THE VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. XXVIII.
REPORT
ON THE
SCIENTIFIC RESULTS
OF THE
VOYAGE OF H.M.S. CHALLENGER
DURING THE YEARS 1873-76
UNDER THE COMMAND OF
CAPTAIN GEORGE S. NARES, R.N., F.R.S.
AND THE LATE
CAPTAIN FRANK TOURLE THOMSON, R.N.
PREPARED UNDER THE SUPERINTENDENCE OF
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AND NOW OF
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ONE OF THE NATURALISTS OF THE EXPEDITION

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CONTENTS.

Report on the Siphonophoræ collected by H.M.S. Challenger during the years 1873–1876.

By Ernst Haeckel, M.D., Ph.D., Hon. F.R.S.E., &c., Professor of Zoology in the University of Jena.

(The Manuscript was received in Instalments between 8th February and 5th July 1888.)
EDITORIAL NOTE.

During the voyage of the Challenger, species of Siphonophorae were continually under observation in the living condition, both on the surface of the ocean and in tanks on board the vessel; none of the naturalists, however, made any special study of this interesting and complicated group of animals; the specimens collected were merely preserved with as much care and skill as was possible in the circumstances.

Probably no class of marine organisms presents, in general, greater difficulties in the way of examination than the Siphonophorae, and these difficulties are increased many fold when the naturalist has to deal with collections preserved in alcohol and other media, which contract and distort the specimens. Indeed it was essential that any naturalist who would undertake a successful examination and interpretation of these varied forms should himself have investigated these organisms during many years in the living state.

Professor Haeckel, through his long-continued and elaborate investigations of living Siphonophorae and Medusae in the Mediterranean, Indian, and Atlantic Oceans, was in a very special manner fitted to undertake such a task, and it must be regarded as fortunate that he should have been willing to undertake the work on condition that some of his own unpublished observations should be incorporated.

This important and masterly Report has thus become a Monograph of the whole class, more complete than any hitherto published; the classifi-
cation has been reformed and placed on a new basis. The new order, Auronecte, discovered by the Challenger in the depths of the ocean, is particularly interesting to naturalists.

The Introduction, giving a general account of the morphology of the order, was translated from the German Manuscript by Mr. J. Arthur Thomson, M.A., F.R.S.E. All the remaining part of the Report was written by Professor Haeckel in the English language.

This Report on the Siphonophorae forms Part LXXVII. of the Zoological Series of Reports, and consists of 383 pages and 50 chromo-lithographic plates.

John Murray.
REPORT on the Siphonophore collected by H.M.S. Challenger during the Years 1873–76. By Ernst Haeckel, M.D., Ph.D., Hon. F.R.S.E., Professor of Zoology in the University of Jena.

PREFACE.

The Siphonophore collected by the Challenger during her cruise round the world were handed to me for investigation in 1879. The examination of this material, among which were to be found many new and remarkable types (especially abyssal forms), led me to recommence my study of the organisation and development of the whole class, which had been interrupted for more than ten years. During a residence of three months at Puerto del Arrecife, the harbour of Lanzarote in the Canary Islands, December 1866, January and February 1867, I had the opportunity of becoming acquainted with nearly all the typical forms of this most attractive group of animals. The facts which I then discovered regarding the curious, but till then little known, ontogenesis of these Acalephs, were embodied in a prize essay published by the Gesellschaft für Kunst und Wissenschaft in Utrecht.¹ I then intended to follow up this embryological memoir with a more extensive comparative anatomical one, or if possible a Monograph, in which also the systematic arrangement of the Siphonophorae should be subjected to a thorough revision, and the very intricate literature of this class critically elucidated. The completion of this scheme was, however, deferred owing to various external hindrances, and the rich material collected at Lanzarote remained for the most part unpublished.

¹ Zur Entwickelungsgeschichte der Siphonophoren, Utrecht, 1869, 14 plates.

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)
In the meantime I found many opportunities of continuing my researches into the Siphonophore during the numerous journeys which I undertook for the purpose of completing my System der Medusen, and to which I made some reference in 1879 in the preface to that monograph. I also collected much valuable material in the different museums which I visited for the same purpose. A further supply of specimens, and among them many new and instructive forms, were received from various travellers, and notably from Captain Heinrich Rabbe of Bremen. Lastly my journey to India furnished me with a long wished-for opportunity of becoming acquainted with the rich though little known Siphonophoral fauna of the Indian Ocean; on the journey out to Ceylon (via Bombay), on my return home (via Socotra), and especially in the expeditions which I made from Belligemma and Matura, I observed a number of new genera, some of which were exceedingly interesting (November 1881 to March 1882). At the same time I was able to extend my earlier observations upon the development and metamorphosis of the Siphonophore.

Valuable systematic contributions were also derived from the study of the excellent original drawings and the manuscripts of Mertens, of which Brandt gave a short account in 1835. I am highly indebted to Professor Alexander Strauch in St. Petersburg for the opportunity of examining these drawings which Mertens took in 1827 from living Siphonophore in the North Pacific, and which, unfortunately, have never been published; they are among the best and most life-like representations of the class that have ever been produced.

I take this opportunity of expressing my best thanks to those gentlemen who have assisted me in this investigation, especially to those travellers and directors of museums who have furnished me with material. By their aid I have been enabled to extend our knowledge of this group, and by the discovery of new morphological types to bring it to a certain degree of completeness. I am especially indebted to my honoured friend, Dr. John Murray, who with the greatest liberality offered to me all the Siphonophore collected by himself, and gave me permission to incorporate my own rich materials in this Monograph. My sincerest thanks are due also to the excellent artist, Mr. Adolph Gitsch, who, aided by his morphological interest and unwearying care, executed the chromo-lithographic Plates of this Report with such perfection, that they will give a complete idea of this most wonderful class of animals.
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREFACE</td>
<td>1</td>
</tr>
<tr>
<td>GENERAL INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>DESCRIPTION OF THE FAMILIES, GENERA, AND SPECIES</td>
<td>25</td>
</tr>
<tr>
<td><strong>Order I. Discneider</strong></td>
<td></td>
</tr>
<tr>
<td>Family I. Discalida</td>
<td>41</td>
</tr>
<tr>
<td>Family II. Porpidrei</td>
<td>51</td>
</tr>
<tr>
<td>Family III. Veledida</td>
<td>70</td>
</tr>
<tr>
<td><strong>Order II. Calyconectae</strong></td>
<td></td>
</tr>
<tr>
<td>Family IV. Eudoxide</td>
<td>103</td>
</tr>
<tr>
<td>Family V. Erseide</td>
<td>121</td>
</tr>
<tr>
<td>Family VI. Monophyide</td>
<td>125</td>
</tr>
<tr>
<td>Family VII. Diphyide</td>
<td>141</td>
</tr>
<tr>
<td>Family VIII. Desmoophyide</td>
<td>167</td>
</tr>
<tr>
<td>Family IX. Polyphyide</td>
<td>173</td>
</tr>
<tr>
<td><strong>Order III. Phystonekte</strong></td>
<td></td>
</tr>
<tr>
<td>Family X. Circalida</td>
<td>196</td>
</tr>
<tr>
<td>Family XI. Athoride</td>
<td>200</td>
</tr>
<tr>
<td>Family XII. Apolemide</td>
<td>204</td>
</tr>
<tr>
<td>Family XIII. Agalmide</td>
<td>213</td>
</tr>
<tr>
<td>Family XIV. Forskalida</td>
<td>236</td>
</tr>
<tr>
<td>Family XV. Neetalida</td>
<td>249</td>
</tr>
<tr>
<td>Family XVI. Discobalide</td>
<td>255</td>
</tr>
<tr>
<td>Family XVII. Anthophydide</td>
<td>268</td>
</tr>
<tr>
<td><strong>Order IV. Auronode</strong></td>
<td></td>
</tr>
<tr>
<td>Family XVIII. Stepalide</td>
<td>296</td>
</tr>
<tr>
<td>Family XIX. Rhodalide</td>
<td>300</td>
</tr>
<tr>
<td><strong>Order V. Cystonekte</strong></td>
<td></td>
</tr>
<tr>
<td>Family XX. Cystalida</td>
<td>314</td>
</tr>
<tr>
<td>Family XXI. Rhisophyide</td>
<td>317</td>
</tr>
<tr>
<td>Family XXII. Saleide</td>
<td>329</td>
</tr>
<tr>
<td>Family XXIII. Epibalide</td>
<td>332</td>
</tr>
<tr>
<td>Family XXIV. Phosalide</td>
<td>338</td>
</tr>
<tr>
<td><strong>BIBLIOGRAPHY OF THE SIPHONOPHORES</strong></td>
<td>353</td>
</tr>
<tr>
<td><strong>LIST OF FAMILIES, GENERA, AND SPECIES</strong></td>
<td>357</td>
</tr>
<tr>
<td><strong>GLOSSARY</strong></td>
<td>373</td>
</tr>
<tr>
<td><strong>STATISTICAL SYNOPSIS</strong></td>
<td>380</td>
</tr>
</tbody>
</table>
THEORIES AS TO THE ORGANISATION OF SIPHONOPHORÆ.

The morphological and physiological peculiarities which distinguish the Siphonophore from other Acalephæ have led, as every zoologist is aware, to very diverse theories as to the real nature and import of their organisation. Two essentially different interpretations still stand in marked antithesis to one another, and these may for the sake of brevity be described as the Poly-organ and Poly-person theories. Of these the poly-organ theory is the older (Eschscholtz 1829, Huxley 1859, P. E. Müller 1871, Metschnikoff 1874). According to this view the adult organism of all Siphonophoræ is a simple "Medusa-like animal," which is distinguished from the typical Medusæ only in the multiplication and differentiation of its polymorphic organs. More accurately defined, the organism remains an individual Hydromedusoid person (a morphon of the third grade, or a "morphological individual of the third order of individuality").

In contrast to this older interpretation is the poly-person theory (Vogt 1848, Leuckart 1851, Kölliker 1853, Gegenbaur 1854, Claus 1863, Chun 1882). According to this view the adult Siphonophoral organism is a colony of animals, composed of many polyp-like individuals, which, according to the laws of the division of labour, have to undergo various modifications, both in the way of specialisation and retrogression. More accurately expressed, it is a "swimming Hydropolyp stock or corm," composed of many polymorphic persons, partly polypoid, partly medusoid (a morphon of the fourth grade, or a "morphological individual of the fourth order of individuality").

Since in the course of the last two decennia the ontogeny of Siphonophoræ has become better known, and since the latter has in the light of the theory of descent been interpreted in causal relation to phylogeny, the main antithesis between the two theories has become more marked. According to the poly-organ theory the ontogenetic primitive form of the Siphonophore is a simple Hydromedusoid person, and with this is involved the phylogenetic corollary that the whole class originally arose from Medusæ. According to the poly-person theory, on the other hand, the ontogenetic primitive form is a swimming Hydropolyp stock, and with this is associated the phylogenetic corollary that the whole class sprang from Polyps.

(Zool. Chall. Exp.—Part LXXVII.—1888.)
According to the present opinion of most zoologists, which we also share, the low sessile Hydropolyp form is the more primitive; the higher Hydromedusa form has been secondarily developed at a much later stage, and that by adaptation to a free-swimming mode of life. In this way has the characteristic swimming organ of the Meduse arisen, namely, the umbrella, with its radially constructed gelatinous disc, which was entirely absent in the primitive ancestral forms—the Polyps. The most important structure of the latter, however, the gastral tube (inherited from the Gastræa), has been transmitted to the Meduse, and has become the “manubrium,” in the wall of which the generative products are developed.

If we apply this fundamental and firmly based conclusion to the two theories of Siphonophore organisation, the following is evidently the antithesis in regard to the question of origin. According to the poly-organ theory the primitive form of Siphonophoræ was a simple Medusa and already possessed an umbrella; from this established swimming organ the various locomotor organs of the Siphonophore (swimming-bells and air-chambers) are derived by multiplication and modification. According to the poly-person theory, on the other hand, the primitive form of the Siphonophore was a Hydropolyp colony, and possessed no umbrella; the locomotor organs which are present are therefore new structures, not to be derived from any pre-existing swimming organ of the primitive form. And this leads to a weighty contrast in regard to the Medusiform larve, which arise directly from the gastrula of Siphonophore. According to the poly-organ theory, such a larva possesses essentially the morphological value of a simple Medusoid person, and as the hereditary repetition of the original primitive form has the greatest palingenetic importance. According to the poly-person theory, on the contrary, it possesses no such importance; it is merely of subordinate kenogenetic value, and is to be regarded as a peculiarly modified Hydroid polyp.

Both these opposing theories have been for forty years supported with much acuteness by distinguished zoologists, but yet without decisive conclusion; both are in fact partially justified; both contain a mixture of truth and error. According to my own opinion, which is based on an extensive comparative investigation of the entire class, and on numerous new facts discovered in the process, the truth lies midway between the two interpretations. The poly-organ theory is right in starting in its whole interpretation and rationale of the Siphonophore from a Hydromedusoid type, in regarding the primary medusiform larva as palingenetic, and further in supposing an extensive multiplication and dislocation of the several Medusa organs. It is wrong, however, in attributing to the fully developed Siphonophoral corm the value only of a person, and in regarding the persons which compose the stock purely as organs in the morphological sense. The poly-person theory, on the other hand, is right in explaining the fully developed Siphonophore as a corm (colony or stock), composed of many poly-morphic persons. It goes, however, much too far, and is in error when it seeks to
attribute to the several (morphological) organs of these persons the same individual value (e.g., to the single protective bracts and capturing filaments); is furthermore wrong in denying an extensive secondary multiplication and dislocation of these organs; and finally is especially at fault in regarding the primary medusoid larva as a merely *kenogenetic* embryonic form, and, by ignoring the palingenetic value of the latter, in interpreting the Siphonophore as “swimming Hydropolyp colonies” comparable to Hydraactinia.

**MEDUSOME THEORY.**

The new theory of the organisation of Siphonophore to which I have been led by my investigations on their comparative anatomy and ontogeny may be briefly designated as the *Medusome Theory*. It seeks to incorporate the elements of truth in the two views above described, but to avoid their errors. The principal positions of this restatement may be briefly resumed:

1. The primary larva, which arises directly from the gastrula of the Siphonophore, is always a simple Medusa; it may be more or less kenogenetically modified, but always retains a predominant palingenetic import, and is explained by the immediate derivation of the Siphonophore from Hydromedusa.

2. The primary medusiform larva of the Siphonophore appears in two essentially distinct forms, as a *Disconula* and a *Siphonula*, and since this distinction is associated with essential differences in the resulting Siphonophoral colonies, the class may be legitimately divided into two legions or subclasses,—Disconanths and Siphonanths.

3. The first legion, or Disconanths, including the single order Chondrophoridae or Porpitariae, develops from a regular and octoradial Medusoid larva (*Disconula*), retains the original corona of marginal tentacles throughout life, and produces the persons of the colony by annual budding from the subumbrella.

4. The second legion, or Siphonanths, on the other hand, includes all the other Siphonophore (Calyeophoridae, Physophoridae, Pneumatophoridae, Aurophoridae); its primary larva is a bilateral Medusa (*Siphonula*), which is distinguished by a ventral umbrellar cleft and by the possession of a single tentacle; it forms the persons of the colony by one-sided linear budding from the stomach-wall or manubrium.

5. The primary larva of the Disconanths (*Disconula*) is to be regarded as the ontogenetic recapitulation of a common primitive octoradial ancestor (*Archeimeda*), and its phylogenetic origin is probably to be sought among the Trachomedusa (Trachynemide, Pectyllidae).

6. The primary larva of the Siphonanths (*Siphonula*) is to be regarded as the ontogenetic recapitulation of a common primitive bilateral ancestor (*Protomeda*), and its origin is probably to be sought among the Anthomedusa (Codonide, Euphyside).
7. All the parts which arise by budding from the primary larva of the Siphonophorae are either medusiform persons or special organs of the same.

8. All organs which belong originally to one medusoid person are included in the definition of a Medusome, whether they bud out from a common basis on the stem, or arise in different positions, in consequence of kenogenetic migration or dislocation; the multiplication of individual equivalent portions (e.g., nectophores, bracts, palpons) which often occurs secondarily is simply to be regarded as a multiplication of organs, not of persons or medusomes.

9. The medusomes appear on the Siphonophoral colony in two distinct main forms, which cannot however be sharply distinguished—in the palingenetic medusomes the principal organs have remained more or less in their original connection (e.g., in the gonophores of Eudoxia); in the kenogenetic medusomes, on the other hand, the principal organs are more or less dislocated, e.g., in the sterile medusome of Eudoxia, which consists of a protective piece (umbrella) and a gastric tube (siphon) with a tentacle.

10. The lateral budding of the secondary medusomes (appendages) on the Siphonophoral stem occurs sometimes singly and sometimes in groups. Those groups which consist of several medusomes we call "cormidia."

11. The cormidia are originally simple segmental repetitions of a medusome-group in metameric succession separated by free internodes (cormidia ordinata), e.g., the Eudoxia of the Calycophoridae, the Prodoxia of the Physophoridae (Apolemia, &c.).

12. By the breaking up of such original cormidia, those centralised corms arise in which the persons bud in a scattered fashion over the stem, their several organs thus becoming separate from one another (cormidia dissoluta), e.g., Agalmopsis, Rhizophysa.

13. The degeneration of the single medusomes and of the disassociated organs is of the greatest importance in the development of the Siphonophoral colonies, and that the more, the more markedly the corm is centralised and the more intimate the mutual relations between the polymorphic medusomes.

DISCONULA LARVA OF THE DISCONANTHÆ.

Among the different medusiform larvae of Disconanthæ (Chondrophoridae or Porpitariae) which I was able to observe, the youngest larva of Porpitidæ (from 0·1 to 0·4 mm. in diameter) are of special importance. They possess a circular, flatly arched disc, the margin of which bears a circle of eight simple tentacles. From the middle point of the subumbrella hang a large central gastric tube, and from the base of this siphon arise at equal distances eight radial canals, which run in the concave subumbrella to the margin of the disc, and are there united in a circular canal. Above this there lies in the middle of the gelatinous disc a pneumatophore, composed of a central lens-shaped air-flask and a circle of eight radial air-chambers surrounding the same. Both
REPORT ON THE SIPHONOPHORÆ.

the former and each of the latter possess on the middle of their upper surface an external aperture (the stigma of the exumbrella). Only in the possession of this hydrostatic apparatus is this Disconula distinguished from an ordinary eight-rayed entirely regular Hydromedusa. Certain Trachomedusæ (Trachynemidæ, Pectyllidæ) present a most striking resemblance. Even in another further advanced larval stage, which we may call a Porpula, the regular structure of a simple Craspedote person is still retained. The Porpula is distinguished from the Disconula in this, that the number of marginal tentacles has increased from eight to sixteen, and several concentric annular air-chambers are opposed to the primary circle of eight. In a still later stage the number of concentric air-chambers is greatly increased, and the tentacles form several rows at the margin of the umbrella. Then between the margin of the umbrella and the central siphon, eight or sixteen conical buds grow out from the subumbrella—the subsequent bearers of the gonophores. They remain closed in the monogastric Discalidæ, but acquire a mouth opening in the polygastric Porpitidæ and Velellidæ. The youngest larvae of the Velellidæ are hardly to be distinguished from those of the Porpitidæ; the difference between them only becomes distinct when in the former the vertical skin-fold of the exumbrella begins to be developed (Rutaría), in the base of which is formed the diagonal crest of the pneumatophore which determines the amphithec ground-form of the Velellidæ. Their youngest larvae, however, are as octoradial as those of the regular Porpitidæ. At an early stage they are distinguished by this, that in the Porpitidæ each of the eight radial air-chambers forms a stigma, in the Velellidæ only two lying obliquely opposed. The resemblance between these larvae and the Pectyllidæ suggests that the Disconanths have been originally developed from this group of Craspedotæ. If the eight sac-shaped gonads, hanging down from the subumbrella of the Pectyllidæ, were not themselves reproductive organs, but medusoid gonophores, and if above these in the gelatinous substance of the disc, a glandular depression or exumbrellar invagination led to the constriction of an air-sac, then from a Pectyllid or Trachynemid there would be derived a very simple Discalid.

SIPHONULA LARVA OF THE SIPHONANTHÆ.

Entirely different from the first stage in the development of the Disconanthæ, is that of the second legion—the Siphonanthæ (Calycophoridae, Physophoridae, Pneumatophoridae, Aurophoridae). Different as are the Siphonophore of this manifold legion in their fully developed form, their primary larval forms are very similar, at least so far as their ontogenetic history is yet known. The Siphonula—or the primary medusiform larva—is in this legion from the first not octoradial and regular, but bilaterally symmetrical. The original circle of tentacles on the umbrullar margin has disappeared; in all cases only a single capturing filament (Fangfaden) persists, the primary unilateral
larval tentacle, which in consequence of the ventral umbrellar eleft has been shifted centripetally to the base of the gastric tube. The primary umbrella itself (Protoecodon) has in consequence of this unilateral development become bilateral; it develops in the Calyconeetæ (or Calyeophoridae) into the primary swimming-bell, in the other three orders (Physoneetæ, Cystoneetæ, and Auroneetæ) into the pneumatophore. The “swimming-bladder” arises here again as a gland-like invagination of the ectoderm, not however centrally in the apex of the exumbrella (as in the Porpitariæ), but in an eccentric position. The primary siphon (Protosiphon) persists in the monogastric Siphonanths as a single stomaehic tube; while in the polygastric forms it develops into the stem from which all the other persons of the colony proceed by lateral budding. The whole structure of the Siphonauthæ, as well as that of their Siphonula larve, suggests the closest relationship with the Anthomeduseæ, and especially with the family of Codonidae. Only in these Anthomeduseæ do the reproductive elements develop in the entire gastric wall (as in the manubrium of the gonophores in all the Siphonanths), without hint of radial divisions. Among the Codonidae, however, the subfamily Euphyseidae (particularly Hybocodon and Amphicodon) is of especial importance. Here only do three of the four primary tentacles of the umbrellar margin disappear, and one alone remains to attain a proportionately greater development. In this way the bilateral modification of the umbrella is determined. This origin of the Siphonauthæ is also corroborated by the marked tendency of many Anthomeduseæ to form Meduseæ by direct budding from the gastric tube (Codonium gemmiferum, Sarsia siphonophora, &c.). Since these Euphyseidae develop from Tubularian polyps of the genus Corymorphæ, the latter are probably to be regarded as the older ancestral forms of the Siphonanths.

CORM AND CORMIDIA.

All Siphonophoreæ are pre-eminently characterised by the development of a stock (corm or colony), that is to say, of an individual organism which is composed of several polymorphic persons (zooids or “individuals proper”). The laws and modifications of this compositeness or colony-formation have been as yet but slightly investigated, though they are undoubtedly very interesting and important. I distinguish in the first place simple and multiple colonies. The simple colony (Cormus simplex) consists of a single centralised group of persons, as in all Disconanthæ and in the monogastric Siphonanths. The compound or multiple stock, on the other hand (Cormus compositus), is formed from the union of several individualised groups of persons, or “groups of individuals scattered upon the stem”—the Cormidia. Such colonies are represented by the polygastric Siphonanths. Each cormidium usually represents, in its general composition of several polymorphic persons, a simple stock, and is in most cases monogastric. There are, however, polygastric cormidia, e.g., Apolemia, Salacia, Physalia. In all
polygastric Siphonanthae the cormidia are lateral, originally metameric branches of a
segmented trunk or jointed stem. This appears, however, in very varied form, as the
cormidia occur in distinct order or irregularly scattered and dissolved.

ORDINATE CORMIDIA.

In most polygastric Siphonanthae (and therefore in the great majority of now existing
genera of Siphonophorae) 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 Phylonectae
(Apolemidae, many Agalmidae) and of the Cystoneetcæ (Salacidae, many Rhizophysidae).
Not unfrequently 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 *Siphonophorae articulata* in contrast to the others or *Siphonophorae inarticulata*. 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 com-
pressed spiral row, as in the Discolabidae and Rhodalidae. In others, and often in nearly
related forms, the regular arrangement disappears, and gradually passes into the scattered
disposition of *Cormidia dissolata*.

DISSOLVED CORMIDIA.

While in the majority of polygastric Siphonanthae 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 *Polyphyses* among the Calyconectae, in *Linophysa, Nectophysa, Rhizophysa*, among the Cystoneetcæ, and in many Agalmidae among the Physonectae. 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
Agalmidae and Forskalidæ. Finally the ordinate arrangement is quite lost, and the
entire stem exhibits hundreds or thousands of different appendages (siphons, palpons,
gonophores, bracts, &c.) in irregular grouping, so that it is impossible to distinguish
the various connected components of the broken up cormidia (Physalia, Agalmopsis, and other Agalmidae). This appearance is of the greatest interest, because, within one and the same family (e.g., Agalmidae, Rhizophysidae), 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.

DISLOCATION AND MULTIPLICATION OF ORGANS.

If our medusome theory is correct, the title of real persons (or "individuals proper") is only to be applied to those portions of the Siphonophoral stock which have originally the morphological value of a medusome-person, and not to those portions which were originally only organs of such a person. If this be so, it is necessary to assume in many cases a far-reaching dislocation and multiplication of the parts which were originally organs of a medusome. This assumption is directly supported by the fact that the replacement of primary organs by equivalent secondary structures does to a very large extent take place. As such vicarious organs (reserve or replacement organs, "Ersatz-organe"), I interpret, for instance, the numerous swimming-bells and covering bracts of many Physonectæ, the successive heteromorphic swimming-bells of the Calyconectæ, the groups of palpons in many Physonectæ. On the other hand, in such an instance as the clustered groups of reproductive members, each separate "gonophore" is to be interpreted as a medusoid person which has lost mouth-opening and tentacles. The morphology and "sociology" of the Siphonophore must take much more account than heretofore of these important tectological distinctions, and the rank of individuality must be more strictly defined.

MONOGASTRIC AND POLYGASTRIC CORMIDIA.

The ordinate cormidia contain usually only a single siphon, more rarely two or more. The most important forms of monogastric cormidia (with a single siphon) are the following:—

1. The Eudoxome of the Calyconectæ (often becoming free as a "Eudoxia"), in which each cormidium consists of two persons, one sterile (siphon with tentacle and covering bract) and one fertile—the gonophore (often with accessory gonophores).

2. The Ersxome of the Calyconectæ (often becoming free as an "Ersxæ"), in which each cormidium consists of three persons, having a medusoid "special swimming-bell" added to the two persons above mentioned in the eudoxome.

3. The Rhodalome of some Rhodalidae, of Hippopodius, Vogtia, Aurophysa, Canno-
physa, Arethusa, &c., in which each cormidium consists of a siphon with a tentacle and of one or more gonophores.

4. The Athorome of Physophora and of the Anthophysidae, in which each cormidium consists of a siphon with a tentacle, one or more palpons, and one or more gonophores.

5. The Crystallome of Crystallodes, Anthemodes and other ordinate Physoneectae, in which each cormidium consists of a siphon with a tentacle, one or more palpons, one or more gonophores, and a group of bracts.

Much rarer and much less manifold are the ordinate polygastric cormidia, in which each group of persons contains several siphons (each with a tentacle); such occur in Apolemia among the Physoneectae, and in Salacia among the Cystoneectae. The line of the stem, in which the cormidia originally bud forth in uniform succession, is the ventral median line of the protosiphon; usually it is rolled up in a wide or narrow spiral, rarely it remains straight (Crystallodes, Stephanomia).

STEM or TRUNK.

(Cenosome, Cenosarc, Axial Body.)

The stem of the Siphonophore, or the central axial body, on which all the various persons and organs of the corm are attached, is generally compared to the stem of a Hydromedusa stock. This comparison is in our opinion in the accurate sense illegitimate; for in the latter the primary larval body from which the corm develops is a Polyp-person, while in the former it is a Medusa-person. The comparison holds so far, however, inasmuch as the trunk is branched in both cases. It is not logical to describe the stem of the Siphonophore as "unbranched" as is generally done. In reality it is always branched, for all the appendages—whether they be interpretable as persons or as organs—arise as lateral branches of the axial body. Only the forking or dichotomous ramification is here absent. Further, the conventional description which is generally given of the stem or axial body of the Siphonophore is strictly applicable only to one legion of the class—to the Siphonanthes. For it is here only that the stem (whether it be long or short) is formed from the primary siphon, and has all its appendages (or branches) budded off in a row from its ventral median line. That they are subsequently often radially disposed depends wholly upon a secondary spiral twisting of the stem, and displacement of its appendages. It is quite different in the second legion, the Disconanthae. Here the proper stem, i.e., the common central portion of the corm, is formed from the primary umbrella, and all its appendages (or branches) bud out from its lower or subumbrellar surface, not in one row, but in concentric circles or rings, which are originally octoradial. On the other hand the primary siphon in this legion has only the value of a central nutritive organ.

(Zool. Chall. Exp.—Part LXXVII.—1888.)
NECTOSOME AND SIPHOSOME.

In all Siphonophore, without exception, both in the monogastric and polygastric forms, the developed stem may be distinguished, both from a morphological and from a physiological point of view, into two main portions, the nectosome and siphosome. The nectosome or the swimming body forms in the Siphonophore which swim quietly on the surface of the sea, the upper, anterior or proximal portion of the stem; the siphosome or nutritive body the lower, posterior or distal portion. Physiologically the former is the organ of locomotion (and often also of respiration), the latter, on the other hand, the organ of nutrition and reproduction. If one compares the Siphonophoral stem with the simple medusoid person, then the nectosome in general represents the umbrella, and the siphosome of the stem the manubrium of the Medusa. In the polygastric Siphonanths the two portions pass through an independent course of development, separated from one another, with distinct points of growth. In those Siphonanths where the stem is spirally coiled, the spiral twisting is usually opposite in the two portions; the nectosome has usually a left-handed ("Lambda"), the siphosome a right-handed ("Delta"), spiral.

NECTOSOMES OF THE FIVE ORDERS.

The swimming apparatus of the Siphonophore is formed of two essentially different organs, the swimming-bell (nectophore) and the swimming-bladder (pneumatophore). The nectophore is the umbrella of a Hydromedusa, in which both the annular muscular layer of the velum and of the subumbrella, and the primary canal-system (four radial canals united by a marginal circular canal) are perfectly developed. The pneumatophore, on the other hand, is an invaginated and much modified umbrella, in the surface of which (by apical or lateral invagination of a gas-gland) a chitinous gas-filled "air-flask" or pneumatocyst is formed. The definition of the five Siphonophoral orders is in the first place determined by the different formation of the swimming apparatus.

I. The Calycometæ or Calycophoridæ possess only one, two, or more swimming-bells, but no pneumatophore.

II. The Cystometæ or Pneumatophoridæ bear only a simple large pneumatophore, but no swimming-bells.

III. The Disconometæ or Chondrophoridæ possess an octoradial pneumatophore, usually composed of concentric annular chambers, but no swimming-bells.

IV. The Physometæ or Phsyophoridæ bear on the apex of the stem a simple pneumatophore, and under that a biserial or multiserial column of swimming-bells; sometimes instead of these a corona of numerous bracts.

V. The Auronectæ or Aurophoridæ (a new and hitherto quite unknown group of very remarkable deep-sea forms) possess on the apex of the stem a colossal pneumatopho-
phore, and underneath that a (simple or multiple) horizontal corona of swimming-bells, and in the middle of the latter (in the dorsal median line of the nectosome, opposite the ventral row of buds) a large aurophore, a new, hitherto unknown organ, which is to be regarded as a swimming-bell modified into a large gas-gland.

NECTOPHORES or SWIMMING-BELLS.

(Nectocalyces, Nectozooiids, Schwimmglocken, Schwimmhöhlenstücke.)

The swimming-bells generally exhibit so clearly the structure of the umbrella of a simple hydromedusa person, that there can be no doubt as to their morphological import as the locomotive organ of such a person—in the sense of the poly-organ theory. The cavity of the gelatinous disc is clad throughout by the circular muscle layer of the subumbrella, and its distal margin protrudes in the form of a true velum, at the base of which runs the circular canal which unites the four radials. The poly-person theory interprets these facts, however, in this way, that each swimming-bell is to be regarded as a medusoid person or "locomotive zooid," in which the locomotor umbrella is well developed, but the nutritive manubrium degenerated. To this the medusome theory has to reply that such a phylogenetic interpretation is not corroborated by the known ontogenetic facts. The protocodon, or the "primary swimming-bell" of the Siphonula is only an organ of this medusoid person. It does not remain as such in most (if not all) of the Calyconectae, but becomes thrown off, and replaced by metacodons or heteromorphic "secondary swimming-bells." In the monogastric Calyconectae the protocodon is modified into the covering bract of the Eudoxia, while in the Physonectae, Cystonectae, and Auronectae it becomes the pneumatophore. The numerous metacodons, which in the Physonectae and Auronectae, as well as in the Polyphyidae, form the two-tiered, many-tiered, or radially disposed swimming column, are either displaced umbrellas of medusomes, which are repeated metamerically in the several cormidia, or are simply vicariae or "reserve bells" ("Ersatzglocken") which arise by the multiplication of such umbrellas, and are often present in great numbers.

PNEUMATOPHORE or SWIMMING-BLADDER.

(Air-Chamber, Luftkammer, Schwimmblase.)

The hydrostatic organ of the Siphonophore, which is known as pneumatophore, is only absent in one order, that of the Calyconectae. In the other Siphonophora it is generally present and that in two different forms; the Physonectae, Cystonectae, and Auronectae possess a simple swimming-bladder at the superior or apical pole of the stem;
the Disconectæ, on the other hand, have a complicated apparatus, composed of concentric annular chambers, which occupy the greater portion of the umbrella. In all cases the pneumatophore arises very early in the primary medusoid larva, and that by a gland-like invagination of the exoderm of the exumbrella. In the bilateral Siphonula of the Siphonanthæ this invagination has an excentric position (being often shifted down near to the umbrellar margin), but in the octoradial Disconula of the Disconanths it is central, in the very apical pole. The marked and apparently considerable differences of the developing pneumatophore, in relations both of time and space, between different (often nearly related) Physonectæ, I simply explain as secondary cenogenetic modifications. That portion of the medusoid larval body on which the first trace of it appears always belongs originally to the exumbrella.

In the Siphonanthæ the invaginated portion of the exumbrella, comparable to a simple, pouch-like, glandular sac, is known as the air-sac (pneumatosaccus); it secretes in its superior or apical half a chitinous membrane, the air-flask (pneumatocyistis), while its inferior or distal portion (the "air-funnel") discharges the function of a gas-gland (pneumadenia). The glandular (usually yellowish or greenish) epithelium of this last portion secretes the air, which passes by the basal opening of the air-flask ("funnel aperture," "Trichterpforte," or pneumatopyle) into the latter. The Cystonectæ or Pneumatorhizæ possess at the apical pole of the pneumatocyst an external air-hole or stigma (the primary opening of invagination), by which the air may be discharged at will. In many Siphonanths the air-secreting glandular epithelium of the air-funnel (or infundibulum) grows through the aperture into the basal half of the pneumatocyst and clothes the latter as endocystal tapetum, or "secondary ectoderm" (Chun).

In most Siphonanthæ the air-sac becomes subsequently united with the peripheral (uninvaginated) portion of the primary umbrella—the pneumatocodon—by a number of vertical radial septa, usually eight, more rarely four or sixteen, and occasionally a variable number. The radial pockets between these septa open inferiorly into the central canal of the stem and represent the radial canals of a simple medusoid umbrella. On this is based the opinion that the entire air-chamber is to be regarded as an "invaginated swimming-bell" (Metschnikoff 1874). In contrast to this the air-chamber is at present regarded by most zoologists as an independent medusoid person (or "medusiform zooid"), and is supposed to originate as a "bud" from the primary larva (Leuckart 1875, Claus 1878, Chun 1887). The antithesis between these two opinions culminates in the interpretation of the air-sac, which according to the first theory is the exumbrella of a medusoid disc, according to the second the subumbrella. The latter opinion is according to my conviction entirely erroneous, the former is in a certain sense admissible. The comparative ontogeny of the Siphonophoreæ appears to me to show conclusively that the air-sac is an apical gas-gland of the exoderm, which in the Disconula of the Disconanthæ sinks centrally into the gelatinous disc from the apex of the same inwards, and in the Siphonula
of the Siphonanthæ lies excentrically beside the apex. It arises in the former, indeed, at the place where some Meduse (e.g., Aglaura) form a suctorial organ of attachment. Only subsequently does this apical air-gland become greatly extended, to occupy the greater part of the original larval umbrella, so that one may in a certain sense speak of an "invagination." At any rate, the "air-sac" is originally a portion of the ectodermic epithelium of the exumbrella, not of the subumbrella. The whole pneumatophore is not a secondary medusoid person, but the modified disc of the primary medusoid larva.

The many-chambered pneumatophore of the Disconanthæ is comparable in its first beginning alone with the single-chambered pneumatophore of the Siphonanthæ; there again it is at first nothing more than an apical gas-gland, which occupies only a small area on the apex of the primary larval umbrella. This simple central chamber becomes rapidly surrounded, however, with a girdle of eight radial chambers, and around these again many concentric rings of chambers are apposed. Thus arises the characteristic octoradial, concentrically chambered air-disc of the Porpitideæ, of which the amphithecet pneumatocyst of the Vcclilideæ represents only a secondary modification. Sometimes its margin is split into eight or sixteen radial lappets. On the upper surface the disc opens by numerous stigmata, of which the central one alone can be compared to the simple apical stigma of the Pneumatophorideæ. From the lower surface proceed numerous small air-tubules or tracheæ, which enter into the so-called "liver" or glandular central organ. I regard only the entodermic canal network of this voluminous "central organ" as "liver" (and perhaps "kidney"), and the compact exodermic parenchyma as a strongly developed gas-gland. The lower ends of the tracheæ are not closed, as is generally supposed, but open. They take off the secreted gas, and their terminal apertures correspond to the "funnel aperture of the air-flask" in the Siphonanthæ. On the other hand, the stigmata of the upper surface (or of the exumbrella) in the Disconanthæ do not serve for the reception of atmospheric air from outside (as is generally supposed), but solely for the exit of the secreted gases, and correspond to the simple apical pore of the Cystonecæ.

AUROPHORE or AIR-BELL.

The new deep-sea families Stephalidæ and Rhodalidæ are distinguished from all the other Siphonophore by the possession of a peculiar organ, belonging to the nectosome, designated the aurophore. Since they are in other respects peculiarly organised, they may be regarded as representing a special order, Auronectæ. The aurophore is a voluminous gas-gland, which has developed out of a medusiform swimming-bell. It lies below the large pneumatophore, in the dorsal middle line of the stem, opposite the ventral row of buds. The disc-cavity of the swimming-bell has been modified into a
narrow muscular air-duct (*auroductus*), which opens internally at the base of the pneumatophore, and externally to the outside. The radial canals of the metamorphic nectophore are modified into a complex radial system of wide glandular chambers.

**Siphosome or Nutritive Body.**

The nutritive body exhibits in the different groups of the class Siphonophore much more manifold and important differences of form and structure than the swimming body. Undoubtedly the most important difference is this, that in the Monosiphonieae (or the monogastric Siphonophorea) the archisiphon or protosiphon (the primary gastric tube of the medusoid larva) remains alone as the organ for the reception and digestion of food, while in the Polysiphonieae (or the polygastric Siphonophorea), "secondary suctorial tubes" or metasiphons are developed by budding, each provided with a gastric cavity and a mouth opening. In the Polysiphonieae the primary mouth opening of the medusoid larva only rarely persists, in all Disconanthae, and in two families among the Siphonanthae (Stephalidæ and Physalidæ). In most (perhaps all the rest) of the polygastric Siphonanthae, the primary mouth opening of the protosiphon is probably closed, and the latter persists only as the stem of the stock (*truncus* or *cænosome*).

The polymorphic appendages, which bud out as lateral branches from the stem of the siphosome, are partly medusoid (*bracts, gonophores*), partly polypoid (*siphons, palpons, cystons, gonostyles*). The poly-organ theory regards the former as multiplied umbrellas of one Medusa, or as secondary vicaria of such, the latter as repeated manubria or vicaria of the same. The poly-person theory, on the other hand, regards each single bract as a medusoid person, which has lost all its organs except the umbrella, and each single siphon and palpon as an independent Hydropolyp. Our medusome theory regards in the different cases these polymorphic appendages partly as dislocated organs of medusomes, partly as multiplied reserve organs or vicaria of the same.

**Siphons or Suctorial Tubes.**

*Polyptites, Gastral Tubes, Stomach Sacs, Nutritive Polyps, Eating Polyps, Hydranthæ, Gastrozooids.*

The siphons, which have given the name Siphonophore to the entire class, are the most important and the most constant appendages of their organism. From a physiological point of view they are rightly regarded as organs for the reception of food and digestion; from a morphological point of view they are sometimes regarded as homologous with an entire Polyp, sometimes with the gastric tube or manubrium of a Medusa.
As in the latter, each siphon or "suctorial tube" possesses at the distal end of the sac-shaped body a mouth opening, at the proximal end a stem opening, through which the simple cavity communicates with the cavity of the umbrella or the stem. By one or two (often even three) annular strictures the simple cavity of the siphon is divided into two, three, or four chambers. When four portions can be distinctly distinguished, the first (proximal) is a thin stalk (pedunculus siphonalis), usually bearing the base of insertion of the tentacle; the second is a thick-walled crop ("Vormagen," basigaster) equipped with masses of urticating cells; the third is the stomach proper (stomachus), usually with "hepatic stripes," more rarely with glandular villi; the fourth is an extremely contractile proboscis. The stomach usually passes without sharp boundary into the proboscis, but is generally definitely marked off from the basigaster, often by means of a pyloric valve. The stalk of the crop region is often degenerate or not distinctly defined. The single tentacle springs from this portion in the majority of Siphonantsae. According as the adult Siphonophoral corm has only one or several siphons, we distinguish Monosiphonae and Polysiphonae.

**MONOSIPHONÆ or MONOGASTRIC SIPHONOPHOREÆ.**

Of great importance for the right understanding of the Siphonophore is the fact, that in all forms the primary medusiform larva (Disconula or Siphonula) bears only a single siphon, and that this remains in one portion of the class, namely in the Monogastricae, while in the other division it is modified into the stem, and is physiologically replaced by numerous secondary siphons (lateral branches of the latter). Hitherto the monogastric Siphonophore have been represented solely by the *Eudoxia* among the Calycophorideae; but among the new deep-sea Siphonophore of the Challenger Expedition which I have described in this Report, there are interesting monogastric forms from three other orders (Discalideae, Athorideae, Crystalideae). Since in both legions of the class the Monosiphonae exhibit close resemblance to the known larval forms of the Polysiphonae, they may be regarded as "sexually mature larvae." In more accordance, however, with the phylogeny is the reverse interpretation, that those larvae of the Polysiphonae repeat, according to the fundamental biogenetic law, the structure of their Monosiphonial ancestors.

In regard to the position of the stomach on the subumbrella, the Monosiphonae exhibit in both legions very important differences, which are explained by their diphyletic origin. In the Discalideae or monogastric Disconants, the primary siphon occupies the central point of a regular octoradial umbrella; in the monogastric Siphonants, on the other hand, it is more or less excentrically situated at the base of a bilateral umbrella.
POLYSIPHONÆ or POLYGASTRIC SIPHONOPHORÆ.

In the great majority of Siphonophore the adult form possesses several suctorial tubes or polypites as organs for the reception and digestion of food. These arise in the Discocantheæ by budding from the primary subumbrella, in the Siphonanthæ on the other hand by budding from the ventral middle line of the primary siphon, which is modified into the stem. In the former these "metasiphons" surround the primary archisiphon as a corona; while in the latter they are disposed upon the protosiphon either on the one side only or on all sides, in a spiral line. In the simplest and most primitive case, such as occurs in the polygastric Calyconectæ and in many Physonectæ, the metasiphons develop in regular metameric succession on the segmented stem, separated by wide internodes. Each individual siphon is (in the Eudocia and the corresponding simplest Prodocia of the Physonectæ) associated with a covering bract; both together form a medusome, the umbrella being represented by the bract, the manubrium by the siphon. In most of the Physonectæ numerous covering bracts soon develop, which are to be considered as mere multiplications of the primary bract, and therefore as entirely subordinate organs. But when from the base of such a medusome gonophores bud forth—appendages that is to say of the morphological value of a medusoid person—then such a "group of persons" acquires the value of a cormidium. In many Polysiphonæ the metameric arrangement of the cormidia subsequently breaks up, and then the connection between the scattered siphons and the separated sexual medusomes is often no longer demonstrable.

PALPONS or TASTERS.

(Feelers, Tasters, Arms, Fluid Receptacles, Hydroyysts, Dactylozooids.)

In the great majority of the Siphonophore, the siphosome bears, scattered between the siphons, or connected in groups with the latter, the tasters or feelers. These are always simple, thin-walled, very contractile sacs, in which the proximal portion communicates with the cavity of the stem, while the distal end is closed. Morphologically the tasters are to be regarded as mouthless manubria, or as the stomachic sacs of medusomes in which the umbrellas have become modified into covering bracts or are entirely degenerate. The palpons are distinguished from the cystons by the absence of a distal opening, from the siphons not in this alone, but also in the absence of the glandular villi and hepatic stripes in the stomach region. Their function appears to be mainly, if not exclusively, sensory. Their sensitive point probably acts generally as a taste organ, and sometimes also as an eye; in a (new) Anthorybia I observed a lens in this ocellus (a sickle-shaped pigment spot on the upper surface of the sensory apex). In some Agalmineæ the distal
part appears to act as an otocyst, since it is constricted off by a strong sphincter from the wide palpon cavity, and forms a spherical terminal bladder in which a crystalline otolith is kept in rotatory movement by a ciliated epithelium. Palpons are found generally distributed in the Physoneectae and Physalidae; they are absent in the Auroneectae, Calyconeectae, and Diseoneectae. Not unfrequently palpons are confused with tentacles, as for instance repeatedly by Claus, even in Physophora.

CYSTONS or ANAL VESICLES.

Under this title I distinguish from the other polypoid organs of the Siphonophorae certain vesicular sacs, which have hitherto been generally confused with the palpons. They are indeed very like the latter, but are very essentially distinguished from them by a terminal aperture. By means of this aperture, which the animals can open or close at will, fluid and excretions are emptied from the excretory system, and water may also be taken in. It is therefore to be regarded as an anus. The distal portion of the cystons is frequently pigmented and furnished with special glandular cells, they also sometimes contain definite crystalline excreta. These anal vesicles obviously stand in closer morphological and physiological relations with the siphons than with the palpons; they are, however, distinguished from the former by the simple structure of the wall. I find these excretory structures widely distributed among the Physoneectae, but they appear to be altogether absent in the other orders.

TENTACLES or CAPTURING FILAMENTS.

(Seukfäden, Stinging Filaments, Tentacular Filaments, Nematozooids.)

Tentacles are present in all Siphonophorae, and are both as capturing organs and as offensive and defensive weapons quite indispensable. Recent reports of their absence in some species are certainly to be explained by the ease with which the delicate threads are sometimes detached from the base. The poly-person theory regards the tentacles as independent polypoid persons. I agree, on the other hand, with the polyorgan theory, which explains them as organs of the siphons. In my opinion the tentacles of the two legions of the class are in their nature entirely different. In the Diseonanthus (or Porpitariae) the primary circle of tentacles on the umbraller margin of the medusoid larva (Disconula = Archimedes) persists; there are at least eight present; their number usually becomes much increased; they have no individual relations to the separate siphons which bud forth in large numbers from the subumbrella. It is

(Zool. chal. exp.—part lxxvii.—1888.)

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quite different in all the other Siphonophora—the Siphonanthae. Even their primary medusoid larva (Siphonula=Protoneda) always possesses only a single tentacle, and this is excentrically attached to the base of the primary siphon. The phylogenetic cause of this peculiar position is to be sought in the bilateral modification, which the older four-rayed medusoid ancestors of this legion (Codonidae) have undergone through the degeneration of three marginal tentacles (Euphyssidae). Only a single tentacle remained persistent, and was all the more strongly developed; it shifted in consequence of the ventral splitting of the umbrella to the inferior surface of the latter beside the base of the siphon. A similar centripetal migration of tentacles occurs also in Medusae, sometimes on the superior, sometimes on the inferior surface of the umbrella. The fact that each individual siphon of the polygastric Siphonanths bears at its base only a single tentacle is simply to be regarded as the (hereditary) result of a metameric repetition of the primary condition.

Only in a few Siphonophora do the tentacles remain simple cylindrical filaments, as in the Velellidae, in Apolemia, Stephalia, Linophysa, Salacia, and allied genera. In the great majority a row of lateral branches (side-filaments, accessory tentacles, secondary filaments, or Tentilla) is formed, as in the Chlonemidae (Pteronema, Gemmarea). The terminal equipment of the latter by manifold cnidocytes or “stinging knobs” is often very characteristic of the several genera and species. The Porpitidae are distinguished by the possession of three longitudinal rows of secondary branches. Some supporters of the poly-person theory regard each of these accessory organs as an autonomous person, and Claus even states that the mantle-like covering (involuterum) which in many Physonectae surrounds each stinging knob, apparently corresponds morphologically to the disc of the Medusa (1878). In my opinion all these appendages, however complex their structure, are merely subordinate organs of the second order.

- PALPACLES or TASTING FILAMENTS.

Under this designation I include only the long, extremely contractile, hollow, simple filaments, which occur in the majority of Physonectae at the base of the palpons. They have the same morphological and genetic relation to the latter as the tentacles to the siphons. While the tentacles are especially of importance as capturing organs and as weapons, the palpaeles act as fine, far reaching, tasting organs auxiliary to the sensory function of the palpons. Each palpon bears always only a single palpacle, and this is always simple, never stalked. While the supporters of the poly-person theory regard each palpacle as an independent “individual,” that is as a distinct person, I must on the other hand agree with the poly-organ theory, which explains them simply as subordinate organs of the palpons.
BRACTS OR COVERING PIECES.

*(Hydrophyllia, Protocerta, Deckblätter, Covering Scales, Phyllozooids)*.

The polymorphic organs which are usually spoken of as “covering pieces” (Deckstücke) are entirely absent in the three orders Disconectae, Cystoneectae, and Auroneectae; in the former originally, in the two latter probably as the result of degeneration. In the two remaining orders the bracts are essentially distinguished in this, that in the Calyconectae they appear singly on each Medusome, in the Physoneectae on the other hand there are several. Only the primary larva of the latter (Siphonula) frequently forms a single “primary covering piece” (Protobractea), which is then to be compared with the single bract of the former *(Eudokia)*, and to the umbrella of the primary ancestral form *(Protomeda)*.

The physiological importance of the bracts consists exclusively in their protective function; they are shields or umbrellar organs, under the shelter of which the other persons of the colony are protected. As regards their morphological import, the poly-person theory regards them as degenerate medusoid persons, which have lost manubrium and tentacles, while the gelatinous disc has been the more developed; the poly-organ theory, on the other hand, regards them as multiplied umbrellas. According to our medusome theory, a distinction must be drawn between primary and secondary bracts. The protobractae or *primary covering pieces*, which occur singly, on the larva of Physoneectae and on the Eudokia of Calyconectae, are to be interpreted as the umbrella of a primary medusoid person. The metabractae or *secondary covering pieces*, however, which usually cover the stem of the Physoneectae in large numbers, may have various phylogenetic origins. They may arise as—

1. Displaced umbrellas of secondary medusomes;
2. Vicariae or multiplied reserve-bracts of the same;
3. Cleft portions of divided (e.g., quadripartite) umbrellas.

The direct transition of nectophores into bracts is to be observed among the Physoneectae in the Athorideae and Anthophysidae. In *Athoria* and *Rhodophyes*, I find in the distal portion of each bract a small rudimentary nectosac or swimming cavity, sometimes with four enidonodes or stinging knobs, which may be regarded as the rudiments of four reduced tentacles. The highest and most manifold development of bracts is found in the Calyconectae, where the sterile medusome of each single cormidium bears a large hydrophyllium of a peculiar form, often characteristic of the genus. The phyllo-cyst, too, or the canal of the bract, here often exhibits several apophyses, which may be regarded as rudimentary radial canals of the umbrella; e.g., *Aglaisma*, the free Eudokia of *Calpe*, possesses four radial canals in its bract, two paired lateral and two odd sagittal (an ascending and a descending canal).
GONOSTYLES OR REPRODUCTIVE STALKS.

(*Blastostyles, Gonoblastidia, Gonodendra, Klinozooids.*)

The gonophores or the medusiform “reproductive persons” of the Siphonophore sometimes develop directly on the stem, that is as buds on the gastric wall of the primary siphon. Such is the case in many monogastric Siphonophora, and in several polygastric forms (*e.g.*, in Agalmideæ) with broken-up cormidia. Much more frequently the buds arise from the stomach-wall of secondary polyoid persons, for which we shall use Allman’s title of *Gonostyles or Blastostyles*. These saes are usually mouthless, and are described as “tasters,” but are better designated sexual palpons. Sometimes (in the Porpitideæ and Veellideæ) these gonopalpons possess a terminal mouth, and may then be called sexual siphons. These saes frequently branch in a very marked tree-like fashion, so that the numerous gonophores attached to them form large clustered masses (*reproductive-trees, gonodendra*). From a physiological point of view the gonostyles are distinguished both from the palpions and from the siphons very essentially in this, that their sole function is the production of gonophores. From a morphological point of view they may be regarded as sterile Polypo-persons, which are related to their gonophore buds, as the Hydropolyp stock to its medusoid buds (poly-person theory). In this case the succession of generations (*strophogenesis*) would replace the original alternation of generations (*metagenesis*). According to the poly-organ theory, on the other hand, each gonostyle is only to be regarded as an organ, corresponding to a Medusa-manubrium, from which sexual medusoid persons of the next generation arise by budding.

GONOPHORES OR REPRODUCTIVE PERSONS.

(*Sexual-Medusoids, Gonozooids.*)

Among all parts of the Siphonophoral organism, the gonophores are always those members which most distinctly preserve the original character of the medusoid person. The two principal organs, the *umbrella* and the *manubrium*, are always present. In the wall of the latter the generative products arise. But only in the Disconectæ (and perhaps in a number of Cystoneectæ) does the oral aperture of the manubrium appear to break through; in the others it remains closed. The reproductive cells arise in both sexes of the Siphonanthæ from the entire surface of the manubrium (*as in the Codonideæ*), and indeed from the exoderm. The umbrella of the gonophores has the velum and the circular canal of the umbrellar margin usually well preserved, and the same is true
of the four radial canals of the subumbrella. Only rarely do these portions become more or less rudimentary, so that the medusoid form is lost and passes over into a more or less degenerate "sporosac." The tentacles on the umbrellar margin of the gonophores have usually disappeared; sometimes, however (as in some Calyconectae), four rudiments are recognisable, and at other times even a corona of tentacular rudiments (Desmophyes). The Disconanthæ, in which free reproductive Medusæ in the sexually mature state are not yet sufficiently known, may perhaps bud off four or eight separate gonads either from the manubrium, or from the subumbrella.

As to the distribution of the two kinds of gonophores on the corm, it must be noticed that most of the Siphonophoræ are monoeccious. Some Calyconectæ (Mitrophyæ, Galeodaria) and some Physonectæ (Apolemia, Athorida) are dioecious. Among the monoeccious coms both kinds of sexual persons occur, sometimes in separate cormidia (dichinous), sometimes associated in each single cormidium (monoeccious). The gonodendra, or the clustered groups of gonophores, are usually distylic, all their branches bearing Medusæ of the same sex; male and female gonodendra arising separately. But sometimes there are monostylic gonodendra, the basal part of the single branched gonostyle bearing female, and the distal part male, gonophores (as in the Auronectæ and Cystonectæ, Forskolia, &c.). On the other hand, hermaphrodite persons (i.e., gonophores which form both spermatozoa and ova) are not known in this class. The male persons are known as androphores, the female as gynophores. Usually the androphores are slender, more oblong, and bear a spindle-shaped or cylindrical spermarium; the gynophores are thicker, more rounded, and bear an ovate or ellipsoidal ovarium.

**FUNDAMENTAL FORM (PROMORPH).**

The promorphology of the Siphonophoræ has led to very different views respecting the ideal geometrical fundamental form (or the "promorph"), which may be recognised by abstraction from the concrete single forms of these Accephæ. One group of authors regards the Siphonophore as "Radiate animals," whilst another group maintains that they are "Bilateral animals." These opposed views are both right in a certain sense. On the one hand, a typical radial structure—generally a quadriradiolar form, composed of four equal quadrants—is recognisable in all Siphonophore (mainly in the gonophores and nectophores), and this is in my opinion produced by inheritance from the older ancestral Medusæ. On the other hand, a distinct bilateral structure—or a dipleural fundamental form, composed of two symmetrical halves or antimeres—is recognisable in most Siphonophoræ, viz., in all Siphonanthæ, whilst it is wanting in the Disconanthæ. This bilateral type is partly inherited from the bilateral Medusæ, which we regard as the ancestors of the Siphonanthæ (Protomeda), and the essential form of
which is preserved in the bilateral larva, Siphonula; but partly the bilateral type is produced by adaptation, and mainly by accommodation to the conditions of development of the single forms. In order to get a clear conception of these difficult promorphological relations, we must distinguish, firstly, the fundamental forms of the entire corona and of the single persons or medusomes composing it; and secondly, the different promorphological development in the two independent legions of the class, the Disconanthis and the Siphonanthis.

The promorph of the single medusome has the quadriradial medusoid type usually clearly expressed, when the umbrella is well preserved, as in the gonophores and nectophores (always with four radial canals and a connecting marginal ring-canal). But also in other parts of the medusomes the radial promorph may be recognised, as in those siphons which possess four, eight, or sixteen hepatic stripes, mouth lobes, &c.

*Promorph of the Corms in the Disconanthis.*—The ideal geometrical fundamental form exhibits in the colonies of Disconanthis two different types; one of these, represented by the Discalidae and Porpitidae, is the primary and original type; the other, exhibited by the Vellellidae, is a secondary modification. All corms of Discalidae (Pls. XLIX., L.) and of Porpitidae (Pls. XLV.—XLVIII.) preserve a completely regular octoradial structure; their ideal promorph is a regular octagonal pyramid. The vertical main axis of this pyramid, around which the eight equal parameres are regularly arranged, bears at its superior or apical pole the apical stigma of the central chamber of the pneumatocyst, at its inferior or basal pole the mouth of the central siphon. The eight equal sides of this pyramid are represented by the eight triangular radial chambers of the pneumatocyst, whilst the eight perradial grooves between these, and the eight canals running in the grooves, further the eight primary tentacles at the distal end of the canals, mark the eight edges of the pyramid. The horizontal lines which connect these edges with the vertical main axis are opposed in four pairs, and represent the four primary or perradial cross-axes of the octagonal pyramid; whilst the four secondary transverse axes alternating with these, and bisecting the eight triangular radial girdle-chambers of the pneumatocyst, are interradial. The perfectly regular octoradial promorph, which is so clearly marked by the structure of the central pneumatocyst, is likewise expressed by the entire structure of the canal-system, the eight primary perradial canals of the exumbrella, the entradenia, the subumbrella, &c., by the regular octoradial corona of the eight primary tentacles and gonostyles, the eight gastrostal ostia in the fundus of the central siphon, the eight lappets of its mouth, &c. The young larva of all Discalidae and Porpitidae (Disconula, Pl. L. figs. 9, 10), and the simplest permanent genus of this legion (*Discalia, Pl. XLIX.*), exhibit the octoradial type in the same complete regularity as any octoradial Medusa (e.g., *Trachyema, Pectyllis*).

The Vellellidae (Pls. XLIII., XLIV.) differ from the regularly octoradial Porpitidae and Discalidae in the amphithoect modification of the promorph, which is usually called
"bilateral," sometimes even "uniradial" (Chun). But a comparative study of their development, and mainly of the central part of their body; demonstrates that the corm of all Vellellidæ originally is also octoradial; this is clearly proved by the girdle of eight radial lobes which surrounds the central chamber of the pneumatoecyst; further, by the eight primary radial canals, which arise from the gastrobasis of the central siphon and give off the ascending branches forming an octoradial liver-star on the upper surface of the centradenia. *Rataria* (Pl. XLIV.), as the simplest form of this family, and the similar *Ratarula*-larvæ of other Vellellidæ, possess marks of an octoradial type also in other organs (eight primary buds of gonostyles, sixteen primary tentacles, &c.). But whilst the eight parameres in the Discalidæ and Porpitidæ are precisely equal (each composed of two symmetrical antimeres), they are unequal in the Vellellidæ (each composed of two asymmetrical antimeres). The two horizontal cross-axes, which are perpendicular one to another, and to the vertical main axis, are both equal in the Discalidæ and Porpitidæ; whilst they are unequal in the Vellellidæ. Their sagittal axis (marked by the vertical sail) is longer than the frontal axis (marked by the transverse groove of the pneumatoecyst). But the dorsal half of the corm (on one side of this frontal groove) is symmetrically equal to the ventral half (on the opposite side), in the same manner as the right half is symmetrically equal to the left (separated from it by the vertical sail). The fundamental form of the corm in the Vellellidæ, therefore, is not "bilaterally-symmetrical," but "amphitheet," or bilaterally-octoradial, similar to that of the Ctenophoræ.

The octoradial structure of the Medusæ is originally derived from the quadriradial type, as I have demonstrated in my Monograph of the Medusæ. The same promorpho-logical law is valid also for the Discenotæ. Their octoradial trunk has arisen from the umbrella of some Medusa, the older ancestors of which were quadriradial. Their next ancestral forms may be Trachynemidae, with eight radial canals, eight tentacles, &c. But these again have arisen from the older Petasidæ, which possess four radial canals, four tentacles, &c. This older quadriradial structure is still preserved in the medusiform gonophores of the Discenotæ (*Discomitra*).

**Promorph of the Corms in the Siphonanthæ.**—The corm of the Siphonanthæ, differing from that of the Discenotæ in all respects from the first beginning, is also distinguished completely by its bilateral promorph. The primary larva (*Siphonula*), which develops the corm of the Siphonanthæ by unilateral budding from its manubrium, has already a markedly bilateral fundamental form. Its primary umbrella has a deep ventral cleft, and its only tentacle is attached to one side of the manubrium. The vertical plane, which passes through the median line of these parts, is the sagittal plane, and bisects the entire body; the two halves separated by it, right and left, are symmetrically equal. That side of the manubrium from which arise the buds of the corm is the ventral side, the opposite the dorsal side.
In order to get a clear conception of the bilateral promorph of the Siphonanthæ (very unnaturally described by many authors), it is very important to distinguish the three primary dimensive axes, and to compare them with those of man or of some other bilaterally symmetrical animal. The first or principal is the vertical main axis, the longitudinal axis of the tubular stem; its upper or apical pole bears the pneumatophore in the majority of Siphonanthæ, the primary nectophore in the Calyconectæ. The opposite end is the lower or basal pole.

The second dimensive axis is the sagittal diameter; its ventral or anterior pole is marked by the series of buds, and usually by a ventral groove of the tubular stem. The opposite dorsal pole is distinguished in the Auronectæ by the aurophore, in Physalia by the crest of the pneumatocyst. The vertical plane, which is determined by the sagittal and the principal axes, perpendicular one to another, is the median or sagittal plane; it separates the right and left halves of the body.

The distinction between right and left halves (often confounded by different authors, and described in striking contradiction) is always clear, when the ventral side is constantly defined in the same sense as that side of the body from which the buds arise. Therefore, the two poles of the frontal diameter, or the third dimensive axis (right and left pole), must be always the same. In the monogastric Calyconectæ, for instance (Eudoxia, &c.), the single siphon is placed on the ventral side of the bract (or the modified umbrella); in the polygastric Calyconectæ, correspondingly, the trunk is placed on the ventral side of the first or proximal nectophore (the nectosure, therefore, on its dorsal side). In the Diphyidæ, the ventral sides of the two nectophores are opposed one to another.

The bilateral promorph of the Siphonanthæ is at the same time quadriradial (or by duplication of the parameres octoradial). This radial structure, inherited from the ancestral quadriradial Medusa, is not only evident in the four radial canals of the gonophores and nectophores, the eight hepatic stripes and mouth-lobes of many siphons, &c., but also in the structure of the primary larval umbrella, and the pneumatophore arising from it. The majority of the Siphonanthæ exhibit in the basal part of the pneumatosaccus eight (more rarely four or sixteen) radial pouches, which are separated by vertical septa and comparable to the radial canals of a Medusa.
DESCRIPTION OF THE FAMILIES, GENERA, AND SPECIES.

SIPHONOPHORÆ.

Definition of the Class.—The Siphonophore are swimming colonies or coms of Hydromedusæ, composed of polymorphous medusoid zooids or persons, which arise by budding from an original simple Medusa. The class is divided into two subclasses:—the Disconanthæ arise by budding from the subumbrella, the Siphonanthæ by budding from the manubrium of the original Medusa. The Disconanthæ comprise one order only (Disconectæ); the Siphonanthæ comprise four orders—Calyconectæ, Physonectæ, Auronectæ, Cystonectæ.

Synopsis of the Five Orders of Siphonophora.

I. DISCONANTHÆ: Truncus or coenosome formed by the umbrella of the original octoradial Medusa, which includes a polythalamous pneumatocyst; the buds arise in concentric circles from the subumbrella. Larva octoradial (Disconula), . 1. DISCONECTÆ

II. SIPHONANTHÆ: Truncus or coenosome formed by the manubrium of the original bilateral Medusa; the buds arise in the ventral line of the manubrium. Larva bilateral (Siphonula).

A monothalamous pneumatocyst or a float filled with air is always present.

| Without aerophore; common stem thin, tubular, with a simple canal, 3. PHYSONECTÆ. |
| With aerophore; common stem thick, bulbous, with a network of canals, 4. AURONECTÆ. |

With neotophores or with bracts (often both together present). With palpons.

Without neotophores, and without bracts. Pneumatocyst with an apical stigma, 5. CYSTONECTÆ.

(ZOOL. CHALL. EXP. — PART LXXVII. — 1888.)
Subclass I. DISCONANTHÆ.

Order I. DISCONECTÆ, Haeckel, 1888.  
(Pls. XLIII. to L.)

Chondrophore, Chamisso, 1821, 16, p. 363.  
Velellite, Eschscholtz, 1829, 1, p. 165.  
Cirrhigrae, Blainville, 1834, 24, p. 303.  
Porpitaris, Haeckel, 1869, MS. Canar.

Definition.—Sphonophoræ with a permanent primary umbrella, without nectophores and bracts. Nectosome campanulate, lenticular or discoidal, including a polythalamous, originally octoradial pneumatocyst, which exhibits numerous stigmata on its upper face, and trachee on its lower face. Siphosome composed of a central primary siphon, and one or more concentric girdles of gonostyles (either secondary siphons, or instead of these palpons), the latter producing gonophores. The primary larva (Disconula) has a regular octoradial umbrella, with eight radial canals and a connecting circular canal at the margin, which bears eight primary radial tentacles.

The order Disconectæ comprises three families, the Discalidæ, Porpitidæ, and Velellidæ; all members of this order agree in so many important characters, and differ so widely from all the other Sphonophoræ, that I divide the whole class into two subclasses, Discantheræ and Sphonantheræ. The first subclass, Discantheræ, represented by the Disconectæ only, is developed from the octoradial and octonemal medusoid larva Disconula; it retains the primary corona of eight or more marginal tentacles, possesses a centradena, and produces the polymorphous persons by budding from the subumbrella. The second subclass, Sphonantheræ, on the other hand, represented by four orders (Calyconectæ, Physonectæ, Auronectæ, and Cystonectæ), differs in the bilateral form of its mononemal larva, Siphonula; this, as well as each of the following siphons, has only a single tentacle; the centradena is wanting, and the polymorphous persons of the cor Nun bud in the ventral line of the primary siphon.

History.—Eschscholtz, in his fundamental work, separated from the other Sphonophoræ the family Velellidæ, comprising the genera Porpita and Velëlle of Lamarck (1815). So early as 1821 these were united as "Medusae Chondrophoræ" by Chamisso and Eysenhardt. Eschscholtz added as a third genus Rataria, and found the peculiar character of all Velellidæ in the possession of an internal polythalamous cartilaginous shell, the chambers of which are filled with air. Brandt afterwards (in 1835, 25) separated the Porpitidæ (with circular shell, without vertical crest) from the true Velellidæ.

1 The figures in black type refer to the Bibliography at the end of the Report.  
2 System der Acalephen, 1829, p. 165, (I).
REPORT ON THE SIPHONOPHORÆ. 27

(with elliptical or oblong shell, and a vertical crest). Huxley (in 1859) gave the first accurate definition of this group (9, p. 71):—"Physophorideæ without nectocalyces or hydrophyllia; with short, clavate, simple or branched, submarginal tentacles. A single central principal polypite. Pneumatocyst flattened, divided into chambers by numerous concentric partitions, and occupying almost the whole of the discoidal eoonosarc." The description which Huxley gave of the two genera Velella and Porpita is very accurate, as is also that given in 1853 by Kølliker (4). Another description of both has been recently published by Alexander Agassiz (1883, 57). His opinion is that these Siphonophoræ are more nearly allied to the Tubulariæ, and on the other side to the Hydrocorallinae (Milleporidae, &c.). The oldest figures are those of Forskål (11).

All authors hitherto agree in the general opinion that the Disconectæ are the most highly developed of all Siphonophoræ, and that they form the terminal group in their systematic arrangement, as being most closely allied to the Physalidæ. In my opinion this general view is quite erroneous. I am convinced, mainly by their ontogeny, that the Disconectæ have preserved the original medusoid structure more than any other Siphonophoræ (or the Siphonanthæ). They retain the original umbrella with its corona of marginal tentacles, and the original manubrium, which is the "principal polypite," or better, "central siphon." The gonostyles, or the polypiform persons which bear the gonophores (either mouthless palpals or mouth-bearing siphons), bud from the subumbrella (or the lower face of the disc); while the polymorphous persons in all the other Siphonophoræ bud from one side of the manubrium (or the primary siphon) in its ventral line. The primary larva of all the Disconectæ (Disconula) is a regular octoradial Medusa, with a marginal corona of eight radial tentacles, widely different from the larva of all other Siphonophoræ (the Siphonula, with bilateral umbrella and a single tentacle). I suppose, therefore, that there is no direct relation between the Disconanthæ and the Siphonanthæ, and that the two subclasses or legions have a different origin: the former arising from Anthomedusæ (Codonidae, Euphysidae), the latter from Trachomedusæ (Trachynemidae, Pectyliidae).

Nectosome and Siphosome.—The two main parts of the fully-developed body, which we separate as nectosome (or swimming apparatus) and siphosome (or nutritive apparatus), have in the Disconectæ a mutual relation very different from that of the other Siphonophoræ (the Siphonanthæ). The nectosome is represented by the exumbrella, or the upper half of the discoidal body, which includes the polythalamous pneumatocyst; the siphosome, however, is formed by the subumbrella, or the lower half of the horizontal disc, and by the different organs which are attached to its margin and to its lower face. The boundary face between the two main parts is the upper face of the centradenia or the so-called "liver"; it is in close contact with the lower face of the pneumatossaccus. The constant organs, which depend from the subumbrella, are the following:—(I.) The large central siphon, in the middle of the lower face; (II.) a simple or multiple corona.
of gonostyles, which bear the gonophores (mouthless palpons in the Discalidæ, mouth-bearing siphons in the Porpitidæ and Velellidæ); (III.) a simple or multiple corona of submarginal tentacles.

_Umbrella._—That part of the body, which is the true homologue of the umbrella in the common Meduse, is in the Disconectæ the most voluminous part of the whole cormus. It includes the polythalamous pneumatozyst, and bears all the other organs on its lower face. The latter corresponds to the subumbrella of the typical Meduse, while the upper face is homologous with their exumbrella. Both faces are separated by the peripheral margin or limb of the umbrella, which constantly bears a corona of muciparous glands. The exodermal epithelium of the umbrella everywhere includes scattered nematozysts. Beyond it there is a nervous plate, mainly developed on the limb and the upper face. The muscles of the umbrella are more developed on the upper than on the lower face; they are composed of an outer layer of longitudinal or radial fibres, and an inner layer of transverse or circular fibres.

_Exumbrella._—The superior (apical or proximal) part of the umbrella, which is separated from the inferior part (or subumbrella) by the glandiferous limb, is sometimes a nearly even horizontal disc, at other times more or less convex. Its upper free face is either smooth or papillate, always pierced by stigmata; its lower face is in contact with the centradenia. The exumbrella in all Disconectæ is composed of two parallel plates, which are separated by the reticulate plexus of the pallial canals; the outer plate is the pneumatozodon, the inner is the pneumatosaccus.

_Pneumatophore._—The hydrostatic apparatus, or the swimming-bladder, which we call pneumatozophore, has in the Disconectæ another and a far more complicated structure than in all the other Siphonophore (or the Siphonanthæ). Only the first beginning can be common to the two subclasses, viz., a simple pneumadenia, or a gas-producing gland of the exumbrella. But this is centrally placed in the Siphonanthæ, excentrically in the Siphonanthæ; and further, the chitinous pneumatozyst, which covers the inside of the pneumadenia, is a simple monothalamous cyst in the latter, a multiple polythalamous cyst in the former. Another important difference is furnished by the openings of the pneumatozyst; the simple pneumatozyst of the Siphonanthæ is either closed, or has only a simple opening (infundibulum) at the lower pole, and another simple mouth (stigma) on the upper pole of its main axis. The polythalamous pneumatozyst of the Siphonanthæ, however, has numerous openings on both faces, internal tracheæ on the lower face, external stigmata on the upper face.

_Pneumatocodon._—The pneumatozophore as a whole, or the hydrostatic apparatus, is composed of all the above-mentioned parts, and of the two plates of the exumbrella also already referred to. The outer or upper of these is the pneumatozodon, the uppermost lamella of the entire umbrella. It is composed of three layers, an outer exodermal epithelium, a nervous plate (composed of a loose reticulum of branched ganglion cells),
and a double muscle plate, with outer radial and inner circular fibres. The plexus of pallial canals separates the pneumatoecodon from the pneumatosaccus.

**Pneumatosaccus.**—That lamella of the exoderm which surrounds immediately the chitinous pneumatoceyl is the pneumatosaccus. It represents the invaginated part of the exumbrella, and has taken its origin from a simple bottle-shaped gland in its apex. This gas-secreting gland—or pneumadenia—originally small and occupying only the apical centre of the exumbrella, has afterwards become so extraordinarily expanded that it usually forms the most voluminous part of the entire umbrella. The exodermal epithelium of the pneumatosaccus is a simple stratum of glandular cells, which secrete the cuticular chitinous plate of the adjacent pneumatoceyl. The basal part, or the inferior face of the former, is probably also the matrix of the centradenia or the so-called "liver." The exodermal cells, and cnidoblasts, which constitute the solid parenchyma of the latter, are probably derived from the basal part of the pneumatosaccus.

**Pneumatoceyl.**—The chitinous polythalamous float filled with air, which we call pneumatoceyl (formerly called "inner shell"), exhibits in all Discocnecetæ a rather complicated structure. Its general form is circular, and originally octoradial in the Discalidaæ and Porpitidae, elliptical or nearly quadrangular (parallelogram) in the Velelidae; but also in the young larvae of the latter its first rudiment is octoradial. It always commences with the formation of a simple central chamber, which is situated in the centre of the exumbrella, just above the gastrostome of the large central siphon. It opens outside by a central stigma in its upper face. Around this primary central chamber (the chitinous lining of a central pneumadenia of the exumbrella) a peripheral corona of eight radial chambers is next formed, each provided with an outer stigma on its upper side, and with an articulate trachea on its lower side. These eight radial chambers are equal and regularly radial in the Discalidae and Porpitidae, while they are more or less amphithecous and somewhat bilaterally disposed in the Velelidae. Sometimes in the latter family they are more or less obliterated.

In the simplest case (*Discalia*, Pl. XLIX.) the formation of the pneumatoceyl is complete with the eight radial chambers; in all the other Discocnecetæ a different number of peripheral concentric chambers is formed around their octoradial corona. All these tertiary chambers are simple rings without radial partitions; they open outside (in the exumbrella) by a different number of stigmata, inside (in the centradenia) by a number of open tracheæ. The rings are circular in the Discalidae and Porpitidae, elliptical or quadrangular (parallelogram) in the Velelidae. In these latter there usually arises afterwards a solid vertical crest, placed diagonally on the upper side of the horizontal disc.

The general opinion regarding the physiological function of the polythalamous pneumatoceyl of the Discocnecetæ may be summed up in the following propositions:—(1) The Discocnecetæ are exclusively pelagic animals, always floating on the top of the ocean, and never sinking below its surface; (2) the air contained in the pneumatoceyl is atmo-
spheric air, taken in by the stigmata of the exumbrella; (3) this air is conducted through the respiratory tracheae to the different appendices of the subumbrella (central siphon and gonostyles); (4) the distal or lower ends of the tracheae are closed.

The observations which I have myself been able to make on the structure and function of the pneumatophore in the different groups of Discocentae have conducted me to quite opposite views, viz.,—(1) The Discocentae are (all or partly) capable of sinking under water, by muscular compression of the pneumatocyst, and expulsion of air by the stigmata of the exumbrella. (2) The air contained in the pneumatocyst is not atmospheric air taken in by the stigmata, but a gas produced by the exodermal cells of the great "central pneumadenia" (the so-called "liver" or central organ). (3) This gas, therefore, has not respiratory, but hydrostatic functions (like the gas in the swimming-bladder of the fishes). (4) The distal or lower ends of the tracheae are not closed by a chitinous plate, but open into the glandular, gas-secreting, exodermal tissue of the centrudenia; they are comparable to the "pylorus infundibuli" of the Siphonanthae.

**Central Siphon.**—The large central polypite, which is placed in the centre of the subumbrella in all Discocentae, is the original manubrium of the primary medusoid larva (Discoula); its terminal mouth is the permanent primary mouth of the latter. The central siphon is the only organ of feeding and digesting in the monogastic family Discalidae, whilst in the other two families of the order, the polygastric Porpitidae and Velellidae, this function is also executed by the numerous peripheral gonostyles, which are here developed in the form of mouth-bearing siphons or secondary polypites. But also in the young monogastic larvae of these latter, the primary central siphon is alone provided with a mouth. Its size is very variable in the different Discocentae; generally it is comparatively large in the small Discalidae, and in the smaller forms of Porpitidae and Velellidae, which possess few secondary siphons; on the other hand, it is relatively small in the larger forms of the two latter families, which possess a great number of feeding peripheral polypites.

The form of the central siphon in the Discalidae and Porpitidae is inversely conical, with circular transverse section; whereas in the Velellidae the inverted cone is strongly compressed from both sides, so as to be elliptical or lanceolate in transverse section. The wider proximal or upper part, or the true stomach, passes without a sharp boundary into the cylindrical, very contractile, distal or lower part, the proboscis. The latter, as well as its distal opening, the mouth, is very variable in size and form, according to its state of contraction.

The surface of the central siphon exhibits in many Discocentae a number of longitudinal or radial folds, visible partly outside, partly inside; usually there are eight or sixteen, sometimes more. The distal mouth correspondingly often exhibits eight or sixteen lobes, sometimes also four larger lobes; at other times it is simply circular, or
in the Vellellidæ elliptical. In the expanded state the mouth may assume the most different forms, trumpet-shaped, discoidal, &c.

The thick wall of the central siphon is always very contractile, and composed of five layers:—(1) An outer epithelium or epidermis, rich in cnidocytes; (2) a very thick layer of strong longitudinal muscles; (3) a solid fulcrum or a homogenous structureless elastic supporting plate; (4) a thin layer of circular muscles; (5) an inner epithelium or entoderm. The mouth is armed with peculiar cnidocysts and provided with sensilla. The upper or proximal half of the central siphon contains in its epidermis often (but not always) a number of bent trachee, which end here.

*Gastrobasal Plate.*—The basal or proximal part of the central siphon in all Disconectæ is separated from the superjacent centradenia by a strong fulcrum, or a structureless elastic supporting plate (*lamina gastrobasalis*). This horizontal fulcral plate (also called the roof of the central polypite, "le plancher" of Bedot, 59, 60) is covered on the upper face by the basal surface of the centradenia, on the lower face by the entodermal epithelium of the stomach. It corresponds to the jelly-plate which forms the roof of the manubrium in the Meduse. Its central part is solid, whilst its peripheral part is pierced by eight or more gastric ostia; these form an octoradial corona in the Discalidæ and the smaller Porpitidæ, whilst their number is increased in the larger forms of the latter family (sixteen to thirty-two or more). Sometimes the numerous ostia form here vertical lanceolate fissures, and the septa between them form an elegant multiradiate star, composed of numerous vertical lamellæ. The Vellellidæ exhibit instead of this regular star a bilateral arrangement of the gastric ostia; they form here two opposite longitudinal rows of fissures (usually sixteen) on the two lateral margins of the lanceolate gastrobasal plate.

*Centradenia or Central Gland.*—The central space of the body, between the apical or proximal pneumatophore and the basal or distal central siphon, is in all Disconectæ occupied by a peculiar large glandular organ, wanting in all the other Siphonophoræ (or Siphonanthæ). This interposed central organ is usually called the liver (*hepar*); but as its structure and function are complicated and not merely hepatic, it may be better called *centradenia*, or central gland. It is composed essentially of a dense network of entodermal gastric canals, and of a compact parenchyma of exodermal epithelium, with innumerable cnidoblasts, filling up the meshes or intervals of that network. The physiological function of the gastric canals may be partly hepatic (digestive), partly renal (excretory); the exodermal epithelium, however, seems partly to perform the function of a pneumatædia (or gas-producing gland), partly to be a large reservoir of cnidoblasts for other purposes.

*The Form of the Centradenia* is in general lenticular or discoidal, sometimes sub-globular or even cylindrical, sometimes more conical or flatly expanded; its peripheral outline is circular, or sometimes regularly octagonal, in the Discalidæ and Porpitidæ; it
is elliptical or sometimes lanceolate in the Vellellidae; often the periphery is more or less lobate, corresponding to the form of the surrounding peripheral part of the umbrella. The upper or proximal surface of the centradenia is attached to the lower or distal surface of the pneumatosacæs, and separated from it by a thinner or thicker fulcrum, a firm and elastic, structureless, supporting plate. But this supporting septum is wanting in the young larvæ, where the exodermal epithelium of the pneumatosacæ is in immediate contact and connection with the upper face of the centradenia.

All the various and often complicated apophyses (radial ribs, circular rings, &c.) which are formed by the distal or inferior face of the pneumatoeyst, and its enveloping pneumatosac, are surrounded by corresponding furrows or envelopes of the proximal or superior face of the centradenia; the latter being always immediately attached to the supporting plate, which separates it from the former in the adult Disconectæ.

The lower or distal surface of the centradenia is in its central part in contact with the base of the central siphon, in its peripheral part with that portion of the subumbrella which bears the gonostyles. The fundus of the central siphon, or the uppermost part of its cavity, is separated from the attached centradenia by a strong support, that supporting plate, which has been described above as "lamina gastrobasalis." This elastic and structureless plate is pierced in the periphery of the basal part of the stomach by eight or sixteen (sometimes more) radial canals, which arise from the fundus of the stomach itself and pass into the vascular system of the centradenia. We call these the primary peripheral gastro-canals. There are originally eight equal and regularly disposed radial canals in the Discalidæ and Porpitidæ. In the Vellellidæ, on the other hand, they are arranged in a bilateral manner; two larger radial canals (a dorsal and a ventral) arising from the opposite poles of the longer (sagittal) axis, two smaller (right and left) from the poles of the shorter (transverse) axis, and four other (diagonal) canals in the middle between the latter and the former. But usually the number of intercalated secondary canals is here much larger, and their arrangement more or less irregular.

Origin of the Centradenia.—For the right understanding of this peculiar organ of the Disconectæ, a knowledge of its origin and development is essential. This question may be solved by the comparison of very young Disconectæ and mainly of the Discalidæ. These simplest and most primitive Disconectæ remain permanently in a lower stage of development, which is transitory in the Porpitidæ and Vellellidæ. In the smallest Disconula-larvæ which I observed the centradenia is a small circular, biconvex, lentilucular disc; its upper face is in direct contact with the pneumatosacæs, whilst its lower face is separated from the central siphon by the gastrobasal plate ("plancher" of Bedot). The entire mass of this solid disc is composed solely of exodermal cells and cnidoblasts; it is not traversed by any canals. The only canals of the centradenia are the eight simple radial canals which run upon its upper face; they arise from the eight ostia of the basilgaster, embrace the surface of the lenticular centradenia like eight meridian lines, and
unite in the centre of its upper face, forming a typical octoradial "liver star." This is quite regular in the youngest Desealidæ and Porpitidae; it is amphitheat in the young Velellidæ, where the two opposite canals of the sagittal axis are larger than the six others, three right and three left (compare Bedot, 60, pl. ix. figs. 1, 2).

These eight primary liver-canals, running between upper face of the centradenia and lower face of the pneumatosacæns, must be regarded originally as ascending branches of the eight primary radial canals of the subumbrella, which run from the basigaster towards the peripheral limb. All the numerous canals (partly hepatic, partly renal vessels) which traverse the centradenia of the larger Discocnætae in all directions, and form a complicated network, are merely secondary branches and ramifications of those eight superficial canals of the primary "liver-star." They seem to be disposed and differentiated in a variable manner. The majority of Discocnætae exhibit in the adult state a superior system of hepatic vessels (characterised by production of brown or blackish pigment granules) and an inferior system of renal vessels (characterised by the production of greenish guanin-crystals), the so-called "white plate" of its discoverer, Köllicher.¹

The cnidoblasts and the intermingled matter, indifferent or interstitial cells of the exoderm, which, densely aggregated, constitute the solid glandular parenchyma of the centradenia, doubtless have their origin in the exoderm. But the locality of their origin, or the point of their exit between the central siphon and pneumatosacæns, has hitherto been doubtful. Bedot, who has given the best and most accurate histological description of the "central organ" of the Velellidæ (58–61), assumes that the place of their origin is the subumbrella. According to his description,² a number of subumbral exoderm-cells immigrate into the interior, passing through numerous pores of the subumbrellar support (his "lamelle aniste externe," loc. cit.). These pores possess, in my opinion, a secondary importance, and are perhaps artificial openings.

It seems to me much more probable that the exodermal cells of the centrdenial parenchyma may be derived from the basal or inferior part of the pneumatosacæns, i.e., that invaginated lamella of the exumbrellar exoderm which encloses and produces the chitinous pneumatocyst ("couche cellulaire qui tapisse le pneumatophore"²). This important part of the pneumatosac is, in young Discocnætae, in immediate contact with the upper face of the centradenia, as Bedot himself has demonstrated.³ The structureless support, which separates the two organs in the adult ("lamelle aniste interne" of Bedot, loc. cit., p. 238), is not yet formed. This, in my opinion, is right, and the constituting exodermal cells of the centrdenial parenchyma are derived from the exumbrellar invagination of the pneumatosacæns; they may be compared to the glandular gas-secreting cells of the "infundibulum pneumatophori" of the Siphonantheæ. I have very often found in well-preserved specimens the cnidoblasts of the centrdenia filled with an air-bubble, and

¹ Köllicher, 4, p. 59.
² Bedot, 59, p. 503, pl. xxv. figs. 4 le, 8 a.
³ Bedot, 59, pl. xxv. figs. 4, 5 in.

(2001. CHALL. EXP.—PART LXXVII.—1888.)
this seems to confirm my opinion that the centradenia is not only a hepatic and a renal, but at the same time a gas-secreting gland.

_Canal System._—The system of gastral vessels or entodermal canals is in the Disconectæ very different from that of all the other Siphonophore (or the Siphonanthæ); it is far more complicated and exhibits from the beginning quite a different type; it is originally octoradial, determined by eight primary perradial gastral canals, which arise from the periphery of the base of the stomach and correspond to the eight subumbrellar radial canals of a common octoradial Medusa (_Trachymena, Pectyllis_). This regular, strictly octoradial type is retained through life in the central part of the canal system of all Discalidæ and Porpitidæ, whilst in the amphithect Vellellidæ it is found only in early stages, and afterwards becomes bilaterally modified, according to the different growth of the two horizontal cruciate axes. No trace of this octoradial canal system is found in the trunk of any other Siphonophore; but a similar type is apparently marked by the octoradial structure of the pneumatosacus in many Physonectæ.

The peculiar development of the gastro-canals in the umbrella of the Disconectæ is produced, firstly, by the voluminous expansion of the pneumatophore and the invagination of the exumbrella connected with it; and secondly, by the development of the centradenia between the latter and the subumbrella. The following eight parts of the canal system may be distinguished in the most highly developed Disconectæ, as we ascend from the central siphon to the top of the pneumatophore:—(1) The system of subumbrellar radial canals (originally eight), arising from the fundus of the stomach, and running horizontally and centrifugally or ascending in the subumbrella towards the margin of the umbrella; they usually form a complicated network of dichotomously branched radial canals. (2) The marginal canal, which connects the distal ends of the latter; it is placed in the true margin of the umbrella, and corresponds to the circular canal of the Hydromeduse. (3) The system of renal canals or white excretory vessels, containing green crystals of guanin; it is formed by a network of branches of the subumbrellar canals, which is placed usually in the basal or inferior part of the centradenia. (4) The system of hepatic canals or brown pigment vessels; it is formed by the apical or superior part of the canal network in the centradenia, in the surface of which it forms a regular octoradial “liver-star.” (5) The system of exumbrellar or pallial radial canals (originally eight); these run centripetally and more or less horizontally in the exumbrella towards the centre of the pneumatophore, where they are united by a small ring, surrounding the apical stigma (“mantle-star”); they may be compared to the eight radial pouches of the pneumatophore in many Siphonanthæ. (6) The system of gonostylic cavities, or the gastral cavities of the polyps which bear the gonophores (palpons in the Discalidæ, siphons in the Porpitidæ and Vellellidæ); they arise as simple subumbrellar diverticula from the inferior branches of the centradenial system. (7) The canal system of each single gonophore, composed of four radial canals and a connecting ring-canal,
identical with that of a simple Medusa; the central union of the former is connected by a pedicellar canal with the gastral cavity of the gonostyle. (8) The system of the tentacular canals or the simple peripheral vessels which arise from the periphery of the subumbrellar system and pass into the tentacles.

