (delle Chiaje, ?1844, Atlas, Volume VII) despite there being little similarity between them, particularly in the structure of the tentillum. But this may have arisen because Haeckel (1888a) had included his *A. canariensis* and *A. ordinata*, as well as *Halistemma picta* Metschnikoff, 1870, in the genus *Anthemodes*. However, both the species *canariensis* and *picta* are junior synonyms of *N. bijuga* and, thus, the genus name *Anthemodes* is a junior synonym of *Nanomia* and is no longer valid. Indeed, Haeckel (1888b, p. 229) partially realised this when he said: "The genus *Anthemodes* was founded by me in 1869[b] for two different Atlantic Agalmids which I had observed in the winter of 1866–67 during my residence in the Canary Islands. One of these, figured as *Anthemodes canariensis* … has loose cormidia and belongs to *Cupulita* (Genus 47b). The second species, described here as *Anthemodes ordinata* and figured in Pls. XIV and XV, has ordinate cormidia, with free internodes, and may be retained as the true type of this genus". This would not be allowed under the present ICZN rules. Nevertheless, Bedot (1896), Schneider (1898) and Bigelow (1911) all retained the genus *Anthemodes* for the species *ordinata*. However, Pugh (2016) came to the conclusion that *A. ordinata* and *C. cordiformis* were one and the same and so he synonymised them as *C. ordinatum*, as the genus *Agalma,* on which *Cordagalma* is based, is neuter. He noted that Haeckel seemed to take no interest in the shape of physonect nectophores as they were wrongly illustrated for many of Haeckel's species, particularly for *A. ordinata* and *Lychnagalma vesicularia*.

Totton (1965, p. 73) had retained *Lychnagalma vesicularia* stating: "A doubtful species. It is not clear from Haeckel's description whether *vesicularia* differs from *utricularia.* It is to be doubted whether much reliance can be placed on Haeckel's beautifully idealized figures, or the record for geographical distribution". Haeckel's single specimen of this species also came from Sri Lanka but, unlike *Agalma haeckeli*, specimens of *L. utricularia* have been collected in the Indian Ocean, particularly from the Bay of Bengal (Daniel, 1985), and so there appears to be no need to accept the minor differences that Haeckel suggested differentiated the two species, and we can relegate *L. vesicularia* to a junior synonym of *L. utricularia*. That species was re-described by Pugh & Harbison (1986).

For the so-called auronectids, now referred to as the physonect family Rhodaliidae Haeckel, Totton (1965) accepted both *Stephalia corona* Haeckel and *Rhodalia miranda* Haeckel, but synonymised *Stephonalia bathyphysa* with the former of these. This was before Pugh (1983) had shown that this family of physonect siphonophores were epibenthic, attaching themselves to the substrate by their tentacles, like tethered hot-air balloons. This led Pugh to

9 Original quote "Ces bractées sont donc différentes de celles des autres Agalmidae connus, mais proches de celles décrites par Haeckel (1 888) chez *Anthemodes ordinata,* espèce énigmatique jamais retrouvée qui, par ailleurs, ne peut être confondue avec *Cordagalma cordiformis*."

suggest that as *S. corona* had only been found in the eastern North Atlantic Ocean, while *S. bathyphysa* was collected off New Zealand that, despite Haeckel's (1888b) brief description, the two species were probably distinct, but retained them both in the genus *Stephalia*.

According to Totton (1965, p. 109) the other physonect currently recognised, *Forskalia tholoides* Haeckel, was: "A little known and doubtful species based on a beautiful idealized figure". However, Pugh (2003) was able to re-describe the species from numerous specimens collected by SCUBA divers and thus prove its validity. In fact, this is one of the very few times that Haeckel accurately drew a physonect nectophore, although it should not have presented much of a problem as the nectophores are so flattened in the upper/lower plane that they are virtually two-dimensional. Totton (1965) also briefly mentioned *Nectalia loligo* Haeckel as he considered that it was a juvenile stage of an agalmatid. Indeed he was correct as Pugh & Baxter (2014) have shown that the species of the genus *Halistemma* do pass through a post-larval *nectalia* stage. However, as they discussed, it is probable that some of his specimens of *N. loligo* from Bermuda (Totton, 1936) actually belong to the species *Stephanomia amphytridis* Lesueur & Petit, 1807; a dioecious species only distantly related to the genus *Halistemma*, which also has a post-larval *nectalia* stage.

For the calycophoran species, there can be little doubt with regard to the validity of *Mitrophyes peltifera* Haeckel, which is presently placed in the prayid genus *Amphicaryon*, and even Totton (1965) had no problem recognising it. He also accepted *Abyla carina* Haeckel, but noted (*ibid*., p. 210): "I suspect that eventually it will become clear that *A. carina* is a synonym of *A. trigona* Quoy & Gaimard. In my experience, species of *Abyla* are very variable and few in number." However, this did not stop him including four species of *Abyla* described by Sears (1953), perhaps because one was named *A. tottoni*! Nowadays none of Sears' species, as well as *A. carina*, is considered as valid.

The other calycophoran that Totton (1965) accepted was *Desmophyes annectens* Haeckel (see Figure 3 D a, b), although Bigelow (1911, p. 199) had reservations as he pointed out: "Haeckel's ('88b) genera *Desmalia* and *Desmophyes* are undoubtedly Prayids, the former without, the latter with special nectophores in the groups of appendages. But instead of only two chief nectophores, *Desmalia* has four, *Desmophyes* six, i.e. three pairs. Schneider ('98, p. 82) has identified *Desmophyes* with *R. medusa* (= "*diphyes*" Graeffe). But though it is true that there is a succession of nectophores in that species (Chun, '88), it is equally certain that the normal number of well-developed bells retained at one time in that genus, and in *Praya*, is two only. Should further study prove that the number of definitive nectophores retained simultaneously in Haeckel's species is six, as in his single example, it would deserve generic separation. I therefore retain *Desmophyes* and *Desmalia*, at least provisionally. The former was described, and beautifully figured—but we know the latter only from an insufficient notice". Indeed, the latter is a *nomen nudum* as, apart from stating the specimen had four biserial nectophores, no specific details were given.

Whether the number of nectophores is a sufficiently important character to warrant the establishment of two different species is unclear, but it is true that prayine siphonophores, with the notable exception of *Stephanophyes superba* Chun, 1888, normally possess just two nectophores, and that applies to all recent colonies identified as *Desmophyes annectens* that have been collected recently using SCUBA or remotely operated vehicles (ROVs). There can be little doubt that Haeckel's (1888b, Plate 30) is a masterpiece of invention, as are so many of his other drawings (see Pugh, 2019a). Although the swollen proximal end of the upper bracteal canal (see Figure 3 D b) can clearly be seen, the equivalent is not apparent in the nectophores, which themselves have a conical shape rather than cylindrical in shape. Indeed, Haeckel (*ibid*. p.171) stated: "From the proximal base of this pedicular canal arises a blind pallial [ascending mantle] canal, which ascends towards the dorsal median line of the exumbrella, and ends near its apical part by a small caecal diverticulum (just as in *Lilyopsis*)". That description more closely matches that of *D. haematogaster* Pugh, 1992 than *D. annectens*, but for that species the cormidial bracts do not possess a swelling on the upper bracteal canal (see Haddock *et al*., 2005).

Prior to Haeckel (1888b) there had been several descriptions of specimens that are presently attributed to *Desmophyes annectens*. For instance, Vogt (1851, 1854) and Kölliker (1853; see Figure 3C) both described the nectophores and the cormidia of specimens closely resembling *D. annectens*. Vogt (1851; 1852a, b) first described it under the name "*Diphyes Brajae*", and later renamed it *Praya diphyes* (Vogt, 1854), which was the same name as used by Kölliker (1853), but listed in his synonyms his previous name as "*D. Prayæ*". Their specimens possessed only two nectophores, which, as with *D. annectens*, were characterised by a single swollen process extending from the ascending mantle canal into the mesogloea, and the upper bracteal canal had a similar process. Kölliker (1853) gave the source of the name *P. diphyes* as Lesson (1843), while Vogt (1854) attributed it to Blainville (1834), and Lesson (1843) gave the source as *Diphyes prayensis* Quoy & Gaimard, (1833 (1834)). I fact, Blainville was the

first to use the name *P. diphyes* but he too based it on the description and illustration (Plate 5, figs. 37–38) by Quoy & Gaimard of "Diphye de Praya" *D. prayensis* (see Figure 3 B). However, those illustrations, although extremely crude, showed no signs of the presence of a swollen process within the mesogloea, and so need not be considered any further. On the other hand, Quoy & Gaimard (1827) described, albeit vaguely, and figured (Plate 4B, fig. 4), equally poorly, a species that did appear to have such a swelling under the name *Rosacea plicata* (see Figure 3 A). Graeffe (1860) then described another siphonophore under the name *P. diphyes*, but that specimen was not the same as Kölliker's and Vogt's as the cormidial bracts were very different, and eventually came to be known as *Lilyopsis. medusa* (see Pugh, 2009).

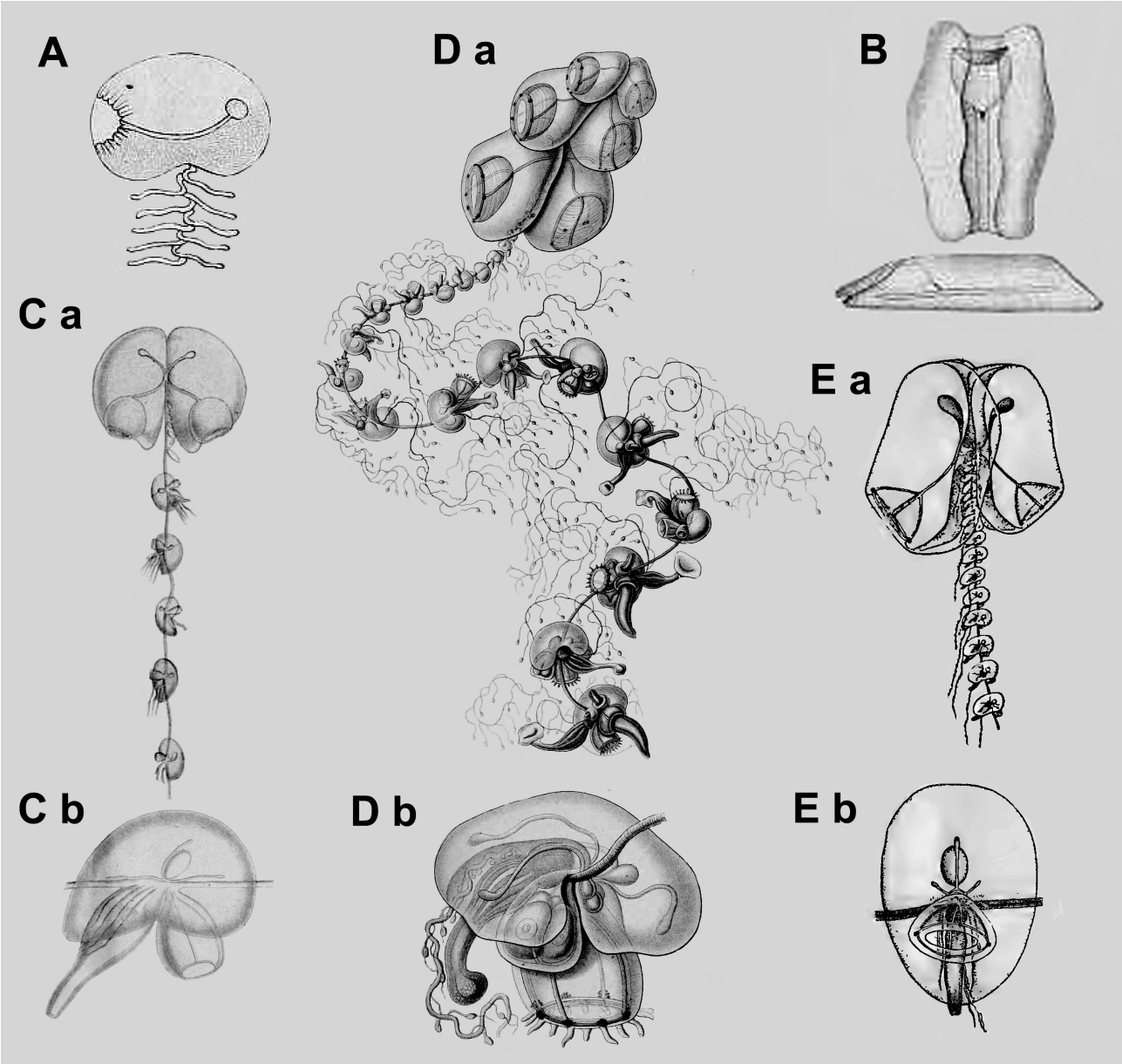

FIGURE 3. A. *Rosacea plicata* Quoy & Gaimard (1827, Plate 4, fig.4); **B**. *Diphyes prayensis* Quoy & Gaimard (1833, (1834, Plate 5, figs. 37 & 38); **C**. *Praya diphyes* Kölliker (1853, Plate 9, figs. 1 & 2); **D**. *Desmophyes annectens* Haeckel (1888b, Plate 30, figs. 1 & 2); **E**. *Rosacea plicata* Kawamura (1915, Plate 7, figs. 6 & 7). For **C**, **D** & **E**: **a**. Polygastric stage; **b**. A cormidium.

The story now becomes very complicated, but suffice it to say that Bigelow (1911) confused Quoy & Gaimard's *Rosacea plicata* with another much commoner prayid, and subsequently the name *R. plicata* was applied to that species. Nonetheless, Kawamura (1915) (see Figure 3 E) described and clearly illustrated, under the name *R. plicata*, a specimen that would presently be referred to as *D. annectens*. Totton (1965 p. 115), who was very reluctant to make changes to the extant nomenclature, decided that: "In order not to complicate further the very involved nomencla-

ture of the Prayinae I propose that *Rosacea* shall continue in use in the sense of Bigelow, 1911b; and I designate *R. plicata* Quoy & Gaimard *sensu* Bigelow as its type species."

Subsequently, Carré (1969) caused some confusion when he described a new species *Rosacea villafrancae* Carré and commented (*ibid*., pp. 115–116)[10]: "On the other hand, the nectophores with their non-sinuous lateral canals, and their somatocyst, whose distal part penetrates deeply into the mesogloea, do not present all the characters chosen for the diagnosis of nectophores of the genus Rosacea. However, these peculiarities do not seem to us sufficient to justify the creation of a new genus and we propose to modify, by supplementing it, the diagnosis of the genus Rosacea given by Totton (1965)". Unfortunately, such a suggestion is completely untenable. Pugh (1992) also described a new prayine siphonophore under the name *Desmophyes haematogaster* Pugh that, like Carré's *R. villafrancae*, had an extension of the ascending mantle canal into the mesogloea. Pugh referred back to Pugh & Harbison (1987) who had discussed the taxonomy of prayine calycophorans and had accepted Totton's definition of the genus *Rosacea*, whose nectophores had sinuous lateral radial canals, and no extension into the mesogloea and, like Totton, thereby placed those species with straight lateral radial canals and an extension into the mesogloea within the genus *Desmophyes*.

This, then, led Margulis (1995) to suggest another approach by re-establishing Quoy & Gaimard's (1827), with an extension of the pedicular canal into the mesogloea being present in the nectophore (see Figure 3A); thereby doing away with the genus *Desmophyes*. In consequence the genus *Rosacea sensu* Bigelow, 1911 was renamed *Neorosacea* and the species *plicata* became *N. bigelowi* Margulis. This seemed an unnecessary complication to the nomenclature and so Mapstone & Pugh (2004) proposed (Case 3309) to the International Commission for Zoological Nomenclature (ICZM) for the conservation of the names *R. plicata* Bigelow, 1911 and *D. annectens* Haeckel, 1888, which the commission, in Opinion 2157, was accepted (ICZM, 2006). Thus the *status quo* was re-established.

In the above quote Bigelow (1911) appears to be a bit confused as Schneider (1898) actually did not synonymise *Desmophyes annectens* with *Rosacea medusa* (= "*diphyes*" Graeffe) for, as noted above, Graeffe (1860) actually described a different prayine siphonophore, *Lilyopsis medusa*, under the name *Praya diphyes*. Unfortunately, the suppression of the name *R. plicata* Quoy & Gaimard, 1827, means that that specific name can no longer be used, and the generic name *Desmophyes* Haeckel has to be retained as there is none other available. But should the specific name *annectens* be maintained? In view of the poor quality of Haeckel's (1888b) description and illustration it would seem better to use one of the only others name available, namely the *brajae* or *prayae* of Vogt (1851, 1854), as both Kölliker (1853) and Vogt (1854) gave much more accurate descriptions of the species in question. If this is acceptable, then the number of siphonophores that Haeckel (1888b) described and are presently considered valid amongst the 204 he listed would be reduced to just six. As *brajae* has chronological priority, although it appears that Vogt had meant to call it *prayae*, it would appear to take precedence.

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10 Original quote "Par contre, les nectophores avec leurs canaux latéraux non sinueux, et leur somatocyste dont 1a partie distale s'enfonce profondément dans la mésoglée, ne présentent pas tous les caractères choisis pour la diagnose des nectophores du genre Rosacea. Toutefois, ces particularités ne nous semblent pas suffisantes pour justifier la création d'un nouveau genre et nous nous proposons de modifier, en la complétant, la diagnose du genre Rosacea donnée par Totton (1965)."

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Appendix
LIST OF FAMILIES, GENERA AND SPECIES.

Haeckel (1888b, pp. 357-372)

Each species has been coloured coded according to whether: -

a. The species had been described previously by an authority other than Haeckel (**Purple**);

b. Haeckel changed the generic or specific name of a species previously described by another authority (**Green**);

c. Haeckel described and illustrated what he believed to be a new species (**Blue**); or

d. Haeckel mentioned a new species with description deferred to a later publication or simply not given (**Red**).

Order I. **DISCONECTAE**, Haeckel (System, 1888a, p. 29).

Family I. **Discalidæ**, Haeckel (System, 1888a, p. 29).

Genus 1. *Discalia*, Haeckel 1888a, p. 29).

1. *Discalia medusina*, Haeckel (Report, p. 46, Pl. XLIX. figs. 1–6).
2. *Discalia primordialis*, Haeckel (Report, p. 46).

Genus 2. *Disconalia*, Haeckel (1888a, p. 30).

3. *Disconalia, gastroblasta*, Haeckel (Report, p. 48, Pl. XLIX. figs. 7–12; Pl. L.).
4. *Disconalia pectyllis*, Haeckel (Morph. Siphon.)[11].
5. *Disconalia ramifera*, Haeckel[12] (?) (= *Porpita ramifera*, Eschscholtz, 1829, p. 178, Pl. xvi, fig. 3).

Family II. **Porpitidæ**, Brandt (1835, p. 40).

[Subfamily 1. PORPALIDÆ, Haeckel.][13]

Genus 3. *Porpalia*, Haeckel (1888a, p. 30).

6. *Porpalia prunella*, Haeckel (Report, p. 58, Pl. XLVIIL).
7. *Porpalia globosa*, Haeckel (= *Porpita globosa*, Eschscholtz 1829, p. 178, Pl. xvi. fig. 4).