Besides these eight parts of the canal system there occurs often (9) a coronal canal, or a horizontal circular ring-canal placed in the coronal groove of the umbrella, between the margin of the pneumatocyst and the centradenia. It represents an inner annular vessel which carries on the circulation in the canals of the centradenia and the sub-umbrella. The entodermal epithelium exhibits a very different and remarkable shape in these different systems of gastro-canals. The most important seems to be the rich production of black or dark brown bilious granules in the hepatic vessels, and of green guain crystals in the renal vessels.

Regarding the morphological value of these different parts of the gastro-canal system of the Disconectæ, and comparing them with the corresponding parts of a simple octoradial Medusa (Trachynemida), we may arrive at the following important conclusions:—

1. The eight primary perradial canals, which arise from the base of the stomach (of the central siphon) and run in the subumbrella towards the margin, are homologous with the eight subumbrellar centrifugal radial canals of a simple Trachynemid (e.g., Pectanthis).
2. The marginal ring-canal, which connects the former and runs along the limb of the umbrella inside the series of marginal glands, is homologous with the usual marginal canal of a simple Medusa. (3) The tentacular canals, which arise from the subumbrellar canals and pass into the tentacles, are comparable to the tentacular canals of those Medusæ which possess submarginal tentacles (e.g., Drymonema). (4) The gonostylar canals, which arise from the subumbrellar canals and pass into the cavity of the gonostyles, are homologous with the cavities of the eight genital sacs of a Trachynemid. (5) The eight centripetal radial canals, which arise from the coronal canal, run in the upper face of the centradenia to its centre and there unite into a “liver star,” may be compared to the centripetal canals of the subumbrella of Carmarina, Pectyllis, and other Trachy-medusæ. (6) The coronal canal, or the inner ring-canal, which runs in the coronal groove on the margin of the pneumatocyst, may be compared to the inner ring-canal which develops by anastomoses of the radial canals in some Medusæ.

Whilst these parts of the canal system of the Disconectæ may be compared to corresponding parts of simple Trachymedusæ, there are other parts which are quite peculiar to the former. These secondary productions are:—(1) The pallial system or the anastomosing radial canals of the exumbrella, which form a network on the upper face of the pneumatophore. (2) The internal reticular canal system of the centradenia, forming a hepatic plexus in its upper and a renal plexus in its lower half. The development of the superficial pallial system of canals is a consequence of the invagination of the apical part of the exoderm which produces the pemunatosaeus. The development of the internal
centradenial system of canals, on the other hand, is the consequence of the centripetal immigration of exodermal parenchyma between pneumatosae and gastrobasal plate, producing the centradenia.

The innumerable ramifying and anastomosing branches of the above-mentioned vessels, which form a very complicated network in the majority of Disconecestae, are secondary productions. Their mutual relations are best understood when we compare them with the typical organisation of the simplest forms of that order, Discalidæ and Disconalia (Pls. XLIX., L.). The canal system exhibits here three typical octoradial horizontal stars:—(1) The pallial star above the pneumatocyst; (2) the hepatic star on the upper face of the centradenia; (3) the gastric star below the gastrobasal plate. The eight peripheral main rays of these stars are united by the coronal ring vessel, which runs in the coronal groove around the equator of the umbrella (Pl. XLIX. fig. 4).

Gonostyles.—The sexual persons of the corona, or the zooids which produce the medusiform gonophores of the Disconecestæ, are arranged in a girdle around the base of the central siphon; they occupy a smaller or broader zone of the subumbrella between it and the corona of tentacles (gonostylar zone). These gonostyles or gonoblastidia are mouthless palpons in the Discalidæ, whilst they are either cystons or true siphons, provided with a terminal mouth, in the Porpitidæ and Vellelidae. They are originally nothing else than secondary manubria of a single Medusa person, budding from the radial canals of the subumbrella. They may consequently be regarded as secondary persons, comparable to the buds of the Gastroblastæ (described by Keller and Lang), and of other Hydro-medusæ budding from the subumbrella. On the other hand they may be compared also to the genital sacs which depend from the radial canals of the subumbrella in the Trachy-nemidæ, Aglaureidæ, Peoctylidæ, and in other families of Hydromedusæ. If we imagine that these genital sacs, instead of themselves producing ova and spermatozoa in their exodermal wall, produce by budding Medusæ which afterwards become sexually mature, we shall understand how the Disconecestæ have originated from Trachomedusæ.

The mouthless medusiferous palpons of the Discalidæ, and the similar secondary siphons of the Porpitidæ and Vellelidae (differing only in the possession of a mouth at the distal end), have the same structure as the large primary central siphon, but are always much smaller. Their number is originally eight, and they form a regular octoradial corona in some smaller and simpler genera (Discalidæ, Pl. XLIX. figs. 1–4; Porpalia, Pl. XLVIII.; Rataria, Pl. XLIV.). Sometimes there are sixteen, e.g., in Disconalia (Pl. L.) and Porpitella (Pl. XLVI.). But usually their number is much increased, and amounts in the larger species to some hundreds. These cover the greatest part of the subumbrella, the large gonostylar zone between the central siphon and the corona of submarginal tentacles, often densely crowded without intervals. The form and size of the gonostyles are very variable, owing to their great contractility. Sometimes they are more spindle-shaped, at other times more cylindrical or pyriform, with a
dilated basal part. Sometimes the proximal half, or the stomach, is separated by a constriction from the distal half or the proboscis. The upper or proximal half only produces by budding the numerous medusiferous gonophores, whilst the distal part, or the contractile proboscis, is armed with cnidonodes. The wall is very contractile, since the longitudinal muscles of the exoderm and the circular muscles of the entoderm are not less developed than in the large central siphon. Sometimes the wall of the gonostyles exhibits eight longitudinal folds or ribs; and often, too, the patches of cnidocysts (or the cnidonodes) are arranged into eight parallel longitudinal rows along the proboscis.¹

The gastric cavity of the gonostyles opens above into a canal of the subumbrella, or of the centredenia. Its lower or distal end is a closed cæcum in the monogastric Discalideæ, the terminal apex being densely beset with cnidocysts. It opens by a terminal mouth in the Porpitideæ and Velellideæ; this mouth is not less contractile and expansible than the larger mouth of the central siphon. Often the former exhibits four cruciate lips, more rarely eight; sometimes it is circular, without mouth lobes (compare the descriptions of the gonostyles by Kölliker (4), Vogt (5), Leuekart (8), Huxley (9), Agassiz (57), and others).

**Gonophores.**—The medusiform gonophores arise from the proximal part of the gonostyles, rarely isolated, usually crowded in smaller or larger groups or bunches. They are in all Disconectæ of the same form, and are detached from the budding gonostyle before coming to sexual maturity. The detached gonophores are very small quadriradial Medusæ of very simple structure. Their subumbrella exhibits four regular radial canals which unite above the velum by a circular canal (compare the above-mentioned authors).

**Tentacles.**—The limb of the umbrella is in all Disconectæ armed with a corona of tentacles, in the same manner as in all fully-developed Hydromedusæ. They are placed not at the margin itself, but more or less inside, at its lower face, the peripheral zone of the subumbrella. They are, therefore, strictly speaking, submarginal tentacles (such as occur also in some Medusæ, *e.g.*, *Drymonema*). Some authors (Claus, Alexander Agassiz, &c.) regard these organs as self-subsistent persons or zooids, and call them "prehensile polypites," "marginal polypites," "tasters," "daetylozooids," &c. But this conception is quite erroneous, and, in my opinion, there can be no doubt that the submarginal corona of tentacles in the Disconectæ are the same organs as in the common Medusæ, both from a morphological and from a physiological point of view.

**Octoradial Corona of Tentacles.**—It is a most important fact, not hitherto pointed out as it deserves, that in the larvæ of most Disconectæ there occurs a typical stage, with a corona of eight equidistant and regularly disposed tentacles. They are placed at the distal end of the eight primary radial canals which arise from the base of the central siphon, run along the subumbrella, and are connected round the margin by the circular

¹ Compare 57, pl. ii. figs. 1–8.
canal; just as in the common octoradial Hydromeduse (e.g., Trachynema, Rhopalonema). This regular corona of eight simple radial tentacles is permanent in the simplest and oldest form of the Disconectae (Discaleia, Pl. XLIX. figs. 1-4). In all other genera of this order the number of tentacles is rapidly increased, either by interpolation of eight inter-radial secondary tentacles between the eight perradial primary ones, or by budding of new secondary tentacles on both sides of the base of the primary ones, so that there arise eight bunches of tentacles (Disconalia, Pl. L.; Porpalia, Pl. XLVIII.). In the larger Porpitidae their number is afterwards so multiplied, that the margin is armed with a rich corona of many hundreds, or even thousands of tentacles (Porpema and Porpita, Pls. XLVII. and XLV.). They are here densely crowded, and arranged in concentric girdles (sometimes six to nine or more); the uppermost (or proximal) girdle usually bears the smallest, and the lowermost (or distal) the largest filaments. Their number is much smaller in the Velellidæ, where they form only a single submarginal series in Rataria (Pl. XLIV.) and Veella, a double (or rarely multiple) series in Armeniesta (Pl. XLIII.). Also in this family the original number seems to be eight, and in some smaller forms are found sixteen; but in consequence of the bilateral development of the umbrella, their number and arrangement is often modified, bilateral, or irregular. In the young larval forms (Ratarula) often two primary tentacles, situated at the opposite poles of the major axis (or sagittal diameter) of the elliptic disc, appear earlier than the others; this heterochronism is certainly kenogenetic.

Structure of the Tentacles.—The tentacles of the Disconectae are very different from those of all other Siphonophora; they are relatively short and thick, rather rigid, and their movements are sluggish, as in most Trachomeduseæ. In general they are far less extensile and contractile, and do not exhibit that peculiar development and movement which are obvious in most of the Siphonantheæ, and are similar to that of the Anthomeduseæ. The body of each tentacle in all Disconectæ is a hollow cylinder with a very strong muscular wall and a narrow canal, closed at the distal end and opening at the proximal end into the annular canal of the margin, or the marginal zone of the canal network. The wall is composed, as usual, of the following five strata, enumerating them from without inwards:—(1) An exodermal epithelium, armed with cnidoblasts, often vibratile in some parts; (2) a strong layer of longitudinal muscles; (3) a thin, but firm and elastic structureless supporting lamella; (4) a thin layer of ring-muscles; (5) a vibratile endodermal epithelium, lining the central canal, composed of very large vacuolate endoderm cells similar to the axial cells in the tentacles of many Trachomeduseæ.

The armature of the tentacles with cnidoblasts exhibits characteristic differences in the families of Disconectæ. Discaleia (Pl. XLIX. figs. 1-4), as the simplest form of all, and likewise probably the youngest larval stages of all Porpitidae, possess eight simple tentacles, which bear a single endosphere (or a spherical knob composed of cnidocysts) at their distal end (Pl. L. fig. 9).
The next larval stage of the Porpitidae exhibits four stalked cnidospheres at the distal end of each tentacle;¹ one of these is the primary terminal knob, whilst the three others are lateral branches (Pl. I., fig. 10). By multiplication of the latter in the prolonged tentacle arise three longitudinal rows of stalked cnidospheres, one of which is situated on the inferior or distal side of the tentacle, the other two opposite on its two lateral sides. These three longitudinal rows of short lateral branches, each of which bears a spherical cnidodome, are very characteristic of all Porpitidae; each row bears six to nine or more branches in the larger species, their size decreasing from the terminal (oldest) branch towards the basal (youngest). The basal half of the tentacles is usually simple, and bears no branches.

The tentacles of the Vellellidae are never branched; they always remain simple cylindrical filaments, and are relatively short and small. The cnidostyles are either irregularly scattered on their surface, or form two opposite ribands on the two lateral sides.

Ontogeny.—The individual development of the Discobriza is very incompletely known, but seems always connected with a peculiar form of metagenesis. The first generation is asexual, the complicated cornus above described producing at its sub-umbrella numerous polypites or secondary manubria (mouthless palpons in the Discalidae, mouth-bearing siphons in the Porpitidae and Vellellidae). From the gastrall wall of these secondary polypites (surrounding the sterile central siphon) there arise numerous medusiform buds of the form Discobriza. These do not become mature whilst sessile and attached to their parents, but are soon detached, and develop into free Hydromeduse, which produce ova and spermarioa. Some advanced stages of this second sexual generation are described by Gegenbaur as Chrysmitra, and possess eight or sixteen radial canals; but they have not hitherto been sufficiently examined in the adult state. The origin and structure of the sexual organs of the Discobriza, ovaria as well as spermatria, require a further accurate examination.

It is very probable (though not observed) that from the fertilised egg of this second generation arises a young Medusa with eight radial canals, and that this early produces in the top of its hemispherical umbrella the pneumatocyst, at first a simple central chamber (comparable to the simple pneumatocyst of the Siphonanthe) and subsequently a corona of eight radial chambers. From this common larval stage probably arise two different lines of individual development. The Discalidae, on one hand, remain regularly octoradial, and develop eight marginal tentacles (with increasing number), and between these and the central siphon eight or sixteen gonostyles, remaining mouthless palpons. The Porpitidae retain the same regular octoradial type, but are further developed, and their gonostyles, at first mouthless, acquire afterwards a distal mouth-opening and metamorphose into secondary siphons.

On the other hand, a different course is followed by the bilateral Vellellidae. Here

¹ Compare A. Agassiz, 59, pl. ix. fig. 1.
there arises early a vertical longitudinal fold of the exoderm above the pneumatocyst; and this commencement of the typical vertical sail determines the amphithecet or bilateral development of this family; the umbrella becomes elliptical, and the gonostyles bud between central siphon and corona of tentacles, not in concentric circles (as in the Porpitidae) but in elliptical or oblongish rings. The ontogenetic metamorphosis of these larvae, developing into the first asexual generation, is not completely known in any Diseonectae. For further particulars regarding the ontogeny reference may be made to the works of Köllicher (4), Vogt (5), Gegenbaur (7), Huxley (9), Pagenstecher (55), Alexander Agassiz (57), and others.

Phylogeny.—The historical or phylogenetic development of the various forms of Siphonophorae, which we unite in the legion Diseonectae, may be partly recognised from the critical study of their comparative anatomy and ontogeny. By this means I have been conducted to new views of the origin of this interesting subclass, quite different from those of all naturalists who have hitherto treated the question. The general opinion is that the Diseonectae are the most highly developed Siphonophorae, terminating the series of this class, and most nearly related to the Cystonectae (Physaliae). Even the radial chambers of the pneumatophore of the Diseonectae have been often compared to the crista-chambers of the pneumatophore of Physalia. This comparison, and all the important consequences deduced from it, are, in my opinion, perfectly erroneous. In direct contradiction to it, I am convinced of the truth of the new theory which I have already shortly explained in my propositions;¹ its principal points are here repeated.

The Diseonectae (or Diseonanthae) have no direct relation to the Siphonanthea (or all other Siphonophorae); they have originated, independently of the latter, in a different way and from a different group of Hydromedusae. Whilst the Siphonanthea are probably the offspring of the Anthomedusae (Codonidae), and their cormus developed by budding from the ventral line of the original siphon, the Diseonanthea, on the other hand, are probably descendants of the Trachomedusae (Trachynemidae), and developed by budding from the subumbrella.

The common ancestral group of all Diseonectae is the family Discalidae (most nearly allied to the Trachynemidae). From these, probably, the two other families, Porpitidae and Velellidae, have been developed as two divergent branches, or, perhaps, the latter have been derived directly from simpler forms of the former family.

Synopsis of the Three Families of Diseonectae.


¹ System der Siphonophoren, Jena, 1888.
Family I. **Discalidae**, Haeckel, 1888.

*Discalidae*, Hkl., System der Siphonophoren, p. 29.

**Definition.**—Disconectæ with an octoradial circular permanent umbrella, including a circular, campanulate or discoidal pneumatocyst, without vertical crest. No vertical sail upon the umbrella. Submarginal tentacles of the umbrella simple or branched, with terminal cnidospheres. Central siphon surrounded by numerous mouthless palpons, which bear the medusiform gonophores.

The family Discalidae comprises some new, small, but very interesting Siphonophore from the deep sea, which were found in the collections of the Challenger. They are in general very similar to young Porpitidae, but differ from them in the very important character, that the large central siphon alone possesses a mouth, while the surrounding gonostyles or blastostyles are mouthless palpons. The Discalidae are therefore "*Disconectæ monogastrice*," and become mature in the monogastric state, which is a transitional larval stage in the Porpitidae. These latter, as well as the Velellidae, are in the adult state "*Disconectæ polygastrice*," each gonostyle possessing a mouth and representing a peripheral sexual siphon. The Discalidae may be regarded as the simplest and most primitive of all Siphonophore, since they retain the original character of a simple octoradial Medusa (like *Trachynema* or *Pectyllis*) more nearly than all the others.

**Umbrella.**—The complete body of all Discalide is circular, sometimes more lenticular or discoidal, at other times more campanulate or even subglobular. The vertical or main axis is, therefore, sometimes nearly as great as the horizontal or equatorial axis, at other times scarcely half as great, or even less. The free prominent margin, or the glanduliferous limbus umbrellæ, marks the boundary between its upper (apical or proximal) face, the exumbrella, and its lower (basal or distal) face, the subumbrella. The former includes the pneumatophore, and represents with it the *nectosome*; the latter is the *siphosome*, and bears in its centre the large primary sterile siphon, around this numerous sexual palpons (or gonostyles), and towards the margin the corona of tentacles.

A vertical meridional section through the umbrella (Pl. XLIX. fig. 4) demonstrates that the superior half of the umbrella is occupied by the pneumatocyst (*ph*), the inferior by the large centradenia (*uc*), and from this depend in the centre the large central siphon (*sa*), and around it the corona of gonostyles (*gs*). A deep circular coronal groove separates this latter from the corona of submarginal tentacles.

**Exumbrella.**—The superior (apical or proximal) face of the umbrella is flat or slightly convex, smooth, and pierced by the stigmata of the pneumatocyst. It is composed of two parallel lamellae, which are separated by the network of the pallial vessels. The external or superior lamella is the pneumatocodon, which contains numerous cnido-
eysts, and (usually) exhibits a distinct otoradial pigment star in its centre (fig. 7). The internal or inferior lamella is the pneumatosaeus, the invaginated plate of the exoderm, which secretes the chitinous pneumatoeyst. Its lower face is in contact with the upper face of the centradenia.

**Limbus Umbrella** (Pl. L figs. 1, 9, us).—The free horizontally prominent margin of the umbrella, which separates the exumbrella from the subumbrella, is in all Disealidae more or less otoholobate; the eight interradial convex lobes are the more prominent, the deeper are the eight incisions in which are inserted the marginal tentacles. The whole edge of the mantle-border is beset with a continuous series of marginal muciparous glands.

**Subumbrella**.—The inferior (basal or distal) face of the umbrella is convex, and bears in its centre the large conical central siphon, around this a corona of gonostyles (eight in *Discalia*, sixteen in *Disconalia*), and in the peripheral part a simple or double corona of tentacles (eight simple tentacles in *Discalia*, Pl. XLIX., eight radial bunches of numerous tentacles in *Disconalia*, Pl. L.).

**Pneumatoeyst** (Pl. XLIX. figs. 4, 5, 8, 9).—The float filled with gas, which is included in the pneumatosaeus, always exhibits in the Disealidae a regular otoradial structure. This is of typical simplicity in *Discalia* (Pl. XLIX. figs. 2–5), composed only of a subspherical central chamber and a surrounding regular ring of eight equal triangular radial chambers. The more advanced genus, *Disconalia* (figs. 8, 9), exhibits the same biconvex otoradial disc in its central part; but it is here surrounded by a peripheral girdle of five to ten eocentric ring-chambers; the middle ones of these are far broader than the innermost and the outermost.

**Pneumothyra**.—Each of the eight radial chambers of the central disc of the pneumatoeyst communicate with the common central chamber by an inner opening or pneumothyra, placed on the proximal apex of the triangular chamber. Opposite to this lies in the centre of its distal base another pneumothyra, which opens into the first or innermost ring-chamber. An interradial series of similar septal openings, by which every two neighbouring chambers communicate, lies in the centrifugal continuation of the interradial line, which bisects each triangular chamber and connects its apical with its basal pneumothyra. They are, therefore, in *Disconalia* eight regular interradial rows of pneumothyra (Pl. XLIX. figs. 8, 9, pg), and these alternate regularly with the eight perradial grooves which separate the eight triangular chambers from one another, are continued to the peripheral margin of the pneumatoeyst, and divide the latter into eight equal triangular octants. The free margin of the pneumatoeyst thus becomes distinctly otoholobate.

**Stigmata** (Pl. XLIX. figs. 2, 5, 8, 9).—The superior (apical or proximal) face of the pneumatoeyst bears the stigmata or the short tubular openings which pierce the exumbrella and permit an expulsion of the enclosed air. *Discalia* (fig. 2) has only nine stigmata, one central, in the central chamber, and one in each of the surrounding eight radial chambers. In *Disconalia* (figs. 8, 9) this number is increased by a variable number of
accessory stigmata, lying in one or in several of the concentric ring-chambers. Usually the third or fourth only of these exhibit eight stigmata, placed in the interradial lines, which pass through the former. But sometimes these accessory stigmata are irregularly scattered. The gas enclosed in the pneumatoeyst may issue by these stigmata, when the strong muscle-plate of the surrounding pneumatosacens contracts.

Trachæ (figs. 5, 9, pt).—The inferior (basal or distal) face of the pneumatoeyst bears the aëriserous tubules which receive the gas secreted by the pneumadenia and conduct it into the chambers of the former. The simplest genus, Discalia (fig. 5), possesses only eight short trachæ, which arise from the peripheral part of the inferior side of the eight triangular radial chambers. The more highly developed Disconalia (fig. 9) exhibits, besides these latter, a greater number of peripheral trachæ, arising from the lower face of the concentric ring-chambers; they are more numerous in the innermost than in the middle ring-chambers, and are wanting in the outermost. Their number amounts to from twenty to eighty or more; their arrangement is variable and irregular. The trachæ in all Discalidae are very short and small, their cylindrical articulate tubules composed of ten to thirty small conical segments. They are more or less irregularly curved, and descend in various directions into the solid glandular parenchyma of the centradenia, where their open distal ends are surrounded by exodermal cells. In no Discalidae do the short trachæ pierce the entire centradenia and the subjacent gastrobasal plate, nor do they enter into the base of the wall of the central siphon and the gonostyles, as is the case in the Porpitidae.

Central Siphon.—The large central polypite, which corresponds to the manubrium or gastric tube of the original Medusa, in the Discalidae is relatively larger and more developed than in the Porpitidae and Velellidae. It is in the former the only organ for the reception of food and digestion, whilst these nutritive functions in the two latter families are executed also by the sexual peripheral siphons. The central siphon of the pyriform Discalia (Pl. XLIX. figs. 1–4, sa) is very elongated, and about as long as the greatest diameter of the umbrella, whilst it is much smaller in the discoidal Disconalia (Pl. L. fig. 1); its diameter (in length and breadth) is here only one-third or one-fourth of the latter. The basal part (or stomach) is ovate or pyriform, the distal half (or proboscis) cylindrical. The thick, very contractile wall is composed, as usual, of a stronger exodermal longitudinal layer of muscles, and a thinner entodermal layer of circular muscles, separated by an elastic structureless support.

The fundus of the stomach is separated from the superjacent centradenia by the horizontal gastrobasal plate. The periphery of this solid circular or octagonal support exhibits eight equidistant openings, the ostia, which conduct into the eight radial canals of the subumbrella. These ostia are prolonged sometimes downwards into eight longitudinal grooves at the inside of the stomach, and to these correspond eight longitudinal folds or ribs on its outside.
The mouth or the distal opening of the central siphon is either circular or octagonal, with eight short regular lips or radial mouth lobes (Pl. L. figs. 1, 3). Its edge is strongly armed with cnidocysts.

_Centradenia_ (Pl. XLIX. figs. 4, 10, 11).—The large central gland, which is called the "liver" in the Porpitidae and Vellellidae, does not exhibit in the Discalidae the complicated structure seen in those two families, but merely a typical and most instructive simple shape. It is a biconvex lenticular disc of circular or octagonal outline, in _Discalia_ (fig. 4) relatively thick and small, in _Disconalia_ (fig. 10) broader and flatter. Its horizontal diameter is two to four times as great as its vertical main axis, and of the same length as that of the pneumatoecyst above it. Its peripheral margin is surrounded by the corona of gonostyles, whilst its inferior face is in contact with the central siphon.

The entire mass of the lenticular centradenia is composed, in the Discalidae, of numerous densely aggregated exodermal cells and cnidocysts, and many of these are (in the well-preserved spirit specimens of the Challenger collection) filled with an air-bubble; it is therefore very probable that these cells secrete the gas, which is taken up by the open distal ends of the tracheæ, and conducted by these into the chambers of the pneumatoecyst. These gas-producing exodermal cells are probably derived from the basal part of the pneumatosaeceus, or the invaginated lamella of the exoderm which includes the pneumatoecyst. The thin structureless supporting plate, which separates the upper face of the centradenia from the overlying pneumatosaeceus, is pierced by numerous pores which permit a direct connection between the two.

The solid exodermal parenchyma, in the Discalidae, is only traversed by the tracheæ, and not by the so-called "liver-canals," which form a complex network in the Porpitidae and Vellellidae. These hepatic canals are here confined to an ocroradial "liver-star," which lies in the superior face of the centradenia. The eight main rays of it lie in the eight perradial grooves between the eight interradial triangular air-chambers, and are united in the centre of the lower face of the central chamber. They arise from the basal part of the eight subumbrellar radial canals (near their opening into the base of the central siphon), and embrace the surface of the centradenia like eight equidistant meridional arches. They remain single in _Discalia_ (fig. 4), whilst they are forked and branched dichotomously in _Disconalia_ (fig. 10).

_Gonostyles._—The polypites (or secondary manubria) which produce by budding the medusiform gonophores are in the Discalidae mouthless palpons, and not siphons provided with a mouth, as is the case in the nearly allied Porpitidae and the more divergent Vellellidae; but also in the latter two families the gonostyles arise from the subumbrella in the same mouthless form, and acquire their mouth opening later. Their structure is the same as in the palpons of the Discalidae. These are spindle-shaped or pyriform, much smaller than the central siphon; they form a regular simple corona around the base of the latter. _Discalia_ (Pl. XLIX. figs. 1, 3) possesses eight, and _Disconalia_
(Pl. L. figs. 1, 2) sixteen gonostyles. The medusiform gonophores arise from their proximal part either isolated or in clusters (compare p. 37 above).

Tentacles.—The corona of submarginal tentacles exhibits in the Discalidæ very interesting forms, since these organs correspond in the two genera of this family to those of two important larval stages of the Porpitidae. Discalia (Pl. XLIX. figs. 1, 4) possesses only eight simple radial tentacles of cylindrical form, which bear no lateral branches, but a simple terminal cnidosphere (or a spherical knob composed of radially disposed enidocysts). The larva of the other genus, Disconalia, also exhibits in its young state eight simple tentacles (Pl. L. fig. 9), and hereafter at their distal end a group of four terminal cnidospheres (fig. 10). These become multiplied in older larvae, and form a subumbrellar corona inside the limb of the umbrella. The adult Disconalia (Pl. L. fig. 1) possesses two rows of tentacles, in which eight perradial bunches are prominent. Each tentacle is cylindrical, with club-shaped distal end, and bears in its distal half three longitudinal rows of pediculate cnidospheres, an odd inferior and two paired lateral series (compare p. 38).

Ontogeny.—The individual development of the Discalidæ is not known, but is probably identical with that of the Porpitidæ (compare p. 39).

Phylogeny.—The phylogenetic value of the Discalidæ is, in my opinion, very great. I regard Discalia as a survival of the common ancestral form of all Disconectæ, and Disconalia as an intermediate form between this and Porpalia.

Synopsis of the Genera of Discalidæ.

Umbrella with eight simple tentacles. Pneumatocyst without concentric ring-chambers. . . . . 1. Discalia.
Umbrella with numerous tentacles, arranged in eight radial bunches. Pneumatocyst with concentric ring-chambers, surrounding the octoradial central disc, . . . . . 2. Disconalia.

Genus 1. Discalia, Haeckel, 1888.

Discalia, Hkl., System der Siphonophoren, p. 29.

Definition.—Discalidæ, with a lenticular or subglobular umbrella, including a lenticular pneumatocyst, which is composed of a central chamber and eight surrounding radial chambers, without concentric ring-chambers. Marginal tentacles eight, simple, with a terminal cnidal knob.

The genus Discalia is the simplest and most primitive form of all Disconectæ, and may be regarded as one of the common ancestral forms of this order. It may be compared to an octonemal Trachomedusa (Trachynema, Marumema, Rhopalonema), which has developed an octoradial pneumatophore in its exumbrella, and in which the eight simple genital sacs of the subumbrella have been replaced by eight palpons or mouthless gonostyles, which afterwards produce medusiform gonophores by budding.

1 Discalia = marine disc, δίσκος, δίσσα.
All Porpitidae probably pass during their metamorphosis through a larval stage, which is essentially identical with Discalia, and differs from it only in the absence of sexual palpons or gonostyles, bearing gonophores. The young larva of Porpita linnæana, which Alexander Agassiz has figured, exhibits a larval stage which is a little more advanced, and forms the transition to the Disconalia-stage.

The phylogenetic importance of Discalia, therefore, is very great. On the one hand, it seems to indicate clearly the origin of the Disconectae from the Trachomedusa (Trachynemidae); on the other hand, all the other Disconectae may be derived from it as from a common ancestral genus.

Two species of Discalia, both inhabitants of the deep sea, were found by me in the Challenger collection. The first species, Discalia medusina, was taken in the centre of the Southern Pacific, at Station 288 (depth, 2600 fathoms), and is figured in Pl. XLIX. figs. 1–6. The second species, Discalia primordialis, was captured in the tropical Pacific, at Station 274 (depth, 2750 fathoms). The latter is distinguished from the former by a more flattened umbrella, and by eight longer (perradial) tentacles, between which eight shorter (interradial) were interpolated; but as its state of preservation was not sufficient, I give here only the description of the first well-preserved species.

_Discalia medusina_, n. sp. (Pl. XLIX. figs. 1–6).

_Habitat._—Southern Pacific, Station 288, October 21, 1875; lat. 40° 3' S., long. 132° 58' W.; depth, 2600 fathoms.

_Umbrella_ (fig. 1, view from below; fig. 2, from above; fig. 3, in profile; fig. 4, in meridional section).—The umbrella, which represents the nectosome, is subspherical, 0·2 to 0·4 mm. in diameter. A deep annular constriction separates the flatter exumbrella from the inflated and highly vaulted subumbrella. The latter bears in its equatorial zone a corona of eight simple tentacles, and beyond it a corona of eight gonostyles, which surround the central siphon.

_Exumbrella_ (fig. 2).—The superior or apical face of the umbrella is rather flat, and exhibits an ooeiradial star of brown pigment, indicating the course of the eight perradial exumbrellar canals, or the superior vessels of the mantle. The apical stigma, or the superior opening of the central air-chamber, is situated in the centre of the pigment-star, whilst eight other stigmata, the outer openings of the eight interradial air-chambers, are placed between the eight rays of the dark pigment-star.

_Limbus Umbrella_ (un).—The circular margin of the umbrella is thickened and divided by eight perradial incisions into eight prominent flat interradial lobes. The whole margin is beset with a corona of the usual marginal glands (fig. 6) (compare p. 42 above).
Subumbrella (fig. 1).—The inferior or basal face of the umbrella is nearly hemispherical. Its centre is occupied by the central siphon (sc), and this is surrounded by a corona of eight gonostyles (gs). The equatorial zone of the subumbrella is beset with eight perradial tentacles, and between these proceed outside the eight interradial lobes of the limbus.

Pneumatocyst (fig. 2; pf, from above; figs. 4, 5 in meridional section).—The central air-chamber (ph) is spheroidal, large, and occupies about half the volume of the float. A prominent tubular stigma (figs. 4, 5, pe) opens in the centre of its upper face. The eight radial air-chambers, which surround the former as a regular corona (pq), are crescentic, concave on the axial side, convex on the abaxial side; each opens by a stigma on the upper face (pe). The pneumatocyst possesses only eight simple tracheae (pt), one arising from the inferior face of each radial chamber; the eight tracheae descend obliquely and contorted downwards, enter into the centradenia (fig. 4, wc), and terminate in it: but they do not pass into the exodermal wall of the central siphon.

Centradenia (fig. 4, wc).—The large central gland is a circular disc, the diameter of which is about three to four times as great as its height, and equals that of the pneumatocyst. The inferior face of the latter is in close contact with the superior face of the former; whilst the inferior face of the centradenia is separated by a thick support, the gastrobasal plate, from the base of the central siphon. The whole mass of the solid centradenia is composed of exodermal cells. Its entodermal system of hepatic vessels is confined to an eight-rayed star on its superior face. The eight radial canals, which are connected in the centre of the latter, arise from the proximal third of the eight subumbrellar radial canals which run from the base of the central siphon towards the margin of the umbrella. This simplest form of the gastro-hepatic canal-system gives the explanation of its more complex form in the other Disconeetea.

Central Siphon (figs. 1–4, sa).—The central polypite is a thick-walled contractile tube, inversely conical in the proximal half, cylindrical in the distal half. Its length about equals the equatorial diameter of the umbrella, and is twice as great as the diameter of its base. The thick muscular wall is composed of a strong outer layer of exodermal longitudinal fibres, and a thin inner layer of entodermal circular fibres, both separated by a structureless elastic fulcrum. The distal mouth is octolobate.

The gastrobasis, or the horizontal roof of the stomach, is regularly octagonal, separated by a thick fulcrum, the gastrobasal plate, from the centradenia above it. It is pierced in the periphery by the gastric openings of the eight radial main vessels. These give off branches for the gonostyles and tentacles, and run centrifugally in the subumbrella towards the limbus, where they are united by a marginal ring-canal.

Gonostyles (figs. 1–4, gs).—The eight sexual palpons are about half as long and broad as the central siphon. They bear clusters of gonophores in their cylindrical basal part, patches of cnidocysts in their spindle-shaped distal part.
Tentacles (figs. 1-4, t).—The eight tentacles are cylindrical, somewhat larger than the diameter of the umbrella, and bear a single endosphere at the distal end.

Genus 2. Disconalia,¹ Haeckel, 1888.

Definition.—Discalidae, with a lenticular or discoidal umbrella, including a discoidal pneumatocyst, which is composed of a central chamber, eight surrounding radial chambers, and several concentric ring-chambers. Marginal tentacles numerous, arranged in eight radial bunches.

The genus Disconalia is closely allied to the preceding ancestral genus Discalia; but it differs from it in the multiplication of the marginal tentacles, which form eight marginal bunches; and mainly in the peripheral increase of the octoradial pneumatocyst, which is surrounded by several concentric ring-chambers. It corresponds therefore to that larval stage of the Porpitidæ which Alexander Agassiz ² has figured of Porpita linnæana. The young larva, probably of all species of Porpitidæ, after having passed the Discalia-form, assume a transitional Disconalia-form.

Perhaps even Eschscholtz observed a Disconecta belonging to this genus. The interesting small form, taken in the tropical Pacific, which he figures under the name Porpita ramifera,³ is either a true Disconalia, or the corresponding larva of some Porpitid passing through this typical stage. The answering of this question is not possible, since the organs of the subumbrella, which would be decisive, are neither figured nor even mentioned in the description given by Eschscholtz.

Two species of Disconalia (both deep-sea inhabitants) were found by me in the Challenger collection, one from the Southern Pacific (Station 181), the other from the Indian Ocean, south of Australia (Station 157). The latter (Disconaliapectyllis) had much longer and less ramified tentacles, and a larger pneumatocyst, than the former (Disconalia gastroblasta); but its state of preservation was not sufficient for a full description. Regarded from a phylogenetic point of view, Disconalia is of the highest importance as a necessary connecting link between Discalia and Porpalia. It is derived from the ancestral genus Discalia by the multiplication of the air-chambers and the tentacles; if its gonostyles acquired a mouth, it would pass into Porpalia.

Disconalia gastroblasta, n. sp. (Pl. XLIX. figs. 7-12; Pl. L. figs. 1-10).

Habitat.—Southern Pacific, north-east of Australia, Station 181, August 25, 1874; lat. 13° 56' S., long. 151° 49' E.; depth, 2440 fathoms.

¹ Disconalia, derivative from Discalia. ²57, pl. ix. fig. 3. ³1, p. 17, Taf. 16, figs. 3a, 3b.
**Umbrella** (Pl. I. fig. 1, from below).—The umbrella is slightly vaulted, lenticular, nearly discoidal, 4 to 6 mm. in diameter; its vertical axis is about 1 mm. The margin is regularly octolobate, with eight deep marginal incisions, from which arise the eight bunches of tentacles.

**Exumbrella** (Pl. XLIX. fig. 7).—The superior face of the umbrella is rather flat, a little vaulted, and exhibits a regular network of brown pigmented canals, the exumbrellar vessels. Eight regular radial canals arise from a central circular canal, in the centre of which is placed the apical stigma of the pneumatoecyst. The eight interradial chambers of the latter are separated by these perradial mantle canals, which anastomose outside and form a ring around each chamber. From this ring arise in each octant four to six centrifugal canals, which are forked and prolonged outside the pneumatosaccus into the exumbrellar canals of the limbus. Their dichotomous branches are connected by anastomoses. A few peripheral stigmata are scattered in the outer half of the exumbrella.

**Limbus Umbrella** (fig. 7, um).—The free margin of the umbrella, outside the corona of tentacles, is distinctly octolobate, and bears a series of pyriform marginal glands on its free edge. The eight interradial convex lobes are more or less prominent between the eight perradial bunches of tentacles.

**Subumbrella** (Pl. XLIX. fig. 11).—The inferior face of the discoidal umbrella is more convex than the superior, and is divided into four different zones. The central zone is occupied by the large central siphon (sa). This is surrounded by a corona of sixteen gonostyles, and this by an octagonal tentacular zone (fig. 12, tu). Outside the latter is prominent the broad octolobate limb of the subumbrella.

**Pneumatocyst** (fig. 8, half of the inferior face; fig. 9, half of the superior face).—The subspherical central chamber (ph) possesses an apical stigma in the centre of its upper face, and is surrounded by a corona of eight equal triangular radial chambers, each of which bears a circular stigma. This octoradial central disc is surrounded by a peripheral girdle composed of eight or nine concentric ring-chambers; the second and third of these (pk) are the broadest, much broader than the peripheral chambers. Eight deep perradial furrows of the lower face separate the eight chambers of the octoradial ring one from another, and are prolonged up to the circular margin of the pneumatoecyst, dividing it into eight slightly prominent lobes. In the middle between each two furrows (therefore in eight interradial rows) may be seen the pneumathyrre, or openings by which the concentric ring-chambers communicate one with another (fig. 8, pg).

The superior or apical face of the discoidal pneumatoecyst (fig. 9) is slightly convex, and bears about twenty stigmata, viz., one central, eight interradial (in the middle of the eight triangular chambers), and eight to twelve peripheral, irregularly placed in the second to the fourth ring-chamber.

The inferior or basal face of the pneumatoecyst (fig. 8) is slightly concave, and bears

(200L chAL exp.—pArt lxxvii.—1888.)
between fifty and ninety short tracheae (six to twelve in each octant). These are placed in the periphery of the ooctradial ring, and in the two to four next following chambers; they are wanting in the periphery.

Centradenia (figs. 10–12, uc).—The large central gland, or so-called "liver," is an octagonal, lenticular, biconvex disc, of the same horizontal diameter as the overlying pneumatocyst. Its thickness is inconsiderable, and decreases towards the periphery. Its convex superior face (fig. 10) is in close contact with the concave inferior face of the latter. The peripheral octagonal margin of the centradenia does not exceed that of the covering pneumatocyst.

The inferior face of the centradenia is rather flat, and is separated by a thin fulcrum from the subumbrella. Its central part is in contact with the gastrobasal plate of the central siphon; its peripheral part with the corona of gonostyles, and its margin with the corona of tentacles.

The structure of the centradenia exhibits in Disconalia the same remarkable simplicity and typical form as in Discalia. The solid parenchyma is entirely composed of masses of aggregated exoderm-cells, with innumerable cnidocysts. A regular ooctradial star of pigmented hepatic vessels is placed on its superior face (fig. 10). From the centre of the latter arise eight perradial brown "liver-canals," which branch dichotomously, and run on its upper face towards its peripheral margin. They pass here over into the peripheral canal-network of the subumbrella, from which arise the canals of the tentacles and gonostyles.

Central Siphon (Pl. L. figs. 1, 3).—The large central polypite has the usual form of an inverted cone. The broad octagonal base occupies the central area of the subumbrella, and is separated from the centradenia above it by the gastrobasal plate. The periphery of the base opens by eight perradial ostia (Pl. XLIX. fig. 12) into the eight radial main vessels which run in the subumbrella towards the limb, and give off the ascending centripetal canals of the "liver-star" (fig. 10).

The muscular wall of the central siphon is very thick. It opens by a distal octolobate mouth, the edges of which are strongly armed with cnidocysts (Pl. L. fig. 3).

Gonostyles (Pl. L. figs. 1, 2).—Sixteen sexual palpons, or mouthless gonostyles, form a corona around the base of the sterile central siphon. They are small spindle-shaped sacs, scarcely half as long as the central siphon. Their wider basal half bears clusters of gonophores (fig. 2, g), whilst the slender distal half is beset with cnidonodes (k); the closed distal end is obtusely conical and entirely covered by cnidocysts.

Tentacles (Pl. L. figs. 1, 4–6).—The tentacles are very numerous and densely crowded in the subumbral groove between the corona of gonostyles and the limb of the umbrella. They alternate here in a double row (Pl. XLIX. figs. 1, 2). The tentacles which arise from the eight perradial corners of the octagonal girdle are much longer than the interjacent interradial, and form therefore eight prominent bunches.
The structure of the cylindrical tentacles is the same as in all Porpitidae. They bear three rows of pediculate cnidospheres in their club-shaped distal half, one inferior and two opposite lateral rows (figs. 4–6).

Family II. Porpitidae, Brandt, 1835.

Porpitidae, Brandt, Prodromus, 25, p. 40.

Definition.—Discocoeaæ with a circular permanent umbrella, including a campanulate or discoidal pneumatocyst, which is composed of an octoradial centre and numerous concentric rings, without vertical crest. No vertical sail upon the umbrella. Submarginal tentacles with three rows of pediculate cnidospheres. Central siphon surrounded by numerous peripheral fertile siphons, which bear the gonophores.

The family Porpitidae, founded in 1835 by Brandt for the genus Porpita, comprises all those Discocoeæ polygastricaæ which have a circular umbrella and a regular originally octoradial ground-form. They agree in their regular octoradiate form with the mono gastric Discalidae, their ancestral group, but differ from them essentially in the polygastric structure which they share with the Velellidae. Not only does the primary sterile central siphon possess a mouth opening at its distal end, but likewise also each of the surrounding gonostyles. These peripheral polypites, which bear the gonophores budding from their proximal part, are therefore not mouthless palpons (as in the Discalidae), but mouth-bearing, feeding, and digesting secondary siphons. The Velellidae, with the same polygastric organisation, differ from the Porpitidae in the amphithect or bilaterally-radial type, and in the development of a vertical sail upon the exumbrella.

Eschscholtz, in his fundamental work,\(^1\) described five different species of Porpitidae, which he united in the single genus Porpita. Lesson\(^2\) added to this two other genera (each with a single species), Ratis and Acies. His description, however, is very incomplete, and not illustrated by any figure, so that it is impossible to decide whether they are merely young forms of Porpita (as most authors suggest) or perhaps Discalidae.

Some interesting new Porpitidae, found in the Challenger collection, and some other new forms observed by myself on different occasions, have led me to divide this family into four genera (characterised in my System).\(^3\) These may again be disposed in two subfamilies, the Porpalidae and the Porpitellidae, each with two genera. The first subfamily, Porpalidae, has a lenticular or subglobular umbrella and a campanulate pneumatophore with lobate margin (Porpalia and Porpema); whilst the second subfamily, Porpitellidae, possesses a flat discoidal umbrella and a median-shaped pneumatophore with a circular, not lobate margin (Porpitella and Porpita).

Umbrella.—The complete body of all Porpitidae is circular, sometimes more lenticular

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\(^1\) 1829, p. 176.  
\(^2\) 3, 1843, p. 592.  
\(^3\) 95, 1888, p. 30.
or subglobular (in the Porpalidæ), sometimes more flatly expanded or discoidal (in the Porpitellidæ). Its vertical main axis is in the first case little shorter or nearly as long as the horizontal or equatorial axis; whereas in the second case it is much shorter, only one-half or one-third as long, or even less. The free prominence margin, or the glandiferous *limbus umbrella*, marks the boundary between the exumbrella (upper or pneumatophorous half) and the subumbrella (lower or siphonophorous half).

**Exumbrella.**—The upper, apical or proximal, part of the discoidal trunk, which corresponds to the exumbrella of the Meduse, and physiologically represents the nectosome, is in all Porpitidæ circular and composed of the pneumatoecyst, filled with gas, and the surrounding pneumatophore. This latter is composed of two parallel membranes, separated by a network of anastomosing radial canals—the outer thicker membrane armed with thread-cells and pierced by the stigmata, is the pneumatoecodon; the inner thinner membrane, immediately including the pneumatoecyst, is the pneumatosaccus or the invaginated exoderm. Both membranes are connected by numerous branched radial septa, and the cavities between these, radiating from the centre of the disc, are the radial canals of the exumbrella (pallial vessels); they open at the margin of the disc into the large circular canal of the limb.

The surface of the exumbrella is in many Porpitidæ smooth, in others more or less papillate, owing to conical protuberances of the pneumatoecyst. Often an elegant multi-radiate pigment-star is visible, produced by a dark pigment in the wall of the pallial vessels. The central part of the exumbrella in all Porpitidæ is pierced by a central stigma, and a surrounding corona of eight stigmata placed in the walls of the eight surrounding radial chambers. The other stigmata of the exumbrella, in larger species several hundreds, in smaller, only few, are sometimes disposed in regular radial rows, at other times more irregularly scattered.

**Pneumatoecyst.**—The chitinous polythalamous float filled with gas, which is called pneumatoecyst (formerly "inner shell"), is in the Porpitidæ always regularly circular, corresponding to the surrounding pneumatosaccus (or the invaginated exumbrella) from which it is secreted. Consequently its general form in the subfamily Porpalidæ is highly vaulted, campanulate or cap-shaped (*Porpalia, Porrpema*, Pls. XLVII., XLVIII.), whereas in the flatly expanded Porpitellidæ it is discoidal, even or slightly vaulted (*Porpitella* and *Porpita*, Pls. XLV. and XLVI.). The pneumatoecyst is always composed of two little distant and nearly parallel lamellæ of structureless chitin, which are connected by numerous concentric annular septa. The latter divide the float into numerous concentric ring-chambers, and these open on the upper or proximal face by stigmata, on the lower or distal face by tracheæ.

The central disc of the pneumatoecyst has in the Porpitidæ the same structure as in the Discalidæ; it is composed of a spherical or subglobular central chamber (with a central stigma above) and of eight equal triangular radial chambers, each of which bears
a stigma above, and a trachea (or a bunch of tracheae) below. This evident octoradial structure of the central part is often lost in the peripheral part of the pneumato-cyst.

The concentric ring-chambers which compose the latter are simple circular rings, without radial septa. Their number is very variable, in the smaller species ten to twelve, or even less, in the larger species forty to sixty, and in the largest more than a hundred. They are usually of nearly equal breadth; often, however, the chambers of the middle part are wider than the more proximal (near the centre) and the more distal chambers (near the margin). The first or innermost of the concentric ring-chambers is different from all others; it embraces the octoradial central disc not only from the outer (abaxial) but also from the lower (basal) side (Pl. XLVI. figs. 3, 6).

Pneumothyrse.—It is a general opinion that the concentric circular ring-chambers of the Porpitidae are perfectly separated one from another by solid annular septa. But this is not the case. I found in all members of this family openings of communication between them, which I shortly call pneumothyrse. The thin chitinous annular septa, which separate the ring-chambers, are concave on the axial side, convex on the abaxial side, they are usually thicker in the upper, thinner in the lower, part. Each annular septum is pierced in its basal part by at least eight pneumothyrse, ovate or roundish openings, which are about twice as broad as the stigmata of the upper surface. The pneumothyrse or ring-gates (Pl. XLVI. figs. 3, 4, pg) lie originally in the same radii as the stigmata (pe). There are, therefore, eight interradial rows of pneumothyrse. But in the larger species their number is increased, accessory pneumothyrse being interpolated between the primary ones in the outer chambers.

The superior, proximal or apical side of the pneumato-cyst is usually flat in the central part, whilst the peripheral part is highly convex or campanulate in the Porpalidse, slightly convex or even in the Porpitellidse. Its surface is sometimes smooth, at other times rough and marked by radial stripes or ribs, and by concentric circles. It is sometimes, mainly in the central part, spiny, papillate, or armed with conical, irregularly scattered tubercles. The chitinous substance in the central part is often much thickened by apposition of secondary layers, and these may close the stigmata of that part. Those of the peripheral part remain always open.

The stigmata, or the pneumatic foramina on the upper face of the pneumato-cyst (pe), are much more numerous in the Porpitidae than in the Discalidse and Velellidse. Constantly there is a central stigma in the apex of the central chamber, and around this a regular corona of eight equidistant stigmata in the eight radial chambers which surround the former. The other stigmata are usually not regularly disposed, but scattered in great numbers over the upper surface. When the latter is provided with radial ribs or prominent ridges, the stigmata are placed in the height of the ridges, not in the valleys between them. The stigmata are sometimes simple openings in the upper wall of the
ring-chambers. But usually they are dilated in the middle, more or less urn-shaped, and sometimes prolonged into short prominent tubules (Pl. XLVIII. fig. 8, pe).

The inferior, distal or basal side of the pneumatocyst, separated by the exodermal epithelium of the pneumatosaccus from the neighbouring superior face of the centradenia, corresponds in its general form to the latter, and has therefore a more complicated shape than its superior face. It is always more or less concave, hemispherical or campanulate in the Porpalidae, slightly concave or cap-shaped in the Porpitellidae. Numerous radial ridges or folds are prominent from the inferior face of the float, and often these arise in the form of vertical radial lamellæ, separated by deep valleys. These latter are filled up by corresponding high radial ridges of the upper face of the centradenia. The number of the radial ridges increases rapidly towards the periphery, numerous secondary and tertiary centripetal lamellæ (which do not reach the centre) being interpolated between the centrifugal primary ones. The concave under surface of the pneumatocyst, and the convex upper surface of the centradenia, catching one into another, become very similar to a Fungia (Pl. XLVIII. fig. 7). From the combs of the prominent radial ridges arise the tracheæ (fig. 6, µd).

Tracheæ.—The pneumatic tubules or aëriterous filaments, which we call shortly tracheæ, are much more numerous in the Porpitidae than in the Discalidae and Vellellidae. Each radial ridge bears in the larger species an average more than one hundred tracheæ, and as the number of the ridges there amounts to some hundreds, the number of the tracheæ reaches many thousands. The innermost tracheæ, nearest the main axis, arise from the eight radial chambers which surround the central chamber. The other tracheæ arise sometimes isolated, in irregular radial series, from the crest of the ridges, at other times in bunches, crowded in small groups of three to six or nine, rarely more.

The aëriterous tubules are usually simple, very rarely branch, and never anastomose. Their thin chitinous wall is cylindrical, of very different length. Their course is never straight, always more or less curved, and often serpentine. The tracheæ of all Porpitidae are distinctly articulate, and seem to be composed of a series of short truncate conical segments; the distal or inferior end of each segment is wider (Pl. XLVI. fig. 8). Sometimes each segment seems to be separated from the other by a transverse septum; but the apparent septum is merely an annular constriction. The two ends of each ring-segment (proximal and distal) remain always open.

The course of the tracheæ is difficult to make out. Descending from the lower face of the pneumatocyst, they enter immediately into the centradenia, and run in sinuous curves between the canal-network of this organ. A great part finishes inside the central gland, whilst another part descends deeper and passes into the wall of the central siphon and the peripheral siphons. They end here in the exoderm of the proximal half of the siphons, and do not enter into their distal half. Usually the great majority of the tracheæ are much shorter than the vertical diameter of the centradenia; they must there-
fore finish in the solid glandular parenchyma of this latter, and cannot pass through it and enter into the wall of the siphons. A small part only of the tracheae enters into this latter. The distal ends of all tracheae are open, surrounded by exodermal epithelia, as in the other Discocinetes. No tracheae are found in the marginal tentacles, nor in the peripheral part of the umbrella outside the centradenia.

The margin of the pneumatocyst is circular and not lobate in the flat discoidal Porpitellidae, whilst it is divided into numerous radial lobes in the campanulate Porpalidae; the lobes are here sometimes small, sometimes widely prominent. Their number is originally eight or sixteen, and by furcation thirty-two or sixty-four (Pl. XLVIII. figs. 4, 5).

*Central Siphon.*—The large central polypide of the Porpitidae is not different from that of the Discalidae, a thick-walled and very contractile tube of very variable form. Usually it is inversely conical, its diameter decreasing gradually from the broad proximal base towards the distal mouth. Sometimes the upper half, or the stomach, is ovate and much wider than the lower half, or the cylindrical proboscis. Its transverse section is either circular or octagonal, in consequence of eight prominent radial folds. In some larger species the outer wall exhibits sixteen longitudinal folds instead of eight, and sometimes eight larger (perradial) and eight smaller (interradial) ribs alternate. To these correspond the same number of internal furrows at the inside of the siphon. These furrows lead into the basal openings of the stomach, in which the primary radial canals open (eight or sixteen). The basal ostia form a regular corona; in some larger species their number is increased, numerous secondary and tertiary ostia being intercalated between the eight primary ones. The base of the stomach is separated completely from the overlaying centradenia by the structureless solid gastrobasal plate.

*Centradenia.*—The large central gland, or the so-called "central organ" (formerly "liver"), exhibits the peculiar composition described above (p. 31). In the Porpitidae it is much more voluminous than in the Discalidae and Velellidae, and occupies the whole space between the inferior face of the pneumatophore and the superior face of the subumbrella which bears the siphons. The central gland is largest in some lenticular or subglobular Porpalidae, where its weight and volume are greater than those of all other parts of the body together; it is relatively smaller in the flat discoidal Porpitellidae. The dense network of canals in the central gland is in its upper brown or blackish half composed of hepatic vessels (with biliary epithelium), in its lower green or whitish half of renal vessels (with epithelium secreting guanin crystals). The compact exodermal epithelium filling up the intervals of the canal-network contains masses of cnidoblasts and probably secretes the gas, which enters into the open distal ends of the tracheae.

*Gonostyles.*—The numerous polypides of the subumbrella, which produce by budding the medusiform gonophores, in the Porpitidae are not mouthless palpons as in the Discalidae, but mouth-bearing siphons as in the Velellidae. They are, therefore, usually called "smaller polyps, sexual polypides, or peripheral siphons" (shortly "perisiphons"). They
either form a simple ring of eight or sixteen gonostyles around the central siphon, or they occupy a broader gonostylar zone, often the whole subumbrella between the central siphon and the submarginal corona of tentacles. At first there is a corona of eight gonostyles only, regularly placed around the central siphon, and this state is permanent in some species of *Porpalia* (Pl. XLVIII). In *Porpitella* (Pl. XLVI) there is a girdle of sixteen gonostyles. But usually their number is soon increased, and they form several concentric circles, more or less regular. Finally, in the largest Porpitidae their number amounts to several hundreds, and they are densely crowded. Their form and structure have been described above (p. 36).

**Tentacles.**—The corona of submarginal tentacles in all Porpitidae is originally regularly octoradial. In all young larvae of this family there occurs a stage in which the umbrella-margin bears only eight tentacles regularly disposed at equal intervals (Pl. L, figs. 9, 10), as permanently in *Discalia* (Pl. XLIX, figs. 1–4). But their number is soon increased either by interpolation of eight secondary interradial tentacles (in the middle between the former), or by budding of several secondary tentacles at the base of each primary one, so that eight regular bunches arise (*Porpalia*, Pl. XLVIII). Sometimes sixteen bunches are formed (*Porpitella*, Pl. XLVI). Usually the number is so increased that hundreds or thousands of tentacles, densely crowded, cover the whole zone beyond the margin of the disc. Often three to nine or more concentric circles may be discerned, and then the uppermost are the smallest, the lowermost the longest. Sometimes their bases are so densely crowded in the tentacular area, that after removing the tentacles there appears an elegant reticulated girdle beyond the margin; each rhomboidal dimple of the reticulum is the place of the basal insertion of a lost tentacle (Pl. XLVII, fig. 3, *tu*; Pl. XLVIII, fig. 2, *tu*).

The *general structure of the tentacles* is the same in the Porpitidae as in the other Discocata; but they differ from those of the Vellellidae in their peculiar constant form and structure. The youngest larvae of the Porpitidae bear eight simple radial tentacles with a terminal endiosphere (Pl. L, fig. 9) like those of *Discalia*. The next larval stage exhibits four pediculate endiospheres at the distal end of each tentacle, one of which is the primary terminal knob, the three others basal branches of it (fig. 10). The number of the latter is soon multiplied, and the older and longer tentacles, which are club-shaped and thickened at the rounded distal end, bear always three longitudinal rows of pedunculated endiospheres; one odd inferior series in the middle line of the lower or distal face, and two paired (lateral) series on the two lateral faces; the upper or proximal face is always smooth.\(^1\) Each endiosphere is a thin lateral branch of the tentacle, having the same structure as the latter, and bearing a terminal sphere composed of radially crowded cnidoblasts. The peduncles of the latter are sometimes shorter, at other times longer. Their length often increases towards the distal end of the tentacle. Their number is very variable in different

\(^1\) 57, pls. ix, x.
species; usually each of the three longitudinal rows bears six to nine branches, often twelve to twenty or more (pl. I, figs. 1-6).

**Ontogeny.**—The individual development of the Porpitidae has hitherto been unknown. I conclude, however, from the comparative morphology of the new Porpitidae and Discalidae here described, that all members of these two families pass through a larval stage very similar to *Discomidia*. This is subject to a shorter or longer metamorphosis, and passes through a stage similar to *Disconalia*. The transition from this to *Porpalia*, the simplest form of Porpitidae, is easy to conceive. The gonostyles acquire a mouth, and so the sexual palpons of the former are replaced by the sexual siphons of the latter.

The medusiform gonophores, which are produced from these gonostyles by budding, have the same form and structure as the well-known *Discomitra* (afterwards *Chrysomitra*) larvae of the Veellidae. They become sexually mature in the free medusoid stage, after having been detached from the gonophores. The larvae which arise from the fertilised egg have not yet been observed.

**Phylogeny.**—The comparative morphology of the Porpitidae and Discalidae admits the phylogenetic hypothesis that the former have arisen from the latter. When *Disconalia* acquires a terminal mouth on the distal end of each blastostyle, it passes over into *Porpalia*.

**Synopsis of the Genera of Porpitidae.**

I. Subfamily Porpalid.e.

<table>
<thead>
<tr>
<th>Tentacles arranged in eight radial bunches, the eight primary more prominent,</th>
<th>3. Porpalia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tentacles very numerous, in a circular corona, the eight primary not prominent,</td>
<td>4. Porpema.</td>
</tr>
</tbody>
</table>

II. Subfamily Porpitellid.e.

<table>
<thead>
<tr>
<th>Tentacles arranged in sixteen radial bunches, the eight primary and the eight secondary prominent,</th>
<th>5. Porpitella.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tentacles very numerous, in a circular corona, the eight primary not prominent,</td>
<td>6. Porpita.</td>
</tr>
</tbody>
</table>

**Subfamily 1. Porpalid.e, Haeckel.**


**Definition.**—Porpitidae with a lenticular or subglobular strongly vaulted umbrella, including a campanulate pneumatocyst with radial marginal lobes. Tentacles numerous, arranged into eight or sixteen prominent radial bunches.

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1 57, pl. x.  
2 *Porpalia* = Marine ring of a buckle, πέρα, δία.  
Hhhh 8
The genus *Porpalia* and the following *Porpema* together make up the subfamily Porpalidæ, characterised by a strongly vaulted, lenticular or nearly spherical, umbrella, which includes a mitriform or campanulate pneumatocyst; the distal margin of the latter being divided into radial lobes. The chitinous substance of this lobate pneumatocyst in the Porpalidæ is much thinner, more delicate, and softer than in the Porrpitetidæ (*Porpitella* and *Porpita*), sometimes it resembles crumpled tissue-paper. The numerous marginal tentacles in *Porpalia* are arranged in eight regularly disposed radial bunches, whilst in *Porpema* they are equally distributed along the margin of the umbrella.

The genus *Porpalia* is founded upon a new species, *Porpalia prunella* (Pl. XLVIII.), well-preserved specimens of which were found in the Challenger collection, taken in the tropical Pacific (Station 222). The incomplete description of another species of this genus, founded upon a single specimen, was given in 1829 by Eschscholtz, under the name *Porpita globosa*. He took this specimen in the tropical Atlantic, near the Cape Verde Islands. The exumbrella is in this Atlantic *Porpalia globosa* much smaller, but the tentacles larger than in our species from the Pacific.

The phylogenetic position of *Porpalia* is clearly indicated by its morphological relation to *Disconalia* on one hand, and to the *Porpula* larvae of the other Porpitidæ on the other. It may be regarded as the common ancestral form of this family derived from *Disconalia* by the formation of a mouth on the distal ends of the gonostyles.

*Porpalia prunella*, n. sp. (Pl. XLVIII).

**Habitat.**—Tropical Pacific, north of New Guinea, Station 222; March 6, 1875; lat. 12° 15' N., long. 146° 16' E. Surface.

**Umbrella** (fig. 1, as seen from above; fig. 2, in profile; fig. 3, in meridional section).—The umbrella is biconvex lenticular; its diameter amounts to 4 or 5 mm. (without tentacles and siphon). A deep submarginal ring-furrow separates the flat exumbrella from the biconvex body, the superior face of which is more strongly vaulted than the inferior. The equatorial diameter of the biconvex lens is twice as great as its vertical main axis.

**Exumbrella** (figs. 1–3, uc).—The superior or apical face of the umbrella is rather flat, with a shallow ring-furrow separating the central disc from the elevated peripheral margin. The central disc exhibits an elegant pigment-star with eight dark brown rays. Numerous stigmata are disposed in irregular rows between them.

**Limbus Umbrella** (figs. 1–3, um).—The free prominent border or limb of the umbrella is as broad as the radius of the central disc of the umbrella, and therefore half as broad as the equatorial radius of the lens. Its upper face is concave, the lower convex. The thickened margin is reflected upwards, and contains a single series of the usual muciparous glands (compare above).

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1. p. 178, Taf. 16, fig. 4.
Subumbrella (figs. 1-3, w).—The inferior or basal face of the umbrella exhibits beyond the deep submarginal ring-furrow a broad naked girdle, in which the radial canals ascend from the tentacular zone to the margin of the umbrella. The tentacular zone begins in the equator of the biconvex lens, and occupies the peripheral half of its lower convexity. Its breadth equals the radius of the central disc of the exumbrella.

Pneumatocyst (fig. 4, from above; fig. 5, from below; fig. 3, p, in vertical meridional section).—The float, filled with air, is campanulate, and envelops the subspherical centradenia, with exception of its basal centre, which is occupied by the central siphon. The equatorial diameter of the pneumatophorous bell is twice as great as its vertical main axis. The basal opening of the central siphon, closed by the base of the central siphon, is scarcely greater than half its height. The concave inferior face (or the cavity of the bell) is in close contact with the centradenia, and the thirty-two prominent radial crests of the former fit into thirty-two deep radial furrows of the latter. The convex superior face is flatly conical above the equator (ug); its peripheral girdle, beyond the equator, is regularly divided into sixteen furcate radial lobes (or thirty-two smaller lobes).

The central chamber of the pneumatocyst is surrounded by a regular girdle of eight radial chambers, each of which possesses a stigma on its upper, and a trachea on its lower side. This octoradial girdle is surrounded by eight to ten complete, concentric, circular ring-chambers, the outermost of which touches the equator of the lens. Outside follows the peripheral girdle of thirty-two lobes, which is recurved inwards and downwards (horizontally expanded by pressure, see fig. 4). The superior or convex face of the pneumatocyst bears in its superior central part (which is in contact with the exumbrella) numerous radial rows of stigmata. From its inferior or concave face, which is in contact with the centradenia, hang down thirty-two prominent radial crests, or rather lamellar pouches (fig. 6); and from the lowermost part of the latter arise numerous long tracheae which enter into the glandular tissue of the liver (fig. 3, uc); the majority of them terminate here with open distal ends, whilst a small part of the tracheae enters into the basal part of the wall of the siphons, and ends in its exodermal epithelium.

The chitinous substance of the thin wall of the campanulate pneumatocyst is very delicate and richly folded, like crumpled tissue-paper.

Centradenia (fig. 3, uc).—The large central gland is nearly spherical, and entirely fills up the subumbrellar cavity of the pneumatocyst. The circular polar area only of its lower pole is in contact with the base of the central siphon. Besides this smooth inferior area, the entire surface of the centradenia is traversed by numerous deep meridional grooves, which are filled by the lamellar radial pouches of the basal face of the pneumatocyst. The dense parenchyma of its exodermal cellular tissue is traversed by numerous bent tracheae, and by a loose network of hepatic canals. The latter arise from a regular octoradial star of superior liver-canals, which unite in the superior or apical pole of the centradenia. These eight radial main canals embrace the greater part of its surface like
eight meridional arches, and open on the periphery of its inferior polar area into the gastric cavity of the central siphon. Their dichotomous branches run along the convex outer surface of the centradenia, enclosed in the numerous radial folds which fit into the corresponding meridional furrows of the subumbrellar face of the pneumatocyst.

Central Siphon (fig. 2, in profile; fig. 3, in longitudinal section).—The large central polypite is a thick-walled cylindrical tube, the length of which surpasses the vertical main axis of the umbrella. Its distal end opens by a four-lobed mouth, whilst its proximal or basal part is conically dilated and closed by the supporting plate separating it from the centradenia (fig. 3). In the periphery of the latter open the eight radial main canals.

Sexual Siphons (figs. 2, 3, sx).—A corona of eight sexual polypites surrounds the base of the central siphon, and separates it from the tentacular zone. These are much smaller than the central siphon (about half as long, and many times thinner). Their thin cylindrical basal part is beset with numerous gonophores; their spindle-shaped distal part opens by a four-lobed mouth.

Tentacles (figs. 1-3, t).—The tentacles are very numerous, and occupy a broad convex zone of the subumbrella, between its equator and the girdle of sexual siphons. After removal of the tentacles, their insertion forms an elegant reticulate girdle, with rhomboidal meshes (fig. 2, tv). The tentacles are arranged in four to five transverse rows, and in eight prominent radial bunches; the longest of each bunch surpassing the diameter of the umbrella.


Porpema, Hkl, System der Siphonophoren, p. 30.

Definition.—Porpitidae with a lenticular or subglobular strongly vaulted umbrella, including a campanulate pneumatoceyst with radial marginal lobes. Tentacles very numerous, equally disposed in several concentric circles, not forming radial bunches.

The genus Porpema has the same strongly vaulted umbrella and the same campanulate and radially lobate pneumatoceyst as the preceding genus Porpalia, from which it differs in the equal distribution of the tentacles along the whole margin of the umbrella. The tentacles are very numerous and densely crowded in several parallel circles (as in Porpita), and they are not grouped into radial bunches.

The new genus Porpema was established for an Indian species, Porpema lenticula, which I observed in 1881 in the Indian Ocean, between Aden and Bombay. Another species, described in the following pages as Porpema medusa (Pl. XLVII.), was found in the Challenger collection; this was taken in the South Atlantic, Station 327 (between Buenos Ayres and Tristan da Cunha). A third species (Porpema pileata) was sent me from Chili; it will be described in my Morphology of the Siphonophora.

1 Porpema = Mantle, cloth, πίππεμα.
Regarding the phylogenetic origin of *Porpema*, we may simply assume that it has been derived from the ancestral genus *Porpalia*, by multiplication and equalisation of the submarginal tentacles, which form circular girdles, without octoradial arrangement.

*Porpema medusa*, n. sp. (Pl. XLVII.).

_Habitat._—South Atlantic, Station 327; March 4, 1876; lat. 36° 48' S., long. 42° 45' W. Surface.

_Umbrella_ (fig. 1, from above; figs. 2 and 3, in profile, fig. 2 with tentacles, fig. 3 after removal of them; fig. 4, meridional section).—The umbrella is nearly spherical, and has a diameter of 4 to 6 mm. (without the tentacles and the siphon). In some specimens the vertical main axis is somewhat shorter than the equatorial diameter, in other specimens a little longer.

_Exumbrella_ (figs. 1, 2, 3, _ue)._—The superior or apical face is slightly convex, cap-shaped, with a flat annular furrow which separates the central disc from the elevated margin, like a flat hat with a recurved brim. The central disc exhibits a dark pigmement-star with sixteen broad rays, and a greater number of finer rays between the dark prominent main rays. A great number of stigmata is arranged in radial rows.

_Limbus Umbrellae_ (figs. 1-4, _uw)._—The free prominent border or margin of the umbrella is nearly horizontally expanded, and slightly reflected upwards, like the broad brim of a flat hat; it is concave above, convex below. The breadth of the margin equals the diameter of the exumbrellar central disc, and half the equatorial diameter of the subglobular umbrella. The thickened edge of the margin is beset with a series of the usual muciparous glands (compare above).

_Subumbrella_ (figs. 1-4, _v)._—The inferior or basal face of the umbrella exhibits beyond the deep submarginal ring-furrow a narrow, smooth zone, which is radially striped; these stripes are the radial canals ascending from the corona of tentacles to the margin of the umbrella. The broad tentacular zone of the subumbrella (fig. 3) is a circular girdle, which embraces the equatorial zone of the whole umbrella; its vertical height equals the radius of the latter. After removal of the tentacles it appears elegantly panelled (fig. 3, _tv)._  

_Pneumatoecyst_ (fig. 7, from above; fig. 8, from below; fig. 4, _p_, in vertical section).—The float, filled with air, is campanulate or nearly spherical, with a central opening at the basal pole of its vertical main axis. The diameter of this inferior opening measures 1 mm., and is about one-third as great as that of the float (3 mm.). The spherical outer surface of the pneumatoecyst is in close contact above with the exumbrella, beyond the equator with the tentacular zone of the subumbrella. The inner cavity of the
campanulate double-walled float is filled up by the centradenia (uc), which passes through its basal aperture (fig. 4).

An exquisite regular octoradial structure is visible in all parts of the pneumatocyst. The central chamber (ph) is nearly cylindrical, with an apical stigma (po), and surrounded by a regular corona of eight radial chambers (pq), each with a stigma above and a trachea below. The deep radial furrows between these eight lobes (fig. 7, pr) are prolonged to the periphery of the pneumatocyst, which is divided into eight large main lobes. Each of the latter is again divided by a median incision into two secondary lobes, and these again into four tertiary lobules. Thus the entire peripheral part of the float, beyond its equator, is radially lobate. The deep radial furrows of the superior face of the pneumatocyst correspond to high prominent radial crests or lamellar pouches of its concave lower face, and from the height of these lamellar crests arise numerous tracheae entering into the centradenia. The double wall of the concentric ring-chambers presents therefore a very large surface, by means of the strong development of these radial folds.

Centradenia (figs. 6 and 9, transverse sections; fig. 4, uc, meridional section).—The large central gland exhibits in this Porpitud a strange cylindrical form, due to the unusual development of the vertical or longitudinal axis; the latter attains 3 to 4 mm., whilst the horizontal diameter of the cylindrical centradenia is only 1 to 1.5 mm. Its middle part is constricted by the embracing inferior margin of the campanulate pneumatocyst. The radial lamellar crests of the latter fit into corresponding meridional furrows on the surface of the upper head-like part of the centradenia. The lower cylindrical part of this latter is surrounded by the corona of sexual siphons, and its circular basal face is in contact with the basal plate of the sterile central siphon. From the periphery of this plate arise eight radial canals, which are soon forked; an outer main branch runs outwards to the tentacular zone and the umbrella margin; an inner main branch ascends vertically between the convex outer surface of the centradenia and the concave inner surface of the pneumatocyst. These eight centripetal liver-canals unite in the apical pole of the central gland, and form here a regular "liver-star" (fig. 8, cm) they give off numerous branches, which form a network in the exodermal parenchyma of the liver; between its branches numerous bent tracheae are visible.

Central Siphon (sh, figs. 2 and 3 in profile, fig. 4 in vertical section, fig. 5 from below, fig. 10 in transverse section).—The large central polypite has an upper pear-shaped part (stomach) and a lower cylindrical part (proboscis). Its length is, in the contracted state, equal to the diameter of the spherical umbrella, and twice as great as its greatest horizontal diameter (near the base). Its thick muscular wall exhibits eight longitudinal exodermal furrows on the outside, and eight corresponding radial entodermal folds on the inside (fig. 10). Between these folds open in the basal part the eight radial canals (fig. 9, sf). The distal mouth has eight radial lappets (figs. 3, 4, so).
Sexual Siphons (ex, figs. 2–5).—A great number of sexual polypites, densely crowded and arranged in four to five concentric rings, occupies the broad basal zone of the subumbrella, between the central siphon and the corona of tentacles; their number may be between sixty and ninety in the smaller, two hundred to three hundred in the larger specimens. The form of these contractile gonostyles is very variable, usually spindle-shaped or pear-shaped. The large sterile central siphon is eight to nine times as long and five to six times as broad as each of the small fertile peripheral siphons. Their mouth is small and exhibits eight radial lappets. The basal part is densely beset with medusiform gonophores.

Tentacles (figs. 2–4, t).—The corona of tentacles occupies a broad equatorial zone, nearly half the height of the entire subumbrella. After removal of the tentacles (fig. 3) this zone appears as a convex elegantly reticulated girdle, the concave inside of which embraces the inferior half of the campanulate pneumato cyst (fig. 4, p). Each rhomboidal mesh of the reticulum is the basal insertion of one tentacle. There are eight to ten transverse rows of tentacles, one alternating with the other, and each row represents a ring composed of fifty to sixty tentacles, so that their whole number may be four hundred to six hundred. The length of the longest (in the middle zone) surpasses the greatest diameter of the umbrella, whilst the length of those placed in the superior and inferior rows decreases towards the limits of the tentacular zone. The tentacles are slender cylindrical filaments, club-shaped at the distal end, and beset with three rows of cnidospheres (compare above, pp. 38, 39).

Subfamily 2. Porpitellidae, Haeckel.


Porpitella, Hk., System der Siphonophoren, p. 30.

Definition.—Porpitidae with a flat discoidal umbrella, including a circular discoidal pneumato cyst without marginal lobes. Tentacles numerous, arranged in eight or sixteen prominent radial bunches.

The genus Porpitella and the following Porpita together make up the subfamily Porpitellidae, characterised by a discoidal or slightly vaulted umbrella, which includes a discoidal pneumato cyst, the distal margin of the latter being circular, not divided into radial lobes. The numerous marginal tentacles in Porpitella are arranged in eight or sixteen regularly disposed radial bunches, whilst in Porpita they are equally distributed along the margin of the umbrella.

The new genus Porpitella is founded for those species, formerly placed among Porpita, which are distinguished by the possession of sixteen radial bunches of marginal

\[Porpitella = \text{Small ring of a buckle, diminutive of Porpita.}\]
tentacles. The first species observed was taken by Eschscholtz in the tropical Pacific, and described in 1829 as Porpita carulea. It is probably the species of which Huxley afterwards gave a very accurate anatomical description. Another species of this genus, also taken in the tropical Pacific (near the Marianne Islands), is Porpita radiata of Brandt. I have been able to compare the excellent (hitherto unpublished) figure and description left by its discoverer, Mertens. Two specimens of a third species, described in the following pages, were found by me in the Challenger collection, from Station 244. It exhibits in several points a remarkable similarity to the interesting deep-sea Medusa, Pectanthis asteroides. I call it therefore after this Trachynemid.

The phylogenetic origin of Porpitella is to be found in Porpalia. It may be derived from this ancestral form by flattening of the highly vaulted umbrella and the pneumatocyst, which thus become more or less discoidal.

Porpitella pectanthis, n. sp. (Pl. XLVI.).

Habitat.—Station 244, Northern Pacific, between Japan and Honolulu; June 28, 1875; lat. 35° 22' N., long. 169° 53' E. Surface.

Umbrella (fig. 1, from above; fig. 2, from below; fig. 3, meridional section).—The disc is a biconvex lens, the horizontal diameter of which amounts to 12 or 15 mm., and is three times as great as its vertical axis (4 to 5 mm.). The meridional section (fig. 3) demonstrates that the larger superior half of the umbrella is occupied by the discoidal pneumatocyst (p), the smaller inferior half by the lenticular centradenia (uc).

Exumbrella (fig. 1).—The superior or apical face of the umbrella is slightly convex, and exhibits an elegant radial striation, crossed by numerous concentric rings. Sixteen more prominent ribs bear a number of conical papillae, and between these numerous more delicate, also denticulate, ribs radiate from the centre. The stigmata open at the apex of the conical papillae. An elegant pigment-star with sixteen brown rays indicates the course of the main ribs.

Limbus Umbrellae (figs. 3, 7, um).—The free margin of the umbrella is prominent at the periphery of the lenticular body, and about one-third or one-fourth as broad as the length of its radius; it is circular, divided by sixteen slight incisions into sixteen flat marginal lobes (fig. 1). Its thickened edge includes a series of marginal glands (fig. 7, us).

Subumbrella (fig. 2).—The inferior or basal face of the umbrella is slightly convex, and divided into four different parts of nearly equal breadth. The central part is occupied by the large sterile central siphon; this is surrounded by three circular concentric zones; the first zone is occupied by sixteen smaller sexual siphons (bearing

1, p. 179, Taf. 16, fig. 5.
clusters of gonophores); the second zone is marked by the corona of tentacles, divided into sixteen bunches; and the third, outermost, zone is formed by the inferior face of the free peripheral limb.

Pneumatoecyst (fig. 4, superior or apical view; fig. 5, inferior or basal view; figs. 3, 6, 7, p, meridional sections).—The float, filled with gas, is a circular disc, the horizontal diameter of which (9 to 12 mm.) is ten to twelve times as great as its vertical diameter (1 to 1.2 mm.). Its thickness is nearly equal throughout, or increases a little towards the margin. The superior or exumbrellar face (fig. 4) is slightly concave, and exhibits numerous denticulate radial ribs, sixteen of which are more prominent (fig. 1). Numerous stigmata (pe) open by the conical papillae of the radial ribs. The inferior or subumbrellar face (fig. 5) is slightly concave and radially folded, numerous radial furrows (sixteen of which are deeper) corresponding to the ribs of the upper face. Numerous articulate tracheae (figs. 5, 6, pt; fig. 8) arise from conical protuberances of the inferior ribs, which are prominent between every two radial sulci.

The central chamber of the pneumatoecyst (figs. 3, 6, ph) opens above by a central apical stigma (pe), and is surrounded by a regular corona of eight triangular radial chambers; each of these bears a circular stigma (fig. 4, pe) on its upper face (placed in variable points), whilst from its lower face arise one or two short tracheae. The corona of concentric ring-chambers, which surround the girdle of eight radial chambers, is composed of nine to twelve rings. The height (or vertical diameter) of these rings increases from the centre towards the periphery, whilst the breadth (or horizontal diameter) decreases (figs. 3, 7, pk). The inner or proximal wall of each ring is concave, the outer or distal wall convex. The concentric rings communicate one with another by eight radial rows of apertures (figs. 3, 4, yg), which are placed interradially between the perradial sulci. The innermost or first ring embraces the octoradial chamber-girdle not only from the distal, but also completely from the basal side (figs. 3, 6, pk); the other concentric rings embrace one another only from the distal side.

Centradenia (figs. 3, 6, 7, uc).—The large central gland (or the so-called liver) is a circular biconvex lens, the horizontal diameter of which (6 to 8 mm.) is three to four times as great as the vertical axis (2 mm.). Its upper surface is in close contact with the concave lower surface of the pneumatophore, its lower surface with the subumbrella. Numerous radial ribs of the upper surface fill up the radial sulci of the lower surface of the pneumatophore. The brown liver vessels are very densely crowded in the upper half, loosely scattered in the lower half of the pneumatophore. All these hepatic canals unite on the lower surface of the centradenia into descending canals, which pierce the fulcrum of the subumbrella; eight of these (forming an inner girdle of openings) open into the peripheral part of the base of the central siphon; sixteen others (forming an outer girdle) open into the sexual siphons (sx). The majority of the canals of the central gland contains in their epithelium that black pigment which is regarded as “hepatic

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)

Hhhh 9
granules"; whilst another part is colourless or more or less filled up with guanin-crystals ("renal granules"). The uppermost canals (between the pouches of the pneumatocyst) are colourless.

Central Siphon (figs. 1, 2, 3, sa).—The large sterile central polypite has the usual form of a thick-walled cylindrical or inversely conical tube. Its dilated base occupies the centre of the subumbrella, and is separated from the centradenia by a thick fulcrum or supporting lamella, the gastrobasal plate; it exhibits a peripheral ring of eight openings, leading into the eight radial main vessels (compare p. 31).

Sexual Siphons (fig. 2, fig. 3, sx).—The sixteen peripheral polypites form a regular corona around the base of the large central polypite, and are separated by a circular furrow from the corona of tentacles. They bear numerous gonophores on their thinner basal part, whilst their spindle-shaped distal part opens by a four-lobed mouth (compare p. 37).

Tentacles (figs. 1–3, f).—The numerous tentacles form a submarginal corona, which occupies about one-third of the subumbrella. They form six to eight concentric rows, and exhibit a very different length. Seen from above or below the corona presents sixteen elegant rays, each of which is composed of an adradial bunch of larger tentacles. The longest tentacles (in the middle of each radial bunch) surpass the diameter of the umbrella in the contracted spirit specimens, and may be much longer in the living animal. The form and structure of the tentacles, with three rows of cnidospheres, is that which is usual in all Porpitidae (compare pp. 38, 39).

Genus 6. Porpita,¹ Lamarck, 1816.


Definition.—Porpitidae with a flat discoidal umbrella, including a circular discoidal pneumatocyst without marginal lobes. Tentacles very numerous, equally disposed in several concentric circles, not forming radial bunches.

The genus Porpita possesses the same flat discoidal umbrella, and the same circular, not radially lobate, pneumatophore, as the preceding genus Porpitella; but it differs from the latter in the equal distribution of the tentacles along the whole margin of the umbrella. The tentacles are very numerous, and densely crowded in several parallel circles (as in Porpema), and they are not grouped into radial lobes.

The genus Porpita, hitherto regarded as the only representative of the family Porpitidae, was founded in 1816 by Lamarck upon the first known species, which Förskål had observed in the Mediterranean, and described very accurately as Holothuria demudata.² Eschscholtz, the founder of the class Siphonophora, in 1829 placed Porpita in his family Velellidae, and gave the following definition.³—"Corpus orbiculare, supra

¹ Porpita = Ring of a buckle, ἔλκυν.
² 11, p. 103, Taf. 26, fig. L 1.
³ 1, p. 176, Taf. 16.
inerme. Tentacula marginalia trifarium glandulosa." He described five different species, Two of these only appertain to the genus Porpita as above defined (Porpita mediterranea and Porpita umbella).

The best and most accurate anatomical descriptions of the genus are those given in 1853 by Kölliker of Porpita mediterranea (4), and in 1881 by Alexander Agassiz of the North Atlantic Porpita lianneana (57). Closely related to the latter is probably the tropical Atlantic Porpita umbella of Eschscholtz (1). The collection of the Challenger contains several specimens of a new species, taken in the Northern Pacific, and figured in Pl. XLV, as Porpita fungia. Three other distinct species seem to be Porpita lütkeana (25), from the Indian Ocean; Porpita pacifica of Lesson (22); and a new southern form, Porpita australis.

The phylogenetic origin of Porpita is to be found in the preceding genus, Porpitella, from which it is derived by multiplication and equalisation of the tentacles, not forming separated radial bunches.

Porpita fungia, n. sp. (Pl. XLV.).

Habitat.—Stations 253 to 255, Northern Pacific, between Japan and Honolulu; 14th to 19th July 1853; lat. 38° 9' N. to 32° 28' N., long. 156° 23' W. to 154° 33' W. Surface.

Umbrella (fig. 1, meridional vertical section).—The disc is flat, circular, of equal thickness throughout nearly its whole extent, like a coin. Its diameter is usually 20 to 25 mm., but amounts in the largest specimens to 30 mm.; its thickness (without the siphon and tentacles) is 4 to 6 mm. A meridional section (fig. 1) demonstrates that three-fourths of the thickness belong to the centradenia, one-fourth to the pneumatocyst.

Exumbrella (fig. 2).—The superior or apical face of the umbrella is flat or slightly convex, a little depressed in the centre. It is covered with numerous, irregularly scattered, conical tubercles, arising from the upper face of the pneumatocyst. Their number and size increase towards the centre. The peripheral half of the exumbrella is pierced by numerous irregularly scattered stigmata (pe). The regular octoradial striation and the numerous concentric rings, which shine through the silvery exumbrella, are due to the structure of the subjacent pneumatocyst. An elegant network of anastomosing canals, with narrow irregular polygonal meshes, is expanded everywhere in the exumbrella.

Limbus Umbrella.—The free membranous border or limbus of the umbrella overlaps the tentacular zone to the extent of 1 to 2 mm. It is flatly expanded or reflected upwards, and includes a series of marginal glands of the usual form (compare above). The numerous canal-branches of the exumbrella anastomose richly, form an irregular network, and unite in a circular canal inside the glandular corona; and from this arise the vessels of the centradenia and the subumbrella.
**Subumbrella** (fig. 1).—The inferior, distal or basal face of the umbrella is divided into four different zones. The central zone, with a diameter of 3 to 4 mm., is occupied by the gastrobasis or the fundus of the large central siphon. The broad middle or gonostylar zone (4 to 6 mm. in breadth) is occupied by the numerous sexual siphons or gonostyles. The third or tentacular zone (2 to 3 mm. broad) bears the numerous tentacles. The fourth or outermost zone (1 to 2 mm. broad) is formed by the inferior face of the free mantle-border.

**Pneumatocyst** (fig. 1, fig. 5, pf).—The float, filled with air, is a flat circular disc of 15 to 20 mm. diameter. Its thickness increases considerably from the centre towards the margin, owing to the height of numerous radial folds. The form of the pneumatocyst presents a great resemblance to a regular *Fungia*, the disc being folded radially in a very regular manner. The vertical folds arise in the upper surface in eighty or ninety high radial ridges, with deep valleys between them, whilst branched radial lamellae are prominent on the lower face.

The octoradial structure of the pneumatocyst is very distinct on its upper face, since the eight equidistant primary rays are more prominent than all the others. They arise from the septa of the eight radial chambers which surround the central chamber. The octant between every two primary folds is bisected by a secondary ray, somewhat less prominent, but also stronger than all the others. Sixteen tertiary or adradial ridges arise in the middle between the eight primary and the eight secondary rays. The other rays are developed in the peripheral half of the disc only. The total number of radial ribs is about eighty in a specimen of 15 mm. diameter, one hundred and twenty in a larger specimen of 20 mm. The most elevated part of each radial rib bears a radial series of stigmata. The number of concentric annular septa is about fifty in the former, eighty in the latter. These are wider (about twice as broad) in the middle part of the disc than in the central and the peripheral part.

The thickness of the chitinous wall of the air-chambers is much greater in the upper than in the lower face, and it increases from the periphery of the disc towards the centre. It equals in the central half of the disc the height of the air-chambers. Numerous strata of chitinous substance are here deposited as secondary supports of the disc-wall, and have closed the stigmata (fig. 1, p²). The conical tubercles of the surface of the disc are produced by stronger deposits at separate places (p³). The stigmata of the air-chambers remain open in the peripheral part of the disc only (pe); they are urn-shaped, very numerous, and irregularly scattered in radial rows (fig. 2, pe).

The lower face of the pneumatocyst, which is in close contact with the centradenia, is more strongly folded than the upper face; the folds are here ramified centrifugally, and form high triangular lamellae, the height and number of which increase from the centre towards the periphery (fig. 1, p⁴). Eight primary radial lamellae, arising from the septa of the eight pericentral radial chambers, are more prominent than the eight secondary...
alternating, and these more than all the other lamellae. The centrifugal dichotomous ramification of the lamellae increases gradually towards the periphery, and new peripheral folds are interposed between the centrifugal folds, so that their number at the margin of the disc is much greater than that of the simple radial ridges of the upper surface. The crest of the folds is elegantly denticulate, and from it arise two opposite radial rows of trachee. The trachee or aërisform tubules in this Porpita are exceedingly numerous, amounting to many thousands. The majority of them are short and end half way up the centradenia. A smaller number pierce the latter and the subjacent support, and project into the exodermal wall of the central siphon and the surrounding gonostyles. They terminate here in the basal half of the latter, inside the exodermal epithelium (fig. 8, pd).

The circular concentric ring-chambers of the pneumatoecyst communicate one with another by radial apertures or "pneumothyras," oblique elliptical openings, which are placed in the radial sulci between the folds of the lower face.

The central chamber possesses, as usual, a central stigma in its upper face, as does also each of the surrounding eight radial chambers. From the basal part of each of the latter arises a bunch of three or four short trachee. In the basal sulci between these are eight openings, which lead into the first ring-chamber.