Genus 4. *Porpema*, Haeckel (1888a, p. 30).

8. *Porpema medusa*, Haeckel (Report, p. 61, Pl. XLVIL).
9. *Porpema lenticula*, Haeckel (Morph. Siphon.)[14].
10. *Porpema pileata*, Haeckel (Morph. Siphon.).

[Subfamily 2. PORPITELLIDÆ, Haeckel.][15]

Genus 5. *Porpitella*, Haeckel (1888a, p. 30).

11. *Porpitella pectanthis*, Haeckel (Report, p. 64, Pl. XLVI).
12. *Porpitella caerulea*, Haeckel (= *Porpita caerulea*, Eschscholtz, 1829, p. 179, Pl. xvi, fig. 5).
13. *Porpitella radiata*, Haeckel (= *Porpita radiata*, Brandt, 1835, p. 40).

Genus 6. *Porpita*, Lamarck (1816, p. 483).

14. *Porpita mediterranea*, Eschscholtz (1829, p. 177).
15. *Porpita linnaeana*, Lesson (1843, p. 588).
16. *Porpita umbella*, Eschscholtz (1829, p. 179 = *Porpita gigantea*, Péron & Lesueur, 1807[16], Pl. xxxi, fig. 6).
17. *Porpita indica*, Haeckel (= *Porpita lütkeana*[17], Brandt, 1835, p. 41).
18. *Porpita fungia*, Haeckel (Report, p. 67, Pl. XLV.).
19. *Porpita pacifica*, Lesson (1830, Pl. vii. fig. 3).
20. *Porpita australis*, Haeckel[18] (Morph. Siphon.).

Family III. **Velellidæ** Esch. (1829, p. 165).

Genus 7. *Rataria*, Eschscholtz (1, p. 166).

21. *Rataria cristata*, Haeckel (Report, p. 79, PI. XLIV.).
22. *Rataria mitrata*, Eschscholtz[19] (1829, p. 168, Pl. xvi. fig. 2).
23. *Rataria cordata*, Eschscholtz[10] (1829, p. 167, Pl. xvi. fig. 1).

11 Haeckel (1888b, p. 48) said that the state of preservation of the specimen was insufficient for a full description to be made, rather than deferring the description for a later publication, as he later intimated.
12 Not mentioned in Haeckel (1888a).
13 Only appears in the text, p. 57.
14 The species is mentioned on p. 60, without any suggestion that a description will be found in a later publication.
15 Only appears in the text, p. 63.
16 Péron & Lesueur (1807) did not mention this species. It appears in the relevant Plate of the Atlas by Lesueur & Petit (1807).
17 In the text, Haeckel (1888b, p. 67) refers to *Porpita lütkeana* as a distinct species, not a synonym of *P. indica*, of which he makes no mention whatsoever.
18 The species is mentioned on p. 67, without any suggestion that a description will be found in a later publication.
19 Not mentioned in text.

Genus 8. *Velella*, Lamarck (1816, p. 481).

24. *Velella spirans*, Eschscholtz (1829, p. 172 = *Velella limbosa*, Lamarck, 1816).
25. *Velella caurina*, Eschscholtz (1829, p. 173, Pl. xv. fig. 2).
26. *Velella scaphidia*, Péron et Lesueur (1807[16], p. 44, Pl. xxx. fig. 6).
27. *Velella oblonga*, Chamisso & Eysenhardt (1821, p. 363, Pl. xxxii. fig. 2).
28. *Velella pacifica*, Eschscholtz (1829, p. 174, Pl. xiv. fig. 4).
29. *Velella patella*, Brandt[20] (1835, p. 38).
30. *Velella cyanea*, Lesson (1830, p. 54, Pl. vi. figs. 3, 4).

Genus 9. *Armenista*[21], Haeckel (Report, p. 83).

31. *Armenista mutica*, Haeckel (= *Velella mutica*, Lamarck)
32. *Armenista sigmoides*, Haeckel (Report, p. 84, Pl. XLIII).
33. *Armenista indica*, Haeckel (= *Velella indica*, Eschscholtz, 1829, p. 175, Pl. xv. fig. 5).
34. *Armenista antarctica*, Haeckel (= *Velella antarctica*, Eschscholtz = *Velella sinistra*, Chamisso & Eysenhardt, 1821, p. 363, Pl. xxxii. fig. 1).
35. *Armenista lata*, Haeckel (= *Velella lata,* Chamisso & Eysenhardt, 1821 p. 364, Pl. xxxii. fig. 3).
36. *Armenista lobata*, Haeckel[22] (Morph. Siphon.).

Order II. **CALYCONECTÆ** Haeckel (1888a, p. 31).

[Sub-order 1. *CALYCONECTÆ MONOGASTRICÆ*][23]

Family IV **Eudoxidæ** Haeckel (1888a, p. 32).

[Subfamily 1. DIPLOPHYSIDÆ. Haeckel (1888a, p. 32][24]

Genus 10. *Diplophysa*[25] Gegenbaur (1854[26], p. 291).

37. *Diplophysa inermis* Gegenbaur (1854[17], p. 291, Pl. xvi, fig. 3 = Eudoxia of *Sphaeronectes gracilis*, Haeckel).
38. *Diplophysa köllikeri* Haeckel (Report, p. 108) (= Eudoxia of *Sphaeronectes köllikeri*, Huxley).

Genus 11[27]. *Eudoxella* Haeckel (Report, p. 108).

39. *Eudoxella galea* Haeckel (Report, p. 108, PL XXXII)[28].
40. *Eudoxella didyma*, Haeckel[29] (Morph. Siphon.).

Genus 12a[30]. *Cucubalus* Blainville (1834, p. 130)[31].

41. *Cucubalus eschscholtzii*, Haeckel (= *Eudoxia eschscholtzi*, Busch, 1851, p. 33, Pl. iv, v: Chun, 1882, Pl. xvii, fig. 3).
42. *Cuculabus pyramidalis*, Haeckel (= *Ersaea pyramidalis*, Will, 1844, Pl. ii).

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20 Haeckel (1888a, p. 31) refers to this species as *V. patellaris*, Mertens, but does not mention *V. pacifica* or *V. cyanea*.
21 Referred to as genus *Velaria* in Haeckel, 1888a, p. 31).
22 Mentioned as a n. sp. in the text, but not referred to a later publication.
23 Only in text, p. 103.
24 Only in text, p. 107, and in Haeckel (1888a, p. 32).
25 In the text (p. 107) Haeckel also includes in this genus *Ersaea truncata* Will (1844, p. 82, Pl. ii, fig. 28) [= *Sphaeronectes ? irregularis*]; and Haeckel (1888a, p. 32) also includes it in the genus *Diplophysa*. The reference should be to Gegenbaur, 1853, not 1854.
26 This should be Gegenbaur, 1853, not 1854.
27 Genus 11a in text (p. 108). Haeckel (1888a, p. 32) gave to his 11th genus the name *Eudoxon*, including the new species *E. didymon*. In addition, there he made no mention of either the genera *Eudoxella* or *Cucubalus*.
28 The description appears as part of his description of *Praya galea* starting on p. 146.
29 The species is mentioned on p. 108, without any suggestion that a description will be found in a later publication.
30 Genus 11b in text (p. 109).
31 Attributed to Quoy & Gaimard, 1824 (MS) in text (p. 109).

43. *Cucubalus cordiformis*, Quoy and Gaimard[32] (1833, Pl. iv, pp. 24–27).

Genus 12b[33]. *Cucullus*, Lesson, (1843, p. 458)[22].

44. *Cucullus campanula*, Haeckel (= *Eudoxia campanula*, Leuckart. 1853, p.43, Pl. iii, figs. 16–20).
45. *Cucullus gegenbauri*, Haeckel (= *Eudoxia messanensis*, Gegenbaur, 1854[17], Pl. xvi. fig. 4).
46. *Cucullus subtilis*, Haeckel (= *Ersaea elongata*, Will, 1844, p. 82, Pl. ii, fig. 30).
47. *Cucullus elongates*, Haeckel[34] (Morph. Siphon.) (= *Eudoxia elongata*, Haeckel).
48. *Cucullus lessonii*, Haeckel (= *Eudoxia lessonii*, Eschscholtz, 1829, p. 126, Pl. xii, fig. 2).
49. *Cucullus gracilis*, Haeckel[35] (Morph. Siphon.) (= *Eudoxia bojani*, Huxley, 1859, p. 58, Pl. iii, fig. 7).

[Sub-family 2. AGLAISMIDÆ. Haeckel (1888a, p. 32)][15]

Genus 13. *Cuboides* Quoy & Gaimard (1827, p.19).

50. *Cuboides vitreus*, Quoy and Gaimard (1827, Pl. ii, figs. 1–3.
51. *Cuboides crystallus*, Haeckel (Report, p. 112, Pl. XLII).
52. *Cuboides vogtii*, Haeckel[36] (= *Cuboides vitreus* Huxley, 1859, p. 63, Pl. iv, fig. 5).
53. *Cuboides nacelle*, Haeckel[37] (Morph. Siphon.).

Genus 14. *Amphiroa*[38] Blainville (1834. p. 133)

54. *Amphiroa trigona*, Haeckel (= *Eudoxia trigonæ* Gegenbaur, 1859, Pl. xxviii, figs. 9–12)[39].
55. *Amphiroa* carina, Haeckel (Report, p. 114, Pl.XXXVI).
56. *Amphiroa alata*, Huxley (1859, p. 64, Pl. v, fig. 1).
57. *Amphiroa angulata*, Huxley[40] (1859, p. 64, Pl. v, fig. 2).

Genus 15. *Sphenoides* Huxley (1859, p. 61)

58. *Sphenoides tetragona*, Haeckel[41] (Morph. Siphon.).
59. *Sphenoides obeliscus*, Haeckel (Report, p. 116, Pl. XXXVIII).
60. *Sphenoides perforata*, Haeckel[42] (compare *Bassia perforata*, Haeckel).
61. *Sphenoides australis*, Huxley[43] (1859, p. 62, Pl. iv, fig. 4).

Genus 16. *Aglaisma*, Eschscholtz (1829, p. 129).

62. *Aglaisma eschscholtzii*, Huxley (1859, p. 60, Pl. iv, fig. 2, = *Eudoxia pentagonæ* Gegenbaur, 1854[17], Pl. xvi, figs. 1, 2).
63. *Aglaisma gegenbauri*, Haeckel[44] (Report, p. 119, Pl. XL).
64. *Aglaisma elongata*, Huxley (1859, p. 61, Pl. iv, fig. 3).

32 Quoy & Gaimard (1833, p. 94-5) described the species *Diphyes cucubalus*, and illustrated it in the 1834 Atlas Plate IV, figs. 24-27. Blainville (1834, p. 130) referred to it as *Cuculabus cordiformis*.

33 Genus 12 in text (p. 109).

34 Although Haeckel, 1888b, p. 360) referred the description of both *Cucullus elongates* and *C. gracilis* to his never to appear Morphology of the Siphonophorae it is not clear why, as he recognised that the two species belonged to extant species that he had placed in different genera. He was also more honest in the text when he recognised the species *C. elongates* as the eudoxid stage of *Diphyes elongata* Hyndman, 1841 [= *Chelophyes appendiculata*].

35 Mentioned in text (p. 110), but no reference to a later description.

36 Not mentioned in Haeckel (1888a).

37 In the text, Haeckel (1888b, p. 111) stated "Different from this Australian species [*Cuboides vogtii*] is an Indian species (*Cuboides nacella*, Hkl.), and the Atlantic species [*C. crystallus*], which I shall describe in the sequel". However, he described the last species on pp.112-113, but made no mention of a further description of *C. nacella*.

38 The genus is spelt *Amphirrhoa* in Haeckel (1888a, p. 33), and attributed to Lesueur.

39 Plate 28 in the Explanation of the illustrations, but actually Plate 27.

40 Not mentioned in Haeckel (1888a). Haeckel (1888b, p. 119) suggested that the species described by Eschscholtz (1829, p. 129) as *Aglaisma baeri* "is possibly identical with our *Aglaisma gegenbauri*"!

41 No reference to a later description in the text.

42 Ultimately, this name links back to *Abyla perforata* Gegenbaur, 1859.

43 Not directly mentioned in text.

44 Not mentioned by Haeckel (1888a, p. 33).

Family V. **Ersaeidæ** Haeckel (1888a, p. 33)

Genus 17a[45]. *Ersaea* Eschscholtz (1829, p. 127).

65. *Ersaea gaimardi*, Eschscholtz (1829, Pl. xii, fig. 4).
66. *Ersaea compressa*, Haeckel (Report, p. 123, Pl. XXXIV).
67. *Ersaea dispar*, Haeckel[46] (= *Eudoxia bojani*, Eschscholtz. 1829, p. 125, Pl. xii, fig. 1).

Genus 17b. *Lilæa*[47] Haeckel (report, p. 122).

68. *Lilæa medusina*, Haeckel[48] (Morph. Siphon.).

Family VI **Monophyidæ** Claus (1874, p. 29).

Subfamily 1. SPHÆRONECTIDÆ, Huxley (1859, p. 50).

Genus 18. *Monophyes*[49] Claus (1874, p. 29).

69. *Monophyes princeps*, Haeckel (Report, p. 129, Pl. XXVII, figs. 13, 14).
70. *Monophyes hydrorrhoa*, Haeckel (=*Sphæronectes hydrorrhoa*, Haeckel 1888a, p. 34).
71. *Monophyes diptera*, Haeckel (= *Monophyes gracilis*. larva, Chun, 1885, Pl. ii, fig. 5).
72. *Monophyes irregularis*, Claus (1874, p. 29, Pl. iv, figs. 16–18).

Genus 19. *Sphæronectes*[50] Huxley (1859, p. 50).

73. *Sphæronectes köllikeri*, Huxley (1859, p. 50, Pl. iii, fig. 4).
74. *Sphæronectes gracilis*, Haeckel (= *Monophyes gracilis*, Claus, 1874, p. 29, Pl. iv, figs. 8–14; Chun, 1885, Pl. ii, figs. 1, 2).

Genus 20. *Mitrophyes*, Haeckel (1888a, p. 34).

75. *Mitrophyes peltifera* Haeckel (Report, p. 131, Pl. XXVIII).

Subfamily 2. CYMBONECTIDÆ, Haeckel (1888a, p. 34).

Genus 21. *Cymbonectes*, Haeckel (1888a, p. 34).

76. *Cymbonectes huxleyi*, Haeckel[51] (Report, p. 134, Pl. XXVII, figs. 1–12).
77. *Cymbonectes mitra*, Haeckel (= *Diphyes mitra*, Huxley, 1859, p. 36, Pl. i, fig. 4).
78. *Cymbonectes cymba*, Haeckel (Morph. Siphon).

Genus 22. *Muggiaea* Busch (1851, p. 48).

79. *Muggiaea kochi*, Chun (1882, Pl. xvii, fig. 2).
80. *Muggiaea pyramidalis*, Busch (1851, p. 48).
81. *Muggiaea chamissonis*, Haeckel (= *Diphyes chamissonis* Huxley, 1859, p. 36, Pl. 1, fig. 3).

45 Genus 17 in Haeckel (1888a, p. 33).

46 The species *Ersaea Bojani* is mentioned by Haeckel (1888a, p. 33), but synonymised with *E.* dispar in Haeckel (1888b, p. 122).

47 Not included in Haeckel (1888a).

48 In the text this species is provisionally named *Lilæa medusina*, with no reference to a subsequent description.

49 Genus 19 in Haeckel (1888a, p. 34), and included species *irregularis* and *Köllikeri*; the latter being placed in the genus *Sphaeronectes* by Haeckel (1888b). *Monophyes diptera* was not mentioned.

50 Genus 18 in Haeckel (1888a, p. 34), and included species *princeps* and *hydrorrhoa*, both included in the genus *Monophyes* by Haeckel (1888b).

51 Not mentioned in Haeckel (1888a, p. 34).

Genus 23. *Cymba* Eschscholtz (1829, p. 133).

82. *Cymba enneagonum*, Eschscholtz[52] (= *Enneagonum hyalinum* Quoy & Gaimard, 1834, Pl. v, figs. 1-6).
83. *Cymba crystallus*, Haeckel (Report, p. 138, Pls. XLI, XLII).
84. *Cymba vogtii*, Haeckel (= *Abyla vogtii* Huxley, 1859, p. 46, Pl. ii, fig. 3).
85. *Cymba nacella*, Haeckel (Morph. Siphon.).

Family VII **Diphyidae** Eschscholtz (1829, p. 122).

Subfamily PRAYIDÆ, Kölliker (1853, p. 33).

Genus 24. *Praya*, Blainville (1834, p. 137).

86. *Praya maxima,* Gegenbaur[17] (1854, p. 301, Pl. xvii, figs. 1–6)[53].
87. *Praya cymbiformis,* [delle] Chiaje (1823-29[54]; Leuckart, 1853 and 1854).
88. *Praya galea,* Haeckel (Report, p. 146, Pls. XXXI, XXXII).

Genus 25. *Lilyopsis* Chun (1885, p. 18).

89. *Lilyopsis diphyes,* Chun (1885, = *Praya diphyes,* Vogt, 1854, Pls. xvi, xvii; Kölliker, 1853, Pl. ix).
90. *Lilyopsis medusa,* Chun (1885, = *Praya medusa*, Metschnikoff, in an inaccessible Russian paper[55]).
91. *Lilyopsis rosea,* Chun (1885. Pl. ii, Figs. 12, 13).
92. *Lilyopsis catena,* Haeckel[56] (Report, p. 150).

Subfamily DIPHYOPSIDÆ, Haeckel (Report, p. 143).

Genus 26. *Galeolaria*, Blainville[57] (1834, p. 139).

93. *Galeolaria aurantiaca*, Vogt (1854. p. 110, Pl. xviii, xix; = *Sulculeolaria quadrivalvis*, Blainville, 1834, p. 138; = *Epibulia aurantiaca*, Vogt, 1854, p. 110).
94. *Galeolaria turgida*, Haeckel (= *Diphyes turgida* Gegenbaur, 1854[17], p. 442, Pl. xxiii)[58].
95. *Galeolaria biloba*, Blainville (Sars, 1846, Part 1, p. 41, Pl. vii, figs. 16-21).
96. *Galeolaria truncata*, Huxley (1859, p. 38; = *Diphyes truncata*, Sars, 1846, Part I, Pl. vii, figs. 1–15).
97. *Galeolaria sarsii*, Haeckel (= *Diphyes sarsii*, Gegenbaur, 1859, p. 20, Pl. xxx, figs. 30, 31).
98. *Galeolaria australis*, Blainville[59] (1834, p. 139; Huxley, 1859, p. 38, Pl. iii, fig. 5).
99. *Galeolaria stephanomia*, Haeckel (= *Diphyes stephanomia*, Mertens[60], 1835, p. 32).

Genus 27. *Diphyes*, Cuvier (1817, p. 61).

100. *Diphyes acuminata*, Leuckart (1853. Pl. III, figs. 11–19, and 1854, Pl. xi, figs. 11–13).
101. *Diphyes sieboldii*, Kölliker[61] (1853, p. 36, Pl. xi).
102. *Diphyes subtilis*, Chun (1886. p. 681).
103. *Diphyes elongata*, Hyndman (1841, P. 166).
104. *Diphyes appendiculata*, Eschscholtz (1829, Pl. xii, fig. 7).
105. *Diphyes gracilis*, Haeckel (Morph. Siphon.).