Centradenia (fig. 1, uh, meridional section; fig. 3, inferior face; figs. 6–8, wn, parts of sections).—The large central gland (or the so-called "liver") is a biconvex lenticular disc, the horizontal diameter of which is four times as great as its vertical axis; the latter measures in a specimen of .20 mm. diameter (umbrella) 3 mm., the former 12 mm. Its superior face has a regular radiate appearance; innumerable radial folds (thirty-two of which are stronger) fitting into the radial grooves which lie between the lamellar pouches of the inferior face of the pneumatoecyst. The height of these folds increases from the centre towards the periphery. The circular margin meets the line which marks the boundary between the gonostylar and tentacular zones.

The inferior face of the centradenia is less convex than the superior, and is divided into a white central disc (kidney) and a peripheral brown radiate zone (liver). The former covers the roof of the central siphon (sw), and surrounds it like a broad, white girdle (fig. 3, wn); the peripheral part of the brown liver (fig. 3, sh) surrounds again the former as a dark radiate ring. The gonostyles arise as well from the former as from the latter.

The meridional or vertical section of the centradenia (fig. 1) demonstrates that its solid exodermal parenchyma is traversed by a dense network of innumerable canals, the greater part of which are darkly coloured by a brown (hepatic) pigment. This is wanting in a part of the superficial canals, and in the inferior white central disc ("kidney"), which contains masses of guanin-crystals. Innumerable trachee terminate between the canal branches; their distal openings being surrounded by (air-secreting?) exoderm cells (compare the explanation of figs. 6–8).
Central Siphon (fig. 1, sm, fig. 4).—The large sterile central polypite is inversely conical, in the contracted state about as long as the diameter of its broad base, which is a quarter or a fifth of the diameter of the umbrella. Its thick muscular wall exhibits sixteen longitudinal folds, and between these run sixteen deep grooves, which open at the bottom of the stomach into the sixteen radial main canals. The distal mouth of the central siphon is octolobate. Its opposite proximal roof is separated by a strong fulcrum or supporting lamella, the gastrobasal plate (fig. 1, $s$), from the superjacent kidney.

The sixteen radial main canals, which arise from the periphery of the base of the stomach, run along the subumbrella towards the peripheral edge of the limb, where they are united in a circular marginal canal. They give off innumerable branches; of these the ascending ones enter into the centradenia, the descending partly into the gonostyles, partly into the tentacles. Numerous superficial mantle-vessels arise from the marginal canal and enter centripetally into the exumbrella, where they form an irregular dense network above the pneumatocyst.

Sexual Siphons (figs. 1, 8, $st$).—The gonostyles cover the greatest part of the sub-umbrella, and are densely crowded in the broad zone which lies between the central siphon and the tentacular zone. Their number amounts to several hundreds. They are covered with bunches of gonophores in the cylindrical proximal half, with patches of cnidocysts in the spindle-shaped distal half. Their distal mouth is often divided into four or eight small lobes.

Tentacles (fig. 1, $t$).—The tentacular zone of the subumbrella, inside the free prominent limb, is about as broad as the base of the central siphon. It presents an elegant reticulum, with rhomboidal meshes, when the tentacles are removed; each mesh being the base of a detached tentacle. These are arranged in six to eight concentric rows. In the largest specimens their number exceeds one thousand. Their length may exceed the diameter of the umbrella; the majority, however, are much shorter. The structure of the club-shaped tentacles is the usual one, with three rows of stalked cnidospheres (compare p. 39).

Family III. V E L E L L I D E, Eschscholtz, 1829.

Vellelidae, Eschscholtz, System der Acanthoph, p. 165 (sensu restricto).

Definition.—Discocentæ with an elliptical or amphitheat, often nearly quadrangular umbrella, including a polythalamous pneumatocyst of the same form, which is composed of numerous concentric rings, and usually bears in its diagonal a vertical crest. Always a membranous vertical sail upon the umbrella. Marginal tentacles simple, without cnidospheres. Central siphon surrounded by numerous peripheral fertile siphons, which bear the gonophores.

The family Vellelidae, founded by Eschscholtz in 1829, comprised originally all Dis-
conectae, or all the "Medusae chondrophorae" of Chamisso and Eyssenhardt. Afterwards (in 1835) Brandt separated the true Vellellidae (with elliptical disc and vertical crest) from the Porpitidae (with circular disc, without crest). The Vellellidae, thus restricted, agree with the Porpitidae in the polygastric structure, not only the large sterile central siphon possessing an open mouth at its distal end, but also each of the surrounding gonostyles. These peripheral polypites, which bear the gonophores budding from their proximal part, are therefore not mouthless palpons (as in the Discalidae), but mouth-bearing, feeding, and digesting secondary siphons. On the other hand, the Vellellidae differ from the Porpitidae (as well as from the Discalidae) in the peculiar amphithect or bilaterally-radial ground-form of the body, produced by the prolongation of the sagittal axis, and shortening of the frontal axis; and, further, in the development of a peculiar vertical crest or sail, which arises from the exumbrella either in the sagittal or in a diagonal axis.

Eschscholtz, in his fundamental work, divided his Vellellidae into three genera:—Rataria, Velella, and Porpita. The genus Rataria, however, was considered by the majority of subsequent observers to consist only of young forms of Velella. A new species of Rataria, found in the Challenger collection, proved to be an autonomous genus, provided with gonophores. Although the different Rataria, described by some authors, may be merely young Velella, there nevertheless exist also Vellellidae which become mature in the permanent Rataria-form. The numerous species of the true Velella were disposed in my System (p. 31) in two genera:—Velella (sensu restricto), with an elliptical umbrella and simple corona of tentacles; and Vedaria, with quadrangular umbrella and double or multiple corona of tentacles. For this latter the old name Armenista (or Armenistarium of Carriérus, 1757) may be better retained.

Umbrella.—The common trunk of the cormus, which corresponds to the umbrella of a hydrocomedusoid person, is in all Vellellidae a flat, horizontally expanded, and floating disc, distinguished from the circular disc of the Porpitidae and Discalidae, firstly, by its bilateral form, and secondly, by the vertical crest or sail. The latter is originally nothing more than a simple longitudinal fold of the exumbrella, and may be regarded as the primary cause of the peculiar fundamental form. The three genera which we have distinguished represent three different degrees or historical steps in its peculiar development:—Rataria, next to the ancestral group Porpitidae, has an elliptical disc, and the sail placed in its sagittal plane, in the longer axis; in Velella the sail turns a little around the vertical main axis, and comes to be situated in a diagonal axis of the disc; finally, in Armenista the disc becomes quadrangular or parallelogram-shaped. Besides, a vertical crest of the pneumatocyst, as a support of the soft sail, is developed in the two latter genera, but is wanting in Rataria.

Amphithect Fundamental Form.—The peculiar fundamental form presented by the
umbrella of the Velellidæ may be called either amphithecet or bilaterally-radial. It is characterised by three unequal dimensive axes, each perpendicular to the other two; one being allopolar (with unequal poles), the other two isopolar (with equal poles). The allopolar axis is the vertical main axis, its upper or apical pole determined by the top of the sail, its lower or basal pole by the mouth of the central siphon. The greater isopolar axis is the sagittal axis of the disc (the major axis of the ellipse), which divides it into two equal symmetrical halves, right and left. The smaller isopolar axis is the transverse or frontal, which is perpendicular to the latter, and separates the disc also into two equal halves, dorsal and ventral; it corresponds to the minor axis of the ellipse.

The octoradial character of their amphithecet ground-form is always indicated by the origin and course of the eight primary gastro-canals, which arise from the base of the central siphon; secondly, it is marked by the centre of the pneumatophore, which exhibits more or less distinctly eight radial chambers around the simple central chamber; thirdly, it is often indicated by the radial arrangement of eight primary marginal tentacles and of other parts. The umbrella of the Velellidæ is therefore composed originally of eight equal parameres (or homotypical radial parts), like that of the Porpitidæ and Discalidæ; but it differs from that of the latter in the fact that the parameres are disposed in pairs, so that the disc may be regarded also as composed of four paired quadrants; and sometimes the limits of these are sharply marked off by four marginal incisions of the pneumatophorous disc.

The quadriradial appearance, the body seeming to be composed of four parameres (as in the most Medusan), is mainly obvious in the more highly developed Velellidæ. But regarding their phylogenetic origin from the Porpitidæ, we must assume that this fundamental form has arisen from a true octoradial type composed of eight parameres. In no case can we regard this fundamental form as uniradial, a point of view which is represented by Chun.¹ I agree perfectly with the explanation of the origin of the sail which Chun there gives (loc. cit., p. 15); but I cannot agree with his promorphological deductions. I cannot concede at all that uniradial fundamental forms exist anywhere.

A true asymmetry, mentioned by many authors in the umbrella of the Velellidæ, does not exist; for in every case the two halves of the body, which are separated by any possible meridional section (through the vertical main axis), are perfectly equal; and the dorsal and ventral halves cannot be distinguished by any character; the right and left halves being likewise equal one to another. The so-called “asymmetry” in the disc of many Velellidæ is only the beginning of a spiral twisting, caused by a slight dislocation of the vertical sail, turning more or less around the vertical main axis. But in the elliptical Rataria (and also in the similar Ratarula-larvæ of Velella and Armenista) the sail is placed in the sagittal plane, and its later dislocation from this plane is a secondary alteration, comparable to the turning of the sail in a boat sailing before the wind.

This sail, or the vertical crest of the Velellidæ, is the most characteristic part of their trunk, and its gradual development is the primary cause of their peculiar amphithetic form. The sail is originally nothing other than a small fold of the exumbrella, or the soft upper lamella of the disc. We may assume that the elevation of such a fold in any ancestral Porpitidæ was very useful as an aid to the locomotion of the pelagic animal floating on the level of the sea by its horizontal disc. Natural selection, therefore, will have increased the height of that crest, driven by the wind, and the immediate effect must have been the transformation of the circular disc into an elliptical one, the sail occupying the major axis of the ellipse (Rataria). Afterwards the soft and contractile sail becomes supported by the development of an inner chitinous crest, arising from the pneumatophore (Velella), and finally the whole outline of the disc, and the arrangement of its marginal parts, assumes the form of a parallelogram, and the sail is placed in its diagonal axis (Armenista). A continuous series of intermediate transitional forms conducts us from the elliptical Rataria (with sagittal sail), through different forms of Velella, to the most specialised parallelogram-shaped Armenista (with diagonal veil). The special form of the sail in the two latter genera depends upon that of the supporting firm crest of the pneumatophore; in Rataria, however, where the skeleton-crest is wanting, its form differs greatly according to its varying state of contraction.

Exumbrella.—That part of the trunk which includes the pneumatocyst, and corresponds to the invaginated exumbrella, is composed in the Velellidæ, as in the other Discenectæ, of two parallel membranes connected by branched septa. The outer membrane, or the permanent exumbrella (the uninvaginated part), is the pneumatocodon; its exodermal epithelium is armed with many cnidoblasts, and beyond it is placed a strong muscular plate, composed of longitudinal or radial fibres. The inner membrane, or the invaginated part of the exumbrella, is the pneumatosaccus; its thinner exodermal epithelium envelops like a complete sac the whole surface of the pneumatocyst, and this is nothing more than the hardened chitinous cuticula secreted by the former. A great number of septa connect both membranes, and between them occur the canals of the exumbrella, more radially in the horizontal surface of the disc, more longitudinally and parallel in the vertical surface of the sail (on both sides of it). These pallial canals open in the periplacry of the horizontal disc into the marginal canal, and along the free margin of the sail into a crescentic canal, running along the whole margin.

Pneumatocyst.—The chitinous polythalamous float filled with air, which we call pneumatocyst (usually called the "inner shell"), always assumes the form of its surrounding matrix, the pneumatosaccus. It is, therefore, in the Velellidæ elliptical or quadrangular, and very different from that of the Porpitidæ and Discalidæ, where it is always circular and regularly octoradial. Since, however, the former have arisen originally from the latter, their pneumatocyst also must be regarded as an amphithetic or bilateral modification of that circular float of the latter. Indeed, in all Velellidæ there are traces, more or
less distinct, of the same octoradial composition of the centre of the float, which is immediately evident in all Porpitidæ and Discalidæ.

The pneumato cyst of Rataria consists only of a horizontal, slightly campanulate or flatly conical disc of elliptical outline, whilst that of Velella and of Armenista bears a solid vertical triangular crest, placed in a diagonal axis of the disc.

The pneumato cyst of Rataria is of the highest interest, since it offers all desirable intermediate forms between the bilateral crested float of the other Velellidæ and the circular crestless float of the Porpitidæ. This is the more important, as the young Ratarula-larvæ of Velella and Armenista exhibit the same structure of the pneumato cyst (during a longer or shorter time) which is permanent in the autonomous genus Rataria. A central chamber, placed in the centre of the exumbrella, is here always surrounded by eight radial chambers, just as in the Porpitidæ and Discalidæ. But whilst in these two families each radial chamber (as well as the central chamber) possesses a stigma, or a free opening on its upper surface, there are in the similar pneumato cyst of Rataria three such openings only, one in the upper face of the central chamber and one on each side of it, in the two chambers, which are directed towards the two sagittal poles, or the poles of the major axis of the ellipse. The stigmata of the six other chambers seem to be lost by phylogenetic reduction (Pl. XLIV. fig. 8). Each of the eight radial chambers usually possesses a trachæa or a bunch of descending air-tubule on its lower face (fig. 9).

The octoradial structure of the pneumato cyst, which is obvious in Rataria, is also recognisable in the similar Ratarula-larvæ of Velella and Armenista. But it is not equally distinct and well preserved in all species of these two genera. The peripheral wall of the central chamber, which separates it from the eight surrounding radial chambers, is pierced by eight openings, connecting the former with the latter. These openings of communication afterwards often become so enlarged that the eight chambers appear only as radial lobes of the central chamber, and sometimes the eight radial septa between the former are so reduced that the eight lobes nearly disappear. This fact explains the striking contradictions of the former observers, some of whom interpret the Ratarula-larvä as young forms of Velellidæ (Huxley, Bedot, &c.), some as larvæ of Porpitidæ (Agassiz, Burmeister, &c.). Indeed all these larvæ belong to the Velellidæ, since the larvæ of the Porpitidæ never develop a vertical sail. But the octoradial structure of the central part of the pneumato cyst, which is always very distinct in the latter, is of very variable distinctness in the former; sometimes it is well preserved, at other times not, and sometimes the cenogenetic modification is so strong that it becomes quite lost.

The concentric ring-chambers of the pneumato cyst, which surround its octoradial central part, are not circular in the Velellidæ (as in the Porpitidæ and Discalidæ), but more or less elliptical, with prolonged sagittal axis, and shortened transverse or frontal

1 Compare Pagenstecher, 55.
axis. The ellipses are short and nearly circular in the young *Rataria*; they become longer and sometimes slightly quadrangular in *Vellella*, and completely parallelogram-shaped in *Armenista*. The number of these concentric ring-chambers is very variable in the different species, two to eight only in the smallest species (*Rataria*), twenty to thirty or more in the larger (*Vellella*), and fifty to eighty or more in the largest forms (*Armenista*).

*Pneumothyra.*—The concentric ring-chambers of the pneumatoecyst are all in open communication one with another. Each annular elliptical septum between two chambers is pierced by two opposite openings or septal pores, one in the dorsal half, the other in the ventral half of the disc. All these septal pores are placed in a straight line, cutting the major axis of the disc at a very small angle, as was first shown by Kolliker. There are, therefore, not eight radial rows of pneumothyrae as in the ancestral Porpitiidae, but only two opposite radial rows. In some species of Vellellide, however, there seem to exist two other opposite rows, placed in a transverse line near the frontal groove.

*Stigmata.*—All Vellellide possess a relatively small number of superficial openings on the ring-chambers, which lie at their apical or superior surface, and serve for the emission of gas. The number of these stigmata is much smaller than in the Porpitiidae. Usually only every third or fourth ring possesses a pair of opposite stigmata; sometimes rings with and without stigmata alternate regularly; rarely each ring possesses one pair. All the gas-pores or stigmata discovered by Kolliker lie in a straight line, just as do the septal pores, and the line of the former is placed between the line of the latter and the base of the vertical crest. Half the stigmata, therefore, lie in the ventral half of the disc on the right side of the crest, and the other half in the dorsal half on the left side, or vice versa (compare Pl. XLIII. fig. 5, *pe*). The direction of the series of stigmata in all Vellellide is already marked by the three first stigmata of their Ratarula-larvae. These, as well as the mature *Rataria* (Pl. XLIV. fig. 8), possess only three stigmata, which are placed in a line, cutting the sagittal axis of the horizontal disc at an acute angle; one of the three pores lies near the centre (*po*); the second on the left (*pe*), and the third on the right side. All the following stigmata develop in the direction of that line. In many Vellellide the stigmata lie so near the crest-basis that they are difficult to find.

*Tracheae.*—The number of tracheae arising from the lower face of the pneumatoecyst in the Vellellide is also much smaller than in the Porpitiidae, but they are longer than in the latter and usually branched. In many species eight tracheae arise from the periphery of the eight radial chambers which surround the central chamber; these are usually branched (Pl. XLIII. fig. 6; Pl. XLIV. fig. 9). A small and variable number of other tracheae arise here and there, irregularly scattered, from other parts of the pneumatoecyst.

The vertical crest of the pneumatoecyst, or the sail-skeleton, wanting in *Rataria*, exhibits different degrees of development in the various species of *Vellella* and *Armenista*.

1 Kolliker, 4, Taf. xi. fig. 11.
At first it is a low thin crest in the base of the soft muscular sail, and afterwards arises as a high vertical lamella, usually of more or less triangular form; the top of the triangle is the highest point of the body, and placed in the upper or apical pole of the vertical main axis. The broad base of the triangle, placed in one diagonal line of the parallelogram-shaped disc, is usually about one and a half times as long as each of the two equal lateral sides. The substance of the crest is a thin chitinous plate, secreted from that part of the pneumatosaccus which arises from the diagonal of the disc as a vertical fold. It is perfectly homogeneous, solid, and structureless, and contains no canals nor air-chambers. A number of lines or thin ridges, parallel to the two ascending edges of the triangular crest, and visible on both flat sides of it, indicate its successive growth.

Central Siphon.—The large central polypite of the Vellellidae differs from that of the Porpitidae and Discalidae in its bilateral compression; the transverse section of its basal part is circular in the two latter families, elliptical in the former; the major axis of the ellipse corresponds to that of the umbrella. Its general structure and shape are otherwise the same as in the other Discocentae. The central siphon is comparatively large in the small Rataria, where the number and size of the peripheral siphons is small, whereas in the larger species of Vellella and Armenista, where the peripheral siphons are very numerous, the central polypite is less preponderant. The thick wall of the central siphon is very contractile, and composed of two strong muscle-plates, an outer longitudinal and an inner circular, both separated by a strong elastic fulcram. The wall often exhibits prominent radial or longitudinal folds, eight in the smaller, sixteen or more in the larger forms. Correspondingly, the terminal mouth is often four-lobed or eight-lobed (Pl. XLIII. figs. 4, 8, so; Pl. XLIV. figs. 2-5, so).

Centradenia.—The large central gland, or the so-called "central organ" (formerly "liver"), exhibits the peculiar composition described above (p. 31). Bedot has given an accurate histological description of its structure (59, 60). In the Vellellidae it is more developed than in the Discalidae, but much less than in the Porpitidae. It does not usually occupy the greater part of the superior face of the subumbrella as in the latter, but only its central part, between the centre of the float above and the base of the large central siphon below. The outline and the horizontal section of the centradenia are not circular, as in the Porpitidae and Discalidae, but elliptical or lanceolate, the major axis of the ellipse corresponding to that of the umbrella. Its superior or apical face is more or less conical, and fills up the concave inferior face of the pneumatoscyt. Its inferior or basal face is even, separated by the gastrobasal plate from the base of the central siphon. The difference between the hepatic vessels in the superior half of the central gland, and the renal vessels in its inferior half, seems to be usually not so striking in the Vellellidae as in the Porpitidae. The canal-plexus, as well as the compact parenchyma of exoderm cells, which fills up the interstices of the canal-network, and probably secretes the gas, is in the former far less developed than in the latter. This weaker development of the
centradenia in the Vellellidae is probably due to their pelagic habit of life, and the development of the vertical sail as an excellent means of passive locomotion. The Porpitidae, on the other hand, are probably inhabitants of different depths, and only occasionally come to the surface; their hydrostatic apparatus and the gas-secreting gland are therefore more developed.

Gonostyles.—The numerous polypites of the subumbrella, which produce by budding the medusiform gonophores, are in the Vellellidae mouth-bearing siphons, as in the Porpitidae, not mouthless palpons as in the Discalidae. They are, therefore, usually called "smaller polyps," "sexual polypites," or "peripheral siphons" (shortly "peri-siphons"). They occupy usually, densely crowded in great numbers, a broad gonosty lar branch zone, and often the whole space of the subumbrella between the central siphon and the submarginal corona of tentacles. But at first their number seems to be restricted to eight or sixteen; at least this is the case in Rataria cristata (Pl. XLIV. fig. 2), and also in some similar young larvae (Ratarula) of Velella. Their form and structure are the same as in the Porpitidae, already described above (p. 36).

Tentacles.—The corona of submarginal tentacles is in the Vellellidae far less developed than in the Porpitidae; their structure, too, is simpler than in the latter. The corona is simple, composed of a single series of filaments in Rataria and Velella; it is double or multiple, and composed of two or three (seldom more) series in Armenista. Their number is probably originally eight, and this occurs in some Ratarula-larvae; but there are other similar larvae in which the corona bears a variable number of tentacles irregularly disposed. Some very small and young larvae of the Ratarula-form exhibit only two tentacles, at opposite poles of the major axis of the ellipse, and corresponding to the two primary stigmata of the pneumatocyst. The only Rataria which I have observed in the adult state (with gonophores) possessed sixteen tentacles, rather regularly disposed along the limb (Pl. XLIV. figs. 1, 2). In Velella this number is soon increased, and amounts in the simple series usually to fifty to eighty, often more than a hundred. In Armenista there are usually some hundreds, or sometimes thousands; the smaller tentacles of the outer (or distal) series alternating with larger filaments of the inner (or proximal) series.

Form of the Tentacles.—The general structure of the tentacles in the Vellellidae is the same as in the Porpitidae, but their form is much simpler, and the three rows of stalked cnidospheres, which are characteristic of the tentacles of the latter family, are wanting. The submarginal filaments of all Vellellidae are simple cylindrical tubes, sometimes slightly compressed, usually gradually tapering towards the rounded distal end, seldom somewhat club-shaped; in very young larvae they are conical and pointed. Their armature with cnidoblasts is very different from that of the two other families. Usually each tentacle bears only two lateral ribands of cnidoblasts, sometimes four (two stronger

1 Compare Bedot, 60, 1884.
THE VOYAGE OF H.M.S. CHALLENGER.

lateral and two weaker medial, an upper and a lower). The enidoblasts are often more crowded towards the distal end. Sometimes they are irregularly scattered.

Ontogeny.—The larvæ of the Velellidæ were described by Eschscholtz, who founded upon them the new genus Rataria. We retain here this genus for those simplest forms of the family, which, at this same stage, develop a corona of sexual siphons around the central siphon, and gonophores from the gastral walls of these gonostyles. The larval forms of Velella, described usually as Rataria, lack the gonostyles, and are better designated as Ratarula. Pagenstecher (55) has given a careful historical and anatomical description of these larval forms. But I suppose that the numerous larvæ examined by him, and all figured as Rataria, may be mixed larvæ of Velella and Porpita. The regular octoradial pneumatocyst, figured in his Taf. xli. fig. 1, seems to belong to Porpita, since the same organ in Velella is always more or less amphitheatrical or bilateral. But no larva of Porpita has the vertical sail or crest shown in his figs. 3–5, &c.; these belong to Velella.

The medusiform gonophores, which bud in clusters from the gonostyles of the Velellidæ, and afterwards become detached (Discomitra, Chrysomitra), are described by many authors (mainly by Kolliker, Vogt, Gegenbaur, Leuekart, Huxley, Alexander Agassiz, and others (compare on the metagenesis of the Velellidæ, p. 39 above).

Phylogeny.—The Velellidæ have probably descended from the older forms of Porpitidæ (or directly from the Discalidæ); their peculiar amphithectical or bilateral development is due to the production of the vertical sail as a longitudinal fold of the exumbrella.

Synopsis of the Genera of Velellidæ.


Rataria, Esch., System der Acalephen, p. 166.

Definition.—Velellidæ with an elliptical umbrella and a vertical membranous sail placed in the major axis of the ellipse. Margin of the umbrella not lobate. Pneumatocyst flatly campanulate or more discoidal, elliptical, without vertical chitinous crest. Submarginal corona of tentacles simple.

The genus Rataria is the simplest and most primitive form of the Velellidæ, and

1 p. 166. 2 Rataria = A float.
comprises those small forms of the family, the vertical sail of which contains no chitinous crest. The pneumatocyst, therefore, is the horizontal elliptical chitinous disc alone; no vertical skeleton crest is developed upon its surface, as in *Velella* and *Armenista*. The soft vertical sail is placed in the major axis of the ellipse, not obliquely in a diagonal. The species of *Rataria* upon which Eschscholtz founded the genus were probably young larval *Vellella*, perhaps the same as those of which Bedot has during the last few years given an anatomical description (58–62). Pagenstecher gave in 1863 a very accurate description of *Rataria*, with historical remarks on the *Vellellidae* in general, and discussed the question whether these forms of *Disconectæ* were only a larval stage of *Vellella* (or perhaps of *Porpita*) or an independent peculiar genus of this group. As a fact both alternatives are true. *Rataria cristata*, from the Tropical Atlantic, described in the following pages, and found in the Challenger collection (Station 348), is a *Vellellid* which produces gonophores in the form of *Rataria*, and therefore is the representative of an independent genus. The larvæ of *Vellella* and *Armenista*, on the other hand, all pass through a larval stage similar to the former. But no *Porpitidae* have a similar larval form, since the vertical sail is completely wanting in this family, and is only to be found in the family *Vellellidae*. Regarded from a phylogenetic point of view, *Rataria* is a necessary intermediate link between the older *Porpita* and the more modern *Vellella*.

*Rataria cristata*, n. sp. (Pl. XLIV.).

*Habitat.*—Station 348, Tropical Atlantic; April 9, 1876; lat. 3° 10’ N., long. 14° 51’ W. Surface.

*Umbrella* (fig. 1, from above; fig. 2, from below; fig. 3, half lateral, half apical view; fig. 4, lateral view; fig. 5, frontal section).—The horizontal disc of the umbrella is elliptical, 4 mm. long and 3 mm. broad in the expanded state. The vertical sail which arises in its sagittal or longitudinal axis, is very contractile, and therefore exhibits very different forms (figs. 3, 4). The vertical transverse section of the umbrella (fig. 5) demonstrates that the greatest part of its volume is occupied by the pneumatocyst (pf), and the centredenia (uc) which lies between this and the central siphon (so).

*Exumbrella* (figs. 1, 3, 4).—The superior or apical face of the umbrella is divided into three parts—the vertical sail (velarium), the campanulate part, which includes the pneumatocyst (pneumatophore), and the broad horizontal free border (limbus).

*Limbus Umbrella* (uu).—The peripheral border of the horizontal disc, which surrounds the campanulate pneumatosaccus, is an elliptical ring of 0.5 mm. in breadth; its outer edge is densely beset with a series of marginal muciparous glands (us), and on the inside of this glandular corona runs the elliptical marginal canal (fig. 10, cc), into which open the numerous radial canals of the umbrella (cc).
Velarium (figs. 3–5, uf).—The vertical sail is a simple fold of the exumbrella, which arises in the longitudinal or sagittal axis of the elliptical disc, along the median line of the campanulate pneumatosaccus. Its form and size are very variable, since it is very contractile; if highly expanded, it appears nearly rectangular, with a median notch at the central top (fig. 3), and its vertical diameter is greater than the major axis of the horizontal disc; if strongly contracted it appears much smaller, and has the form of a shallow vertical elliptical disc (fig. 4). At other times it is more crescentic in form, or cordate with a deep constriction in the middle of the top.

The velarium is composed of an elastic support, or a thin vertical plate of jelly in its median plane (fig. 5), and a thin mantle-plate of the exumbrella, covering both sides of this fulcrum. This mantle-plate exhibits beyond the exodermal epithelium a double strong muscular layer, composed of two different strata, an outer thinner layer of transverse or horizontal muscles, and an inner thicker layer of longitudinal or vertical muscles; the bundles of the latter are parallel, of equal breadth, about forty or fifty on each side.

The parallel vertical bands of equal breadth ascending in the velarium to its top (twenty to thirty in the sagittal diameter) are simple vessels, which arise from the exumbrella of the campanulate pneumatosaccus. They are united at the free superior edge of the sail by a marginal sail canal. This runs along the whole free edge of the sail and opens at its base into the two sagittal canals of the exumbrella, which run to the two opposite poles of its major axis.

Subumbrella (fig. 2).—The inferior or basal face of the umbrella, beyond the series of marginal glands, consists from without, inwards, of the following parts:—(1) The inferior or subumbral side of the broad mantle border (um); (2) the elliptical corona of tentacles (t); (3) the corona of gonostyles (gs); and (4) the large central siphon (so).

Pneumatoecyst (fig. 8, from above; fig. 9, from below; fig. 3, pf, in profile; fig. 5, pf, in vertical section).—The chitinous thin-walled float, filled with gas, is flatly campanulate with an elliptical quadrilobate outline. Its length (or principal axis) is 2 mm., its breadth or transverse axis 1.5 mm., and its height (or sagittal axis) also 1.5 mm. It is composed of an elliptical central chamber, an inner corona of eight radial chambers, and an outer corona of four to eight concentric elliptical ring-chambers. These latter are divided by two crossed centripetal furrows (a sagittal and a frontal notch) into four rounded lobes (figs. 8, 9). These are systematically arranged in pairs. The left anterior and right posterior lobes are smaller than the right anterior and left posterior.

Stigmata (fig. 8, pe).—The convex superior face of the pneumatoecyst, which is covered by the exumbrella, exhibits only three stigmata. These lie in a straight line which crosses the major axis of the elliptical disc at a very small angle. The subcentral stigma (po) lies nearly in the top of the central chamber, and opens on the left side of the base of the sail; the second lies on the surface of the left anterior quadrant, and
the third on the right posterior quadrant of the pneumatocyst, each at the base of a radial chamber (fig. 8, pe' anterior, pe" posterior stigma).

*Trachee* (fig. 9, pt).—The concave inferior face of the pneumatocyst, which is in close contact with the superior convex face of the centradenia, gives off eight small bunches of trachee, each composed of two to four. These are simple undivided tubules, which arise from the periphery of the eight radial chambers of the pneumatocyst, and enter into the centradenia, where they end in its exodermal parenchyma.

*Centradenia* (figs. 3, 4, uc, in profile; fig. 5, wc, in vertical transverse section; figs. 6 and 7 in horizontal section, fig. 6 through the inferior, fig. 7 through the superior part).
—The central gland, or the so-called "liver," has the form of a flat cone, strongly compressed from the two lateral sides, or of a thick vertical triangular lamella, which is somewhat sigmoidal, or slightly bent in an S-form. Its upper face is completely covered by the campanulate pneumatocyst; its lower face is in contact with the gastrobasal plate of the central siphon (fig. 5, st), and the surrounding corona of sexual siphons.

The glandular parenchyma of the centradenia is composed in the superior half more of entodermal canals, in the inferior half more of exodermal cells and cnidoblasts. The vascular reticulum of the superior face exhibits a star of eight radial main vessels; two of these, opposite in the longitudinal axis of the disc, are longer and stronger than the six others, which are disposed symmetrically on both sides of the former, three on the right, three on the left; the middle of these, or the frontal canal, is the shortest, whilst the two diagonal canals of each side are longer than the latter, shorter than the sagittal canals. The numerous smaller vessels, which arise from these eight superior hepatic vessels, form an irregular network, which is rather dense in the superior half of the centradenia, loose in its inferior half; the axial part of the latter is chiefly composed of exoderm-cells.

The descending superficial canals of the centradenia pass over at its basal periphery into four different groups of canals:—(1) The numerous radial canals of the free mantle border (or pallial canals, fig. 10, ce); (2) the canals of the tentacles (fig. 5, t); (3) the canals of the gonostyles (gs); (4) the eight innermost canals which open into the base of the central siphon.

The pallial canals (fig. 10, ce), which run nearly horizontally from the periphery of the base of the liver to the edge of the mantle border, are very numerous, and so densely attached one to another, that their intervals are smaller than their lumen. Their distal ends, which open into the annular elliptical marginal canal (ce), are partly simple, partly forked; usually a simple and a forked vessel regularly alternating.

*Central Siphon* (fig. 2, so; fig. 3, sa; fig. 5, sa, in longitudinal section).—The large central polypite is a slender inverted cone, strongly compressed from both sides. Its elliptical basal plate is in contact with the basal face of the centradenia, and separated from it by the strong fulcrum of the gastrobasal plate (fig. 5, st). The periphery of this is

1 Compare the figure of Belot, 59, pl. ix. fig. 1.
pierced by eight openings which conduct into the eight primary radial vessels, arising from the original manubrium of the Medusa. The thick wall of the central siphon exhibits eight strong radial longitudinal folds, and its slender proboscis has eight lips around the terminal mouth (figs. 3, 5, so).

Gonostyles (figs. 2, 3, 5, gs).—The sexual siphons, sixteen in number, form an elliptical corona around the central siphon and separate it from the tentacular zone and the mantle-border. Their slender cylindrical basal part bears clusters of medusiform gonophores, whilst their dilated spindle-shaped distal part opens by a four-lobed mouth.

Tentacles (figs. 1–5, t).—The sixteen tentacles form an outer corona around the inner corona of gonostyles, and alternate regularly with the insertions of the latter. They are simple, cylindrical, very contractile, and beset with two opposite rows of cnidoblasts.

Genus 8. Vellella, Lamarek, 1816.

Vellella, Lmk., Hist. nat. anim. sans vert., t. ii, p. 481.

Definition.—Vellellide with an elliptical or slightly quadrangular (parallelogram-shaped) umbrella, and a vertical triangular sail, placed obliquely in a diagonal line of the ellipse. Margin of the umbrella not lobate. Pneumatoeyst discoidal, of the same form as the surrounding umbrella, with a vertical chitinous crest supporting the sail. Submarginal corona of tentacles simple.

The genus Vellella is, next to Physalia, the oldest and best known form of all Siphonophore, since it is generally distributed in all warmer seas, often very common, and in some countries used as food. Owing to its striking form and sailing movement it is well known to the fishermen. The Italian naturalists Ferrante Imperator (1599) and Columna (1616) mention it under the names Vela or Vellella, Carburus (1757) and Dana (1776) under the names Armenista or Armenistaria. The first good description and figure were given in 1776 by the excellent Swedish naturalist Forskål; he named the Mediterranean species Holothuria spirans. Afterwards Lamarek erected the genus Vellella with three species (the Mediterranean Vellella limbosa, the North Atlantic Vellella mutica, and the South Atlantic Vellella scaphidia). Eshscholtz in his fundamental work described ten different species, and Lesson as many as sixteen. But the greater part of these descriptions are worthless and quite insufficient, since they are founded only upon the different coloration and other characters of little value (for example, the different direction of the sail).

Two species of Vellella only are hitherto completely known; the Mediterranean Vellella spirans, very accurately described by Köllicher and by Vogt, and the North Atlantic Vellella mutica by Alexander Agassiz.

1 Vellella = Diminutive of Vela, sailing-boat.
5 6, pls. i., ii.
6 7, pls. i.–vi.
The collection of the Challenger contains different species of *Veabella*, collected in widely distant parts of the Atlantic and Pacific Oceans. The comparison of these species and of others which I have seen in many museums, has led me to the opinion that about a dozen different “good species,” at least “geographical species,” may be distinguished, and that these may be placed in two different genera, *Veabella* (sensu stricto) and *Armenista*. The genus *Veabella* (sensu stricto), the type of which is the well-known *Veabella spirans* of the Mediterranean, has an elliptical umbrella with an integral, not lobate margin, and a simple series of tentacles; it stands nearer to the ancestral form *Rataria*.

The second, more differentiated and larger genus, *Armenista*, has a more quadrangular or parallelogram-shaped umbrella, with a broad lobate margin, and a double or multiple series of tentacles. Perhaps even four genera may be distinguished when the numerous local varieties are better known.

The following species may be distinguished of the true *Veabella* (sensu stricto):—

2. *Veabella caurina*, Eschscholtz, 1 (North Atlantic, observed by me in 1866 in the Canary Islands).
3. *Veabella scaphidia*, Peron (12), collected by the Challenger in the Guinean Current (Stations 346 to 352).
4. *Veabella oblonga*, Chamisso (21), collected by the Challenger off Volcano Islands, south of Japan (Stations 229 to 237).
5. *Veabella patella*, Brandt (25), collected by the Challenger in the Tropical Pacific (Stations 265 to 279).

Nearly related to the latter seem to be *Veabella pacifica* of Eschscholtz and *Veabella cyanea* of Lesson (South Pacific).

The other species of *Veabella* described seem to belong to the following genus, *Armenista*.


**Definition.**—Velellidae, with a quadrangular or parallelogram-shaped (sometimes slightly elliptical) umbrella, and a vertical triangular sail, placed obliquely in a diagonal line of the parallelogram. Margin of the umbrella lobate. Pneumatozyst discoidal, of the same form as the surrounding umbrella, with a vertical chitinous crest supporting the sail. Submarginal corona of tentacles double or multiple.

The genus *Armenista* (enumerated in my “System” as *Velaria*, a name already

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1 The name *Velaria* adopted in my System der Siphonophoren, 1888, p. 31, had previously been employed for a Sponge (Aplysinidae).

2 *Armenista* or *Armenistrium* (Carburies, 1757) is the Cephalonian term for sail = *Veabella*. 
employed for a Sponge) comprises those Velellidæ which differ from the true *Velella* by the broad lobate margin of the umbrella and by the double or multiple corona of tentacles; usually also by the quadrangular form of the umbrella, which in the former is more elliptical. Although a sharp boundary line between the true *Velella* (s. str.) and *Armenista* cannot be drawn, the differences of the extremely divergent forms are very striking; and when the intermediate forms are neglected, they represent two widely different genera. The elliptical umbrella with integral border of the mantle, and the simple corona of tentacles, brings the true *Velella* nearer to the ancestral *Rataria*. On the other hand, the larger *Armenista*, with the broad lobate border of the mantle of the quadrangular umbrella, and the double or multiple corona of tentacles, is a more recent and more differentiated form. To this genus belong probably the following species:—

(1) *Armenista sigmoides*, n. sp., from the Southern Tropical Atlantic, figured in Pl. XLIII., and taken by the Challenger at Station 346.

(2) *Armenista mutica*, Lamarck, from the North-western Atlantic, very good figures of which were published in 1883 by Alexander Agassiz (57).

(3) *Armenista antarctica*, Eschsholtz (1), and

(4) *Armenista indica*, Eschsholtz (1), from the Indian and Antarctic Oceans, and the Cape of Good Hope.

(5) *Armenista lata*, Chamisso (21), from the Northern Pacific.

(6) *Armenista lobata*, n. sp., from the Southern Pacific.

*Armenista sigmoides*, n. sp. (Pl. XLIII.).

*Velella sigmoides*, Hkl, 1881, MS.

**Habitat.**—Station 346, Tropical Atlantic; April 6, 1876; lat. 2° 42' S., long. 14° 47' W. Surface.

**Umbrella** (fig. 1, from above; fig. 2, from below; fig. 3, half lateral, half superior view).—The umbrella is nearly rectangular, with rounded edges, about one and a half or twice as long as broad; the longitudinal or sagittal diameter of the horizontal disc is in the largest specimens 80 to 90 mm., the transverse or frontal diameter 30 to 40 mm. This latter about equals the height of the triangular vertical crest or sail.

**Exumbrella** (fig. 1).—The superior or apical face of the umbrella is divided into the broad lobed mantle-border and the colourless pneumatic disc, both separated by a sharp line which is not parallel to the margin of the border. The vertical diagonal crest divides the exumbrella into two equal halves, an antero-dextral and a postero-sinistral. When we regard the disc in profile from the broad side (its major axis perpendicular to the axis of vision), the crest or sail runs from our proximal and left to our distal and right side; but seen from behind, from the smaller side (the major axis of the disc
parallel to the axis of vision), the vertical sail runs from our proximal and right to our
distal and left side ("Veeliea sinistra," Chamisso).

_Limbus Umbrella_ (fig. 1).—The broad soft border of the horizontal disc is widely
prominent over the edge of the pneumatophore, and has four deep marginal incisions.
Two opposite ones of these correspond to the diagonal axis of the sail (the macrodiagonal),
and touch the two ends of its base; the two others correspond to the diagonal
axis of the transverse or frontal groove (the brachydiagonal). The border of the mantle
is divided by these four marginal incisions into four large lobes, which are disposed in
pairs. The two lateral lobes (right and left) are nearly rectangular, and much smaller
than the two crescentic sagittal lobes (anterior and posterior). Besides these four deep
marginal incisions, which correspond to those of the edge of the pneumatophorous disc,
the margin of the mantle-border often exhibits four smaller incisions alternating with
the former; but these are not constant.

_Subumbrella_ (fig. 2).—The inferior or basal face of the umbrella exhibits the smooth
and lobed mantle-border to the same extent as the upper face. A deep elliptical
incision, the tentacular or submarginal furrow (ut), separates it from the elliptical central
area of the subumbrella. This area is bisected by the longitudinal axis of the spindle-
shaped, long and narrow centradenia and the base of the central siphon. Numerous sexual
siphons occupy the greatest part of that subumbrellar central area, whilst a double or
triple corona of tentacles surrounds it.

_Margin of the Sail._—The triangular vertical sail is composed of an inner chitinous
crest arising from the pneumatoeyst, and of a canaliferous plate of the exumbrella,
covering the two sides of the former. This plate is prolonged over the free margin of
the crest, and borders it as a soft contractile limb, which is the uppermost part of the
original longitudinal mantle-fold.

_Pneumatoeyst_ (fig. 5, from above; fig. 6, from below; fig. 4, p, in vertical section).—
The pneumatoeyst is composed, as in all species of _Veeliea_ and _Armenista_, of two different
parts, the horizontal discoidal float filled with air, or the pneumatodisc, and the vertical
triangular crest, which is the inner skeleton-plate of the soft sail, perpendicular to the
disc, and placed in its greater diagonal.

The pneumatodisc, or the horizontal float, is sometimes elliptical or nearly rec-
tangular in outline, at other times distinctly S-shaped. It is two and a half times as
long as broad; in the largest specimen 50 to 60 mm. long, 18 to 21 mm. broad.

The four characteristic marginal incisions, which are described above of the mantle-
border, are marked also in the periphery of the pneumatodisc (fig. 5); the two notches
of the macrodiagonal touch the two ends of the base of the crest, whilst the two notches
of the brachydiagonal approach the two ends of the frontal furrow. The four quadrants
of the disc, which are separated by these four diagonal notches, are disposed in pairs
opposite; the two lateral pairs form an oblique triangle with concave base, and their
surface occupies less than half the area of the two opposite sagittal pairs (posterior and anterior); these form a much broader oblique triangle with a prominent convex base.

The superior or apical face of the disc is slightly convex, the inferior concave; the convexity is much stronger in younger specimens (fig. 4) than in older (fig. 3).

The central chamber of the pneumatocyst (fig. 6, ph) exhibits nearly the same form as that figured in *Ranaria cristata* (Pl. XLIV. figs. 8, 9). It is elliptical and distinctly octolobate. The deep frontal furrow proceeds near to the central chamber, so that the octoradial ring is bisected by it; its ventral half is composed of two anterior and two left chambers; its dorsal half of two posterior and two right chambers. Each of the eight radial chambers possesses a branched trachea, arising from the periphery of its basal side. The apical side of the octolobate ring, however, exhibits three stigmata only, placed near the macrodiagonal, one subcentral, an anterior upon the left ventro-lateral, and a posterior upon the right dorso-lateral chamber.

The concentric elliptical ring-chambers, which surround the octolobate central part of the float, are sixty to eighty in number in the largest specimens; those of the central and those of the peripheral part are half as broad as the intermediate chambers placed between them. Each elliptical ring-chamber is deeply bisected by the frontal furrow of the brachy-diagonal. All elliptical ring-chambers communicate with one another by two opposite openings or pneumothyreae, which are placed one on each pole of the sagittal axis (fig. 5, pq).

The stigmata, or the external openings of the exumbrellar face of the float, are placed in one straight line, very near the base of the vertical crest, and this line bisects the latter at a very small angle (fig. 5, pc). There are in the largest specimen (besides the central stigmata) about thirty to forty stigmata opposite in pairs; these are situated, the half in the right ventral quadrant of the disc (to the right of the basis of the crest); the other half in the left dorsal quadrant (to the left of the basis of the crest).

The tracheae, which arise from the inferior face of the disc, are not numerous. Besides the eight above-mentioned tracheae, which usually arise from the octolobate ring (fig. 6, pt), there is in some specimens another corona of sixteen tracheae, which arise from the sixth or ninth ring, or between these. But in other species there is no regular arrangement, a few scattered tracheae arising here and there from one of the middle chambers. In a few specimens I found an oblique double series of tracheae arising along the frontal furrow, on both sides of it. The number, size, disposition, and branching of the tracheae seem to be subject to many variations in this as well as in other species of the Velellidae. Some tracheae are very long (about equal to the diameter of the centradenia), and bear ten to twelve or more irregular and curved branches (fig. 10); others are much smaller, and bear only a few short branches. The majority of tracheae run more horizontally beyond the pneumatocyst, and finish in the glandular tissue of the centradenia; but a few larger tracheae pierce this latter, and enter partly into the exodermal wall of the central siphon, partly in that of the gonostyles, where they end in their proximal half.
The *Centradenia* (fig. 4, *uc*; fig. 7), or the so-called liver, is a lanceolate gland, the upper convex surface of which is flatly conical, and fills up the inferior concave face of the pneumatocyst (fig. 4, *uf*). Its lower flat horizontal face forms the roof of the central siphon, and is separated from its base by the gastrobasal plate, a thick structureless fulcrum (fig. 4, *st*). The periphery of this plate is pierced by sixteen radial main canals, which arise from the lanceolate base of the central siphon in two longitudinal rows, and run along the subumbrella towards its margin; they give off at their base sixteen ascending liver-canals, which run in the convex upper surface of the centradenia towards its conical apex, where they unite and form a central “liver-star.” Very numerous lateral branches, which arise everywhere from these main canals, penetrate into the solid exodermal parenchyma of the centradenia, and form a very dense network by innumerable anastomoses. The vessels in the upper and outer (hepatic) part of the central gland are dark brown or black, thickly filled with pigment-granules (fig. 4, *u*), except the uppermost; whilst the canals in the lower and inner (renal) part are white or colourless, and contain numerous small greenish guanin-crystals (fig. 4, *w*).

**Central Siphon** (fig. 2; fig. 4, *sa*; fig. 7, *sa*).—The large central polypite is inversely conical, sharply compressed from both sides, very contractile, and variable in form and size. Its lanceolate roof is nearly half as large as the adjacent basal face of the centradenia, and separated from it by the structureless fulcrum or the gastrobasal plate. Its muscular wall is very thick, and exhibits in some specimens outside eight or sixteen thick longitudinal ribs, which are prominent inside as deep grooves. The opening of the mouth has often eight triangular lips (fig. 4, *so*).

The periphery of the lanceolate base of the central siphon exhibits sixteen openings, which conduct into the sixteen radial main vessels of the subumbrella; two opposite of these gastric canals lie nearly in the sagittal axis of the subumbrella (one ventral and one dorsal), and these are much wider and longer than the fourteen other vessels which arise symmetrically from both sides (fig. 7).

**Canal System** (fig. 7).—The reticuliferous system of anastomosing gastro-canals, which arise from the branches of the sixteen above-mentioned radial main canals, is in this, as in other large Veelldidae, very complicated. The following principal branches may be distinguished:—(1) The sixteen ascending superficial canals, which pass off from the former immediately at their origin, and end centrifugally in the upper face of the centradenia; (2) very numerous canals which form a dense reticulum in the subumbrella; (3) numerous vessels which arise from the peripheral part of the centradenia, and enter into the gonostyles; (4) a smaller number of vessels, outside the latter, which open into the tentacles; (5) a corona of radial submarginal vessels which run in the peripheral part of the subumbrella, between the tentacular zone and the margin; these open into (6) a marginal ring-canal, which runs inside the series of marginal glands; (7) a coronal canal, or inner submarginal ring-vessel, runs in the furrow between
border and tentacular zone; from this arise (8) the numerous mantle-vessels of the exumbrella, which form a dense network in the latter, and from these arise (9) the mantle-vessels of the vertical crest, which form a dense network of different form on its two sides; four of these crest-canals are much stronger than the others, two opposite longer, which run along the free upper edge of the crest, and two opposite shorter, which bisect the triangular sides of the crest, and arise near the centre of the frontal groove; (10) a double series of elegant pinnate sail-canals, which arise from the large superior edge-canal of the crest, and run in the soft sail border towards its free margin; they are here united by a small outermost canal running in the free edge of the sail. The special form and reticulation of these numerous canals is about the same as figured by Alexander Agassiz\textsuperscript{1} in \textit{Vellella} (Armenista) mutica.

\textit{Gonostyles} (fig. 2; fig. 4, gs; fig. 8, gs).—The small sexual siphons, or "gonoblastidial polypites," are very numerous (many hundreds in the larger specimens) and densely crowded, occupying the entire broad gonostylar zone between the base of the central siphon and the corona of tentacles. Their upper or proximal half is cylindrical, and covered with bunches of medusiform gonophores \textit{(g)}; their lower or distal half is a contractile muscular stomach, beset with sixteen longitudinal rows of cnidoducts; its proboscis opens below by a very extensile mouth, and this is sometimes distinctly lobed (fig. 8, so). The special form and structure of the gonostyles is the same as figured by Alexander Agassiz\textsuperscript{2} in \textit{Vellella} (Armenista) mutica.

\textit{Tentacles} (figs. 1–4, t).—The corona of tentacles, placed in the elliptical groove between the outer edge of the gonostylar zone and the inner edge of the broad mantle-border, is composed of two or three rows of tentacles; those of the innermost row are the largest, and in the expanded state about as long as the transverse diameter of the umbrella. The tentacles of the outer row, alternating with the former, are only half as long; and when there is a third outermost row, these are very short. The form and structure of these cylindrical tentacles are the same as in other Vellellidae; they are beset on both sides with two lateral rows of sessile cnidocysts.\textsuperscript{3}

\textit{Armenista sigmoides}, as described above from the Tropical Atlantic (Station 346), is perhaps identical with a \textit{Vellella} of which I have obtained several specimens from Cape of Good Hope, collected by Dr. W. Bleek. The short description and the figures which Eschscholtz (1) has given of \textit{Vellella indica} (also occurring at the Cape) are not sufficient to decide the question of the identity of these species. Further accurate examinations and comparative studies are required to enable a better distinction of the different species of Discocetæ.

\textsuperscript{1} 57, pl. iv., v. \textsuperscript{2} 57, pl. ii. \textsuperscript{3} Compare Kölliker, 4; Vogt, 6; Huxley, 9; Agassiz, 57.
Subclass II. Siphonanthæ.

Order II. Calyconectæ, Haeckel, 1888.

(Pls. XXVII.—XLII.)

Diphyidae, Eschscholtz, 1829, p. 122.
Calyconectæ, Leuckart, 1834, 8, p. 256.

Definition.—Siphonophore with one or more nectophores, without pneumatophore, and without palpons. Nectosome always without pneumatocyst, represented only by the nectophores. Siphosome either a single siphon (Monogastricea) or a long tubular stem, bearing a series of equidistant siphons, separated by free internodes (Polygastriceae). Each siphon with a single tentacle bearing a series of tentilla or lateral branches; each tentillum with a cnidosac and a simple terminal filament.

The order Calyconectæ, hitherto usually called Calycophoridae, comprises all Siphonophore without pneumatophore. No doubt this large group is very natural; it differs from all the other Siphonophore, not only in the complete absence of the important pneumatic apparatus, but also in a number of other peculiarities. The primary larva develops first a nectophore (in the others a pneumatophore). The siphons have always the same structure, and so also the single tentacle, which is attached to each siphon; it bears a naked cnidosac (without involucrum) of a constant structure. The long tubular stem of the polygastric Calyconectæ always bears a single row of ordinate cormidia, separated by naked free intervals. Each cormidium constantly bears a single siphon only, and a single tentacle. Palpons and palpacles never occur in the Calyconectæ.

History.—Eschscholtz, in his fundamental work, divided the order Siphonophore into three natural families; the first of these, Diphyidae, differs from the two other (Physophoridae and Vellellidae) in the complete absence of any float filled with air. He distinguished six different genera; three of these (Eudoxia, Ersa, Aglaisma) are monogastric ("with a single suctorid tube"); the three others (Abyla, Cyma, Diphyes) are polygastric ("with a long digestive tube bearing numerous suctorid tubes").

The oldest known of these six genera was Diphyes, founded by Cuvier in 1817, upon an apparently double animal, or twin-zoophyte, of which Bory had given the first figure in 1804 under the name Biphora bipartita (13) (=Diphyes dispar, Chamisso).

Lesson adopted in 1843 (3, p. 424) the system of Eschscholtz, and divided the family Diphyidae also into Monogastricæ and Polygastricæ. But he distinguished a greater number of genera and subgenera (partly constituted already in 1827 to 1833 by Quoy and Gaimard, 2 and 20). Lesson collected all the scattered descriptions of Diphyidae

1 System der Acalephen, 1829, p. 122.
2 Régne animal, édit. l., tome iv, p. 61.
published up to his time; but he could not distinguish the natural groups critically. Marked progress in our anatomical knowledge of the Calycophoridae was made by the excellent descriptions of different Diphyidae which were published in the third period of our knowledge of Siphonophore (from 1853 to 1859, 4–10) by Köllicher, Leuckart, Vogt, Gegenbaur, and Huxley. Two of these celebrated zoologists simultaneously and independently discovered, in the spring of the year 1853, that the monogastric Diphyidae, or the so-called Eudoxiae, were the isolated individual groups (or cormidia) of the polygastric Diphyidae, detached from the common stem, and that the former were connected with the latter by a regular metagenesis. Gegenbaur observed in Messina the detached Eudoxiae of Abyla pentagona.1 The same observation was made at the same time in Nice by Leuckart, who further demonstrated that the monogastric Eudoxia campanula was the detached sexual zooid of his Diphyes acuminata (5, pp. 41, 69).

Leuckart in the next year (8, p. 256) replaced the name Diphyidae by the more convenient term Calycophoridae, and united in this family the true Diphyidae (with two nectophores, loc. cit., p. 257) and the Hippopodidae (with a biserial nectosome, composed of four or more nectophores, loc. cit., p. 298). The latter were formerly regarded as a separate family of Physophoridae, though they possess no float filled by air.

Huxley in his great work (9, 1859) adopted the main group Calycophoridae, and opposed it to all other Siphonophore or Physophoridae. He gave the first exact description of many hitherto incompletely known forms, mainly Abylidae. He was also the first to describe a very remarkable Calycophorid, which possesses only a single permanent nectophore, under the name Sphaeronectes köllikeri, and rightly regarded it as the type of a new family, Sphaeronectidae.2 Fifteen years later a very similar species of the same genus was described by Claus under the name Monophyes gracilis (70, pl. iv.). He observed its metagenesis and connection with that Eudoxia which Gegenbaur had described in 1854 as Diphyopsis inermis.3 The peculiar family represented by these Calycophoridae, the Sphaeronectidae of Huxley, was called by Claus Monophyidae, in opposition to Diphyidae. Following the systematic manuals of recent years, I adopt the term Monophyidae for all those polygastric Calycophora which possess only a single permanent nectophore, while I restrict the term Diphyidae to those forms which have two permanent nectophores. A third family is formed by the Hippopodidae,4 which possess numerous (at least three or four) nectophores arranged in a biserial nectosome; they were afterwards named Polyphyidae by Chun (86, p. 12).

The Polyphyidae differ from the other Calycophoridae in the lack of bracts. A new group, described in the sequel as Desmophyidae, is intermediate between the Diphyidae and Polyphyidae, having in common with the former the possession of a bract on each endosome, with the latter a biserial nectosome, composed of numerous nectophores.

1 7, p. 256; 4, p. 78; 31, p. 106. 2 9, pp. 29, 50, pl. iii. fig. 4. 3 7, Taf. xvi. fig. 3. 4 Köllicher, 4, p. 28.
In the numerous voyages which I have made during the past twenty-five years, in order to complete my System der Medusen (compare the Preface to that Monograph), I have found also many opportunities of examining a great number of Calyconectae belonging to all the genera described in the following pages. The richest harvest was reaped during my residence in the Canary Islands (December 1866 to February 1867), where I was able to examine accurately a great number of new or imperfectly known Monophyidae, Diphyidae, and Polyphyidae. I there traced the complete metagenesis of many typical genera and the ontogenetic connection of monogastric and polygastric Calyconectae. Supported by this rich personal experience, I have in the following pages attempted to give a more correct definition of genera and a more natural arrangement than has hitherto been possible.

**Nectophores.**—The Calyconectae differ from all other Siphonophore in the complete absence of any pneumatophore, so that the nectophores are the only organs of locomotion. The polygastric Calyconectae bear on the top of the long tubular stem either one or two large nectophores (Monophyidae and Diphyidae), rarely a biserial nectosome, which is composed of two opposite rows of nectophores, four to six or more (Desmophyidae and Polyphyidae). The locomotion of the monogastric Calyconectae is effected usually by the subumbrella of the gonophores (Eudoxidae); but in the Erseidæ the first-formed gonophore loses its sexual functions, and acts as a "special nectophore."

The larva of the Calyconectae, which develops from the fertilised egg, and which we call *Calyconula* (Pl. XXVII. figs. 8–11), is a bilateral medusoid person, the manubrium of which lies outside the campanulate umbrella, apparently protruded through a ventral fissure of the latter. The "primary nectophore" of this Calyconula often (perhaps always) becomes detached, and replaced by a secondary nectophore, which is often heteromorphous.

The number, arrangement, and form of the nectophores in the different Calyconectae are very variable, and serve mainly for the distinction of genera. Regarding the general form of the nectophores, we may distinguish two different main groups, Sphaero-nectartiae and Cymbonectartiae; the umbrella of the former consists of a very soft jelly, and is subspherical, nitriiform or reniform, always devoid of distinct edges, with rounded surface. The umbrella of the latter, on the contrary, has always a definite geometrical form, and is polyhedral, either pyramidal or prismatic, with polygonal faces and sharp, often denticulate, edges; its jelly-substance is rather hard and firm, often cartilaginous.

**Nectosae and its Canals.**—The original form of the muscular subumbrella in the Calyconectae is hemispherical, but usually in correlation with the fundamental form of the nectophores (primary as well as secondary umbrella) it is more or less bilateral, and at the same time quadriradial; the latter structure (inherited from the ancestral Anthomedusae) is indicated by the constant four radial-canals of the subumbrella;

\[1, \text{Taf. xvi. figs. 12–21; 85, Taf. vii., viii.; 86, Taf. xvii. figs. 6, 7.}\]
and these are always so differentiated, that two opposite lateral vessels (right and left) are symmetrical, different from the two sagittal vessels (shorter ventral and longer dorsal canal). The sagittal plane, which divides the body of the nectophore into right and left halves, is therefore precisely marked by the two latter opposite canals. Usually both halves are symmetrical, but sometimes more or less asymmetrical. The velum which surrounds the ostium of the muscular nectosac is usually rather broad and strong. The four radial canals are connected above the insertion of the velum by a constant circular canal.

**Palial Canals.**—Besides the four constant radial canals, there are in many Calyconectae one or two palial canals or nutritive vessels of the jelly-substance of the nectophore. An apical palial canal runs in many Diphyopsidae from the top of the nectosac to the apex of the umbrella. Praya and others have two palial canals at the ventral side, an ascending and a descending.

**Number and Arrangement of the Nectophores.**—The number of the swimming-bells, and their arrangement on the top of the stem, are employed by modern authors to divide this order into three families:—Monophyidae, Diphyidae, and Polyphyidae. The Monophyidae (or Sphaeronectidae) possess a single large nectophore on the top of the stem; this is smooth and without distinct edges in the true Sphaeronectidae, sharp-edged or pyramidal in the Cymbonectidae.

The Diphyidae, comprising the great majority of genera and species (among the living Calyconectae), have always two large nectophores on the top of the stem. These are opposite, of nearly equal size and similar form, with rounded exumbrella, in the subfamily Prayidae. They are also of nearly equal size and similar form in the subfamily Diphyopsidae; but in this group the exumbrella is sharp-edged, pyramidal, and the two nectophores are not opposed, but one placed behind or below the other. The remarkable subfamily Abylidse is distinguished by two nectophores of very unequal size and dissimilar form; the first or anterior being much smaller than the second or posterior. The form of the two very different nectophores becomes in this group extraordinarily strange and complicated.

The Polyphyidae (or Hippopodidae) and the closely allied Desmophyidae are distinguished from the other Calyconectae by the possession of a biserial nectosome, similar to that of most Physonectae. There are here at least four to six nectophores (sometimes ten to twelve or more), arranged in two opposite series. They have here no definite edges, and are mitriform or reiform in Desmophyes, Hippopodia, and Polyphyes; whereas they are angular (pentagonal), prismatic, or pyramidal in Vogtia.

It may be that all the Calyconectae with rounded nectophores represent a natural suborder of this order (Sphaeronectariae), and all the others (with edged or pyramidal nectophores) another suborder (Cymbonectariae). The first suborder (Sphaeronectariae) comprises the Sphaeronectidae, Prayidae, Desmophyidae, and Hippopodidae. The second
suborder (Cymbonectariae) would include the Cymbonectidae, Diphyopsidae, Abylidae, and Vogtidae.

_Hydræcum or Infundibulum_ (funnel cavity, house-room, Gehäuschkammer, Trichterhöhle, Stammbehälter).—All polygastric Calyonectidae possess a protective cavity, into which the contracted siphosome may retire. This hydrecium (or infundibular cavity) is always an external space, filled with sea-water and invested by the exoderm. In the Monophyidae it is originally an open groove or fossula on the ventral side of the single nectophore (_Monophyes, Cymbonectes_, Pl. XXVII). This open groove, or the "hydræcial sulcus," becomes a closed cylindrical or conical canal, by concrescence of the two opposite margins, or by deeper invagination of the exodermal fossula, in another part of the Monophyidae (_Sphakronectes, Muggiwa, Cymba_, Pl. XLI). The singular genus _Mitrophyes_ (Pl. XXVIII) has no hydrecium, but it is replaced here by a pouch-like space between the permanent secondary nectophore and a mitre-shaped or scutiform bract, which is the remnant of the reduced primary nectophore.

The hydrecium of the Diphyidae exhibits various degrees of development. In the Prayidae it is an incomplete canal, formed by two opposite ventral grooves of the two nectophores, fitting one into another. _Diphyes, Diphyopsis, _and the Abylidae possess a conical infundibular cavity at the ventral side of their first or apical nectophore, and this continues into an incomplete hydrecial canal, formed by a longitudinal groove at the ventral side of the second or basal nectophore. The two margins of this groove are often partly united by concrescence, so as to form a shorter or longer canal. In other cases the two opposite margins of the hydrecial groove are developed in the form of two broad dentate plates (right and left) which overlap one another. The genus _Galeolaria_ has no hydrecium, the siphosome hanging freely down between the distal end of the first and the proximal end of the second nectophore.

The hydrecium of the Desmophyidae and Polyphyidae is an infundibular cavity between the two opposite rows of nectophores, almost as in the Prayidae.

_Somatocyst or Acrocyst_ (top-cavity of the stem, epphyal cavity; Saftsack, Saftbehälter, es).—The single nectophore of the Monophyidae, and the first or proximal nectophore of the Diphyidae, contains a remarkable cavity, the acrocyst or somatocyst, at the ventral side of its nectosac and at the top of its hydrecium. This is the uppermost part of the common trunk included in the jelly-substance of the first nectophore; it may be compared to the apical canal or peduncular canal of the ancestral Medusa, which was connected by it with its hydropolyp-parent. The somatocyst is usually spindle-shaped or ovate, at other times subspherical or cylindrical; its upper or apical end is blind, whilst its lower or basal end passes directly into the small apical central cavity, from which arises the central canal of the stem and the pedicular canal of the nectosac.

The narrow cavity of the somatocyst, or the acrocyst-canal, is invested by very large entoderm cells, usually vacuolated and polyhedral owing to mutual compression. Its
uppermost part usually includes a smaller or larger oil globule, the oocyst (co). The physiological function of the somatocyst may be hydrostatic (as a float) and nutritive (as an accumulation of nutritive, strongly refracting albuminous globules). Its morphological nature is explained by the medusome-theory which compares it with the apical canal or original peduncular canal of a Medusa-person.

Trunk or Cenosarc.—The common stem in all polygastric Calyconectae is a long cylindrical and highly contractile tube, very long and thin in the expanded state, short and thick in the contracted state, when it is retracted into the hydrocoelum. The cormidia are always ordinate, arranged in a single series on the ventral side of the articulated stem; they are separated by free naked internodes of equal length. Very rarely (in Polyphyes) the cormidia begin to be scattered. The number of the cormidia is in the smaller cormi ten to twenty (rarely less), usually forty to eighty or more, sometimes several hundreds. In the largest species (mainly of Praya) the expanded stem attains a length of more than a metre. The structure of the stem-wall is that usually found in the Siphonanthae; the tubular fulcrum (or structureless supporting plate) is invested on its inner side by a thin layer of entodermal circular muscles, on the outside by a strong layer of exodermal longitudinal muscles; these are arranged, as usual, in parallel bundles along the lamellar radial folds of the fulcrum.

Cormidia.—The aggregation of different medusoid persons, by which the cormus of the Calyconectae is formed, follows certain simple and regular laws, but is different in the two kinds of cormidia, which we distinguish as Eudoxomes and Ersxesmes. The cormidia of the great majority of Calyconectae are Eudoxomes, or in the free independent state “Eudoxia” or “Diphyozooids”; each Eudoxome is a twin-group, composed of two medusoid persons, a fertile and a sterile medusome. The sterile medusome is composed of a bract, a siphon, and a tentacle. The fertile medusome is represented originally by a single medusiform gonophore, but afterwards this is often replaced by a cluster of several gonophores.

The Ersxesmes (or the monogastric generation of Lilyopsis and Diphyopsis) differ from the Eudoxomes in the fact that the primary gonophore loses its sexual manubrium, and is converted into a so-called “special nectophore”; its sexual function is replaced by a secondary gonophore. The Ersxome, therefore, is composed of three medusoidal persons, a sterile medusome (bract, siphon, and tentacle), a sterile nectophore, and a fertile gonophore. Afterwards the latter is often replaced by a cluster of several accessory gonophores.

The sessile gonophores of the Eudoxomes and Ersxesmes attain sexual maturity, whilst attached to the trunk, in Mitrophyes and Cymbonectes among the Monophyide, Praya and Galeokaria among the Diphyide, probably in all Desmophyide and Polyphyide. This is not the case in the majority of Monophyide and Diphyide. Here the cormidia become detached from the common stem before reaching maturity, and swim freely.
about under the individual form of self-subsistent monogastric Calyconectae (Eudoxia and Ersew, Families IV. and V.).

**Bracteae or Hydrophyliae** (Protective persons or shields, Protecta, Phyllozooids— "Deckstücke, Deckschuppen" of German authors).—Three families of polygastric Calyconectae, the Monophyidae, Diphyidae, and Desmophyidae, possess constantly a single bract on each cormidium; it is wanting only in the fourth family, Polyphyidae, where it has been lost by reduction. The single bract of each cormidium is the reduced umbrella of the Medusa-person, the manubrium of which is the single siphon of the former. This is very obvious in Praya, Calpe, and some other genera, where the bract still possesses four radial canals. Usually some of these canals are lost, or they have disappeared altogether.

Each bract has a convex exumbrella and a concave subumbrella, both separated by the basal margin of the umbrella. The form of the bract is very various, and characteristic of the single genera of monogastric Calyconectae; usually it corresponds more or less to the form of the first nectophore. It is hemispherical, mitriform or subspherical, with a smooth exumbrella, in the polygastric Sphaeronecidae, Prayaide, and Desmophyidae. The bract is pyramidal, spathiform or conical, with sharply edged exumbrella, a ventral fissure, and a pointed apex in the Cymbonecidae and Diphyopsidae; it is prismatic with polygonal faces and sharp edges in the Abylidae.

The bracteal cavity corresponds with the subumbrellar cavity of the ancestral Medusa, but has lost its important muscle-plate; it embraces the siphon, the single tentacle, and the gonophore; the last is placed at the ventral side of the siphon, the tentacle at its dorsal side. The nutritive canals of all the organs unite in the top or the centre of the bracteal cavity, where it communicates also with the central canal of the common stem by a short bracteal canal. From the same point arises also the phyllocyst.

**Phyllocyst.**—The apical cavity or coryphal cavity of the bract, which we call shortly "phyllocyst," corresponds to the aeroecyst or somatocyst of the nectophore. Its form and the number and disposition of its apophyses are often very characteristic of the individual genera of Calyconectae. Usually the phyllocyst is an ovate or spindle-shaped sacculus of the same structure as the aeroecyst, filled with large polyhedral vacuolated cells, and often containing also an oecophore or an apical oil-globule. It arises usually more or less vertically from the top of the subumbrellar cavity, and projects into the thick jelly-substance of the bract. From its base arise sometimes four radial canals, which correspond to the four original subumbrellar radial canals of the nectophores, in Praya (Pl. XXXII. figs. 8, 9) and in Calpe (Pl. XL. figs. 14–18). These are so arranged that two paired canals lie on both sides of the bilateral bract (right and left), and two odd in the sagittal plane (dorsal and ventral). The majority of the Calyconectae do not now possess the four original canals. Cymba and Abylida have only two lateral canals; Bassia a single basal canal, arising from the base of the phyllocyst; often they are entirely lost (Diphyes, Monophyes, &c.).
The genus *Mitrophyes* among the Monophyide (Pl. XXVIII.) differs from all other Calyconectæ in the remarkable peculiarity that the convex exumbrella of the single nectophore is covered by a large concave scutiform bract, and that the contracted siphosome is retracted into the space between the former and the latter. We may assume that here the primary nectophore of the larva, instead of being lost, is converted into a permanent bract.

**Siphons or Polypites.**—Each cormidium of the Calyconectæ possesses constantly only a single siphon, and this is the manubrium of the medusome, the modified umbrella of which is the bract. A single long tentacle is always attached to the base of the siphon, between its dorsal side and the concave bract-wall. When the cormidium is detached from the common stem, and represents an independent free Eudoxia or Ersea, it is therefore called a "Monogastric Calyconecta."

The siphons of all Calyconectæ are of similar form, of moderate or small size, very contractile. The four segments or parts of each siphon are usually very distinct, viz., (1) a short peduncle to which is attached the tentacle; (2) a hemispherical or subspherical basigaster with a thick wall; (3) an ovate or ellipsoidal stomach; and (4) a very mobile proboscis with the terminal mouth. (Compare Pl. XXVII. fig. 8, &c.)

The pedicle of the siphon (*sp*) is usually very short, sometimes rudimentary, and connects as a narrow cylindrical canal the gastric cavity of the former with the common alimentary cavity of the stem. The tentacle arises from it sometimes more proximally, at other times more distally; sometimes even more from the following part.

The basigaster (*sb*), or the bulbous basal portion of the siphon, is usually subspherical or ellipsoidal, and distinguished by a much-thickened exodermal wall; this is filled with innumerable densely crowded nematoceysts. Its outer and inner surfaces bear a vibratile epithelium. Its small ovate cavity is separated from the stomach by a pyloric valve, which can be closed completely.

The stomach (*sm*) is ovate or ellipsoidal, with a thin, non-ciliated exoderm; its entoderm, however, is very thick, glandular, and often exhibits eight or sixteen hepatic stripes (often of a yellow, red, or orange colour), sometimes instead of these hepatic villi; some of the entoderm cells are usually vacuolate.

The proboscis (*sr*) or the distal portion of the siphon, is very contractile and extensible, with a strong muscular plate; its free distal end opens through the mouth. The very mobile mouth may be expanded in the form of a suctorial disc, circular, or polygonal; it is often octolobate (more rarely with four, twelve, or sixteen lobes).

**Tentacles.**—The capturing filaments or tentacles of the Calyconectæ exhibit in all members of this order essentially the same structure, and are very uniform, compared with the manifold and richly varied forms which we find in the similar tentacles of the following order—Physonectæ. In all Calyconectæ, without exception, each siphon bears at its base a single, tubular, very long and extensible tentacle, which is beset with a single
series of lateral branches or tentilla. Each tentillum is a thinner cylindrical tubule, and is constantly composed of three different parts—(1) a thin pedicle or proximal portion \((tp)\), (2) an inflated cnidosac as a dilated middle part \((tk)\), and (3) a thin distal portion, the terminal filament \((t')\). The closed distal end of the latter is sometimes vesicular; so also the distal end of the pedicle is sometimes club-shaped. The structure of the thin cylindrical pedicle and of the long terminal filament is simple and always the same, whilst the cnidosac, placed between them, exhibits a complicated, and more or less varied structure (compare Pl. XXVII. fig. 7; Pl. XXVIII. fig. 8; Pl. XXXII. figs. 12-14; Pl. XXXIV. fig. 18; Pl. XXXVI. fig. 26; Pl. XXXVIII. fig. 16; Pl. XL. figs. 19, 20).

The cnidosac (or sacculus) of all Calyconectae is originally nothing more than an inflated dilatation of the middle part of the simple cylindrical tubular tentillum. This dilatation seems to be produced by the stronger development of larger cnidocysts on one side of its middle part. This side, which contains the so-called "cnido-battery," is the convex dorsal side of the cnidosac, whilst the opposite ventral side is usually more or less concave; it contains two parallel elastic bands, which seem to form together a noose at the distal end of the cnidosac, the so-called "cnido-band or angle-band." The whole cnidosac, therefore, has a bilateral form, usually more or less ovate, pyriform, or kidney-shaped. In most Calyconectae it is more or less compressed from both sides, so that the sagittal axis is larger than the frontal, but smaller than the principal axis.

The differentiated cnidocysts, or thread-cells, which are crowded in great numbers in the "cnido-battery" at the convex dorsal side of the cnidosac, occur generally (probably in all Calyconectae) in three different forms—(1) very numerous, small, and palisade-shaped \((\text{paliformes})\); (2) few, large, and sabre-shaped \((\text{ensiformes})\); (3) small and pear-shaped, in a distal group \((\text{pyriformes})\). These are so arranged that several parallel rows of paliform or medial cnidocysts occupy the whole convex dorsal side of the cnidosac \((km)\), two bilateral groups of a few large ensiform cnidocysts are placed at each side of its proximal basal part \((kj)\), and an odd distal group of small pyriform cnidocysts \((kp)\) lies at its distal end, at the base of the terminal filament \((t')\).

The small palisade-shaped or medial thread-cells \((\text{Cnidocysta paliformis}, km)\) are always very numerous, usually some hundreds in number, and comprise far the greatest part of the crescentic cnido-battery, occupying the dorsal half of the sacculus. They are arranged so regularly that they form together a certain number (usually four, six, or eight) of parallel longitudinal columns, each composed of a single series of numerous (twenty to fifty, or more) cnidocysts. All the latter are cylindrical or spindle-shaped bacilli, of similar form and equal size, three to six times as long as broad, sometimes straight, at other times slightly curved. Their axis is perpendicular to that of the sacculus. The convex dorsal surface of the sacculus, therefore, appears elegantly panelled or facetted, the outer or abaxial ends of the paliform cnidocysts forming regular transverse rows (crossing the longitudinal rows).

(2ool. ChalL. exp.—Part LXXVII.—1888.)
The large sabre-shaped or lateral thread-cells (*Cnidocystae ensiformes, kg*) form constantly two small lateral groups in the basal or proximal part of the sacculus, covering both the right and left sides of the base of the enido-battery. Their number and form are often characteristic of the individual species of Calyconectae. Thus, for example, *Mitrophyes peltifera* (Pl. XXVIII. fig. 8) has only two, *Cymbonectes huxleyi* (Pl. XXVII. fig. 7) three, *Diphyopsis compressa* (Pl. XXXIV. fig. 18) six large lateral thread-cells on each side of the base of the sac; their number is larger in the Abylidae (usually eight to twelve), and especially in the Prayidae (sixteen to twenty, or more, on each side). Their form is usually slender, spindle-shaped or sabre-shaped, four to eight times as long as broad, straight, sometimes slightly curved; but sometimes they are more rounded, ovate (as in the smallest Calyconectae). They are always placed in a single longitudinal row, parallel to one another, and also (more or less) to the axis of the sacculus. Usually the axis of the ensiform enidocysts is so directed obliquely that the dorsal end is more proximal and medial, the ventral end more distal and lateral.

The small pear-shaped or distal thread-cells (*Cnidocystae pyriformes, kp*) always form an odd group at the distal end of the enidosac and touch the base of the terminal filament (*tf*). Their number is very variable, usually between twenty and sixty. The group formed by these pyriform enidocysts has usually the form of a rounded cap, covering the distal end of the enido-battery, and is evidently sensitive to a remarkable degree, since long enidocils arise from these thread-cells. Sometimes the group is tri-lobate, with an odd middle and two lateral lobes; and in some species it is even divided into three separate parts, an odd medial group being separated from two paired lateral groups, as in *Praya* (Pl. XXXII. figs. 12–14) and in *Bassia* (Pl. XXXVIII. fig. 16).

The elastic angle-band, composed of two very long linear and parallel ribbands, is closely coiled up spirally in the thin-walled ventral pouch of the closed enidosac. But when this becomes opened (by rupture of the thin ventral wall), then the angle-band is expanded to a great length, often folded in a zigzag. Its proximal end remains in connection with the pedicle (*tp*), its distal end with the terminal filament (*tf*). The enido-battery becomes hung out, and is freely prominent, and its distal end only remaining in connection with the proximal part of the terminal filament and its junction with the elastic angle-band (Pl. XL. fig. 20).

Gonophores.—The sexual persons of the Calyconectae are always quadriradial Meduse, with a well-developed umbrella and a manubrium, in the thickened wall of which the sexual cells are produced from the exoderm. The cavity of the manubrium has, however, no mouth opening, and the margin of the umbrella bears no tentacles. Originally each cormidium possesses only one gonophore, and in many Calyconectae never more than a single sexual medusome is attached to the siphon. But when this gonophore is mature, it usually detaches itself from the cormidium (*Eudoxia*) and may be replaced by a secondary or vicarious gonophore. In many species (mainly of Abylidae)
two or three gonophores are developed simultaneously in a single cormidium, and in some genera (*Lilyopsis*, *Desmophyes*) a bunch of numerous clustered gonophores; then usually their umbrella is more or less rudimentary, whilst still a “special nectophore” is developed as a swimming organ.

Each single gonophore is always gonochorist, either male or female. Those cor- 

midia, which bear two or more gonophores, are usually also gonochorist (dici- 

nic); but in some cases they are hermaphrodite, one of the gonophores being female, the other male (monoecin cormidia). The corms of the polygastric Calyconectae are usually monoein and bear cormidia of both sexes, sometimes regularly alternating (as in *Cymbonecestes*, Pl. XXVII., and *Desmophyes*, Pl. XXX.). At other times the distal (older) cormidia are males, and the proximal (younger) cormidia females. A few genera of polygastric Calyconectae are dioecin, each cormus bearing only gonophores of one sex, either male or female (*Mitrophyes*, *Galeolaria*). But the question of the relation of these different forms of sexual differentiation requires a further examination.

**Umbrella of the Gonophores.**—The calyx or umbrella of the sexual persons has in all Calyconectae the same structure as in a common simple quadriradial Hydromedusa. Its form is very rarely quite regular, hemispherical (as in *Diplophysa* and some Poly- 

phyidae); usually it is more or less bilaterally symmetrical, in adaptation to its place inside the bracteal cavity, at the ventral side of the siphon; sometimes it is strongly asymmetrical, as in *Amphiroa* (Pl. XXXVI. figs. 12–25); here two gonophores are developed simultaneously on each side of the siphon (right and left); each cor- 

responding to an antimere, so that the two together form a symmetrical pair.

**The Exumbrella of the Gonophores** corresponds in its general form to a certain degree with that of the nectophores. It is therefore evenly convex and smooth, without pro- 

minent edges, in most Sphæronectariae (*Sphæronectidae*, Prayidae, Hippopodidae). On the other side, it is quadrangular, pyramidal, or prismatic, in most *Cymbonecestae* (*Cymbonecestidae*, Diphyopsidae, Abylidae). Usually in the latter the four edges of the exumbrella are sharp and prominent, often elegantly denticulate, and wing-like dilated in the distal part; their distal ends are often prominent as four strong triangular teeth over the basal ostium of the umbrella. Often two paired dorsal edges and their terminal teeth are much more developed than the opposite two ventral edges. More rarely a single wing is stronger than the three others, or even five wings may be developed instead of four (compare *Amphiroa*, Pl. XXXVI.). The uppermost part of the exum- 

brella is usually prolonged into an apical horn, or a hook-shaped apophysis, which serves for its insertion into the bracteal cavity.

**The Subumbrella of the Gonophores** has always a well-developed layer of ring-muscles (*w*), and, on its distal prolongation, a circular velum (*v*) which closes the peripheral part of the opening of the subumbrellar cavity. Four radial canals (*cr*) always run in the subumbrella from its apex, diverging to its basal ostium, where they are united, above
the insertion of the velum, by a ring-canal (cc). From their apical junction arises a peduncular canal (cp) which runs through the pedicle of the gonophore (or the apical horn) to its insertion into the bracteal cavity and opens here into the phyllocyst.

**Gonads.**—The gonad, or sexual gland of each gonophore, is represented by the manubrium, which depends from the apex of the subumbrella into its cavity. In the mature state it usually fills about the apical half of that cavity, but in many cases the entire cavity, and sometimes by further growth it becomes much larger than the latter, and is widely prominent through its distal opening (for example, in *Lilypopsis, Desmophyes, Voglia*, Pl. XXX.). Each gonad is a simple, cylindrical, ovate, or spindle-shaped sac, and contains a central cavity, which is closed at the distal end, whilst it opens at the proximal end into the peduncular canal. The thick wall of the cavity consists of three different layers, outside a covering exodermal epithelium, and inside a vibratile entodermal epithelium, which includes the cavity (spadix); between these is a layer of sexual cells, which are originally derived from the exoderm. They produce a number of large ovules (usually between twenty and forty) in the female, and innumerable small zoosperms in the male gonophores. The ovaria or female gonads are usually somewhat rounded, ovate or club-shaped, colourless (Pl. XXVIII. figs. 4; Pl. XXXIV. figs. 13, 14, &c.). The spermatoria or male gonads are rather elongated, cylindrical, or fusiform, often vividly coloured (yellow, orange, red) (Pl. XXVIII. fig. 6; Pl. XXXIV. figs. 11, 12, &c.).

**Ontogeny.**—The development of the Calyconectae from the fertilised egg has hitherto been very little known. The first observations were made in the spring of 1853 by Gegenbaur in Messina. He observed the segmentation of the egg of *Diphyes sieboldii*, and the development from it of a larva, which is a peculiarly modified medusome, composed of a simple nectophore and a cylindrical sac-shaped larval body, which is attached externally to the ventral side of the nectophore. In my opinion the mouthless larval body is the original siphon, protruded through a ventral fissure of the nectophore. From its base the primary tentacle arises afterwards. I call this larva *Calyconula*.

A similar *Calyconula* is developed from the egg of *Galeolaria aurantiaca* (= *Epibulia aurantiaca*), which Metschnikoff described in 1874. The *Calyconula* of *Hippopodius globa*, described by the same author, exhibits still more distinctly the dislocation of the siphon, the axis of which is perpendicular to that of its nectophore, in the subumbrellar cavity of which it was originally placed. The remnant of the ventral fissure of the bilateral umbrella is yet partly visible.

The *Calyconula* of a Monophyid (*Muggiaea koehii*), and its development from the egg as well as its metamorphosis, were described in 1882 by Chun. This larva developed...
directly into *Cucubalus eschscholtzii* (= *Eudoxia eschscholtzii*), the monogastric generation of *Maggiera kochii*.

Scurcey different from this is the ontogeny of another Monophyid (*Cymbonectes huxleyi* (Pl. XXVII. figs. 8–11), which I observed in December 1881 during my residence at Belligemna, in Ceylon. The Calyconula here presents distinctly the character of a bilateral Medusa, through the ventral fissure of which the siphon was protruded; its distal end opens through the mouth rather early. Its similarity to the young Eudoxia of the same species is interesting.

**Metamorphosis.**—All Calyconectae seem to undergo a metamorphosis, since the gastrula, developed from the fertilised egg, develops into a larva differing more or less considerably from the adult state. But the metamorphosis of the larva is very little known, and has been observed in a few species only. Chun, who has observed accurately the metamorphosis of some Monophyidae and Diphyidae (86–88), holds the opinion that the primary umbrella of the medusiform larva is always lost and replaced by a heteromorphous secondary umbrella. More extended researches are required to prove whether this supposition is generally true.

**Metagenesis.**—The majority of Calyconectae are subject to a regular metagenesis, two different generations alternating regularly, as in the majority of the Anthomedusae. The first generation is a monogastric and sexually developed cormidium—Eudoxia or Erssea. From its fertilised egg arises a larva, which is transformed by metamorphosis into the second generation—Monophyid or Diphyid. Its body is a polygastric corm, the tubular stem of which produces numerous cormidia by budding asexually. Each cormidium, provided with a single siphon, afterwards becomes detached from the stem, and maturing as a Eudoxid or Erseid returns to the first generation.

**Hypogenism.**—The minority of Calyconectae develop by hypogenesis (not by metagenesis); the cormidia arrive at full sexual maturity whilst sessile on the common stem, and are not detached from the latter. There is here, therefore, no free and independent monogastric generation; neither free Eudoxid nor Erseid arise. The ontogeny of these polygastric corms is in a strict sense a strophogenesis.¹

The Calyconectae which are developed by hypogenesis are the following:—All the Polyphymidae and Desmophymidae, some Diphyidae (*Galeolaria, Lilypsis*, and *Praya*? and several Monophymidae (*Monophyges* partly?, *Mitrophyges*, and *Cymbonectes*). All the other Calyconectae develop by metagenesis. There seem to be, however, some intermediate forms of ontogeny, in some species the male gonophores becoming detached, whilst the females remain attached to the stem, or inversely. These relations, as well as the whole ontogeny of the Calyconectae, require further accurate examination.

¹ On the difference between metagenesis and strophogenesis, see my *Generelle Morphologie*, 1806, Ed. ii. pp. 104–109, and on Hypogenesis, op. cit., p. 99.
METAGENESIS Calyconectarum.

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.

Diplophysa inermis, Ggbr., Mediterranean.
Diplophysa köhlkii, Hkl., Tropical Pacific, Indian Ocean.

I Eudoxella didyma, Hkl., Atlantic.
I Eudoxella galea, Hkl., North Atlantic.
Cuculalus eschocollae, Huxley, Mediterranean.
Cuculalus pyramidalis, Will., North Atlantic.
I Cuculalus cordiformis, Quoy, Tropical Pacific.

Cuboides citrus, Quoy, Mediterranean.
Cuboides cristallus, Hkl., North Atlantic.
Cuboides nacella, Hkl., Indian Ocean.
Cuboides vogti, Hkl., Tropical Pacific.

Cucullus campanula, Hkl., North Mediterranean.
Cucullus pygmaeus, Hkl. (=Eudoxia messerensis, Ggbr.), South Mediterranean.
Cucullus subtilis, Hkl., Mediterranean.
I Cucullus elongatus, Hkl., North Atlantic.
Cucullus lessonii, Lesson, Pacific.
Cucullus gracilis, Hkl., Indian Ocean.

Amphiroa trigona, Hkl., Mediterranean.
Amphiroa carina, Hkl., Tropical Atlantic.
I Amphiroa alata, Huxley, Indian and Pacific Ocean.
I Amphiroa angulata, Huxley, South Pacific.

Sphenoides tetragona, Hkl., Indian Ocean.
Sphenoides obeliscus, Hkl., North Atlantic.
I Sphenoides perforata, Hkl., Tropical Atlantic.
Sphenoides australis, Huxley, South Pacific.

Aglaismus eschocollae, Huxley, Mediterranean.
Aglaismus pygmaeus, Hkl., Tropical and Subtropical Atlantic.
I Aglaismus elongata, Huxley, Tropical Pacific.

I Ersea guinardi, Esch., Mediterranean.
Ersea compressa, Hkl., Tropical Atlantic.
Ersea dimor, Hkl., Tropical Pacific.

II Polygastric Generation.

Sphoromecestes gracilis, Hkl., Mediterranean.
Sphoromecestes köhlkii, Huxley, Tropical Pacific, Indian Ocean.

I Praya cymbiformis, Leuck., Atlantic.
I Praya galea, Hkl., North Atlantic.
Muggia kochii, Chun, Mediterranean.
Muggia pyramidalis, Busch, North Atlantic.
I Muggia charrionensis, Hkl., Tropical Pacific.

Cymba erneaeon, Esch., Mediterranean.
Cymba cristallus, Hkl., North Atlantic.
Cymba nacella, Léson, Indian Ocean.
Cymba vogti, Hkl., Tropical Pacific.

Diphyes acuminata, Leuck., North Mediterranean.
Diphyes sieboldii, Koll. (=Diphyes gracilis, Ggbr.), South Mediterranean.
Diphyes subtilis, Chun, Mediterranean.
I Diphyes elongata, Hyndman, North Atlantic.
Diphyes appendiculata, Esch., Pacific.
Diphyes gracilis, Hkl., Indian Ocean.

Abyla trigona, Quoy, Mediterranean.
Abyla carina, Hkl., Tropical Atlantic.
I Abyla alata, Hkl., Indian and Pacific Ocean.
I Abyla leuckarti, Huxley, South Pacific.

Bassia tetragona, Hkl., Indian Ocean.
Bassia obeliscus, Hkl., North Atlantic.
I Bassia perforata, L. Ag., Tropical Atlantic.
Bassia quadriradiata, Quoy, South Pacific.

Calpe pentagona, Quoy, Mediterranean.
Calpe pygmaeus, Hkl., Tropical and Subtropical Atlantic.
I Calpe hurleyi, Hkl., Tropical Pacific.

I Diphyopsis campaudi, Hkl., Mediterranean.
Diphyopsis compressa, Hkl., Tropical Atlantic.
Diphyopsis dimor, Hkl., Tropical Pacific.

I Lilyopsis medusina, Hkl., Indian Ocean.
Synopsis of the Families of Calyconectae.

I. Suborder
Calyconectae monogastricae.

Cormus represented by a single cormidium, with a single siphon and a single tentacle.

II. Suborder
Calyconectae polygastricae.

Cormus represented by a long tubular stem, which bears numerous ordinat organs, separated by free intermediodia; each cormidium with a siphon and a tentacle.

Family IV. Eudoxidae, Haeckel, 1888.

Eudoxidae, Hkl., System der Siphonophoren, 95, p. 32.

Definition.—Calyconectae monogastricae, representing a single cormidium, which is composed originally of two persons; a sterile medusome (siphon with tentacle and bract) and a fertile medusiform gonophore (male or female).

The family Eudoxidae comprises those monogastric Calyconectae which present in the fully developed and sexually mature state only a single cormidium, composed of two different medusomes, a sterile and a fertile. The sterile medusome is a bilateral medusoid person with three essential and constant organs, a bract (umbrella), a siphon (manubrium), and a tentacle (capturing filament). The fertile medusome is a gonophore with umbrella and manubrium, but without tentacles; the sexual cells are produced in the wall of the mouthless manubrium.

Eschscholtz (1, p. 124) in his System of the Diphyidae, distinguished first two main groups in this family—1. Monogastricae (“with a single suctorial tube”), Eudoxia, Ersea, Aglaisma; and II. Polygastricae (“with a long digestive tube bearing numerous suctorial tubes or lateral branches”), Abyla, Cymba, Diphyes.

Lesson (3, p. 437), adopting the division of Eschscholtz, and collecting the descriptions of other observers (mainly Quoy and Gaimard, 2 and 20), described a greater number of “Diphyidae monogastricae,” with not less than nine genera (loc. cit., pp. 453–462). Some other species were described by Will (65) and Busch (67).

The true nature of the monogastric Diphyidae (called usually Eudoxia sensu ampliori) was not recognised before 1853. In the spring of that year Gegenbaur discovered that
the cormidia of *Abyla pentagona*, detached from the common stem, live independently and develop into a sexual *Eudoxia*. Leuckart, who had made the same observation simultaneously, demonstrated further that the monogastric *Eudoxia campanula* is nothing more than the detached cormidium of the polygastric *Diphyes acuminata* (5, pp. 41, 69; 8, pp. 268, 277).

Huxley, in his excellent description of Diphyidae, separated the monogastric forms or *Eudoxia* under the title "Diphyozooids." He pointed out, with full reason, that it is necessary on practical grounds to retain generic and specific names for the single Diphyozooids, though they may possibly be only detached and independent portions of "Polygastric Diphyidae." He gave a full anatomical description of many new or imperfectly known *Eudoxia*, and comparing their structure with that of the sessile cormidia of corresponding polygastric Diphyidae, he suspected an ontogenetic connection between these two forms (op. cit., 1859).

During my residence in the Canary Island, Lanzarote (in the winter of 1866–67), I had occasion to examine nearly all the interesting genera of Diphyozooids which Huxley had accurately described. I was able to confirm most of his suppositions concerning their connection with certain polygastric Diphyidae, observing directly the development and detachment of the former from the latter (compare above, pp. 101, 102).

The metagenesis which connects the monogastric and polygastric Diphyidae is usually combined with a peculiar metamorphosis, some interesting cases of which have recently been described by Chun (86–88).

The detached and independent cormidia of *Calyconectae*—or the "Diphyozooids"—arise in two different main-forms, *Eudoxia* and *Ersea*, which we regard here as representing two different families, *Eudoxidae* and *Erseidae*. Each *Eudoxia* is composed of two medusoid persons, a sterile medusome (bract with siphon and tentacle) and a fertile medusome (gonophore). *Ersea* differs from *Eudoxia* in the possession of a sterile "special nectophore," and is therefore composed of three medusomes.

The sterile medusome has in all *Eudoxidae* the same characteristic composition of three essential parts—a bract (covering scale or hydrophyllum), a siphon placed in the dorsal part of the bractal cavity, and a tentacle attached to the base of the siphon. The fertile medusome, or the gonophore, occupies the ventral part of the bractal cavity.

*Bract or Hydrophyllum.*—The protectum or bract of each *Eudoxia* ("Deckstück or Deckblatt" of German authors) is the modified umbrella of the sterile medusome. This is very obvious in the genera *Eudoxella* (Pl. XXXII.) and *Aglaisma* (Pl. XL.), where the four radial canals of the subumbrella are preserved by heredity, whilst its muscle-plate is lost by adaptation; furthermore, the jelly cap is strongly developed, forming a thick and firm protecting shield or cap ("covering scale").

Regarding the characteristic form of the bract, I distinguish two subfamilies among

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1 4, p. 78; 7, p. 295, Taf. xvi. figs. 1, 2.
2 9, pp. 57–66, pls. iii.–v.
the Eudoxide. The first group, Diplophysideæ, possess a smooth umbrella with rounded surface, never prismatic; hemispherical or nitiriform in Diplophysa and Eudoxella, conical or spathiform in Cucubalus and Cucullus. The second subfamily, Aglaismidæ, has a polyhedral or prismatic umbrella with angular surface; it is more or less cuboidal in Cuboides and Aglaisma, wedge-shaped or similar to a prompter's box in Sphenoides and Amphiroa. The cuboidal form (Pls. XL, XLII.) is of special interest as a reminiscence of the quadriradial structure in the original umbrella of the ancestral Medusa.

**Bracteal Cavity.**—Whilst the superior or proximal face of the bract is convex, and corresponds to the exumbrella of the Medusa, its inferior or distal face is concave and comparable to the subumbrella. In the fundus of this cavity hangs the siphon, like the manubrium or gastric tube of the Medusa. Its point of insertion is usually dislocated towards the dorsal side. The single tentacle, which arises from the base of the siphon, is placed between this and the dorsal wall of the subumbrellar cavity. The greater ventral part of the cavity is occupied by the gonophore.

The form of the bracteal cavity has sometimes preserved the original hemispherical form of the subumbrella; but usually it is more campanulate or conical, and often at the same time bilateral, more rarely asymmetrical. Its basal opening, or the bracteal mouth, is usually oblique, more or less bevelled off, sometimes armed with prominent teeth.

**Phyllocyst.**—The central part of the subumbrella, where the siphon is inserted, contains in each Eudoxia a ceceal diverticulum of the entoderm, which is in direct communication with the basal part of the siphon, and in the young sessile Eudoxia with the central canal of the stem. This phyllocyst (bursa centralis bracteæ) is comparable to the apical canal, which in certain Medusæ (Codonidae, &c.) ascends vertically from the base of the manubrium, and ends blindly in the jelly of the umbrella.

The cavity of the phyllocyst is usually small, lined by large clear vacuolated entodermal cells, which are polyhedral from mutual pressure. The apical part of the phyllocyst usually contains an oleoceyst (œ), an oil-globule, which has a hydrostatic function. The phyllocyst of the bract is, therefore, similar to and comparable with the somatocyst of the neptophore.

The phyllocyst is sometimes a simple cylindrical ceceal canal or an ovate sac, placed in the vertical axis of the bract, or somewhat excentric; as in Diplophysa, Cucubalus, and Cucullus. But usually some nutritive canals arise from its base, which enter into the jelly mass of the bract. The number and disposition of these phyllocyst canals are characteristic of the different genera, and of interest as remnants of the four radial canals, which run in the subumbrella of Medusæ towards its margin. Eudoxella (Pl. XXXII.) and Aglaisma (Pl. XL.) still possess all four canals; two of them are placed in the sagittal plane (one dorsal and one ventral), two others symmetrically on both sides (one right and one left). The latter are preserved too in Cuboides (Pl. XLII.) and in Amphiroa (Pl. XXXVI.), whilst the two sagittal canals are lost. Sphenoides (Pl. XXXVIII.) possesses only a single canal, descending on the dorsal side; the three others have disappeared.

(Zool. Chal. Exp.—Part LXXXVII.—1888.)
Siphon.—The single polypite of *Eudoxia*, or the manubrium of the sterile medusome, always exhibits the same structure as in other Calyconectae. It is composed of four constant parts:—(1) A short pedicle (*sp*); (2) a thick-walled, usually hemispherical, basilaster, with masses of cnidoblasts (*sb*); (3) a dilated stomach, separated from the latter by a pyloric valve, and usually provided with liver-stripes (*sm*); and (4) a very extensible and contractile proboscis; the latter opens through the mouth, which often exhibits four or eight lobes. (Compare Pl. XXXII. fig. 8; Pl. XXXIV. figs. 9–11; Pl. XXXVIII. fig. 12; Pl. XL. figs. 13, 14, &c.)

Tentacles.—The single tentacle, which arises in each Eudoxia from the pedicle of the siphon, has usually the structure which is characteristic of the calyconectae. The long cylindrical and very contractile tubule is beset with numerous lateral branches or tentilla, separated by equal intervals. Each tentillum is composed of three parts, a slender pedicle, a reniform or ovate cnidosae, and a slender terminal filament. On the structure of the cnidosae compare above, p. 97.

Gonophores.—Each Eudoxia produces originally only a single gonophore, and this fertile medusome is placed in the ventral part of the bracteval cavity of the sterile medusome, before its siphon. In many species there is constantly found only a single gonophore, and when this becomes detached, it is usually soon replaced by a secondary or vicarious gonophore ("Ersatz-Geschlechts-Glocke"). But in some species usually two, or even three, gonophores are found at the same time developing in one bracteval cavity; they are usually of different sizes and ages, one placed at the right of the siphon, the other at its left (Pls. XXXIV., XLII.).

Eudoxia with a single gonophore are always gonochoristic, either male or female. When, however, two or three gonophores are developed simultaneously, then they are either of the same sex (*Eudoxia diconicla*, Pl. XLII. figs. 10, 14) or of different sexes (*Eudoxia monoclinae*, Pl. XL. fig. 14).

Each single mature gonophore of the Eudoxidæ is a well-developed quadriradiate Medusa, without mouth and tentacles, with sexual cells in the wall of the manubrium (spadix). The umbrella is rarely rounded, and without sharp edges, as in the gonophores of *Diplophysa* and *Eudoxella*; usually it is four-edged, prismatic or pyramidal; commonly two dorsal edges are more strongly developed, and more prominent over the basal ostium, than the two ventral edges. The apex of the umbrella is always prolonged into a beak-shaped apophysis or apical horn, the pedicle by which the gonophore is attached to the bracteval cavity. The quadriradial form of the umbrella in the single gonophore is usually symmetrical (with equal right and left halves); but when two gonophores are placed symmetrically on the two sides of one siphon, they are often modified by mutual pressure, and the single umbrella assumes an asymmetrical (sometimes pentagonal) form. (Compare p. 115, and Pl. XXXVI. figs. 12–25.)

Compare on the development of the Eudoxidæ above, pp. 100–102.
Synopsis of the Genera of Eudoxidae.

I. Subfamily Diplophtsidæ.
Bracts not polyhedral, never prismatic, without complete sharp edges and polygonal faces. (Exumbrella rounded and smooth, not facetted.)

Bract hemispherical or mitri-form, rounded, without sharp edges, and without pointed apex.

Phyllocyst simple, without radial canals, without pointed apex.

10. Diplophysa.

Phyllocyst with four radial canals arising from its base.

11a. Eudoxella.

Phyllocyst simple. Bracteal exumbrella smooth, with no sharp edge.

11b. Cucubulus.

Phyllocyst simple. Bracteal exumbrella with three or five edges.

12. Cucullus.

Bract conical, spathiform or pyramidal, with a pointed apex, and often with some incomplete edges.

Phyllocyst with two lobate lateral canals. Bract without caudal apophysis.

13. Cuboides.

Phyllocyst with four cruciate radial canals. Bract with a pyramidal caudal apophysis.


Phyllocyst descending, with two superior lateral canals. Bract with five odd trapezoidal and two paired pentagonal faces.


Phyllocyst ascending, with an odd inferior canal. Bract with four odd and four paired faces.

15. Sphenoides.

II. Subfamily Aglaismide.
Bracts polyhedral, more or less prismatic, with many sharp edges and polygonal faces. (Exumbrella faceted and angular.)

Bract more or less cuboidal, with an inferior opening into its cavity at the basal face.

Phyllocyst with two lobate lateral canals. Bract without caudal apophysis.

13. Cuboides.

Phyllocyst with four cruciate radial canals. Bract with a pyramidal caudal apophysis.


Bract not cuboidal, with an anterior opening into its cavity at the obliquely bevelled ventral face.

Phyllocyst descending, with two superior lateral canals. Bract with five odd trapezoidal and two paired pentagonal faces.


Phyllocyst ascending, with an odd inferior canal. Bract with four odd and four paired faces.

15. Sphenoides.

Genus 10. Diplophysa,⁴ Gegenbaur, 1854.


Definition.—Eudoxide with a hemispherical or subspherical bract, without sharp edges, in the vertical axis of which is placed a simple ovate or cylindrical phyllocyst. (Eudoxia of the genus Spheronectes.)

The genus Diplophysa comprises those monogastric Eudoxide which arise from the polygastric Monophyid genus Spheronectes (Genus 18). It was founded in 1854 by Gegenbaur for a Mediterranean Eudoxia, distinguished by a subspherical bract with a simple phyllocyst. ³ It is very similar to another Mediterranean species, described in 1844 by Will under the name Ersaea truncata.⁵ Thirty years later Claus (70) demon-

¹ Diplophysa = Double vesicle, βίμελος, δίς. ⁴ 7, p. 291, Taf. xvi. fig. 3. ⁵ 65, p. 82, Taf. ii. fig. 28.
strated that this monogastric Calyeonica is the detached free Eudoxia of a polygastric Monophyid, which was first described in 1859 by Huxley as Sphaeronectes kollikeri (9, p. 50). He called it Monophyes gracilis (compare below the descriptions of Genera 18 and 19). The peculiar metagenesis of these two forms of Calyeophoridae was afterwards accurately described by Chun (86, 87).

A few Eudoxia of this genus were found by me in a bottle in the Challenger collection, taken in the Tropical Pacific, Station 274. Since the same bottle contained a specimen of Sphaeronectes kollikeri, it is probable that they were detached from the latter. I call them Diplophysa kollikeri.

Diplophysa differs from all other Eudoxidae in the hemispherical, or nearly spherical, form of its bract, and the simple ovate or cylindrical shape of its phyllocyst, which ascends vertically in the axis of the bract. In the centre of the shallow subumbral cavity of the bract is suspended a hemispherical gonophore, of about the same size, and between these two, at the ventral face of the latter, is a simple siphon with its tentacle.

Genus 11a. Eudoxella,¹ Haeckel, 1888.
Eudoxella, Hkl., System der Siphonophoren, p. 32.

Definition.—Eudoxidae with a mitriform, helmet-shaped, or hemispherical bract, the exumbrella of which is smooth and without sharp edges. Phyllocyst with four radial canals arising from its base. (Eudoxia of the genus Praya?)

The genus Eudoxella, as defined in my System, comprises free Eudoxia, the bract of which is essentially identical with that of the sessile cormidia of Praya (Pl. XXXII). I suspect, therefore, that this genus is the monogastric generation of a true polygastric Praya. But the well-known species of this latter (Praya galea, Praya maxima, Praya cymbiformis) are generally assumed to possess eudoxomes, which become mature whilst still attached to the common stem. The question, however, whether this holds good as a general rule, requires further accurate examination.

A bottle in the Challenger collection, containing surface animals taken in the Tropical Atlantic (Station 343, April 10, 1876), contained a few specimens of a Eudoxella, which is very similar to the sessile eudoxome of Praya galea (Pl. XXXII). But the helmet-shaped bract was more highly vaulted, and the four radial canals, arising from the base of the phyllocyst, were shorter and more equally disposed. The main difference was indicated by the remarkable fact, that each Eudoxia exhibited no trace of the stem of a Praya, and contained a large, completely mature gonophore. It is therefore probable that this Eudoxia, which I call Eudoxella didyma, may be the detached cormidium of some unknown species of Praya (Praya cymbiformis?), the gonophores of which are not brought to maturity whilst sessile on the stem.

¹ Eudoxella = Small Eudoxia.

*Cucubalus,* Blainville, Manuel d'Actinologie, 1834, p. 130.

*Definition.*—Endoxidae with a conical, spatthiform or cordiform bract, obliquely bevelled on the ventral side, evenly convex on the smooth dorsal side, pointed at the apex. Phyllocyst simple, ovate. (Endoxie of the genus *Muggiæa.*)

The genus *Cucubalus* was founded by Quoy and Gaimard (2, pl. iv. figs. 24, 27) upon a Eudoxia from the Tropical Pacific, which Blainville afterwards described as *Cucubalus cordiformis* (24, p. 130). It may be, perhaps, the monogastric generation of *Muggiæa chamissonis* (= *Diphyes chamissonis,* Huxley, 9, pl. i. fig. 3). The best known representative of the genus is the Mediterranean *Cucubalus eschscholtzii,* which was described by Busch as *Eudoxia eschscholtzii.* Its development from the polygastric *Muggiæa kochii,* and the regular metagenesis of these two forms, were afterwards described very accurately by Chun (86, 87). A similar and nearly allied species was observed by me in 1866 in the Canary Island, Lanzerote, and I found it again in some bottles from the Challenger collection taken in the Tropical Atlantic (Stations 348, 352). This Atlantic species may retain the name of *Cucubalus pyramidalis,* and its polygastric generation *Muggiæa pyramidalis,* with respect to the original names of Busch and Will (compare Chun, 85).

The genus *Cucubalus* is closely allied to the following *Cucullus,* the monogastric generation of *Diphyes.* It differs from the latter in the smooth and edgeless shape of the bract, which is more rounded and not pyramidal.


*Cucullus,* Blainville, Manuel d'Actinologie, 1834, p. 131.

*Definition.*—Endoxidae with a cowled or cucullate, sometimes three-sided pyramidal bract, open at the bevelled ventral side, evenly convex, or sometimes with three incomplete edges on the dorsal side, pointed at the apex. Phyllocyst simple and conical. (Endoxie of the genus *Diphyes.*)

The genus *Cucullus* contains those monogastric Endoxidae which arise from the polygastric genus *Diphyes,* in the restricted sense in which recent authors have employed it, and which we have accepted. The bract is irregularly conical, or pyramidal, with a deep ventral fissure, which passes into the obliquely truncated cavity. Its dorsal face is either evenly convex, or slightly three-sided, its apex pointed. The inferior half of the spatthiform bract embraces the included siphon and gonophore like a mantle, and

1 *Cucubalus* = Name of a plant.  
2 *Cucullus* = Cowl.

67, p. 33, Taf. iv. figs. 7-10; and Taf. v. figs. 1-9.
often one of its free ventral margins overlaps the other; the superior half is comparable to the cowl of the mantle, and includes the simple ovate ascending phollocyst. The free inferior part of the mantle-lobes often exhibits two small prominent teeth.

The genus Cucullus was founded by Quoy and Gaimard upon an Australian Eudoxia, which they figured first under the name Diphyes cucullus (2, p. 92), synonymous with Eudoxia lessonii of Eschscholtz (1, p. 126). Blainville called the former in 1834 Cucullus doreyanus (24, p. 131), and Lesson himself separated the latter as Cucullus lessonii (3, p. 459). Indeed the genus Cucullus of the French authors (published in 1834) is identical with Eudoxia of Eschscholtz (1829). But since Gegenbaur and Leuckart, in 1853, demonstrated that the Eudoxia are the isolated cormidia of Diphyidae, the term Eudoxia is generally used for all these "Diphyozoooids" (Huxley, 1859, 9, p. 57). It seems, therefore, best, to avoid further confusion—to employ the term Eucullus for the monogastric generation of those Diphyidae which constitute the genus Diphyes in the strictest sense (compare below, Genus 27). The typical and oldest species remains Cucullus lessonii, as the free Eudoxia of the Pacific Diphyes appendiculata, Esch.

Scarcely different from Cucullus is the genus Cucubatus of Quoy and Gaimard. This genus, however, may be retained for the Eudoxia of the Monophyid Muggia, which are very similar to those of Diphyes. (Compare the preceding genus.)

Many bottles of surface animals in the Challenger collection contained specimens of Eudoxia belonging to Cucullus, and in some cases it was possible to demonstrate their connection with a species of Diphyes contained in the same bottle as the former. Supported by the comparative study of these forms, and of similar forms compared in other collections, and partly observed living by myself, I have been led to state the ontogenetic connection of the following species of monogastric Cucullus with corresponding species of polygastric Diphyes:

2. Cucullus gracilis, Hkl., synonymous with Eudoxia bojani, Esch. (1, p. 125) and Huxley (9, p. 59), is the free Eudoxia of Diphyes gracilis, Hkl., taken in the Southern Pacific and in the Indian Ocean.
3. Cucullus elongatus, Hkl., is the free Eudoxia of Diphyes elongata, Hyndman (64, p. 166), occurring in different parts of the Northern Atlantic, Gulf Stream, &c.
4. Cucullus gegenbauri, Hkl., synonymous with Eudoxia messanensis, Ggbr. (7, Taf. xvi. fig. 4), is the free Eudoxia of Diphyes sieboldii, Köll. (4, Taf. xi.), Mediterranean and Tropical Atlantic.
5. *Cucullus campanula*, Hkl., synonymous with *Eudoxia campanula*, Leuckart (5, p. 43), is the free *Eudoxia* of *Diphyes acuminata*, Leuck. (5, Taf. iii.), inhabitant of the Mediterranean.

6. *Cucullus subtilis*, Hkl., synonymous with *Ersawa elongata*, Will (65, p. 82, Taf. ii. fig. 30), is the free *Eudoxia* of *Diphyes subtilis*, Chun (88, p. 687), also Mediterranean.


**Definition.**—*Eudoxidæ* with a cuboidal bract, bounded by six quadrangular faces, twelve edges, and eight angles. Phyllocyst composed of a slender vertical canal, and two broad horizontal lateral lobes at its base. (*Eudoxia* of the genus *Cymba*.)

The genus *Cuboides* (Pl. XLII) comprises those very remarkable monogastric *Eudoxidæ*, which arise from the polygastric *Monophyid* genus *Cymba* (Genus 23, Pl. XLI). Its bract has the extraordinary form of a subregular cube, and is distinguished by a very characteristic phyllocyst. This is composed of a slender, vertically ascending canal, which usually includes an oleocyst; and a wide basal diverticulum, which is divided into two broad, horizontally diverging, and ventrally directed lobes. We may compare these latter with the two symmetrical lateral canals of a bilateral Medusa, whilst the ascending canal corresponds to the odd ventral vessel. The fourth, dorsal and descending canal (preserved in *Aglaisma*) is lost in *Cuboides*. The basal diverticulum of the latter is the proper phyllocyst.

The genus *Cuboides* was founded by Quoy and Gaimard (*loc. cit.*) upon an isolated *Eudoxia*, found in the Straits of Gibraltar, and called *Cuboides vitreus*. This is probably the detached monogastric form of the polygastric *Cymba enneagonum* found by the French authors at the same locality. It seems different from the species occurring in the Eastern Tropical Atlantic, and figured by me in Pl. XLII. as *Cuboides crystallus*. The figures and descriptions of the French authors are too insufficient to identify the two forms. The first accurate description of this peculiar *Eudoxia*, its cuboidal hydrophyllum and bilobed phyllocyst, was given in 1859, by Huxley (9, p. 63, pl. iv. fig. 5). He took it twice, once on the east coast of Australia, and once on the south coast of New Guinea, called it *Cuboides vitreus*, and suspected, rightly, that it might be derived from his *Abyla vogtii* (*loc. cit.*, pl. ii. fig. 3). Different from this Australian species is an Indian species (*Cuboides nacella*, Hkl.), and the Atlantic species, which I shall describe in the sequel. It occurred in a bottle of the Challenger collection, from Station 352, near the Cape Verde Islands. I myself examined this species living in the Canary Islands in February 1867, and observed directly its origin and detachment from the polygastric *Monophyid* *Cymba crystallus* (compare below, Genus 23).

² *Cuboides = Cuboidei, xapă, orbi.*
Cuboides crystallus, n. sp. (Pl. XLII.).

_Habitat._—Tropical and Subtropical Atlantic, Station, 352; lat. 10°55' N., long. 17°46' W. Surface.

Canary Islands, Lanzarote, February 1867 (Haeckel).

_Bract_ (fig. 9, _u_, lateral view from the right side; fig. 10, _v_, dorsal view; fig. 13, _w_, basal view; fig. 14, _w_, apical view; figs. 11, 12, a younger specimen, seen from the left and from the dorsal sides respectively).—The hydrophyllium or bract is very large (10 to 12 mm. diameter), nearly cuboidal, with six flattened, slightly concave, quadrangular faces, twelve serrate, slightly concave edges, and eight prominent, three-sided pyramidal angles. The six faces are of nearly equal size, the apical face (_wa_) somewhat smaller, and the basal face a little larger than the four lateral faces (_wd_, dorsal; _wv_, ventral; _wv_, right; _ul_, left). The basal, inferior or distal face is occupied by a wide, flattly conical, subumbrellar cavity (_m_), its apex reaches the centre of the cube.

_Phyllocyst_ (_cs_)._—The apical canal of the bract, or the phyllocyst, consists of two very different parts, the axes of which are nearly perpendicular one to another. The slender apical part is subvertical, spindle-shaped, includes a fusiform oleocyst (_co_), and touches with its apex the centre of the concave apical face of the bract (_wa_). The dilated basal part of the phyllocyst, however, is divided into two broad ovate horizontal lobes (_cs", right; _cs", left); these are filled up with large clear entoderm cells, directed towards the ventral face of the bract (_vu_), and embrace the uppermost part of the peduncle of the siphon (_s_).

_Siphon_ (_s_)._—The siphon or polypite is pyriform, very contractile, suspended in the top of the subumbrellar cavity, and exhibits a pale yellowish colour. Its short pedicle bears at its thickened base, on its dorsal side, the tentacle (_t_); on its ventral side are placed one or two gonophores (_y_).

_Tentacle_ (_t_)._—The single tentacle of this cuboidal _Eudoxia_ is usually coiled up and hidden in the dorsal part of the infundibular cavity, behind the siphon. The tentilla or secondary filaments (fig. 16) have a thin pedicle (_ts_) and a simple terminal filament (_tf_), and between them a large reniform sacculus. This endosac has a leather-yellow or reddish-yellow colour, and contains on the convex dorsal side numerous (six to nine) rows of medial endocysts (_km_), and on each side of this battery, in the proximal part, a series of six to nine very large, spindle-shaped, lateral endocysts (_ky_); at the distal end a small group of small pyriform endocysts.

_Gonophores._—The _Eudoxia_ develop in the bracteal cavity, on the ventral side of the siphon, either male or female gonophores. The young _Eudoxia_ (figs. 11, 12) exhibit only one gonophore, the older two or three (figs. 9, 10, 13, 14). The umbrella of the gonophores (or the gonocalyx) is quadrangular, slightly bilateral, a little asymmetrical.
Its superior or proximal half has four smooth edges, is pyramidal, and forms a prominent ventral crest. Its inferior or distal part is a quadrilateral prism with four strong serrate edges, prominent below as four three-sided pyramidal apophyses, the two dorsal far larger than the two ventral (fig. 11).

_Canal of the Gonophores_ (fig. 17, _cp)._—This is long, peduncular, and divides at the apex of the subumbrella (_v_) into four rather regular radial canals (_cr_). These exhibit an elegantly pinnulated appearance, produced by alternately prominent small diverticula. They are connected at the base of the large velum (_v_) by a circular canal (_cc_).

The _ovaria_ (fig. 17, _o_), as well as the _spermalia_ (figs. 9-14, _hm_), are spindle-shaped manubria, which hang freely in the upper half of the umbrellar cavity of the gonophores. They contain a large central cavity (spadix).

Genus 14. _Amphiroa_,¹ Blainville, 1834.

_Amphiroa_, Blainville, Manuel d'Actinologie, p. 133.

_Definition._—Eudoxidae with a bilateral, prismatic bract, bounded by five odd trapezoidal faces and two paired pentagonal faces. Phyllocoyst composed of an ovate descending dorsal sac, and two slender horizontally diverging lateral canals at its apex. (Eudoxia of the genus _Abyla_.)

The genus _Amphiroa_ (Pl. XXXVI.) comprises those monogastric Eudoxidæ which arise from the polygastric Diphyd genus _Abyla_ (Genus 29, Pl. XXXV.). Its bract has a peculiar and very complicated form, which may best be compared with a prompter's box. It is composed of two four-sided prisms, which are united at right angles. The vertical prism covers the dorsal side of the Eudoxia, and is nearly filled up by a very large sac-shaped phyllocoyst. From the apex of the latter arise two divergent lateral canals which run horizontally in the second prism, covering the apical face of the Eudoxia.

The genus _Amphiroa_ was first observed and named by Lesueur (probably in 1803), but first published from his drawings by Blainville, in 1834.² A very accurate description of it was given in 1839 by two excellent observers, Huxley (9, p. 64) and Gegenbaur (10, p. 17). These two authors, independently of each other, arrived at the same opinion, that _Amphiroa_ is the free Eudoxia of _Abyla trigona_. The latter, therefore, called it _Eudoxia trigona_. We retain this name for the Mediterranean species, whilst _Amphiroa alata_ of Huxley is the Eudoxia of _Abyla alata_, inhabiting the Tropical Pacific and Indian Ocean. A third species, described by Huxley as _Amphiroa angulata_ (9, pl. v. fig. 2), is probably the Eudoxia of _Abyla leuckartii_, Huxley. Different from these three species is _Amphiroa carina_, which occurred in a bottle in the Challenger collection, taken at Station 348. I myself observed this species living, and detaching itself from _Abyla carina_ in February 1867, in the Canary Islands.

¹ _Amphiroa_, Ἀμφύρω, a daughter of Okeanos. ² 24, p. 133, Atlas, pl. iv. fig. 1.

(Zool. Chall. Exp.—Part LXXVII.—1888.) Hhhh 15
Amphiroa varina, n. sp. (Pl. XXXVI).

Habitat.—Tropical and Subtropical Atlantic, Station 348; April 9, 1876; lat. 3° 10' N., long. 14° 51' W. Surface.
Canary Islands, Lanzerote, February 1867 (Hacekel).

Bract (figs. 14, 19, and 21, ventral view; fig. 15, dorsal view; fig. 16, apical view; figs. 17 and 20, basal view; figs. 13 and 18, lateral view from the left side; fig. 12, lateral view from the right side. Figs. 12 and 13 taken from immature Eudoxomes, sessile on the stem).—The bract or hydrophyllium has a diameter of 6 to 8 mm., and in general the form of a prompter's box; it may be described as a bilateral polyhedron, which is composed of two four-sided prisms united perpendicularly; the superior or horizontal prism includes the two diverging horizontal phyllocyst canals; the posterior or vertical prism includes the large vertically depending phyllocyst. The obliquely bevelled ventral face of the bract (the inferior face of the first, and the anterior face of the second prism) is deeply excavated, and encloses the siphon and the gonophores.

The horizontal apical or superior face (fig. 16) is trapezoidal, the ventral edge three times as long as the parallel dorsal edge; the two equal lateral edges are concave, as long as the former, and diverge ventrally.

The vertical dorsal or posterior face (fig. 15, ud), through which the phyllocyst (be) shines, is also trapezoidal, the basal edge twice as long as the parallel apical edge and half as long as the two lateral edges, which are slightly concave, and diverge towards the base.

The two lateral faces of the bract (figs. 12, 18, between ventral and dorsal faces) are concave, irregularly pentagonal, nearly vertical, and divergent from the dorsal to the ventral side. The superior horizontal and the posterior vertical edge of the pentagon are the longest, of nearly equal size, and meet at right angles (in the apical corner of the dorsal face). The vertical anterior and the horizontal inferior edge are only half as long as the former. The ventral (or antero-basal) edge of the pentagon, between the anterior and inferior edges, is deeply emarginate and serrate.

The horizontal basal or inferior face of the bract (fig. 17, ub) is nearly square, and the smallest of all its six faces. Its ventral edge is bisected by the prominent median groove of the bract-cavity.

The ventral or anterior face of the bract (figs. 14, 21) has the most complicated form of all six faces, and is deeply excavated by the cavity which includes the siphon and the gonophores. The ventral opening of this cavity has again a trapezoidal outline; its upper horizontal edge is three times as long as the parallel basal edge, and somewhat longer than the two dentate lateral edges which diverge upwards. The superior part of the ventral face, above the opening of the cavity, is formed by a broad frontal face through
which the two phyllocyst-canals shine. This facet is nearly rectangular, its horizontal inferior edge somewhat longer than the parallel superior, and three times as long as the two short lateral edges which diverge downwards.

The bract of the young Eudoxomes, sessile on the stem (fig. 13), exhibits the characteristic form of the adult to a much less degree, and has a more irregular cuboidal form. The bract of the young, just detached Eudoxia (figured in fig. 12, b), forms the transition from the latter to the former.

**Bracteal Cavity** (figs. 12, 18, bb).—The subumbrellar cavity of the hydrophyllum is deeply campanulate or nearly conical, somewhat compressed from both lateral sides. Its posterior or dorsal wall is nearly vertical and touches the siphon and the tentacle. Its anterior half is filled up by one or more gonophores. The inferior and anterior trapezoidal opening of the cavity has been already described.

**Phyllocyst** (figs. 12–18, bc).—The canal system of the bract is composed of a very large dorsal sac-shaped phyllocyst, which stands vertically, and of two slender horizontal canals, which arise from the apex of the former and diverge laterally. The large phyllocyst occupies nearly the dorsal half of the bract, and is a vertical cylinder with rounded basal faces, or nearly ellipsoidal, three times as long as broad. Its small internal cavity is surrounded and almost filled with very large vacuolate endoderm-cells.

The two paired lateral canals of the bract (figs. 12–18, cx right, cl left), which arise from the apex of the phyllocyst at right angles, are slender and run divergently towards the two frontal corners of the bract, in their first half horizontally, in the second curved upwards. Their blind distal ends (at the junction of the apical, ventral, and lateral faces) are somewhat club-shaped.

**Siphon** (figs. 12, 13, 21, s).—The polypite is hidden in the dorsal part of the bracteal cavity, and exhibits the usual structure of the Calycomtæ—a short pedicle, a thick-walled basigaster, a wide stomach with hepatic stripes, and a proboscis with a four- or eight-lobed mouth.

**Tentacle** (figs. 12, 13, t, 26).—The single tentacle, which arises from the pedicle of the siphon, exhibits the same structure as that of other Abylidæ. Each tentillum bears on its pedicle (fig. 26, ts) a slender reniform cnidosac, and in the proximal part of this six to eight large spindle-shaped cnidocytes at each side of the cnido-battery (kb). The terminal filament (tf) is slender and long.

**Gonophores** (figs. 22–25, isolated; figs. 12–19, included in the cavity of the bract).—Each ripe Eudoxia usually bears a pair of gonophores in the ventral part of its cavity, before the siphon. The two gonophores, right and left, are so transformed by mutual pressure that their umbrella or gonocalyx (originally a tetragonal prism) assumes an asymmetrical pentagonal form. The inner or medial faces (in which the two neighbouring gonophores meet in the sagittal plane of the bract) are flattened, whilst the outer or lateral faces are prominent above, in form of a lateral horn. One of the five edges
(u²) is dentate. The five teeth of the basal mouth are very unequal, two much larger than the three others. The two paired gonophores together form a double body of bilaterally symmetrical form. Sometimes they are of the same sex, at other times of different sexes.


Sphenoides, Huxley, Oceanic Hydrozoa, p. 61.

Definition.—Endoxidae with a bilateral prismatic or sphenoidal bract, bounded by eight faces, twelve edges, and twelve angles. Phyllocyst composed of a large apical sac and a slender odd dorsal canal descending from the base of the sac. (Endoxidae of the genus Bassia.)

The genus Sphenoides (Pl. XXXVIII.) comprises those monogastric Endoxidae which arise from the polygastric Diphyid genus Bassia (Genus 30, Pl. XXXVII.). Its bract has a very complicated sphenoidal form, and is distinguished by a large ovate sac of the phyllocyst in the apical half of the umbrella, whilst a long slender odd dorsal canal (similar to a basal spur) descends into the basal half. The original main axis of the umbrella is strongly curved, so that its ventral part is shortened and its dorsal part correspondingly expanded. The twelve edges of the wedge-shaped umbrella are produced into twelve three-sided pyramidal teeth, five of which belong to the ventral (u¹–u²), seven to the dorsal half (u³–u⁸). The eight faces of the umbrella are four larger paired lateral (a superior pair quadrangular, an inferior pair hexagonal) and four smaller odd frontal faces, two superior triangular (one ventral and one dorsal) and two inferior (a triangular dorsal and a hexagonal basal). The comparison of the young bract (Pl. XXXVIII. fig. 13) and the adult (fig. 14) exhibits the curious development of this cuneiform hydrophyllium.

The genus Sphenoides was founded by Huxley (loc. cit.) upon an Australian species, which he rightly suspected to be the Diphyozooid of Abyla bassensis (= Bassia quadrilateralis). This species is rather different from the Atlantic species described in the following, the development of which from Bassia I observed in the Canary Islands; and from another species (Sphenoides tetragona) which I observed in the Indian Ocean. A fourth species may be the Eudoxia of the South Atlantic, Bassia perforata (10).

Sphenoides obeliscus, n. sp. (Pl. XXXVIII.).

Habitat.—Northern Atlantic; Canary Islands, Lanzerote, February 1867 (Haeckel).

Bract (fig. 12, u), lateral view from the left side, with the included parts; figs. 13 and 14, lateral view from the right side; fig. 13, of a younger attached Eudoxia; fig. 14, of

¹ Sphenoides = Wedge-shaped, σφηνοίδης.
an older free Eudoxia).—The hydrophyllium or bract has a diameter of 10 to 12 mm., and a sphenoidal or wedge-shaped, rather complicated form, which is best understood if we imagine the true axis of the umbrella standing vertically, its upper or apical pole marked by the top, the lower or basal pole by the centre of the aperture of the cavity. The latter (or the original ostium subumbra) is surrounded by five prominent points, an odd dorsal basal point (u$^a$) and four paired lateral; two of these are dorso-lateral basal points (u$^b$ right, u$^c$ left), the two others ventro-lateral basal points (u$^d$ right, u$^e$ left).

The opposite apical or superior part of the ripe bract (fig. 14) has the form of a house- roof or of a triangular prism, inclined ventrally. The apical crest (u$k$) is strongly inclined towards the ventral side, so that the dorsal apical point (u$^{12}$) may be regarded as the original apex of the bilateral umbrella. The opposite ventral apical point (u$^i$), on the contrary, marks the upper pole of the curved axis of the phyllocoyst (b$c$).

The ventral face of the bract is pentagonal and marked by five prominent points, one odd and four paired. The odd is the above-mentioned ventral apical point (u$^i$). The upper pair of points are the ventro-lateral apical (u$^b$ right, u$^c$ left); the lower pair of points are the ventro-lateral basal points (u$^d$ right, u$^e$ left).

The dorsal face of the bract is quadrangular in the upper part, crest-shaped in the lower part, and is marked by five points, three odd and two paired. The uppermost is the odd dorsal apical point (u$^{12}$), the lowermost the odd dorsal basal point (u$^i$), the hindermost (between the former) the odd dorsal caudal point (u$^s$). At the right side (u$^{10}$) and left side (u$^{11}$) the two dorso-lateral points are prominent. The wedge-shaped dorsal crest (u$y$) is in the ripe bract (fig. 14) opposite and parallel to the apical crest (u$k$). All crests and edges of the bract are elegantly denticulated.

The mature bract of the free Eudoxia (fig. 14) differs from the young bract of the sessile Eudoxoma (fig. 13) mainly in the development of a pair of arched prominent transverse ridges or girdle-wings (u$^a$, u$^{10}$; right: u$^b$, u$^{11}$, left). These separate more distinctly the thicker apical half of the hydrophyllium from its thinner ventral half. An accurate comparison of fig. 13 (young) and fig. 14 (adult) will explain the other differences of these two forms, which are produced by further growth.

Bracteal Cavity (figs. 13, 14, bh; see from the right side).—The subumbrellar cavity has the form of a helmet or a Phrygian cap; it is campanulate, with strongly curved axis, concave at the ventral, convex at the dorsal side. The cavity occupies in the young bract (fig. 13) about two-thirds of the whole body; in the adult (fig. 14) only the basal half. Its basal aperture, or the original mouth of the umbrella, is armed with five large triangular, pyramidal points or teeth, one odd and four paired; the posterior odd tooth (u$^a$) is the dorsal basal point; the two ventro-lateral basal teeth (u$^b$, u$^c$) are larger and wider apart than the two dorso-lateral basal teeth (u$^{10}$, u$^{11}$). A deep ventral groove, through which passes the stem of the cormus (fig. 13, a), is placed in the sagittal plane of the bract, immediately to the ventral side of the subumbrellar cavity (bh).
Phyllocyst (fig. 13, bc).—The canal system of the bract is composed of three parts of a large ovate phyllocyst (bc), a short peduncular canal, and a long dorsal caecum. The small peduncular canal arises from the common stem (at), and runs immediately to the ventral base of the large ovate phyllocyst (be). This latter is placed in the apical half of the bract, and contains in its uppermost part a spherical oleocyst (co). Its rounded apex does not reach the apical crest (nk). The dorsal canal (cd) is a slender caecum, which arises from the base of the phyllocyst, and runs along the dorsal median line of its cavity, separated from it by a thin jelly-plate. The dorsal canal is therefore spur-shaped and crooked, concave on the ventral, convex on the dorsal side. Its blind lower end does not reach the basal edge (mf).

Siphon (fig. 12, s).—The polypite or siphon is suspended in the top of the subumbrellar cavity of the bract, and may be completely hidden in it. From its short pedicle arises the tentilla (t). A pyloric valve separates the thick basigaster (sb) from the stomach, which exhibits eight yellow striae hepaticæ. The proboscis (sv) is very contractile; its mouth exhibits sixteen short indentations.

Tentacle (fig. 12, t).—The single tentacle of the siphon is distinctly segmented by numerous constrictions, and from each constriction arises a tentillum. The pedicles (ts) and the terminal filaments (tf) of the tentilla are long and slender. The reniform cnidosac exhibits on its convex side six to eight longitudinal rows of medial cnidocysts (fig. 16, km), on both sides of its base a group of large spindle-shaped lateral cnidocysts (kg), and at the distal end a group of small pyriform cnidocysts (kp).

Gonophores (fig. 12, h; fig. 15).—The sexual Medusa which arises from the stem at the ventral side of the siphon, has a four-winged umbrella, which is pyramidal in the smaller apical half, prismatic in the larger basal half. Its four prominent and denticate wings are unequal in pairs in the younger gonophores, the two dorsal wings (fig. 12, hu) being much larger than the two ventrals; afterwards (fig. 15) they become nearly equal. A long peduncular canal (fig. 15, cp) runs through the pedicle of the umbrella to the top of the subumbrella (w), and divides here into four equidistant radial canals. The spindle-shaped spermaria of the male gonophore (fig. 12, hs), and the ovate or subspherical ovaria of the female (fig. 15, o), occupy the apical half of the subumbrellar cavity.


Aglaisma, Eschscholtz, System der Acalephen, p. 129.

Definition.—Endoxieae with a bilateral prismatic bract, which is cuboidal in the larger upper part, obliquely pyramidal in the smaller lower part. Phyllocyst with four cruciate radial canals, two odd sagittal (an ascending and a descending) and two paired lateral canals. (Endoxie of the genus Calpe.)

1 Aglaisma, ἀγλαίασμα=Ornament.
The genus *Aglaisma* (Pl. XL.) comprises those monogastric Eudoxideae which arise from the polygastric Diphyid genus *Calpe* (Genus 31, Pl. XXXIX.). Its bract is nearly cuboidal, similar to that of *Cuboides* (Genus 13), but differing from it in the possession of a pyramidal, trigonal, or pentagonal apophysis, which descends vertically from the dorsal and basal part of the cube. It is further distinguished by the possession of four radial canals, arising from the small subcentral phyllocyst. Two of these four cruciate canals are slender and vertical (an ascending and a descending), two others saccate and horizontal (a right and a left).

The genus *Aglaisma* was founded in 1829 by Eschscholtz for a Tropical Atlantic species of monogastric Diphyideae, which he called *Aglaisma baeri* (1, p. 129); it is possibly identical with our *Aglaisma gegenbauri*. Afterwards Huxley,¹ in 1859, gave an accurate description of two nearly related species, which he called *Aglaismoides eschscholzii* and *Aglaismoides elongata*. He suspected rightly that the former might be the Eudoxia of the common Mediterranean *Abyla pentagona*. The other species, *Aglaismoides elongata*, might be the Eudoxia of *Calpe huxleyi*. During my stay in the Canary Islands (1867) I observed the development of the species described in the following pages, from *Calpe gegenbauri*. It occurs also in a bottle of the Challenger collection, taken at Station 346.

*Aglaisma gegenbauri*, n. sp. (Pl. XL.).

**Habitat.**—Tropical and Subtropical Atlantic, Station 346; April 6, 1876; lat. 2° 42′ S., long. 14° 41′ W. Surface.  
Canary Islands, Lanzarote, February 1867 (Haeckel).

**Bract** (fig. 13, *b*, lateral view from the right side; fig. 14, *b*, from the left side; fig. 15, basal view; fig. 16, apical view; fig. 17, dorsal view; fig. 18, ventral view).—The hydrophyllium or bract is subregularly cuboidal in its apical or superior half, in its basal or inferior obliquely pyramidal, bevelled off at the ventral and basal face. The length or height of the bract is 1·2 to 1·5 mm., the breadth 0·6 to 0·8 mm.

The apical or superior face of the bract (figs. 13–16, *ad*) is nearly square, slightly concave, with four equal concave edges. The phyllocyst and its two lateral eeca shine through it in the apical view. The ventral or anterior face (fig. 18, *ad*) has the same square form, but is somewhat longer, and dilated towards the concave basal edge. The dorsal or posterior face of the bract (fig. 17, *ud*) is more concave, and has the form of a bilateral pentagon, which is twice as long as broad. Its odd superior edge is horizontal, and half as long as the two divergent superior lateral edges. These are somewhat longer than the two convergent inferior lateral edges, which meet in the basal apex of the

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¹ See p. 60, pl. iv, figs. 2, 3.
pyramidal caudal apophysis. Whilst the superior half of the dorsal face is nearly vertical, square, and concave, its inferior pentagonal half is convex and prominent, directed more dorsally downwards, and bisected by a sagittal crest which becomes obsolete towards the upper half. This crest bears about the middle of its length an odd prominent tooth (figs. 13, 14).

The two-paired lateral faces of the bract (right, fig. 13; left, fig. 14) are hexagonal, square and vertical in their upper half, irregularly hexagonal and more prominent in the lower half. The superior horizontal edge of each lateral face is half as long as the ventral, and one-third as long as the basal and the dorsal edge. The vertical ventral edge is concave. The opposite dorsal edge bears a prominent tooth between its middle and lower thirds, and so also does the obliquely descending basal edge.

The basal or inferior face of the bract is occupied by the square opening of the bracteal cavity (fig. 15, middle portion), and behind this by the triangular ventral face of the caudal apophysis (fig. 18).

The caudal apophysis, which distinguishes the cuboidal bract of *Aglaisma* from the similar bract of *Cuboides* (Pl. XLIII.), is a bilateral oblique pyramid, which descends from the prolonged dorsal and basal part of the hydrophyllum. The pyramid is five-sided, directed downwards and dorsalwards up to the apex, which is slightly curved inwards. The five angles of its base are marked by the five above-mentioned teeth, viz., the odd dorsal tooth of the sagittal crest (in the inferior half of the dorsal face), the paired teeth of the latero-dorsal edges, and the paired (somewhat inferior) teeth of the lateral basal edges.

All the edges of the polyhedral transparent bract are elegantly denticulate, and more or less curved.

The bracteal cavity (figs. 13–18, wi) opens in *Aglaisma* (as in *Cuboides*) more on the basal or inferior face; whereas in *Amphiroa* and *Sphenooides* the aperture is rather on the ventral or anterior face. It occupies the greater part of the inferior half of the bract, and is obliquely campanulate. The apex of the cavity is directed dorsally.

*Phyllocyst* (figs. 13–18, bc).—The phyllocyst is a small subspherical cavity, placed immediately above the basigaster (sh), and gives off four large canals, two odd and two paired, which are comparable to the four radial canals of a bilateral Medusa. The superior odd canal (ce), which corresponds to the original ventral canal of the Medusa, ascends vertically near the median line of the dorsal face, and ends above in a spindle-shaped diverticulum which includes an olloecyst (co). The inferior odd canal (cd) is somewhat longer, also placed in the median plane, and descends obliquely downwards; it runs parallel to the neighbouring dorsal crest, and corresponds to the dorsal radial canal of a Medusa. The two paired lateral canals (ce right, cd left) are much shorter, wider, and sac-shaped, as in *Cuboides*. They are geniculate and filled by large vacuolate entoderm-cells; their dorsal half is placed nearly horizontally, whilst their ventral half is
curved downwards. Their blind ends are directed towards the ventro-basal angles of the lateral faces.

_Siphon_ (figs. 13, 14, s).—The single polypite occupies originally the dorsal half of the bracteal cavity (fig. 13), but, when two gonophores are developed, it becomes placed between them more ventrally (fig. 14). Its thick-walled basigaster (sb) is nearly spherical. The spindle-shaped stomach (sm) bears eight yellow hepatic stripes. The contractile proboscis (sr) opens by an octolobate mouth (ss).

_Tentacle_ (figs. 13, 14, t).—The single tentacle exhibits the same structure, which is accurately described in the case of _Calpe pentagona_ by Kölliker, Leuckart, and others. It arises from the short pedicle of the siphon, between the basigaster and phyllocyst. It bears numerous tentilla, each with a reniform enidosae and a long terminal filament coiled up spirally in fig. 19. Fig. 20 exhibits its elastic band expanded.

_Gonophores_ (fig. 13, f; fig. 14, hf).—The bracteal cavity contains sometimes a single gonophore (fig. 13), at other times two or even three gonophores associated, besides some buds of vicarious function. Fig. 14 exhibits a well-developed monoclinic Eudoxia, with a male (h) and a female (f) gonophore. The sexual manubria of both are club-shaped, and fill about the half of the subumbrellar cavity. The umbrella is in both sexes of the same form, distinctly bilateral, with four paired denticulate edges, prolonged at the basal ostium into four strong triangular pyramidal teeth. The two dorsal teeth are much larger than the two ventral. The apex of the umbrella is a curved horn, and contains the pedicular canal; this gives off at the apex of the subumbrella the four radial canals, as usual.

Family V. _ERSÆIDÆ_, Haeckel, 1888.

_Ersæidæ_, Hkl, System der Siphonophoren, 95, p. 33.

_Definition._—Calyconectæ monogastrice, representing a single cormidium, which is composed originally of three persons; a sterile medusome (siphon with tentacle and bract), a sterile special nectophore (without manubrium), and a fertile medusiform gonophore (male or female).

The family Ersæidæ comprises those monogastric Calyconectæ which differ from the preceding Eudoxidæ in the possession of a so-called “special nectophore.” Their cormidium is therefore composed not of two, but of three, medusomes or persons of the morphological value of a Medusa. The Ersæidæ, as independent forms, occur much more rarely than the Eudoxidæ. I have observed two genera only, both rather rare, _Ersaea_ and _Lilaea._

The sterile medusome of the Ersæidæ is composed (as in the Eudoxidæ) of three organs—viz., bract (umbrella), siphon (manubrium), and tentacle (cnido-filament); all three (Zool. chall. exp.—Part lxxvii.—1888.)
organs possess essentially the same structure as in the preceding Eudoxidæ. The bract occurs only in two forms, one of which (Lišea) is equal to that of Praya, or Lilyopsis; it is rounded and has a phyllocyst with four radial canals; the other (Ersse) is similar to that of Muggiæa or Diphyæ; it is pointed, eucullate or spathiform, and has a simple phyllocyst, without radial canals.

Gonophores.—The sexual medusomes of the Ersseideæ have the same form and structure as those of the Eudoxidæ; and mainly of those species, where two or more gonophores are produced in a single cormidium (compare above, pp. 100 and 121).

The special nectophore, which is characteristic of the Ersseideæ, and distinguishes them from the Eudoxidæ, has been originally the first gonophore. This has completely lost its manubrium, and has, therefore, given up its sexual function; it has been developed merely as an organ of swimming.

Ontogeny.—On the development of the Ersseideæ, compare above, pp. 100–102.

**Synopsis of the Genera of Ersseideæ.**

Bract spathiform, with an apex. Phyllocyst simple, without radial canals, 17a. Ersse.

Bract rounded, without apex. Phyllocyst with four radial canals, 17b. Lišea.

**Genus 17a. Ersse, Eschscholtz, 1829.**

Ersse, Eschscholtz, System der Aculephen, p. 127.

**Definition.**—Ersseideæ with a campanulate or spathiform bract, divided by a collar constriction into a proximal cowl, with an apical point, and a distal mantle, with a wide ventral fissure. Phyllocyst large, simple, without radial canals. (Cormidia of the genus Diphyopsis.)

The genus Ersse was founded by Eschscholtz, in 1829, to include two Atlantic monogastric Diphyideæ, differing from Eudoxia in the possession of a special nectophore, which is prominent from the cavity of the bract ("Tubulus suitorius unicis; pars corporis nutritoria cavitate parva natatoria, tubuli instar prominenti instructa"). The two *species*, however, which Eschscholtz there described (Ersse quogy and Ersse gaimardi), are too incompletely represented to determine with certainty their position and their connection with any species of Diphyopsis. Possibly Ersse gaimardi may be the free cormidium of Diphyopsis campanilifera, and Ersse bojani (= Eudoxia bojani, Eschscholtz), the cormidium of Diphyopsis dispar. I myself observed in 1866, in the Canary Island Lanzerote, numerous free-swimming specimens of the species figured in PI. XXXIV. as Ersse compressa, and afterwards recognised its ontogenetic connection with Diphyopsis compressa (Pl. XXXIII.).

1 Ersse = Liquisia, covered with dew.

2 1, p. 128, Taf. xii. figs. 3, 4.
Erzsea, as the monogastric generation of Diphyopsis, differs essentially from Cucullus as the free Eudoxia of Diphyes. The latter never possesses the individual "special nectophore," which is characteristic of the former. This swimming organ must be regarded as the first sterile gonophore, which has lost the manubrium, the muscle-plate of the subumbrella being the more strongly developed.

Erzsea compressa, n. sp. (Pl. XXXIV.).

Habitat.—Tropical and Subtropical Atlantic; Stations, 348, 349, 352, 353, &c. Canary Islands, Lanzerote, December 1866 and January 1867 (Haeckel).

Bract (figs. 9, 10, 11, b).—The hydrophyl or bract is in general irregularly conical or campanulate, with a deep fissure along the truncate ventral side; the broad basal or inferior aperture is also obliquely truncate. An annular collar constriction, corresponding to that part of the umbrella which was attached to the stem of Diphyopsis, divides the bract into a smaller apical (proximal or superior) part (fig. 11, bs) and a larger basal (distal or inferior) part. The latter encloses the siphon and its tentacle, and partly the gonophores, like a mantle, while the former is comparable to the eowl of the mantle. This cowl contains in its solid dorsal half the phyllocyst (cs), with a central cavity and a globular oleocyst on the apex (co); its ventral half is excavated and originally embraces the stem of siphosome (fig. 9, a); the two ventral wings of this cavity overlap one another in the middle part. The length of the bract is 6 to 8 mm., its breadth 3 to 4 mm.

The campanulate mantle, or the larger distal half of the bract, exhibits around its wide basal opening four acute triangular teeth, comparable to the four corners of the original medusa-umbrella. The pair of dorsal teeth is larger and more prominent than the pair of ventral teeth. The two opposite free ventral margins of the bract are smooth.

Siphon (figs. 9, s, 10, s, 11, s).—The polypire or siphon occupies originally the axial part of the bracteal cavity, between the dorsal tentacle (t) and the ventral nectophore (mn). The basigaster (sb) is separated by a sharp pyloric constriction from the stomach, the wall of which exhibits eight longitudinal hepatic ridges. The mouth of the muscular proboscis is surrounded by sixteen short lobes (so).

Tentacle (figs. 9, t, 10, t, 11, t).—The long cylindrical tentacle is distinctly articulated, and from the constriction between every two segments arises a thin tentillum or secondary filament (fig. 18). The terminal filament of the latter (tf) is about as long as its pedicle (ts). The ovate enidosae placed between them exhibits on its convex side six to eight longitudinal rows of small medial enidocysts (km), on its base two paired groups of large lateral enidocysts (six to eight spindle-shaped enidocysts, kg, in each), and at the distal part a trilobate group of pyriform enidocysts (kp).
**Nectophore** (figs. 9, 10, 11, nn).—The special nectophore, which contains no manubrium, occupies the ventral fissure of the bracteal cavity, in which only its basal part is enclosed. The umbrella is a slender four-sided pyramid, distinctly bilateral, since the two dorsal edges are stronger, and more prominent at the base, than the two ventral edges. All these edges, and also the quadrangular basal edge, with the four prominent teeth, are elegantly denticulate (fig. 17). The basal and ventral faces of the exumbrella are concave, the dorsal and the two lateral faces convex.

**Nectosac.**—The peduncular canal, which arises from the base of the phyllocyst, enters through the obliquely truncate top of the nectophore, and divides on the top of the muscular subumbrella (w) into four subregulur radial canals (cv). These unite at the ostium of the umbrella by a circular canal (cc) above the broad velum (v).

**Gonophores** (fig. 11, hm; figs. 12–14).—The young Erssea compressa possesses, besides the sterile nectophore, only a single gonophore, the older form two or three gonophores. These are usually of the same sex (the cormidia therefore diconic); but sometimes a male and a female gonophore are present in the same Eudoxia (the cormidium therefore monoedonic). The umbrella (u) of the male, as well as of the female gonophores, is slender ovate, with four edges which are smooth in the proximal half, elegantly denticulate in the distal half. They are prolonged over the mouth of the umbrella, and form four prominent triangular teeth, the two dorsal teeth being larger than the two ventral. The subumbrella (w) exhibits in the gonophores the same four subregulur radial canals, connected by a circular canal, as in the nectophore (figs. 9–11, nn).

The male gonophores (fig. 11, hm; fig. 12) have in their umbrellar cavity a large spindle-shaped or ovate spermarium (hm), with a wide central spadix (hx).

The female gonophores (figs. 13, 14) exhibit an ovarium of very variable size (fm). Sometimes the entire umbrellar cavity is filled with eggs (fig. 13), whilst, at other times, only a few ova (four in fig. 14) occupy its proximal half.

**Genus 17b. Lilsea,¹ n. gen.**

**Definition.**—Ersideae with a hemispherical or mitriform rounded bract, without sharp edges and without pointed apex. Phyllocyst small, with four radial canals arising from its base. (Cormidia of the genus *Lilyopsis*?)

The genus *Lilsea* comprises those Ersideae which possess a mitriform rounded bract, without sharp edges or apical point. Its form agrees with that of the eudoxomes of *Praya* and *Lilyopsis*. A further resemblance to the latter is given by the fact, that each cormidium possesses a sterile nectophore, the mouth of which bears a circle of rudimentary tentacles and four red pigment-spots (ocelli) at the distal end of the four radial canals. They are very similar to the medusiform special nectophores of *Desmo-

¹ *Lilsea* (Ἀλήας), name of a Naiad.
physes annectens (Pl. XXX.). The latter agrees also in the formation of the gonophores. Each cormidium possesses, besides the large vigorously swimming special nectophore, a cluster of small gonophores, all either male or female. The umbrella of the male gonophores is more developed than in Desmophyes. Among six specimens examined four were males and two females.

I observed half a dozen of these small interesting Eschscholtz, which will be more accurately described on another occasion, living in the Indian Ocean, during my voyage from Aden to Bombay, in November 1881. I suspect that they are the detached cormidia of some species of *Lilyopsis* (Genus 25). They may bear provisionally the name *Lilia medusina*.

**Family VI. Monophyidae, Claus, 1874.**

*Monophyidae*, Claus, 1874, 70, p. 29.  
*Sphcronecidae*, Huxley, 1859, 9, p. 50.

**Definition.**—Calyconeectae polygastricae, with a single nectophore at the apex of the long tubular truncae. Cormidia ordinate, eudoxiform, separated by equal free internodes; each siphon with a bract.

The family Monophyidae comprises a small number of little known polygastric Calyconeecte, which are rather rare, of small size, but very interesting on account of their simple structure. They all possess only a single permanent nectophore, and differ in this character from the nearly allied Diphyidae, with which they were formerly united.

Eschscholtz, in his fundamental work (1829, 1, p. 134), described only a single form of Monophyidae, *Cymba enneagonum*, the free Eudoxia of which is his *Cyma cuboides*. Both forms were discovered in the Straits of Gibraltar by Quoy and Gaimard, who called the first (polygastric) form *Enneagonum hyalinum*; and the second (monogastric) form *Cuboides vitreus*.

A second species of Monophyidae, inhabiting the Gulf of Trieste, was described in 1844 by Will, under the name *Diphyes kochii*, and in 1851 by Busch, as *Muggiwa pyramidalis*. The same form was afterwards, by combination of both names, called *Muggiwa kochii*, by Chun (86, p. 3). He described its metagenesis and development from the monogastric *Eudoxia eschscholtzii*.

Huxley, in his excellent work on Oceane Hydrozoa (1859, 9), described not less than four different Monophyidae, viz.:

1. *Spheronecacites köllikeri*, pl. iii. fig. 4.
2. *Diphyes mitra*, pl. i. fig. 4 (now *Cymbonecetes mitra*).
3. *Diphyes chamissonis*, pl. i. fig. 3 (now *Muggiwa chamissonis*).
4. *Abyla vogtii*, pl. ii. fig. 3 (now *Cymba vogtii*).
Huxley gave an accurate description of the only nectophore observed of these four "Diphyide"; he supposed (as did also his predecessors) that the second nectophore had been accidentally lost; it does not, however, exist at all. The genus *Sphaeronectes* was rightly regarded by Huxley as the type of a peculiar family—*Sphaeronectidae*.

During my residence in the Canary Island of Lanzerote (December 1866 to February 1867), I observed four different species of Monophyidae, viz.:

1. *Monophyes hydrorrhoa*.
3. *Muggia pyramidalis*.
4. *Cymba crystallus*.

I was able to examine the complete metagenesis of the latter species, and the development of its *Eudoxia*, *Cuboides crystallus* (Pls. XLI., XLI.).

A Mediterranean species of *Sphaeronectes*, very similar to the Australian form discovered by Huxley, was described in 1874 by Claus, and called *Monophyes gracilis* (70, pl. iv.). He observed the development of its *Eudoxia*, which was formerly described by Gegenbaur as *Diphypha inermis* (7, Taf. xvi. fig. 3). Another Mediterranean Monophyid described by him, *Monophyes irregularis*, may remain the type of this genus. Claus replaced the term *Sphaeronectidae* of Huxley by the name *Monophyidae*, which was accepted as more significant, in opposition to *Diphyidae*.

The metagenesis of the two Mediterranean Monophyidae was afterwards very accurately examined by Chun (86–88). Compare his memoirs also for the history of this family.

During my voyage through the Indian Ocean (November 1881 and March 1882) and in Ceylon, I had the opportunity of examining some very interesting new forms of Monophyidae and their development, viz., *Monophyes princeps* and *Cymbonectes huxleyi* (Pl. XXVII.). Supported by these observations, and by some specimens found in the Challenger collection, I was able to give the following description of Monophyidae.

**Nectophore.**—The single nectocalyx of the Monophyidae exhibits differences in form and structure similar to the first or proximal of the Diphyidae. Accordingly, I divide the family Monophyidae into two subfamilies; the first of these, *Sphaeronectidae*, has a smooth hemispherical or mitriform nectophore, without sharp edges, and is allied to the Prayidae among the Diphyidae. The second subfamily, *Cymbonectidae*, has a pyramidal nectophore with five prominent edges, and is nearly allied to the Diphyopsidae and Abylidae. The single nectophore of the Monophyidae is relatively large, of a bilateral and quadriradial fundamental form, sometimes symmetrical, at other times asymmetrical. The first nectophore of their larva is replaced by a permanent, often heteromorphous, swimming-bell.

**Hydrocranium.**—Since the single nectocalyx of the Monophyidae corresponds to the first apical or proximal nectophore of the Diphyidae, it possesses a hydrocranium for the reception of the retiring siphosome. This is an open hydrocracial groove, protected by
two overlapping ventral wings, in Monophyidae and Cymbonectes (Pl. XXVII.); it is a conical or campanulate hydrocereal cavity in Mugyiea and Cymba (Pl. XLI), a cylindrical canal in Siphononectes. These closed hydroceles are secondary cavities, produced by concrescence of the two parallel ventral wings, which overlap the hydrocereal groove of the former.

The singular genus Mitrophyes (Pl. XXVIII.) is distinguished by the lack of a hydrocereum. It is replaced by an apical scutiform bract, which covers the nectophore and protects the siphosome hidden between them both. The apical bract is probably the remnant of the original primary nectophore.

Nectosac.—The subumbrella in most Monophyidae occupies the dorsal part of the nectophore, whilst the hydrocereum is placed in its ventral part. The nectosae of Siphononectes and Mitrophyes is placed rather basally (as in the ancestral Medusa), in the other genera rather dorsally. The four radial canals are in the former genera rather regularly disposed, but usually more bilaterally, the ventral canal being shorter, and the dorsal longer than the two paired lateral canals. The ring-canal of the margin, which unites them, is placed above the velum.

Somatoecyst.—The acroecyst or somatoecyst (“Saftbehälter”) in most Monophyidae is of moderate size, placed in the apical prolongation of the stem; its cavity is narrow, usually filled by large vacuolate entoderm-cells, and its apex mostly contains an oleocyst. It is directed sometimes vertically upwards, at other times more obliquely. Its structure is the same as in the other Calyconecte (compare above, p. 93).

Siphosome.—The long tubular stem exhibits in the Monophyidae the same structure as in the Diphyidae. The median ventral line of the common stem is beset at regular intervals by the cormidia, whose number is very variable. The contracted siphosome may be retracted into the hydrocereum more or less completely.

Cormidia.—Each cormidium (Diphyzyooid or Eudoxia) is composed in the Monophyidae (as in the most Diphyidae) of two medusomes; the sterile medusome has a bract, a siphon, and a tentacle; the fertile medusome is a gonophore, the umbrella of which has the usual medusoid structure, whilst the manubrium produces the sexual cells (compare above, p. 94).

Siphon and Tentacle exhibit no important differences in the cormidia of the various Monophyidae, whilst the bracts or hydrophyllia are of very different form and structure, characteristic of the genera (compare above, pp. 95, 96).

Eudoxix.—The cormidia of some Monophyidae arrive at sexual maturity whilst attached to the stem; they remain sessile eudoxomes. This is the case in Mitrophyes and Cymbonectes, and probably also in Monophyidae. The cormidia of the three other genera are detached from the stem, and become mature as free-swimming Eudoxix; those of Siphononectes are described as Diplophyka; those of Mugyiea as Cucubalus, whilst the free Eudoxix of Cymba belong to Cuboides.

Ontogeny.—On the development of the Monophyidae, compare above, pp. 100–102.
Synopsis of the Genera of Monophyidae.

I. Subfamily Sphrønectidae.
   Nectophore hemispherical or mitriform, with rounded surface, without sharp edges.
   - Hydrecium a ventral groove of the nectophore, incompletely closed by two overlapping wings. 18. Monophyes.
   - Hydrecium a complete cylindrical canal in the ventral wall of the nectophore, with a basal opening. 19. Sphrønectes.
   - Hydrecium wanting. Nectophore protected by a cap-shaped dorsal bract; between them is the siphosome. 20. Mitrophyes.

II. Subfamily Cymbonecidae.
   Nectophore pyramidal, with five prominent sharp edges.
   - Hydrecium a complete conical or campanulate cavity in the ventral wall of the nectophore. Bracts of the cormidia conical or spathiform, with a deep ventral fissure. 22. Mungrisa.
   - Bracts of the cormidia cuboidal, with six square faces and a basal cavity. 23. Cyamba.

Genus 18. Monophyes, 1 Claus, 1874.

Monophyes, Claus, Die Gattung Monophyes, &c., 70, p. 29.

Definition.—Monophyide with a rounded, edgeless, mitriform nectophore, and an open hydrecial groove on its ventral side; the latter includes the siphosome, which is incompletely protected by two overlapping lateral wings. Bracts mitriform or hemispherical, with rounded surface and a simple phylloycyst.

The genus Monophyes was founded in 1874 by Claus for two different Mediterranean species of Calyconectes, which bear a single mitriform nectophore on the top of the stem. One of these two species, Monophyes gracilis, belongs to the following genus Sphrønectes, which possesses a closed tubular hydrecium, open only at the distal end. The other species, Monophyes irregularis, may be retained as the type of the present genus; it differs from the former in the bilateral arrangement of the four radial canals of the sub-umbrella, and mainly in the shape of the hydrecium, which is not a tubular canal, but an open groove or infundibular cavity. 2 This peculiar character is more developed in two other species, which I have myself observed, Monophyes princeps, from the Indian Ocean (Pl. XXVII. figs. 13, 14), and Monophyes hydrorrhoea, from the Atlantic Ocean (Canary Islands). The hydrecial groove extends here along the whole ventral side of the bilateral nectophore, and its two edges are prominent as two free wings, one of which overlaps the other more or less. The Atlantic species (Monophyes hydrorrhoea) is very similar to a small Mediterranean form figured in 1885 by Chun, who supposed it to

1 Monophyes = Single animal (μονος ψαλις); Calyconectes with a single nectophore.
2 70, p. 32, Taf. 1v. figs. 16-18.
be the "primary nectophore" of Monophyse gracilis (= Sphæronectes gracilis), afterwards replaced by a heteromorphous secondary nectophore (87, Taf. ii. fig. 5). But this supposition is not very probable, and I call this form provisionally Monophyse diptera, provided that it does not belong to Cymbonectes (Genus 21). The eudoxomes of Monophyse seem to ripen attached to the stem, and not to form free Eudoxine as in Sphæronectes.

Monophyse princeps, Haeckel (Pl. XXVII. figs. 13, 14).

Sphæronectes princeps, Hkl., 1887, System der Siphonophoren, p. 34.

Habitat.—Indian Ocean; between the Maldive Islands and Socotra, March 1882 (Haeckel).

Nectophore (fig. 13, lateral view from the left side; fig. 14, transverse section at the middle of the height).—The single nectocalyx is 6 mm. long and 3 mm. broad. Its form is asymmetrical, nearly ovate, with a flat constriction near the base. The surface is perfectly smooth, rounded, and without sharp edges. The transverse section (fig. 13) is subcircular in the upper half, more ovate in the lower half.

The dorsal half of the nectophore, which includes the nectosae (w), is of a quite simple ovoid form, bilaterally symmetrical. The ventral half, which includes the siphosome in its hydroæcial groove, is asymmetrical. The thin frontal septum (u!l), or the vertical transverse jelly-plate, which separates the dorsal nectosac (w) from the ventral hydroæcial canal (ui), gives off two large parallel and vertical ventral wings, which enclose the latter. The right wing (ux) is larger, and overlaps the smaller left wing (ul), so that the ventral opening of the hydroæcial groove becomes incompletely closed by the two overlapping wings. The two wings are united at the apical or upper blind end of the groove, whilst they are prolonged into two broad ovate terminal lobes at the basal or lower opening of the groove.

Nectosac (figs. 13, 14, w).—The subumbrella of the nectophore occupies its dorsal half (with exception of the apical third) and is subcyllindrical, slightly concave on the dorsal, convex on the ventral side, with curved axis. The nectocalyce duct, which arises from the top of the stem, is very short, enters into the ventral wall of the nectosac somewhat below its rounded apex, and divides into four curved radial canals; the ventral of these (ev) is shorter, the dorsal (ed) longer, than the two paired lateral canals (el left, cx right). They are united by a circular canal above the broad velum (v).

Hydroæciwm (figs. 13, 14, ul).—The cavity at the ventral side of the nectophore, which includes the retracted siphosome (ax), is a flattened canal, the frontal diameter of which is twice as great as the sagittal. It is separated from the neighbouring ventral side of the nectosac (w) by the thin frontal septum. The hydroæcial canal is blind at
its apex, where the top of the stem is inserted; it is protected at its ventral side by the two overlapping wings, and opens below by a dilated basal mouth, whence issues the siphosome.

Somatocyst (es).—The uppermost rounded apical part of the nectophore is occupied by an ovate somatocyst, which arises, as the apical prolongation of the stem, between the apical ends of the nectosac and the hydroecial canal. It is filled with large vacuolate entoderm cells, and contains in its rounded apex a globular oleocyst (eo).

The somatocyst of the Indian Monophyes princeps is wanting in the Atlantic Monophyes hydrorrhoa, and the similar Mediterranean Monophyes diptera (Chun, 87, Taf. ii. fig. 5). These two species represent an older phylogenetic state, since the two parallel ventral wings of the nectophore are separated in its whole length, and not united in the apical third; this difference explains the absence of the somatocyst in them.

Siphosome (figs. 13, 14, es).—The common stem, retracted into the hydroecial canal (wu), was in the specimen observed rather short (probably broken off), and bore (besides numerous small buds) not more than five or six immature eudoxomes. Each eudoxome had a hemispherical bract and, protected by it, a siphon with its tentacle, and a small ovate gonophore; the form and structure of these parts, which I could not sufficiently examine, seems to agree with those of Monophyes irregularis.

Genus 19. Sphäronectes,¹ Huxley, 1859.

Sphäronectes, Huxley, The Oceanic Hydrozoa, p. 50.

Definition.—Monophyidae with a rounded, edgeless, subspherical nectophore, and a complete tubular hydroecium on its ventral side; the latter includes the siphosome. Bracts mitriiform or subspherical, with rounded surface and a simple phyllocyst (Diplopodia, Genus 10).

The genus Sphäronectes was founded in 1859 by Huxley for an Australian Monophyid, Sphäronectes kollikeri,² which was remarkable for a single subspherical nectophore with a tubular hydroecium. Another closely allied Mediterranean species was described fifteen years later by Claus under the name Monophyes gracilis (70, p. 29, fig. 8). The same author there gave the description of a similar third Monophyid under the name Monophyes irregularis (ibid., p. 32, figs. 16, 17). We retain the generic name Monophyes for this latter species, whilst the two former are better placed in Huxley’s original genus, Sphäronectes. The first-described Australian species, Sphäronectes kollikeri, differs from the Mediterranean Sphäronectes gracilis in the flatter, more depressed nectophore, and the subhorizontal, not geniculate somatocyst. A specimen of Sphäronectes kollikeri was found by me in the Challenger collection, taken from the surface of the Tropical Pacific at Station 274. The same bottle con-

¹ Sphäronectes = Swimming sphere (σφαρός, σφαίρα).
² 9, p. 50, pl. iii. fig. 4.
tained a few detached Eudoxiae of this species, which fully developed represent the monogastric *Diplophysa köllikeri*, Haeckel.

*Spheronectes* may be derived from *Monophyes* by concrescence of the two parallel crests or wings, which arise from the ventral side of the nectophore. The hydrefcial groove of the latter becomes converted by this process into a closed tubular hydrefcum, which includes the siphosome. The cormidia, which are attached to the common stem at regular intervals, possess a subspherical bract with a simple vertical phyllocyst, and detached from the stem represent the genus *Diplophysa* (compare p. 107).


*Mitrophyes*, Hkl., System der Siphonophoren, p. 34.

*Definition.*—Monophyidæ with a rounded, edgeless, hemispherical or mitriform nectophore, without a true hydrefcum. Trunk free between the exumbrella of the nectophore, and a scutiform or cap-shaped bract, depending from the junction of these two pieces. Bracts spatliiform or semi-ovate, without phyllocyst.

The genus *Mitrophyes* was founded by me for an Atlantic Monophyid, which I observed living in the Canary Sea, in January 1867. I observed there two complete specimens, a male and a female. A third specimen (female) was found in the Challenger collection, among other pelagic animals from Station 352. The latter specimen was well enough preserved to enable me to identify it with the former.

*Mitrophyes* differs from all other Monophyidæ in the possession of a peculiar bract, which covers the single nectophore like a shield or cap, and in the absence of a hydrefcum, the trunk depending freely between those two pieces and arising from their junction. It may be compared to a *Praya* or a similar Diphyid, the first nectophore of which is rudimentary and transformed into a bract.

*Mitrophyes peltifera*, n. sp. (Pl. XXVIII.).

*Habitat.*—Tropical and Northern Atlantic, Station 352; April 13, 1876; lat. 10° 55' N., long. 17° 46' W. Surface.

Canary Islands, Lanzerote, January 1867 (Haeckel).

*Nectophore.*—The single large nectophore is nearly hemispherical, somewhat oblique, its nectosæ being higher in the ventral than in the dorsal half; it is 6 to 8 mm. long, 4 to 5 mm. high. The voluminous jelly-mantle of the umbrella is twice as thick in the dorsal part as in the ventral. The equatorial diameter of the smooth rounded exumbrella is nearly twice as great as that of the subumbrella, and as the height of the nectophore.

¹ *Mitrophyes* = Mitrophorous, animal provided with a mitre, μίτερ, ἀνέσ.
The obliquely egg-shaped subumbrella is much more vaulted in the ventral than in the dorsal half; the diameter of its aperture is about equal to its height. The velum (figs. 1, v, 2, v) is small. The four radial canals of the subumbrella are arranged symmetrically; the dorsal canal (figs. 1, 2, ed) is shorter, the ventral (ev) longer than the two lateral canals (ex right, el left). The apical canal (fig. 7, cv), which arises from their proximal junction, is short, and passes obliquely through the jelly substance of the top in ventral direction to the somatocyst (cs).

*Apical Bract* (figs. 1, b, 2, b, 7 b).—The peculiar organ, which we call the apical bract, distinguishes at once *Mitrophyes* from all other Monophyidae, and from all Calycocete in general. It covers the exumbrella of the nectophore in the same manner as a cap covers the head of a man. The bract is a circular concave-convex shield, the diameter of which nearly equals that of the subjacent nectophore.

Its morphological signification is difficult to make out; it may be nothing other than the reduced umbrella of a medusome, which has lost all its other parts; but it may also be the remnant of the primary nectophore, the place of which is taken by the permanent nectophore afterwards developed. These two pieces are connected by a narrow short pedicle (figs. 2, 7) which is probably the uppermost part of the original trunk. The jelly substance of the bract is rather thin in the peripheral, thicker in its central part, and includes here three short blind radial canals, a longer dorsal (fig. 1, cb) and two smaller lateral canals; from their junction arises a short braeveal canal (fig. 7, cb) which passes through the pedicle to the somatocyst (cs).

*Somatocyst* (figs. 1, 2, 7, cs).—The somatocyst, or the coryphal cavity of the stem, is a slender conical canal, placed nearly horizontally in the gelatinous umbrella of the nectophore, in its sagittal plane, and directed towards the dorsal side. Its direct continuation towards the ventral side is the axial canal of the trunk. Its proximal apex is closed. From its distal base arise two lateral branches nearly opposite; proximally the peduncular canal of the bract (fig. 7, cb), and distally the peduncular canal of the nectophore (fig. 7, cn).

*Hydrcecium.*—*Mitrophyes* does not possess a distinct hydrcecium, but it has a very small cavity, which may be considered as the rudimentary homologue of such a "funnel cavity" (figs. 1, 7, w). This rudiment of a hydrcecium is placed nearly in the apex of the nectophore, and represents a very small funnel-shaped foveola of its exumbrella, which surrounds the origin of the free trunk (a).

*Siphosome* (figs. 1, 2, 7, a).—The common trunk or stem of the siphosome in the expanded state (fig. 1) is a very long thin cylindrical tube, attaining a length of 20 to 30 mm. The internodes between the ordinate cormidia are twice as long as these. In the contracted state (fig. 2) the internodes disappear, and the convoluted stem becomes hidden between the nectophore and bract. The number of the cormidia in the largest specimen observed was between thirty and forty.
Cormidia (figs. 3, 5).—The cormidia, or the single "groups of persons," disposed regularly in metameric order, are sessile eudoxomes, the sexual organs becoming ripe on the stem. There are no free Eudoxiae developed. In two of the three observed specimens all the eudoxomes were female (figs. 3, 4), in the third specimen male (figs. 5, 6). Mitrophyes, therefore, is one of the rare dioecious Siphonophore. Each eudoxome is composed of two medusomes, one sterile (siphon with tentacle and bract) and one fertile (the gonophore).

Lateral Bracts (figs. 3, b, 5, b).—The bract of each cormidium is an oblongish scale, nearly of the form of a bisected egg. Its proximal part is rounded and attached to the stem (o), its distal part is obtusely pointed. The convex umbrella is smooth. Its sub-umbrellar cavity covers the included siphon and gonophore only partly. There is no phyllocoyst or bracteal canal.

Siphon (figs. 3, s, 5, s).—The siphon of each cormidium is placed between bract (dorsally) and gonophore (ventrally). Its pedicle is very short, the basigaster (sb) very thickened, nearly spheroidal, with a dense accumulation of enidoceysts. The stomach (sm) is ovate, thick-walled, and includes numerous scattered large enidoceysts (ke) in the exoderm; its endoderm possesses hepatic strie. The proboscis (sr) is very muscular, cylindrical, with a simple circular mouth-opening (so).

Tentacle (figs. 1, 3, 5, t).—The single long tentacle which arises from the pedicle of each siphon bears a great number of tentilla. The enidosae of each tentillum (fig. 8) is kidney-shaped, and bears at its proximal base only two pairs of large ovate enidoceysts (kg). The terminal filament is about as long as the pedicle of the tentillum (figs. 5, 8).

Gonophores (figs. 3, f, 4, female; figs. 5, h, 6, male).—Each cormidium bears only a single gonophore without accessory sexual bells. They possess the usual shape of medusoid gonophores in Calyconectae, and are about as large as the siphon. The spermia (figs. 5, 6, kS) are more longish than the ovaria (figs. 3, o, 4). The umbrella possesses in both sexes four regular radial canals, which are united by a ring-canal at the basal ostium (uo).


Cymbonectes, Hkl., System der Siphonophoren, p. 34.

Definition.—Monophyide with an angular, pyramidal nectophore, and an open hydroidal groove on its ventral side; the latter includes the siphosome, which is incompletely protected by two overlapping lateral wings. Bracts spathiform, with an open ventral fissure, and a simple ovate phyllocoyst.

The genus Cymbonectes has hitherto been known by a single species only, described in 1859 by Huxley as Diphyes mitra, and taken only once in the Indian Ocean.2

1 Cymbonectes = Swimming boat, κυμβόνεκτης.
2 9, p. 36, pl. i. fig. 4.
That author observed only a single nectocalyx, and supposed that it might be a young and imperfect *Diphyes*. But I find the same form in different bottles from the Challenger, taken in the Pacific, and also in the collection of Captain Rabbe. One nectophore only (the first or proximal) is always present, whilst there is no trace of a second or distal nectophore. I am therefore convinced that this form is a true Monophyid, not a Diphyid, and this the more as the peculiar character of this group is yet more distinct in another Indian species, *Cymbonectes huxleyi*; I observed this species, described in the following pages, during my stay in Ceylon. A third species, *Cymbonectes cymba*, inhabits the Atlantic Ocean, and will be described afterwards.

*Cymbonectes* has no complete hydrceium, but an open infundibular groove on the ventral side of its nectosae; it agrees in this respect with the genus *Monophyes* (*sensu stricto*, compare p. 128), but it differs from this in the pyramidal form of its angular nectophore.

Whilst in Belligemma I succeeded in observing the development of the fertilized egg of *Cymbonectes huxleyi*; it is very similar to that of *Galeolaria aurantiaca*, described by Metschunikoff (84, Taf. vi., vii.). The four most important stages of it are figured in Pl. XXVII. figs. 9-12.

*Cymbonectes huxleyi*, n. sp. (Pl. XXVII. figs. 1-12).

*Habitat.*—Indian Ocean; Belligemma, Ceylon, December 1881 (Haeckel).

*Nectophore* (fig. 1, lateral view from the right side; fig. 2, dorsal view; fig. 3, ventral view; fig. 4, transverse section through the middle part).—The single nectocalyx is helmet-shaped or slenderly campanulate, 6 to 7 mm. long, 2 to 3 mm. broad; it is somewhat broader in the upper than in the lower half. The exumbrella has five prominent, elegantly denticulate edges which unite above in the pointed apex, and end below in the median crests of five triangular teeth surrounding the basal mouth.

The five edges of the nectophore are arranged as in *Diphyes*, one odd running along the dorsal median line (near the nectosae), two lateral corresponding to the two lateral canals of the latter, and two ventral forming the edges of the hydrceial canal. From the base of these latter arise in the lower half of the nectophore two broad triangular wings, the larger left of which overlaps the other and thus incompletely closes the hydrceial groove (fig. 4); the free edges of these wings are strongly denticulate (fig. 3). The bases of the wings are continued above the basal ostium of the nectophore, and here form on its ventral side two broad ovate basal lobes with elegantly denticulate edges. These lobes support the siphosome proceeding from the basal mouth of the hydrceial canal.

*Nectosae* (fig. 2, w).—The subumbrellar cavity is ovate, twice as long as broad, and
broader in the upper than in the lower half. It occupies the two distal thirds of the nectophore, whilst its proximal third is taken by the somatocyst (cs). Its ventral side is separated by a thin frontal septum from the adjacent hydromé. The basal mouth of the nectosac is obliquely truncate and surrounded by five strong triangular teeth, the distal ends of the five exumbrellar crests. The two ventral teeth (as the terminal lobes of the two hydroméal plates) are about four times as large as the three other teeth, which form an odd dorsal point and two paired lateral points.

Canals of the Nectosac.—The nectocalycine duct, which arises from the top of the stem (aa), descends nearly to the middle of the dorsal median line of the subumbrella, and divides here into four radial canals, two odd and two paired. The odd ventral canal (cv) is the shortest, and descends immediately straight to the ostium of the nectosac. The odd dorsal canal (cd) is the longest; it ascends, in the dorsal median line, to the apical top of the nectosac, and then descends downwards along its whole ventral median line. The two paired lateral canals (right ce, and left cl) are intermediate in length between the former and the latter, and have a strongly bent course. They run firstly ascending towards the dorsal side, form in the upper half of the nectosac a nearly circular loop, and then are turned ventrally and downwards. The four radial canals are united at the ostium of the nectosac by a circular canal, which embraces the velum (v).

Hydromé (figs. 1-4, ui).—The funnel-cavity of the nectophore, into which the contracted siphosome may be partly retracted, is a long, nearly cylindrical and slightly bent canal, which occupies the two distal thirds of the ventral half of the umbrella. It is separated from the dorsally adjacent nectosac by a thin frontal septum, and incompletely closed on its ventral side by the two triangular ventral wings of the exumbrella overlapping one another (figs. 3, 4, nx right, nl left). Its basal ostium is protected at the dorsal side by the two terminal lobes of the ventral crest. The apex of the hydroméal canal touches the base of the somatocyst.

Somatocyst (cs).—The axial canal of the tubular stem is prolonged above its apex into a pyriform cavity, nearly filled up by large vacuolated entoderm-cells. This is the pyriform somatocyst, which encloses in its dilated uppermost part a hydrostatic oil-globule (co). It occupies the uppermost or apical third of the nectophore, and is far prominent over the top of the nectosac. It is twice as long as broad, and nearly one-third as long as the nectophore.

Siphosome.—The common tubular stem, which arises in the closed apex of the hydromé, at the base of the somatocyst, proceeds through the basal ostium of the former to a considerable length. It is beset by a series of numerous buds in the upper part, and eight to twelve fully-developed cormidia in the lower part. These are alternating male and female, separated by equal free internodes (fig. 1).

Cormidia (figs. 6, 7).—Each cormidium, or "group of individuals," is a eudoxome, composed of two medusomes, a sterile and a fertile. The sterile Medusa exhibits a
spathiform bract, and hidden in its cavity a siphon with its tentacle. The fertile medusome, placed at the ventral side of the former, is a medusiform gonophore, either male or female.

**Bract (figs. 5, 6, b).—**The protecting rudimentary umbrella or hydrophyllum is similar to that of Diaphyes, spathiform, or irregularly conical, with a deep ventral fissure, and an obliquely truncate base. Its structureless jelly-plate is very thin in the lower half, thick in the upper half, which encloses a large pyriform phyllocyst. This contains large vacuolate entoderm cells, and an oil-globule in its apex. The truncate base of the bract has four corners, two ventral smaller and two dorsal larger triangular lobes.

**Siphon (figs. 5–7, s).—**The single polypite which is attached on the top of the sub-umbrellar cavity of the bract has the formation usual in the Calycomenidae, a short pedicle, an ovate basigaster with very thick exoderm, full of cnidosacs (sb), a utricular stomach with thick entoderm (sm), and a very protractile proboscis (sr); the distal mouth-opening of the latter may be expanded in form of a circular suctional disc (fig. 5, ss).