52 Not mentioned by Haeckel (1888a) p. 34.
53 The reference should be to Gegenbaur, 1853, not 1854.
54 See delle Chiaje (1830-31).
55 Metschnikoff (1870).
56 Haeckel (1888b, p. 150) stated that "A fourth specie, *Lilyopsis catena*, similar to the latter [*L. rosea*], was observed by me in 1866 in the Canary Island *Lanzerote*, but not sufficiently examined.
57 In Haeckel (1888a, p. 35) Genus 26 is said to be *Epibulia* Eschscholtz (s.m.) (= *Galeolaria*, Blainville)
58 The reference should be to Gegenbaur, 1853, not 1854.
59 Name not mentioned by Haeckel (1888a, p. 35).
60 As noted by Bigelow (1911) this species was established by Brandt, based on an unpublished drawing by Mertens. However, the description is inadequate to characterise the species, which thus is treated as a *nomen nudum*.
61 Not mentioned by Haeckel (1888a) p. 35.

Genus 28. *Diphyopsis*, Haeckel (1888a, p. 35).

106. *Diphyopsis campanulifera*, Haeckel (= *Diphyes campanulifera*, Quoy & Gaimard, 1827, Pl. i, fig.7; [Eschscholtz][62], 1829, p. 137).
107. Diphyopsis compressa, Haeckel (Report, p. 153, Pls. XXXII, XXXIV).
108. *Diphyopsis dispar*, Haeckel (= *Diphyes dispar*, Chamisso & Eysenhardt, 1821, Pl. xxxiii, fig. 4).
109. *Diphyopsis angustata*, Haeckel[51] (= *Diphyes angustata*, Eschscholtz, 1829, p. 136, Pl. xii, fig. 6).

Subfamily ABYLIDÆ L. Agassiz (1862, p. 372).

Genus 29. *Abyla*, Quoy and Gaimard (1827, p. 11[63]).

110. *Abyla trigona*, Quoy and Gaimard[64] (1833, Pl. iv, figs. 11–17; best figure and description by Gegenbaur, 1859, Pls. xxvii, xxviii).
111. *Abyla carina*, Haeckel (Report, p. 156, Pl. XXXV, XXXVI).
112. *Abyla alata,* Haeckel (= *Abyla trigona* Huxley, 1859, Pl. iii, fig.2).
113. *Abyla leuckarti*, Huxley (1859. p. 9. Pl. iii, fig. 2).

Genus 30. *Bassia*, Quoy and Gaimard ("**3**", p. 451)[65].

114. *Bassia tetragona*, Haeckel (Morph. Siphon.).
115. *Bassia obeliscus,* Haeckel (Report, p. 160, Pls. XXXVII, XXXVIII).
116. *Bassia perforata*, L. Agassiz (1862, p. 372; = *Abyla perforata* Gegenbaur, 1859, Pl. xxx, figs. 20, 21).
117. *Bassia quadrilatera*, Quoy and Gaimard ("**3**"[66], p. 451 = *Abyla bassensis*, Huxley, 1859, p. 45, Pl. ii, fig. 1).

Genus 31. *Calpe*, Quoy and Gaimard (1827, p. 11).

118. *Calpe pentagona*, Quoy and Gaimard (1827, p. 11, Pl. ii A, figs. 1–7; = *Abyla pentagona*, Eschscholtz). Accurate description and figures by Kölliker (1853, Pl. x); Leuckart (1853, Pl. iii, figs. 1-10; 1854, Pl. xi, figs. 1-10); Gegenbaur (1859, Pl. xxix).
119. *Calpe gegenbauri*, Haeckel (Report, p. 164, Pls. XXXIX, XL)
120. *Calpe huxleyi*, Haeckel (= *Abyla pentagona*, Huxley, 1959, p. 40, Pl. ii, fig. 2).

Family VIII **Desmophyidæ**, Haeckel (1888a, p. 36).

Genus 32a. *Desmalia*, Haeckel (Report, p. 169).

121. *Desmalia imbricata* Haeckel[67] (Report. p. 169).

Genus 32b. *Desmophyes*, Haeckel (1888a, p. 36).

122. *Desmophyes annectens*, Haeckel (Report, p. 170, Pl. XXX).

Family IX. **Polyphyidæ** Chun (1882, p. 120).

62 Name omitted.

63 Actually p. 13.

64 In the text Haeckel (1888b, p. 156) noted that "The genus *Abyla* was founded by Quoy and Gaimard (1827 …) for the Mediterranean *Abyla trigona*, observed by them in the Strait of Gibraltar". So it is unclear why he cites here Quoy & Gaimard (1833) as the authority. He also comments here that the best illustrations are given by Gegenbaur (1859) Plates xxvii and xxviii but, in the text (p.156) he cited Gegenbaur's Plates i, ii. Actually Gegenbaur made no references, in his text, to Plate numbers, only to a consecutive series of figure numbers. However, these were arranged into 7 plates, numbered from 26 to 32, while the legends to them were numbered XXVII-XXXIII. It appears, according to the list of authors, that Pl. XXVI (26) should have appeared in the paper that preceded Gegenbaur's, but this was replaced by an unnumbered foldout. So the Plate, not the legend numbering is correct.

65 Quoy & Gaimard did not mention the generic name *Bassia* in any of their published papers and, indeed reference **3** refers to Lesson (1843), where the *species bassensis*, but not the genus, was dealt with. Otherwise, the reference is of no relevance. According to Bigelow (1911) the generic name must be attributed to L. Agassiz (1862, p. 372). See also footnote 44.

66 The name *Bassia quadrilatera* was first used by Blainville (1830, p. 125) who attributed it to Quoy & Gaimard (1827). However, according to Bigelow (1911, p. 229), as it was not described then the name becomes a *nomen nudum*.

67 Species included in genus *Desmophyes* by Haeckel (1888a, p. 36). The specimen decomposed before Haeckel (1888b) could sketch it. *Nomen nudum*.

Genus 33. *Hippopodius* Quoy and Gaimard (1827, p. 172).

123. *Hippopodius gleba*, Leuckart (1854, p. 299, Pl. xii, figs. 1–4).
124. *Hippopodius squamatus*, Haeckel[68] (Morph. Siphon.).
125. *Hippopodius cupola*, Haeckel[69] (Morph. Siphon.).

Genus 34. *Polyphyes*[70] Haeckel (1888a, p. 36).

126. *Polyphyes elephantopus* Haeckel (= *Hippopodius neopolitanus* Kölliker, 1853, p. 28, Pl. vi, figs. 1-5; = *Elephantopus neopolitanus*, Lesson, 1843, p. 473).
127. *Polyphyes ungulata* Haeckel (Report, p. 179, Pl. XXIX, figs.1-8).

Genus 35. *Vogtia* Kölliker (1853, p. 31).

128. *Vogtia pentacantha* Kölliker (1853, p. 31, Pl. viii).
129. *Vogtia spinosa* Keferstein & Ehlers (1861, p. 24, Pl. v, figs. 16, 17).
130. *Vogtia köllikeri* Haeckel[71] (Report, p. 182, Pl. XXIX, figs. 9–14).

Order **PHYSONECTÆ** Haeckel 1888.

Family X. **Circalidæ,** Haeckel (1888a, p. 38).

Genus 36. *Circalia*, Haeckel (1888a, p. 38).

131. *Circalia stephanoma* Haeckel (Report, p. 198, Pl. XXI, figs. 1–4).
132. *Circalia haplorhiza* Haeckel (= *Physophora alba*, Quoy & Gaimard, 1833, Pl. I, figs. 1–9; = *Haplorhiza alba*, L. Agassiz, 1862, p. 368).
133. *Circalia papillosa*, Haeckel (= *Agalma papillosum*, Fewkes, 1881, Pl. v, figs. 5, 6)[72].

Family XI. **Athoridæ**, Haeckel (1888a, p. 38).

Genus 37. *Athoria*, Haeckel (1888a, p. 39).

134. *Athoria larvalis*, Haeckel (Report, p. 202, Pl. XXI, figs. 5–8).
135. *Athoria bractealis*, Haeckel (Report, p. 201).

Genus 38. *Athoralia*,Haeckel, 1888.

136. *Athoralia coronula*, Haeckel[73] (Morph. Siphon.).

Family XII. **Apolemidæ**, Huxley (1859, p. 70).

Genus 39 *Dicymba*, Haeckel (1888a, p. 30).

137. *Dicyma diphyopsis*, Haeckel (Report, p. 210, Pl. XVII, figs. 1–7).

Genus 40a. *Apolemia*, Eschscholtz, (1829, p. 143).

138. *Apolemia uvaria*, Eschscholtz[74] (Kölliker, 1853, Pl. vi, figs. 6-9; Gegenbaur[17], 1854, p. 319, Pl. xviii, figs. 1–4; Leuckart, 1854, Pl. xii, figs. 8–11, etc.).

68 Species not mentioned in the text.
69 Haeckel (1888b) made no mention of this species in the text.
70 Haeckel (1888a) included only the species. *P. luteus* Kölliker, 1853 and *P. dissolutus* sp. nov.
71 Not mentioned in Haeckel (1888a).
72 Actually published in 1882.
73 No reference to a later description in the text.
74 Instead of referring to Eschscholtz (1829, p. 143, Pl. xiii, fig. 2) Haeckel referred to other papers with, presumably, better illustrations.

Genus 40b. *Apolemopsis*[75], Brandt (1835, p. 36)[76].

139. *Apolemopsis uviformis*, Haeckel (= *Stephanomia uviformis* Lesueur, in an unpublished plate, and Lesueur, 1813[77]; = *Apolemia lesueuria*, Lesson, 1843, p. 518).
140. *Apolemopsis dubia*, Brandt (1835, p. 36).