**Tentacle (figs. 5–7, t).—**The single tentacle which arises from the pedicle of the siphon is of medium size, and bears a row of ten to fifteen or more tentilla. Each of these lateral branches bears upon its club-shaped pedicle a reniform endosac (fig. 8, km). This includes on its convex side about four to six longitudinal rows of smaller paliiform cnidosacs, and at its base, on both sides, three very large ensiform cnidosacs; the terminal filament (tf) is usually coiled up, and armed at the distal end with a hemispherical group of pyriform cnidosacs, provided with long cnidocils (kp).

**Gonophores (figs. 5, 6).—**The sexual medusoids alternate regularly in the cormidia, so that each two neighbouring ones form together a diclinic pair. The male endoxomes (fig. 6) are nearly of the same shape as the female (fig. 5). Each gonophore is an ovate or club-shaped sac, placed at the ventral side of the siphon. The rudimentary umbrella, which possesses the usual four radial canals, and the uniting marginal canal, embraces closely the manubrium. The spadix or central canal is large in the spermaria (fig. 6, hx), small or rudimentary in the ovaria (fig. 5, f).

**Genus 22. Muggiwa,** Busch, 1851.


**Definition.**—Monophyidae with an angular pyramidal nectophore and a complete infundibular hydroceum on its ventral side. Bracts spathiform or conical, with a deep ventral groove, a bevelled basal face, and a simple ovate phyllocyst.

The genus _Muggiwa_ was founded in 1851 by Busch (67, p. 48) for a Mediterranean Monophyid, which Will had figured seven years before under the name _Diaphyes kochii_ (65, p. 77, Taf. ii. fig. 22). The identity of these two forms was demonstrated in 1882

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1 _Muggiwa_ = Inhabitant of the port of Muggia, near Trieste.
by Chun, who called it *Muggiara kochii* (86, p. 1157, Taf. xvii. fig. 2). Chun demonstrated that this polygastric Calyconecta is a true Monophyid, and that the eormidia, arising from the common stem, become detached and sexually developed as the free monogastric generation, which was described by Busch under the name *Eudoxia eschscholtzii*. Chun also gave the full description of its ontogeny, and found that the larva, arising from the fertilised egg of *Eudoxia eschscholtzii*, does not possess the pentagonal pyramidal nectophore of *Muggiara*, but the edgeless campanulate nectophore of *Monophyse*; the latter afterwards buds from the base of the former, and remains when the former is detached. Chun supposed, therefore, that three different generations should be distinguished in this species—(1) *Monophyse pyramidalis* (85, fig. 1), (2) *Muggiara kochii* (fig. 2), and (3) *Eudoxia eschscholtzii* (fig. 3). I cannot agree with this opinion, but I regard the first form (fig. 1) only as the larva of the second (fig. 2). The primary edgeless nectophore of *Monophyse* is only a provisional larval organ, and the fact that it is afterwards replaced by the secondary five-edged pyramidal nectophore of *Muggiara* may be explained by the fundamental law of biogeny—by the hypothesis that *Monophyse* is the original ancestral form of *Muggiara*.

The mature *Eudoxia* of *Muggiara* is very similar to the monogastric genus *Cucubalus*, the *Eudoxia* of *Diphyes*. It differs in the rounded and edgeless surface of the conical or spathiform bract, which has three or five edges in *Cucubalus*. In respect of this difference, the name *Cucubalus* (given in 1824 by Quoy and Gaimard, 24) may be retained for it. The spathiform bract is obliquely conical, with a deep ventral groove, rounded dorsal convexity, pointed apex, and simple phyllocyst (compare above, Genus 11b, p. 109). The free *Eudoxia* of the Mediterranean *Muggiara kochii* may, therefore, bear the name *Cucubalus eschscholtzii*.

A second species, slightly differing from the Mediterranean one, was observed by me in the Canary Island Lanzarote, and may retain the name *Muggiara pyramidalis*; it differs from the former mainly in the size of the conical hydroceium, the top of which attains half the length of the nectosac. The free *Eudoxia* of this Atlantic species has a conical bract, with a blunt apex and an ovate larger phyllocyst; it may be called *Cucubalus pyramidalis*.

A third species of *Muggiara* is probably the Tropical Pacific form, described by Huxley in 1859 as *Diphyes chamissonis*. It agrees with *Muggiara pyramidalis* in the size of the high hydroceium, but differs from this Atlantic and from the Mediterranean species in the more campanulate form of the nectophore, the denticulate shape of its edges, and the stronger teeth of its mouth. The free *Eudoxia* of this Pacific species may, perhaps, be *Cucubalus cordiformis* of Quoy and Gaimard.  

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1 67, p. 33, Taf. iv. figs. 7-10; Taf. v. figs. 1-9.
2 9, p. 36, pl. i, fig. 3.
3 2, p. 94, pl. iv. figs. 24-27; 24, pl. vi. fig. 1.
(zool. chall. exp.—part lxxvii.—1888.)

Hhh 18
Cymboneetes mainly in the complete infundibular cavity of the hydrecium, and, therefore, bears to it the same relation that Sphaeroneastes exhibits to Monophyes.

Genus 23. Cymba,1 Eschscholtz, 1829.

Cymba, Esch., System der Acalephen, p. 133.

Definition.—Monophyidae with an angular, pyramidal nectophore, and a complete infundibular hydrecium on its ventral side. Bracts cuboidal, with six quadrangular faces, and two lateral lobes arising from the base of the phyllocyst.

The genus Cymba of Eschscholtz comprised in the system of its founder three different species, the first of which (Cymba sagittata) belongs to a different genus of Calyconectae (it is an Abylid). The second species, which I retain as the type of our genus, is the Mediterranean Cymba enneagonum, Esch. (= Enneagonum hyalinum, Quoy et Gaimard, 2, pl. v. figs. 1–6). The monogastric generation, or the Eudoxia of this polygastric Monophyid, is the third species of Eschscholtz, Cymba cuboides (= Cuboides vitreus, Quoy et Gaimard, not Huxley!).

Different from this typical and oldest known Mediterranean form is a second, Australian, species, which Huxley described very accurately in 1859, under the name Abyla vogtii (9, fig. 46, pl. ii. fig. 3). He rightly suspected that his Cuboides vitreus (not identical with that of Quoy et Gaimard) might be the detached Eudoxia of the former; he found both together at the same place on the south coast of New Guinea.

A third species, Cymba nacella, was found by me in 1881 in the Indian Ocean, and will be described on another occasion. It is more similar to Cymba vogtii (= Abyla vogtii, Huxley) than to the two western species. Its Eudoxia is Cuboides nacella.

The fourth species, here described as Cymba crystallus, was observed living by me in the Canary Islands in 1867, and from these living specimens are taken the figures on Pls. XLI. and XLII. (compare above, p. 111). The same form occurred in the Challenger collection, having been taken in the Guinea current at Station 348.

The remarkable cuboidal form of the bracts, and the bilobate horizontal diverticulum of their phyllocyst, distinguishes Cymba at once from all other Calyconectae.

Cymba crystallus, n. sp. (Pls. XLI., XLII.).

Abyla crystallus, Haeckel, 1867, MS. Canar.

Habitat.—Tropical and Subtropical Atlantic, Station 348; April 9, 1876; lat. 3° 10' N., long. 14° 51' W. Surface.

Canary Islands, Lanzarote, February 1867 (Haeckel).

1 Cymba = Boat, πηρα.
Nectophore (fig. 1, basal view; fig. 2, apical view; fig. 3, dorsal view; fig. 4, ventral view; fig. 5, lateral view from the left side).—The single nectophore (or the apical nectocalyx) has a diameter of 10 to 15 mm., and a complicated polyhedral form. In that position which is regarded as the normal in figs. 3, 4, and 5, the two parallel axes of the nectosac and of the hydrecium stand vertically. The umbrella of the nectophore appears composed of a quadrilateral pyramid in the apical half, and of a polygonal prism in the basal half.

The apical view of the nectophore (fig. 2) exhibits a rather regular quadrilateral pyramid. Its four perradial edges (the dorsal \( ud \), the opposite ventral or coryphal \( nk \), and the two lateral, right and left) meet in the central apex of the pyramid at right angles. The four faces separated by them are irregularly rhombic, the two dorsal (left \( ud' \), and right \( ud'' \)) and the two apici-ventral faces (left \( ua' \), and right \( ua'' \)). Each of these four faces is slightly concave, and in the middle between each two pyramid edges is prolonged into a descending pyramidal apophysis; these four basal apophyses alternate regularly with the four pyramid edges, and are of course interradial.

The basal view of the nectophore (fig. 1) shows that these four interradial basal apophyses are three-sided pyramidal, and that their inferior crests or basal edges are directed radially towards the centre of the basal face. The centripetal end of the basal edge of the two dorsal apophyses passes over directly into the two lateral teeth of the mouth of the nectosac, whereas the centripetal end of the basal edge of the two ventral apophyses finally passes over into the two smaller dorsal teeth of the mouth of the hydrecium. The four basal faces of the nectophore, which are separated by those four interradial basal crests, are also concave, and have a bilateral-rhombic, or, strictly speaking, pentagonal form. The ventral basal face \( (uv) \) is somewhat smaller than the dorsal basal face \( (uj) \), and the two pentagonal lateral basal faces are intermediate between them.

The ventral view of the nectophore (fig. 4) therefore exhibits the smaller ventral basal face \( (uv) \) surrounded by four larger faces (fore-shortened); the two ventral basal faces \( (ux \) right, \( ul \) left) and the two ventral apical faces \( (ua'' \) right, \( ua' \) left). The somato-cyst \( (es) \), with its apical oleophore \( (eo) \), and beyond it the hydrecium \( (ui) \), with the included siphosome, appear through the ventral wall of the nectophore in this view (fig. 4). The basal opening of the hydrecium \( (ui) \) is surrounded by four serrate triangular teeth, two smaller ventral and two larger dorsal.

The dorsal view of the nectophore (fig. 3) exhibits the two large quadrilateral dorsal apical faces \( (ud' \) left, and \( ud'' \) right), and beyond them the pentagonal dorsal basal face of the nectosac may be seen through the dorsal wall of the nectophore, and above it the oleocyct (fig. 3, \( es \)).

Nectosae (fig. 6, \( w \), lateral view, right side; fig. 5, lateral view, left side; fig. 3, \( w \), dorsal view; fig. 2, \( w \), apical view; fig. 1, \( w \), and 7, basal view).—The nectosae, or the muscular subumbrella of the nectophore, includes a slenderly ovate cavity, which in the
contracted state is three to four times as high as broad. Its height equals half the height of the complete nectophore. Its dorsal face is more convexly vaulted than the ventral, which is nearly in contact with the dorsal wall of the hydrcecium. The canal of the nectophore (fig. 6), which arises from the constriction between somatocyst (cs) and hydrcecium (ui), descends nearly vertically to the centre of the ventral median line of the nectosac, and here gives off the four radial canals, which have very different lengths. The shortest is the ventral canal of the nectosac (fig. 6, cv); it extends only through the basal half of the nectosac. The longest, on the contrary, is the opposite dorsal canal (cd); it runs from the basal circular canal (cc) along the whole dorsal side (in the dorsal median line of the nectosac), and then from its top downwards through the apical half of the ventral line. The two symmetrical lateral canals (ex right, and el left) are equal and form an S-shaped loop; they ascend from the basal circular canal (cc) in the dorsal half of the nectosac vertically, send off into its apical third a slender caecal sac (cy), and then descend in the ventral half, meeting each other and the two other canals near to the centre of the ventral line.

The mouth of the nectosac (figs. 1, no, and 7, no, basal view; fig. 8, no, lateral view from the right side) is surrounded by a broad velum (v) and armed with five serrate teeth of nearly equal size, the odd dorsal tooth (fig. 8, nd) is perradial; the two paired dorso-lateral teeth (n1 left, n2 right) give off the two dorsal basal crests of the nectophore; finally, the two paired ventro-lateral teeth (fig. 8, n2 left, n4 right) may be regarded as separated branches of a forked (originally odd) ventral tooth.

Hydrcecium (figs. 1 and 7, ui, basal view; fig. 2, ui, apical view; fig. 4, ui, ventral view; fig. 5, ui, lateral view from the left side; fig. 6, ui, from the right side).—The hydrcecium or the funnel cavity of the umbrella completely includes the retracted siphosome; it is slenderly campanulate or nearly cylindrical, and about as large as the nectosac, which is placed at its dorsal side. The vertical main axes of these two organs are nearly parallel; but the apical half only of the hydrcecium is in immediate contact with the basal half of the nectophore, whilst the basal half of the former projects freely beyond in the form of a short and wide campanulate tube (figs. 5, 7, 8, ui). The basal mouth of the latter is the lowermost base of the entire nectophore, and is armed with two pairs of serrate teeth, the two teeth of the dorsal pair being larger than those of the ventral pair (figs. 7, 8).

Somatocyst (fig. 4, cs, ventral view; figs. 5, 6, cs, lateral view).—The somatocyst or the coryphal cavity is ovate or spindle-shaped, about half as long and broad as the hydrcecium. It is placed at the apex of the latter, in the apical prolongation of its vertical main axis, and is nearly filled with large polyhedral entoderm cells. Its dorsal wall is in contact with the upper half of the ventral wall of the nectosac. Its apex bears a vertical oleocyst, containing a large ovate oil-bubble, about one-third as long and broad as the somatocyst.
REPORT ON THE SIPHONOPHORÆ.  

Siphosome (figs. 4–6, i).—The common trunk bears in its upper part very numerous buds of cormidia (i), in its lower part ten to twelve or more well-developed eudoxomes. These are soon detached from the stem and swim about as free Eudoxæ of the special form represented in Pl. XLII. as Cuboides crystallus (compare their description above, p. 112, Genus 13). When fully contracted the entire siphosome, with all cormidia, is hidden in thehydroœm (figs. 4–6).

Family VII. Diphyidæ, Eschscholtz, 1829 (sensu restricto).

Diphyide, Esch., System der Acæphen, 1, p. 122.

Definition.—Calyconectæ polygastrice, with two nectophores at the apex of the long tubular trunk. Cormidia ordinate, eudoxiform, separated by equal free internodes, each siphon with a bract.

The family Diphyidæ, as defined in my system, comprises only those polygastric Calyconectæ which bear two permanent nectophores on the top of the stem. I exclude, therefore, those forms, formerly united with them, which possess only a single nectophore (Monophyidæ). I exclude, further, on practical grounds, the monogastric independent forms, which are connected with the Diphyidæ by metagenesis, the so-called Diphyozooids, the families (IV. and V.) Eudoxidae and Erseidae. The Diphyidæ are very common in all the seas of the world, far more frequent than all other Siphonophoræ, and richer in different species than the other Calyconectæ.

The first Diphyid was described in 1804 by Bory under the name Biphora bipartita (13, vol. i. p. 134). Cuvier founded for it the genus Diphyes (in 1817, 91), and Chamisso figured the same as Diphyes dispar (16, p. 365, Tab. xxxiii. fig. 4).

The naturalists of the “Astrolabe,” Quoy and Gaimard, discovered in 1826, in the Straits of Gibraltar, a greater number of Diphyidæ, and distinguished in this family six different genera:—1. Diphyes (campanulifera); 2. Calpe (pentagona); 3. Abyla (trigona); 4. Cymba (sugittata); 5. Enneagonum (hyalinum); and 6. Cuboides (vitreus) (20). These and some other Diphyidæ were described and figured by the same authors in 1833 in the Zoophytes de l’Astrolabe (2, pp. 81–106) as fifteen different species of the genus Diphyes, nearly every species of which is now the type of a special genus.

Eschscholtz (1, p. 122) gave the first accurate description and a better systematic arrangement of the Diphyidæ; they form, in his System der Acæphen, the first of the three large families of Siphonophore. He distinguished six genera; three of these (Eudoxia, Erseæ, Aglaisma) are monogastric, and form now our family Eudoxidae (p. 103); the three others (Abyla, Cymba, Diphyes) are polygastric; one of these (Cymba) is according to my observations a Monophyid, so that only Diphyes and Abyla remain as types of true Diphyidæ.
Blainville, in his Actinologie (24, pp. 125–140), and Lesson, in his Acalephes (3, pp. 425–465), collected the scattered descriptions and figures of the older observers, and distinguished a greater number of genera, but without any clear anatomical understanding and without critical judgement.

The excellent naturalists, who, in the sixth decade of our century (1853 to 1859), did so much for the anatomical knowledge of Siphonophore, gave also the first accurate description of the typical Diphyidae, mainly Diphyes and Abyla (4–10). Kölliker (4, Tab. ix.–xi.) gave an excellent description of three Mediterranean types—Praya diphyes, Diphyes sieboldii, and Abyla pentagona. Vogt (6, Tab. xvi.–xxi.) gave beautiful drawings of the same forms, and also of Galeolaria aurantiaca. But the greatest progress in the knowledge of Diphyidae, mainly regarding their development and connection with Eudoxidae, was made by Gegenbaur (7 and 10) and by Leuckart (5 and 8). The former described, too, a greater number of new species (of Praya, Diphyes, and Abyla, 10).

The most complete anatomical and systematic description of the polygastric Diphyidae, and of their offspring, the monogastric Eudoxidae, as also the best and fullest account of the whole family up to our days, was given in 1859 by Huxley (9, pp. 30–66, pls. i.–v.). He restricted the family Diphyidae to the genera Diphyes and Abyla in the sense of Eschscholtz, and separated them from Praya, as the type of another family, Prayidae (Kölliker, 4, p. 33). He gave, further, the first accurate description of numerous Diphyozooids (or Eudoxidae), of seven different genera, and indicated probable ontogenetic connection with different forms of Diphyes and Abyla.

During my residence in the Canary Islands, from December 1866 to February 1867, I had the opportunity of examining typical representatives of all the eight genera of true polygastric Diphyidae which are described in the sequel, and there I drew from nature the figures, which will be seen in Pls. XXXI. to XLII. of this Report. The greater number of the Diphyidae, there observed by me, were afterwards found again in the collection of the Challenger, mainly in bottles containing surface animals, which were taken in the Tropical and Subtropical Atlantic (Stations 334 to 354; March 14 to May 7, 1876). In Lanzerote I observed directly the metagenesis of Diphyes (with Cucullus), Diphyopsis (with Erseus), Abyla (with Amphiroa), Bassia (with Sphenoides), and Calpe (with Aylastra).

Nectophores.—The two nectocalyces, which, in all Diphyidae, are placed at the top of the stem, appear in three different stages of phylogenetic development, and these determine the division of the family into three divergent subfamilies. The first subfamily, Prayidae, has two nectophores of nearly equal size and similar form, opposed to one another; sometimes the first is somewhat smaller than the second; their surface is rounded, the jelly-substance very soft. Their shape is either mitriform or reniform (Praya, Pl. XXXI.), or more hemispherical (Lityopsis).
The two nectophores of the second subfamily, Diphyopsidae (Pl. XXXIII.), are also of nearly equal size and similar form; but they are pyramidal, pentagonal, and placed one behind the other. Their junction is very loose in Galeolaria, whilst in Diphyes and Diphyopsis the apical part of the second is hidden in the hydroceum of the first nectophore. The sharp edges are often elegantly denticulate, and the hyaline jelly-substance of the umbrella is rather hard and firm, cartilaginous, as also is that of Abylidæ (Pls. XXXV.-XL.).

The differentiation of the two nectophores attains the highest degree in the third subfamily, Abylidæ. The first (proximal or apical nectophore, often also called superior or anterior) is here always symmetrical and much smaller than the second (distal or basal nectophore, often called inferior or posterior); this is more or less asymmetrical. Both nectophores are here polyhedral, prismatic, or truncate-pyramidal, with numerous polygonal faces and sharp prominent edges. The form of the second nectophore and its basal ostium is especially characteristic; it offers three prominent wings in Abyla (trigona), four in Bassia (tetragona), and five in Calpe (pentagona).

Canals of the Nectophores.—Each of the two nectophores constantly possesses four radial canals in the subumbrella, which are united above the velum by a circular canal. The size, course, and form of the four vessels are very variable, according to the place of their apical junction, where the nectocalycine duct, coming from the top of the stem, enters into the subumbrella. This point of junction is usually placed not at the apex of the nectosac but in its ventral median line, more or less dislocated downwards, so that the ventral canal (cv) is shorter, and the dorsal (ed) longer than the two symmetrical lateral canals (ex right, el left); the latter are often more or less curved or loop-shaped. The ventral canal is very short, rudimentary, or even lost, in the first nectocalyx of Galeolaria, because here the point of junction has quite descended, and the nectocalycine duct enters into the base of the subumbrella, instead of into the apex. The opposite dorsal canal is so much the longer.

Hydroceum.—The differences which the hydroceum offers in the Diphyideæ, have been already mentioned above (p. 93). The Prayidæ are distinguished by a cylindrical hydroceal canal open at both ends, composed of the ventral grooves of the two opposite nectophores, fitting one into another. Galeolaria has no true hydroceum, since the apex of the second nectophore is simply attached to the base of the first, and the siphosome is suspended freely between them. All other Diphyideæ have a conical or campanulate hydroceal cavity on the ventral side of the first nectophore, and as its continuation, a hydroceal canal on that of the second; this is sometimes an open groove, protected by two overlapping wings, at other times a closed canal, produced by concrecence of the two wings.

Somatoceyst (cs).—The acrocyst or somatoceyst ("Saftbehälter") is wanting in the Prayidæ and in Galeolaria; it may be replaced in the former by the ascending pallial
All other Diphyidae possess a somatocyst in the first or apical nectophore; it must be regarded as the uppermost part of the original common stem, overgrown and enclosed by jelly-substance of the first nectophore. The somatocyst is usually rather large, spindle-shaped, or ovate, sometimes more cylindrical, at other times more ovate. Usually it ascends from the apex of the hydræcium; but in Abyla it descends along its ventral side. The structure is the same as in the other Calyconeæ (compare above, p. 93).

Siphosome.—The tubular trunk or common stem of the Diphyidae is very contractile, and beset at regular intervals with the cormidia, the number of which is very variable. The stem is very long in the lower and older forms of the family, in the Prayidae and Galeolaria, where it sometimes attains a length of more than one metre, and bears more than one hundred cormidia. Their size and number are much smaller in the specialised Abylidae, intermediate in the Diphyidae. The contracted stem may usually be retracted more or less completely into the hydræcium. The structure of the stem is described above (p. 94).

Cormidia.—The cormidia of the Diphyidae, or the Diphyozooids of Huxley (9, pp. 57–66), occur in two different principal forms, eudoxomes and ersæomes. The majority of the genera possess eudoxomes; each cormidium is composed of a sterile medusome (bract with siphon and tentacle) and a fertile medusome (gonophore). The two genera Lilyopsis and Diphyopsis possess ersæomes, a sterile special nectophore, as locomotive person, being added to the eudoxome.

Bracts.—The bracts or hydrophyllia are of very different form and structure, characteristic of the single genera and even of the three subfamilies. The bracts are mitriform and rounded in the Prayidae, spathiform or conical in the Diphyopsisidae, prismatic or polyhedral in the Abylidae. Besides, the form and place of the phyllocyst, and the number, form, and course of the radial canals which arise from its base, exhibit characteristic differences in the various genera.

Siphon and Tentacle.—The form and structure of the polypites exhibit no important differences in the cormidia of the various Diphyidae. The structure, too, of the tentacles is in general the same; but the special form of the tentilla, and especially the composition of the cnidosacs and the arrangement of their different cnidocysts, are subject to many specific variations.

Eudoxia.—The minority of the Diphyidae produce sessile eudoxomes, which mature whilst attached to the stem. This is the case in some of the Prayidae and in Galeolaria. In all the other Diphyidae they become early detached from the stem, and mature as free Eudoxiae (compare above, p. 101).

Ontogeny.—On the development of the Diphyidae, compare above, pp. 100–102.
Symposium of the Genera of Diphyidae.

I. Subfamily Prayidæ.

Two nectophores of nearly equal size and similar form, opposite to one another; edgeless, rounded.

Bracts of the corollia hemispherical, cup-shaped or helmet-shaped, edgeless, rounded. Phyllocyst with four radial canals.

Cormidia (or Eudoxiae) without special nectophores, sessile. Each corollium (or Eudoxiae) with a special nectophore. . . . 24. Praya.

Cormidia without special nectophores, sessile. First nectophore without hydroceum, . . . 25. Lilypsia.


Cormidia without special nectophores, free. First nectophore with a conical hydroceum, . . . 27. Diphyes.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

II. Subfamily Diphyopsidæ.

Two nectophores of nearly equal size and similar form, one placed behind the other; prismatic, with polygonal faces and sharp edges.

Bracts of the corollia prismatic, with three wing-shaped edges. Mouth trigonal, . . . 29. Abyla.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

Bracts of the corollia pyramidal, conical, or spathiform, with a pointed apex, and an obliquely bevelled basal face and a deep ventral fissure. Phyllocyst ovate, simple or rudimentary, without radial canals.

III. Subfamily Abylidae.

Two nectophores of very different size and form, one placed behind the other; both prismatic, with polygonal faces and sharp edges.

Bracts of the corollia six-sided prismatic. Phyllocyst descending, with two lateral canals at its apex.

Bracts of the corollia four-sided prismatic, below wedge-shaped. Phyllocyst ascending, with an oval basal canal.

Bracts of the corollia cuboidal, with a caudal apophysis. Phyllocyst with four radial canals.

Basal nectophore three-sided prismatic, with three wing-shaped edges. Mouth trigonal, . . . 29. Abyla.

Basal nectophore four-sided, pyramidal, with four wing-shaped edges. Mouth tetragonal, . . 30. Bassia.

Basal nectophore five-sided prismatic, with five wing-shaped edges. Mouth pentagonal, . . 31. Calpe.

Subfamily Prayideæ.


Praya, Blainville, Manuel d’Actinologie, 24, p. 137.

Definition.—Diphyidae with two rounded, reniform or mitriform, edgeless nectophores of similar form and subequal size, opposed to one another. A hydroceial canal is formed by the opposite hemicylindrical ventral grooves of the two nectophores. Bracts hemispherical, helmet-shaped or reniform. Phyllocyst with (four) radial canals. Cormidia without special nectophores.

1 Praya=Porto Praya, the name of a place in the Cape Verde Islands, where this Siphonophore was first observed. (Zool. Chall. Exp.—Part LXXVII.—1888.)

Hhhh 19
The genus *Praya*, and the following genus *Lilypopsis*, compose together the subfamily Prayidae, differing from the other Diphyidae (Diphyopsis and Abylidae) mainly in the rounded, edgeless exumbrella of the nectophores, which consist of a particularly soft jelly-substance, much softer than in the latter. The two nectophores are of similar form and nearly equal size, one opposed to the other, and not the first before the second (as in the Diphyopsis and Abylidae). The nitiform or reniform nectophores have a longitudinal furrow on their ventral side, and the two hemicylindrical furrows are so applied one to another as to form a hydrozoal tube, in which the upper part of the siphosome can be retracted. The bracts are navicular or reniform, provided with four irregular radial canals.

The best known type of the genus *Praya* is the large Mediterranean form described by Gegenbaur as *Praya maxima* (7, Taf. xvii. figs. 1-4). Perhaps different from this species is another Mediterranean form, which also inhabits the North Atlantic, *Praya cymbiformis*, delle Chiaje (18), very accurately described by Leuckart (5 and 8). A third species, differing from the two former in the form of the nectophores and bracts and their canals, is the tropical Atlantic *Praya galea*, which I observed living in the Canary Island Lanzerote, in February 1867. Scattered bracts of it are found in a bottle in the Challenger collection from Station 352.

*Praya galea*, n. sp. (Pls. XXXI., XXXII.).

*Praya galea*, Haeckel, System der Siphonophoren, 1888, p. 35.

**Habitat.**—Tropical and Subtropical Atlantic, Station 352; April 13, 1876; lat. 10° 55' N., long. 17° 46' W. Surface.

Canary Islands, Lanzerote, February 1867 (Haeckel).

**Nectophores** (Pl. XXXI. figs. 1-7, natural size; fig. 1, lateral view; fig. 2, dorsal view; fig. 3, apical view of the two united, fig. 4, of the two separated nectophores; fig. 5, first (smaller) nectophore from the left side; fig. 6, second (larger) nectophore from the right side; fig. 7, the same from the ventral side). The two large nectophores or nectocalyces, which are the powerful locomotive organs of the long chain-like body, are both of similar kidney-shaped form, but of different sizes. The first, apical or proximal nectophore is somewhat smaller than the second, basal or distal swimming bell; both possess a deep longitudinal groove on their ventral side, and are so opposite one to another at the top of the stem, that the larger distal bell is placed more below and embraces the smaller proximal bell by means of its two lateral ventral wings (figs. 3, 4). The smaller nectophore was in the largest specimen, which I examined living in the Canary Islands, 40 mm. long and 25 mm. broad; the larger (second) nectophore 50 mm. long and 35 mm. broad. Another specimen had only two-thirds of this size.
Each of the two nectophores has in general the form of a kidney or bean, with a
deep longitudinal sulcus or groove at its ventral side, corresponding to the hilus of the
kidney. This furrow is the hydroceical sulcus (fig. 4, \( n \)) included between the two
lateral longitudinal wings of the bell (\( n \times \) right wing, and \( n \xi \) left wing, in figs. 2–7). In
the middle of this groove, in the ventral median line of the nectophore, arises its pedicle,
a small triangular vertical plate (fig. 4, \( np \)). The proximal apex of the triangle
(fig. 7, \( np \)) connects the bell with the top of the siphosome (fig. 4\( v, \alpha \)). The dorsal or
abaxial side of the nectophore, as well as its lateral sides, are equally rounded, without
crests, and the two ventral nearly parallel longitudinal wings are its only edges. The
jelly-substance of the umbrella is, as in the other species of the genus, extremely soft and
nearly diffusant, so that the bell, taken out of the water, loses its natural form.

_Nectosac._—The nectosac, or the subumbrellar cavity of the nectophores (figs. 5–7, \( w \)),
is relatively larger than in the other species of the genus hitherto described. It occupies
nearly the aboral half of the umbrella, whereas in the latter it takes up only one-third or
one-fourth of it. The form of the nectosac is sometimes campanulate or ovate (figs. 1, 6),
at other times hemispherical or subglobo (figs. 2, 5). Its axis is not identical with the
longitudinal axis of the reniform bell, but inclined towards it at an acute angle. The
basal opening of the nectosac is circular and surrounded by a broad velum (figs. 2, 6, \( v \)).

_Canals of the Nectophores._—A short peduncular canal (figs. 5, 6, \( cp \)) passes from the
top of the siphosome immediately to each nectophore, obliquely ascending in the apical
bell, descending in the basal bell. The peduncular canal runs through the lamellar
pedicle of the nectophore obliquely to the top of the nectosac, and gives off in this
course two vertical blind pallial canals or "mantle-vessels," an ascending and a descending.
The superior or ascending mantle-canal (figs. 2–7, \( c s \)) runs vertically upwards towards
the top of the bell, near to the apical edge of its triangular peduncle, and may be
regarded as the homologue of a somatoecyst. The inferior or descending mantle-canal
(figs. 2–7, \( cs' \)) runs in the opposite direction downwards, between the basal edge of the
peduncle and the ventral canal of the nectosac, parallel to the latter. The four canals of
the nectosac, which arise from the distal end of the peduncular canal, are arranged in two
pairs of very different length and form. The ventral (\( cx \)) and the dorsal canal (\( cd \)) are
nearly equal, and lie in the sagittal plane, following the simple curvature of the nectosac,
whereas the two lateral canals (\( cx \) right, and \( cl \) left) are twice as long as the former, and
form in their course a double sigmoidal loop; they descend from the top of the nectosac
curved towards the dorsal face, then are bent twice downwards and twice upwards, and
finally reach the circular canal near the ventral face (figs. 2–7).

_Hydroceium._—There is no true hydroceium or funnel cavity in the genus _Praya_,
but the two deep ventral grooves of the two opposite nectophores, or the funnel-furrows,
(fig. 4\( u, 4b, n \xi \)), are so turned one to another, that there is formed a cylindrical hydroceial
canal, open at both ends. Its smaller apical half, with the upper aperture, is empty; its
larger basal half encloses the siphosome, which proceeds through its lower aperture; the two halves are separated by the apex of the trunk, from which arise also the pedicles of the two neotophores (fig. 4b, $a$; fig. 7, $ap$). The two ventral wings of the larger basal neotophore (fig. 4b) embrace the two opposite ventral wings of the smaller apical neotophore (fig. 4A) so completely that the lateral sides of the hydromedusal canal are perfectly closed (fig. 3, apical view).

*Siphosome* (fig. 1).—The common trunk of the cormus is a cylindrical tube of the highest contractility, and in the contracted state is very short and partly hidden in the hydromedusal canal; in the fully expanded state it attains a length of more than two feet and offers a splendid aspect, the numerous cormidia (forty to fifty or more) being separated by equal intervals, each giving off a bright yellow contractile siphon, and a long tentacle with numerous tentilla, the latter armed with yellow cnidosacs.

*Cormidia* (Pl. XXXII).—Each cormidium is a eudoxome, composed of two medusoid persons, a sterile medusome (siphon with bract and tentacle), and a fertile medusome (the gonophore). Sometimes two gonophores occur in the same group. The gonophores in the proximal part of the trunk are usually female, those in the distal part male; but sometimes both sexes alternate rather regularly. The cormus is therefore monoeccious. The gonads are very small; often perhaps they do not become ripe until the Eudoxine have become detached from the stem, but usually they seem to ripen sessile on the trunk. Some free-swimming *Eudoxine*, belonging to the genus *Eudoxella* (Genus 11A) are so similar to the sessile Eudoxome of this species of *Praya*, that I suppose they have been detached from a species of this genus.

*Bract* (Pl. XXXII, fig. 8, b; fig. 9).—The bract or hydrophyllum (the umbrella of the sterile medusome) somewhat repeats the kidney-form of the neotophores. It attains a length of 10 to 12 mm., a height of 8 to 10 mm. Its jelly-wall is very thick and soft, mainly in the rounded apical half. The basal half is deeply excavated, and its thinner-walled cavity, corresponding to the subumbrella ($w$), encloses the siphon with its tentacle, and the gonophore. The convex exumbrella is rounded and smooth all round, and at its basal margin presents three deep sinuses or incisions, two paired lateral and one odd dorsal (fig. 9). The trunk of the siphosome (fig. 8, $a$) passes through the two lateral incisions, while the tentacle (fig. 8, $t$) steps out through the dorsal incision. Two lateral, nearly quadrangular lobes, comparable to the two bucal valves of a helmet, are separated by those sinuses.

*Canals of the Bract* (figs. 8, $c$, 9, $c$).—Each hydrophyllum must be regarded as the reduced umbrella of a Hydromedusa, and still possesses the four radial canals, characteristic of the latter. A short peduncular canal or apical vessel (figs. 8, 9 $ca$), goes from the trunk ($c$) to the apical part of the subumbrellar cavity, gives off a short spindle-shaped ceaeum (phylloeyst), and four divergent, irregularly bent canals, two odd sagittal and two paired lateral. The odd ventral canals ($ce$) forms an $S$-shaped loop in the solid
jelly mass of the apical and ventral half of the nectophore. The odd dorsal canal (cd) runs along the convexity of its basal and dorsal half. The two paired lateral canals (cx right, cl left) pass into the two lateral lobes or buccal valves of the helmet-shaped bract. The blind ends of all four canals are somewhat swollen and club-shaped. Their course, as well as the mode of their apical junction, are very variable, and subject to many individual abnormalities. Usually the ventral canal is shorter than the dorsal, and the right shorter than the left.

Siphons (Pl. XXXI. fig. 1; Pl. XXXII. fig. 8, s; fig. 11).—The siphon or polypite, which is attached to the stem at the lateral incision of each bract by a very short pedicle, exhibits a hemispherical basigaster (sb), the thick wall of which is filled up by enidoblasts. The stomach (sh) is ovate and exhibits eight broad yellow hepatic striae (sh). The contractile proboscis (sv) is very muscular and opens through a mouth of very variable form (so). Sometimes the distal part of the siphon is so invaginated and retracted into the proximal part, that it assumes the peculiar form shown in fig. 11.

Tentacles (fig. 8, t; figs. 12-14).—The tentacle, which depends from the short pedicle of each siphon, is very long and mobile, cylindrical and distinctly articulated, beset with a series of very numerous tentilla or lateral branches. These arise from the constrictions between each two segments of the tentacle. Each tentillum (figs. 12-14) contains a canal, which is somewhat convoluted before entering into the dilated enidosac (fig. 13). The latter is reniform or crescentic and contains a strong battery of enidocysts, six to eight longitudinal rows of small medial paliform enidoblasts (km), and on each side (right and left) a longitudinal series of large sabre-shaped lateral enidoblasts (kl), eighteen to twenty-four in each series. Three groups of small pyriform thread-cells (an odd dorsal, kp, and two paired ventral, kp), are found on the base and on both sides of the distal end of the battery. The terminal filament of the tentillum (tf) forms in the contracted state three coiled spiral turnings.

Gonophores (fig. 8, h; fig. 10).—Each cormidium usually exhibits, half hidden under the bract, a single gonophore, either male or female. It is placed at the ventral side of the siphon, whilst the tentacle arises from its dorsal side. The umbrella of the gonophore (fig. 10) is laterally compressed, bilateral, and exhibits two very broad wings in the sagittal plane; the dorsal wing (nd) is triangular and nearly as large as the nectosae, whilst the ventral wing (nv) is much smaller. The nectosae (w) is hemispherical or campanulate, with a broad velum (v). The peduncular canal enters between the two wings into the jelly umbrella and gives off at the apex of the nectosae the four radial canals (cd dorsal, cv ventral, cx right, cl left). The spindle-shaped spermarium (fig. 8, h) and the ovate or subspherical ovarium (fig. 10, f) are rather small, and in the largest Eudoxiae only fill the superior half of the subumbrellar cavity.
Genus 25. Lilyopsis, Chun, 1885.


**Definition.**—Diphyide with two rounded, hemispherical or mitriform, edgeless nectophores, of similar form and subequal size, opposed to one another. A hydroæal canal is formed by the opposite hemicylindrical ventral grooves of the two nectophores. Bracts hemispherical, mitriform, or reniform. Phyllocyst with (four) radial canals. Each cormidium with a sterile special nectophore.

The genus *Lilyopsis* was founded by Chun in 1885 (86) for those Diphyide, formerly described as *Praya*, which differ from the true *Praya* in two important points. The Eudoxie of *Praya* are composed of two persons, a sterile medusome (bract with siphon and tentacle), and a fertile gonophore. The Eudoxie of *Lilyopsis* possess, besides, a third medusome, a sterile special nectophore, and usually they have a cluster of gonophores instead of a single fertile medusoid. *Lilyopsis*, therefore, bears the same relation to *Praya* that *Diphyopsis* has to *Diphyes*. The special nectophore is in some species of this genus more medusiform than in any other Siphonanthæ. It possesses a circle of numerous rudimentary tentacles at the margin of the umbrella, and, besides, often a number of red pigment spots, which may be regarded as ocelli. *Lilyopsis* agrees in this respect with the nearly allied *Desmophyes* (Pl. XXX.).

It is probable that in some species of *Lilyopsis* the cormidia are detached from the stem, and represent a self-subsistent free-swimming form of *Lilsea* (Genus 17b).

The first described species of *Lilyopsis* (1853) is the Mediterranean *Praya diphyes* of Vogt (6, Tab. xvi., xvi.) and of Kolliker (4, Taf. ix.). Another Mediterranean species was figured in 1870 by Mtschikoff under the name *Praya medusa*, and described in the Russian language, therefore inaccessible. It is probably the same as that of which Fewkes published a figure in 1880 (42). A third species, also Mediterranean, was announced by Chun in 1885 under the name *Lilyopsis rosea*. A fourth species, *Lilyopsis catena*, similar to the latter, was observed by me in 1866 in the Canary Island Lanzarote, but not sufficiently examined.

**Subfamily Diphyopsisæ.**


*Galeolaria*, Blainville, Manuel d’Actinologie, 1834, p. 139.

**Definition.**—Diphyide with two angular slenderly pyramidal nectophores of similar form and subequal size, one placed behind the other. First nectophore without hydrecceum. Cormidia without special nectophores. Bracts conical or spathiform, with a pointed apex. Phyllocyst small or rudimentary, without radial canals.

1 *Lilyopsis* = Similar to a lily.
2 86, p. 18, Taf. ii. figs. 12, 13.
3 *Galeolaria* = Provided with small helmets, *galea*.
The genus *Galeolaria* (confounded by later authors with *Epibulia*) was founded in 1807 by Lesueur, in a manuscript not published, for two Australian *Diphyes*, which were figured by Quoy and Gaimard under the names *Galeolaria australis* and *Galeolaria quadridentata* (2, pl. v. figs. 30–33). The same were afterwards regarded by Blainville as the types of this genus (24, p. 139). The first accurate description of two Atlantic species belonging to it was published in 1846 by Sars (under the names *Diphyes truncata* and *Diphyes biloba* (27, p. 41, Taf. vii.). A Mediterranean species was accurately described by Gegenbaur as *Diphyes turgida* (68), and another by Vogt as *Epibulia aurantiaca* (6). An Arctic *Galeolaria*, inhabiting the Greenland Sea, is *Diphyes sarsii* of Gegenbaur (10, Tab. xxx. figs. 30, 31). The Indian *Galeolaria filiformis* described by Huxley (9, pl. iii. fig. 5) is probably identical with the original *Galeolaria australis* of Lesueur. Different from all these species is the *Galeolaria stephanomia*, inhabiting the Tropical Pacific, described by Brandt as *Diphyes stephanomia* (25, p. 32). I was able to compare the excellent figure and description of it (unfortunately not published!) which Martens had taken from nature as early as 1827.

*Galeolaria* (synonymous with *Salableolaria* of Blainville) differs from *Diphyes* in the complete absence of a hydrocæum. The basal part of the truncate ventral side of the first nectophore is simply attached to the corresponding apical part of the second. Between them the siphosome depends freely. The nectocalycine ducts are therefore very different in the two nectophores, entering into the first at its base, into the second at its apex. The ventral radial canal is very short in the first, very long in the second nectophore. The ventral plate of the umbrella is prolonged in both nectophores over their basal ostium in the form of a bilobate lamellar apophysis (compare Leuckart, 8, p. 279, and Huxley, 9, p. 38). The gonophores ripen on the stem, and are not detached as free-swimming Endoxieae. The eorms are dioecious (p. 99).

Genus 27. *Diphyes*, Cuvier, 1817 (*sensu restricto*).


**Definition.**—*Diphyidae* with two angular, slenderly pyramidal nectophores, of similar form and subequal size, one placed behind the other. First nectophore with a conical or campanulate hydrocæum. Cormidia without special nectophores (free as *Cucullus*, Genus 12). Bracts pyramidal, conical, or spathiform, with a pointed apex. Phylloeyst simple, usually large and ovate, without radial canals.

The genus *Diphyes* was founded by Cuvier in 1817 upon the first figure published of any Calyconecta, the *Diphyes dispar* of Chamisso (16), which was figured first by Bory in 1804 under the name *Biphora bipartita* (13, p. 134). Eschscholtz gave in 1829 a more accurate description of *Diphyes*, and the following definition:—*"Ductus nutritorius*

1 *Diphyes* = Double animal (*ди́фй́*); Calyconecta with a double nectophore.
tubulis pluribus obsitus. Tubuli squamis cartilagineis oblecti. Pars corporis nutritoria
cavitate natatoria interna, extrorsum se aperiente instrueta." He distinguished four
different species, the fourth of which, Diphyes appendiculata, from the Pacific Ocean, is
here retained as the representative type of the genus (1, p. 138, Taf. xii. fig. 7). Nearly
allied to this are two Mediterranean species, Diphyes acuminata of Leuckart (5), and
Diphyes sieboldii of Kölliker (4). A third Mediterranean species is Diphyes subtilis of
Chun (87). Different from these is Diphyes elongata, Hyndman, from the northern
Atlantic (64), and an Indian species, Diphyes gracilis. Huxley united all these species
under the name Diphyes appendiculata; there seem to be, however, constant differ-
cences between these species, which may be considered as specific, the more so as they are
inhabitants of widely distant seas. A more accurate distinction is required.

Gegenbaur, in 1859, distinguished not less than ten different species of the genus
Diphyes (10, p. 50); the majority of these belong, however, to other genera of Diphyidæ,
Diphyopsis (Diphyes campanulifera, &c.), and Galeolaria (Epibidia quadrivalvis, &c.).

The cormidia of Diphyes (in the sense here restricted) possess a spathiform or three-
sided pyramidal bract, with a deep ventral fissure, and become mature as free Eudoxiæ
belonging to the genus Cucullus (compare above, Genus 12).


Diphyopsis, Hkl., System der Siphonophoren, p. 35.

Definition.—Diphyidæ with two angular, slenderly pyramidal nectophores of similar
form and subequal size, one placed behind the other. First nectophore with a conical
or campanulate hydroæcum. Each cormidium with a special nectophore (free as Ersæa,
Genus 17a). Bracts pyramidal, conical or spathiform, with a pointed apex. Phyllocyst
simple, ovate, without radial canals.

The genus Diphyopsis comprises those Diphyidæ hitherto described as Diphyes,
which differ from the true Diphyes in the possession of numerous special nectophores,
each of which is the locomotive organ of a cormidium, swimming free as Ersæa (compare
above, Genus 17). Diphyopsis bears the same relation to Diphyes that Lilyopsis has to
Praya. The special nectophore of each cormidium (wanting in Diphyes) is the originally
first gonophore, which has lost its sexual function, and produces no manubrium; it is
subservient only to locomotion.

The first described species of Diphyopsis is Diphyes dispar of Chamisso and Eysen-
hardt, inhabiting the Tropical and Southern Pacific (16, p. 365, Tab. xxxiii. fig. 4). A
very accurate description of it was given by Huxley (9, p. 30, pl. i. fig. 1). Probably
identical with it is Diphyes angustata of Eschscholtz. The Challenger collection con-

1 Diphyopsis—Similar to Diphyes.
tains specimens of this species, taken in different parts of the Pacific (e.g., Stations 175, 222, 265 to 279, &c.).

A second species may be the Mediterranean Diphyopsis campanulifera, described as Diphyes campanulifera by Eschscholtz, first observed by Quoy and Gaimard in the Strait of Gibraltar.

A third species is described in the following lines as Diphyopsis compressa. It inhabits the Tropical and Subtropical Atlantic. The Challenger collection contains many specimens of it, taken between Stations 327 and 353.

*Diphyopsis compressa*, n. sp. (Pls. XXXIII., XXXIV.).

*Diphyes compressa*, Hkl., 1866, MS. Canar.

**Habitat.—**Tropical and Subtropical Atlantic, Stations 327, 334, 348, 352a. Canary Islands, Lanzarote, December 1866 (Haeckel).

**Neotophores** (fig. 1, the two nectocalyces in their natural connection, seen from the left side; fig. 2, from the ventral side; fig. 3, from the dorsal side).—The two large swimming bells are of nearly equal size and similar form; their usual length is between 25 and 30 mm., the breadth between 10 and 15 mm., the thickness 5 to 7 mm.; the first or apical nectophore, however, is a little larger, longer as well as thicker, than the distal one. The former encloses on its ventral side a campanulate hydrcecium (and above its top a somatocyst); the latter an incomplete subcylindrical hydroidal canal.

**Apical Neotophore.**—The first, superior, anterior or proximal nectocalyx, appears in the lateral view (fig. 1) as a broad triangle, the dorsal side of which (ad) is the longest and slightly convex; the opposite ventral side (nv) is more convex, one-fifth shorter, and twice as long as the obliquely bevelled basal side. The ratio of the three sides therefore is 5:4:2. Seen from the ventral side (fig. 2), or from the dorsal side (fig. 3), the nectophore appears as a very long and narrow isosceles triangle, the two equal lateral sides of which are four times as long as the basal side. Seen from the basal face (fig. 8) it appears nearly rectangular, three times as long as broad, with a small triangle imposed on the dorsal side. The exumbrella therefore has the form of a bilateral pentagonal pyramid, which is very strongly compressed from both sides. Its surface exhibits five prominent ridges, one odd dorsal and two pairs of laterals, meeting in the slender pointed top of the nectophore. The odd dorsal ridge (figs. 1, 3, ad) runs in the median dorsal line of the exumbrella and ends below in the odd dorsal tooth of the mouth of the nectosac. The two dorso-lateral ridges run along the lateral faces of the nectosac and end below in the smaller dorso-lateral teeth of its mouth (nv, n)),. The two ventro-lateral ridges run along the ventral face of the hydrécium and end in two small ventral teeth (fig. 8, n, n).
Between the former and the latter pair of ridges there arise in the basal third of the exumbrella two convergent incomplete medio-lateral ridges, which end in the two large ventro-lateral teeth of the nectosac mouth \( (n^3, n^4) \). The five teeth of the mouth and the basal parts of the ridges are elegantly denticulate.

**Nectosac (figs. 1–3, w).**—The umbrellar cavity of the first nectophore is nearly cylindrical, conical above, and in the contracted state four to six times as long as broad. It occupies two-thirds of the length of the umbrella, and is placed in its dorsal half, close to the ventral hydrcecium. From the top of the nectosac arises a long tubular cecum, or a vertical apical canal (figs. 1, 2, cp); its blind end nearly reaches the outmost apex of the umbrella. The nectocalycine duct (or the peduncular canal of the first nectophore) descends from the top of the trunk obliquely towards the ventral side of the nectosac and enters into it at a point between the first and second third of its height. It divides here into the four radial canals of the nectosac. The shortest of these is the straight ventral, the longest is the loop-shaped dorsal canal. The two lateral canals are shorter than the latter, longer than the former, ascend like the dorsal, and then descend beyond the apex.

**Mouth of the Nectosac (fig. 1, lateral view; figs. 3 and 7, dorsal view; figs. 6 and 8, basal view).** The basal opening of the subumbrella is rather narrow, with a broad velum \( (v) \), and protected by five convergent teeth, the ends of the above-mentioned longitudinal ridges. The odd dorsal tooth \( (nd) \) and the two dorso-lateral teeth \( (n^1, n^2) \) are of nearly equal size, half as large as the two ventro-lateral teeth \( (n^3, n^4) \).

**Hydrcecium (fig. 1, \( wi \), lateral view; fig. 2, \( wi \), ventral view).**—The funnel-cavity of the first nectophore, or the hydrcecium, occupies the basal half of its ventral side. It is slenderly campanulate and two-thirds as long as the nectosac, which is placed closely at its dorsal side. The ventral half of the hydrcecium includes the peduncle or the apical apophysis of the second nectophore \( (np) \), the dorsal half the upper part of the siphosome. The basal mouth of the hydrcecium (fig. 8) is rectangular, three times as long as broad, and armed with four pointed teeth, two ventral \( (n^3, n^4) \), and two dorsal \( (n^3, n^4) \); the latter are the ventro-lateral teeth of the nectosac-mouth.

**Somatocyst (figs. 1, 2, cs).**—The acrocyst or the coryphal cavity of the first nectophore is a spindle-shaped or subcylindrical cecal canal, half as long as the hydrcecium. It arises vertically from the top of the latter and extends over the top of the nectosac, about as far as the basal half of its apical cecum.

**Basal Nectophore (figs. 1 and 4 seen from its right side, figs. 3 and 5 from the ventral side).**—The second, inferior, posterior or distal nectocalyx, is of the same length as the apical nectophore, but not so broad. The form of its dorsal half (with the nectosac and the quinque-dentate ostium) is very similar to that of the former; but it has no somatocyst, and the form of the ventral half and the apex are very different. The apical part, above the nectosac, is nearly as long as the latter, isosceles triangular, and elongated into a pointed apophysis, which is completely received within the hydrcecium.
of the first nectophore. Along its dorsal side runs the nectocalycine duct or pedicular canal (cp), which opens at the apex into the top of the stem.

*Hydrceial Canal.*—Whilst the dorsal half of the basal nectophore is occupied by the slender, cylindrical, slightly curved nectosac, its ventral half is occupied by the hydrecial canal (nf). This is an open groove in the greater part of its length, limited by two ventro-lateral wings of the umbrella; but in the middle part (opposite to the superior third of the nectosac) the two wings have grown together and form a complete canal (figs. 4, 5 ub), and in the inferior third the broader left wing (nl) overlaps the smaller right wing (nx). The five denticulate edges of the second nectophore and the five basal teeth around the mouth correspond to those of the first.

*Siphosome* (fig. 1, a).—The common stem of the body is a very long and slender tubule in the expanded state, four to six times as long as the nectophores. It is enclosed in the hydrecial canal of the basal nectophore, is attached at the apex to the top of the hydrecium of the apical nectophore, and is here directly prolonged into the somatocyst of the latter (cs). Whilst a great part of the siphosome can be retracted into the hydrecial canal when contracted perfectly, it can be widely prominent by its lower aperture when expanded.

*Cormidia.*—The eudoxomes, which beset the whole stem at regular intervals (about equal to their lengths) are very numerous, in large specimens sixty to ninety, or more (fig. 1). They have a spathiform bract, which is prolonged above its insertion upwards into a cowl (Pl. XXXIV. figs. 9, 11). This cowl is open at the ventral side, and contains a spindle-shaped phyllocyst (cs), which encloses in its apex an oleocyst (co). The ventral side of the bract is opened by a deep fissure, and its base obliquely bevelled, and armed with four short triangular teeth; the two dorsal teeth are larger than the two ventral.

The cavity of the bract encloses a cylindrical siphon with a long tentacle, and besides a large special nectophore, and one or two, rarely three, gonophores. These are brought to maturity after the eudoxome has been detached from the stem. It then swims freely about as *Ersa compressa* (compare the description of this genus, pp. 122–124, and Pl. XXXIV.).

Subfamily *Abylidae.*


*Definition.*—Diphyidae with two angular, pyramidal or prismatic nectophores of different size and form. The basal nectophore is three-sided-pyramidal, asymmetrical, and much larger than the symmetrical apical nectophore. Bracts six-sided-prismatic, with

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3 *Abyla* = *Abyla*, the southern column of Hercules, opposite to Calpe, Strait of Gibraltar.
a vertically descending phyllocyst, and two lateral, horizontally diverging canals, arising from its apex (*Amphiroa*, Genus 14).

The genus *Abyla* was founded by Quoy and Gaimard (1827, 20) for the Mediterranean *Abyla trigona*, observed by them in the Strait of Gibraltar. I retain this species as the characteristic type of the genus, *sensu strictiori*. The majority of later authors have united with this typical species the very different Diphyidae which belong to the two following genera, *Bassia* and *Calpe*. But the characteristic form of the nectophores, as well as of the bracts, justifies the separation of these three genera of Abylidae. The large distal or inferior nectophore is trigonal in *Abyla*, tetragonal in *Bassia*, and pentagonal in *Calpe*. The polyhedral form of the hydrophyllia or bracts, too, exhibits characteristic differences in the three genera, and their phyllocysts give off two horizontal lateral canals in *Abyla*, one odd descending canal in *Bassia*, and four canals (one ascending, one descending, and two lateral) in *Calpe*. The free Eudoxia of the first genus is *Amphiroa*, of the second *Spheneoides*, and of the third *Aglaisma*.

The new species of *Abyla*, here described as *Abyla carina*, differs as well from the well-known Mediterranean *Abyla trigona*, very accurately described by Gegenbaur (10, Taf. i., ii.), as from the species inhabiting the Tropical Pacific which Huxley has described under the same name (9, pl. iii., fig. 1); I call this latter *Abyla alata*. Different from these is *Abyla levackerti* of Huxley (9, pl. iii fig. 2), inhabiting the Southern Pacific. I observed myself *Abyla carina* in 1867 in the Canary Island Lanzerote, and made there the drawings reproduced on Pls. XXXV. and XXXVI. from the living specimen. The same species occurred in a bottle in the Challenger collection, taken at Station 348.

*Abyla carina*, n. sp. (Pls. XXXV., XXXVI.).

Habitat.—Tropical and Subtropical Atlantic; Station 348; April 9, 1876. Coast of Sierra Leone, lat. 3° 10' N., long. 14° 51' W. Surface.

Canary Islands, Lanzerote, February 1867 (Haeckel).

Nectophores.—The two nectocalyces united are 35 to 40 mm. long; they are very different in form and size. The distal or posterior nectophore is 25 to 30 mm. long and 12 to 14 mm. broad, about twice as large as the proximal or anterior, the length of which is 10 to 12 mm., the breadth 7 to 8 mm. The ground-form of the smaller is symmetrical, of the larger asymmetrical.

Apical Nectophore (fig. 3, apical view, from above; fig. 4, basal view, from below; fig. 1 and fig. 5, lateral view, from the left side; fig. 6, ventral view; fig. 7, dorsal view).—The first nectophore (the proximal, anterior, superior or apical nectocalyx) is a hexagonal prism of a completely symmetrical bilateral ground-form. When the axis of the nectosac stands vertically (as in figs. 5–7), then the six lateral faces of the prism
are also nearly vertical; whilst the two terminal faces (superior and inferior) bear a pyramidal apophysis.

The six lateral faces are two odd and four paired. The dorsal odd face (fig. 7) covers the nectosac, and is nearly rectangular, twice as long as broad, its superior edge a little longer than the inferior. The opposite ventral odd face, covering the somatocyst (fig. 6, w) is smaller, isosceles triangular, three times as long as broad; the apex of the triangle is directed downwards, the two lateral edges are convex. The two paired ventrolateral faces (fig. 5, cs) are quadrangular, their dorsal edge longer than the parallel ventral, and the straight superior edge smaller than the concave inferior. The two paired dorso-lateral faces cover the lateral sides of the nectosac (fig. 5, v), and are hexagonal; their two parallel, nearly vertical, lateral edges are two to three times as long as each of the two superior or the two inferior edges.

The apical or superior face (fig. 3) of the hexagonal prism is not a simple face, but divided by a prominent transverse frontal crest (fig. 3, ut) into two unequal apical facets, a dorsal and a ventral. The dorsal apical facet is far larger, and covers the apex of the nectosac (fig. 3, w'); it is hexagonal, with two odd and four paired edges; the odd dorsal and ventral edges (ut) are parallel and of equal length; they are longer than the two ventro-lateral, and smaller than the two dorso-lateral, deeply emarginated edges.

The ventral apical facet is quadrangular, much smaller, and covers the top of the somatocyst (fig. 3, cs). Its two lateral edges are twice as long as the inferior and superior edge (fig. 3, ut), and are so deeply emarginated that the facet appears to be nearly bisected by a frontal constriction.

The basal face of the hexagonal prism (fig. 4) is also divided by a prominent transverse frontal crest into two unequal basal facets, a dorsal and a ventral. The dorsal basal facet is square, and contains the opening of the nectosac (fig. 4, w'). The ventral basal facet contains the opening of the hydrocæum (fig. 4, uv), and is isosceles triangular; the apex of the triangle is directed ventrally, and meets with the apex of the triangular ventral face (fig. 6, cs).

The interior of the first nectophore contains the nectosac (w) in its dorsal third, the somatocyst (cs) in its ventral third, and between both the hydrocæum (uv) in the middle third. The longitudinal axes of these three organs are nearly parallel, a little convergent towards the apex (fig. 5).

Nectosac (figs. 1 and 5, w, from the right side; fig. 7, w, from the dorsal; fig. 3, from the apical; fig. 4, from the basal side).—The subumbrella is subcylindrical, four times as long as broad; it occupies the dorsal third of the first nectophore, and is separated by a very thin frontal septum from the adjacent hydrocæum. The nectocalycine duct is very short, and enters into the bent apex of the nectosac, so that the four radial canals of the latter are very regular, and of nearly equal length. The basal opening of the nectosac is very small, and surrounded by a small velum (fig. 4, v).
Hydræcium (figs. 1, 5, wi, from the right side; fig. 4, from below). The infundibulum of the first nectophore, or the hydræcium, occupies its middle third, and is larger than both the nectosac (w) at its dorsal, and the somatocyst (cs) at its ventral side. It is slenderly campanulate or conical, in the superior half rather cylindrical, in the inferior much dilated. Its blind apex reaches nearly the frontal crest of the apical face. Its basal opening is isosceles triangular (fig. 4, wi); the base of the triangle is formed by the prominent frontal septum, whilst the apex meets with the inferior apex of the triangular ventral face of the nectophore.

Somatocyst (figs. 1, 5, cs, lateral view; fig. 6, cs, ventral view).—The somatocyst is a very large cylindrical sac, and occupies the ventral third of the first nectophore. Its cavity is nearly filled with large vacuolated polyhedral entoderm-cells. It is separated by a thin septum from the ventral wall of the hydræcium. A short bent canal connects its apex with the top of the common stem.

Basal Nectophore (figs. 1, 9, lateral view from the left side; fig. 10, distal part from the right side; fig. 8, ventral view; fig. 11, basal view).—The second nectophore (the distal, inferior, or basal nectocalyx) is about twice as long and broad as the first, and has in general the form of an asymmetrical pentagonal pyramid; but three of its five edges are far more developed than the other two, so that the general appearance of the irregular pyramid is more trigonal. Its apex is a curved conical condyle, its base rounded.

The five edges of the basal nectophore, one odd dorsal and four paired, corresponding to those of Diphyes and Calpe, are developed in a different manner; the largest and most prominent wing is the right ventro-lateral edge (nx), and next to it the obliquely opposed left dorso-lateral edge (n3). The odd dorsal edge (nd) is of intermediate size. The left ventro-lateral edge (nl) is short and broad in the middle part; the right dorso-lateral edge is the smallest, and more rudimentary.

The hydræcial canal of the second nectophore is an open groove on its ventral side, protected by the two broad ventro-lateral wings, the right of which (nx) is much larger and overlaps the left (nl). The shorter left wing is prominent as a vertical triangular plate, the inferior part of which is broad and its margin strongly dentate (figs. 8, 9, nl). The larger overlapping right wing (nx) is more crescentic, and has a convex dentate margin, which is much thickened in the inferior third; the free basal edge of this thickened margin bears two parallel rows of teeth; the right row (nx") is somewhat larger than the left (nx', figs. 8, 11).

The apical condyle of the triangular pyramid (figs. 8, 9, nq) on the articular apophysis of the second nectophore, which fits into the hydræcium of the first and connects them, is curved and beak-shaped; it contains on its concave ventral side a deep hydræcial groove, in its convex dorsal part the nectocalycine duct (en).

The base of the second nectophore, seen from below (fig. 11), offers a very peculiar
aspect, distinguishing the genus *Abyla* at once from the other *Abylidae*. Its outline is irregularly triangular, and its sagittal axis (vertical in fig. 11) one and a half times as long as the frontal (horizontal) axis. The three more prominent wings are so turned in the inferior part that the basal edge of the right ventro-lateral wing (*nx*) occupies the ventral half of the sagittal axis, and is just opposed to the dorsal wing (*nd*). The left dorso-lateral wing (*n'*) on the other side, occupies the left half of the frontal axis. The five strong denticulate teeth, which form the basal ends of the five lateral wings, are so turned that the basal mouth of the second nectophore, beyond the ostium of the nectosae, forms a broad transverse or frontal fissure (like the mouth of a Plagiostome), and perpendicular to this is a larger ovate longitudinal fissure (in the dorsal half of the sagittal axis).

*Nectosae* (figs. 8–10, *w*).—The subumbrella of the second nectophore is very long, subcylindrical, about six times as long as broad. Its apex touches the base of the apical condyle (*ug*) and receives the nectocalycine duct (*cn*), which passes through the latter. The four radial canals of the subumbrella are regularly disposed, and united by a small velum at its basal opening (fig. 11, *wo*). This opening is strongly protected and partly hidden by the five basal teeth proceeding from the five wings of the exumbrella, and described above (fig. 11).

*Siphosome.*—The common stem, when contracted, is completely hidden in the hydreccial canal described above. When the animal floats quietly on the surface of the tranquil sea it offers the peculiar aspect figured in figs. 1 and 2, Pl. XXXV., which I drew from a living, intact specimen, 11th February 1867, in the Canary Island Lanzarote. The longitudinal axis of the body (marked by the straight line of the expanded stem, on the dorsal median line of the hydreccial canal) is so inclined that it cuts the horizontal level of the sea at an angle of 20°. The level is touched by the most prominent dorsal parts of the body, the frontal crest of the first nectophore, and the uppermost part of the dorsal edge of the second. A bunch of fishing tentacles issues through the basal opening of the hydreccial canal.

*Cormidia.*—The Eudoxiae attached to the siphosome, forty to sixty or more, are regularly arranged in the usual ordinate manner, and do not reach sexual maturity before being detached from the common stem. After being detached, they swim freely about as Eudoxiae, which assume the characteristic form of *Amphiroa carina* described above (Genus 16). They are distinguished from other Eudoxidae by the six-sided prismatic bract, with its large vertically descending dorsal phyllocaust, and the two horizontal lateral canals arising perpendicularly from its uppermost apex (compare p. 114 and Pl. XXXVI.).
**Genus 30. Bassia,** 1 Quoy et Gaimard, 1827.

_Bassia_, Quoy et Gaimard, MS. (compare Lesson, Acéphales, p. 451).

**Definition.**—Diphyide with two angular, pyramidal or prismatic nectophores of different size and form. The basal nectophore is four-sided pyramidal, asymmetrical, and much larger than the symmetrical apical nectophore. Bracts, four-sided prismatic and wedge-shaped below, with an ovate, ascending phyllocoyst, and an odd descending canal arising from its base (_Sphenoides_, Genus 15).

The genus _Bassia_ was founded by Quoy and Gaimard in 1827 for a Diphyid which they found in Bass Strait, and called, from its four-sided nectophore, _Bassia quadrilatera_. The majority of later authors have called it _Abyla quadrilatera_ (following Blainville, 24), or _Abyla bassensis_, following Huxley, who gave an excellent description of it in 1859 (9, p. 45). Another species, from the Tropical Atlantic, taken off the coast of Guinea, was described at the same time very accurately by Gegenbaur under the name _Abyla perforata_ (10, p. 26, figs. 20, 21). I myself have observed a third species in the Indian Ocean (_Bassia tetragonata_), and a fourth species, different from the three others, in the Canary Islands, _Bassia obeliscus_. Since the latter also occurs in a bottle in the Challenger collection, taken in the Northern Atlantic, near the Azores (Station 354, May 6, 1876), I give its special description here, and the figures which I drew in 1867 from living specimens in Lanzarote. _Bassia_ differs from _Abyla_ (with trigonal nectophore) and _Calpe_ (with pentagonal nectophore) in the tetragonal shape of its distal nectophore, which retains better the original form of a quadrilateral Medusa-umbrella. It differs further in the peculiar form of its wedge-shaped hydrophyllia and Eudoxiae, which are free _Sphenoides_ (p. 116) with an odd basal canal descending from the phyllocoyst.

_Bassia obeliscus_, n. sp. (Pls. XXXVII., XXXVIII).

_Abyla obeliscus_, Hkl., 1867, MS. Canar.

**Habitat.**—Northern Atlantic; Station 354, south of the Azores, west of the Canary Islands, May 6, 1876; lat. 32° 41' N., long. 36° 6' W. Surface.

Canary Islands, Lanzarote, February 1867 (Haeckel).

**Nectophores.**—The two nectophores united are 12 to 16 mm. long, 5 to 7 mm. broad; they are very different in form and size. The distal or posterior nectophore is 10 to 12 mm. long, 5 to 7 mm. broad; twice as long and broad as the proximal or anterior. The ground-form of the latter is symmetrical, that of the former asymmetrical.

**Apical Nectophore** (fig. 5 seen from the ventral face, fig. 6 from the dorsal face, fig. 7 from the coryphal edge or the original top, fig. 8 from the basal face).—The apical

1 _Bassia_ = Inhabitant of Bass Strait.
nectophore (first, superior or proximal nectocalyx) has the form of a pentagonal prism. Its main axis is 5 mm. long, lies in the natural position of the vertical cormus (figs. 1–4) nearly horizontally, and is therefore perpendicular to the vertical main axis of the large basal nectophore. The latter is three times as long as the former. The length of the main axis of the apical nectophore equals the sagittal diameter of the basal nectophore.

The dorsal face of the apical nectophore (fig. 6) is pentagonal, and in the natural position of the vertically standing cormus directed upwards (fig. 1–3, wd). Seen from above (fig. 6) the somatocyst (cs) and the nectosac (w) are visible through the transparent dorsal face. The ventral face (fig. 5) is heptagonal, in the natural position (figs. 1–4) directed downwards, and bisected by a horizontal transverse crest. The apical half of the bisected face is pentagonal, slightly concave, and through it appears the somatocyst (fig. 5, cs), whereas the basal half is excavated, and contains the campanulate hydroceium (fig. 5, w), in the fundus of which the siphosome arises. The basal face of the apical nectophore (fig. 8) is square with four equal concave edges, and in its centre is placed the aperture of the nectosac (wo). The remaining four faces are two basi-laterals and two api-calaterals; the former are pentagonal, the latter tetragonal; and these two are separated by the coryphal crest or sagittal edge (ak).

The Nectosac of the Apical Nectophore (fig. 6, w; fig. 8, w) is ovate and occupies its basal half. Its circular basal aperture (fig. 8, wo) is small and surrounded by a broad velum (r), and a circular canal (cc). The four radial canals of the subumbrella, which discharge into the latter, are of unequal length; the ventral canal (cr), near the hydroceium, being shorter, the dorsal canal (fig. 6, cd) longer than the two curved lateral canals (cx right, cl left). The four radial canals unite in the apex of the nectosac, which is united by a very short peduncular canal with the apex of the siphosome.

Somatocyst (figs. 1, 2, 5, 6, 7, cs).—The somatocyst is subglobular, or spheroidal, with slightly shortened main axis. It occupies the apical half of the proximal nectophore and is nearly filled with large polyhedral entoderm cells, so that its central cavity is very small. It is everywhere surrounded by the thick jelly-mass of the umbrella, and only at its base in contact with the apex of the nectosac (fig. 6, w) and with the meeting apex of the hydroceium (fig. 5, w) and the siphosome.

Hydroceium (fig. 1, w; fig. 5, w).—The hydroceium or the funnel-cavity is campanulate or obliquely conical, and its wide quadrangular mouth occupies the basal half of the ventral face of the apical nectophore. The main axis of the hydroceium is obliquely inclined, and in the normal position (figs. 1, 2) directed from above and behind downwards and forwards. The apex of the hydroceium is the common central point, in which the somatocyst meets with the peduncular canal of the apical nectophore and the apex of the siphosome.

The Basal Nectophore (figs. 1–4), or the distal nectocalyx, has in general the form of an obelisk, or of a truncated four-sided pyramid. Its main axis is vertical in the normal

(2004, Chal. Exp.—Part LXXVII.—1888.)

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position, and therefore perpendicular to the horizontal main axis of the smaller apical pneumatophore. The truncated apical or upper face, where it unites with the latter (fig. 10), exhibits a short condyle or apical apophysis, is deeply notched, and presents a sort of articular face, into which the solid angle of the apical nectophore, formed by the junction of its two ventral faces, is received. The siphosome (fig. 10, a) enters through the apical apophysis into the hydroæcial canal (u).

The opposite basal face of the basal nectophore (fig. 9), or the base of the obelisk, is nearly rectangular; its sagittal diameter is twice as great as its frontal axis. The centre of the dorsal half of the basal face is occupied by the small aperture of the nectosac, which is surrounded by a broad velum (v) and the circular canal, whereas the ventral half of the basal face contains the wide opening of the funnel canal (ui) through which the trunk (a) proceeds. The four corners of the basal face are somewhat asymmetrical and project downward as irregular three-sided pyramids; the two dorsal corners are smaller than the two ventral; the right dorsal corner (u') is the smallest, and the right ventral corner (w') the largest.

The four lateral faces of the basal nectophore (standing vertically in figs. 1–4) are nearly rectangular, slightly concave, and separated by four prominent, finely serrated edges. The nectosac is seen through the dorsal face (fig. 4, w), the hydroæcial canal with the included siphosome through the ventral face (fig. 3, a). This latter is bisected in the basal half by the hydroæcial fissure; a broad dentate plate stretching from the right ventral ridge (u') over the smaller opposite plate, which arises from the left ventral ridge (w'). These two ventro-lateral crests are stronger and project more downwards over the basal face than the two dorso-lateral crests; the right of these (u') is somewhat larger than the left (w'). The four interradial crests are not rectilinear, but slightly curved, S-shaped, and turned a little spirally around the vertical main axis.

The Nectosae of the Basal Nectophore (figs. 1–4, v) is slenderly ovate and occupies its dorsal half. It is twice as broad and three times as long as the nectosac of the apical nectophore. The dorsal face is more strongly vaulted than the ventral. The circular basal aperture is small and surrounded by a broad velum (v). The four radial canals of the subumbrellum, which discharge into the circular canal, are of unequal length; the ventral (cv) is shorter, the dorsal (cd) longer than the two curved lateral canals (cw right, cl left). The four canals do not meet in the apex of the nectosac, but a little beyond it on the ventral face; and from their meeting point arises a rather long peduncular canal, which ascends nearly vertically, pierces the articular apophysis of the upper face of the nectosac, and unites at its apex with the top of the siphosome (figs. 1, 10).

The Hydroæcial Canal occupies the half of the basal nectophore; it is rather narrow, subcylindrical, and is separated by a thin jelly-plate from the ventral side of the neighbouring nectosac. Its apical opening (fig. 10) is obliquely truncate, ovate, and opens into the apical dorsal part of the apical nectophore (fig. 1). Its basal opening (fig. 9, w)
is far larger and subcircular. The ventral margin of the latter is cleft in its middle; the large dentate plate arising from the right ventral crest of the basal nectophore here covers, like a valve, the free margin of the smaller plate which arises from the opposite left crest (figs. 3, 9, uk).

The Siphosome, which arises in the apex of the hydroæcum of the apical nectosæ, enters into the hydroæcal canal of the basal nectosæ by its apical aperture, runs through it along the ventral face of the nectosæ, and proceeds freely through its basal aperture (fig. 1). In its contracted state, however, the retracted siphosome is completely hidden in the hydroæcal canal (fig. 2).

Cormidia.—The numerous cormidia, which are attached to the stem of the siphosome, are separated by regular free internodes, and become mature in the form of free Eudoxia, which belong to the monogastric genus Sphenoides (compare Genus 15 and Pl. XXXVIII.). These are characterised by the peculiar wedge-form of their bracts, and mainly by the odd spur-shaped dorsal canal, which descends from the base of the large ovate phyllocyst downwards.

Genus 31. Calpe,¹ Quoy et Gaimard, 1827.


Definition.—Diphyidae with two angular, pyramidal or prismatic nectophores of different size and unequal form. The basal nectophore is five-sided pyramidal, asymmetrical, and much larger than the symmetrical apical nectophore. Bracts cuboidal, with a five-sided pyramidal apophysis, and a vesicular phyllocyst, from the base of which four canals arise, two slender odd sagittal and two broader paired lateral canals (Aglaisma, Genus 16).

The genus Calpe was founded by Quoy and Gaimard in 1827 for the well-known Mediterranean species Calpe pentagona. Eschscholtz (1, p. 132), and the majority of later authors, have described this striking form under the name Abyla pentagona (Köllicher 4, Leuckart 5, Huxley 9, Gegenbaur 10, &c.). But, beside the other characters, the pentagonal form of the distal nectophore distinguishes the true Calpe at once from the trigonal Abyla and the tetragonal Bassia, and still more the different form of the bracts in these three genera of Abylidae. The phyllocyst of the true Calpe gives off four radial canals, two of which are odd and slender (an ascending and a descending), and two others paired and lateral. The free Eudoxia belongs to the monogastric genus Aglaisma (Genus 16). It was in this genus that Leuckart (8) and Gegenbaur (7), both independently, at the same time, observed the detachment of free Eudoxia from the Diphyid corm (compare above, p. 90).

The new species of Calpe, described in the following as Calpe gegenbauri, inhabits

¹ Calpe = Ρηχ, Kαλπ; also the northern column of Heracles, opposite to Abyla, Strait of Gibraltar.
the Tropical and Subtropical Atlantic, and was collected by the Challenger at Stations 338 and 346. In 1867 I had observed the same species living, during my stay in the Canary Island, Lanzerote. A comparison of its form (Pl. XXXIX.) with the figures of the Mediterranean *Calpe pentagona* exhibits, at first sight, the important differences between the two species. A third species, different from both, is the inhabitant of the Tropical Pacific and Indian Ocean, figured by Huxley in his excellent work also as *Abyla pentagona* (9, pl. ii. fig. 2). I name it in honour of this naturalist, so highly respected for his additions to our knowledge of the Acalephs, *Calpe huxleyi*.

*Calpe gegenbauri*, n. sp. (Pls. XXXIX., XL.).

*Habitat.*—Tropical and Southern Atlantic; Station 338, March 21, 1876; lat. 21° 15’ S., long. 14° 2’ W.

Station 346, April 6, 1876; lat. 2° 42’ S., long. 14° 41’ W. Surface.

Canary Islands, Lanzerote, February 1867 (Haeckel).

*Nectophores.*—The two nectocalyces united are 24 to 28 mm. long; they are very different in form and size. The posterior or distal nectophore is 20 to 22 mm. long and 9 to 10 mm. broad; it is twice as broad and four times as long as the anterior or proximal, whose length is 5 to 6 mm., and the breadth 4 to 5 mm. The ground-form of the larger is very asymmetrical, that of the smaller quite symmetrical.

*Apical Nectophore* (figs. 1-4, cs; fig. 5, apical view; fig. 6, dorsal view; fig. 7, ventral view; fig. 8, lateral view from the left side).—The first nectophore (also called the proximal, anterior, superior or apical nectocalyx) is a pentagonal prism of a completely bilaterally symmetrical ground-form. When the axis of its nectosae stands vertically, then the two pentagonal and parallel terminal faces of the prism are also vertical, and one of their five angles (opposed to the basal side) is directed upwards; the two odd apical angles being connected by the horizontal coryphal crest (figs. 5-8, uk).

The pentagonal dorsal face of the first nectophore (fig. 6, u) covers the nectosae (w), and is much smaller than the similar ventral face (fig. 7, w), through which the somatocyst (cs) appears, and beyond it the hy droceum (ui). The two superior lateral angles of each pentagonal terminal face are much more distant than the two inferior; and the lines connecting the two angles at each side (the inferior lateral edges of each pentagon) are turned inwards, and form an obtuse angle.

The five lateral faces of the pentagonal prism, which separate its two parallel terminal faces (dorsal and ventral) are two pairs of lateral faces (superior and inferior), and an odd inferior or basal face (with the openings of the dorsal nectosae and the ventral hydroceum).

The two paired supero-lateral faces of the first nectophore are quadrangular, nearly rectangular, and connected in the sagittal axis of the body by the coryphal crest (uk);
the latter separating them like the ridge of a house-roof. The middle of the coryphal edge is nearly in contact with the oleocyst (co).

The two infero-lateral faces of the first nectophore are much larger, and of a more complicated form, sexangular; the ventral half of their larger quadrangular upper part being prolonged into an obliquely quadrangular descending plate of half its size (fig. 8); this plate forms the lateral wall of the hydrecium (ui). The inferior dorsal angle of this plate (between the openings of the hydrecium and the nectosac) is the lowermost point of the first nectophore; it marks the basal pole of its principal axis, whilst the apical pole of the latter is formed by the opposite oleocyst (co), and the centre of the coryphal edge (nk).

The inferior or the proper basal face of the first nectophore (opposed to the coryphal crest, nk, fig. 8) is divided by a prominent frontal septum (nt) into two divergent obliquely ascending secondary faces; the dorsal or posterior of these is quadrangular and contains the opening of the nectosac (fig. 6, wo); the ventral or anterior is pentagonal and contains the mouth of the hydrecium (fig. 7, inferior thixi). The basal edge of the frontal septum is emarginate.

First Nectosac (figs. 5–8, w).—The subumbrella of the apical or proximal nectocalyx occupies its dorsal half, and is separated by the frontal septum from the ventral parts, the somatocyst (cs) in the upper, and the hydrecium (ui) in the lower half. The nectosac is subcylindrical, four times as long as broad; its closed upper end is near the dorsal end of the coryphal crest (nk); the ostium of its lower end (wo) is surrounded by a small velum, and opens in the dorsal half of the basal face.

Canals of the Nectosac (figs. 5–8).—A nectocalyxine duct (cn) arises from the apex trunci or the top of the hydrecium, and ascends obliquely to the dorsal face of the nectosac (fig. 8, v). It divides here into four radial canals; the shortest is the descending ventral canal of the nectosac, the longest the opposite dorsal canal (fig. 6, cd), both placed in the median place of the nectophore; intermediate in size are the two paired lateral canals (right cx, and left cl); these form a small arch in their upper part. A far larger arch is formed by the dorsal canal, which ascends to the top of the nectosac and descends along its whole dorsal median line.

Hydrecium (fig. 7, ui, ventral view; fig. 8, wi, lateral view from the left side).—The hydroecial or funnel cavity is campanulate and occupies the basal half of the ventral part of the first nectophore. Its rounded apex is closed and from it arise the two small canals running to the nectophore and the somatocyst. The larger dorsal wall of the hydrecium is formed by the frontal septum (nt), which separates it from the neighbouring nectosac. The smaller ventral wall is deeply emarginate (fig. 7). The inferior opening of the hydrecium is quadrangular, obliquely truncated, with four prominent points or teeth. The two dorsal teeth are the inferior corners of the frontal septum, and much stronger than the two ventral teeth.
**Somatocyst** (figs. 5–8, es).—The somatocyst is spherical, very large, and occupies the apical half of the ventral part of the first nectophore. It is filled with large vacuolate entoderm cells and therefore appears reticulate. It is connected at its dorsal side by a small inferior descending canal with the top of the stem (uu), and by a small superior ascending canal with the oleocyst (co). The somatocyst is twice as broad and half as long as the nectosac (w). The oleocyst (co) is a small cecal process filled by an oil-globule, and is nearly in contact with the middle of the coryphal crest (uk).

**Basal Nectophore** (fig. 1, ventral view; fig. 2, dorsal view; fig. 3, lateral view from the right hand; fig. 4, from the left hand side).—The second nectophore (also called the distal, posterior, inferior or basal nectocalyx), is four times as long and twice as broad as the first, and of a very different form. It is in general a slender, pentagonal, truncate pyramid, the five edges of which are asymmetrically developed and somewhat spirally twisted. The ground-form is internally (with respect to the four radial vessels of the nectosac) quadriradial; externally (with respect to the five edges of the exumbrella) quinqueradial; and at the same time bilateral, with respect to the sagittal plane, which divides the body into right and left halves, and is determined by the ventral position of the hydrocral canal, and the dorsal position of the nectosac (w).

The five edges of the truncate pyramid are more or less wing-like, prominent, and finish at the distal end in five triangular pyramidal teeth; they are elegantly denticulate in the lower third, and twisted in a deltoidal (or right-hand ascending) spiral. Their development is unequal and asymmetrical. The odd dorsal edge (nd), which runs along the dorsal median line of the nectosac, is less prominent than the four others, which are paired. The broadest wing, and the strongest terminal tooth, are developed from the left ventral edge (nv), and next to this from the right dorso-lateral edge (nv'); whilst the right ventral edge (nv'), and the left dorso-lateral edge (nv") are smaller.

The two dorso-lateral edges (nv', nv") correspond to the two symmetrical lateral edges of a bilateral and quadriradial Medusa, whilst the two ventro-lateral edges are produced by the development of the hydrocral canal on the ventral side of the second nectophore. This canal is not closed, but covered by the two broad wings which develop from the two ventro-lateral edges; the right of these (nx) is broader and overlaps the left (nx'); their inferior free margin is dentate.

The truncate apical or proximal face of the second nectophore is obliquely bevelled, and bears a triangular apophysis, which enters into the hydrocium of the first nectophore, and encloses the nectocalycine duct. The five edges are more equally developed at this superior end (fig. 10); a horizontal transverse section beyond it (fig. 11) demonstrates how the two ventro-lateral wings develop more strongly, and form the hydrocral canal (wu). The differentiation of the five wings is strongest at the distal or inferior end.

The basal or distal face of the second nectophore (seen from below in fig. 12) exhibits
the opening of the nectosae (uo) surrounded by the velum (v), and at its ventral side
the opening of the hydrellial canal (ui). Near the velum arise two small lateral spines,
which lie in the radius of the two much larger triangular teeth, being the distal pro-
longations of the two dorso-lateral edges (u left, u right).

Neilacs (figs. 1-4, w).—The subumbrella of the second nectophore is cylindrical
and occupies its dorsal half. The neetocalycine duct, which comes from the top of the
stem and enters into the subumbrella somewhat below its apex, divides into the four
radial canals (cd dorsal, ce ventral, cx right, cl left). These descend vertically and
nearly parallel to the ostium, where they are united by the circular canal.

Hydrellial Canal.—The ventral groove of the second nectophore, which forms the
continuation of the hydrellium of the first, has an irregular form (figs. 10–12, wi, in
transverse section). It is enclosed between the ventral wall of the second nectophore,
and the two broad ventro-lateral wings which arise from it, the right (we) overlapping
somewhat the left (ul).

Siphosome (as).—The long stem, which may be retracted completely into the
hydrellial canal, bears a series of twenty to thirty or more cormidia. These are
detached from the stem before they reach sexual maturity and swim freely about as
Aglaisma gegenbauri (Pl. XL). They are characterised by a euboidal bract, which has
a caudal prolongation at the inferior dorsal edge, and by four radial canals arising from
the phylloeyst (two slender odd sagittal and two paired broad lateral). Compare on their
structure, above p. 119.

Family VIII. Desmophyidae, Haeckel, 1888.

Desmophyidae, Hkl, System der Siphonophoren, 95, p. 36.

Definition.—Calyconecta polygastrica, with a biserial nectosome, composed of four
to six or more opposite nectophores. Cormidia ordinate, eudoxiform or erasiform,
separated by equal free internodes; each siphon with a bract.

The family Desmophyidae, represented by two new genera only, is of special interest
as a connecting link between the preceding (VII.) and the following family (IX.). It
agrees in general structure and composition with the Diphyidae, but differs from them in
the greater number of nectophores which are arranged in a biserial nectosome. This
latter character is also found in the Polyphyidae, which, however, differ in the absence
of bracts. The Desmophyidae may be derived immediately from the Diphyidae, by
multiplication of the nectophores. The Polyphyidae may have arisen from the former
by reduction and loss of the bracts.

Two genera only of Desmophyidae have been observed by me, each with a single
species. Both agree in the form of the rounded edgeless nectophores and bracts with the
Prayidae, and are probably derived from this subfamily of Diphyidae. The two genera of the former correspond to those of the latter.

*Desmalia*, the first genus, is in general appearance very similar to *Praya* (Pls. XXXI., XXXII.), and possesses, like it, eudoxiform cormidia. Each eudoxome is composed of two medusomes, a sterile and a fertile. The sterile medusome exhibited in the only species observed nearly the same shape as that of *Praya galea*, figured in Pl. XXXII. The cavity of the helmet-shaped bract contained a single siphon with a tentacle, and on the ventral side of the former a single gonophore with a well-developed umbrella. All gonophores of the single specimen observed were female. The corm of *Desmalia* may be, therefore, dioecious.

*Desmophyse*, the second genus, is described in the sequel (Pl. XXX.). It is in general composition and special structure very similar to *Lilypopsis*, and possesses, like this Prayid, ersseiform cormidia. Each ersseome is composed of two sterile and one or several fertile medusomes. The first sterile medusome consists of a bract (an umbrella with four radial canals), a manubrium (siphon), and a tentacle. The second sterile medusome is represented by a well-developed "special nectophore," a medusiform umbrella with four radial canals and a ring canal, muscular subumbrella and velum, but without manubrium. The umbrella margin of this Medusa was beset (in the only species observed) with a corona of rudimentary tentacles and ocelli (almost as in some species of *Lilypopsis*). The group of sexual medusomes was represented by several clustered fertile gonophores; one large, and a number of small vicarious buds. The corm was monococious and dicoelid, the cormidia alternately males and females.

The development of the Desmophyidae is not known; but it will probably be found to be hypogenesis, the gonophores ripening whilst sessile on the stem; as is also the case in the closely allied Polyphyidae.

**Synopsis of the Genera of Desmophyidae.**

Cormidia eudoxiform, composed of two medusomes (one sterile and one fertile), without

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<th>Special nectophore</th>
<th>32a. Desmalia</th>
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Cormidia ersseiform, composed of three or more medusomes, with a special nectophore,

| 32b. Desmophyes |


**Definition.**—Desmophyidae with rounded edgeless nectophores, arranged in a biserial nectosome. Cormidia without special nectophores.

The genus *Desmalia* is represented by a polygastric Calyconect, which is in general very similar to the common forms of the well-known genus *Praya*, but differs from

¹ *Desmalia* = Marine chain, ὄρχος, ὁλος.
them in the possession of numerous (four to six or more) nectophores, arranged in a biserial nectosome similar to that of *Hippopodius* and *Polyphyses*.

A single specimen only of this genus was captured by me during my voyage through the Indian Ocean, between the Maldive Islands and Socotra, in March 1882. But unfortunately it was injured during capture, and decomposed before I could make a sketch of it. The general appearance and the form of nectophores and bracts were similar to the figure which Fewkes published in 1880 as "the young of *Praya cymbiformis*." But instead of two opposite nectophores there were four present, the superior pair somewhat smaller than the inferior. The cormidia, fifteen to twenty or more, succeeded on the stem of the siphosome nearly without intervals, so that the helmet-shaped bracts covering one another formed a continuous series of scales, whence I called this species provisionally *Desmalia imbricata*. A fragment of a similar siphosome was found in a bottle from the Challenger collection, taken in the South Pacific (Station 165). The structure of the cormidia, and mainly the form of the helmet-shaped bract (with four radial canals), was similar to that of *Praya galea* (Pl. XXXII). Each eudoxiform cormidium contained on the ventral side of the siphon a single gonophore with well-developed umbrella and a small ovariun. All the cormidia were female.