Family XIII. **Agalmidæ** Brandt, 1835.

Subfamily 1. CRYSTALLODINÆ Haeckel (1888a, p. 39).

Genus 41. *Stephanomia*, Péron & Lesueur, 1807[16].

141. *Stephanomia amphytridis*, Péron & Lesueur[16] (1807, pl. xxix, fig. 5; Huxley, 1859, p. 72, Pl. vi.).
142. *Stephanomia nereidum* Haeckel[78] (Morph. Siphon.).

Genus 42. *Crystallodes*, Haeckel (1869a, p. 43).

143. *Crystallodes rigida*, Haeckel (1869b, p. 43, Pls. vi–xiii).
144. *Crystallodes vitrea*, Haeckel (Report, p. 222, Pl. XVII).
145. *Crystallodes mertensii*, Haeckel (= *Agalma mertensii* Brandt, 1835, p. 34[79], figured by Mertens).
146. *Crystallodes plethosoma*, Haeckel (= *Plethosoma crystalloides* Lesson, 1830, Pl. iv, fig. 2).

Genus 43. *Phyllophysa*, L. Agassiz (1862, p. 369).

147. *Phyllophysa squamacea*, Haeckel[80] (Morph. Siphon.). (= *Stephanomia amphitrites* Huxley, 1859, Pl. vi).
148. *Phyllophysa foliacea*, L. Agassiz (= *Stephanomia foliacea* Quoy & Gaimard, 1833, Pl. iii, figs. 8-12).

Genus 44. *Agalma*, Eschscholtz (1825, p. 743; 1829, p. 150).

149. *Agalma okenii*, Eschscholtz (1829, Pl. xii, fig. 1; 1825, Pl. v, fig. 17).
150. *Agalma breve*, Huxley (1859, p. 75, Pl. vii).
151. *Agalma eschscholtzi*, Haeckel (Report, p. 226, Pl. XVIII, figs. 8–17).
152. *Agalma polygonata*, Haeckel (= *Crystallomia polygonata*, Dana, 1857, p. 459).
153. *Agalma clavata*, Leuckart (1853, Pl. xiii, figs.1–6).

Subfamily 2. ANTHEMODINÆ, Haeckel (1888a, p. 40).

Genus 45. *Anthemodes*, Haeckel (1888a, p. 40)[81].

154. *Anthemodes ordinata*, Haeckel (Report, p. 229. Pls. XIV, XV).
155. *Anthemodes articulata*, Haeckel[82] (Morph. Siphon.).

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75 Brandt (1835, p. 236) refers to the generic name *Apolemiopsis* , not *Apolemopsis*. Haeckel (1888a) does not include the genus. See also footnote 66.

76 Haeckel cites the reference for Brandt (1835) as "Prodromus descriptionis animalium ab H. Mertensio in orbis terrarium circumnavigatione observatorum, pp. 31-41". The version in the Biodiversity Heritage Library is entitled "Prodromus animalium ab H .Mertensio observatorum" and includes pp. 203-275. Perhaps the pages that Haeckel referred to were a summary of specific names.

77 Lesueur (1813) only mentioned a genus *Stephania*, possibly a misspelling of *Stephanomia*, but gave no description of it. Presumably Haeckel was referring to the figure of *Stephanomia uvaria* = *Apolemia uvaria* in Lesueur (?1815).

78 Haeckel (1888b) made no reference to a later description of this species.

79 P. 234 in the Biodiversity Heritage Library version.

80 In his "List of Families, Genera and Species" Haeckel (1888b, p. 366) apparently referred to *Phyllophysa squamacea* as a new species that would be described in his Morphology of the Siphonophorae, but actually he was giving a new specific name to the specimen that Huxley (1959) described at *Stephanomia Amphitridis*, not *S. amphitritis* as stated by Haeckel. This appears to be a singular example of Haeckel both moving a species into a new genus, but also changing its name. He made no reference in the text to a further description.

81 Haeckel (1888a, p. 40) also included *A. canariensis* Haeckel, 1869 in this genus, but in his *challenger* Report moved it into the genus *Cupulita*.

82 Haeckel (1888b, p. 229) made no reference in the text to a further description.

Genus 46. *Cuneolaria*[83], Chamisso & Eysenhardt (1821, p. 369).

156. *Cuneolaria incisa*, Chamisso & Eysenhardt[84] (1821, p. 393, Pl. xxxiii, fig. 5).
157. *Cuneolaria imbricata*, L. Agassiz (= *Stephanomia imbricata* Quoy & Gaimard, 1830, Pl. iii, figs. 13–15).

Genus 47a. *Halistemma*, Huxley (1859, p. 129).

158. *Halistemma rubrum*, Huxley (= *Agalma rubra*, Vogt, 1854, Pl. vii–xi).
159. *Halistemma punctatum*, L. Agassiz (1862, p. 369; = *Agalmopsis punctata* Kölliker, 1853, Pl. iv).

Genus 47b. *Cupulita*, Quoy and Gaimard (1824, p. 580).

160. *Cupulita bowdichii*, Quoy & Gaimard (1824, Pl. lxxxvii, figs. 14-16).
161. *Cupulita sarsii*, Haeckel (= *Agalmopsis elegans* Sars, *partim,*1846, Part I, Pl. v, not vi).
162. *Cupulita canariensis*, Haeckel (= *Anthemodes canariensis*, Haeckel1869b, p. 36, Pl. i).
163. *Cupulita cara*, Haeckel (= *Nanomia cara* A. Agassiz, 1865, p. 200).
164. *Cupulita fragilis*, Haeckel (= *Agalmopsis fragilis* Fewkes, 1881, Pl. v, fig.2, Pl. vi)[85].
165. *Cupulita picta*, Haeckel (= *Halistemma pictum* Metschnikoff, 1871, in an inaccessible Russian paper, Pl. ii[46]).
166. *Cupulita tergestina*, Haeckel (= *Halistemma tergestinum* Claus, 1878, Pls. i–v).

Genus 48. *Agalmopsis*, Sars (1846, part I, p. 32).

167. *Agalmopsis elegans*, Sars, *partim* (1846, part I, Pl. vi not v).
168. *Agalmopsis catena*, Haeckel (= *Agalma elegans* Fewkes, 1881, p. 163, Pls. ix, x). Ontogeny, Fewkes, 1885, p. 239, Pls. i-iv.
169. *Agalmopsis dissoluta*, Haeckel[86] (Morph. Siphon.).
170. *Agalmopsis sarsii*, Kölliker (1853, p. 10, Pl. iii).

Genus 49. *Lychnagalma*, Haeckel (1888, p. 40).

171. *Lychnagalma vesicularia*, Haeckel (Report, p. 235, Pl. XVI).
172. *Lychnagalma utricularia*, Haeckel (= *Agalmopsis utricularia*, Claus, 1879; = *Calliagalma utricularia*, Fewkes, 1880, p. 844[87]).

Family XIV. **Forskalidæ,** Haeckel (1888a, p. 42)[88].

Genus 50 *Strobolia*, Haeckel (1888a, p. 42)[89].

173. *Strobolia cupola*, Haeckel (Morph. Siphon.).
174. *Strobolia conifera*, Haeckel (Report, p. 243).

Genus 51. *Forskalia*, Kölliker (1853, p. 2)[90].

175. *Forskalia contorta*, Leuckart (= *Stephanomia* [*contorta*] Milne Edwards, 1841, Ps. vii–x).
176. *Forskalia edwardsii*, Kölliker (1853, p.2, Pl. i, ii).
177. *Forskalia tholoides*, Haeckel (Report, p. 244, Pls. VII-X).
178. *Forskalia atlantica*, Haeckel (= *Stephanomia atlantica*, Fewkes, 1881, Pl. v, fig.1).

83 Haeckel (1888a, p. 40) included *C. elegans* (= *Agalma elegans*, Fewkes) on this genus, but made no mention of *C. imbricata.*

84 Haeckel (1888b, p. 367) makes reference to only Eysenhardt.

85 Paper published in 1882. The species name was *Agalmopsis fragile*, not *fragilis*, and only figs. 16-17 & 23-25 on Plate VI refer to this species.

86 Haeckel (1888b, p. 234) made no reference in the text to a further description.

87 Footnote to p. 134, not 844.

88 Family 16 in Haeckel (1888a, p. 42).

89 Genus 55 in Haeckel (1888a, p.42).

90 Genus 56 in Haeckel (1888a, p.42).

Genus 52 *Forskaliopsis*, Haeckel (Report, p. 247)[91].

179. *Forskaliopsis ophiura*, Haeckel (= *Forskalia ophiura*, Leuckart, 1854, p. 351, Pl. xii, figs. 18–21).
180. *Forskaliopsis magnifica*, Haeckel[92] (Report, p. 248).

Genus 53. *Bathyphysa*, Studer (1878, p. 21)[93].

181. *Bathyphysa abyssorum*, Studer (1878 , p. 21, Pl. iii).
182. *Bathyphysa grandis*, Haeckel (= *Pterophysa grandis* Fewkes, 1884[94], p. 969).
183. *Bathyphysa* gigantea Haeckel (Morph. Siphon).

Family XV **Nectalidæ** (Haeckel 1888a, p. 41)[95].

Genus 54a. *Nectalia* Haeckel, 1888[96].

184. *Nectalia loligo* Haeckel (Report, p. 252, Pl. XIII).

Genus 54b. *Sphyrophysa* L. Agassiz (1862, p. 368)[97].

185. *Sphyrophysa intermedia* L. Agassiz (= *Physophora intermedia* Quoy & Gaimard, 1833, Pl. I, figs. 10–18).