*Desmophyes*, Hkl., System der Siphonophoren, p. 36.

**Definition.**—*Desmophyidae* with rounded edgeless nectophores, arranged in a biserial nectosome. Each cormidium provided with a small special nectophore.

The genus *Desmophyes* is closely related to the preceding *Desmalia*, but differs from it in the possession of a special nectophore on each cormidium, and by the reduction of the umbrella of the gonophores. It agrees in these characters with *Lilyopsis*, and has the same relation to this Diphyid genus as *Desmalia* bears to *Praya*.

The only species of *Desmophyes* which I observed, and which is described in the sequel, agrees with some species of *Lilyopsis*, not only in the general composition of the cormidia, but also in the special form of their component parts. The special nectophore of each cormidium bears on the margin of the medusiform umbrella a number of ocelli and a corona of rudimentary tentacles (almost as in *Lilyopsis medusa*, &c.). Whilst the subumbrella is strongly developed in these special nectophores, it is reduced in the gonophores, which possess a long prominent manubrium. Each cormidium has a number of buds besides the mature gonophore.
Desmophytes annocetens, n. sp. (Pl. XXX.).

Habitat.—Indian Ocean, south coast of Ceylon, December 1881 (Haeckel).

Nectosome (fig. 1).—The swimming column was composed, in the only specimen observed, of six nectophores arranged in two opposite series. The two uppermost nectophores were half as large as the two lowermost, and the two bells of the second pair placed between them, intermediate in size. Each of the two largest inferior nectophores had a length of 15 mm. and a breadth of 10 mm., and the entire biserial nectosome was about 30 mm. long and 18 mm. broad.

Nectophores.—The swimming-bells are on the whole very similar to those of Praya galea, their jelly soft and delicate, the surface smooth and rounded, without edges. The form is obliquely campanulate or mitriform, the apical part rounded, the basal part with the ostium obliquely truncate.

The dorsal (outer or abaxial) face of each nectophore is convex and smoothly rounded, as is also the lateral face. The ventral face, however (turned to the common axis of the stem), is concave and forms two parallel, longitudinal, prominent wings, which embrace a hemicylindrical groove. The ventral grooves of each two opposite nectophores are so fitted one into another that they form together a cylindrical canal. This axial tube, tapering towards the apex, is the hydrozooal canal, which encloses the superior part of the common stem; the contracted siphosome may be partly retracted into it.

Each nectophore is attached to the common stem by means of a short pedicle, a vertical triangular lamella, which arises by a broad base from the upper third of the ventral groove, and is fixed at its apex to the uppermost part of the stem. The pedicle encloses the peduncular canal which connects the stem-cavity with the nectosome.

Nectosae.—The inferior basal or distal half of each nectophore is occupied by the muscular subumbrella, which has an obliquely campanulate form. Its basal mouth is wide, and surrounded by a broad velum. The four radial canals of the subumbrella are of different lengths, the two lateral canals (right and left) being larger than the ventral (or axial) canal, and smaller than the dorsal (or abaxial) canal. They unite at the base of the velum by a circular marginal canal, and this is beset with eight red pigment spots or ocelli, similar to those in the special nectophores of the cormidia. Four of them are placed perpendicularly (at the distal end of the four radial canals) and four others inter-radially (between the former). There are no rudimentary tentacles on the margin of the umbrella; these are peculiar to the special nectophores.

The superior, apical or proximal, half of the nectophore contains two canals which are placed in its sagittal plane. The peduncular canal, which arises from the canal of the common stem in its uppermost part, enters by the triangular pedicle of the nectophore in its jelly-substance, and descends obliquely in a curve towards the apex of the subumbrella,
where it divides into the four radial canals. From the proximal base of this pedicular canal arises a blind pallial canal, which ascends towards the dorsal median line of the exumbrellia, and ends near its apical part by a small oesal diverticulum (just as in *Lilyopsis*). There is no inferior or descending pallial canal, as in *Praya*.

**Siphosome.**—The long tubular stem of the cornus, which proceeds from the basal opening of the hydreecial canal (between the two lowermost neotophores), is beset in its upper part with numerous buds of cormidia, and bears in its lower part a series of fully developed sexual cornidia, separated by equal free internodes; their number in the specimen observed was about a dozen. Male and female alternate regularly.

**Cormidia.**—Each cormidium is essentially composed as in *Erssea*, of at least three different medusomes; firstly, a sterile medusome composed of a bract, a siphon, and a tentacle; secondly, a special neotophore; and thirdly, a male or female gonophore; the latter bears a number of similar buds or reserve gonophores at its base. The entire composition of the cormidia is very similar to those of *Lilyopsis*. The subumbrellar cavity of the bract covers the greater part of the other organs; these are placed as usual, so that the siphon and its tentacle occupy the dorsal part of the cavity, the special neotophore the ventral part, and the gonophores lie between them on both sides.

**Bracts** (fig. 2b, from the right side; fig. 3b, from the left side).—The covering scales of the cormidia, bracts or hydrophyllia, are very similar to those of *Praya*. They have the form of a flat cap or an overturned boat, and are about 10 mm. long by 5 mm. broad. Their ground-form is bilateral, more or less asymmetrical, their surface smooth, with rounded edges. The upper convex face is compressed from both lateral sides; the lower face contains a deep irregular subumbrellar cavity, in which the organs of the cormidium are partly hidden. The jelly-substance of the umbrella is much thicker in the ventral than in the dorsal part of the bract; it is thinnest on both lateral sides, which are deeply eleft in the middle.

Through the base of this deep lateral fissure passes the common stem of the siphosome (*a*). The axial canal of this latter gives off a short branch to each bract, which forms near the point of its attachment a small pyriform diverticulum (*bc*). From the base of this phyllocyst arise four radial canals, which enter into the jelly-mass of the bract, are irregularly bent, and end in a vesicular diverticulum. Two of these four canals are odd, and lie in the oblique sagittal plane of the bract, a shorter ventral (*ce*) and a longer dorsal (*cd*); the two others are paired lateral canals, and enter into the dorsal lobes of the bract (right *œ*, and left *cl*).

**Siphons** (figs. 2, 3, s).—The single polypite, which occupies the dorsal part of each bract-cavity, has the usual form of siphons in Calycomete. A thick-walled ovate basigaster (*sb*) is connected by a short pedicle with the common stem (*a*). The large ovate or pyriform stomach exhibits in its wall eight distinct orange-coloured liver-stripes
(sh). The contractile and very mobile proboscis (sr) terminates in a suctorial mouth, the margin of which sometimes is regularly octolobate (fig. 3, ss).

_Tentacles_ (figs. 1, 2, 3, 4, 8).—The single tentacle which arises from the pedicle of each siphon in the most dorsal part of the bract-cavity is of the form usual in Calyconectes. It is very long and contractile, and beset with very numerous equidistant tentilla. Each of the latter (fig. 8) bears on its pedicle an elongated reniform cnidose (tk), and this contains on each side of the cnidoband (km) a group of six to eight large ensiform cnidocysts (kl). The pedicle (tt) as well as the terminal filament (tf) is inflated and vesicular at the distal end.

_Special Nectophores_ (figs. 2, nn, 6).—The special nectophore of each cormidium, which is placed in the ventral part of the bract-cavity, offers in Desmophyes a most interesting medusiform structure, similar to that of _Lilyopsis_. The umbrella is bilaterally symmetrical, since its jelly-mass is more developed in the dorsal than in the ventral part; it arises by a conical pedicle, which fits into the apex of the bract-cavity. The pedicular canal, which arises from the common stem, does not enter into the apex of that pedicle, but into the middle of its dorsal edge (fig. 6, cp).

The subumbrella of the special nectophore (w) is hemispherical, occupies its basal half and opens by a wide mouth, surrounded by a broad velum (v). The four radial canals (cv), which arise from its apex, are united at its margin by a circular canal (cc). The margin of the umbrella, beyond the latter, is beset with eight red pigment spots or ocelli (uy), four of these lie perradially (at the distal end of the radial canals), four others in the middle between them. They are relatively larger than in the main nectophores. Besides, the margin of the umbrella is beset with a corona of sixteen short tentacles (t); eight placed beyond the ocelli, and eight others alternating with these, between the former.

_Gonophores_ (figs. 2, f, 4, 5).—Desmophyes is monocious and diclinic, both sexes alternating so regularly that each cormidium has gonophores of one sex only, and two neighbouring gonophores always being of different sexes, forming together a pair. Each cormidium bears only one fully-developed gonophore; but at its base are placed the buds of several reserve gonophores. They lie between the dorsal siphon and the ventral special nectophore.

_Androphores_ (fig. 4).—The male gonophores exhibit, fully developed, a very large, spindle-shaped manubrium (hm), with a cylindrical central spadix (hx); it is widely prominent from the cavity of the small retracted umbrella (u); the latter envelopes only the base of the former, but exhibits four distinct radial canals (cv) and a uniting circular canal (cc).

_Gynophores_ (figs. 2, f, 5).—The female gonophores have a campanulate umbrella (f) larger than that of the males, also with four well-developed radial canals (cv) and a connecting circular (cc). The cavity of the subumbrella in ripe females is filled by a large pyriform or subglobular manubrium, which contains usually four large ovules of equal size, disposed in form of a cross (o).
Family IX. Polyphyidæ, Chun, 1882.

Polyphysidae, Chun, 86, p. 12.
Hippopodidae, Kolliker, 4, p. 28.

Definition.—Calyconectæ polygastrice, with a biserial nectosome, composed of four to six or more opposite nectophores. Cormidia ordinate, separated by equal free internodes, always without bracts.

The family Polyphysidae differs from the other polygastric Calyconectæ in the complete absence of bracts. The nectophores are numerous, and arranged in a biserial nectosome, as in the preceding Desmophyidae, from which they may be derived by the reduction of the bracts. The general composition of the cormidia, as well as the special structure of the single parts composing them, is very similar to that of the other Calyconectæ (mainly Prayidae); but in some respects they approach more to the Physonectæ.

The oldest and best known form of Polyphysidae is the common Mediterranean Hippopodius globa, described and figured so early as 1775, by Forskal, under the name Gleba hippopus (11, pl. xliii. fig. 8). It has been mentioned under very different names by later authors (compare 33, p. 22). The first accurate anatomical description of it was given in 1853 by Kolliker (4), others by Vogt (6) and Leuckart (8). Kolliker observed a second Mediterranean form of this family, which he called Vogta pentacantha (4, p. 31, Tab. viii.); and he established for these two genera the family Hippopodidæ, differing from the Physophoridae in the absence of a pneumatophore, from the Diphyidae in the possession of numerous nectophores arranged in a biserial nectosome similar to that of the Agalmaidæ. Chun afterwards (1882) called the same family Polyphysidae (in opposition to Diphyidae and Monophyidae). Leuckart united the Hippopodidæ and Diphyidae in his group Calycophoridae (8).

Nectosome.—The nectophores of the Polyphysidae are always numerous, at least four to six, often eight to twelve, sometimes more. They are constantly opposed in alternate pairs and arranged in a biserial column, similar to that of the Agalmaidæ. But a remarkable difference exists in the form and the structure of the trunk. The tubular trunk or common stem of the nectosome, which bears the nectophores, is, in the Agalmaidæ, Apolemidae, and other Physonectæ, the rectilinear prolongation of the trunk of the siphosome, which bears the siphous and gonophores; the former is the superior and the latter the inferior part of a straight, cylindrical tube. Quite different is the relation of the two parts of the trunk in the Hippopodidæ, as was first pointed out by Leuckart.¹ The superior part of the common stem, or the trunk of the nectosome, is connected with the inferior part, or the trunk of the siphosome, at a small acute angle, which forms the top of the corn. Both descend together from the top, and the deflexed trunk of the nectosome, bent down upon itself, forms a spiral band which surrounds the

¹ 8, p. 303, Taf. xii. fig. 3; 35, p. 553, Taf. xlvii. fig. 27.
trunk of the siphosome in wide spiral turnings. Hence, it appears as though the axis of the cone formed by the nectophores was only a lateral branch of the upper end of the ccenosarc; but in reality the upper part of the latter is deflexed and turned around the lower part. The youngest and smallest nectophores, therefore, are placed at the uppermost part, the oldest and largest at the lowermost part of the nectosome. The point of vegetation of the former is very near to that of the siphosome, but separated from it by a small interval (Pl. XXIX. fig. 7, x. Compare 35, p. 553, Taf. xlvii. fig. 27, ab).

**Nectophores.**—The nectocalyces of the Polyphyideæ appear in two different forms, which are characteristic of the two subfamilies of this family. The Hippopodideæ (*sensu stricto*) have smooth nectophores, similar to a horse-shoe, with rounded surface (*Hippopodius* and *Polyphyes*, Pl. XXIX. figs. 1–8); they may be derived from the Prayideæ. The Vogtideæ, on the other hand, represented by the genus *Vogtia* (figs. 9–14), have pentagonal nectophores with angular surfaces; they may be derived from the Diphyopsideæ. The fundamental form is always bilaterally symmetrical, a deep ventral groove dividing the nectophore into two equal halves. The jelly-substance is very voluminous and usually hard, cartilaginous; the nectosac is relatively very small and more or less rudimentary.

The special form and the arrangement of the nectophores in alternately opposite pairs are very peculiar. That part of the nectophore which bears the circular opening of the nectosac must be regarded, of course, as the basal part. Opposite to this is the apical part, or the true pedicle of the nectophore, a small triangular lamella, by which it is attached to the common stem. This pedicle arises in the sagittal plane of the nectophore, midway between the two parallel ventral wings, which include the deep concave ventral groove. Strictly speaking, only the vertical inferior half of this axial groove, beyond the pedicle, represents the ventral side, whilst its superior half, above the pedicle, belongs to the dorsal side. The outer or abaxial part of this latter forms the free convex dorsal face of the nectophore, which ascends more or less vertically in the lateral profile view of the nectosome. Each nectophore embraces with the two lateral wings of the ventral groove the adjacent parts of two other (superior) nectophores; with the descending ventral part of the wing the same part of the opposite nectophore, and with the ascending dorsal part of the wing the basal part of the superjacent nectophore of the same side. An important consequence of this peculiar arrangement is, that the openings of the nectosacs become hidden and nearly closed by the uppermost covering part of the subjacent nectophore; only the openings of the two lowermost (oldest and largest) nectophores lie quite open, and are not covered.

**Nectosac.**—The swimming cavity in the nectophores of the Polyphyideæ is very small, flat, and reduced, and the muscle-plate of its subumbrella very thin; the power of swimming therefore very weak. Indeed these Calyconectae swim more slowly than any of the other groups of this order. The velum, too, which surrounds the wide opening of the nectosac, is very small, usually crescentic or sickle-shaped, broader in the dorsal
(superior or abaxial) half than in the rudimentary ventral (inferior or axial) half. The wide opening or ostium of the flat nectosac is sometimes circular, at other times reniform or even cordate, notched by a deep incision in the middle of the ventral margin. Usually two strong ventral teeth (or the lowermost apophyses of the two lateral wings) are prominent over both sides of that notch.

Canals of the Nectosac.—The subumbrella of the nectophores possesses in the Polyphyidæ, as in all other Siphonophoræ, four radial canals, united by a marginal ring-canal above the velum. But they are here peculiarly differentiated. The pedicular canal of each nectophore, which arises from the tubular stem and runs through the lamellar pedicle, is short and divides in the middle of the ventral groove into two branches, an ascending and a descending. The ascending branch is a simple blind pallial vessel (corresponding to the superior mantle-canal of Praya); it runs in a radial direction, inside the jelly-mass of the nectophore, towards its outermost and uppermost dorsal angle (between the median line of the ventral groove and the dorsal side of the nectosac). The descending branch runs to the top of the subumbrellar cavity, and divides here into four very unequal branches or radial canals. The median dorsal and the two paired lateral canals are very short, and soon open into the marginal canal. The median ventral canal, however, is very long and dilated towards the margin of the umbrella; it forms here a flat sinus or diverticulum, the form of which is very characteristic of the individual species (sinus ventralis, see', figs. 3, 4, 13, 14). It is elliptical or ovate in Hippopodius gleba, hexagonal in Polyphyes unguilata, two-winged in Vogtia kollikeri, &c. The cells of the entoderm, which line the flat and broad cavity of this ventral sinus, are very large, polygonal, and filled with peculiar fine granules. The narrow intervals between the single cells have been described by Claus as "peculiar ramifications of the vessel" (35, p. 553).

Siphosome (fig. 1).—In the Polyphyidæ the trunk of the siphosome, or the common stem which bears the cormidia, is usually contracted and retracted into the hydrocæial cavity of the nectosac. But in the expanded state, and protruded through the basal opening of that cavity, it is a rather long tubular stem, two, three, or more times as long as the nectosac. The number of cormidia is sometimes small, four to eight, at other times much larger, twenty to thirty or more; besides the numerous buds of young cormidia, which are found in a crowded ventral series along the uppermost part of the siphosome (Pl. XXIX. fig. 7, is).

Cormidia.—The groups of polymorphous persons, which cover the trunk of the siphosome, differ from those of all other polygastric Calycomonæ in the complete absence of bracts. This may be explained either by total reduction and loss of the hydrophyllia (perhaps in correlation with the development of the large nectosome and its peculiar hydrocæial cavity), or by a phylogenetic dislocation of organs which were originally connected. It is possible, that in older ancestral forms of this family, the
umbrellæ of the sterile medusomes were separated from the appertaining siphons, and both so dislocated, that the former migrated upwards and together composed the nectosome; whilst the manubria with the tentacles remained in the cormidia, composed of clustered sexual medusosomes or gonophores.

The cormidia of the Polyphyllidae are ordinate and monogastric, as in all other Calyconectæ, separated by free internodes of the stem, of equal length. Each cormidium contains a single siphon and one tentacle, besides a group of clustered gonophores. These are sometimes of one sex in each cormidium, so that this is diclinic. The corm itself is monocious, male and female cormidia occurring on the same stem; usually the androphores occupy the lower or distal part, the gonophores the upper or proximal part of the siphosome. At other times the cormidia are monoecious (composed of gonophores of both sexes) as described by some authors (Kölliker, 4, and Weismann, 1883, p. 194).

The general rule, that the cormidia are ordinate in all polygastric Calyconectæ, has perhaps a single exception in Polyphyllæ. The clustered gonophores are here separated from the base of the siphon by a small interval, and this seems to become larger in some species, so that the cormidia may be described as alternate (or even irregular), the sterile medusosomes (siphon and tentacle) alternating with the fertile (gonophores), just as in many Physonectæ (Agalma, Agalmopsis, &c.). This is perhaps the case in the Mediterranean form described by Kölliker as Hippopodiæ neapolitanus (4, Tab. vi.), and in a similar South Atlantic form, an incomplete specimen of which I observed in a bottle from the Challenger collection (from Station 325), and which I have called provisionally Polyphyllæ dissolutæ (95, p. 36). The preservation of this fragment, however, was not sufficiently good to furnish confirmation of that statement, and since the description of Kölliker has not been confirmed by later authors, it may be that an accidental error occurred, and that the cormidia are always ordinate as in the common Hippopodiæ.

Siphons (fig. 1, s).—The polypites of the Polyphyllidae are in general of the same shape as in the other Calyconectæ. The pedicle arising from the siphosome is sometimes longer, at other times shorter or even rudimentary. The basigaster is subspherical or ellipsoidal, its thickened exoderm full of cnidocysts. It is separated by a pyloric valve from the ellipsoidal or spindle-shaped glandular stomach, which passes over without a sharp boundary line into the long and very contractile proboscis. Sometimes these parts are very prolonged and veriform. The distal mouth is small and simple, but may be expanded in the form of a circular sectorial disc.

Tentacles (fig. 1, t).—The single tentacle, which is attached to the base of each siphon, is very long and thin, beset with a series of very numerous tentilla. Each tentilium (fig. 8) is composed of a long pedicle, a roundish cnidosæ, and a cylindrical terminal filament; the latter is often coiled up spirally. The cnidosæ is relatively small, ovate, ellipsoidal or subspherical, often coloured by yellow or orange pigment. Its cnido-battery is placed in form of a curved band along the convex dorsal side of the cnidosæ, and
composed of innumerable small paliform cnidocysts; on each side of it lies a bunch of a few large ensiform cnidocysts (usually four to eight, rarely more).

**Gonophores.**—The sexual medusomes of all Polyphyidae come to maturity whilst sessile on the stem. There is, therefore, in this family no true metagenesis, as in the Diphyidae and Monophyidae. The cormidia are sometimes dicalinic (*Hippopodius*), at other times monoclinic (*Polyphyes* and *Vogtia*). Usually the gonodendra are small, and only one or two large mature gonophores exist between a small number of immature and young buds. Usually in the dicalinic forms the female gonophores occupy the superior, the male gonophores the inferior part of the siphosome. The gonophores of both sexes have a well-developed, hemispherical or campanulate umbrella, with four radial canals and a connecting ring-canal above the small velum. The manubrium, from the exoderm of which the sexual cells are developed, is ovate, spindle-shaped or cylindrical; it becomes very large and widely protruded through the ostium of the subumbrella, often two to four times as long as the latter, or even more. Thus the form of the gonophores in the Polyphyidae is more like that in the Physonectae than in the other Calyconectae.

**Synopsis of the Genera of Polyphyidae.**

<table>
<thead>
<tr>
<th>Subfamily</th>
<th>Nectophores</th>
<th>Ostium</th>
<th>Cormidia</th>
<th>Gonophores</th>
<th>Genus</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Subfamily Hippopodidae</td>
<td>rounded, not prismatic</td>
<td>without teeth</td>
<td>dicalinic</td>
<td>attached to base of siphons</td>
<td>33. <em>Hippopodius</em></td>
</tr>
<tr>
<td>II. Subfamily Vogtidae</td>
<td>five-sided, prismatic</td>
<td>with five teeth</td>
<td>monoclinic</td>
<td></td>
<td>35. <em>Vogtia</em></td>
</tr>
</tbody>
</table>

**Subfamily Hippopodidae.**


**Definition.**—Polyphyidae with rounded horseshoe-shaped nectophores, the ostium of which is smooth or slightly lobate. (Cormidia dicalinic. Gonophores attached to the base of the siphons.)

The genus *Hippopodius* is the most common of the three genera of Polyphyidae, and is represented by the well-known Mediterranean type *Hippopodius gleba*, and by several similar species, which are widely distributed over all warmer seas. I found single detached nectophores of it in different bottles in the Challenger collection, taken in the Tropical Pacific and Atlantic; and also in the collection of Captain Rabbe, from the Indian

1 *Hippopodius* = Horse-shoe, ἵππος, πόδος.

(Zool. Chall. Exp.—Part lxxvii.—1888.)
Ocean. They differ in size and form, and especially in the shape of the basal face and the ventral sinus, more or less from the Mediterranean species, but were not sufficient for the definition of distinct species. To enable this, a further accurate examination and comparison of the entire corm, from different localities, is required.

The most accurate description of the Mediterranean Hippopodius gleba (= Hippopodius luteus, Vogt, 6, very common on the Riviera) is given by Leuckart. It differs somewhat from similar forms taken in other parts of the Mediterranean. That form which Kölliker has described as Hippopodius neapolitanus from Messina (= Elephantopus neapolitanus, Lesson, 3) seems to belong to the following genus, Polyphyes. The mouth of the neotocac is surrounded in the latter by six prominent teeth (four dorsal and two ventral), whilst it is smooth and toothless in Hippopodius. Another important difference between these two genera seems to be found in the composition of the cormidia. The clustered gonophores are d臨mic, and attached to the base of the siphon in Hippopodius, whilst they are monoclinic and separated from it by a small interval in Polyphyes. Both genera together make up the subfamily Hippopodidae.

The striking contradictions between various authors, respecting the sexual organs of Hippopodius, can be explained only by the assumption that these two similar genera have been confounded. The description which Leuckart has given of the d臨mic cormidia of Hippopodius gleba (8) is as correct as that which Kölliker has given of the monoclinic cormidia of Hippopodius neapolitanus (4). The accuracy of these latter observations has been confirmed recently also by Weismann, in his work on Die Entstehung der Sexual-Zellen bei den Hydromedusen (1883, p. 194). He found in each cormium associated a single female and two male gonophores. Perhaps these differences in the composition of the cormidia of the two genera are more important than those in the form of their neotocophores.

Genus 34. Polyphyes, Haeckel, 1888.
Polyphyes, Hkl., System der Siphonophoren, p. 36.

Definition.—Polyphyide with rounded horseshoe-shaped neotocophores, the ostium of which is surrounded by six prominent apophyses. (Cormidia monoclinic. Gonophores separated from the base of the siphons.)

The genus Polyphyes differs from the preceding closely allied Hippopodius as well in the form of the neotocophores as in the composition of the cormidia. The neotocophores have in general the same horseshoe-shape as in Hippopodius; but in this latter their dorsal face is equally convex and smooth, and passes over into the lateral faces without a sharp edge. In Polyphyes their dorsal face is nearly quadrangular, and separated by two lateral parallel smooth edges from the lateral faces; further, the basal edge of their

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1 8, pp. 299–300, Taf. xii. ffigs. 1–4.  
2 Polyphyes = Animal with numerous buds, πολυφύος.
dorsal face, or the dorsal circumference of the ostium, is provided with four descending lobes or triangular teeth, which are wanting or but slightly indicated in *Hippopodius*. The two basal apophyses of the lateral ventral wings are also more prominent than in the latter, and the mouth of the nectosac therefore surrounded by six teeth. The general form of nectophores in *Polyphyes*, therefore, is intermediate between that of *Hippopodius* and of *Voglia*. Another difference seems to be indicated by the monoclinic cormidia and the position of the gonophores, which are attached to the base of the siphons in the two latter genera, separated from it by an interval in *Polyphyes*. (Compare the preceding description of *Hippopodius*.)

The typical species of this genus, described in the sequel, was observed by me in 1866 in the Canary Islands, and detached nectophores of it found again in the Challenger collection (Station 352, Tropical Atlantic). The characteristic form, however, of the nectophores, with the six strongly prominent teeth, figured in Pl. XXIX., is more developed in the specimens from Station 352 than in those which I observed myself in Lanzerote. These latter approach more to the southern Mediterranean form described by Kölliker as *Hippopodius neapolitanus* (4).

*Polyphyes unguilata*, n. sp. (Pl. XXIX. figs. 1–8).

*Habitat.*—Tropical and Subtropical Atlantic; Station 352, April 13, 1876; lat. 10° 55' N., long. 17° 45' W. Surface.
Canary Islands, Lanzerote; December 1866 and January 1867 (Haeckel).

*Nectosome* (fig. 1).—The swimming column is composed of five or six pairs of obliquely opposed nectophores, the size of which increases from the rounded top towards the bevelled base. The general outline of the compressed nectosome is ovate seen from the broad side, more lanceolate seen from the narrower side. The connection of the united nectophores is very firm, each embracing the base of the superjacent nectophore by the two lateral wings of its ventral groove; and also the opposite basal apophyses of the opposite superior nectophore.

*Nectophores* (figs. 1, 2, lateral view; fig. 3, apical view; fig. 4, basal view; fig. 5, ventral view; fig. 6, dorsal view).—The largest nectocalyces have a diameter of 15 to 20 mm., and possess the form of an inverted horse's hoof, the lower face of which is turned upwards. Five faces may be distinguished in the wedge-shaped horse-shoe, which represents an obliquely bevelled segment of a cone; an inferior basal face, an exterior dorsal face, an interior ventral face, and two paired lateral faces. The basal face, directed obliquely downwards and outwards, contains the reniform or subcircular mouth of the nectosae (figs. 3, w, 4) and the crescentic velum (e); it is surrounded by six prominent paired teeth, four dorsal and two ventral triangular apophyses; the two lateral dorsal
teeth are larger than the two median, and smaller than the two descending ventral teeth (fig. 4, nε, right; nl, left).

Exactly opposite to the basal face of the nectophores is the large axial or ventral groove directed obliquely upwards and inwards; it is limited by two prominent wings, the axial edges of the two paired lateral faces; these wings diverge towards the inferior (ventral) and more strongly towards the superior (dorsal) end of the axial groove, while they approach one another in the middle and at the dorsal corner of the groove (fig. 3). A small and thin triangular lamella, the pedicle of the nectophore, arises in its sagittal plane, in the middle of the axial groove, and is attached to the trunk of the nectosome by its axial apex. Strictly speaking, that part of the axial groove which lies below the pedicle is the ventral, and the opposite part, above the pedicle, the dorsal portion.

The dorsal or abaxial face of the nectophore (superior half of fig. 4) is a convex, vertical, nearly quadrangular plate, limited by four edges, and divided by three nearly parallel ridges into four oblong facettes. Each of these ends below in a triangular descending tooth; the two median teeth being smaller than the two lateral. The opposite superior edge of the dorsal face exhibits an odd median prominence and two smaller paired lateral (fig. 4, above).

The two paired lateral faces of the nectophore (right and left) are oblongish, convex, smooth (figs. 1, 2), and prolonged below into the two ventral teeth, which embrace the common stem of the nectosome. They are separated from the concave axial groove by the prominent edge of the lateral wing, from the convex dorsal face by the vertical lateral edge of the latter.

_Nectosae_ (figs. 2–5, w).—The subumbrellar cavity, which occupies the bevelled basal face of the nectophore, is very shallow (fig. 2, w, in profile). Its wide ostium is subcircular, slightly reniform owing to a small median notch on its ventral side. The muscle-plate of the subumbrella is very thin and weak. The small velum (v) is sickle-shaped, rudimentary in the ventral half, broader in the dorsal half.

_Canals of the Nectophores_ (figs. 2–4, c).—The nectocalycine duct passes from the trunk through the small pedicle of the nectophore directly towards the top of the subumbrella. Before reaching this, it gives off an odd long pallial vessel, which ascends obliquely in the jelly of the umbrela (immediately below the sagittal median line of the axial groove) and ends blindly near the dorsal apex of the nectophore (figs. 2–4, ce). The four radial canals, which arise from the top of the subumbrella and are united by the circular marginal vessel, are of very unequal length. The two paired lateral canals (right and left) are little longer than the short dorsal canal and ascend obliquely upwards, close to the latter. Much longer is the ventral canal (cv), which descends obliquely and before reaching the marginal canal expands in the form of a hexagonal or square ventral sinus (cv'). Its form is very characteristic of the species; it has six prominent corners, two median in the sagittal axis, two smaller ventral and two larger dorsal on both
sides; it occupies nearly the ventral half of the subumbrella. It is relatively three or four times as large as the small ovate or lanceolate ventral sinus of the common Hippopodius gleba. (Compare Leuckart, 8, Taf. xii. figs. 1, 2.)

Siphosome (figs. 1, 7).—The siphosome of Polyphyes ungulata, and its numerous appendages, are very similar to those of the well-known Mediterranean Hippopodius gleba, accurately described by Leuckart (8) and others. An important difference, however, seems to lie in the origin of the clustered gonophores, which are not attached immediately to the base of the siphons (as in the latter), but separated from them by a small interval. The cormidia, therefore, strictly speaking, are not perfectly ordinate, but more or less loose, since the loosely aggregated gonophores alternate with the single siphons. The number of the cormidia is very great in the largest specimens, up to twenty or twenty-five; besides the numerous small buds of developing cormidia, which are crowded at the top of the siphosome (fig. 7, as). The latter is separated from the top of the deflexed nectosome (au) by a small interval. The trunk of the nectosome is coiled spirally around the proximal portion of the trunk of the siphosome.

Siphons (fig. 1, s).—The polypites are in the expanded state about as long as a nectophore, and bear on a small pedicle a subspherical basigaster, followed by a long spindle-shaped stomach; this passes over into a long and narrow, very contractile proboscis, which opens by the terminal mouth. The mouth is often expanded in the form of a circular sectorial disc (fig. 1, ss).

Tentacles (fig. 1, t).—The capturing filament, attached to the pedicle of each siphon, is very long and bears a single series of equidistant tentilla. Each tentillum bears on a long pedicle, which is covered with papillæ (fig. 8, tp), a subspherical or ellipsoidal cnidosac, and attached to its base a long simple terminal filament (spirally coiled up in fig. 8, tf). The cnidosac contains a long, nearly annular cnido-battery, following its dorsal convexity, and composed of very numerous, small paliform cnidocysts (fig. 8, km); and on each side of it a paired lateral patch, composed of four very large ensiform cnidocysts (fig. 8, kl).

Gonophores.—Attached to the trunk, near the pedicle of the siphon, but separated from it by a small interval, are the monoecinic gonophores. Each cormidium bears in the superior part usually a single large female, in the inferior one or two male, gonophores, besides a small number of buds or younger forms. The male as well as the female gonophores have a well-developed umbrella with four radial canals and a ring-canal, and a large, widely prominent manubrium. That of the androphores (h), or the spermarium, is more oblong, spindle-shaped, and about twice as long as the ellipsoidal ovarium, or the manubrium of the gynophores (f). Usually one larger gonophore of each sex, with a very prolonged manubrium, is prominent from a group of smaller gonophores and of buds. The special structure of the gonophores is the same as in Hippopodius gleba. (Compare above, p. 178.)
Subfamily Vogtidae.

Genus 35. Vogtia,\(^1\) Kölliker, 1854.


Definition.—Polyphyide with pentagonal prismatic nectophores, the ostium of which is provided with five prominent apophyses. (Cormidia monoclinic. Gonophores attached to the base of the siphons.)

The genus Vogtia, established by Kölliker for the Mediterranean Vogtia pentacantha, differs from the two preceding genera mainly in the prismatic form of the pentagonal nectophores. Since this difference is similar to that between Diphyes and Praya, it perhaps justifies the distinction of two subfamilies: Vogtidae (derived from Diphyidae) with pentagonal exumbrella of the prismatic nectophores, and Hippopodidae (derived from Prayidae) with an edgeless exumbrella of the rounded nectophores. Probably the general composition of the nectosome as well as of the siphosome in Vogtia is similar to that in Hippopodius. But neither the first description of Kölliker (4), nor the supplementary remarks of Claus (35), and Keferstein and Ehlers (33), are sufficient to give a full idea of its anatomy. The last named authors have described a second species, Vogtia spinosa, from the coast of Brazil (33, p. 24). Similar to this are some scattered nectophores, which I found in the Challenger collection, taken in the South Atlantic (Station 326); they are here described as Vogtia köllikeri.

Vogtia köllikeri, n. sp. (Pl. XXIX. figs. 9–14).

Habitat.—Station 326, South Atlantic; March 3, 1876; lat. 37° 3′ S., long. 44° 17′ W. Surface.

Nectophores (fig. 9, lateral view, right side; fig. 10, oblique lateral view, half dorsal, half right side; fig. 11, basal view of a younger, fig 12, of an older nectophore; fig. 13, ventral view; fig. 14, dorsal view).—The nectocalyces have a cartilaginous consistence, vitreous aspect, and the general form of a flat pentagonal prism. The largest nectophore has a length of 6 mm., a height of 10 mm., and a breadth of 16 mm. The two large terminal faces of the prism are nearly parallel and pentagonal, an inferior (and abaxial) basal face, and a superior (or axial) apical face; this latter contains the broad ventral or axial groove, bounded by the two lateral wings. The five lateral faces of the prism are two paired dorsal, two paired ventro-lateral and an odd medio-ventral face; this latter is the smallest face and deeply bisected.

The basal face of the nectophore (fig. 11, of a younger, fig. 12, of an older specimen) contains in its middle part, nearer the axial side, the ostium of the nectosome (\(w\)); it is

\(^1\) Vogtia, named in honour of Carl Vogt.
slightly concave, smooth, and probably directed (as in *Hippopodius*) obliquely downwards and outwards, in the vertical position of the axis of the nectosome. The opposite, almost parallel, apical face is also smooth, more concave, directed obliquely upwards and inwards; it contains the axial groove, which is limited by the two prominent lateral wings; it passes over downwards into the odd ventral face (fig. 13), which appears bisected by the lowermost part of the axial groove, limited by the two descending ventral teeth (the lowermost parts of the two axial wings).

The dorsal face of the nectophore (fig. 14) is convex, broad and depressed, and bisected by the prominent sagittal crest, which divides it into two paired lateral facettes, densely covered with conical spines (figs. 11, 12). Two strong paired frontal teeth, with a triangular spiny outside (fig. 9), separate the two dorso-lateral facettes from the two ventro-lateral; these are smaller, rather smooth, and separated one from another below by the smaller odd ventral face.

The five edges of the prismatic nectophore, which separate its five lateral faces, correspond to the four edges of the exumbrella of a bilateral Medusa. The odd dorsal edge, prominent in the sagittal median line of the dorsal face, is strongly dentate. The opposite ventral edge is divided by the lower part of the axial groove into the two ventral teeth, which embrace the stem. On both sides, to the right and left, are widely prominent the two triangular, strongly dentate, lateral apophyses which are placed at the opposite poles of the frontal axis; they separate the two dorso-lateral facettes from the two ventro-lateral faces, and correspond to the two lateral dorsal teeth of *Polyphyes*.

The numerous spines which cover the free outside of the nectophores (dorsal and lateral faces) are mammillate or flatly conical, with a small apical point. Their number amounts in each nectophore to more than a hundred.

*Nectosac.*—The subumbrellar cavity is very small, scarcely half as long and broad as the basal face of the nectophore, of which it occupies the axial or inner half (figs. 11, 12). Its wide ostium is reniform, with a deep median notch at the ventral side. The muscular plate of its shallow cavity is weak, the ereecentric or sickle-shaped velum is rudimentary at the ventral side, more developed on the two lateral sides. The nectocalyicine duct, which enters through the axial pedicle into the nectophore, gives off a blind pallial canal in its dorsal part (fig. 12, *ce*), and divides at the top of the nectosac into the four radial canals; three of these (the dorsal and the two lateral) are very short; the fourth (ventral) canal (*cv*) is long, and expands near the circular canal in form of a broad two-winged ventral sinus (figs. 11, 12, *cv″*). The concave dorsal edge of this sinus is smooth, whilst the convex ventral edge is much longer, and irregularly denticulate.
Order III. PHYSONECTÆ, Haeckel, 1888.  
(Pls. VIII.—XXI.)

_Physochoris_, Eschscholtz, 1829, 1, p. 139.
_Physohora_, Goldfuss, Auctt.

**Definition.**—Siphonophore with a pneumatophore and several nectophores (or instead of these bracts), without aurophore. Nectosome composed of a simple, apical, monothalamous pneumatocyst, and beyond it a biserial or multiserial group of nectophores, sometimes instead of these a corona of bracts. Siphosome always with numerous palpons, usually covered with numerous bracts. The trunk of the siphosome is either a single siphon (Monogastrice) or a tubular or vesicular stem, bearing numerous cormidia (Polygastrice). Each cormidium with a single siphon and a single tentacle, a group of palpons and gonophores. The cormidia are sometimes ordinate, at other times irregular.

The order Physonectæ, hitherto usually called Physophoridae, comprises those very numerous and variously organised Siphonophora, which possess a nectosome composed of an apical pneumatophore and a group of nectophores. They agree in this combination with the following order Auronectæ, but differ from these as well in the absence of the aurophore as in the simple structure of the tubular trunk. Sometimes the nectophores are replaced by bracts; but these are also originally nectophores, with a reduced or lost nectosae. A further character common to all Physonectæ is the general presence of palpons or cystons; these are lacking in most other Siphonophora, with the exception of the Cystopectæ. The form of the Physonectæ is rarely simple, and represents a single cormidium (in the monogastric Cirealidæ and Athoridae); usually it is composed of numerous cormidia, which are sometimes ordinate (with free internodia), at other times irregular (with scattered organs). The primary larva is always bilateral, and develops a pneumatophore very early (_Physonula_).

**History.**—The oldest descriptions and figures of Physonectæ are those of Forskål (1775), and relate to three Mediterranean forms, which he united in the genus _Physophora_—_Physophora hydrostatica_, _Physophora rosacea_, and _Physophora filiformis_ (11). The first has been retained as the permanent type of the genus _Physophora_; the second was afterwards called by Eschscholtz (1) _Athorybia_, and the third _Epibulia_; this latter, however, is a _Rhizophysa_, and belongs to the Cystopectæ.

In the beginning of the present century the first observations on Physonectæ were made by Péron and Lesueur. In 1807 they published figures of _Physophora myzonema_ and _Stephanomia amphitrites_ (14, pl. xxix.). An excellent plate by Lesueur, with a splendid figure of _Stephanomia uviformis_ (=_Apolemopsis uviformis_), was unfortunately never published. Afterwards a number of detached portions of Physonectæ, and fragments
of corms were described by Quoy and Gaimard (2, 19, 20) and by Lesson (3, 22); but their figures are so unnatural and incomplete, and their descriptions so superficial and devoid of scientific understanding of the subject, that they have only produced extraordinary confusion and numerous mistakes.

Eschscholtz, the founder of the System der Acalephen (1829), first established the family Physophoridæ, and distinguished it from the other two families of his Siphonophoræ (Diphyidæ and Velellidæ) by this definition:—"The soft body bears at its upper end a swimming-bladder filled with air." He distinguished (1, p. 141) ten different genera; three of these, however, belong to the Cystonectæ, and one to the Calyconectæ, so that six remain; of these, Apolemía and Athorybia are types of two separate families; Agalma and Stephanomía belong to the Agalmidæ; Physophora and Discalæ to the Discolabidæ. The system founded by Eschscholtz was much extended, but not advanced, by Lesson, who in his Acalephæ (1843) gave a most confused compilation of all descriptions published up to his time. Brandt (in 1835) founded the two families Agalmidæ and Anthophysidæ (25). The first good anatomical description of a Physonect was published in 1841 by Milne-Edwards, who illustrated the Mediterranean Stephanomía (= Forskalia) contorta (71). Another excellent paper on Agalmopsis elegans was written in 1846 by Sars (27, i.).

A more accurate knowledge of the peculiar organisation of the Physonectæ, and a more natural explanation of their complicated structure, was not acquired before the sixth decade of this century. At this time Kölliker (4), Vogt (6), Leuckart (5 and 8), Gegenbaur (7 and 10), and Huxley (9) so greatly advanced our knowledge by a series of excellent illustrations and accurate descriptions, that most succeeding observers have only been able to add single particulars. Claus, in his monographs of Physophora hydrostatica (34), Hallistemma terygina (74), and Agalmopsis utricularia (75), advanced mainly our histological knowledge of the Physonectæ; as did afterwards, more especially, Korotneff (1884), but, unfortunately, without sufficient knowledge of their morphological and systematic relations (50).

My own observations on the Physonectæ were commenced in 1859 in Messina, and advanced much in 1866 during my residence at Lanzarote in the Canary Islands. I found here, and still more in 1881 in Ceylon, and during my voyage in the Indian Ocean, the opportunity of examining a number of interesting new forms and even new types of Physonectæ (Circalia, Athoria, Dieyoda, Crystallodes, Anthemodes, Lychnagalma, Neotalia, Discalæ, &c., Pls. XI–XXI). The Challenger collection, however, contained only very few specimens of Physonectæ which were preserved well enough for description; only scattered fragments and detached parts (nectophores, braets, siphons, gonophores) were found in many of the bottles.

Relying on these extended observations, and comparing the numerous scattered descriptions and figures of former observers, I was enabled to establish the new system (Zool. Chall. Exp.—Part lxxvii.—1888).
of Physonects, which I communicated to the Medicin. Naturwiss. Gesellschaft in Jenae on July 8 and November 25, 1887 (95, pp. 38–42). I then gave the definition of twenty-five different genera (ten of which were new), and disposed them in eight families, four of which were new. Four families had already been distinguished by Huxley (9, p. 70), viz.:—(1) Apolemidae; (2) Stephanomidae (=Agalmidae, Brandt); (3) Physophoridae (sensa restricto); and (4) Athorybidae (=Anthophysidae, Brandt). The four new families of my system are—(1) Circalidae; (2) Athoridae; (3) Forskalidae; and (4) Nectalidae.

All authors up to this time have employed for this order the name Physophoridae, given by Eschscholtz (1, p. 139). But this name has become unserviceable, since it is used with no less than four different meanings (95, pp. 38, 41). Huxley applies it to all Siphonophore, with the single exception of the Calycophoridae (9, p. 67). The majority of authors employ the name in the sense of Eschscholtz, comprising not only our Physonectæ, but also the Cystonectæ (fifth order). Chun first separated the latter from the former, and proposed the term Physophoridae for the first, and Pneumatophoridae for the second (86, p. 1168). But, besides, the special family which I call Discolabideæ (XVI) is generally named Physophoridae. To avoid this general confusion, I propose for this order the name Physonectæ.

Nectosome.—The swimming apparatus is composed in all Physonectæ of an apical float or pneumatophore placed at the top of the trunk, and of a variable number of neptophores or swimming-bells, arranged in a variable manner around the trunk; rarely these neptophores are replaced by paddling bracts (Athoridae, Anthophysidae). The Physonectæ have therefore combined in their locomotive apparatus the active swimming-bells of the Calyconectæ and the passive hydrostatic float of the Cystonectæ and Disconectæ. They agree in this combination with the Auronectæ, but differ from these in the absence of the auruphore as well as in the simple tubular trunk and the structure of the siphosome. The physiological function of the two portions of the nectosome is very different; the hydrostatic float is comparable to the swimming-bladder of the fishes, and enables the Physonectæ to rise or descend; whereas the active movements of the neptophores, or the paddling bracts which these replace, effect the voluntary locomotion in every direction.

Pneumatophore.—The float filled with air, rising from the top of the axial trunk, is in all Physonectæ relatively small; much smaller than that of the Auronectæ and Cystonectæ; it rarely attains the size of a neptophore (Circalidae); usually it is scarcely half as large, or less. Whilst the physiological importance of the float rests in its hydrostatic function (as "swimming-bladder"), its morphological nature is explained by its development; the pneumatophore is the modified umbrella of the original Medusa, the manubrium of which is the axial trunk (or the first siphon). (Compare above, p. 11.) Its form is usually ovate, spindle-shaped or pyriform, sometimes subspherical, at other
times cylindrical; it is more or less variable, and may be changed by the contraction of its muscular walls. The apex of the float is usually coloured by pigment (red or brown); sometimes this forms a regular octoradial star, with a colourless centre.

**Pneumatosaccus.**—Since the float is developed by an invagination of the original exumbrella,—comparable to a simple air-secreting gland of the exoderm (p. 12),—the central air-flask or pneumatoceyst, filled with gas, is always surrounded by a double wall; the inner or invaginated wall (comparable to the entoderm of a gastrula) is the pneumatosaccus (or "Luftsack"), which secretes the structureless thin chitin-plate of the pneumatoceyst; the outer or non-invaginated wall (comparable to the exoderm of a gastrula) is the pneumatoceodon (or "Luftschirm"). The cavity between the two walls (cavum pneumatophore) is everywhere closed and filled with the nutritive fluid of the axial trunk, with which it communicates at its distal or basal end. This cavity is usually divided by a number of equidistant vertical septa into radial pouches, which correspond to those in the umbrella of a Medusa (e.g., *Aegina, Camina*). I find constantly eight radial pouches, regularly disposed around the pneumatosac, in the great majority of the Physonectae; the number, however, is not quite constant; single individuals have seven or nine, instead of eight; some species (*Holistemna, Nectulina*) possess only four, other species twelve or sixteen. Sometimes the radial septa divide the whole cavity of the pneumatophore into chambers, at other times only its basal or inferior part; this remains simple in the Athoridae and Apolemidae, where no septa are developed.

**Pneumatoceyst.**—The delicate chitinous air-flask, which is produced (as a cuticle) and immediately surrounded by the exodermal invaginated pneumatosae, seems to be closed in all Physonectae at the apex (or the upper pole of its vertical axis); it is open at its thickened annular base (or the lower pole). This opening is the circular pneumatoceyst or funnel aperture ("Trichterpforte," Chun, 48, p. 512). It corresponds to an annular constriction of the surrounding pneumatosae, by which this is divided into two portions; the larger superior (or apical) portion alone secretes the chitinous plate of the flask; the smaller inferior (or basal) portion secretes no chitinous cuticle, and has a stratified exodermal epithelium of a peculiar shape and a yellowish or greenish colour; this is the important pneumadenia or the "air-funnel," which secretes the gas ("Lufttrichter," Chun, 48, p. 512). The glandular epithelium of the pneumadenia often passes, owing to a secondary growth and further expansion, through the pneumatoceyst into the cavity of the pneumatoceyst and lines its basal portion—usually only one-fourth or one-third of its inner face ("secondary exoderm," Chun, 48). The pneumadenia is then divided by the thickened chitinous ring of the pneumatoceyst into a superior (endoceystal) and an inferior (hypoceystal) portion. At other times the pneumadenia gives off peripheral branches or lateral solid cord-shaped apophyses which enter into the septa and were formerly described as peculiar caecal canals by Claus (74, p. 22) and Korotneff (50, p. 272). This is the case in the Discolabidae (Family XVI.): in these, and perhaps also in other Physonectae, the
funnel-cavity opens outside by a pore (or stigma) in the median line of the dorsal side, on the base of the pneumatosac; the animal can expel the air through this basal stigma voluntarily (compare 33, p. 3, and 84, p. 35).

Nectophores.—The swimming-bells of the numerous Physonectae exhibit a great variety in number, form, and arrangement. They appear to be wanting in two families, the monogastric Athoridae (Pl. XXI. fig. 5) and the polygastric Anthophyside (Pl. XI.); but in reality they are here replaced by paddling bracts, which are nothing else than modified nectophores. One genus only, Dieymba (Pl. XVIII. fig. 1), has two opposite nectophores, similar to Diphyes and Praya among the Calyceonectae; and the same condition occurs in the young larvae of Discolabide (Pl. XIX. fig. 8), and probably of many other Physonectae. Usually the number of nectophores is six to twelve or more, in the largest forms thirty to fifty or more. They are arranged in two longitudinal opposite rows in most Apolemidse, all Agalmine (Pls. XIII.-XVII.), some Nectalidae (Nectalia) and Discolabide (Physophora). Some other genera of the two latter families have four cruciate longitudinal rows (Sphyrophysa and Discolabe, Pl. XIX.). All Forskalide (Pl. VIII.), and Stephanospire among the Discolabide, possess a strobiliform nectosome, with several spiral rows of nectophores, arranged like the scales of a fir-cone. The Circalide (Pl. XXI. fig. 1), finally, are distinguished by the possession of a horizontal corona of nectophores radially arranged, similar to that of the Stephalide (Pl. VII. fig. 39). The same arrangement, either in a single horizontal corona, or in several flat, densely apposed spiral rings, is seen in the numerous bracts of the Athoridae (Pl. XXI. fig. 5) and the Anthophyside (Pl. XI. fig. 1). Sometimes the distal end of these paddling bracts still possesses a rudimentary nectosac (Athoria, Rhodophysa), and thus proves its nature as a modified nectophore.

Umbrella of the Nectophores.—The fundamental form of the umbrella in all Physonectae is bilateral and composed of two symmetrically equal halves (antimeres); but it is at the same time quadriradiial, marked by the four radial canals. Usually its principal axis is more or less obliquely inclined towards the axial trunk, sometimes almost horizontally; so that the position of the proximal apex is higher than that of the distal ostium. The nectophores of most Physonectae are depressed and shortened in the dorso-ventral direction, so that the sagittal axis is shorter than the frontal. Usually there arise from the truncate apex two lateral horns or wings, which embrace the trunk. The ventral (or inferior) face of the umbrella has a concave groove, and from its middle line, near the apex, arises the short pedicle which attaches it to the stem. More rarely (in the strobiliform nectosome of the Forskalide) the pedicle is longer than the nectophore and arises from the very apex. The jelly-substance of the umbrella is usually rather consistent and firm, sometimes almost cartilaginous.

Nectosac.—The muscular subumbrella of the swimming-bells is of very variable size and form, sometimes little smaller than the umbrella, at other times scarcely half as
large. Usually its form is also bilaterally symmetrical, and often divided into three portions; an odd narrow basal part, and two paired apical wings. The pedicular canal, coming from the cavity of the trunk, divides at the top of the subumbrella into four radial canals. Usually the two sagittal canals (shorter ventral and longer dorsal) have a simply curved course in the median plane of the subumbrella, whilst the two paired lateral canals (right and left) are much longer and form several loops. The circular ring-canal, which connects the four radial canals on the ostium of the nectosac above the velum, is usually small. Many Physoneetæ bear a red or brown pigment-spot (ocellus), the point where the radial canals open into the ring-canal. But usually only the two lateral canals, or the dorsal also, exhibit this ocellus, whilst the ventral canal has lost it (Pl. XVIII. fig. 9).

_Siphosome._—The Physoneetæ exhibit very great differences in the form of the siphosome and in its composition from various parts. Accordingly three principal groups (or suborders) may be distinguished in that great order, the Siphostelia, Macrostelia, and Brachystelia. The first group, Siphostelia, are the monogastric Physoneetæ (Circalidæ and Athetaææ), Pl. XXI.; the axial trunk is represented by a single central siphon; from the superior or basal part of this (as from the manubrium of a budding Medusa) arise the buds of the various medusomes, which compose the single cormidium. The two other suborders are polygastric, therefore their corm is composed of numerous cormidia. The second group, Macrostelia, has a long tubular trunk of the siphosome, much longer than that of the nectosome, and the siphons of the cormidia are separated by long internodes (Apolemidæ, Agalmidæ, and Forskalidæ, Pls. VIII., XIV., XVIII.). The third group, Brachystelia, on the other hand, possesses a short vesicular trunk of the siphosome, either a flat sac or a spirally convoluted bladder, and the cormidia are densely apposed one to another, with very short internodes (Nectalidæ, Discolabidæ, and Anthophysidæ, Pls. XI., XIII., XIX., XX.).

The long tubular siphosome of the Macrostelia is very extensible and contractile, and exhibits in the most contracted state (Pl. IX. fig. 6) the same appearance which the Brachystelia offer permanently. The long internodes of the former (similar to those of the Calyconææ) are extremely shortened in the latter. The insertion of the cormidia, however, and of the single parts composing them, is the same in both groups. All parts arise originally by budding from the ventral median line of the trunk, in the same way as the nectophores from the ventral line of the trunk of the nectosome. But when the trunk becomes spirally twisted, then the direction of the spiral turning is usually or always opposite in the two portions of the corm; the spiral of the nectosome is mostly left-handed or deltoidal (like that of the spiral enidobands in the tentilla); the spiral of the siphosome, however, is usually right-handed or deltoidal. The cavity of the axial trunk is continuous in both portions. The original situation of the ordinate cormidia, succeeding at equal distances in the straight median ventral line of the trunk, is
THE VOYAGE OF H.M.S. CHALLENGER.

permanent in two remarkable genera of the Agalmidae, *Crystallodes* (Pl. XVII.) and *Stephanomia* (*Amphitrites*, Péron). The horizontally swimming trunk is here so densely covered with thick prismatic bracts, that it becomes rigid and almost every contraction is excluded, no spiral turning possible.

_Cormidia._—The arrangement of the polymorphous medusomcs in the Physonectae, their composition and metameric succession along the stem, offer numerous important modifications, hitherto much neglected. The general opinion has been up to this time, that in most Physonectæ the polymorphous persons and their organs are intermingled without definite order, and that only in a few cases, as in _Apolemia_ and _Physophora_, they may be disposed according to certain laws, as in the Calyeonectæ (6, p. 311, &c.). But in reality the reverse is the case. The great majority of Physonectæ possess ordinate cormidia, and in the minority only irregular cormidia with more or less scattered parts occur. The cormidia are ordinate and separated by free internodes of equal length in the _Apolemidae_, and _Stephanomidae_ (the first subfamily of Agalmidae); they are also ordinate, but separated by narrow internodes or constrictions of the trunk, in the _Nectalidae_, Diacolabidae, and Anthophysidae. On the other hand, the cormidia are irregularly placed, and the polymorphous parts scattered along the stem, in the _Forskalidae_ (except _Strobalia_) and the _Halistemmidae_ (the second subfamily of Agalmidae).

The cormidia of nearly all Physonectæ are monogastric, with a single siphon and a single tentacle attached to each node of the trunk. A single exception is formed by _Apolemia_ and the closely allied _Apolemopsis_; these possess two to four or more siphons in each ordinate cormidium, and the same number of tentacles.

_Bracts._—Nearly all Physonectæ possess a great number of hydrophyllia, bracts or covering scales; they are wanting in two families only, the _Circalidae_ and the _Diacolabidae_; in the latter they are probably lost by phylegenetic reduction. Usually the bracts cover the entire stem in hundreds or thousands, and arise not only from the nodes of the siphosome, but also from the internodes between them; or even from the pedicles of the siphoms (_Forskalidae_); but sometimes they arise only from the nodes. Their general function is that of protective organs, or shields, which cover the other parts of the corm; in two families, however, the _Athoridae_ and _Anthophysidae_, where nectophores are wanting, the bracts take on besides a locomotor function and become paddling organs (Pl. XXI. fig. 5; Pl. XI. fig. 1). Sometimes the distal end of the bract in this case encloses a small rudimentary subumbrella, and is thus proved to be developed from a reduced nectophore (Pl. XXI. fig. 6). At other times it is possible that each bract may not be homologous with a complete umbrella, but a separate portion of a cleft (e.g., quadripartite) umbrella. Their jelly-substance is always colourless, hyaline, and transparent, usually rather firm, often cartilaginous. Their form is extremely variable. The bracts in the majority of Physonectæ are rather thin scales, lanceolate or triangular plates, more or less foliaceous or squamiform, with a convex upper (or dorsal) and a
concave lower (or ventral) side; the proximal end being attached to the trunk by a short pedicle, which can be raised and lowered by a muscle. The peripheral margin is usually thin, often with a few teeth. Sometimes the dorsal face is provided with a prominent median crest, or a number of parallel or divergent ribs (three to five or more) which are armed with cnidocysts and prominent at the distal end as free teeth. More rarely the bracts are very thick and compact, either roundish clubs (in the Apolemide) or prismatic bodies (in the Crystallodine). In these latter they are so thick and densely apposed one to another, that the movable stem loses its contractility and the siphosome becomes rigid. Each bract contains a simple canal, which arises from the trunk, runs along the ventral side of the bracts (usually in the median line), and ends blindly near to its distal end.

*Siphons.*—The Physonectae have usually large and well-developed siphons, in which the four usual portions or segments may be distinguished; these exhibit, however, a rather various development in the different groups. The pedicle, or the first portion, is usually a short cylindrical tubule; but it is longer in some Agalnidae, and very prolonged (similar to a very long lateral branch of the trunk) in the Forskalidae. The basigaster, the second segment, is usually small, hemispherical or ovate, with a narrow cavity and a thickened exodermal wall, full of cnidocysts; it is often elongated and pyriform, in the Brachystelia (mainly in the Discolabidae). The true stomach, or third portion of the siphon, is usually the largest part, with a wide and very extensible cavity, the exoderm of which is very muscular, the entoderm glandular. The hepatic glands are usually developed in the form of long parallel hepatic ridges, more rarely in the form of numerous scattered hepatic villi, as in the Athetae and Brachystelia (Nectalidae, Discolabidae, Anthophysiidae), also in the gigantic *Bathyphysa* among the Forskalidae. There is, however, no sharp boundary between these two forms of liver; sometimes the hepatic villi are arranged in regular longitudinal series and thus pass over into true liver-ridges ("Leberstreifen"). The number of the latter is usually eight, more rarely four, six, twelve, or sixteen; sometimes four larger perradial ridges alternate regularly with four smaller interradial, and between these are interpolated eight shorter adradial ridges (Pl. IX. fig. 7). The proboscis, or fourth and last portion of the siphon, is usually a cylindrical, very mobile and contractile tube; its distal mouth opening may be expanded in the form of a very large and thin sectorial disc, sometimes circular, at other times polygonal, often octagonal or square. The edge of the mouth is usually armed with peculiar cnidoblasts and palpoblasts. The outside of the siphon is often covered with vibratile epithelium, especially the proboscis.

*Tentacles.*—Each siphon bears a single tentacle attached to its basal portion, either to the distal part of the pedicle, or to the basigaster itself, often in a constriction between them. The tentacles in all Physonectae are very long and contractile, cylindrical, tubular filaments, of the same structure as the trunk, with an outer strong layer of exodermal longitudinal muscles, and an inner thin layer of entodermal circular muscles.
They are simple in one family only, the Apolemidae. In all the other families they bear a series of equidistant lateral branches or tentilla. These are rarely quite simple secondary filaments (Cirrulida). Usually each tentillum is divided into three portions, a basal pedicle, an intermediate cnidoband, and a terminal filament; this latter is either simple or multiple. The greatest variety of structure and form is exhibited by the middle part, the cnidoband (sacculus, "Nesselknopf"), and this presents the chief characters for the distinction of genera. The basal pedicle is always a simple cylindrical tubule, often dilated or vesicular at the distal end.

The cnidoband or cnidonode (cnidosae, sacculus, "Nesselknopf"), the middle and most important portion of the tentillum, is originally nothing more than a dilatation of the middle part of the simple filiform and tubular tentillum, produced by the unilateral development of larger cnidocysts in its wall. Then follows the dislocation of the central canal, which becomes excentrically placed; next a bilateral form, and soon a spiral twisting of the dilated portion. That side, in which the excentric canal runs, is the ventral side of the cnidoband, the opposite, in which the cnidobattery (or the accumulation of larger cnidocysts) is placed, is the dorsal side. Between them is developed the elastic "angleband," a group of two or four parallel elastic ribands. The excentric canal, also more or less coiled, runs in the axis around which the cnidoband is twisted. The spiral is always a left-handed, or lamelloidal. The cnidocysts which compose the cnidobattery are usually of two kinds, very numerous small and paliform, and a smaller number of large ovate or ensiform thread-cells; the latter are arranged usually in two lateral rows on the proximal part of the enidobattery.

The spiral cnidoband is usually coiled up in three or four left-handed turnings; but sometimes it makes six to eight turnings or even more. It remains naked, without involucrum, in Athoria (Pl. XXI. fig. 8), Halistemma, the Forskalidae (Pl. X. fig. 23) and in part of the Anthophysiidae (Rhodophysa). In the majority of the Physonectae there is developed around its proximal end a peculiar involucrum, covering it like a cap or hood; it is a solid annular fold of the exoderm, which arises from the distal end of the pedicle and grows distally. Claus maintains that this envelope "evidently corresponds in morphological relation to the umbrella of a Medusa" (74, p. 2); but their likeness is merely external. The involucrum is nothing more than a simple protecting mantle for the naked cnidoband. At first it envelops the proximal base only (Stephanomia, Cupulita, Anthemodes, Pl. XV. fig. 11, &c.), but afterwards it grows around the entire cnidoband and envelops it distally as an external capsule. The most complicated structure is exhibited by the involucrum in the Discolabidae; where it often bears a pair of red lateral ocelli (Pl. XX. fig. 14); the convex dorsal side is here so strongly developed, prolonged and much twisted, that the cnidoband is recurved and its distal end placed near the proximal base on the contracted ventral side; the terminal filament becomes reduced in this case and finally disappears.
The simple terminal filament is permanent in the majority of the Physonectae (in all Forskalide, a great part of the Agalme, Stephanome, Anthemodes, Pl. XV. fig. 11, Cupulita, &c.), some Anthophyside, &c. But in another great part of the genera it becomes tris or developed in the form of three terminal appendages, an odd median vesicle (or terminal ampulla) and two paired lateral filaments or horns (Crystallodes, Pl. XVII. figs. 4, 5, Agalma, Pl. XVIII. fig. 14, Agalmopsis, &c.). To these three appendages is added in Athorybia a peculiar conical solid appendage, a dorsal spur (Pl. XII. figs. 12, 13, tf), and in the closely allied Anthophysa a pair of two lateral palmate appendages on the dorsal side. The remarkable Agalid Lychnagalma is distinguished by a large hydrostatic terminal ampulla, and a corona of eight radial filaments surrounding it (Pl. XVI. figs. 1, 9).

Palpons.—Hydrocysts or tasters are generally present in all Physonectae, and usually in far greater number than the siphons, so that each cormidium possesses a group of several palpons (Pl. XII. figs. 7-9, q); Pl. XVIII. fig. 2, q, &c.). The true palpons or tasters are, however, often confounded with other organs, especially with the cystons and even with the tentacles (Chaus, 34, 35, &c.). The true palpons are mouthless, cylindrical, pyriform or spindle-shaped tubes, which morphologically correspond to the manubrium of a Medusa, but not to the tentacle. They differ from the siphons as well as from the cystons, in the absence of a distal opening; also from the former in the simpler structure of their thin very contractile wall, and especially in the absence of hepatic glands, and of a basigaster. Sometimes, however, two annular constrictions are more or less distinct, so that a short pedicle, a middle main part and a distal appendage or terminal ampulla may be distinguished. The latter often exhibits various structures, an accumulation of terminal cnidocytes, of pigment, of palpoblasts, &c. The main function of this distal part seems to be sensory, mainly feeling; sometimes an ocellus is developed on its dorsal side, provided in some species with a small lens (Pl. XI. fig. 4, qo); at other times the spherical distal end is separated by a constriction from the main part and contains a group of crystals or concretions, rotated by vibratile epithelium, thus resembling an otocyst. The largest palpons are developed in the Discolabide (Pl. XIX. fig. 1), where they replace the missing bracts; they form at the proximal end of the siphosome a corona of very large and thick-walled protecting tubes, which are at the same time vigorous capturing arms; each ordinate cormidium possesses either two palpons (Physophora) or a single large one (Discolabe). Another part of the palpons has a direct relation to the gonophores, and the gonostyles may be originally always sexual palpons. These latter have often a peculiar structure and may be distinguished as gonopalpons. Those corms of the Physonectae which have ordinate cormidia usually possess a constant number of palpons attached above the base of the siphon; in those corms, however, in which the cormidia are dissolved, usually very numerous palpons are scattered along the whole trunk of the siphosome.

(2001. CHALL. EXP.—PART LXXVII.—1888.)
Cystons.—Numerous Physonectæ, mainly the Macrostelia (Apoleniaæ, Agalmiæ, and Forskalidaæ), possess cystons or anal vesicles, excretory polypites which occur in no other order of Siphonophoræ. They have hitherto been confounded with the similar palpons, although some authors have observed the distal opening, by which fluid and crystalline excretions are ejected. The cystons differ from the similar but smaller palpons essentially in the possession of the distal opening, which may be closed by a muscular sphincter, and with respect to its function called an anus (Pl. XV. figs. 8, 9, yq). They seem to differ further in the peculiar structure of the wall, which is often intensely coloured (Pl. XVIII. fig. 2, y) and glandular, at least in the distal part. The characteristic hepatic glands of the siphons, however, are wanting. The cystons are therefore excretory polypites, which in morphological relations are intermediate between the digesting siphons and the feeling palpons. I have never observed more than a single cyston in each monogastric cormidium. In the polygastric cormidia of the Apolentaæ the number of cystons seems to correspond to that of the siphons.

Palpæcles.—Usually in the Physonectæ each single palpon, as well as cyston, is provided at its base with a long palpacle, or a simple "accessory tentacle." It is a very slender, never branched, cylindrical tube, the thin wall of which contains small cnidoblasts and palpoblasts. It is in perpetual motion, and its function is mainly sensory. Perhaps these feeling filaments ("Tastfäden") are generally distributed among the Physonectæ; they are not observed in various genera, but it may be possible that here they have been either overlooked or lost accidentally.

Gonodendra.—Nearly all the Physonectæ have monoeocious corms, male and female gonodendra being developed from the same trunk. There are two exceptions only where the corms are dioecious:—Athoralia among the monogastric, and Apolentia among the polygastric Physonectæ; in these two genera each corm bears either male or female gonodendra.

The ordinate cormidia are usually monoeclin, each provided with two gonodendra, a male and a female, which arise separately from the node of the trunk (Pl. XVIII. fig. 2; Pl. XX. figs. 9–16). Usually here the female is placed more proximally (near the palpon) and the male more distally (near the siphon). These gonodendra may be called distylie, since their stems or gonostyles are two independent branched palpons. There occur, however, sometimes monostylie gonodendra, where the basal part of the single branched gonostyle bears female, and the distal part male gonophores. This is the case in Forskalia (Pl. X. fig. 21; compare Kölliker, 4, Tab. ii. fig. 1).

The irregular cormidia are sometimes monoeclin, at other times diclinie; in the former male and female gonodendra occur scattered over the same internode; in the latter arising separately from different internodes. In many Physonectæ with irregular cormidia (mainly Halistenmiidae) very numerous gonodendra of both sexes are scattered irregularly along the whole trunk.
Gonostyles.—The stems of the gonodendra, which bear the clustered gonophores, and which we call gonostyles, are sometimes themselves simple palpons, at other times branches of sexual palpons, or in a peculiar manner combined with sterile palpons. The ramification is in most Physonectae not very rich (mainly in the males), and not to be compared with that of the Cystonectae. There are, however, exceptions, as in the female gonodendra of some Discobolidae (Pl. XX. figs. 11–16). The male gonostyles of the latter exhibit a peculiar appearance, since their distal part, after the detachment of the ripe androphores, is covered with tubercles (as the remaining pedicles of the latter), whilst the proximal part produces vicarious gonophores.

Gonophores.—The medusiform gonophores of the Physonectae are in general of small size, especially the females. Their umbrella is sometimes well developed, with four equidistant radial canals and a marginal ring-canal, whilst at other times it is more or less reduced, and sometimes rudimentary. The manubrium is larger in the androphores, where it is usually club-shaped or cylindrical, with a central spadix; often coloured white, yellow, or red; it is often very prominent from the narrow mouth of the reduced umbrella (Pl. XII. fig. 17; Pl. XVIII. fig. 17, &c.). The manubrium of the gynophores is much smaller, ovate or subspherical, and develops constantly a single large ovum only. This is often surrounded by an irregular network of peculiar anastomosing canals (Pl. XV. fig. 15; Pl. XVIII. fig. 16). These “spadice canals” arise by a peculiar process: the original central spadix in the axis of the young ovarium becomes excentric by the unilateral development of a single large ovum; it grows around the latter in the form of a hemispherical cup, and envelops it finally like a capsule; by the partial irregular concrescence of its two walls arises the reticulum of canals, which is called "netzförmiges Canal-System" by German authors.¹

Ontogeny.—The development of the fertilised egg is hitherto known in the case of only very few Physonectae. The first observations on it were made by myself in the Canary Island Lanzarote, in December 1866, and January and February 1867. I was able to observe there the embryonic development and the metamorphosis of Physophora magnifica, Crystallodes rigida, and Athorybia ocellata (84, Tafs. i.–xiv.). Further observations were published in 1874 by Metschnikoff, who illustrated the ontogeny of Halistemma rubrum, Cypulita picta, and Agalmopsis sarsi (85, Tafs. viii.–xii.). The embryology of Agalma elegans was afterwards described by Fewkes (89, pls. i.–iv.). Judging from these few observations, it seems that the Physonectae are subject to a rather complicated metamorphosis and produce medusiform larvae, the morphological value of which is probably very great for their phylogeny. Usually these monogastric larvae ( Physonula) develop the pneumatophore from their exumbrella very early, and around it a corona of provisional bracts. (Compare Family XI., Athoridae, p. 200, and Pl. XXI. figs. 5–13.)

Synopsis of the Eight Families of Physonectae.

**Physonecte monogastrica**, with a single siphon and a single tentacle (*Siphonestella*).

- Nectosome with a corona of nectophores, without bracts, . . . . 10. Circalidae.
- Nectosome with a corona of bracts, without nectophores, . . . . 11. Athetaeidae.

**Physonecte polygastrica**, with numerous siphons, each of which is provided with a tentacle.

- Siphosome with a long tubular stem, longer than the axis of the nectosome (*Macrostella*).
  - Nectosome biserial, with two opposite rows of nectophores.
  - Pneumatophore without radial pouches.
- Nectosome multiserial, strobiliform, with several spiral rows of nectophores, . . . . 14. Forskalidae.
- Siphosome with a short vesicular stem, shorter than the axis of the nectosome (*Branchystella*).
  - Nectosome with two, four, or more rows of nectophores.
  - Siphosome without bracts, . . . . 15. Nectalidae.
  - Nectosome without nectophores, instead of these a corona of bracts, . . . . 17. Anthophysidae.

Family X. **Circalideae**, Haeckel, 1888.

*Circaalia*, Hkl., System der Siphonophoren, p. 38.

**Definition.**—Physonectae monogastricae without bracts, with a corona of nectophores which surrounds the pneumatophore, and a corona of palpons which surrounds the base of the single siphon and the single tentacle. Pneumatophore with radial pouches.

The family Circalideae is founded by me for the new genus *Circaalia*, and comprises those monogastric Physonectae which possess an upper corona of nectophores around the apical pneumatophore, and a lower corona of palpons around the basal siphon. They are similar to the polygastric Discolabidae, and may be compared to a *Stephanospira* which has developed a single siphon only and a single spiral row of nectophores.

The single specimen of *Circaalia* which I have been able to examine living was observed by me in September 1869 on the west coast of Norway, off the mouth of Sogne Fjord; it is figured in Pl. XXI, figs. 1–4. But perhaps there belongs to the same genus (or forms a new closely allied genus) another, larger, monogastric Physonect, which was captured in August 1826 by Captain Dumont d'Urville in the Atlantic Ocean (lat. 30° S., long. 15° E.). It is described and figured by Quoy and Gaimard under the name *Physophora alba*.1 L. Agassiz afterwards established for it the genus *Haplorhiza* (a name previously employed for a Rhizostomid) (36, p. 368). According to the description

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1 Voyage de "l'Astrolabe " (Zoophytes), p. 53, pl. i, figs. 1-9.
of the French observers, the apical pneumatophore was surrounded by a corona of five nectophores, and the single large basal siphon by a corona of numerous palpons; two tentilla are figured, but probably these were only parts of a loop of a single one. The tentilla, however, arranged in a single long series along the tentacle, were not simple lateral branches as in our Circalia stephanomata, but provided with an ovate endosac at the distal end. It is possible, therefore, that this Circalia haplorhiza represents another genus of Circalidae; it may be called provisionally Circionalia.

Another monogastric Physonect, which is very similar to Circalia, and inhabits the western part of the Gulf Stream (near the Tortugas Reefs, Florida), has recently been described by Fewkes under the name Agalma papillosum. Its nectophores are papillate, and the tentilla, which form a long series on the single tentacle, are tricornuate with a median terminal ampulla and two lateral horns at the distal end of the spiral endosac (as in Agalma, Agalmopsis, &c.). But since no gonophores were observed on this remarkable form, it is perhaps only the larva of another Physonect.

The single cormidium, which represents the mature corm of Circalia, is of great interest on account of its typical simplicity and its morphological relations to other Siphonanths, especially to the Discalidae (Physophora, Stephanospiria) on one hand, and to the Rhodalidae (Stephalia, Rhodalia) on the other hand. The entire cormidium may be compared with a Medusa, which has preserved the original simple manubrium (the central siphon), but whose umbrella has been transformed into a pneumatophore, and produced by budding (from the base of the manubrium) a corona of radial medusomes (eight in Circalia stephanomata), each medusome being composed of a proximal nectophore and a distal palpon (or a pair of palpons), and beyond this a gonodendron.

It is perhaps a fact of great morphological value, that the octoradial type of Medusa in Circalia is expressed not only in the structure of the pneumatophore (with eight radial pouches of the cavity, and eight pigment-rays at the apex), and of the single central siphon (with eight liver-ridges and eight mouth-lobes), but also in the composition of the nectosome (with eight radial nectophores) and of the siphosome (with sixteen palpons and eight gonodendra); these latter numbers, however, may be accidental.

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.


*Circalia,* Hkl., System der Siphonophoren, p. 38.

Definition.—Circalidae with a single corona of nectophores radially arranged around
the pneumatophore, and with a series of simple filiform tentilla on the single tentacle.

The genus *Circalia* (Pl. XXI. figs. 1–4), as the single known genus of Circalidae,
possesses the characters of the family described above. As a peculiar character of the
genus may be pointed out the remarkable composition of the corona of (eight) radial
nectophores, similar to that of *Stephalia* (Pl. VII. figs. 39, 48). Another character of
generic value may be the simple tubular shape of the tentilla, or the filiform lateral
branches of the single tentacle (similar to *Nectophysea vireillei*, Pl. XXIII. fig. 5). It
differs in this from the similar *Circonalia haplorhiza* (=Physophora alba, Quoy and
Gaimard, 2). Compare above, p. 197.

*Circalia stephanoma,* n. sp. (Pl. XXI. figs. 1–4).

Habitat.—North Atlantic, west coast of Norway, near the Sogne Fjord; September
1869 (Haeckel).

Nectosome.—The swimming apparatus has a diameter of about 5 mm., and is composed
of a large apical pneumatophore and a corona of eight nectophores radially arranged
around it. These are attached by short ventral pedicles to a central axial trunk, the
uppermost dilated part of which is the pneumatophore, whilst the lower part of the
trunk passes over directly into the base of the siphon. From the dorsal side of the latter
arises the single tentacle, whilst in the median line of the opposite ventral side (between
the two ventral nectophores) a small group of young buds is visible.

Pneumatophore.—The float at the apex of the trunk is pyriform or subspherical,
of about the same size as the nectophores (2 or 3 mm. in diameter). Its apex bears
a ventral depression or umbilicals (perhaps the closed opening?) and around this a red-
brown pigment-star, composed of eight equidistant triangular rays. The basal half exhibits
eight longitudinal grooves, the insertions of the radial septa which divide the cavity of
the pneumatophore into eight radial pouches (fig. 4, pq, in horizontal transverse section).

Nectophores (figs. 1, 2, n).—The eight swimming-bells which compose the octoradial
corona around the central pneumatophore are of rather regular campanulate form.

1 *Circalia* = Marine corona, κίρας; κίρας.
Their principal axis is longer than the transverse axis, and is directed obliquely from above downwards and outwards. The dorsal or superior face is convex in the proximal, concave in the distal part. The opposed ventral or inferior face is more concave, with a ridge in the middle line; from the upper or apical part of this ridge arises the short pedicle which attaches the nectophore to the axial trunk. Their jelly-umbrella is rather thin, but firm. The nectosome is large; its four equidistant radial canals are of nearly equal length and run in a simple curve (without loops) from the top of the subumbrella (where the pedicle canal enters) towards the basal ostium; they are here united by a circular ring-canal, above the small velum.

_Siphosome._—The basal part of the monogastric corm, below the nectosome, is composed of a single, very large central siphon, and a corona of numerous palpons which surround its proximal base; each palpon bears a simple palpacle, whilst the siphon bears at its dorsal side a single very long tentacle, beset with a row of numerous tentilla. The basal part of the siphon, immediately below the palpons, is surrounded by a corona of gonophores. The diameter of the siphosome in the expanded state is about 10 mm.

_Siphon_ (s).—The large central polypite, which represents the axial trunk of the monogastric corm, is divided into four segments. The first and uppermost segment, comparable to the pedicle of the siphons of the polygastric Siphonanthse, is a cylindrical vertical tube, to which are attached three coronas; the upper corona composed of nectophores, the middle of palpons, and the lower of gonophores. Below this follows the second segment, corresponding to the basigaster, a small ovate dilatation with a thickened wall full of cnidocysts. The third segment is the large spindle-shaped stomach, the wall of which exhibits eight equidistant red-brown villous hepatic ridges (sh). The fourth and last segment is the distal proboscis (sr), a very contractile cylindrical tube with eight strong longitudinal muscle-bands. Its terminal mouth opening exhibits eight rounded radial lobes (ss).

_Tentacle_ (t).—The single large tentacle, which arises from the base of the siphon on its dorsal side, is a very long cylindrical tube, furnished with a single series of very numerous tentilla (ts); these are simple thin lateral branches of the tentacle, densely covered with small ovate cnidocysts. The structure of the tentacle is similar to that of _Nectophyse wyvillei_ (Pl. XXIII. figs. 5, 6).

_Palpons_ (q) and _Palpacles_ (r).—The corona of palpons which is expanded around the base of the siphosome, immediately below the nectosome, is very similar to that of the Discobabidae. It is composed (in the single specimen observed) of sixteen to twenty—or perhaps more—cylindrical tubular palpons, tapering towards the two ends; the proximal end is rounded and attached by a short and thin pedicle to the axial trunk; the distal end is closed, pointed, and armed with a group of cnidocysts. From the dorsal side of the basal pedicle arises a long and very movable palpacle, a thin cylindrical tubule, the wall of which contains small cnidocysts.
Gonodendra.—The corm is monocious and monoclinoic, and bears numerous gonophores of both sexes, densely crowded beyond the corona of palpons, and forming an inner corona around the base of the siphon. At the first glance I supposed that this corona was composed of two large gonodendra only, a male and a female. A closer examination, however, of the well-preserved spirit specimen, informed me that it was composed of eight small gonodendra, four males (fig. 3, k) and four females (fig. 3, f) alternating. The umbrella is well developed in both sexes, with four radial canals and a ring-canal. Each gynophore contains a single large ovum, each androphore a club-shaped spermarium with a central spadix.

Family XI. Athorideæ, Haeckel, 1888.

Athorideæ, Hkl, System der Siphonophoren, p. 38.

Definition.—Physonectæ monogastrice without nectophores, with a corona of bracts which surrounds the pneumatophore, and a corona of palpons which surrounds the base of the single siphon and the single tentacle. Pneumatophore without radial pouches.

The family Athorideæ comprises some small, hitherto undescribed Physonectæ, which are in general similar to Athorybia or Anthophysa, but differ essentially from them in the possession of only a single siphon. They agree with these Anthophysidae (Family XVII.) in the absence of nectophores, which are replaced by a corona of bracts. On the other hand, they are similar to those well known Athorula-larvae, or "Athorybia-like larvae," which are developed from the fertilised egg of certain Physonectæ, especially Agalmideæ. Compare Vogt (6, pl. x. figs. 32–37), Gegenbaur (7, Taf. xvi. fig. 11), Claus (35, p. 557, Taf. xlviii.), Haeckel (84, Tafs. vii., viii., ix., fig. 60), Metschnikoff (85, Tafs. ix., xi.), Fewkes (89, pl. iv.).

The resemblance of the monogastric Athorideæ to these larvae of polygastric Agalmideæ, and the morphological likeness of their structure, make it probable that the former are either remnants of the ancestral forms of the latter, or that they are larval forms which under certain conditions sometimes attain sexual maturity (Pædagogenesis). A further accurate examination of these interesting small Physonectæ, and a complete knowledge of their anatomy as well as ontogeny are required to recognise their relations to the other families of this order.

Two different forms of Athorideæ were observed by me in 1881 during my residence in Ceylon. The first and larger, Athoridalia coronula, was very similar to a small young Athorybia (Pls. XI., XII.); it will be described on another occasion. The second and smaller form is described in the sequel as Athoria larvalis (Pl. XXI. figs. 5–8); it differs from the former in the possession of a small rudimentary nectosac at the distal
end of the bracts, similar to that which is found in some Athorula larvae of Agalminae (Pl. XXI. figs. 7, 10, 12). Another similar form, but with more numerous and slender bracts, was found in a preparation in the Challenger collection (Athoria bractealis). It was insufficiently preserved. Possibly these small and delicate Physonecetes have already been seen by former observers, but regarded as mere larvae.

The entire eorm of these monogastric Athorideae represents a single cormidium, and may be regarded as a medusome, the umbrella of which is the pneumatophore, and the manubrium the central siphon. From the proximal base of the latter is produced by budding a corona of secondary medusomes; each of these is again composed of a modified umbrella (the bract) and a manubrium (the palpon); the palpaele, which is attached to the base of each palpon, is the persistent tentacle. The gonophores, which are developed beyond the palpons, represent a second corona of medusomes, which become sexually mature. The small nectosae which occupies the distal end of the bracts in Athoria is of special interest, since it demonstrates that the bracts are modified umbrella.

Synopsis of the Genera of Athorideae.

Bracts with a rudimentary nectosae on the distal end. Corms monoeocious. Tentilla without involucrum, ................................. 37. Athoria.


Athoria, Hkl, System der Siphonophoren, p. 39.

Definition.—Athorideae with a rudimentary nectosae at the distal end of the bracts. Tentilla with a naked spiral cnidoband, without involucrum. Corms monoeocious.

The genus Athoria is remarkable for the possession of a rudimentary subumbrella, a small campanulate nectosae at the distal end of the bracts; its mouth is armed with four groups of cnidocysts which may be regarded as small rudiments of tentacles. They agree in this character with the genus Rhodophyse among the Anthophysidae (Genus 58) and with the Athorula larvae mentioned above (p. 200). The tentilla are similar to those of Halistemma and Forskalia, with a naked spiral cnidoband. Athoria larvalis (Pl. XXI. figs. 5–8) was observed living by me in Ceylon. A similar species, but larger, with more numerous and slender bracts, was found in a mounting of the Challenger collection (from Station 288, South Pacific). It was not well enough preserved to be described and figured.

1 Athoria, name of an Oceanid, 'Athéa.'

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)

Hhhh 26
**Athoria larvalis**, n. sp. (Pl. XXI. figs. 5–8).

**Habitat.**—Indian Ocean; Belligemma, Ceylon, December 1881 (Haeckel).

**Nectosome.**—The swimming apparatus is composed of an apical pneumatophore and a corona of fifteen to twenty large bracts; these are attached by the pointed end of a pyramidal pedicle to the axial trunk, immediately below the base of the float. They are raised and lowered by special muscles in the same manner as in the similar Anthophysidae. The thick bracts are therefore not only protective but also paddling organs, as in *Athorybia*. The diameter of the entire nectosome is 5 to 6 mm.

**Pneumatophore** (figs. 5, 6, p).—The apical float is of medium size, pyriform, with rounded top and dilated basal part. The latter is divided by a horizontal annular constriction (or pneumatic pylorus) into an upper and a lower cavity; the greenish epithelium of the latter is the pneumadenia. A chitinous pneumatocyst (fig. 6, pf) was recognisable in the upper part. The pericystal cavity of the pneumatophore (pc) is simple, without radial septa; similar to that of the Apolemidae.

**Bracts** (figs. 5, 6, b).—The large hydrophyllia are five-sided, prismatic, with five prominent convex edges, about three times as long as thick. An odd superior or dorsal edge, and the two parallel dorso-lateral edges are elegantly denticulate, whilst the two inferior or ventro-lateral edges are smooth. The ventral or axial face between the last is concave. The proximal fourth of the bract is a five-sided irregular pyramid and its apex prolonged into the short pedicle, which attaches the hydrophyllum to the trunk. The distal third is obliquely truncated and contains a small hemispherical or campanulate cavity (fig. 6, bs). This is the rudimentary subumbrella, the muscular nectosae of which is preserved. The simple bracteal canal (bc) which enters by the pedicle, runs along the middle line of the concave ventral face and touches the top of the subumbrella; four very small radial canals (cr) seem to arise from it, run along the nectosae towards its small distal ostium, and are there connected by a small ring-canal. The four equidistant points, where they open into the ring, are armed with a small cnidodone (k), which is composed of four cnidocysts (rudiments of lost tentacles?).

**Siphosome.**—The inferior part of the corm, beyond the superior corona of bracts, is composed of a large central siphon and a corona of palpons which surrounds its proximal base. From this arises a long tentacle, beset with a series of tentilla. Each palpon bears at its base a simple palpaede. A pair of gonostyles is attached on each side of the trunk of the siphonal pedicle, between the palpons and the basigaster. The male gonophore lies on the left and the female on the right side of the siphon, whilst the insertion of the tentacle occupies the middle of the dorsal side of its base, and a small group of buds the middle line of its ventral side. The frontal section in fig. 6, which exhibits these topographic relations, is semi-diagrammatic.
REPORT ON THE SIPHONOPHORÆ.

Siphon (figs. 5, 6, s).—The large central polypite which represents the axial trunk of the monogastric corm is composed of four distinct segments. The first and uppermost segment, which corresponds to the pedicle of the siphons in the polygastric Siphonanthæ, is a vertical spindle-shaped tube which passes over above into the pneumatophore, below into the basigaster. From this basal segment (at) arise three coronas of lateral appendages, the upper corona of bracts (b), the middle corona of palpons (q), and the lower corona of gonophores (f, h). The second portion of the siphon is a pyriform basigaster (sb), the thick exoderm wall of which is filled with cnidocysts. The third and largest segment (sm) is the wide cylindrical or spindle-shaped stomach; its thickened eutoderm bears numerous conical glandular villi, which usually contain one or two glossy, strongly refracting globules (vacuoles ?). The fourth and last segment is the distal proboscis (sr), a very contractile and muscular cylindrical tube which opens through the distal mouth; this may be expanded in the form of a broad lobulate suctorial disc (ss).

Tentacle (figs. 5, 6, t).—The single capturing filament, which arises from the base of the siphon on its dorsal side, is a long cylindrical tube and bears a series of very numerous tentilla. These are composed of three parts, a slender proximal pedicle (fig. 8, ts), a broader cnidoband in the middle (tk), and a simple thin terminal filament (tf). The cnidoband is naked, without involucrum (as in Rhodophysa, Forskalia, and Halistemma); it is a simple spiral, like a cork-screw, with four or five turns.

Palpons (fig. 6, q) and Palpacles (r).—The palpons are attached to the axial trunk immediately below the bracts and seem to correspond in number to the latter (fifteen to twenty). They may perhaps be regarded as the dislocated manubria of the medusomes, the transformed umbrellas of which are the bracts. Each palpon is a very retractile cylindrical tube, tapering towards the two ends. The open proximal end is attached by a short pedicle to the trunk and communicates with its cavity; the closed distal end is pointed and armed with a bunch of cnidocysts, and coloured with bright-red pigmentspots. From the pedicle arises on its upper or dorsal side the palpacle, a long, thin, simple filament, beset with small cnidocysts (fig. 6, r).

Gonodendra.—Below the corona of palpons, between it and the basigaster (sb), is attached to the trunk an annular group of small buds. These seem to develop into gonophores; but only two small gonodendra were developed in the specimen figured, a male and a female. These were so disposed symmetrically, that the female gonophore (fig. 6, f) occupied the right side, and the male gonophore (h) the left side of the basigaster. The clustered gonophores were small and very numerous, with a well-developed umbrella, four radial canals, and a ring-canal. The female manubrium is subspherical and contains a single large ovum; the male manubrium is club-shaped and the central spadix surrounded by ripe sperm.
Genus 38. \textit{Athoralia}, Haeckel, 1888.

\textit{Athoralia}, Hkl., System der Siphonophoren, p. 39.

\textit{Definition.}—Athoridae without a nectosac at the distal end of the bracts. Tentilla with an involucre around the spiral enidoband. Corms dioecious.

The genus \textit{Athoralia} differs from the preceding similar \textit{Athora} in three characters. The rudimentary nectosac, which occupies the distal end of the bracts in the latter, is wanting in the former; the corms are dioecious; and the enidoband of the tentilla is not naked, but enveloped by an involucrum. \textit{Athoralia}, therefore, has a relation to \textit{Athora} similar to that which \textit{Athorybia} exhibits to \textit{Rhodophyza}. A single species only, \textit{Athoralia coronula}, was observed by me, in December 1881, during my residence in Ceylon. It was very similar to a small young \textit{Athorybia}, but possessed a single siphon only, with a single tentacle. Three specimens of it were captured, one male and two females. The former possessed a single small gonodendron, composed of about a dozen club-shaped spermaria, besides a number of young buds. Each of the two females had also only a single gonodendron, composed of numerous clustered, very small gynophores, each containing a single ovum. \textit{Athoralia coronula} is therefore one of the rare dioecious Physonectae, like \textit{Apolemia}.

Family XII. \textit{Apolemidæ}, Huxley, 1859.

\textit{Apolemidæ}, Huxley, Oceanic Hydrozoa, pp. 70, 127.

\textit{Definition.}—Physonectæ polygastricaæ, with a long tubular stem of the siphosome, bearing numerous siphons, palpons, and bracts, each siphon provided with a simple unbranched tentacle. Nectosome biserial, with two opposite nectophores or two alternate series of opposite nectophores. Pneumatophore without radial pouches.

The family Apolemidæ, founded by Huxley upon the single genus \textit{Apolemia}, comprises those Physonectæ which possess a biserial nectosac and a long tubular stem of the siphosome, similar to the Agalmaidæ. They differ, however, from these latter in two important points. The pneumatophore is a simple glandular invagination of the top of the trunk, whilst in the Agalmaidæ the pericystic cavity is divided by vertical septa into radial pouches. Further, the tentacles in the former are simple, not branched filaments, whilst in the latter they bear a series of lateral branches or tentilla, each provided with a cnidobattery.

The first Siphonophore belonging to this family was observed in the North Atlantic by Lesueur, who in 1813 executed a large and excellent picture of it, drawn and engraved by himself from life. He called it \textit{Stephanomia uiformis} (not \textit{uvaria}). Eschscholtz observed the same animal in the North Atlantic, and recognising it in the

\textsuperscript{1} \textit{Athoralia}, derived from \textit{Athora}. 
unpublished plate of Lesueur, founded upon it a new genus, *Apolemia uvaria* (1829, 1, p. 143). Blainville copied in 1834 a part of Lesueur's splendid figures in his Actinologie (24, pl. iii. fig. 1), and Lesson copied the description of it and named it "*Apolemia Lesueuria*" (3, p. 518). I myself obtained in 1878 at Paris, owing to the kindness of Professor Perrier, a copy of Lesueur's beautiful plate, and on comparing it with the Mediterranean *Apolemia uvaria*, was convinced that these two forms are not identical, as preceding observers had supposed, but belong to different species or even genera.

The Mediterranean *Apolemia uvaria*, the largest Physonect of this sea, was described in the years 1853 to 1863 by Kolliker (4), Vogt (6), Gegenbaur (7), Leuckart (8), and Claus (35). The descriptions of these authors together give a satisfactory idea of this interesting type of the family. It differs from the *Apolemia lesueuria* in the dioecious corn and the naked internodes of the siphosome, which in the latter are densely covered with innumerable bracts. Since the corms, too, in this latter are monoecious, I separate it as *Apolemopsis lesueuria*.

Closely related to this latter seems to be an Apolemid from the Tropical Pacific, which Mertens observed near the Caroline Islands, and Brandt described in 1835 under the name *Apolemopsis dubia* (25, p. 36). Comparing the accurate figure of it, which Mertens had drawn from life, with the plate of Lesueur, I think these two forms belong to the same genus, but are distinct species.

During my voyage through the Indian Ocean, from Aden to Bombay, in 1881, I captured a single but complete specimen of the interesting new Physonect, which is figured in Pl. XVIII. figs. 1-7, of this Report, under the name *Dicymba diphyopsis*. The composition of the corn and the form of the single organs are almost as in the well-known Mediterranean *Apolemia uvaria*; but there are two important differences; the nectosome is composed of two opposite nectophores only (as in *Praya* and *Diphyes*), and the cormidia are monogastric, with a single siphon and tentacle (as in the Diphyidae and Agalmaidæ). This Indian Physonect may therefore be regarded as the type of a new subfamily, or even family—Dicymbidæ.

**Nectosome.**—The swimming apparatus of the Apolemidae is similar to that of the Agalmaidæ, but differs from it in two characteristic peculiarities. The pneumatophore is a simple invagination of the exoderm, without radial pouches; and the nectophores beyond it are provided with tentacles wanting in the Agalmaidæ. The number of nectophores is different in the two subfamilies; *Dicymba*, the single known type of the subfamily Dicymbidæ, possesses only two large opposite nectophores, similar to *Praya* and *Diphyes*, and approaches in this as well as in other respects to the Diphyidae. The subfamily Apolemopsideæ, represented by *Apolemia* and *Apolemopsis*, on the other hand, has two obliquely opposite series of alternating nectophores (four to six pairs or more), similar to the Polyphyidae and Agalmaidæ. The long and thin contractile filaments which arise from the trunk of the nectosome between the single nectophores are
generally described as "tasters." It may, however, be possible, that they are originally not palpons, but palpecles. In this case their morphological value would be different, as is now assumed. They would be the dislocated tentacles, and not the manubrium of the metamorphosed medusome, the umbrella of which is the nectophore. A proof of this explanation seems to be given by the fact, that in *Apolemopsis* (according to the accurate figure of Lesueur) a bunch of four tasting filaments arises from the base of each nectophore. Kölliker (4, p. 19) and Leuckart (8, p. 317) state, that in *Apolemia* also a bunch of three or four tasters belongs to each single nectophore.

*Nectophores.*—The float filled with air is relatively small in the Apolemidae, compared with the large nectophores. It has a very simple structure, as in the oldest and lowest forms of Physocyraetra. The ovate pneumatosaccus (which sometimes contains no pneumatocyst?) is a simple invagination of the apex of the tubular trunk. The inflated pyriform uppermost part of the latter, or the pneumatocodon, which loosely surrounds the pneumatosae, is not connected with it by vertical radial septa (as is constantly the case in the Agalmaidæ and Forskalidæ). There is wanting, therefore, in the Apolemidae the corona of radial pouches which is characteristic of the pneumatophore in the two latter families. The spheroidal basal or lowermost part of the pneumatosae—the pneumatic infundibulum, or the gas-secreting gland, pneumadenia—is separated from its ovate larger upper part by an incomplete annular constriction, the pneumatopyle (pylorus infundibili). (Compare 50, p. 272, Taf. xix. fig. 93.)

*Nectophores.*—The large and vigorous nectocalyces of the Apolemidae have a somewhat different shape in the two subfamilies. The two opposite nectophores of *Dicymba* (Pl. XVIII. fig. 1) resemble those of *Praya* (Pl. XXXI. figs. 1-7). They are ovate, with a rounded and edgeless exumbrella, and bear at the ventral or axial side a large longitudinal furrow, bounded by two parallel wings; between these wings there arises in the upper part the lamellar triangular pedicle, which attaches the nectophores to the top of the stem, beyond the pneumatophore. The two ventral grooves of the two opposite nectophores, the larger of which embraces the smaller, form together a hydroccial canal, in which the siphosome may be partly retracted. *Apolemia* bears to *Hippopodius* much the same relation as *Dicymba* exhibits to *Praya*. The large ventral groove of each nectophore here embraces a corresponding part of two obliquely opposite nectophores, a superior and an inferior (compare 8, p. 314). The form of the umbrella is similar to that of *Hippopodius*, and so also is the arrangement in the biserial nectosome. The mouth of the nectosome is relatively small, and directed downwards and outwards. The four radial vessels of the powerful subumbrella, connected by a small ring-vessel above the insertion of the velum, are strongly differentiated. The two sagittal canals (shorter ventral and longer dorsal) make a simple curve in the median plane of the nectophore, whereas the two lateral canals (right and left) are much prolonged and have a complicated course, with two to four undulate turnings; from the
REPORT ON THE SIPHONOPHOREÆ.

uppermost turning often arises a series of short diverticula or villiform lateral branches (compare 4, p. 18, Taf. vi. figs. 6–9, and 8, p. 315, Taf. xii. fig. 7).

_Siphosome._—The tubular trunk beyond the nectosome in all Apolemidae is very long, and attains in the extended state a length of two or three feet or more. It bears a great number of ordinate cormidia, separated by long internodes of equal length. These are naked in _Dicymba_ and _Apolemia_ (similar to those in the polygastric Calycodynamæ), whilst they are densely covered with innumerable bracts in _Apolemopsis_ (as in _Agalmopsis_). The trunk is much shortened in the highly contracted state; the internodes then nearly disappear and the entire corm is covered by a carapace of scales, the densely crowded bracts.

_Cormidia._—The two subfamilies of Apolemidae are similar in the general conformation of the cormidia, and the structure of their single parts; they exhibit, however, an important difference in their composition. Each cormidium of the Dicymbidae has only a single siphon and a single cyston, surrounded by numerous bracts and palpules; whereas in the Apolemopsideæ each cormidium possesses several (two to four or more) siphons, and the same number of cystons. The Dicymbidae, therefore, have monogastric cormidia (like the Rhizophysidae, Pls. XXIII., XXIV.), whilst the Apolemopsideæ possess polygastric cormidia (like the Solacidae, Pl. XXV.). The number of bracts (usually twenty to forty in each cormidium) seems to be in all Apolemidae about the same as the number of palpules and palpules, so that perhaps each bract, together with an appertaining palpon and a single palpule, represents originally a medusome, the organs of which are modified and dislocated; the bract corresponding to the umbrella, the palpons to the manubrium, and the palpules to the single tentacle.

_Bracts._—The hydrophyllia, as the metamorphosed umbrella of the medusomes, exhibit in all Apolemidae hitherto observed the same peculiar form. They are ovate, club-shaped or pyriform, with rounded distal end and pointed proximal end; the latter is attached to the stem by a short pedicle, which is raised or lowered by a muscle. The convex outside (exumbrella) is armed with numerous whitish patches composed of cnidian cysts, whilst the concave inside (subumbrella) is smooth. Near the latter there runs in the median line of the bract a simple bracteal canal, which arises from the axial canal of the trunk and ends blindly towards the distal end; sometimes it is provided, near the latter, with a small eucal diverticulum directed towards the lower face (compare 7, p. 320, Taf. xviii. figs. 1–3, and 8, p. 316, Taf. xii. fig. 8).

_Siphons._—The feeding polypites have in all Apolemidae the same structure; the single siphon in the monogastric cormidia of _Dicymba_ (Pl. XVIII. figs. 1, 2, s), however, is relatively larger, whilst the several siphons (two to four or more) in the polygastric cormidia of _Apolemia_ are smaller, and are more like the palpons. The four segments of the siphon (Pl. XVIII. fig. 2, s) are usually distinct, and already very well represented in the oldest figure, given by Lesueur. The short pedicle, to which is attached the single
long tentacle (t), bears a hemispherical basigaster with a thick exodermal wall full of cnidocysts (sh). The large ovate or fusiform stomach (s) possesses four or six strong hepatic ridges (sh), composed of small villi and coloured red or brown (four in *Dicymba* and *Apolemopsis*, six in *Apolemia*). The long tubular proboscis (sr) bears a corresponding number (four or six) of longitudinal muscle-bands, and at the distal mouth a similar number of small rounded lobes.

**Tentacles and Palpacles.**—All Apolemidæ bear very numerous long and thin filaments, which are usually described as tentacles. According, however, to the general definition, which holds good for other Siphonophore, we may call only those larger filaments which are attached (singly) to the base of the siphons tentacles, whilst we call the similar smaller filaments which arise from the base of the cystons and palpans palpacies (thus a single one from each polypite). The structure is otherwise the same in both. They are simple, thin and long cylindrical tubules, closed at the distal end, opening into the pedicle of the polypite at the proximal end; they never bear lateral branches. The structure of the cylindrical wall is the usual one, a vibratile entodermal epithelium inside, a cnidial exodermal epithelium outside, and between them an elastic fulerum, which bears inside a thin plate of ring-muscles, and outside numerous radial ribs covered with longitudinal muscles. The cnidocysts are larger and more numerous in the abaxial part of the exoderm and towards the distal end, often arranged in two or four longitudinal series.

**Cystons.**—Each siphon or feeding polypite of the Apolemidæ is associated with a cyston or excreting polypite (fig. 2, y). The Dicymbide, therefore, have in each monogastric cormidium a single cyston, the Apolemopsidæ in each polygastric cormidium several cystons, two to four or more. The cystons or "anal vesicles" are intermediate in size between the larger siphons and the smaller palpans, and at once distinguished from both by the dark (red or brown) colour of their nontransparent body. Their four segments are usually not so distinct as in the similar but more fully developed siphons; the hepatic ridges of the latter are replaced by series of glandular villi, secreting a granular red or brown pigment-mass. This is accumulated in a vesicular terminal diverticulum of the proboscis, and may be ejected through a small opening of the latter (anus).

**Palpons.**—The Apolemidæ possess exceedingly numerous tasters or palpans, usually twenty to forty or more in each single cormidium, therefore several thousands, when the number of cormidia exceeds a hundred, as is often the case in corals of two or three metres in length. The palpans are slender, very mobile, cylindrical or spindle-shaped tubes, closed at the pointed distal end, which is richly armed with cnidocysts and long cnidocils. The middle part of the utricle exhibits sometimes four or six longitudinal ridges, corresponding to the hepatic stripes of the siphons and the excretory pigment-stripes of the cystons. The pedicle of each palpon bears a long, very thin palpacle, similar to that of the cyston (compare 7, pl. xviii. fig. 4, and 8, Taf. xii. p. 10).
REPORT ON THE SIPHONOPHORiE.

—The

209

from branched gonoa well-developed umbrella with four
styles, and possess in both sexes of the Apolemiche
radial canals and a connecting ring-canal
Dicymba (PI. XVIII. figs. 4, 6) is besides
Gonophores.

rnedusiform

arise in clusters

gonophores

;

distinguished by the possession of four rudimentary tentacles which are placed at the
distal end of the radial canals and bear a red ocellus (as in Desmopliyes and Lilyopsis).

The ovarium

(or

the manubrium of the female Medusa) includes a single large ovule

surrounded by an irregular network of spadicine canals (figs. 3, 4). The spermarium (or
the manubrium of the male Medusa) is a large club-shaped sac with a central spadix

Apolemia are dioecious and bear in each cormidium a single
gonodendron, all of the same sex in one corm. The corms of Apolemopsis and Dicymba
are monoecious and bear in each cormidium two gonodendra, a male and a female
they
(figs.

The corms

5, 6).

of

;

arise separately

from the

common trunk on

the base of the cormidium.

Synopsis of the Genera of Apolemidse.
I.

Internodes of the siphosome naked.
Corms
moncecious.
Cormidia monoclinic, with

Subfamily Dictmbidje.
Nectosome with two opposite neotoCormidia monogastric,
phores only.
each with a single siphon and cyston.

......

two gonochoristic gonodendra
a female),

(a

male and
39. Dicymba.

'

Internodes of the siphosome naked.
II.

Subfamily Apolemopsim;.
Nectosome with two opposite rows of
Cormidia polygastric,
nectophores.
each with several siphons and eystons.

Genus

Cormidia

dioecious.

single

Corms
with

a

gonodendron (either male or female),

Internodes of the siphosome covered with
bracts. Corms monoecious. Cormidiamonoclinic, with two gonochoristic gonodendra,

39.

40a. Apolemia.

40?;.

Apolemopsis.

1

Dicymba, Haeckel, 1888.

Dicymba, Hkl., System der Siphonophoren,

Definition.

diclinic,

p. 39.

— Apoleroidse with two large opposite nectophores only.

Internodes of the

a single siphon and
siphosome naked. Cormidia monogastric and monoclinic, each with
Corms moncecious.
a female.
cyston, and with two separate gonodendra, a male and

The genus Dicymba

is

represented

by

a

new

interesting

Apolemid, which

I

observed living during my voyage through the Indian Ocean, from Aden to Bombay, in
The special organisation of the single parts which compose the
November 1881.
polygastric corm,

number

is

similar to that of the

are different.

nectophores only (as in

The nectosome

Praya and

of

common Apolemia but their disposition and
Dicymba is composed of two large opposite
;

The cormidia, which

are separated

by long
and
a
with
a
single
cyston
provided
single siphon
is
also
The rnedusiform structure of the gonophores

Dipliyes).

free internodes, are monogastric, each

numerous palpons.
These differences seem to be

only, besides
peculiar.

from the true Apolemidae as the representative type of a
1

T)icymhri

(ZOOL, CIIALL. EXP."

-PART

I.XXVTI.

— 1888.)

Dicymba might be separated
new family Dicymbidse.

so important, that

= Double

boat, nixvpfia.

Ilhbli 27


Diecymba diphyropsis, n. sp. (Pl. XVIII. figs. 1-7).

Habitat.—Indian Ocean, between Aden and Bombay, November 1881 (Haeckel).

Nectosome (fig. 1).—The swimming apparatus is composed of a small pneumatophore placed at the top of the stem, and of two large opposite nectophores beyond it. These are slightly different in size, and rather similar to the nectocalyces of Praya (Pl. XXXI.) in form, structure, and arrangement, so fitting one into another, that the two longitudinal ventral wings of the larger embrace the opposite wings of the smaller swimming-bell. The subcylindrical hydrozool canal, formed by the two longitudinal ventral grooves, is traversed by the apical part of the trunk, and embraces a great part of the retracted siphosome. This attains in the fully expanded state a length of about half a metre.

Pneumatophore.—The float is a pyriform vesicle of 10 mm. in length and 6 mm. in breadth. Its apical part is covered with red pigment (fig. 1, p). The pneumatocodon is a simple invagination of the exoderm of the stem-top, and not connected with the surrounding pneumatocodon by radial septa (compare above, p. 206).

Nectophores.—The two opposite nectophores are of equal form, but a little different in size, 40 mm. to 50 mm. long, 25 mm. to 30 mm. broad. Their form is ovate, with rounded apex and truncate base. The dorsal or abaxial side is evenly convex, without edges, but with a number of flat roundish tubercles, which bear white patches composed of cnidocytes. The ventral or axial side is concave, with a broad longitudinal groove bounded by two prominent lateral wings. In the upper third of the groove, midway between the two wings, arises a short, obliquely triangular lamella, the pedicle of the nectophore. The apex of this triangular pedicle is inserted near the apex of the trunk, somewhat below the base of the pneumatophore. The larger nectophore embraces by its ventral groove the opposite groove of the smaller in the same way as is described above in the case of Praya galea (Pl. XXXI. figs. 1-7).

Nectosae.—The umbrellar cavity occupies about two-thirds of the nectophore, and is subspherical in the larger proximal half, subcylindrical in the smaller distal half. The opening of the latter is surrounded by a broad velum (fig. 1, v). The muscle-plate of the subumbrella is strong. The nectocalycine duct arising near the top of the stem, passes downwards through the pedicle of the nectophore and ends in the upper third of the dorsal median line of the subumbrella. It divides here into four radial canals of very different lengths; the ventral is about half as long as the dorsal, and both are shorter than the two paired lateral canals (right and left); these are four times curved in different directions and form the four loops figured in fig. 1, n. All four canals inosculate in the circular canal of the umbrella margin at equal distances.

Siphosome.—The long and thin tubular trunk of the siphosome had in the single specimen observed, in the fully expanded state, a length of 40 to 60 cm. It bore (besides
a number of buds in the uppermost part, beyond the nectophores) a series of a dozen fully-developed cormidia. The internodes of the trunk between these were naked, and had a length of 4 to 5 cm. In the contracted state the trunk was so shortened that the naked internodes disappeared, and the cormidia formed a continuous clustered mass; the upper part of this was hidden in the space between the ventral grooves of the two nectophores, comparable to a hydrecium.

_Cormidia_ (fig. 2).—Each cormidium is composed of a single siphon with its tentacle; a single cyston with a palpacle; a bunch of palpons, each with a palpacle (ten to twenty); a clustered mass of club-shaped bracts (fifteen to twenty-five); and a pair of clustered gonodendra, a male and a female. We may suppose that each bract is the reduced umbrella of a medusome, the manubrium of which is either a siphon, or a cyston, or a palpon: each one is provided with a tentacle or a palpacle. In this case the number of sterile medusomes in each cormidium would be fifteen to twenty-five. The number of sexual medusomes is much larger since the male as well as the female gonodendron is composed of twenty to thirty or more clustered gonophores.

_Bracts_ (fig. 2, b).—The hydrophyllia, fifteen to twenty-five in each cormidium (besides numerous small buds of young bracts), form together a clustered mass which covers and protects the dorsal or superior side of each cormidium. The form and structure of the bracts are nearly the same as in the common _Apolemia_. They are club-shaped or pyriform bodies 15 to 25 mm. in length and 10 to 15 mm. in breadth, rounded at the thickened distal end, pointed at the basal end, where they are attached to the trunk by a short mobile pedicle. Their convex outer face is covered with white patches composed of cnidocysts. Near the concave inner face there runs along the median line a simple braceteal canal, which ends blindly near the distal end.

_Siphons_ (figs. 1, 2, s).—The single siphon, which represents the only feeding person of each cormidium, is rather large, in the expanded state 20 to 30 mm. long and 4 to 8 mm. thick. It has a yellowish colour, and exhibits the usual four segments distinctly; a slender pedicle, to which the tentacle is attached; a pyriform thick-walled basigaster (sb), the exoderm of which contains masses of thread-cells; an ovate or spindle-shaped stomach, distinguished by four strong undulate liver-ridges of a red-brown colour (sh), and a muscular proboscis, in the expanded, very contractile wall of which four longitudinal muscle-bands can be distinguished (sr). The distal mouth opening may be expanded in form of a broad suctorial disc, which is sometimes circular, at other times provided with four or eight slight mouth lobes.

_Tentacles_ (figs. 1, 2, t) and _Palpacles_ (figs. 1, 2, r).—The single tentacle which is attached to the base of each siphon, is a long, simple, cylindrical filament, beset with two longitudinal rows of cnidocysts. It has nearly the same structure as the similar palpacles attached to the cystons and palpons; these, however, are smaller, much thinner, and less developed (compare above, p. 208).
Cystons (figs. 1, 2, y).—Each cormidium possesses a single cyston or anal vesicle, attached to the trunk near the base of the siphon. It is smaller than the siphon, but larger than the palpons, and at once distinguished from both by its deep red colour. The cyston is a slender spindle-shaped tube with two slight constrictions and a middle dilatation. This corresponds to the stomach of the siphon, and is densely covered internally with red glandular villi. The granular pigment secreted by these is accumulated in a head-like terminal expansion of the distal proboscis, and thrown out by a small terminal opening, the anus. The slender basal pedicle of the cyston bears a simple palpacle, of the same shape as that of the palpon.

Palpons (figs. 1, 2, 3).—The tasters occur in each cormidium nearly in the same number as the bracts, ten to twenty or more, besides numerous small buds of young ones. They are slender cylindrical or spindle-shaped tubules, very extensile and contractile, and as in Apolemia have a restless dashing motion. The closed distal end of each palpon is pointed and richly armed with cnidocysts and palpocils. The thinner and pediculate basal end opens into the axial canal of the trunk, and bears a long and thin palpacle (r), similar to that of the cyston.

Gonodendra.—Each cormidium is hermaphrodite (monoclinic) and bears two—clustered gonodendra, a male and a female; they arise separately from the trunk, both near the base of the cyston. The female gonodendron (fig. 3) is composed of twenty to thirty gynophores, besides numerous small buds. The male gonodendron (fig. 5) is smaller and bears only fifteen to twenty androphores. The umbrella of the gonophores is in both sexes well developed, with four radial canals, and a circular ring-canal on the margin; the latter bears, at the distal end of the four radial canals, four small tubercles with a red pigment-spot, which are rudiments of reduced tentacles, with a basal ocellus. The gynophores (fig. 4) have a campanulate umbrella and a colourless subspherical manubrium, which contains a single large ovulum, surrounded by spadicine canals. The androphores (fig. 6) have a more oblong umbrella and a club-shaped manubrium of a bright red colour; its central spadix is surrounded by a thick layer of sperm.

Genus 40a. Apolemia,1 Eschscholtz, 1829.

Apolemia, Esch., System der Acalephen, p. 143.

Definition.—Apolemidae with a biserial nectosome, composed of two opposite series of necophores. Internodes of the siphosome naked. Cormidia polygastric and didinie, each with several siphons and cystons, and with a single gonodendron, either male or female. Corms dioecious.

The genus Apolemia was established by Eschscholtz for that North Atlantic form which Lescueur had figured in 1813 under the name Stephanomia uviformis (not 1 Apolemia = Pacific, απόλημι.
Köllicher (4) and the following observers, who described in the years 1853 to 1863 the Mediterranean *Apolemia uvaria* (called *Agalma punctata* by Vogt, 6), supposed that these two species were identical. But a comparison of both has convinced me that they belong to different genera. The internodes of the long tubular siphosome are naked in the Mediterranean *Apolemia uvaria*, whilst they are densely covered with bracts in the North Atlantic *Apolemopsis uvaria* (or *Apolemia lesueuria*); the corms are dioecious in the former, monoecious in the latter. I retain, therefore, the name *Apolemia uvaria*, now generally accepted for the Mediterranean form, for this type of the genus, the gigantic corm of which attains a length of two or three metres and more. Compare the descriptions of the corm by Vogt (6), Gegenbaur (7), and Kuenen (8), of the nektophores by Köllicher (4), and of the gonophores by Claus (35).

**Genus 40b. Apolemopsis, 1 Brandt, 1835.**

*Apolemopsis*, Brandt, Prodromus, 25, p. 36.

**Definition.**—Apolemidae with a biserial nektosome, composed of two opposite series of nektophores. Internodes of the siphosome densely covered with bracts. Cormidia polygastric and monoecious, each with several siphons and cystons, and with two separate gonodendra, a male and a female. Corms monoecious.

The genus *Apolemopsis* was established by Brandt (25) for an Apolemid, which Mertens had observed in the Tropical Pacific, near the Caroline Islands. Comparing his accurately drawn figures with the splendid pictures which Lesueur had given in 1813 of his North Atlantic *Stephanomia uvaria* (or *Stephanomia uvaria*), I suppose that these two similar forms may be distinguished as two species of one genus. This genus, for which I retain Brandt’s name *Apolemopsis*, seems to differ from the true *Apolemia (uvaria)* in two essential characters. The entire siphosome of *Apolemopsis* is densely covered with innumerable bracts, as in *Agalmopsis*, whilst in *Apolemia* the long internodes between the cormidia are naked, as in the Diphyidae. The corms of the former are monoecious, those of the latter dioecious. Each siphon possesses in *Apolemopsis* four liver-ridges (as in *Dicymba*), in *Apolemia* six. A further careful comparison, however, of the two genera, as well as of the different species belonging to them, is necessary by future observers.

**Family XIII. Agalmideæ, Brandt, 1835.**

*Agalmideæ*, Brandt, Prodromus, &c., 1835, 25, p. 34.

*Stephanomideæ*, Huxley, Oceanic Hydrozoa, 1859, pp. 70, 72.

**Definition.**—Physonectæ polygastricæ, with a long tubular stem of the siphosome, bearing numerous siphons, palpons, and bracts, each siphon provided with a branched

1 *Apolemopsis* = Similar to *Apolemia.*
tentacle. Nectosome biserial, with two opposite rows of nectophores. Pneumatophore with radial pouches (compare Pls. XIV.–XVII.).

The family Agalmaidæ, the largest of all Physonectæ, comprises those polygastric "Physophoridae" which possess a biserial nectosome, and at its apex a pneumatophore with radial pouches; the long tubular stem of the siphosome bears numerous siphons, bracts, and palpons; the tentacles are always branched, with a single series of tentilla.

The genera and species of Agalmaidæ are rather numerous, and widely distributed over all seas; they occur in the Arctic as well as in the temperate zones, but mostly in the Tropics. The majority, however, occur only at certain seasons and not in great numbers; nearly all are extremely delicate and sensitive, and the component parts easily detached from the stem. Most of the older observers, therefore, have only described fragments or single isolated pieces. A further great obstacle to accurate examination is the extraordinary mobility and contractility of most Agalmaidæ.

The first figures and descriptions of Agalmaidæ were given by Péron and Lesueur (14, Stephanomia, 1807), and by Eschscholtz (21, Agalma, 1825). Lesson (3, 22) and Quoy and Gaimard (2, 19, 20) published figures and descriptions of numerous scattered pieces, but without great value. Brandt in 1835 described Agalma mertensiæ from an excellent (though alas unpublished) figure by Mertens (made in 1827), and founded upon it the family Agalmaidæ (25). Sars in 1846 published accurate figures of the northern Agalmopsis elegans. The excellent observers in the sixth decade of our century (1853–1859), Kölliker (4), Vogt (6), Leuckart (5, 8), Gegenbaur (7, 10), and Huxley (9), greatly advanced our knowledge of the Agalmaidæ, which were also called Stephanomidae (including Forskalæa). Some new interesting species have been described recently by Claus (74, 75), Fewkes (42–45), &c. In general, however, there yet remains much to be done towards a more accurate knowledge of this important and interesting family.

My own observations on numerous different Agalmaidæ were commenced in 1859 in Messina, and continued in the winter of 1866–67 in the Canary Islands; but the richest harvest was found during my residence in Ceylon, where I had the opportunity of observing several new and interesting forms. The Challenger collection contained many isolated and scattered portions of detached parts of Agalmaidæ, but no complete specimens of any value.

Nectosome.—The swimming apparatus of the Agalmaidæ is composed of a small apical pneumatophore and of two opposite rows of large alternating nectophores. These are so arranged around the axial trunk, that the apical part of each nectophore fits into the interval between two neighbouring nectophores of the opposite row, a superior and an inferior. The trunk itself, therefore, is spirally twisted, since the insertions of all the nectophores originally form a single straight series in the ventral median line of the trunk. The spiral line usually is lenticoporic (or a lambdoid spiral), therefore opposed to the spiral of the siphosome, which is (perhaps always) dextrotropic (or a deltoid spiral). The number of nectophores is in most species ten to twenty, but in some smaller forms only four
or six, in the largest forty to fifty or more. The pedicles of the nectophores are usually small, and easily detached from the axial trunk.

*Pneumatophore.*—The aeriferous float in all Agalmidae is small, often very small in comparison to the nectophores. It is placed at the top of the trunk, the uppermost part of which is sometimes prolonged, so as to form a contractile pedicle to the float; in this case it is able either to pass forward over the uppermost nectophores, or at other times to be retracted between them. Usually the float is ovate, spindle-shaped or pyriform. Its top seems to be closed, without a constant opening; it is often coloured by a small red or brown pigment-spot, and sometimes this forms a regular octoradial star, the centre of which is colourless, like an ocellus. The lower half of the pneumatophore often exhibits a number of equidistant longitudinal ribs, the insertions of the radial vertical septa which connect the outer with the inner wall, and divide the cavity of the pneumatophore into radial pouches; the number is usually eight, sometimes variable (seven or nine), at other times four, six or twelve; the upper portion of the septa passes over into the circular muscular ring, which surrounds the pylorus infundibuli like a sphincter or diaphragm.

*Nectophores.*—Although the form of the nectocalyces in the numerous Agalmidae is very manifold, it is always developed from the same original type, and represents only variations of a single type, which is defined by their alternately pinnate arrangement on the axial trunk of the biserial nectosome. The quadri radial umbrella of the nectophores is always bilateral, with a complete symmetry of both its halves. It is more or less depressed in the sagittal direction, from the convex dorsal to the concave ventral side, so that the frontal or transverse axis is longer than the sagittal. The principal axis is sometimes longer, at other times shorter than the frontal; it is directed towards the axial trunk more or less obliquely, and intersects it at a variable angle; but the apical pole (with the pedicle) is always situated more highly than the basal pole (with the ostium); the narrower ostium is directed outwards and downwards. The pedicle of the nectophore, which arises in the median line of its lower or ventral side, is a short triangular lamella; its proximal apex is inserted on the ventral median line of the axial trunk. This latter is constantly embraced by a pair of large auricles, apical wings or frontal horns, which arise from the dilated lateral parts of the nectophore. The sharp proximal edges of the wedge-shaped horns fit so one over another between the two opposite nectophores, that the axial part of the nectosome in the lateral view exhibits a very characteristic zigzag shape.

*Nectosae.*—The subumbrella occupies sometimes scarcely the distal half of the nectophore, at other times its greater part. It exhibits constantly the same bilateral form, with a complete symmetry of both lateral halves, and is depressed in sagittal, dilated in frontal direction. Usually it is divided into three parts, an odd median part with the basal ostium, and two paired lateral parts which correspond to the two frontal horns. The distal ostium is usually small. The four radial canals of the nectosae are
always in two very different pairs; the two opposite sagittal canals (shorter ventral and longer dorsal) are simply curved in the median plane of the neクトosae; the two paired and equal lateral canals (right and left) are much longer, and more or less curved in different directions, usually with three or four roundish loops, the course of which is often characteristic of the single species. The top of the subumbrella, where the four radial canals arise from the peduncular canal, is dislocated more or less towards the ventral side. The points where the four radial canals open into the circular ring-canal, above the insertion of the small velum, are sometimes marked by four red pigment-spots; at other times only two or three ocelli are preserved (an odd dorsal and two paired lateral); the fourth (ventral) has disappeared (Pl. XVIII. figs. 8, 9).

**Siphosome.**—The external form and internal structure of the siphosome, as well as the character of the motions and habits, are so different in the various Agalnidæ, that we may divide this large family for that reason into two subfamilies: Crystallodinæ and Anthemodinæ (25, pp. 39, 40). The siphosome of the Crystallodinæ (Agalma, Crystallodes, &c.) is relatively short, about as long as or little longer than the neクトosome; it is very little expansive and contractile, and distinguished by a peculiar rigidity, caused by the peculiar shape and junction of the bracts; these are very thick and firm, prismatic or wedge-shaped, cartilaginous portions, so densely packed one over the other that the intervals nearly disappear; they form a complete carapace of scales around the trunk even in its most expanded state. The motions of the siphosome in the Crystallodinæ, therefore, are very weak and inconsiderable (compare Pl. XVII.).

The second form of the siphosome, very different from the first, is represented by the Anthemodinæ. It is very long and movable, usually much longer than the neクトosome, and in the expanded state often many times longer. The tubular trunk of this siphosome is very extensible and contractile, and in the expanded state only loosely covered by the bracts; these are usually thin scales, often foliaceous, and separated by dilatable intervals. The motions of the siphosome in these Anthemodinæ (Halistemma, Agalmopsis, &c.) are usually very active and quick; the expanded stem may be suddenly contracted and then occupy a much smaller space (one-tenth or less of the expanded corm) (compare Pls. XIV.–XVI.).

**Cormidia.**—The polymorphous persons and their organs are arranged and grouped in the siphosome of the Agalnidæ in a very variable order; generally we may distinguish ordinate and irregular cormidia; there are, however, intermediate stages between these two types. Perhaps the whole family may be divided according to this difference into two subfamilies—Stephanomidæ (with ordinate cormidia) and Halistemidæ (with irregular cormidia); in both subfamilies occur Crystallodinæ (with rigid siphosome) and Anthemodinæ (with movable siphosome). The ordinate cormidia of the Stephanomidæ are equidistant and separated by internodes of equal length, which are only covered with bracts. They exhibit a most primitive and simple arrangement
in *Stephanomia* and *Crystallodides*, where they form a single rectilinear series in the ventral median line of the rigid trunk; all parts of the cormidia here hang down from its ventral or inferior side, whilst the dorsal or superior side is only covered with bracts (Pl. XVII. fig. 1). *Anthemodides* and *Cuneolarias* differ from the former in the spiral twisting of the prolonged and very movable stem; the cormidia, therefore, are turned in all directions; but they are also separated by long internodes which are only covered with bracts (Pl. XIV.). Each cormidium is composed in these four genera of a single siphon with its tentacle; one or more palpions (or cystons), usually each with a palpacle; a group of bracts, and a monolobed pair of distylic gonodendra (a male and a female) (Pl. XV. fig. 5, f, h; Pl. XVII. fig. 4, f, h).

The Halistemnidae—or the Agalmidae with dissolved cormidia—comprise the majority of this family, viz., all the genera except the four above mentioned. The polymorphous persons and their organs are here more or less dislocated and scattered; the palpions and gonostyles arise (singly or united in groups) directly from the trunk of the siphosome, not from the base of the siphons as in the Stephanomidae. Usually also here the internodes between the siphons are of equal length; they are, however, not free, but covered with palpions, cystons, and gonodendra variously arranged: sometimes rather regularly (as in *Phyllophysa*, *Capulita*, &c.); at other times very irregularly (as in *Halistemma*, *Agalmopsis*, &c.). A peculiar structure already described by Eschscholtz (1, p. 150) is developed in *Agalma*, where the bracts compose a scale, a carapace with a central cavity, or an axial hydrecium into which the distal part of the siphosome may be retracted (Pl. XVIII. fig. 8).

**Bracts.**—The hydrophyllia or "covering scales" in all Agalmidae are very numerous, often several hundreds, in the largest forms more than a thousand. They arise usually not only from the nodes of the trunk, where the siphons are attached, but also from the internodes between them. The carapace of scales, which is composed of the jointed bracts apposed one to another, is always complete in the contracted state of the siphosome, and often also in the expanded state. Their special form and arrangement are very different in the various Agalmidae. Generally the bracts are thick, prismatic or wedge-shaped in the Crystalloglanae, where they cover the rigid trunk so densely that their intervals nearly disappear and the siphosome loses its contractility. In the Anthemodidae, on the other hand, where the stem is very extensile and contractile, the bracts are usually thin, foliaceous or squamous, and the intervals between them of very variable size. The general form of the bracts is sometimes ovate, lanceolate, or rhombic, at other times trigonal, tetragonal, or pentagonal, often with three to five (rarely more) prominent teeth at the distal margin. Usually the superior or outer face is more or less convex (often with prominent ribs, armed with cnidocysts), the inferior or inner face concave; near this runs in the median line of the bract the simple blind bracteal canal. The clear and hyaline jelly-substance of the
colourless bracts is usually more or less cartilaginous, sometimes soft; it is thickened in the middle part and often towards the distal edge. The proximal base tapers towards the small movable pedicle, which attaches the bract to the trunk.

Siphons.—Each cormidium of the Agalmidae possesses a single siphon only, and this is placed originally always (and in the ordinate cormidia permanently) at its distal or lower end. The four segments of the siphon exhibit a varying degree of development. The pedicle (sp) is usually short, but sometimes prolonged (e.g., in *Lychnagalma*). The basigaster (sb) is usually small, sometimes rudimentary. The stomach (sm) in most Agalmidae is large and provided with longitudinal equidistant liver-ridges, usually of a red or brown colour. Their number in most Agalmidae is eight, sometimes four (*Anthemodes*, Pl. XV. fig. 7), twelve (*Cuneolaria*), or sixteen (*Hалистемма, 6*, pl. viii. fig. 1). Usually the hepatic ridges are continuous glandular bands, but sometimes composed of single villi arranged in longitudinal series. The proboscis (sr) is always a very muscular cylindrical tube, highly expansible. Its distal mouth is extremely variable in form and size; it may be expanded in the form of a very large and thin-walled suctorial disc, sometimes circular, at other times polygonal (often octagonal). Its edge is usually armed with enidocysts.

Tentacles.—The single long tentacle, which is attached to the base of each siphon, exhibits the same essential structure in all Agalmidae, but shows great variety in the form of its equidistant lateral branches. The various forms of these tentilla have been already employed by Eschseholtz (1829) and afterwards by Huxley (1859) for the distinction of genera. The simplest and most primitive form is found in *Hалистемма*; the enidoband is a simple, thickened, spirally convoluted dilatation of the middle part of the tentillum, with a double elastic band (or angle-band) on its ventral side, and a strong enidobattery on the dorsal side; the terminal filament is a simple thin tubule, similar to the pedicle. Four other genera (*Stephanomia, Phyllophysa, Anthemodes,* and *Cupulita*) have the same form of the tentillum, but with this difference, that a campanulate involucrum arises from the distal end of the pedicle and encloses the proximal part of the enidoband (Pl. XV. fig. 11). This involucrum is complete in four other genera (*Crystallodes, Agalma, Cuneolaria,* and *Agalmopsis*); the simple terminal filament in these is replaced by a tricorneate appendage, an odd median terminal ampulla, and two paired, often spirally coiled lateral horns (Pl. XVII.). The highest degree of development, finally, is attained by *Lychnagalma*; the long enidoband, enclosed in a complete involucrum (or enidosae), bears at its distal end a very large, hydrostatic, terminal ampulla surrounded by a corona of eight radial horns (Pl. XVI.).

Palpons.—All the Agalmidae possess a number of hydrocysts on the siphosome, either true (mouthless) palpons, or excreting cystons (with a mouth). The distinction between them is often difficult and requires further accurate observations. Usually each cormidium (with a single siphon) possesses several (four to six or more) palpons; but sometimes
only a single one or a group of two. The palpons are united in a bunch, attached to the basal insertion of the siphon, in the ordinate cormidia of the Stephanomidae; they are isolated, attached immediately to the trunk, and scattered between the siphons, in the dissolved cormidia of the Halistennimidae; sometimes their succession is regular, at other times irregular. Usually one palpon (or cyston) is in direct connexion with the gonodendra, whilst others are independent of them. The palpons are thin-walled, cylindrical, very contractile and movable tubes, closed at the distal end, which is armed with thread-cells. Sometimes the distal part of the palpon is separated by an annular constriction and forms a subspherical cavity, in which a group of crystals or concretions (like an otolith) is turned round by the ciliated entoderm, as in an otocyst.

Cystons.—Hydrocysts with a terminal mouth opening, or cystons, occur very frequently (perhaps even constantly?) in the Agalmidae; they were formerly confounded with the similar mouthless palpons. They are larger than the latter, with a thicker entoderm, which is partly glandular, and often coloured (red or brown). The fluid secretion, or the pigmented, granular or crystalline masses secreted by it, are ejected by the distal mouth, or rather the anal opening, which is closed by a muscular sphincter. Sometimes the distal part is separated from the dilated middle part by an annular constriction (Pl. XV. figs. 8, 9). I have never found more than a single cyston in each cormidium, whilst the number of palpons is usually large and variable.

Palpacles.—Many Agalmidae, but not all, possess a number of long and thin palpacles, feeling or tasting filaments. Usually a single palpacle (or "accessory tentacle") is attached to the base of each palpon and probably also of each cyston. But in some species they have not been described; possibly they were either overlooked or lost accidentally. Each palpacle is a very slender cylindrical tube, the muscular wall of which is very expansible and contractile, the cells of the exoderm covered with palpoleis and partly containing small cnidocytes.

Gonostyles.—All the Agalmidae have monoecious corms and monoclinic cormidia; each cormidium possesses a male and a female gonodendron. These arise sometimes from a common pedicel, at other times separated from two neighbouring gonostyles. The ordinate cormidia of the Stephanomidae always bear a small pair of gonostyles, a male and a female, attached to their common trunk near the siphon. The loose cormidia of the Halistennimidae, however, exhibit a variable arrangement. Sometimes a monoclinic pair of gonodendra, united with a palpon or cyston, arises from each internode, midway between two neighbouring siphons; at other times each internode bears two to four or more pairs of gonodendra; and sometimes their disposition is quite irregular, numerous male and female gonodendra being scattered irregularly along the whole trunk of the siphosome. Usually the gonodendra are small clusters, and their gonostyles simple or little branched. The female gonophores are smaller and more numerous than the male. Their umbrella is usually well developed, pedunculate, but sometimes rudimentary.
The ovaria are ovate or subspherical, each with a single large ovum only, which is often surrounded by an irregular net of spadicine canals (Pl. XV. fig. 15; Pl. XVIII. fig. 16). The spermaria are more oblong, spindle-shaped, cylindrical or club-shaped, with a simple central spadix (Pl. XV. fig. 14; Pl. XVIII. fig. 17).

Ontogeny.—The development of the fertilised egg and the peculiar metamorphosis of the larva (Physonuda) arising from it, is known only in a few Agalmidæ. It was first described by myself in 1869, in Crystallodes rigidum (84, Tab. vi.–xiii.); afterwards by Metschunikoff, in 1874, in Halistemma rubrum, Cupulita picta, and Agalmopsis sarstii (85, Taf. viii.–xii.), and finally by Fewkes in Agalmopsis elegans (89).

Synopsis of the Genera of Agalmidæ.

I. Subfamily

Crystallodinæ.

Siphosome short and rigid, about as long as the nectosome. Trunk of the siphosome stiff, scarcely contractile, densely covered with thick prismatic or spheroidal bracts.

| Cormidia ordinate. Internodes free, covered only with bracts. Palpons and gonostyles at the base of the siphons. | Tentilla with a simple terminal filament, 41. Stephanomia. |
| Cormidia loose. Palpons and gonostyles attached to the internodes, between the siphons. | Tentilla with a simple terminal filament, 42. Crystallodes. |

II. Subfamily

Anthemodinæ.

Siphosome very long and movable, much longer than the nectosome. Trunk of the siphosome very extensible and contractile, loosely covered with thin scales or foliose bracts (rarely with prismatic bracts).

| Cormidia ordinate. Internodes free, covered only with bracts. Palpons and gonostyles at the base of the siphons. | Tentilla with a simple terminal filament, 43. Phyllophysa. |
| Cormidia loose. Palpons and gonostyles attached to the internodes, between the siphons. | Tentilla tricornuate, with a triple terminal filament, 44. Agalma. |

| Tentilla tricornuate, with a triple terminal filament, 45. Anthemodes. |
| Tentilla with a simple terminal filament, 46. Cuneolaria. |

| Cormidia loose. Palpons and gonostyles attached to the internodes, between the siphons. | Tentilla tricornuate or multicorneate, with a triple or multiple terminal filament. |
| Tentilla with a simple terminal filament. | Tentilla tricornuate or multicorneate, with a triple or multiple terminal filament. |

| Cudodand naked, without involucre, 47a. Halistemma. |
| Cudodand enveloped by a campanulate involucre, 47b. Cupulita. |

| Terminal ampulla of the tentilla, with two lateral horns, 48. Agalmopsis. |
| Terminal ampulla of the tentilla, with a corona of eight radial horns, 49. Lychangalma. |

*Stephanomia*, Péron et Lesueur, Voyage aux terres australes.

**Definition.**—Agalmidae with a short and rigid siphosome, the trunk of which is scarcely contractile. Bracts with small intervals. Cormidia ordinate, with free internodes, in a single, straight, ventral series. Tentilla with a simple terminal filament.

The genus *Stephanomia* is the oldest known form of Agalmidae, and was founded in 1807 by Péron for an Australian Physonect, of which his collaborator Lesueur has left an excellent picture (14, pl. xxix. fig. 5). The figure represents the siphosome only, without the nectosome; but fortunately I had the opportunity during my residence in Ceylon (in December 1881) of examining a complete living specimen of a closely allied species. The cylindrical siphosome of this Indian *Stephanomia nereidum* had exactly the same form as that of the Australian *Stephanomia amphitrites* in Lesueur's figure, except the special form of the bracts; these are all tridentate in the latter, and arranged very regularly in four longitudinal series; whilst in the former they were provided partly with three, partly with five teeth, and arranged in six less regular series. The long internodes between the cormidia were free, and the yellowish gonostyles attached near the base of the red-coloured siphons. The biserial nectosome composed of twelve complete nectophores, had nearly the same form as that of *Crystallododes vitrea* (Pl. XVII. figs. 1–3). The position of the quietly swimming animal was the same as in Lesueur's figure, the trunk lying horizontally and the cormidia forming a rectilinear series on its ventral side; the siphons and tentacles, therefore, depending vertically. The same position is exhibited also by the similar Agalmaid, which Huxley afterwards described as *Stephanomia amphitrites* (9, pl. vi.); but this has loose cormidia, and belongs probably to *Phyllophysa* (Genus 43).

Genus 42. *Crystallododes*, Haeckel, 1869.

*Crystallododes*, Hkl., Entwickelungsgeschichte der Siphonophoren, p. 43.

**Definition.**—Agalmidae with a short and rigid siphosome, the trunk of which is scarcely contractile. Bracts with small intervals. Cormidia ordinate, with free internodes, in a single, straight, ventral series. Tentilla tricornuate, with a terminal ampulla and two paired horns.

The genus *Crystallododes* was established by me in 1869 for an Atlantic Agalmaid, the complete anatomy and ontogeny of which I observed in January and February 1867, during my residence in the Canary Island Lanzerotic (84, p. 43, Taf. vi.–xiii.). Another closely allied species, differing from the Atlantic *Crystallododes rigidus* mainly in the special form and arrangement of the bracts, was examined by me fifteen years after-

1 *Stephanomia* = *Corona*, στεφάνιον.
2 *Crystallododes* = Crystal-shaped, κρύσταλλος.
wards in Ceylon, in January 1882; it is figured in Pl. XVII. of this Report. A third species may be an Agalmid, from the Tropical Pacific, the siphosome of which was figured by Lesson under the name *Plithosoma crassituberosus* (22, pl. iv. fig. 2); the nectosome was detached in the only specimen observed. A fourth species is the North Pacific form, which Mertens observed in 1827 (lat. 42° N., long. 210° E.), and of which Brandt has given a short description under the name *Agalma mertensi* (25, p. 34). I had recently the opportunity of comparing the excellent pictures (unfortunately not published) which Mertens had executed most carefully from the living animal. They have convinced me that this *Crassituberosus mertensi* is a peculiar species, differing in the special form of the nectophores and the arrangement of the bracts.

*Crassituberosus vitreus*, n. sp. (Pl. XVII.).

*Habitat.*—Indian Ocean, Ceylon (Belligemma), January 1882 (Haeckel).

*Nectosome* (upper half of figs. 2, 3; fig. 1, lateral view, from the left side; fig. 2, dorsal view; fig. 3, ventral view).—The swimming apparatus in the single specimen observed was 14 mm. long, 8 mm. broad, and composed of an apical pneumatophore and of five pairs of opposite nectophores, besides some undeveloped buds on the base of the former. The axial trunk of the nectosome is a slender colourless tube, slightly undulating; its uppermost part is the thin pedicle of the pneumatophore, and was often stretched by the swimming animal in the usual position, with horizontally lying trunk (fig. 1); the pedicle of the pneumatophore was often bent upwards, and formed a right angle with the trunk, so that the float stood vertically. The column composed of the nectophores is a six-sided amphitheat prism, corresponding to the regular union of the opposite pairs (fig. 6).

*Nectosome* (upper half of figs. 2, 3; fig. 1, lateral view, from the left side; fig. 2, dorsal view; fig. 3, ventral view; fig. 8, basal, fig. 7, apical view).—The cartilaginous umbrella of the nectophores is strongly compressed from both faces, so that the proportion of the frontal diameter to the principal and the sagittal axis = 3 : 2 : 1. The principal axis is nearly horizontal. The two large faces, upper dorsal and lower ventral, are nearly parallel and hexagonal in outline, the former slightly convex, the latter concave, with a prominent crest in the ventral median line; from this arises the short pedicle which attaches the nectosome to the trunk. The proximal half of the umbrella is wedge-shaped, thickened towards its equator, with a deep apical incision by which the two paired auricles or apical horns embracing the trunk are separated. The narrow lateral faces of the nectophores (right
and left) are triangular in the proximal half, quadrangular in the distal half, which is separated from the former by an equatorial crest. The distal (or basal) face, which encloses the small ostium of the nectosae (fig. 8, v), is small, and nearly square.

Nectosae.—The subumbrella, placed in the distal half of the nectophore, is cordiform or hammer-shaped, with an odd distal part bearing the mouth, and two paired lateral parts, which expand right and left; the three parts are subequal in size and similar in the quadrangular outline, seen from the face. The frontal axis of the nectophore passes through the broad proximal face of its subumbrella. The lateral view of the latter is oblong. The course of the four radial canals is as usual, straight in the two sagittal vessels (shorter ventral and longer dorsal), complicated and bent with three loops in the two paired lateral vessels (compare pp. 189, 216, and figs. 6–13).

Siphosome (lower half of figs. 2, 3; fig. 1, lateral view, from the left side; fig. 2, dorsal view; fig. 3, ventral view).—The siphosome of the single specimen observed possessed five fully-developed eormidia, and was in size (length as well as breadth) one and a half times as large as the nectosome; it equalled the latter in rigidity, and presented a glassy cylinder of 20 mm. in length and 12 mm. in diameter. Its axial trunk was nearly straight, and bore on its ventral median line the five equidistant ordinate eormidia. These occupied in the swimming animal (with horizontal trunk) only the ventral half of the siphosome, whilst its dorsal half was exclusively composed of bracts. All the siphons depended from the ventral side, and the long tentacles were prominent only on this side; in the same form which I have figured in the case of Crystallodes rigida (84, pl. x. figs. 65, 66). The same characteristic form is clearly represented in an excellent (unfortunately not published) figure of Crystallodes mertensii, drawn from life by Mertens in 1827.

Cormidia (fig. 4).—Besides numerous buds of undeveloped eormidia, placed at the top of the trunk of the siphosome (immediately beyond the nectosome), there were attached to the ventral median line of the trunk in the specimen figured five equal, well-developed and equidistant ordinate eormidia. Each of these is composed of the following parts arising from a common base:—(1) a siphon with its tentacles; (2) a group of four (sometimes three or five) palpons; (3) a group of bracts (of the same number?); (4) a male gonodendron; and (5) a female gonodendron. The equal intervals between the eormidia, or the free internodes of the stem, were only covered by thick prismatic bracts, densely attached one to the other.

Bracts (figs. 1–3, b; figs. 14–16).—The hydrophyllia are thick glassy polyhedral bodies of cartilaginous consistence, completely transparent, similar to colourless crystals. They are easily detached from the stem, and offer very different forms, partly subregular, partly irregular. The majority are wedge-shaped or obliquely pyramidal, with a tapering proximal end attached to the trunk, and a truncate facetted distal face. The upper face of the bracts is usually somewhat convex, the lower concave, and the outer
(or distal) face divided by several crests into trapezoidal facettes (mostly three, four, or five). Since the fundamental form of the cylindrical siphosome is bilateral, with symmetrical right and left halves, the paired bracts corresponding in both halves are so symmetrically disposed on both sides of the median plane (or the sagittal plane of the siphosome) that the panelled surface of the carapace offers an elegant and very regular pavement. Their special arrangement on the different sides of the siphosome is intelligible by comparison of figs. 1–3. Since the free terminal facettes on the surface of the scale-carapace are slightly concave, and their edges touch one another, the prominent crests between them form an elegant network over the whole surface. This pavement is in the Pacific Crystallodes mertensii, according to the beautiful figures of Mertens, still more regular and elegant (with subregular rhomboidal meshes, apparently arranged in eight longitudinal columns) than in our Indian Crystallodes vitrea. But also in this latter eight subregular alternating longitudinal columns may be distinguished. The entire cylindrical carapace is very firm and scarcely variable in form, since the protective scales may recede one from another only in a very slight degree. On the ventral side there remain small, free elefts between them, through which the tentacles proceed. Each bract encloses a simple blind canal, which runs in its median line, near to the lower concave surface.

Siphons (fig. 4, s).—The pedicle of the siphon is rather long and thin, the basigaster rudimentary. The wide cylindrical stomach exhibits eight longitudinal liver-ridges, each of which is composed of a series of conical villi (about ten or twelve large villi in each series). Each villus contains three to five roundish glossy and strongly refracting bodies (probably glandular vacuoles). The proboscis is long and very extensible, cylindrical, with eight strong longitudinal muscle-bands and eight alternating furrows inside. Its distal mouth is armed with cnidocysts and may be expanded as a sectorial disc.

Tentacles (figs. 1, 5).—The tentacle which arises from the pedicle of each siphon is very long, and bears a series of very numerous tentilla. The pedicle of the latter is also long, and often spirally coiled. It bears a purple cnidoband, which is included in a campanulate involucre and coiled up spirally in three to four turnings (fig. 5). The terminal ampulla (ta) is large, spindle-shaped, and covered with long vibratile cilia. On both sides of its base arise the two paired lateral horns, which are usually curved or spirally coiled (fig. 5, tc).

Palpons.—Each cornium usually seems to possess four palpons attached to the trunk immediately at the base of the siphon. They are much smaller than the latter, simple, cylindrical, or spindle-shaped tubes, with a thin pellucid wall, very expansive and contractile. Their pointed distal end is closed and armed with a number of cnidocysts (fig. 4, q). The inner and the outer surfaces are covered with long vibratile cilia. I did not notice and so did not figure the presence of palpacles at the base of the palpons; but it may be that they were accidentally lost, or that I have overlooked them.
Gonodendra.—Each cormidium is monoclinic and bears two small grape-like, shortly pediculate gonodendra, a male (fig. 4, h) and a female (fig. 4, f). Their clustered gonophores are small and not very numerous. The ovaria, however, are more numerous and much smaller than the spermaria. The umbrella is well developed in both sexes, with four radial canals and a ring-canal. The manubrium of the gynophores is colourless, ovate, or subspherical, and contains only a single large ovum, surrounded by a network of irregular spadiceine canals (similar to those of Agalma, Pl. XVIII. fig. 16). The manubrium of the androphores is much larger, cylindrical or spindle-shaped, milk-white, and includes an axial spadix; it is prominent more or less from the ostium of the umbrella in the ripe androphores (as in Agalma, Pl. XVIII. fig. 17).

Genus 43. Phyllophysa; L. Agassiz, 1862.


Definition.—Agalmidæ with a short and rigid siphosome, the trunk of which is scarcely contractile. Bracts with small intervals. Cormidia loose; palpons and gonostyles on the internodes, scattered between the siphons. Tentilla with a simple terminal filament.

The genus Phyllophysa was established in 1862 by L. Agassiz for an Agalmid, of which Quoy and Gaimard had figured a fragment only, under the name Stephanomia foliacea (2, p. 74, pl. iii. figs. 8–12). The description and the figures, however, which Quoy and Gaimard have left, are (as usual) far too incomplete and fragmentary to determine with certainty the true nature of the form captured near New Guinea. I retain the name of the genus, given by L. Agassiz, to designate that similar Agalmid, the siphosome of which Huxley described and figured under the name Stephanomia amphitrites (9, pl. vi.). It has loose cormidia, the palpons and gonophores being attached separately to the trunk, between the siphons. It differs, therefore, essentially from the similar Agalmid described under the same name by Péron and Lesueur; this has ordinate cormidia, with free internodes; and the gonophores are attached to the nodes at the base of the siphons (compare above, p. 221). Phyllophysa exhibits therefore the same relation to the true Stephanomia which Agalma has to Crystallodes. To avoid further confusion it seems advisable to call Huxley’s form (9, pl. vi.) Phyllophysa squamacea.

Genus 44. Agalma; Eschscholtz, 1825.

Agalma, Eschscholtz, Oken’s Isis, 1825, p. 743; System der Acalephen, p. 150.

Definition.—Agalmidæ with a short and rigid siphosome, the trunk of which is scarcely contractile. Bracts with small intervals. Cormidia loose; palpons and

1 Phyllophysa = Leaf-bladder, φύλλος, φύσα.
2 Agalma = Ornament, ἀγαλμά.

(zool. chall. exp.—part lxxvii.—1888.)
gonostyles on the internodes, scattered between the siphons. Tentilla tricorne, with a terminal ampulla and two paired horns.

The genus *Agalma* was established by Eschscholtz in 1825 for a new Physophorid which he had observed living in the Northern Pacific (21, p. 743, Taf. v. fig. 17, and 1, p. 150, Taf. xiii. fig. 1). The figure and description are very accurate, and this *Agalma okenii* must therefore be retained as the permanent type of the genus. It is closely allied to *Crystallodes*, but distinguished from this by the loose cormidia and the formation of a peculiar hydrocence in the axis of the siphosome; the thick bracts are here so arranged that they enclose together a central cavity into which the contracted stem with the cormidia may be retracted. Eschscholtz had already pointed out this peculiar character as an essential difference from the similar *Stephanomia*. The same characteristic structure is very obvious in the new Indian species, which is described in the sequel as *Agalma eschscholtzii* (Pl. XVIII. figs. 8–17). A comparison of its loose cormidia with the ordinate cormidia of *Crystallodes* (Pl. XVII.) illustrates their distinction; the siphons and tentacles in this latter issue separately between the bracts, in a ventral series; whilst they issue in the former, crowded in a bunch, from the basal ostium of the hydrocence. The same seems to be the case in three other species of this genus, which are described by Dana as *Crystallomia polygonata* (North Pacific, 73, p. 459), by Huxley as *Agalma breve* (9, pl. vii.), and by Leuckart as *Agalma clavatum* (8, Taf. xiii. figs. 1–6). Later authors have described as *Agalma* a number of Agalmidae which belong to other genera of this family.

*Agalma eschscholtzii*, n. sp. (Pl. XVIII. figs. 8–17).

**Habitat.**—Indian Ocean, Ceylon (Belligemma), December 1881 (Haeckel).

*Nectosome* (fig. 8, upper half).—The swimming apparatus, in the single specimen observed, was composed of an apical pneumatophore, and two opposite rows of nectophores, four in each row, besides some buds of undeveloped nectophores at the apex of the tubular trunk, at the base of the pneumatophore. The trunk was undulating, nearly zigzag, of a yellowish colour. The length of the nectosome is 40 mm., the sagittal axis 30 and the frontal axis 20 mm.

*Pneumatophore* (fig. 8).—The float is ovate or pyriform, about half as long as a nectophore, and covered with purple pigment-cells in the upper or apical half. The lower or distal half is yellowish, and exhibits eight equidistant longitudinal lines, the insertions of the eight vertical septa which divide the pericyclic cavity of the pneumatophore into eight radial pouches.

*Nectophores* (fig. 8, lateral view; fig. 9, dorsal view).—The nectophores have the form of a broad and flat wedge, with a deep median incision on the two-horned
apical or proximal side. The two lateral sides (right and left) are irregularly triangular, with a prolonged proximal apex. The convex dorsal and the concave ventral faces are bilaterally symmetrical and nearly hexagonal; the two lateral edges of each hexagon are slightly convex; the two basal (or distal) edges are separated by the small ostium of the nectosac, and the two apical (or proximal) edges by the deep axial incision which embracing the stem. The two lateral horns or auricles, separated by the latter, are nearly rhombic. The thickness of the wedge-shaped nectophore increases gradually from the proximal apex towards the distal base, which is bilaterally truncated. In the median line of the concave ventral side of the nectophore arises the short triangular pedicle which attaches it to the stem.

**Nectosac (figs. 8, 9, w).—**The subumbrellar cavity of the nectophore is small and occupies only the middle part of its distal or basal half. It is oblongish in the profile view (fig. 8), bicornuate in the dorsal view (fig. 9). The two symmetrical apical horns are rounded. The basal mouth of the nectosac is narrow, and provided with three scarlet ocelli or pigment-spots at the base of the velum, just on the three points where three radial canals (the dorsal and the two lateral) insculate into the marginal ring-canal. The fourth (ventral) canal possesses no ocellus. The course of the four radial canals is as usual (compare above, p. 216).

**Siphosome (fig. 8, lower half).—**The trunk of the siphosome is of about the same length as that of the nectosome, and densely covered with very thick and large bracts, which can recede only very little one from another, and permit, therefore, no considerable extension and shortening of the siphosome. This is almost globular, of 50 mm. diameter. The bracts are so arranged that the subspherical outside of the siphosome is completely loricated by the convex urticating abaxial face of the cartilaginous covering scales; these compose a continuous spiral, which is dexiotropic and ascends around the undulating axial trunk in four to six complete turnings. The trunk forms the axis of a subcylindrical or slenderly conical hydrorium, *i.e.*, a cavity which serves for the reception of the contracted and retreating cormidia; this protective cavity is closed around by the carapace of the covering scales, and open only at the dilated distal end, whence the siphons and tentacles can proceed (fig. 8, s).

**Cormidia.—**The polymorphous persons which compose the siphosome, siphous, palpons, and gonostyles arise scattered and separately from the common trunk; I was however, not able, in the single specimen observed, to determine with full certainty their peculiar arrangement, and the true composition of the loose cormidia. It seemed to me that about half a dozen (or perhaps eight) siphons and tentacles arose from the lower or distal half of the trunk of the siphosome, intermingled with a number of palpons; whilst distylic gonodendra, male and female separately, were attached to its upper or proximal half, together with numerous palpons and palpacles, which were protruded between the scales. Unfortunately most of the appendages were detached
and the peculiar structure of the siphosome destroyed before I could begin its closer anatomical examination.

**Bracts** (fig. 8, b; figs. 10 and 11, dorsal view; figs. 12 and 13, profile view).—The covering scales which compose the firm carapace of the globular siphosome are very thick and hard wedges of cartilaginous consistence. Their thickness increases from the proximal pedicle towards the middle part and decreases again towards the distal part, which is usually trilobed or five-lobed. The form of the larger bracts is rather regular and symmetrical; there are, however, intermingled, mainly in the proximal part of the siphosome, numerous smaller bracts which have a more irregular form, and partly fill up the void intervals between the former. The majority of bracts were detached from the stem before I could examine their peculiar arrangement. Their lower or inner face is concave; and near to it runs in the median line the blind bracteal canal (figs. 10–13, bc); the upper or outer face is convex and usually provided with three or five prominent ribs; each rib is three-sided, prismatic, and bears on its prominent abaxial edge a series of large cnidocysts.

**Siphons** (fig. 8, s).—The feeding polypites, which proceed through the basal ostium of the hydroidal cavity just described, are of medium size, and of the form usual in Agal- midae. Their pedicle is long and slender, the basigaster small and ovate, the stomach fusiform and provided with four double rows of red-brown liver glands; the proboscis is slender, very protractile, and ends in a mouth, which may be expanded in the form of a circular or polygonal suctorial disc.

**Tentacles** (figs. 8, 14).—The long tentacle which is attached to the base of each siphon bears a series of very numerous tentilla. Each tentillum (fig. 14) is composed of a slender pedicle (tp) and a campanulate involucre (th) which encloses a purple spiral cnidoband (tk); this exhibits seven or eight spiral turnings, and bears at its distal end three appendages, a large spindle-shaped terminal ampulla (ta), and a pair of slender lateral horns (tc).

**Palpons and Palpacles** (fig. 8, q, r).—The tasters are very numerous and seem to be irregularly scattered over the entire stem of the siphosome, partly between the siphons and bracts, partly connected with the gonostyles. They are very slender pellicid tubes, cylindrical or spindle-shaped, closed at the apex, which includes a number of cnidocysts. From their tapering base arises usually (or always?) a long palpacle, a very thin and mobile tasting filament, of the usual shape. The palpons as well as their palpacles are stretched and protruded through the intervals of the bracts as well as through the basal opening of the hydroidal cavity.

**Gonodendra.**—A small number of sexual clusters is attached to the trunk of the siphosome, mainly (or exclusively) to its upper or proximal half (?). The corm is monoecious, but the cormidia distylic, since each cluster contains gonophores of one sex only. The umbrella is well developed in the gonophores of both sexes, campanulate in
the female (figs. 15, 16), subcylindrical in the male (fig. 17); the four radial canals are connected at the ostium by a ring-canal. The ovate manubrium of the gynophores (fig. 15) includes a single large ovum only, surrounded by an irregular network of anastomosing spadice canals (fig. 16, cy, compare p. 195). The cylindrical manubrium of the androphores (fig. 17, km) is very large, purple, prominent from the narrow ostium of the umbrella, and contains a simple axial canal or central spadix.


*Anthemodes*, Hkl., Ueber Arbeitstheilung, &c., 38, p. 140.

Definition.—Agalmidæ with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia ordinate, with free internodes; palpons and gonostyles on the nodes. Tentilla with a simple terminal filament.

The genus *Anthemodes* was founded by me in 1869 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* (38, Taf. i.) has loose cormidia and belongs to *Capulita* (Genus 47b). The second species, described here as *Anthemodes ordinata*, and figured in PIs. XIV. and XV., has ordinate cormidia, with free internodes, and may be retained as the true type of this genus. Fragments of a similar species, *Anthemodes articulata*, have been found in a bottle in the Challenger collection from the South Atlantic (Station 325); it seems to differ from the former mainly in the thin foliaaceous shape of the triangular bracts and the broader form of the nectophores. The cormidia in *Anthemodes* are as regularly ordinate as in *Stephanomia*, from which it differs mainly in the prolonged and very movable stem of the contractile (not rigid) siphosome.

*Anthemodes ordinata*, n. sp. (Pis. XIV., XV.).

Habitat.—North Atlantic, Canary Islands (Lanzerote), January 25, 1867 (Haeckel).

Nectosome (Pl. XIV. figs. 1–4).—The swimming apparatus was composed in the only specimen observed of a small pyriform pneumatophore at the top of the tubular trunk, and of eight nectophores disposed alternately in two opposite rows. Between the uppermost nectophore and the base of the pneumatophore were visible a few buds of young and undeveloped nectophores. Fig. 1 exhibits the nectosome from the lateral and fig. 2 from the dorsal side. The swimming movements of this most elegant Agalmid are very rapid.

Pneumatophore.—The float filled with air at the apex of the trunk is very small, pyriform; its pointed apex bears an octoradiate pigment-spot, composed of red-brown

1 *Anthemodes* = Flower-shaped, ἀνθημόδες.
polygonal cells. The dilated basal part presents eight longitudinal stripes, the external insertions of the eight radial septa which divide the pericystic cavity of the pneumatophore into eight radial pouches.

Nectophores (figs. 1, 4, lateral view; figs. 2, 3, dorsal view).—The nectocalyces are broad and short, truncate, conical in the tapering distal or basal part, provided with a pair of large auricles in the dilated apical or proximal part. The frontal axis of the latter is three times as long as that of the former, and twice as great as the principal and the sagittal axis. The principal axis is directed obliquely from above and within downwards and outwards. The upper or dorsal face is emarginate convex; the lower or ventral face concave, with a median groove, from which arises the short triangular pedicle attaching the nectophore to the trunk. The two lateral auricles or apical wings are nearly square, slightly bilobate on the lateral edge, and embrace the trunk in the middle interval between two nectophores of the opposite series (an upper and a lower). Each of the two paired wings is nearly as large as the odd basal part of the nectophore.

Nectosac (figs. 1–4).—The subumbrella of the nectophores has nearly the same form as the surrounding exumbrella, from which it is separated by a rather thin but firm jelly-plate. The two lateral auricles, however, are more deeply emarginate in the former, nearly bilobate. The four radial canals are, as usual, of very different size and form; the two sagittal simply curved in the sagittal plane (the dorsal about twice as long as the ventral); whilst the two lateral vessels (right and left) are much longer, and exhibit a complicated undulating course (with four loops), which is intelligible by comparison of figs. 3 and 4 (compare above, p. 216).

Siphosome (fig. 1).—The axial trunk of the siphosome is a slender and exceedingly contractile cylindrical tube, many times longer than the trunk of the nectosome. It has in the fully expanded state a length of 200 mm. or more, and is therefore ten times as long as in the strongly contracted state, when it is only 20 mm. long. The corm contracts very suddenly, and passes over rapidly from the former into the latter state. The entire trunk is densely covered with innumerable prismatic bracts, and at regular large intervals with a great number of ordinate cormidia. All the parts of the corm are so hyaline and transparent, and for the most part so glassy and colourless, that the animal is difficult to perceive, even in the fully expanded state and in motion. The swimming power of the nectosome is great and the usual locomotion very quick.

Cormidia (Pl. XIV. fig. 1; Pl. XV. fig. 5).—Each cormidium is composed of a large siphon (s), with a tentacle (t), a peculiar cyston (y), a male gonostyle (h), and a female (f), and a number of bracts, which compose a protecting cavity for the former parts. Besides, numerous other bracts cover the long internodes between the cormidia, which bear no other organs.

Bracts (Pl. XIV. fig. 1; Pl. XV. figs. 5, b, 6, b, 10).—The hydrophyllia are extremely numerous and of a peculiar form, difficult to perceive because of their glassy transparency,
and subject to many variations. The majority of the bracts have the form of a flat obelisk, or an irregular truncated four-sided pyramid, sometimes more approaching to a regular four-sided prism, at other times to an irregular spheroid. There are intermingled, too, three-sided and five-sided (or even six-sided) truncate pyramids between the prevailing four-sided ones. The four trapezoidal lateral faces are usually of nearly equal size; the lower or basal terminal face is more or less concave, and about twice as large as the upper or apical face. The edges are slightly convex and armed with a series of cnidocysts, a larger one being prominent from each angle (fig. 10). A single blind bracteal canal (figs. 5 and 6, eb) arises from that corner of the basal face which is attached by a short mobile pedicle to the trunk. The canal runs along the middle line of the concave basal face to about its centre, and ends there in a club-shaped blind dilatation.

*Siphons* (figs. 5, 6, s, 7).—The single polypite of each cormidium is relatively large, very contractile, transparent and colourless, and attached to the trunk by a short pedicle (sp). The entire surface of the siphon is covered with very long vibratile cilia, arising from the exoderm cells (fig. 7). The basigaster is rudimentary. The large stomach (sm) is spindle-shaped, and contains inside four longitudinal rows of prominent hepatic villi, each row composed of half a dozen conical villi (sv). Each villus seems to be a single very much enlarged, glandular entoderm cell, which contains besides the nucleus a large roundish hyaline vacuole, probably a digestive vacuole. Many stomachs were filled with the eaten tentilla of the animal itself. The proboscis (sr) is a long cylindrical tube with a very thick and mobile muscle-wall. It opens at the distal end by a very expansile mouth, the edge of which is armed with thread-cells (fig. 7, so). The mouth may be expanded and attached in the form of a circular or polygonal suctorial disc (fig. 5, ss); this becomes sometimes as large as the entire cormidium.

*Tentacles* (Pl. XV. figs. 5, t, 6, t, 7, t, 11–13).—The single tentacle, which is attached to the base of each siphon, is very long and bears a series of very numerous tentilla. Each tentillum is composed of a long pedicle (fig. 11, ts), an ovate cnidosac (k), and a thin simple terminal filament (tf). The pedicle is beset with numerous papillate villi (fig. 11, tv). The proximal half of the cnidosac is enclosed by a campanulate and ciliate involucre, whilst its distal half is free and beset with numerous, very large, radially distant cnidocils. The proximal base of the cnidosae contains a vesicular diverticulum of the canal, the middle part a horizontal turning of the spiral cnidoband, beset on both sides with a series of very large ensiform cnidocysts (kgy) and above it a red pigment-spot; the distal end of the cnidosae is filled by globular cnidocysts. Whilst fig. 11 in Pl. XV. exhibits the fully-developed tentillum, two immature stages of its development are represented in figs. 12 and 13.

*Cystons* (figs. 5, y, 8, 9).—The single cyston, which is attached in each cormidium near to the base of the siphon, is about half as large as the latter. It consists of three parts: a short and small pedicle (yp), a large spherical thin-walled bladder, covered with
an elegant epithelium of large hexagonal cells (fig. 8, y), and a distal proboscis. This latter is spindle-shaped, covered outside and inside with long cilia, and has in the middle a spherical glandular dilatation, which contains a group of six to eight spherical (crystalline?) concretions; they are black in transmitted light, white in reflected light. The pointed distal end of the cyston (figs. 5, 8, yo) can be widely opened (fig. 9, yo) and the excreta ejected through this anal opening.

*Gonodendra.*—Each cormidium is monoecine, and bears at its base two small clustered gonodendrons, a male (fig. 5, h) and a female (fig. 5, f). The gonostyles are in both sexes little branched, and the gonophores attached by simple pedicels; their umbrella is little developed or rudimentary. Each gonophore (figs. 5, f, 15) encloses only a single, large, subspherical ovum, surrounded by a network of spadicine canals (fig. 15, xm). The manubrium of the androphores (figs. 5, h, 14) is large, club-shaped, and contains a simple axial canal or central spadix (fig. 14, he).

**Genus 46. Cuneolaria, Eysenhardt,** 1 1821.


**Definition.**—Agalmidae with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia ordinate, with free internodes; palpons and gonostyles on the nodes. Tentilla tricorne, with a terminal ampulla and two paired horns.

The genus *Cuneolaria* was established in 1821 by Eysenhardt (16, p. 369) for an Agalmid from the Northern Pacific, near the Sandwich Islands, of which he had observed (in September 1817) only the detached nectophores (fig. 5, a), bracts (fig. 5, be), and tentacles (fig. 5, d, e, f). These seem to be identical with some fragments of an Agalmid which was captured by the Challenger in the same region in September 1875 (Station 269). The form of the nectophores, bracts, and tentacles agrees perfectly with the figures of Eysenhardt. A fragment of the siphosome exhibited four ordinate cormidia, separated by free internodes, of the same composition as in *Anthemodes* (Pl. XV.). *Cuneolaria* differs, however, from this latter in the form of the tentilla, which are tricorne, as in *Crystallodes* (Pl. XVII.). *Stephanomia heptacantha,* captured by Quoy and Gaimard near the Molucca Islands (2, pl. iii. figs. 16–18), is perhaps identical with that species. *Stephanomia imbricata* of the same authors, from New Zealand (2, pl. iii. figs. 13–15), may be another species of the same genus. The figures and descriptions of the French authors are, however, too incomplete to determine with any certainty the true anatomical composition and systematic position of these Agalmids. *Cuneolaria* exhibits the same relation to *Anthemodes* that *Crystallodes* bears to *Stephanomia.*

1 *Cuneolaria =* Animal with wedge-shaped pieces, cuneolus.
Genus 47a. Halistemma,¹ Huxley, 1859.

Halistemma, Huxley, Oceanic Hydrozoa, pp. 70, 129.

Definition.—Agalmidae with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia loose; palpons and gonostyles on the internodes scattered between the siphons. Tentilla with a naked cnidoband and a simple terminal filament.

The genus Halistemma was established by Huxley in 1859 for that Mediterranean Agalmid, the first description of which Vogt had published under the name Agalma rubrum (6, Tab. vii.–xi). Perhaps identical with this species (from Nice) is another Mediterranean form, which Kölliker has figured under the name Agalmopsis punctata (4, Tab. iv.). Succeeding observers have described many different Agalmidae as Halistemma, and mainly those forms which belong to the following genus Cupulita. But the true Halistemma, according to the definition given by Huxley, differs from all allied Agalmidae in the simple structure of the tentilla, which have the same form as in Forskalia (Pl. IX. fig. 7, t; Pl. X. fig. 23). The naked cnidoband is a simple spirally convoluted riband without involucre, and bears a simple terminal filament. In all other respects Halistemma seems to agree with Cupulita; but perhaps both genera differ also in the structure of the palpons, which in the former seem to be mouthless, in the latter provided with a terminal mouth (cyston).

Genus 47b. Cupulita,² Quoy and Gaimard, 1824.

Cupulita, Quoy et Gaimard, Voyage de l'Uranie, &c., p. 580.

Definition.—Agalmidae with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia loose; palpons and gonostyles on the internodes scattered between the siphons. Tentilla with an involucrate cnidoband and a simple terminal filament.

The genus Cupulita was founded in 1824 by Quoy and Gaimard for an Agalmid, which Gaudichaud had captured at Port Jackson. The description of their Cupulita bowdichii (19, pl. lxxxvii. figs. 14–16) is very incomplete; but the figure which they give of the nectosome is so similar to that of Halistemma tergestinum and some closely allied species, that we employ the older name for these latter, instead of giving a new name. Cupulita is in all respects very similar to the true Halistemma (rubrum or punctatum), but differs in the form of the tentilla; the spiral cnidoband is not naked (as in the latter), but enveloped by a campanulate involucre. Another difference is perhaps marked by the structure of the palpons, which in Cupulita are true excretory

¹ Halistemma = Marine corona, Ἀλιστέμμα, Halistema. ² Cupulita = Beset with cupules.
cystons (with a terminal mouth), whilst they seem to be mouthless in *Halistemma*. Besides the oldest known form, the Australian *Cupulita bowdichii*, the following species probably belong to this genus:—(1) *Nonomia cara*, A. Ag. (North-west Atlantic, 37, p. 200); (2) *Anthemodes canariensis*, Haeckel (North-east Atlantic, 38, p. 140, Taf. i.); (3) *Agalmopsis fragilis*, Fewkes (Tropical Atlantic, 44, pl. v. fig. 2); (4) *Agalmopsis elegans*, Sars, partim! (North Atlantic, 27, Heft i. Taf. v.); (5) *Halistemma pictum*, Metschikoff, described in 1871 in the Russian language, Mediterranean); (6) *Halistemma tergestinum*, Claus (Adria, 74, Taf. i.–v.).

Genus 48. *Agalmopsis*¹, Sars, 1846.

*Agalmopsis*, Sars, Fauna littoralis Norvegia, Heft i. p. 31, taf. v., vi.

Definition.—Agalmidae with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia loose; palpons and gonostyles on the internodes scattered between the siphons. Tentilla tricornuate, with a terminal ampulla and two paired horns.

The genus *Agalmopsis* was described very accurately by Sars in 1846, and illustrated by excellent figures. The North Atlantic Agalmidae, however, which are represented in his pls. v. and vi., belong to two (or even three?) different genera. The first form, figured in pl. v., has simple terminal filaments of the tentilla, and belongs therefore to the preceding genus *Cupulita*. The second form, represented in pl. vi., has tricornuate tentilla, with an odd terminal vesicle and two paired lateral horns. This form may retain the original name *Agalmopsis elegans*, and represent the type of this genus. Closely allied to it is the North American *Agalmopsis cotena*, described by Fewkes as *Agalma elegans* (43, viii. pls. ix., x.). A different species, *Agalmopsis dissoluta*, Hkl., inhabits the Tropical Atlantic. A fourth species is the Mediterranean *Agalmopsis sarsii*, accurately described by Kölker (4, p. 10, Tab. iii.).


Definition.—Agalmidae with a long and movable siphosome, the trunk of which is very contractile; bracts with large intervals. Cormidia loose; palpons and gonostyles on the internodes scattered between the siphons. Tentilla multicor- nuate, with a terminal ampulla and a corona of eight radial horns.

The genus *Lychnagalma* was established by me for a most elegant small Agalmid, a complete specimen of which I had captured in December 1881, during my residence in

¹ *Agalmopsis* = Similar to an Agalma; ² *Lychnagalma* = Candelabrum ornament, ἀγάλμα, ἀγάλμα.

² *Lychnagalma* = Candelabrum ornament; ἀγάλμα; ἀγάλμα.
Ceylon. It is represented in Pl. XVI. A similar species was described in 1879 by Claus from the Mediterranean, as Agalmopsis utricularia (75, p. 199, Taf. xvi.). Fewkes proposed for it in 1883 the generic name Calliagalma (42, xviii. p. 844); but this name has been previously employed for an Insect. The peculiar and very remarkable form of the tentilla distinguishes this interesting genus not only from the closely allied Agalmopsis, but also from all other Agalmidae. Each tentillum bears a large terminal ampulla, which is surrounded by an elegant corona of eight radial filaments. The ampulla is a hydrostatic apparatus, lighter than the sea water, and directed upwards, whilst the surrounding filaments are either horizontally expanded or move in different directions. They form an extended net around the corm, well fitted for capturing prey.

*Lychnagalma vesicularia*, n. sp. (Pl. XVI).

**Habitat.**—Indian Ocean, Ceylon (Belligenima), December 1881 (Haeckel).

**Nectosome.**—The swimming apparatus is similar to that of Cupulita and Agalmopsis, composed of a small apical pneumatophore (figs. 1, 2, *p*, 4) and two opposite series of about sixteen alternating nectophores (figs. 1, *n*, 5, 6).

**Pneumatophore.**—The float is ovate, with an octoradial red-brown pigment-star on the apex, and eight equidistant longitudinal ribs in the basal half. These are the insertions of the eight vertical septa which divide the cavity of the pneumatophore into eight radial pouches (fig. 4, *pq*). A horizontal annular septum, similar to a diaphragm, divides the pneumatosac, somewhat beyond its equator, into two unequal halves; the superior larger half contains the chitinous pneumatoecyst; the inferior smaller half is lined by a greenish, air-secreting epithelium, the pneumadenia; both halves communicate by a circular opening in the diaphragm, the pneumatopyle.

**Nectophores** (figs. 5, 6).—The swimming-bells are very similar to those of Cupulita canariensis, rather square in the frontal view (fig. 6), irregularly pentagonal in the lateral view (fig. 5). The convex dorsal face has a median rounded ridge, which fits into a corresponding groove on the concave ventral face of the superjacent nectophore. From the apical part of the latter arises a short triangular pedicle which attaches the bell to the axial trunk. The two paired lateral facettes (on both sides of the median groove) are produced into two apical horns, or nearly triangular-pyramidal auricles. The distal base of the nectophore is obliquely truncate. The large nectosac is correspondingly tripartite hammer-shaped, with an odd median basal or distal part, and two paired ovate lateral pouches. Its four radial canals exhibit the usual shape, the two sagittal vessels run simply curved in the median plane of the subumbrella, whilst the two lateral vessels (figs. 5, 6, *cl*) are much longer and form several loops.

**Siphosome** (fig. 1).—The axial trunk of the siphosome is in the expanded state four
to six times as long as in the contracted state, and as the trunk of the nectosome. It bears twelve to sixteen siphons, and between them very numerous palpons and gonophores scattered along the trunk. The cormidia are, therefore, loose. The entire siphosome is densely covered by innumerable bracts, similar to Cupulita and Agalmopsis.

**Bracts** (figs. 7, 8).—The hydrophyllia are rather flat and broad scales, ovate or triangular in outline, with a convex dorsal and a concave ventral side. Near the latter a blind bracteal canal (bc) runs in the middle line. The proximal end is tapering, and attached by a short pedicle to the trunk. The broadened distal end is provided with three to five short triangular teeth (figs. 1, 3, b).

**Siphons** (fig. 3, s).—The polypites are large, and very movable, provided with a long pedicle. The ovate basigaster is narrow. The spindle-shaped stomach exhibits eight hepatic ridges. The cylindrical proboscis opens by a mouth which may be expanded in the form of a large and thin polygonal sucker-disc (fig. 3, ss).

**Tentacles.**—The long tentacle which is attached to the base of each siphon, in the constriction between pedicle and basigaster, bears a series of numerous tentilla. The thin pedicles of the tentilla are directed vertically upwards (fig. 1). The enidosea contains a long purple enidoband coiled up spirally (fig. 9, th), and enclosed by an ovate involucre (th); the spiral turnings (six to eight) are in the proximal part horizontal, in the middle part oblique, and in the distal part nearly vertical. The terminal ampulla (fig. 9, ta) is ovate, larger than the enidosea, and encloses in its distal apex an oil-globule, acting like a hydrostatic float. The base of the ampulla is surrounded by a corona of eight slender and very movable radially divergent filaments (fig. 9, te).

**Palpons.**—The entire trunk of the siphosome is covered with scattered palpons, about six to eight between every two siphons. They are slender, spindle-shaped, and very movable tubes, the distal apex of which is armed with cnidocysts. Each palpon (fig. 3, q) bears on its base a long and very thin palpacle, or a simple tasting filament (r).

**Gonodendra.**—The corm is monoeious, and the cormidia monochine. Numerous male and female gonodendra are scattered along the trunk, about half a dozen between every two siphons, two males and four females. The gonophores are larger and less numerous in the male gonodendra (fig. 3, h) than in the females (f). Their structure, which I could not sufficiently examine, seems not to differ from that of other Agalmideae.

**Family XIV. FORSKALIDÆ, Haeckel, 1888.**

Forskalidae, Hkl., System der Siphonophoren, p. 42.

**Definition.**—Physonecte polygastricea, with a long tubular stem of the siphosome, bearing numerous siphons, palpons, and braets, each siphon provided with a branched tentacle. Nectosome multiserial, strobiliform, with several spiral rows of nectophores. Pneumatophore with radial pouches.
The family Forskalidæ comprises those Physonectæ polygastriceæ which have a long tubular stem of the siphosome densely covered with bracts, and a strobiliform nectosome composed of numerous spiral rows of nectophores. The siphons are very large, and distinguished by a very long pedicle. They differ in these characters from most other Physonectæ, the nectosome of which is either biserial or quadriserial. The crown of bracts of the Anthophysidæ, however, may be compared with the spiral nectosome.

Although the Forskalidæ are the largest and the most splendid of all Physonectæ, and some species occur in the Mediterranean and the Atlantic in large numbers, nevertheless they remained perfectly unknown up to the year 1841. In that year Milne-Edwards published the first description of two Mediterranean species, under the names *Stephanomia contorta* and *Stephanomia prolifera* (71, p. 217, pls. vii.–ix.). It was completed twelve years afterwards by Kölliker, who established for them the genus *Forskalia* (4, p. 2, Taf. i., ii.). Additions were afterwards made by Leuckart (8), Vogt (5), Keferstein and Ehlers (33), and Claus (35). Recently (1881) an Atlantic species of *Forskalia* has been described by Fewkes, under the name *Stephanomia atlantica* (44, p. 264, pls. v., vi.). Another Atlantic species, *Forskalia tholoides*, was observed by me in 1866 off the Canary Islands, and is described in the following pages (Pls. VIII.–X.).