Family XVI. **Discolabidæ**. Haeckel (1888a, p. 41) [98].

Genus 55. *Physophora,* Forsskål (1775, p. 119)[99].

186. *Physophora hydrostatica*, Forsskål (1775, p. 119; Claus, 1860, Pls. xxv–xxvii).
187. *Physophora philippii*, Kölliker[100] (1853, p. 19, Pl. v).
188. *Physophora magnifica*, Haeckel (1869a, p. 36, Pls. i–v).
189. *Physophora borealis*, Sars (1846, Part iii, Pls. v, vi).
190. *Physophora disticha*, Lesson (1830, Pl. xvi, fig. 3).
191. *Physophora myzonema*, Péron & Lesueur (1807, Pl. xxix, fig. 4)**[16]**.

Genus 56. *Discolabe*, Eschscholtz (1829, p. 155)[101].

192. *Discolabe mediterranea*, Eschscholtz = (*Physophora tetrasticha* Philippi, 1843, Pl. v.).
193. *Discolabe tetrasticha*, Haeckel[102] (Morph. Siphon.).
194. *Discolabe quadrigata* Haeckel (Report, p. 263, Pls. XIX, XX)[103].

Genus 57. *Stephanospira* Gegenbaur (1859, p. 67)[104].

195. *Stephanospira insignis*, Gegenbaur (1859, p. 67, figs. 53–56).
196. *Stephanospira corona*, Haeckel (Morph. Siphon.).

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91 Genus not mentioned in Haeckel (1888a).
92 Haeckel (1888b, p. 248) had a large specimen of this species "but unfortunately it was destroyed before I could examine it sufficiently."
93 Genus 57 in Haeckel (1888a, p. 42).
94 Actually published in 1886.
95 Family 14 in Haeckel (1888a, p. 41).
96 Genus 50 in Haeckel (1888a, p. 41).
97 Genus 51 in Haeckel (1888a, p. 41). He also included *S. brevis*, Agassiz (= *Agalma breve*, Huxley) in this genus, but returned it to the genus *Agalma* (see above) in his *Challenger* Report.
98 Haeckel (1888a, p. 41) states "Familie: Discolabidae, Hkl. (= *Physophoridae mult. aut.*)".
99 Genus 52 in Haeckel (1888a, p. 41.
100 Not mention in Haeckel (1888a). The species *P. philippii* and *P. disticha* do not appear to be mentioned in the text.
101 Genus 54 in Haeckel (1888a, p. 41).
102 Haeckel (1888b, p. 263) makes no mention of a deferred description of this species.
103 Species not mentioned by Haeckel (1888a, p. 41).
104 Genus 53 in Haeckel (1888a, p. 41). He included *S. myzonema* Péron in this genus but in 1888b placed it in the genus *Physophora*.

Family XVII. **Anthophysidæ,** Brandt (1835, p. 35)[105].
(*Athorybidae*, Huxley, 1859, pp. 71, 85).

Genus 58. *Rhodophysa*, Blainville (1834, p. 123).
197. *Rhodophysa corona*, Haeckel[106] (Report, p. 274).

Genus 59. *Melophysa*, Haeckel (1888a, p. 42).
198. *Melophysa melo*, Haeckel (= *Athorybia melo* [107] ? Quoy and Gaimard, 1833, Pl. ii, figs. 7–12).

Genus 60. *Athorybia*, Eschscholtz (1829, p. 153).
199. *Athorybia rosacea*, Eschscholtz ([Eschscholtz, 1829, p. 153][108] Kölliker, 1853, p. 24, Pl. vii).
200. *Athorybia heliantha*, Gegenbaur (1859, Pl. xxxi, figs. 43, 44).
201. *Athorybia ocellatus*, Haeckel (Report, p. 276, Pl. XI, Pl. XII, figs. 10–18).
202. *Athorybia indica*, Haeckel[109] (= *Athorybia rosacea* Huxley, 1859, p. 86, pl. ix).

Genus 61. *Anthophysa*, Mertens (in Brandt,1835, p.35).
203. *Anthophysa rosea*, Mertens ([in] Brandt, 1835, p. 35).
204. *Anthophysa formosa,* Haeckel (= *Athorybia formosa*, Fewkes, 1882, Pl. v, figs. 3, 4).
205. *Anthophysa darwinii*, Haeckel[110] (Report, p. 278, Pl. XII, figs, 7–9).

Order IV. **AURONECTÆ**, Haeckel (1888a, p. 43).

Family XVIII. **Stephalidæ**, Haeckel (1888, p. 43)[111].

Genus 62a. *Stephalia*, Haeckel (1888a, p. 43).
206. *Stephalia corona*, Haeckel (Report, p. 297, Pl. VII).

Genus 62b. Stephonalia, Haeckel (Report, p. 299)[112].
207. *Stephonalia bathyphysa*, Haeckel (Report, p. 299, Pl. VI).

Family XIX. **Rhodalidæ,** Haeckel (1888, p. 43).

Genus 63. *Auralia*, Haeckel (1888a, p. 43)[113].
208. *Auralia profunda*, Haeckel (Report, p. 301)[114].

105 Haeckel (1888b, p. 280) added a note to the section on the Anthophysidæ with regard to a recently described species *Plæophysa agassizii* Fewkes, 1888. Haeckel considered that it belonged to either the genus *Athorybia* or *Anthophysa*. It is very clear that the species in question is *Athorybia rosacea* (Forsskål, 1775).

106 Haeckel (1888b, p. 274) stated that this species was "in general very similar to the well-known Mediterranean *Athorybia rosacea* ... Each bract exhibited at the distal end a small rudiment of a nectosac, similar to that of *Athoria larvalis* ... Unfortunately the single specimen of this remarkable *Rhodophysa corona* was destroyed before I could make a representation of it. It requires further examination". An example of one of the many figments of Haeckel's imagination.

107 The original name for this species was *Rhizophysa melo* Quoy & Gaimard (1827, p. 180), as Haeckel (1888a, p. 42) cites. Quoy & Gaimard (1833, p. 65) referred to it as "*Stephanomia melo*", so Haeckel (1888b, p. 369) is somewhat strange.

108 Haeckel (1888b, p. 369) omitted the original reference to Eschscholtz, presumably preferring to quote a reference with an illustration of the species.

109 Not mentioned by Haeckel (1888a, p. 42).

110 No mention of this species in Haeckel (1888a).

111 Haeckel (1888a, p. 43) consider this family as "18A I. Subfamilie: **Stephalidae**, Hkl" within the family Rhodalidae.

112 Haeckel (1888a, p. 43) did not mention this genus or species.

113 Haeckel (1888a, p. 43) placed this genus in "18B II. Subfamile: **Auralidae**, Hkl." within the family Rhodalidae.

114 Haeckel (1888b, p. 301) referred the description of this species to his Morphology of the Siphonophoræ.

209. *Auralia globosa*, Haeckel (= *Angelopsis globosa* Fewkes, 1884[115], p. 972, Pl. x, figs. 4, 5).

Genus 64. *Rhodalia*, Haeckel (1888a, p. 43)[103].

210. *Rhodalia miranda*, Haeckel (Report, p. 302, Pls. I-V).

Order V. **CYSTONECTÆ,** Haeckel (1888a, p. 44).

Family XX. **Cystalidæ,** Haeckel (1888a, p. 44)[116].

Genus 65. *Cystalia*, Haeckel (1888a, p. 44).

211. *Cystalia monogastrica*, Haeckel (Report, p. 316, Pl. XXII, figs. 1-5).

212. *Cystalia challengeri*, Haeckel (Report, p. 314)[117].

Family XXI. **Rhizophysidæ,** Brandt (1835, p. 33)[118].

Subfamily 1. CANNOPHYSIDÆ, Haeckel (1888a, p. 44).

Genus 66. *Aurophysa*, Haeckel (1888a, p. 44).

213. *Aurophysa ordinata*, Haeckel [Morph. Siphon.][119].

214. *Aurophysa inermis*, Haeckel (= *Rhizophysa inermis* Studer, 1878, p. 13, Pl. i, figs. 3, 8, 9, 10).

Genus 67. *Cannophysa*, Haeckel (1888a, p. 41).

215. *Cannophysa murrayana*, Haeckel (Report, p. 324, Pl. XXIV).

216. *Cannophysa gracilis*, Haeckel (= *Rhizophysa gracilis*, Fewkes, 1881[62], p. 269, Pl. vi, figs. 1–6).

Subfamily 2. LINOPHYSIDÆ, Haeckel (1888a, p. 45).

Genus 68. *Linophysa*, Haeckel (1888a, p. 45).

217. *Linnophysa conifera* Haeckel(= *Rhizophysa conifera*, Studer, 1878, p. 4, Pl. i).

Genus 69. *Nectophysa,* Haeckel (1888a, p. 45).

218. *Nectophysa wyvillei*, Haeckel (Report, p. 327, Pl. XXIII).

219. *Nectophysa eysenhardtii*, Haeckel (= *Rhizophysa eysenhardtii*, Gegenbaur, 1859, p. 78, Pl. xxxi, figs. 46–49).

Genus 70. *Pneumophysa*, Haeckel (1888a, p. 45)[120].

220. *Pneumophysa gegenbauri*, Haeckel (Morph. Siphon.).

Genus 71. *Rhizophysa*, Péron & Lesueur (1807)[16].

221. *Rhizophysa filiformis*, Lamarck (= *Physophora filiformis*, Forsskål; Gegenbaur, 1854[17], p. 324, Pl. xviii, figs. 5-11).

222. *Rhizophysa planestoma*, Péron et Lesueur (1807, Pl. xxix, fig. 3)[16].

115 Actually Fewkes (1886).

116 Family 19 in Haeckel (1888a, p. 44).

117 Haeckel (1888b, p. 314) stated "During my residence in Ceylon I captured by the tow-net several times the elegant form, which I called in my System (1888a, p. 44*) Cystalia larvalis*. A very similar, and perhaps identical, form was found in a bottle of the Challenger collection, from Station 288 (centre of the Southern Pacific); I named it there *Cystalia challengeri*. A closer comparison of them makes it very probable that these two species are identical; the more significant name *Cystalia monogastrica* may, therefore, be retained for both". It is thus not clear why he retained it in his list of species.

118 Family 20 in Haeckel (1888a, p. 44).

119 Haeckel (1888b, pp. 323-324) made no reference to his Morphology of the Siphonophorae.

120 Haeckel (1888a, p. 45) included a second species, *Pneumophysa Mertensii* Hkl (= *Epibulia Mertensii*) Brandt, 1835, but Haeckel (1888b, p. 328) decided that the species would be better placed in the genus *Rhizophysa*.

223. *Rhizophysa mertensii*, Lesson (1843, p. 492; = *Epibulia mertensii*, Brandt, 1835, p. 33).

Family XXII. **Salacidæ,** Haeckel (1888a, p. 45)[121].

Genus 72. *Salacia*, Haeckel (1888a, p. 45).
224. *Salacia polygastrica*. Haeckel (Report, p. 331, Pl. XXV).
225. *Salacia uvaria*, Haeckel (= *Rhizophysa uvaria*, Fewkes, 1884[106], p. 967, Pl. x, fig. 6).

Family XXIII. **Epibulidæ**, Haeckel (Report, p. 332)[122].

Genus 73a. *Epibulia*, Eschscholtz (1829, p. 148; = *Arethusa* Haeckel, 1888a, p. 46).
226. *Epibulia ritteriana*, Haeckel (Report, p. 335, Pl. XXII, figs, 6-8).
227. *Epibulia chamissonis*, Eschscholtz (= *Rhizophysa chamissonis* Eysenhardt, 1821, Pl. xxxv, fig. 3).
228. *Epibulia erythrophysa*, Brandt (1835, p. 34), figured by Mertens.

Genus 73b. *Angela*, Lesson (1843, p. 496).
229. *Angela cytherea*, Lesson (1843, p. 496, Pl. ix, fig. 1).

Family XXIV. **Physalidæ,** Brandt (1835, p. 36).

Subfamily 1. ARETHUSIDÆ Haeckel (Report, p. 347)[123].

Genus 74a. *Alophota*, Brandt (1835, p. 37)[124].
230. *Alophota giltschiana* Haeckel (Report, p. 348, Pl. XXVI, figs. 1-3)[125].
231. *Alophota olfersii*, Brandt (1835, p. 37).
232. *Alophota mertensii* Haeckel (Morph. Siphon.)[126].

Genus 74b. *Arethusa*, Haeckel (Report, p. 349)[127].
233. *Arethusa challengeri*, Haeckel (Report, p. 349, Pl. XXVI, figs. 4–8).
234. *Arethusa thalia*, Haeckel (Morph. Siphon.)[128].

Subfamily 2. CARAVELLIDAE, Haeckel (Report, p. 347).

Genus 75a. *Physalia*, Lamarck (1816, Vol. ii, p. 480)[129].
235. *Physalia pelagica*, Bosc[130] ([1802, p. 166, Pl. 10] Eysenhardt, 1821, p. 45, Pl. xxxv, fig. 2).

121 Family 21 in Haeckel (1888a, p. 45).
122 Neither the family Epibulidae, nor its two genera, *Epibulia* and *Angela*, were mentioned in Haeckel (1888a).
123 Not mentioned in Haeckel (1888a).
124 Genus 74 in Haeckel (1888a, p.46).
125 *Alophota Giltschii*, Hkl in Haeckel (1888a, p. 46).
126 Species not mentioned by Haeckel (1888a, p. 46), while *Alophota Challengeri* Hkl is. The latter was moved into the genus *Arethusa* by Haeckel (1888b).
127 Haeckel (1888a. p. 46) does not refer to either of these *Arethusa* species, while mentioning three others, two of which, *A. erythrophysa* and *A. Chamissonis*. he later placed in the genus *Epibulia*, and the third, *A. brachysoma*, was a new species that seems to have vanished into thin air.
128 Haeckel (1888b, p. 349) considered that this species "is similar to *Alophota giltschiana*", so it is not clear why he included it in the genus *Arethusa*. He made no mention of a later description.
129 Genus 75 in Haeckel (1888a, p. 46), where *P. caravella*, *P. pelagica*, and *P. utriculus* are mentioned, but not *P. cornuta* or *P. megalista*
130 Haeckel (1888b, p. 372) attributed the species name *Physalia pelagica* to Bosc (1802), although he did not make full reference to that paper, preferring to mention Eysenhardt (1821). However, Bosc referred to the species *P. pelasgica*, and it was Lamarck (1801, p 356) who first appears to have used the name *P. pelagica*.

236. *Physalia cornuta*, Tilesius[131] (1813. p. 42, Pl. I, figs. 15, 16).
237. *Physalia utriculus*, Eschscholtz (1829, p. 163, Pl. xiv, figs. 2, 3).
238. *Physalia megalista*, Lamarck[132] (Péron & Lesue**ur, 1807[16], Pl. xxix, fi**g. 1), Mertens (?).

Genus 75b. *Caravella*, Haeckel (Report, p. 351)[133].

239. *Caravella gigantea*, Haeckel (= *Physalia cystisoma* Lesson, *partim*; = *Physalia gigantea*. Bory; Postels et Mertens, Icon.).
240. *Caravella maxima*, Haeckel (= *Physalia caravella*, Eschscholtz, 1829, Pl. xiv, fig.1; = *Physalia arethusa* Olfers, 1831[134], Pls. I, ii; L. Agassiz, 1862, Pl. xxxv).

131 Species not mentioned in Haeckel (1888a, p. 46)
132 Haeckel (1888a, p. 46) made no reference to this species. Haeckel (1888b, p. 372) referred to Lamarck (1816) as the authority for this species, but then refers to the plate and figure in, not Péron & Lesueur (1807), but Lesueur & Petit (1807,) where the first usage of the name occurred.
133 Not mentioned by Haeckel (1888a).
134 Actually Olfers (1832).

METAGENESIS CALYCONECTARUM.
[Haeckel (1888b) p. 102]

Synopsis of the alternation of generations in the genera of monogastric and polygastric Calyconectae (compare the descriptions of the individual genera and species in this Report).

I. Monogastric Generation.	II. Polygastric Generation.
Diplophysa inermis, Gegenbaur.	***Sphaeronectes gracilis*, Haeckel**.
***Diplophysa kollikeri*, Haeckel**.	*Sphaeronectes köllikeri*, Huxley.
? *Eudoxella didyma*, Haeckel.	? *Praya cymbiformis*, Leuckart.
? *Eudoxella galea*, Haeckel.	**? *Praya galea*, Haeckel.**
Cucubalus eschscholtzii, Huxley.	*Muggiæa kochii*, Chun.
Cucubalus pyramidaiis, Will.	*Muggiæa pyramidalis*, Busch.
? *Cucubalus cordiformis*, Quoy & Gaimard.	**? *Muggiæa chamissonis*, Haeckel.**
Cuboides vitreus, Quoy & Gaimard.	*Cymba enneagonum*, Eschscholtz.
***Cuboides crystallus*, Haeckel.**	***Cymba crystallus*, Haeckel.**
***Cuboides nacella*, Haeckel.**	*Cymba nacella*, Lesson.
***Cuboides vogtii*, Haeckel**.	***Cymba vogtii*, Haeckel.**
***Cucullus campanula*, Haeckel.**	*Diphyes acuminata*, Leuckart.
Cucullus gegenbauri, Haeckel (= *Eudoxia messanensis* Gegenbaur).	*Diphyes sieboldii*, Kölliker. (= *Diphyes gracilis*, Gegenbaur.).
***Cucullus subtilis*, Haeckel.**	*Diphyes subtilis*, Chun.
***? Cucullus elongatus*, Haeckel**.	? *Diphyes elongata*, Hyndman.
Cucullus lessoni, Lesson.	*Diphyes appendiculata*, Eschscholtz.
***Cucullus gracilis*, Haeckel.**	***Diphyes gracilis*, Haeckel.**
***Amphiroa trigona*, Haeckel.**	*Abyla trigona*, Quoy & Gaimard.
***Amphiroa carina*, Haeckel.**	***Abyla carina*, Haeckel.**
? *Amphiroa alata*, Huxley	**? *Abyla alata*, Haeckel.**
? *Amphiroa angulata*, Huxley.	? *Abyla leuckarti*, Huxley.
***Sphenoides tetragona*, Haeckel.**	***Bassia tetragona*, Haeckel.**
***Sphenoidesobeliscus* Haeckel.**	***Bassia obeliscus*, Haeckel**.
? *Sphenoides perforata*, Haeckel.	? *Bassia perforata*, L. Agassiz.
Sphenoides australis, Huxley.	*Bassia quadrilatera*, Quoy & Gaimard.
Aglaisma eschscholtzii, Huxley.	*Calpe pentagona*, Quoy & Gaimard.
***Aglaisma gegenbauri*, Haeckel**	***Calpe gegenbauri*, Haeckel.**
? *Agalisma elongata* Huxley.	**? *Calpe huxleyi*, Haeckel.**
? *Ersæa gaimardi*, Eschscholtz.	**? *Diphyopsis campanulifera*, Haeckel.**
***Ersæa compressa*, Haeckel**.	***Diphyopsis compressa*, Haeckel.**
***Ersæa dispar*, Haeckel.**	***Diphyopsis dispar*, Haeckel.**
? *Lilæa medusina*, Haeckel.	**? *Lilyopsis medusina*, Haeckel**