A very remarkable and gigantic deep-sea Physonect, which probably belongs to this family, was described in 1878 by Studer (40) under the name *Bathyphysa abyssorum*, and in 1884 by Fewkes (45) as *Pterophysa grandis*. A similar form, of which I was able to examine some fragments, makes it probable that these giants of the deep sea do not belong to the Rhizophydidæ (as the last-named author supposes) but to the Forskalidæ. Another new and interesting genus of this family, described in the following pages as *Strobalia*, was observed by me in 1881 in the Indian Ocean, and illustrates the affinities of this peculiar family.

**Nectosome.**—The swimming apparatus in the Forskalidæ is larger, stronger, and more highly developed than in any other Physonectæ. The pneumatophore at the apex of the trunk is small, but the nectophores are very numerous (usually more than one hundred) and arranged in a continuous spiral. The whole nectosome is sometimes cylindrical or conical, at other times more campanulate or hemispherical; its different forms are comparable to those of the different cones of firs. Its rounded surface is elegantly panelled or facetted by the basal ostia of the nectophores, which are regularly disposed in a quinucnial manner. The spiral line which connects the basal insertions of the nectophores has four to eight or more turnings, and is usually leotropie, therefore opposite to the dexiotropic spiral of the siphosome. The genus *Forskaliopsis* is distinguished by the possession of palpons which are scattered between the nectophores. The physiological activity of the nectosome is more highly developed than in all the other Physonectæ, since the great number of nectophores and their pointing in all directions enables the animal to perform a greater variety of swimming motions.
Pneumatophore.—The float at the top of the trunk is relatively small, usually ovate or pyriform, and pigmented in the apical part. Its outer wall (pneumatocodon) is connected with the inner wall (pneumatocosaccus) by a variable number of vertical radial septa: four in 

Strobalia, six to eight or twelve in Forskalia and Forskaliopsis, sixteen in Bathypsysa. The radial pouches or chambers of the pericystic cavity, which are separated by these septa, are closed above, but open below in the common trunk, beyond the funnel-cavity of the pneumatocosac.

Nectophores.—The numerous nectocalyces, owing to their multiserial and spiral arrangement on the nectosome, differ in form considerably from those of the other Physonectae. Usually they are attached to the common trunk by a long pedicle of conical or pyramidal form. Their umbrella is prismatic, with polygonal faces, produced by the mutual pressure of the densely associated nectophores. The subumbrella is more or less compressed in the sagittal direction, dilated laterally, often provided with two lateral horns. Sometimes the exumbrella of the apical part, corresponding to the latter, bears two prominent apophyses. The four radial canals of the nectosac, according to that dorso-ventral compression, are usually of different sizes, the two lateral longer than the two sagittal vessels. The ring-canal which connects them at the constricted ostium of the nectosac is sometimes circular, at other times elliptical. Often some ocelli, red or brown pigment-spots, are visible above the small velum, at the inosculatation of the radial canals. From the proximal union of the latter in the top of the nectosac arises a long peduncular canal which runs through the pedicle of the nectophore and opens into the axial canal of the trunk (Pl. VIII. figs. 2, 3).

Siphosome.—Corresponding to the high development of the nectosac in the Forskalidæ, this interesting family surpasses all the other Physonectae also in the complicated composition and extraordinary size of the siphosome; it attains in the largest species a diameter of more than one metre in the fully expanded state; in Bathypsysa probably four to six metres or more; in the strongly contracted state it is much smaller. The numerous siphons are attached to the long trunk of the siphosome by very long peduncles, and these, as well as the trunk itself, are densely covered with innumerable bracts. These envelop, densely crowded, the outer surface of the contracted siphosome like a protecting carapace of scales. The entire form of the siphosome is sometimes more cylindrical or inversely conical, at other times more ovate or hemispherical; fully expanded, with widely prominent and brilliantly coloured appendages, it presents a most splendid spectacle.

Cormidia.—The number of the cormidia which compose the siphosome is usually very large, thirty to fifty or more, in the larger species several hundreds (sometimes more than five hundred). They are arranged around the axial trunk in a continuous spiral, the turning of which is usually right-handed (or dexiotropic), in contrast to the left-handed (or leotropic) spiral of the nectosome. The trunk itself is correspondingly
more or less spirally convoluted; it is sometimes regularly articulate, with equidistant segmental constrictions (in *Strobalia* and *Forskalia*, Pl. IX. fig. 7, a); at other times the annular constrictions disappear and the cylindrical or slightly compressed stem is not articulate (in *Forskaliopsis* and *Bathyphysa*). Respecting the composition of the cormidia and their attachment at the trunk, we distinguish in the Forskalidæ ordinate and loose cormidia; the former occur in *Strobalia*, the latter in the three other genera.

The ordinate cormidia of *Strobalia* are similar to those of *Stephanomia*, *Crystallodes*, *Anthemodes*, &c. Each cormidium is attached to a node of the trunk, or a constriction of the stem, and composed of five different medusomes, three sterile (a siphonal, a cystonal, and a palponal) and two fertile (a male and a female). The siphonal medusome is composed of a pedunculate siphon, a tentacle, and a corona of bracts on the base of the pedicle. The cystonal medusome consists of a cyston and a palpace, surrounded by a group of bracts. The palponal medusome is composed of a palpon with its palpacle and a basal corona of bracts. The two sexual medusomes are represented by a pair of gonodendra, which bear clustered gonophores, a male and a female. The long internodes of the stem, between these ordinate distylic cormidia, are free and covered only by small bracts.

The loose cormidia of the other three genera of Forskalidæ may be derived from the ordinate cormidia of *Strobalia* by dislocation of the associated medusomes. The axial trunk of the siphosome preserves in *Forskalia* the distinct articulation, whilst this is lost in *Forskaliopsis* and *Bathyphysa*. The polymorphous medusomes which compose the cormidia are here more or less separated, and the different persons and their organs more or less scattered. In *Forskalia* sometimes each cormidium is composed rather regularly of four separate and different medusomes, attached at intervals to the succeeding internodes of the stem. The first medusome is a siphonal one (with siphon and tentacle), the second a cystonal (with cyston and palpacle), the third a palponal (with palpon and palpacle), and the fourth a sexual (with a sexual palpon and a monostylic gonodendron). But in the larger corms of *Forskaliopsis* and of *Bathyphysa* the number and succession of medusomes in each cormidium seems to be variable and often perfectly irregular.

**Bracts.**—The hydrophyllia or covering scales are always very numerous, and cover, densely crowded, not only the stem of the siphosome, but also the long pedicles of the single siphons, cysts, and palpons. Their number is even in the smaller species several hundreds, and in the larger many thousands. The splendid Mediterranean *Forskaliopsis ophiura* has more than five hundred siphons and on the pedicle of each siphon more than a hundred bracts; the number of cystons and palpons, however, amounts to two thousand to four thousand or more; and since the pedicles of these are also covered with bracts, the total number of the latter may amount to more than
a hundred thousand. The form and size of the bracts are extremely variable and usually more or less irregular; their arrangement is very difficult to recognise, since they are hyaline and easily detached. Usually they have the form of oblongish scales, with concave lower and convex upper face; the latter bears often three to five dentate ribs or crests. The bracteal canal is always simple and runs along the lower face. The great variety in size and form of bracts, in one and the same specimen, is exhibited by figs. 10 to 18 of Pl. X.

*Siphons.*—The polypites of the Forskalide are very large and highly developed, and sometimes of an extraordinary size. The spindle-shaped siphons of *Bathyphysa* are larger than those of any other Siphonophorae hitherto known; they attain (in a strongly contracted state) the length of 50 to 60 mm. and the thickness of 30 mm., and are attached by pedicles of 200 mm. in length. But even in the smaller species of this family the siphons and their pedicles attain a considerable size. The thin tubular pedicles are usually covered with numerous bracts, in manner similar to the trunk of the siphosome. The three parts of the siphon proper are usually well developed (Pl. IX. figs. 7-9). The thick-walled basigaster, with masses of cnidocysts, is sometimes divided by four longitudinal furrows into four equal quadrants. The wide stomach bears usually eight, twelve, or sixteen longitudinal liver-ridges, coloured brown or red; these are wanting in *Bathyphysa*, being replaced by innumerable small hepatic villi (similar to those of *Athorybia*). The muscular proboscis is very strong and extensible, and provided with a widely expansible mouth. The opening of the mouth is often surrounded by a corona of eight or sixteen short lobes.

*Tentacles.*—The form and structure of the single large tentacle which is attached to the base of each siphon seems to be the same in all Forskalide. The point of insertion is in the constriction between the basigaster and the distal end of the long pedicle (Pl. IX. figs. 7, 8). The number of equidistant tentilla or lateral branches, which are inserted in the nodes of the regularly segmented tentacle, is very large. Each tentillum (Pl. X. fig. 23) has a long pedicle (*ts*), a large spiral cnidoband (*tk*), and a long terminal filament (*tf*). The number of the spiral turnings of the naked cnidoband, which is not enclosed by an involucre, is variable in the single species, usually two, three, or four. Its colour corresponds to that of the siphon (usually red). The broad spiral riband is composed of many series of innumerable small paliform cnidocysts, and of two simple lateral series of large ensiform cnidocysts (fig. 23, *tk*).

*Cystons.*—All Forskalide possess a great number of hydrocysts or spindle-shaped vesicles, which are attached to the base of the siphons in *Strobalia*, whilst they are inserted into the trunk of the siphosome, between the siphons, in the three other genera. They are usually described as "tasters." An accurate examination of them, however, shows that three different forms of them must be distinguished, viz., cystons, palpions, and gonopalpons. The two former bear a palpacle, wanting in the latter. The cystons,
anal or excretory vesicles (Pl. X. fig. 19), differ from the two other forms in the
possession of a terminal opening. They are much smaller than the siphons, and without
hepatic ridges, but exhibit a similar composition of four different segments; a basal
pedicle (fig. 19, qp), a thick-walled hemispherical basigaster, at the base of which is
inserted the single long palpacle (r), a large thin-walled stomach (q), and finally a
conical or pyriform chromatendia, with a distal opening. This latter segment, which is
comparable to the proboscis of the siphons, is most characteristic of the cystons; it is a
colour-gland, which produces a great mass of pigment-granules, and extrudes it through
the terminal anus. The dark glandular entoderm of the chromatendia is much thicker
than the colourless entoderm of the thin-walled stomach; the pigment-granules secreted
by it are usually red or brown, sometimes intermingled with small crystals. When a
quietly floating Forskalia is touched, it suddenly discharges the contents of the
chromatendia, and makes the surrounding water dark and intransparent. Kölliker
(4, p. 8) and Leuckart (5, p. 17, and 8, p. 348) have already described this interesting
excretion; but they suppose that there is no true opening at the distal end of the
cystons, and that the pigment is discharged by rupture of their wall. Repeated
observations on the living Forskalia tholoides have convinced me that the pyriform
red chromatendia, or the opaque distal portion of the cyston, possesses a constant
terminal opening. This anus or excretory opening, however, is difficult to observe in
the closed state (as is also the case in the mouth and the anus of many lower animals).
The opening has been observed too by Studer in the cystons of Bathyprya abyssorum,
which he has described as bracts (40, p. 20). The excretion of the pigment-masses and
the darkening of the water by it have probably the same physiological function as in the
Cephalopoda,—to protect the attacked animal from its persecutors, and facilitate the
capture of food-animals.

Palpons.—Whilst one cyston only belongs to each cormidium of probably all
Forskaliidae, the number of true palpons (formerly confounded with the cystons) is
usually much larger. In Forskalia there belong usually two palpons (arising from a
common pedicle) to each cormidium, in Forskaliopsis three, four, or more; in some of
the largest forms a pediculate bunch of four to six or more palpons arises from the
trunk between each siphon and the appertaining cyston. The true palpons differ from
the latter mainly in the absence of a distal opening; they are closed at the pointed
distal end, and communicate only by the pedicle with the tube of the trunk. Their
size is usually about half that of the siphons and cystons, but very variable according
to the different state of contraction. Sometimes the palpons are simple pyriform or
spindle-shaped vesicles, at other times divided by an annular constriction into a
smaller proximal and a larger distal part. The pointed apex of the latter is usually
provided richly with larger cnidocysts and long sensitive cnidocils, sometimes also
coloured by pigment. Their function is sensory. The long palpacle which arises from

(Zool. Chall. Exp.—Part lxxvii.—1888.)
the base of each palpon is always a simple thin tasting filament, richly provided with small cnidocysts and cyanidocils.

_Gonodendra._—The corns of all Forskalidæ seem to be monocious; the cornidia are usually monoclinc; but in _Bathyphysa_ perhaps diclinic. The gonodendra are distylic, either male or female, in _Bathyphysa_ and _Strobalia_, whilst they are monostylic in _Forskalia_ and _Forskalipysis_. Each cornium usually possesses in these two typical genera a single pediculite gonodendron, which arises separately from the siphon and cyston, and bears upon a common pedicle a spindle-shaped sexual palpon (Pl. X. fig. 21) and numerous roundish gynophores in the proximal part, oblongish androphores in the distal part. Each female gonophile (f) develops only a single large ovum, each male a large club-shaped spermarium (h). In some species two sexual palpons ("twin-tasters"), more rarely three or four, are attached to the base of the hermaphroditic gonodendron. There seems to be some variety in this arrangement. _Strobalia_ differs in the possession of two separate clustered gonodendra, a male and a female, both arising separately from the common base of the ordinate cornium.

**Synopsis of the Genera of Forskalidæ.**

| Trunk of the siphosome not articulate, without regular annular contractions. | Cormidia loose. Gono<ref>domendra monostylic, between the siphons, which have hepatic ridges (no villi), 52. Forskalipysis. | 52. Forskalipysis. |
| Trunk of the siphosome articulate, with regular equidistant annular constrictions. | Cormidia loose. Gono<ref>domendra distylic, between the siphons, which have hepatic vili (no ridges), 53. Bathyphysa. | 53. Bathyphysa. |

Genus 50. _Strobalia_, Haeckel, 1888.

_Strobalia_, Hkl., System der Siphonophoren, p. 42.

**Definition.**—Forskalidæ with ordinate cornidia, and segmented trunk of the siphosome. Gonodendra distylic, arising from the base of the siphonal pedicles. Siphons with hepatic ridges. Nectosome without palpons.

The genus _Strobalia_ comprises some new species of Forskalidæ, which are very similar in general appearance to some smaller forms of the true _Forskalia_, but differ from it in two important points. The cornidia are perfectly ordinate, not loose; and the gonodendra are gonochoristic or distylic. Each cornium of the siphosome is composed of five different medusomes, three of which are sterile (a siphonal, a cystonal, and a palponal) and two fertile (a male and a female). Each of the three sterile

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1 _Strobalia_ = Marine spiral, στρόβαλος, στροβιλός.
medusomes is again composed of three corresponding organs, viz., a manubrium (a siphon, a cyston, or a palpon), an appertaining filament (tentacle or palpacle), and a corona of bracts (corresponding to the umbrella of the original medusa). The two sexual medusomes, or rather clusters of medusomes, are represented by two gonochoristic bunches of gonodendra, a male and a female; they arise separately from the common base of the cormidium, from the basal insertion of the long pedicle of the polypites; the male bunch is smaller than the female. The form and structure of the single parts are essentially the same as in the closely allied Forskalia; but the internodes of the trunk, between the equidistant cormidia, are covered only with bracts. Strobalia therefore exhibits a similar relation to Forskalia as Anthomodes does to Halistenina, or Crystallodes to Agalma. A beautiful species of this genus, Strobalia cupola, was observed living by me in the Indian Ocean, and will be described in my Morphology of the Siphonophoræ; a fragment of a similar species, Strobalia conifera, was collected by the Challenger in the South Pacific (Station 288).

Genus 51. Forskalia, Kölliker, 1853.

Forskalia, Kölliker, Die Schwinampolypen von Messina, p. 2.

Definition.—Forskalidæ with loose cormidia and segmented trunk of the siphosome. Gonodendra monostylic, arising from the trunk, separate from the siphonal pedicles. Siphons with hepatic ridges. Nectosome without palpons.

The genus Forskalia, hitherto the only representative of this family, comprises in the definition here stated those forms, the well-known type of which is the Mediterranean Forskalia contorta, Leuckart (8), probably identical with Forskalia edwardsii of Kölliker (4). The trunk of the siphosome is in this species, as well as in Forskalia tholoides described in the sequel, distinctly segmented or articulate, with equidistant annular constrictions, from which the single medusomes of the loose cormidia take origin. Usually three different medusomes arise separately from the stem between every two siphons, viz., (1) a sterile cyston with a palpacle; (2) a sterile palpon with a palpacle; and (3) a sexual palpon, to the base of which is attached a clustered monostylic gonodendron (with female gonophores on the proximal part and male gonophores on the distal part). But sometimes the number of palpons is multiplied (often two or three arising from a common pedicle), and their arrangement is more irregular. Another difference between Forskalia and Forskaliopsis is seen in the presence of palpons in the nectosome of the latter, wanting in the former. The general appearance of Forskalia is more delicate and similar to Strobalia and to Agalmopsis. Probably to this genus belong a number of different species inhabiting the warmer seas, e.g., Stephanomia atlantica of Fewkes (44); but their distinction requires a further accurate comparison.

1 Forskalia, named in the honour of the celebrated naturalist, Petrus Forskål (1775).
Forskalia tholoides, n. sp. (Pls. VIII.–X.).

Forskalia tholoides, Hkl., 1866, MS. Canar.

Habitat.—Lanzarote, Canary Islands, December 1866 (Haeckel).

Nectosome (Pl. VIII.; Pl. IX. fig. 6).—The swimming apparatus is very large, campanulate or cupola-shaped, and has a diameter of 35 to 40 mm. The axial trunk is a slender tubule, slightly curved and twisted spirally, of a reddish colour. Its apex bears a small pyriform pneumatophore. The nectophores are very numerous, and so densely aggregated that no intervals remain between them. They are arranged as regularly in a continuous spiral as the bracts in a fir-cone. In the lateral view of the nectosome of a middle-sized specimen (fig. 1) about sixteen to twenty longitudinal rows of nectophores may be distinguished, and nearly the same number of alternating transverse rows, so that their total number may amount to three hundred or four hundred, and in the larger specimens more.

Pneumatophore (figs. 1, 6, \( \rho \)).—The float is an ovate, relatively small vesicle, slightly prominent over the surrounding corona of nectophores at the top of the stem, and coloured pink in the upper or apical half. Its outer membrane, or the pneumatocodon, is connected with the inner membrane, or the pneumatosaccus, by eight vertical radial septa. These divide the cavity of the pneumatophore into eight radial pouches. Its structure is the same as figured by Claus in Forskalia edwardsii, which, however, has only six radial pouches (35, Taf. xlvii. fig. 16). The apex of the pneumatophore (Pl. X. fig. 24) has the form of an ocellus, a dark circular apical spot (similar to a closed opening), being surrounded by a clear colourless ring, and this again by a regular pink pigment-cross. The four rays of this cross are forked, and the eight fork-branches, composed of elegant pigment-cells, are divergent and equidistant towards the equator of the pneumatophore, corresponding to the abaxial insertion of the eight internal radial septa.

Nectophores (Pl. VIII. figs. 1–5).—The nectocalyces are irregularly prismatic, with polygonal lateral faces produced by mutual compression. They are attached to the axial trunk of the nectosome by long pyramidal pedicles (\( \alpha \rho \)). These are shorter in the superior, longer in the inferior nectophores, where they attain double the length of the umbrella. A long nectocalycine duct (\( \alpha s \)) enters into the axial apex of the pyramidal pedicle and runs in its axis towards the top of the campanulate subumbrella. It divides here into four radial canals (\( \alpha v \)), which are united above the small velum (\( \nu \)) by a ring-canal (\( \alpha e \)). Figs. 2–5 exhibit four different stages in size in the development of the nectophores (fig. 5 a very young one).

Siphosome (Pl. VIII. fig. 1, inferior half; seen in profile; Pl. IX. fig. 6, apical view).—The siphonophorous part of the entire corm, or the siphosome, has a very
different appearance according to the state of contraction of the different persons composing it. In the strongly contracted state (fig. 6) it is nearly spherical, scarcely larger than the dome-shaped nectosome above it; in the highly expanded state it is three or four times as large, and presents a most elegant aspect. The numerous cormidia (forty to fifty in the figured specimen) are arranged around the central spirally-turned trunk in a large dextrotrpic spiral (or Delta-spiral), whilst the spiral arrangement of the nectophores is an opposite one (laeotropic or Lambda-spiral), similar to that of the cnidoband in the tentilla (Pl. X. fig. 23). The spiral axial trunk (fig. 7) is articulate, and its pink central canal (ae) runs near the concave dorsal side.

**Cormidia** (figs. 1, 6, 7).—The cormidia, which compose the siphosome, are arranged in this species in an irregular manner, and disposed in a different way from those of other nearly allied species. It may represent, therefore, a separate genus, *Forskalidse*. The trunk of the siphosome (Pl. IX. fig. 7, a), which is distinctly articulate, bears the series of cormidia on its convex ventral side, where they arise from equidistant nodes, or annular constrictions of the stem. Usually each loose cormidium is composed of four different medusomes, viz., (1) a long-stalked siphon, with its tentacle and numerous bracts; (2) a stalked cyston, with a palpacle and a group of bracts; (3) a stalked palpon, with a palpacle and a bunch of bracts; (4) a gonostyle with a sexual palpon and a monoclinic gonodendron. This kind of regular composition is probably the original one, and is characteristic of this species. It is, however, not quite constant, but subject to some individual variations, which may be partly accidental. A further accurate examination and comparison of the composition of the loose cormidia is particularly required in this as well as in all other Forskalidse hitherto described.

**Bracts** (figs. 1, 7, b, 10–18).—The innumerable hydrophyllia which cover the siphosome are attached as well immediately to the trunk of it as to the pedicles of the siphons, and to the bases of the pediculate cystons and palpons. Their number amounts to more than a thousand in the largest specimens. The greatest number of these bracts are small or of medium size, and of simple form (figs. 10–13); some of them become larger and are developed in the form of large protective scales (figs. 7, b, 17, 18) covering the convex outside of the siphosome (fig. 1). These larger bracts are three-sided prismatic, more or less asymmetrical, with a concave smooth lower or distal face, and a convex dentate upper or proximal face. This latter bears usually a strong dentate longitudinal crest, and the two lateral edges are also armed with a few teeth. The smaller bracts have no crest and dentation; they seem to fill up the intervals between the larger, and are of very irregular form and different sizes (compare figs. 10–14). A blind longitudinal bractial canal arises from the trunk and runs near the concave inferior face of the bract.

**Siphons** (figs. 1, 6, s, 7, s, 8, 9).—The polypites are large, 10 mm. to 15 mm. long, and
attached to the distal end of pedicles of about the same length. These pedicles (fig. 7, sp) are slender cylindrical tubes, very contractile, and covered with a series of small bracts. (The insertions of the detached bracts are visible in fig. 6, sp.) Usually four larger bracts (comparable to a quadripartite umbrella) arise from the base of the pedicle and cover its whole length (fig. 7, b). The siphon itself has a subspherical thick-walled basigaster, the cnidocysts of which are sometimes arranged on four square radial plates (figs. 7, 8, sb). The ovate stomach (sm) possesses sixteen red longitudinal liver-ridges, which are disposed regularly in a very remarkable manner (fig. 7, sb). Four larger perradial ridges extend throughout the whole length of the stomach, while four interradial, alternating with them, are shorter; and between the former and the latter are interpolated in the basal part of the stomach eight smaller adradial ridges. The contractile proboscis (sr) has four stronger longitudinal muscular bands. Its distal mouth exhibits sometimes eight, at other times sixteen, distinct lobes (fig. 8, so), which are separated in pairs by constrictions and armed with cnidocysts (fig. 9).

_Tentacles_ (figs. 1, 7, t, 8, t, 23).—The single tentacle, which arises from the basigaster of each siphon (at the distal end of the long pedicle, fig. 8, sp), is very long and strong, distinctly articulate, and beset with a series of very numerous tentilla which arise from the equidistant nodes (fig. 7, t). Each tentillum (fig. 23) is composed of three parts, a thin pedicle (ts), a large spiral cnidoband (tk), and a long slender terminal filament (tf). The spiral cnidoband (or “cnidobattery”) is naked, without involucre, has usually four open spiral turnings (like a corkscrew), and is composed of innumerable small paliform cnidocysts, with a lateral series of larger ensiform cnidocysts on each side. The peculiar arrangement, exhibited by the small fusiform cnidocysts in the terminal filament, is represented in fig. 23a from its proximal part, figs 23b and 23c from the middle parts, and fig. 23d from the distal part.

_Cysts_ (Pl. X. fig. 19).—The cysts or anal vesicles, one of which arises from the trunk of the siphosome between every two siphons, are smaller than the latter, but larger than the neighbouring palpons. Each cyst is composed of four segments, which are comparable to those of the similar siphon. The first segment is a slender and thin pedicle (qp), not covered with bracts, and annulate towards the club-shaped distal end. The second segment is a thick-walled hemispherical basigaster, with thickened exoderm, full of cnidocysts; it bears the long palpacle (r). The third segment (fig. 19, q) is a long thin-walled cylindrical tube, comparable to the stomach of the siphon, but without the characteristic liver-ridges of the latter; it is separated by an annular constriction from the basigaster at the proximal, and from the colour-gland at the distal end. The fourth and last segment of the cyston is the colour-gland (chromadenia), a pyriform or conical vesicle of a dark red colour, with a terminal mouth-opening, or rather an anus. Its thick glandular endoderm secretes a mass of red pigment-granules, which often fill up and expand the terminal vesicle. When the animal is attacked or irritated, it opens the anus
spontaneously and ejects the masses of red pigment-granules which darken the seawater.

Palpons (Pl. X. fig. 20).—The tasters seem to occur between the siphons in variable number and arrangement, sometimes a single one in each cormidium, at other times two or even three associated. They are similar to the cystons, but smaller and without a terminal opening. Each palpon is a spindle-shaped or pyriform vesicle, separated from its thin pedicle by a ring composed of enidocysts, which corresponds to the larger basigaster of the cystons and siphons. The closed distal end is more or less pointed, and armed with patches of small enidocysts (fig. 20). From the enidal ring of each palpon arises, just as from the basigaster of each cyston, a very long and thin palpae (fig. 19, r) or a tasting filament, which is beset with numerous small enidocysts. The variable arrangement of the latter is represented by fig. 19b in the proximal part, fig. 19a in the middle, and fig. 19c in the distal part of the palpae.

Gonophores (Pl. IX. fig. 7, f, h; Pl. X. figs. 21, 22).—Each cormidium bears a pediculate monostylic gonodendron, which is composed of a sexual palpon and numerous clustered gonophores, females in the proximal part and males in the distal part. The sexual palpon or gonopalpon (figs. 7, q, 21) is a spindle-shaped vesicle, which bears at its base a pair of crescentic patches, composed of larger spherical enidocysts; its apex is densely covered with smaller enidocysts. The female gonophores (fig. 21, f) are pyriform or subspherical; each contains a single large ovum only, surrounded by a loose network of irregular spadicine canals. The male gonophores (figs. 21, h, 22) are ovate or club-shaped, with a simple central spadix (hx). The umbrella in both sexes closely embraces the manubrium, and exhibits the usual four radial canals, connected by a very small ring-canal above the velum.

Genus 52. Forskaliopsis, n. gen.

Definition.—Forskalidæ with loose cormidia and unsegmented trunk of the siphosome. Gonodendra monostylic, arising from the trunk, separate from the siphonal pedicles. Siphons with hepatic ridges. Nectosome with palpons.

The genus Forskaliopsis comprises those forms of Forskalidæ, the typical representative of which is the Mediterranean Forskalia ophiura, Leuckart; it differs from the true Forskalia (hitherto confounded with it) in several important characters. The trunk is not articulated, without annular constrictions, and everywhere densely covered with innumerable bracts in the same manner as the long pedicles of the siphons. The nectosome is distinguished by the presence of numerous tasting palpons scattered between the nectophores (8, p. 352); these are wanting in Forskalia, and remind one of the nectosome of Apolemia. The numerous cormidia in the large siphosome of

1 Forskaliopsis = Similar to Forskalia.
Forskaliopsis seem to be looser, and their organs more irregularly scattered than in the preceding Forskalia. The palpons of the former are much more numerous, often three, four, or more arising from a common pedicle. Perhaps other constant differences may be found between these two genera, which are also rather different in external appearance. Forskaliopsis is one of the largest and most splendid Physonecæ; its size in the fully expanded state attains more than a metre, and the number of nectophores as well as of siphons amounts in the larger specimens to five hundred or more, the number of braets to several thousands. I observed a gigantic representative of this splendid genus, Forskaliopsis magnifica, distinguished by the blackish-brown colour of the siphons and enidoeysts, in 1881, in the Indian Ocean; but unfortunately it was destroyed before I could examine it sufficiently.


Definition.—Forskaliidæ with loose cormidia and unsegmented trunk of the siphosome. Gonodendra distylic (?), arising from the trunk, separate from the siphonal pedicles. Siphons with hepatic villi and a pair of lateral wings. Nectosome probably with palpons between the nectophores (?).

The genus Bathyphysa (perhaps the representative of a separate family, Bathyphysidæ) was established in 1878 by Studer for a gigantic deep-sea Siphonophore, which surpasses all other animals of this class in the extraordinary size of the siphons and of the gonodendra. It was taken by the S.S. "Faraday" in 1875, on the occasion of the third Atlantic Cable Expedition, and brought up by a grapnel from depths of 1000 and 1780 fathoms, in the North Atlantic (lat. 43° 45' N., long. 43° 36' W.). The fragments of this most interesting genus, preserved in the Zoological Museum of Berlin, are unfortunately very incomplete, partly without connection, and do not allow us to compose a satisfactory idea of the complete structure and the natural affinities of the genus. The strong tubular trunk of Bathyphysa abyssorum, which even in the highly contracted state has a length of more than a metre, is divided into two halves of very unequal thickness. The proximal or superior half is only 3 to 5 mm. in diameter and is the trunk of the nectosome; it bears at its apex an ovate pneumatophore of 20 mm. in length, and beyond it numerous lateral apophyses (not mentioned by Studer, but figured by him in fig. 28, loc. cit.), which are probably the bases of the pedicles of the detached and lost nectophores. The distal or inferior half of the trunk is much thicker (10 to 15 mm. in diameter), laterally compressed, and beset in the ventral median line with two series of numerous appendages, siphons and gonodendra alternating. The thin tubular pedicles of the siphons attain a length of 20 centimetres, and bear numerous pisi-
form prominences ("erbsengrosse Anschwellungen"), probably the basal parts of the detached and lost bracts. The siphons themselves (in a strongly contracted state) attain a length of 50 to 60 mm. and a thickness of 30 mm., and are therefore much larger than in any other known Siphonophorae; in the fully expanded state they may have a length of half a metre or more. The basal half of the spindle-shaped siphons is distinguished outside by the possession of two opposite lateral wings or crests. Their whole inside is covered with innumerable small villi, which replace the wanting hepatic ridges. The gonodendron, which seem to alternate with the siphons, are elegant oblongish bunches 70 mm. to 80 mm. in length and 10 mm. to 15 mm. in breadth, attached directly to the trunk by thin tubular pedicles of nearly the same length. Each gonodendron is richly branched, and bears many hundreds of pediculate ovate gonophores, about 1 to 1.3 mm. in diameter. The bad state of preservation did not allow the recognition of their structure; but all the gonophores in each gonodendron seemed to be of the same sex.

Unfortunately the bracts as well as the nectophores were all detached and lost in the fragments of the corn described by Studer; but the great facility with which these parts are detached in all Forskalidæ explains their complete absence sufficiently; and the more so, as the mode of capturing this gigantic deep-sea form, brought up on a grapnel from depths of 1000 to 1800 fathoms, must have injured the delicate corn in the most violent manner. The tentacles which were originally attached to the base of the siphons were also found separate from them; they bore a series of tentilla, with ovate cnidosaæ 12 to 15 mm. in length and 4 to 5 mm. in thickness; their spiral cnidosaund had numerous turnings. Similar to the siphons, but of half their size, and provided with two larger longitudinal wings, were detached bodies, which Studer has described as "braets" (loc. cit., p. 20, Taf. iii. fig. 25); they are probably cystons.

Probably to the same genus belongs a gigantic deep-sea form, the detached siphons of which Fewkes has described in 1886 as Pterophyza grandis, taken from a depth of 2109 fathoms in the Gulf Stream (45, Nr. xxxvi. p. 960, pl. x. figs. 1–3). Scattered fragments and detached parts of another large Forskalid, probably closely allied, were found in a bottle in the Challenger collection taken in the South Atlantic (Station 323, depth 1900 fathoms). It may be called provisionally Bathyphyza gigantea.

Family XV. Nectalidæ, Haeckel, 1888.

Nectalis, Hkl., System der Siphonophoræ, p. 41.

Definition.—Physonecete polygastrica, with a short vesicular stem of the siphosome, bearing numerous siphons, palpons, and bracts, each siphon provided with a branched tentacle. Nectosome with two or four rows of nectophores. Pneumatophore with radial pouches.

(zool. chall. exp.—part lxxvii.—1888.)
The family Neitalidae is founded by me for the interesting new genus *Nectalia* (Pl. XIII.), to which probably *Sphyrophysa* of L. Agassiz (36) is closely allied. They have in general a similar organisation to the well-known Discalobidae (*Physophora*), but differ from them essentially in the possession of a large protecting corona of cartilaginous bracts at the apex of the siphosome.

*Nectosome and Siphosome.*—The corona of the Neitalidae is composed of a long columnar nectosome and a flat elongiform siphosome. The trunk of the nectosome is a slender vertical tubule, and bears either two opposite or four eruciate rows of nectophores; and at the apex a pneumatophore with four radial chambers. The trunk of the siphosome is shortened, vesicular, and horizontally expanded in form of a spiral bladder, to which are attached the following parts:—Uppermost a corona of bracts, beyond it a corona of palpons or eystons, below a bunch of siphons and tentacles, and at the distal base a group of clustered gonophores. Probably these polymorphous persons and organs are arranged regularly in ordinate cormidia, as in *Physophora*; but in the single specimen observed by me it was impossible to make out this metameric arrangement with full certainty. I suppose, however, that each nectophore belonged originally to a cormidium, which was composed of the following parts: One bract, one palpon, one siphon with a tentacle, and two gonodendra, a male and a female.

*Pneumatophore* (Pl. XIII. figs. 1–3, p. 4).—The float, placed at the apex of the siphosome, is in *Nectalia* pyriform, and exhibits four vertical radial septa, which connect the outer with the inner wall; the cavity of the pneumatosae is divided by them into four large radial pouches. An opening at the apex of the pneumatoecyst was not visible, but there seems to be one at its base (just as in *Physophora*).

*Nectophores* (figs. 1, n, 5–8).—The column of nectoealvees in *Nectalia* is composed of two opposite longitudinal rows, in *Sphyrophysa* of four eruciate rows; the former bears therefore the same relation to the latter as in the following family *Physophora* does to *Discalobae*. The nectophores are similar in form and structure to those of many other Physoneetes, and they embrace the trunk of the siphosome so fully by two apical horns or wings, fitting in the space between two obliquely opposite nectophores, that the structure of the nectosome becomes very solid. The subumbrella of the nectophores has a strong muscle-plate, and renders possible a very rapid movement of the swimming corona. The velocity of the swimming *Nectalia* is much greater than that of most other Physoneetes, and comparable to that of *Diphyes, Sagitta*, and *Loligo*.

*Bracts* (figs. 1, 9–12).—The prominent character of the family Neitalidae is found in the corona of bracts, which is attached to the apex of the siphosome immediately beyond the base of the nectosome; it is similar to that of the Anthophysidae, and is wanting in the Discalobidae, which are otherwise nearly related. The bracts of *Nectalia* are strong cartilaginous covering scales of a peculiar form and differentiation, especially described below. They are raised and subhorizontally expanded in the quietly-floating
corm, whilst they form a closed bilaterally compressed calyx in the rapidly swimming animal.

**Palpons (p).**—The corona of palpons, which is placed immediately beyond the corona of braets in the Nectalidae, is comparable to that of the Anthophysidae as well as of the Discobasistidae. The number of palpons, however, is much smaller than in the last two families, and seems not to exceed that of the superjaeent braets. It may be that each palpon and the appertaining braet originally composed a medusome, the former representing its manubrium, the latter its reduced umbrella. The distal end of the tubular, very mobile palpons, seems to possess a mouth-opening (fig. 2, go), and in this case they should be called cyistsons. Palpaeae or tasting filaments were not observed.

**Siphons (s).**—The large polypites of Neoteca exhibit distinctly the four usual segments, a short pediele, a basigaster with very thick wall filled by cnidoocytes (figs. 2, 13, sb), a stomach (sm), the inside of which bears longitudinal rows of glandular villi (sv), and a very extensile and contractile proboscis with a thick muscular wall (sr). The distal mouth of the latter is four-lobed (so).

**Tentacles (t).**—The long tubular tentacle which is attached to the base of each siphon bears a series of numerous tentilla. The cnidosae of the latter includes in Neoteca a strong, spirally-twisted cnidoband, and bears at its distal end a simple terminal filament; the latter is replaced in Sphyrophysa by an odd terminal vesicle and two lateral horns. The difference between the two genera is therefore similar to that between Stephanomia and Agalma, or between Halistemma and Agalmaopsis.

**Gonophores.**—The corms of Neoteca are monoeous and the cormidia monoeinic, since two clustered gonodendra, a male and a female, are attached near the base of each siphon. The medusoid gonophores are very small and numerous, and have a reduced umbrella. As usual, the spermaria are oblong or spindle-shaped, the ovaria roundish or subspherical.

**Genus 54a. Neoteca,1 Haeckel, 1888.**

Neoteca, Hkl., System der Siphonophoren, p. 41.

**Definition.**—Nectalidae with a biserial nectosome, composed of two opposite rows of nectophores. Cnidosae of the tentilla with a simple terminal filament.

The genus Neoteca, as the type of this family, is represented by the North Atlantic species figured in Pl. XIII. It is similar to Physophora, but differs from it essentially in the corona of large braets which separates the biserial nectosome and the flower-shaped siphosome. The cnidosae of the tentilla bear a simple terminal filament.

The single specimen of this genus which I have examined, and which is described in the sequel, I captured by scooping it up with a glass vessel without touching it, on

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1 Neoteca = Swimming in the sea; νητης, δυς.
January 15, 1867, in the Canary Island Lanzerote. Quietly expanded on the surface of the water, it had the form drawn in fig. 1, but this lasted only a few minutes. Most of the time the animal was in continuous very rapid motion, quite unusual among the Physonectae. It swam through all parts of the vessel very quickly, without touching its sides, with rapidly succeeding contractions of the nectophores. The siphosome was in the swimming animal strongly contracted, the corona of bracts closed, and the strong bilateral compression of the corm, with two sharp opposite keels in the sagittal plane, seemed to be excellently adapted for the rapid swimming motion.

*Nectalia loligo*, n. sp. (Pl. XIII.).

*Habitat.*—North Atlantic, Canary Islands, Lanzerote, January 15, 1867 (Haeckel).

*Nectosome* (figs. 1–8).—The swimming apparatus is composed of a rather long tubular trunk, which bears at the apex a pyriform pneumatophore, and beyond it a double series of opposite nectophores in four pairs obliquely. The length of the nectosome is 20 mm. to 25 mm., and about equals that of the largest bracts of the siphosome. There was a group of buds of nectophores at the base of the pneumatophore, marking the blastocrene of the nectosome, or its point of vegetation.

*Pneumatophore* (figs. 1, 2, 3, p, 4).—The float at the apex of the nectosome was in the living animal pyriform, with a red apex and an oblongish pneumatocyst filling up its upper half (fig. 1, p f). Preserved in alcohol (fig. 4) it appeared under an altered form, subcylindrical, with two annular constrictions of the included pneumatocyst (p f). The pneumatocystaeae surrounding the latter is rather wide, and connected with the pneumatocodon by four cruciate radial septa or vertical mesocuternae (p v). The pericolastic cavity of the pneumatophore, therefore, is divided into four radial pouches (ps).

*Nectophores* (figs. 1, n, 3, in, buds, fig. 5, a young nectophore, figs. 6–8, adult nectophores, 6, dorsal view, 7, basal view, 8, lateral view from the left side).—The umbrella of the nectophores is strongly compressed in the direction of the sagittal axis, which is 3 mm. or 4 mm. long, half as great as the frontal and the principal axes (both 6 to 8 mm. in length). The truncate basis, with the ostium of the nectosae, is directed obliquely outwards, whilst the opposite apex has a deep square excision. The two lateral horns or wings, which are separated by the latter, are square in frontal view (fig. 6), triangular in lateral view (figs. 1, 8), of a three-sided prismatic form, and embrace the trunk of the nectosome, so fitting in the interval between the two opposite nectophores (superior and inferior) that they fill up the interval between them. The superior or dorsal face of the umbrella is slightly convex, with a median sagittal groove, and fitting exactly into the concave lower or ventral face of the next superior nectophore. In the median line of the ventral groove arises a sagittal ridge, which bears a short pedicle
simple

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Nectosae (w).—The subumbrella occupies about two-thirds of the nectophore, and is also strongly compressed in the sagittal direction. Its upper or dorsal face is concave, the lower or ventral convex. Its axial or proximal half is dilated, twice as broad as the abaxial or distal half. The latter opens by a narrow triangular mouth (m), which is surrounded by a small velum (v). The nectocalycine duct (fig. 8, cp), which enters through the pedicle of the nectophore, divides on the top of the nectosac into four radial canals of very different length and form. The shorter concave dorsal canal and the longer convex ventral canal run straight in the sagittal plane; whilst the two lateral canals (right cc, and left cl) are about three times as long, and form not less than four curved loops, the complicated course of which may best be seen by comparison of figs. 6–8. The small ring-canal, which connects the four radial canals at the mouth of the nectosac, makes a simple bend in the dorsal half, a pair of loops in the ventral half (fig. 7, oc).

Siphosome (fig. 1 drawn from the living specimen; fig. 2 from the same dead, in contracted state, after detachment of the bracts and nectophores).—The inferior half of the corn, below the nectosome, has the aspect of a flower, which is compressed from two sides, in the same direction as the bilateral nectosome. The trunk of the siphosome (fig. 3, as) is an ovate vesicle, which bears a series of buds (is) in the median line of its ventral side, as an inferior continuation of the superior series of buds of nectophores (in). The polymorphous appendages, which arise from the bud series, are so disposed that immediately beyond the nectosome a corona of bracts is expanded. Below this follows a corona of cystons or mouth-bearing palpons, and inside of these a group of siphons (s) with the tentacles (t); finally, at the distal base the bunches of gonophores. When we compare the composition of the siphosome with that of a dichlamydeous flower, then the bracts correspond to the calyx, the cystons to the petals, the siphons to the stamens, and the gonophores to the pistils. If the animal floats quietly at the surface of the sea, then the calyx is opened and the petals and stamens expanded (fig. 1); but when it swims quickly by the action of the nectophores, then the calyx is closed and the appendages included in it form a dense, bilaterally compressed bunch.

Bracts (figs. 1, 9–12).—The corona of large and firm cartilaginous bracts or covering scales, which expands beyond the nectosome and covers the other parts of the siphosome, exhibits a very remarkable composition, not observed hitherto in any other Siphonophore. The corona has an amphithect fundamental form, compressed from the two lateral sides of the corn, and is composed of eight foliaceous, symmetrically arranged bracts (fig. 1). A pair of larger and slender lateral bracts (figs. 11, 12) is placed on the two poles of the frontal axis of the trunk (right and left); they are 25 mm. long, 5 to 6 mm. broad. A second pair of bracts, which have the same breadth, but only one-third of the length
(fig. 9), covers the two poles of the sagittal axis (dorsal and ventral pole), and lies therefore immediately beyond the two lowermost nectophores. Between the former and the latter (in two crossed diagonal axes) lie two pairs of opposite bracts of medium size (fig. 10). Each bract has a concave ventral or axial face, and a convex dorsal or abaxial face, in the median line of which arises a prominent crest or keel (bd). A simple bractecal canal (cb) runs near the ventral side, in the median line, and ends blindly near the distal apex. The two lateral margins form a pair of thin lamellar wings, each with a prominent tooth towards the distal end. The base of the bract (bb) bears a curved hook, for insertion into the trunk; and the opposite distal apex is provided with a bunch of enidocysts. These are wanting, however, in the two large lateral bracts, which appear straight in profile (fig. 12), whilst the other six have a sigmoidal curve (fig. 10). The two large and very vigorous lateral bracts may act in the rapidly swimming animal like the so-called "swords" in a sailing boat. *Nectalia loligo* has a more rapid swimming motion than any other known Physonect, and agrees in this with *Diphyes*, *Sacitta*, and *Loligo*.

**Palpons** (q).—Immediately beyond the corona of bracts is placed a corona of palpons or tasters, comparable to that of *Physophora*, but much less developed. The number of palpons which are attached to the trunk close inside the base of the bracts seems to correspond to that of the latter. Their body is a long and slender cylindrical tube, very mobile and flexible. The palpons may be perhaps better called cystons, since they seem to possess a mouth-opening at the distal end (fig. 2, qo?). I could, however, not be absolutely certain on this point.

**Siphons** (figs. 1, 2, s, 13).—The number of fully-developed siphons was in the single specimen observed four, and they were attached to the base of the vesicular trunk of the sphosome, inside the corona of palpons. When fully expanded and prominent between the bracts (fig. 1) the siphons were longer than the latter (up to 30 mm.). The short pedicle of the siphon bears a pyriform basigaster (sh), and upon this an ovate, very dilatable stomach (sn); its inside exhibits eight to twelve or sixteen longitudinal rows of prominent, glandular, red-coloured villi (sv). The following proboseis (sr) is a cylindrical, very mobile tube with a thick muscular wall; its entoderm is in some siphons red. The mouth at its distal end is often dilated, and its opening, also reddish, square or provided with four short lobes (so).

**Tentacles** (figs. 1, t, 2, 14).—Each siphon bears at its base a long tentacle, beset with a series of numerous tentilla. The latter (fig. 14) have a long pedicle (ts), a large enidosae (tk), and a simple small terminal filament (tf). The enidosae has a peculiar form, being composed of two large subspherical ampullae (one proximal, tk₁, and one distal, tk₃), and between both a cylindrical middle part (tk₄), which contains a large enidobattery (tk₅). This latter is a long spiral riband of four to five coils, composed of innumerable small paliform enidocysts (fig. 15) and two lateral rows of large ellipsoidal enidocysts (fig. 16).
Gonophores.—The sexual medusomes are placed at the distal base of the siphosome, below and inside the siphons. There seems to be a couple of clustered gonodendra (a male and a female) attached to the base of each siphon, composing with it (and with the appertaining palpon and bract) an ordinate monoclinic cormidium. The gonostyle of the male as well as of the female gonodendron is richly branched, the number of gonophores large, their size small. The spermatoria are oblongish, the ovaria roundish, as usual. The umbrella is reduced. The special structure of the gonophores, which I could not sufficiently examine, seems to be similar to that of Physophora.

Genus 54b. Sphyrophysa, L. Agassiz, 1862.

Definition.—Nectalidae with a quadriserial nectosome, composed of four cruciate rows of nectophores. Cnidosacs of the tentilla with three terminal appendages, an odd median ampulla, and two lateral horns.

The genus Sphyrophysa was established by L. Agassiz for the Physonect which Quoy and Gaimard had found in the Tropical Atlantic (lat. 7° N.) in February 1829, and figured under the name Physophora intermedia (2, p. 56, pl. i. figs. 10–18). As far as it is possible to recognise it from their incomplete representation, it seems to be closely allied to the preceding Nectalia, but differs from it in two essential characters of generic value. The nectosome seems to be composed not of two opposite, but of four cruciate rows of nectophores (as in Discolabe among the Physophoridae). The cnidosacs of the tentilla are tricornuate, and bear at the distal end an odd median vesicle and two paired lateral horns (as in Agalma, &c.).

L. Agassiz also has placed in the same genus, Sphyrophysa, the similar Physonect which Huxley had described as Agalma breve (9, p. 75, pl. vii.). But this species is probably a true Agalma, and more allied to the form which Leuckart has described as Agalma clavatum (compare above, p. 226).

Family XVI. Discolabidæ, Haeckel, 1888.
Discolabidae, Hkt., System der Siphonophoren, p. 41.
Physophoridae, Huxley, et multor. autor.

Definition.—Physonectæ polygastricae, with a short vesicular stem of the siphosome, bearing numerous siphons and a corona of large palpons (instead of the wanting bracts), each siphon provided with a branched tentacle. Nectosome with two, four, or more rows of nectophores. Pneumatophore with radial pouches.

1 Sphyrophysa = Hammer-bladder, σβυροσ, σβυρα.
The family Discolabidae comprises those polygastric Physophoraceae, the nectosome of which is well developed, with a long trunk and two or more series of nectophores, whilst the trunk of the siphosome, without bracts, is shortened and subhorizontally expanded in the form of a wide spiral bladder, the ventral periphery of which bears a series of ordinate cormidia, protected by a corona of large palpons.

The well-known type of this family is the Mediterranean Physophora hydrostatica, figured and described in 1775 by Petrus Forskal. Its accurate anatomical description was given in the years 1853 to 1860 by Kölliker (4), Vogt (6), Gegenbaur (10), and Claus (34). Huxley (9) established for this genus the family Physophoridae and gave to it the following definition:—"Physophoridae with nectocalyces, but without hydrophyllia. The distal end of the filiform cenosarc dilated. Tentacular branches with involucrate saculi. Pneumatoeyt small." The name Physophoridæ for this family has also been retained by later authors; but unfortunately it is employed with no less than four different meanings, and therefore has lost all value (compare above, p. 186). It may be, therefore, best to call this family Discolabidæ, from another genus belonging to it, Discolabe (Eschscholtz, 1, p. 155). A third genus is Stephanospira of Gegenbaur (10, p. 67).

Nectosome.—The swimming apparatus of the Discolabidæ is composed of numerous large nectophores, arranged in various ways around the vertical tubular trunk, and of an apical pneumatophore at the top of the common trunk. Usually (in the typical Physophora) the nectosome is biserial (disticha), as in the Agalmidae, composed of two opposite longitudinal rows of nectophores (usually four to six pairs). Discolabe differs in having a quadriserial nectosome (tetristicha), similar to Sphyrophysa; it is composed of four cruciate longitudinal series of nectophores (or of four to six quadriradiate coronas). Stephanospira, finally, has a conical or multiserial nectosome (polysticha), similar to that of the Forskaliæ; the nectophores are here very numerous and arranged in a long continuous spiral, with four to six or more turns. The trunk of the nectosome, after the detachment of the nectophores, is a cylindrical, or in the contracted state, spindle-shaped bladder, which bears on its ventral side a lamellar longitudinal fold, like a mesentery, and at the free edge of this a series of spirally convoluted folds, the insertions of the detached nectophores. The tapering proximal end of the vertical spindle-bladder is separated by a constriction from the pneumatophore, and the broader distal end by a similar constriction from the inflated trunk of the siphosome (Pl. XX. figs. 9-12).

Pneumatophore (figs. 1, p, 9-13, p).—The float filled with air has in the Discolabidæ the same structure as in the Agalmidae. It is ovate or subcylindrical, with a red pigment-spot at the apex, and with a variable number (usually eight) of longitudinal ribs in the outer wall. These arise in the lower half as eight (more rarely seven or nine) vertical radial septa, which connect the inner with the outer wall and divide the
pericystic cavity into the same number of radial pouches. Claus (74, p. 22) and Korotneff (50, p. 272) have described peculiar caecal canals in the wall of the radial septa; but these hypothetical canals are in fact solid fibres composed of exoderm cells, and arising from the pneumatophora (or the air-secreting exoderm of the infundibulum), as has been shown by Chun (48, p. 514). The apex of the pneumatophore has no opening; but there is a stigma, or a constant opening through which the air is emitted, at the base of the pneumatophore, in the median line of its dorsal side, opposite to the ventral buds of the youngest nectophores; its place corresponds to that point where, in the Auranectae, the aureophore is situated. Kefferstein and Ehlers (33, p. 3) have already described the spontaneous emission of air by this stigma, and I have repeated the same observation in the Canarian Physophora magnifica (84, p. 35, pl. iii. fig. 26).

Nectophores (Pl. XIX. figs. 1–4).—The nectocalyces are in general very similar in form to those of the Agalmidae. The bilaterally symmetrical umbrella is attached to the trunk by a lamellar triangular pedicle, which arises in the middle line of its concave ventral side. The opposite dorsal side is more or less convex. The principal axis is directed obliquely from above and within, downwards and outwards, so that the apical pole is situated more highly than the basal pole with the ostium. This latter is obliquely truncate, often with a pair of lobiform apophyses on the ventral side. The axial or apical half of the nectophore is always much broader than the basal half, and provided with a pair of auricles or apical horns which embrace the stem. Correspondingly, the large nectosac, which is not much smaller than the surrounding umbrella, is cordate and composed of three parts, a smaller odd basal part and a pair of large lateral lobes; the former is subcylindrical or subconical, the latter are subovate or trapezoidal. The four radial vessels are of very different shape, since the two paired lateral canals enter into the two dilated auricles; they form here several loops, and are therefore much longer than the two sagittal canals (shorter ventral and longer dorsal) which run simply curved in the median plane of the nectosac. The circular canal which connects the four radial canals above the insertion of the velum is small and ovate, corresponding to the small ostium of the nectosac. (Compare 10, Taf. xxx. figs. 33–35; 34, Taf. xxv. figs. 6–8; 27, Heft iii. Tab. vi. figs. 1–4, &c.)

Siphosome (Pl. XX. figs. 9–13).—The trunk of the siphosome in the Discolabidae was regarded by all former observers as a simple sac-shaped and inflated dilatation of the blind basal part of the trunk of the nectosome, and the general opinion was, that the different appendages, beyond the corona of tasters, were more or less irregularly crowded at its basal face (with loose cornidia). This error was not corrected until the year 1877, when the excellent figures of Physophora borealis by M. Sars were published in the third part of the Fauna littoralis Norvegiae (27, Heft iii. Taf. v. figs. 1–6). This celebrated observer had discovered, many years before, that the siphosome of Physophora is expanded subhorizontally, beyond the nectosome, in form of a large, reniform, spirally-twisted sac,
with an asymmetrical incision, and that the different polymorphous appendages are
attached in regular order to the peripheral convex margin of their discoidal sac. This
margin is divided by a series of equidistant radial constrictions into a number of roundish
polygonal or quadrangular facets (ten to twenty or more). Each articular facet is
surrounded by a prominent muscular wall or frame, and bears a single large palpacle, and
beyond it is attached a single siphon with its tentacle; in the interval between them is a pair of gonodendra, a proximal female and a distal male. The cormidia
are, therefore, perfectly ordinate, and succeed one to another regularly in the subhoriz-ontal ventral median line of the depressed trunk of the siphosome (compare figs. 9 to 13).
The observations of Sars (already made in 1857) were twenty years afterwards confirmed
and more fully carried out by Claus (in 1878, 74, Taf. iii. figs. 1–4). Moreover,
Gegenbaur had already (in 1859) described in Stephanospira the spiral twisting of the
discoidal inflated trunk, and the regular order in which the siphons and the paired
gonodendra (a male and a female) were attached to the peripheral margin of the spiral
disk; hence he derived its name. The spiral twisting in the siphosome of all Discolabidæ
seems to be dextrotrropic, opposite to the lectotropic spiral of the nectosome; Claus,
who calls the former also lectotropic, seems to have confounded the proximal and the distal
part of the spiral (74, p. 13).

Cormidia.—The numerous ordinate cormidia which compose the siphosome of the
Discolabidæ, are disposed along the ventral median line of its trunk not less regularly
than in the Apolemidae and the polygastric Calycocentæ. The only difference is, that
the naked internodes are in the latter very long, in the former very short; but they are
sharply marked by the limits of the facettes, or the basal insertions of the single groups
of medusomes. The effective cause of that difference is the divergent development of the
trunk of the siphosome; this is tubular and much prolonged in a vertical direction in the
Apolemidae, as in the Agalmonidae; it is vesicular, much shortened and inflated, and coiled
up spirally in a subhorizontal direction in the Discolabidæ, as in the Nectalidae. The
trunk of the latter possesses, therefore, permanently about the same shape which the
trunk of the former exhibits only in the state of the strongest contraction.

The composition of the ordinate cormidia is in all the three genera of Discolabidæ
essentially the same. Descending from the proximal or apical (superior and external) face
of the trunk, towards the distal or basal (inferior and internal) face, we find successively
the following parts:—(1) a large palpacle with its palpacle; (2) a female gonodendron;
(3) a male gonodendron; (4) a large siphon with its tentacle. Sometimes the number of
palpons is doubled, so that a pair of them (a larger superior and a smaller inferior) belong
to each cormidium; but it seems that this duplication is often accidental, and variable in
one and the same species.

Siphons (Pl. XX. figs. 13, 16, s).—A single large polypite is attached to the distal side
of each cormidium, and occupies therefore the innermost place on the subhorizontal basal
face of the spirally coiled up trunk. When we regard the latter from below, after the detachment of the siphons, the remaining pedicles of these form an innermost spiral line (fig. 12, sp) inside the spiral corona of gonodendra. In *Stephanospira* these pedicles were regarded by Gegenbaur as the siphons themselves (10, Taf. xxxii. fig. 53, e). In spirit specimens of Discolabidae the siphons are usually all detached from their pedicles, which remain as short conical prominences connected with the trunk (compare 6, pl. iv. fig. 5). The body proper of the siphon consists of the usual three segments. The proximal basigaster is very large and occupies in the contracted siphon about its basal half; its thickened wall is full of small cnidocysts and surrounds a narrow cylindrical cavity (6, pl. iv. fig. 5). The stomach proper is very dilatable, usually ovate or spindle-shaped, and exhibits either hepatic ridges, or instead of these numerous glandular villi developed from its thickened endoderm. The distal proboscis is cylindrical, very contractile, and exhibits usually eight, twelve, or sixteen parallel longitudinal muscle-bands; it opens distally by a mouth which is very dilatable and may be expanded in the form of a circular or slightly lobate suctorial disc. Often this distal part is turned over like the inverted finger of a glove (6, pl. iv. figs. 4–6).

*Tentacles* (Pl. XIX. fig. 1; Pl. XX. figs. 13, 16, t, 14).—The single tentacle, which is attached to the pedicle of each siphon, near to the insertion of the basigaster, is in all Discolabide very long and beset with a series of very numerous and large tentilla. The enidosae of the latter has a peculiar structure, differing from that of all other Siphonophore. The fully-developed tentillum is composed of two segments only, a very large pedicle and a large involucrate cnidosae; the third and distal segment, the terminal filament, has disappeared. The pedicle again is often divided into two portions, a thin cylindrical proximal tube, and an inflated vesicular distal sac, usually club-shaped or pyriform. The enidosae (saeculus or urticating knob) is ovate, spindle-shaped, or pyriform, bilaterally symmetrical, with a more convex dorsal and a less convex or even concave ventral side; it contains, included in a double involucre, a very long enidoband or urticating chord, coiled up in several spirals. The latter is composed of innumerable small, palmiform cnidocysts, and of two lateral series of large ensiform or spindle-shaped cnidocysts. These latter are placed at the distal end of the vesicular enidosae, whilst they are situated in the other Siphonantliae usually at its proximal end.

This apparent anomaly, and the divergence in structure from the normal form, is fully explained by the development of the cnidosae; it passes during its ontogeny through different stages, which are represented by the permanent enidosae of the genera *Cirrallia*, *Stephanonia*, *Halistemma*, and *Agalmopsis*. The simple cylindrical tubule of the youngest tentillum becomes divided into the three usual portions, the pedicle, the enidoband, and the terminal filament. The middle one of these is spirally coiled up as a simple and naked spiral enidoband. The distal portion of the pedicle becomes inflated, forms a campanulate fold around the top of this band, and grows around it entirely,
forming a complete external involucre. The canal of the pedicle runs along the extended and convex dorsal side of the involucre, which overgrows the ventral side. The axis of the spiral cnidoband, originally vertical, becomes more and more inclined, is afterwards horizontal and perpendicular to the axis of the pedicle, and finally inverted completely, so that the original distal end of the cnidoband is situated at the proximal base of the enidosae, on its ventral side. The terminal filament, originally the simple prolongation of that distal end, is early divided into three apophyses, an odd median (the terminal ampulla) and two paired lateral horns (as in Agalma, &c.). But these are not fully developed (being rudimentary organs) and disappear finally. The basal point of their original insertion remains visible at the distal end of the reflected cnidoband, near the proximal base of the enidosae, in its ventral median line. Compare the full description of this interesting metamorphosis by Gegenbaur (10, p. 63, Taf. xxx.), Claus (34, pp. 295 et seq., Taf. xxvi.), Keferstein and Ehlers (33, p. 10, Taf. iv.), Sars (27, Heft. iii. Taf. v.), &c.

**Palpons** (Pl. XIX. fig. 1, q; Pl. XX. fig. 16, q).—The large corona of palpons, which expands at the base of the nectosome and covers the entire siphosome as a protective roof, is very characteristic of the Discolabidse. The tasters or palpons are in this family far larger and relatively far more developed than in all the other Siphonophora. They are not only organs of feeding and tasting, but also of capturing and protecting; they were, therefore, formerly confounded with other organs; Vogt described them erroneously as bracts (6), and Claus as tentacles (34). Each cormidium possesses either a single or two palpons, a larger proximal and a smaller distal; and the corona, therefore, is either simple or double. This difference may perhaps serve also for the definition of genera, as I have employed it in my System (95, p. 41). *Discolabe* and *Stephanospira* possess a simple corona of tasters, while it is double in Physophora. But in this latter also usually one corona only (the upper and larger) is fully developed, and the accessory (lower and smaller) corona is incomplete or rudimentary. The development of the latter is variable in one and the same species (74, p. 15). Each palpon is a spindle-shaped, cylindrical, or slenderly pyriform tube, with a simple wide cavity and a very thick muscular wall; the structure of the wall is similar to that of the trunk; both the entoderm and exoderm are glandular; the fulerum bears inside a plate of ring-muscles, outside numerous high radial folds which are covered with longitudinal muscles. The consistence of the fuleral plate is nearly cartilaginous (compare 74, p. 43, Taf. v. fig. 7). The pointed and closed distal end of the palpon is provided with a corona of large cnidocyts and tasting cells. The dilated and obliquely truncated proximal end is apposed by a broad elliptical articular face to the facette of the siphosome described above, but connected with the latter by a very small pedicle only. The palpons, therefore, are very easily detached from the siphosome, and a small pore only in the middle of each articular facette indicates the place of the narrow canal which connected the wide cavities of the trunk and of the palpon (Pl. XX. figs. 9–13, eq).
Palpacles (Pl. XIX. fig. 1, r; Pl. XX. fig. 16, r).—From the upper face of the proximal base of each palpon arises a very thin tasting filament, usually two or three times as long as the palpon, but very extensible. It is usually described as an "accessory tentacle," and represents a narrow cylindrical tubule with a very thin muscular wall, distinctly articulated, like the antenna of a longicorn insect. The palpacles of the living Discolabidae, quietly floating at the surface of the sea, are usually in a perpetual feeling motion, undulating, tasting, and protruding in all directions.

Gonostyles (Pl. XX. figs. 11–16, q).—The corms of all Discolabidae are monoeccious, and their cormidia monoclinic, each possessing two gonostyles, a male and a female. These are placed on the peripheral margin of the vesicular spiral trunk, between the siphon and the palpon of each cormidium, the male (qh) below the female (qf). The female gonostyle is placed beyond the palpon, richly branched, and forms in the developed state an ovate bunch composed of many hundred subspherical clustered gynophores. The male gonostyle (qh) is placed above the siphon, and is very different in form. It is a single, very large, undivided palpon, with very contractile muscular wall; cylindrical in the expanded, slenderly pyriform in the contracted state. It is often elongated, hangs down like a tentacle, and is densely beset with numerous oblongish or spindle-shaped androphores arising from short pedicles, either arranged spirally or scattered irregularly. When the ripe androphores in the distal part of the gonostyle are detached, their pedicles remain as short knobs or papillae (fig. 16, hp). (Compare 27, Heft iii. Taf. v. figs. 9–15.) The umbrella of the gonophores is small or rudimentary. The subspherical manubrium of the gynophores contains a single ovum only, and is much smaller than the oblongish manubrium of the androphores.

Ontogeny (Pl. XIX. figs. 5–8).—The larva which arises from the fertilised egg of the Discolabidae is a Siphonula, the helmet-shaped umbrella of which (b) includes a pneumatophore (p) and has a deep ventral cleft. A large spindle-shaped siphon is suspended in the bilateral cavity of the umbrella or bract, beyond the pneumatophore, and at its dorsal side a tentacle, the tentilla of which bear each a simple subspherical cnidial knob, very different from that of the adult Discolabidae. The development of this medusiform larva from the fertilised eggs of Physophora magnifica and its metamorphosis were observed by me in February 1867, in the Canary Island Lanzarote, and described in my Entwickelungsgeschichte der Siphonophoren (84, p. 17, Taf. i.–iv.).

The Challenger collection contained some larvae of Discolabidae very similar to these latter. The most remarkable are figured in Pl. XIX. figs. 5–8. Fig. 5 represents a very young Siphonula, the umbrella of which is nearly cap-shaped; the siphon possesses no tentacle, but some small buds of tentilla at its base. The larva, fig. 6, somewhat older, has a large bract with a canal, some buds of palpions, and a long tentacle, beset with a series of sessile cnidial knobs. These are replaced in the older larva, fig. 7, by pediculate spherical cnidonodes, or larval tentilla; the ventral cleft of the bract is much
deeper, the palpons larger; a pedicular canal (cp) passes from the bраcteal canal to the exumbrella (compare 84, p. 106, Taf. ii. figs. 17–22, y).

The most remarkable larva, however, is the Physonella figured in Pl. XIX. fig. 8; it was very well preserved in a preparation in the Challenger collection, taken at Station 325, in the South Atlantic (March 2, 1876; lat. 36° 44' S., long. 46° 16' W.), in the tow-net which had been down to a depth of 2650 fathoms. The nectosome was composed of an apical pyriform pneumatophore (Ƿ) and two opposite nectophores (similar to Dicyema, Pl. XVIII. fig. 1). The siphosome consisted of a large spindle-shaped siphon (s), with a simple cylindrical tentacle (t), and a basal corona of about a dozen slender palpons (q), each provided with a thin and long palpacle (r). The trunk of the nectosome in this monogastric larva was apparently the thin pedicle of the siphon itself (am); its apex bore the pneumatophore, as the modified original umbrella of the primary medusome.

**Synopsis of the Genera of Discolabidae.**

Nectosome biserial, with two opposite rows of nectophores, 55. Physophora.
Nectosome quadriral, with four cruciate rows of nectophores, 56. Discolabae.
Nectosome multiral, with several continuous spiral rows of nectophores, 57. Stephanoophora.

**Genus 55. Physophora,** Forskál, 1775.

*Physophora*, Forskál, 11, Descript., &c., p. 119.

**Definition.**—Discolabidae with a biserial nectosome, composed of two opposite rows of nectophores. (Siphosome with a double corona of palpons.)

The genus *Physophora*, as one of the oldest known Siphonophore, was founded in 1775 by Forskál, who distinguished three species of it (11, p. 119). The first of these, *Physophora hydrostatica*, has been retained by later authors as the true type of the genus, whilst the two others belong to different genera, *Athorybia* (rosacea) and *Rhizophysa* (filiformis). Péron and Lesueur figured, in 1807, an Atlantic species under the name *Physophora myzonema* (14, pl. xxix. fig. 4). Quoy and Gaimard published, in 1833, an incomplete description of four species of *Physophora*; they seem to belong to four different genera (*Physophora australis, Discolabae discoidea, Cirkel alba, Sphyrophysa intermedia*). Lesson distinguished no less than eight species (3, p. 503). The first accurate anatomical description of the typical Mediterranean *Physophora hydrostatica* was given in 1853 by Kolliker (4), and Vogt (6), afterwards completed by Leuckart (8), Huxley (9), Gegenbaur (10), and Claus (34, 74). The ontogeny of *Physophora*, and its peculiar metamorphosis, were described by myself in 1869, as observed in a new splendid Atlantic form, which I called *Physophora magnifica* (84, Taf. i.–v.). A very careful

1 *Physophora* = Dening a vesicle, *évifosa*. 
description of a North Atlantic species, *Physophora borealis*, was published in 1877 by Sars (27, Heft iii. Taf. v., vi.). At present it is not possible to distinguish exactly the different species of *Physophora* described by numerous authors; a far more accurate anatomical description of the various parts and their arrangement, and a comparison of good figures 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."

Genus 56. *Discolabe;*† Eschscholtz, 1829 (s. str.).


**Definition.**—Discolabidae with a quadriserial nectosome, composed of four cruciate rows of nectophores. (Siphosome with a single corona of palpons.)

The genus *Discolabe* was established in 1829 by Eschscholtz for a Mediterranean Physophora, which was described and figured very incompletely by Quoy and Gaimard under the name *Rhizophysa discoidea* (20, Isis, Bd. xxi. Taf. iv. fig. 7). The same authors called it afterwards *Physophora discoidea* (2, p. 59, pl. i. figs. 21–24). No doubt this Mediterranean form represents some Physophorid or Discolabid, the nectophores of which were detached from the stem; probably either *Physophora hydrostatica* (Forskål, 11, p. 119) or *Physophora tetrasticha* (Philippi, 72). This latter possesses four cruciate rows of nectophores and differs generically from the former (with two opposite rows of nectophores). *Physophora tetrasticha* may, therefore, retain the name *Discolabe mediterranea*, given by Eschscholtz. Another closely allied species, taken in the North Atlantic (in the Gulf Stream), may be called *Discolabe tetrasticha*. A third species, *Discolabe quadrigata*, inhabits the Indian Ocean, and was observed living by me during my residence in Belligemma, in December 1881. It is described in the following pages, and figured in Pls. XIX. and XX. Some incomplete but well-preserved corms, taken in the Indian Ocean, which I received from Captain Rabbe (of Bremen), seem to belong to the same species.

*Discolabe quadrigata*, n. sp. (Pls. XIX., XX.).

**Habitat.**—Indian Ocean, Ceylon (Belligemma), December 1881 (Haeckel).

**Nectosome** (figs. 1–4).—The swimming apparatus has the form of a slender tetragonal pyramid, which is twice as high as broad; its height is 40 mm., the basal breadth 20 mm. It is composed of an ovate apical pneumatophore, and of four longitudinal rows of nectophores, which are arranged around the axial trunk in a leotropic spiral. Each

† *Discolabe* = Discoidal nose or spiral, δισκός, δισκές.
row has five or six developed nectophores, besides some young buds at the apical blastocrene, below the pneumatophore. Their total number, therefore, is twenty to twenty-four. Their size increases gradually from the top towards the base of the nectosome; the lowermost are the largest. The transverse section of the nectosome, or the apical view (fig. 15), exhibits a cross composed of four nectophores, lying in different horizontal planes according to the spiral twisting of their line of insertion. This leotropic spiral line is the ventral median line of the trunk. When the nectophores are detached from the trunk (figs. 9–13), this latter (\( an \)) appears as a spindle-shaped bladder about four times as long as thick, and tapering towards the two constricted ends; in its ventral median line arises a thin membranous vertical lamella, the mesentery of the nectosome, which bears the contracted pedicles of the detached nectophores (\( np \)).

*Pneumatophore* (figs. 1, 9–13, \( p \)).—The apical float is ovate, 10 mm. long and 5 mm. broad, with a pink oenaradial pigment-star at the top. Eight equidistant meridian lines connect the two poles of its vertical axis, and are visible outside, as very delicate threads in the upper, and broad bands in the lower half. These lines are the insertions of eight meridian ribs on the inside of the pneumatocodon, which connect it in the lower half with the pneumatosacculus, and so form eight radial pouches. The breadth of the vertical radial septa separating the latter is effected by eight apophyses of the exodermal pneumadenia, extending in the fulcrum of the septa, which are covered by entoderm.

*Nectophores* (figs. 1 and 4, basal view; fig. 2, lateral view, from the right side; fig. 3, dorsal view).—The bilaterally symmetrical umbrella of the largest nectophores is twice as long and broad as thick; its principal axis (directed obliquely from above and inside downwards and outwards) is 12 mm. in length, and the frontal axis the same, whilst the sagittal axis is only 6 mm. In the median line of the concave ventral side arises the lamellar pedicle (fig. 2, \( np \)), the superior apex of which attaches the nectophore to the ventral mesentery of the trunk. The ventral edge of this pedicle fits into a corresponding median groove in the dorsal side of the subjacent nectophore. Seen from the base (figs. 1, 4), the outline of the nectophore is nearly rectangular, with a deep furrow in each side. The proximal half of the nectophore is much broader than the distal half, and dilated in the form of two ovate lateral lobes or auricles (fig. 3). To these correspond two shorter triangular basal lobes, which arise from the ventral side of the ostium of the umbrella.

*Nectosac* (figs. 1–4, \( w \)).—The muscular subumbrella of the nectophores is relatively large, since their jelly umbrella is rather thin-walled; the form of the latter is determined originally by the development of the former. The nectosac is composed of three different parts, which have an irregular ovate form; an odd median part and two paired lateral lobes in the proximal half. The nectocaleyceine duct, which passes through the pedicle of the umbrella, enters into the ventral side of the nectosac below its top. It divides into four radial canals of very different shape, two odd sagittal and two paired lateral.
The two former run simply curved in the median plane of the nectosome; the ventral is shorter than the dorsal. The two symmetrical lateral canals are much longer, each about three or four times as long as each of the sagittal canals; they pass into the two large lateral lobes of the nectophores, where they form half a dozen loops; their complicated course will be intelligible by comparison of figs. 2, 3, and 4. The small ring-canal which unites the equidistant distal ends of the four radial canals is elliptical and lies above the insertion of the velum (fig. 4, cc).

Siphosome (Pl. XX. fig. 9, apical view, from above; fig. 12, basal view, from below; figs. 10, 11, 13, ventral and half-lateral view, in different states; all the figures twice natural size. In Pl. XIX. fig. 1, the trunk of the siphosome is completely covered and hidden by the cormidia).—The trunk of the siphosome is a large reniform bladder, or an inflated disc of rose colour, subhorizontally expanded and depressed in a vertical direction; its breadth (30 mm.) is about twice as great as its height (15 mm.). The wide cavity of the thin-walled bladder is closed, filled with chyle, or the fluid of the gastrocanal-system, and communicates only at its apex with the base of the trunk of the nectosome, and by a peripheral corona of numerous small pores with the cavities of the cormidia. A comparison of figs. 9–13 in Pl. XX. demonstrates that the kidney-shaped and spirally twisted disc, from which the name *Discolabe* is derived, is nothing other than the inflated trunk of the siphosome twisted up in a low and broad spiral; the turning of the spiral is dexirotropic (delta-spiral), opposite to that of the trunk of the nectosome, the nectophores of which are arranged leio tropically (lambda-spiral). The trunk of the siphosome in *Physophora* is described erroneously as a lambda-spiral by Claus (74, p. 13, Taf. iii. figs. 1–4). The spiral of the latter is also dexirotropic, but flatter and less developed than in *Discolabe*; in the largest specimens of the latter two complete turns may be distinguished (fig. 12). The superior or proximal face of the discoideal bladder is covered in the living animal by the base of the nectosome, the inferior or distal face by the axial parts of the cormidia, whilst the abaxial parts of the latter form a splendid corona around its peripheral margin.

Cormidia.—The number of ordinate cormidia covering the trunk of the siphosome is in the smaller specimens of *Discolabe* ten to twenty, in the larger thirty to fifty or more, besides the numerous small buds of undeveloped cormidia which arise from the blastoeorene or the point of vegetation situated at the top of the siphosome. Beginning from this point, the age of the succeeding cormidia increases gradually, so that the lowermost (at the distal end of the trunk) are the oldest. These, however, are not the largest; the size of the cormidia is the greatest in the middle of the spiral series, and decreases towards the two ends of it. The peripheral margin of the spiral bladder, to which the articulated series of the ordinate cormidia is attached, is the ventral median line of the trunk of the siphosome. It appears elegantly facettted and regularly segmented after the detachment of the covering corona of palpous; the size of these polygonal articular facettes, the largest of which are

(2004, CHALL. EXP.—PART LXXVII.—1888.)
4 to 5 mm. in diameter, decreases also towards the two ends of the spiral, according to that of the inserted cormidia. Each single cormidium (Pl. XX. fig. 16) is composed of the following parts, which succeed one another in the distal direction, beginning from the uppermost part of the facette:—(1) a simple palpacle (r); (2) a large palpon (p); (3) a female gonodendron (gf); (4) a male gonostyle (gh); (5) a tentacle (t); and (6) a siphon (s). Since the tentacle is only an organ of the siphon, and the palpacle an organ of the palpon, each cormidium may be explained as originally an association of four medusomes, two fertile and two sterile; the umbrellas belonging to the latter may have been originally the nectophores, widely dislocated and separated. The common base of the trunk from which these parts of each cormidium arise, corresponds to a node or a lateral branch of those Siphonanthse which have prolonged stems with large internodes and widely distant ordinate cormidia. The muscular frame which surrounds each polygonal facette corresponds to the muscle-group of the internode. The facette itself, which becomes visible after the detachment of the palpons, above the gonodendra, is the base of their insertion, with the palponal canal in the centre (figs. 9–13, cq).

Siphons (Pl. XIX. fig. 1; Pl. XX. figs. 13, 16, s).—The single siphon of each cormidium is inserted into its distal side or the inferior part of the node of the trunk; this is the innermost part in the subhorizontally coiled-up trunk, on the concave inside of the spiral bladder. When the siphons are detached from their pedicles, and the trunk seen from below (Pl. XX. fig. 12), the conical papilliform pedicles remaining connected with the trunk form a regular dextrorotund spiral line on its basal face (fig. 12, sp). The siphon proper, besides the pedicle, is spindle-shaped or ovate, and has in the dilated state a length of 20 or 30 mm. or more, in the contracted state scarcely 4 to 8 mm. Its basigaster is ovate, large, the thick-walled exoderm full of small cnidocysts. The dilated stomach is rather thin-walled, inside covered with vacuolated villi, without coloured hepatic stripes. The contractile proboscis is very dilatable, with eight strong longitudinal muscle-bands. The distal mouth may be expanded in the form of a large suctorior disc, and is sometimes circular, at other times slightly octolobate (figs. 13, 16, so).

Tentacles (Pl. XIX. fig. 1; Pl. XX. figs. 13–16, t).—The long capturing filament, which arises from the pedicle of each siphon, near the attachment of its basigaster, bears a series of very numerous large tentilla. Each fully-developed tentillum exhibits the peculiar well-known structure of Physopora, and is composed of two parts, a long pedicle, the distal portion of which is inflated, and a large pyriform endosarc (fig. 14). This latter contains, included in a double involucere, a very large, spirally coiled up and reflected pink cnidoband. The two lateral groups of large ensiform cnidocysts, which were originally placed on the proximal end of the cnidoband, lie in the fully-developed tentillum on its distal end; this remarkable inversion is effected by the peculiar development of the involucere described above (p. 260). The proximal base of the involucere is connected in the median line of its concave ventral side with the distal end of the reflected
enidoband, and here are visible in younger tentilla the rudiments of the tripartite terminal filament. This has disappeared in the adult tentillum (fig. 14). The enidosae of this latter is convex on the dorsal, concave on the ventral side, and bears near its middle zone a pair of lateral purple pigment-rings, like ocelli, similar to those which I have described in *Physophora magnifica* (84, pl. iv. fig. 28). These ocelli (fig. 14, ty), like the similar ocellar spots of many other animals, are probably protective ornaments discouraging and frightening the attacking enemies.

**Palpons** (Pl. XIX. fig. 1, q; Pl. XX. fig. 16, q).—Immediately beyond the nectosome is expanded the large corona of palpons, which arises from the top of the siphosome. This corona is simple in *Discoloboe* (as also in *Stephanospira*), whilst it is double in *Physophora*. Each coroidium bears only a single taster, attached to its uppermost or proximal part. It is rose coloured, violet towards the apex. The fully-expanded palpon is a thick-walled, very firm, cylindrical or spindle-shaped tube 30 to 40 mm. in length and 6 to 8 mm. in breadth; in the contracted state it is scarcely half as long, and pyriform. The thick muscular wall is supported by a strong cartilaginous fulcrum and surrounds a wide cavity, which is closed at the pointed distal end; this is provided with a corona of twenty to thirty very large enidocysts, the protruded cnidofilament of which is more than 1 mm. in length. The proximal base of the palpon is obliquely truncated and apposed to the articular facet of the trunk by a very small pedicle. The narrow canal of the pedicle, which connects the wide cavities of the trunk and the palpon, is visible after the detachment of the latter as a small pore in the centre of the facet (figs. 9–13, cq).

**Palpaeles** (Pl. XIX. fig. 1, r).—Each palpon bears attached to its proximal base, in the middle of its upper face, a very long and thin tasting filament. It may be extended to a length which surpasses that of the palpons three or four times or more. The thin wall of the cylindrical tubule is distinctly segmented, with very numerous equidistant annular constrictions (Pl. XX. fig. 16, r).

**Gonostyles** (Pl. XX. figs. 9–16, g).—Each coroidium possesses two gonostyles, arising from the periphery of the vesicular trunk, one very near to the other, between siphon and palpon. The female gonostyle is an ovoid, richly branched bunch (gff), composed of many hundred small gynophores. These are subspherical, pediculate, and contain a single ovum only. The male gonostyle is very different in form, not branched, but a long cylindrical tube with wide cavity and thin muscular wall, which can be widely extended or strongly contracted. The surface of this gonopalpon (gg) is covered with numerous oblongish, spindle-shaped, or subcylindrical androphores, the size and age of which increases from the proximal towards the tapering distal end. When the ripe androphores in the latter are detached, their short pedicles remain as small hemispherical papille. Older gonostyles bear only a few androphores at their proximal base, while the greater part of the naked tube hangs down like a papillate tentacle (fig. 16, 10p). The ripe androphore is about four times as long as broad, and much larger than the ripe gynophore.

*Stephanospira*, Gegenbaur, Neue Beiträge, &c., 10, p. 67, figs. 53–58.

**Definition.**—Discolabide with a multiserial nectosome, composed of several rows of nectophores spirally arranged. (Siphosome with a single corona of palpons.)

The genus *Stephanospira* was established in 1859 by Gegenbaur for a Physophorid of unknown origin, of which he could only examine a single incomplete specimen, preserved in alcohol; the nectophores as well as the siphons and palpons were detached and lost; the trunk only was preserved, with the pneumatophore at the apex and the corona of gonodendra in the periphery of the siphosome. It is, therefore, easy to explain that the description of Gegenbaur contained some errors, and that he supposed it to be a widely aberrant type of Physophoridæ. Sars has since corrected those errors, and made it probable that *Stephanospira* may be only a mutilated specimen of *Physophora* (27, Heft iii. p. 42). The same opinion is supported by Claus (74, p. 16, &c.). Indeed, it may be that this opinion is right, and in any case *Stephanospira* belongs to our family Discolabideæ. But the incomplete state of the single specimen examined, which it is impossible to identify, and mainly the entire absence of nectophores, leaves open the question, whether these were arranged originally in two opposite, four cruciate, or numerous spiral rows. Having recently seen an excellent picture by Mr. Wild, taken from life, representing an Atlantic *Physophora*, the conical nectosome of which is similar to that of *Forskalia* and composed of numerous nectophores spirally arranged, I retain for this form the name *Stephanospira*. I shall publish the description and figures of this *Stephanospira corona* in my Morphology of the Siphonophore. In form the vesicular spiral trunk and the distinctly ordinate monoclinic pairs of gonodendra are similar to those of *Stephanospira insignis*, Gegenbaur.

Family XVII. **Anthophysideæ**, Brandt, 1835.

*Anthophysideæ*, Brandt, 1833, Prodromus, &c., 25, p. 35.

*Athorybidæ*, Huxley, 1859, 9, pp. 71, 85.

**Definition.**—Physonectæ polygastrice, with a short vesicular stem of the siphosome, bearing numerous siphons and palpons, each siphon provided with a branched tentacle. Nectosome without nectophores, but with a corona of bracts. Pneumatophore with radial pouches.

The family Anthophysideæ of Brandt (1835), identical with the Athorybidæ of Huxley (1859), differs from all the other Physonectæ polygastrice in the absence of nectophores, which are replaced by a corona of bracts. It agrees in this striking

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1 *Stephanospira* = Spiral corona, στρικος, σπηλις.
character with the monogastric Athoridae, but differs from this closely allied family in the possession of numerous siphons.

The first described and the best known type of Anthophysidae is the Mediterranean Anthorybia rosea. It was discovered by Forskal, who figured it under the name Physophora rosea as early as 1775 (11, Tab. xliii. fig. B). Two other closely related species, taken in the Strait of Gibraltar, were described by Quoy and Gaimard as Rhizophysa heliantha and Rhizophysa melo (20), and afterwards placed by the same authors in the genus Stephanomia (2). These three species together were united in the genus Anthorybia by Eschscholtz (1, p. 153) in 1829. A similar fourth form, taken in the Northern Pacific, was described by Mertens as Anthophysa rosea (25, p. 36), and Brandt in 1835 established for all these together the family Anthophysidae.

The first accurate anatomical description of Anthorybia was published in 1853 by Külker (4, Taf. vii.), and supplemented by Huxley in 1859 (9, pl. ix.). He called the family represented by it Athorybidae. The genus Anthophypha differs from the former in the possession of two kinds of tentacular knobs. An American species of this genus was afterwards accurately described by Fewkes, under the name Anthorybia formosa (44, p. 271, pls. v., vi.). The development of the fertilised egg was examined in 1866 by myself (84, p. 88, Taf. xiv.).

The Anthophysidae, or Athorybidae, are among the most beautiful and most delicate Siphonophorae. But they are in general rare, and owing to their small size and fragility their anatomical investigation is difficult. Some interesting new forms of this family, which I was able to examine living in the Mediterranean, the Atlantic, and the Indian Ocean, have enabled me to complete their anatomical knowledge (Pls. XI., XII.).

Truncus.—The coenosome or common stem is in all Anthophysidae a small ovate, pyriform, or flatly conical vesicle. Its apical (proximal or superior) half is the nectostyle, includes the pneumatocyst, and bears the corona of bracts; its basal (distal or inferior) half is the siphostyle, and bears in the periphery a corona of very numerous palpons, in the central part a smaller number of siphons, tentacles, and gonostyles.

Although the general appearance of the corm in all Anthophysidae is radial, nevertheless the fundamental form of the trunk is always bilateral, as in all the other Siphonanthes. The series of buds, which is visible as well in the nectosome (Pl. XII. fig. 9, ib) as in the siphosome (fig. 9, is), marks the ventral median line of the trunk.

Cormidia.—The numerous polymorphous persons or medusomes, which compose the corm of the Anthophysidae, are arranged around the common central trunk in a certain regular manner. This has hitherto escaped all observers, owing to the small size and the great delicacy of the object. The specimen of Anthophypha darwinii, which I found in the Challenger collection, and which is figured in Pl. XII. figs. 7–9, exhibited this regular arrangement of the cormidia more distinctly than the smaller species of Anthorybia hitherto described. In general this ordinate structure seems to be
similar to that of *Physophora* and the other *Discolabidae*, the cormidia being ordinate and arranged symmetrically in a flat spiral line, which is twisted around the flat and broad base of the shortened vesicular stem. (Compare Pl. XII. figs. 7-9; fig. 7, dorsal view; fig. 8, lateral view, from the left side; fig. 9, ventral view.)

The ventral view (fig. 9) exhibits at once the bilateral form of the corm, which is bisected in the ventral median line by the series of buds; these develop from two separate blastocrenes (springs of buds, or "puncta vegetationis"). The superior blastocrene (*ib*) is the point of development of the nectosome (bracts), and from it radiate bilaterally the ridges which bear the pedicles of the bracts. Each convex ridge is composed of four finer parallel ribs; these are straight and horizontal in the uppermost and oldest ridges, undulating and vertical in the youngest and lowermost ridges. There are five or six quadripartite ridges on each side of the trunk of the nectosome, divergent from the ventral towards the dorsal side, where the large ovate pneumatophore arises. The inferior blastocrene (fig. 9, *is*) is the punctum vegetationis of the siphosome; its numerous buds, densely crowded in the lower half of the ventral median line, become so developed and dislocated that the superior compose a corona of palpons (*q*), the inferior a basal corona of gonostyles (*g*) and alternating siphons (*s*) and tentacles (*t*). The arrangement of these parts in the lateral view of the corm, after removal of the majority of the palpons (fig. 8), seems to demonstrate that the cormidia, although densely crowded without interval, are nevertheless ordinate. Each cormidium seems to be composed of a large siphon, and the appertaining tentacle, of two gonodendra (a male and a female group of gonophores), and of a certain number of palpons. Further, each cormidium of the siphosome seems to belong to a corresponding quadripartite ridge of the nectosome, with four parallel ribs bearing a number of bracts (figs. 8, 9, *bp*).

Respecting the phylogenetic origin and development of this peculiar arrangement, we may assume that originally each ridge of the nectosome (with a group of bracts), and each cormidium of the siphosome, have arisen from a single medusome, the former from its umbrella, the latter from its manubrium; both being widely dislocated afterwards. But in these ordinate cormidia of the *Anthophysidae*, as well as in the similar ones of the *Discolabidae* and *Nectalidae*, a further comparative morphological study is required to solve the difficult question of their original composition.

*Pneumatophore.*—The float filled with air occupies the upper half of the cenosome, and is usually ovate or ellipsoidal. Its uppermost part is sometimes prominent over the corona of bracts, at other times retracted and hidden between them. Its apex usually bears a pink or purple pigment-star with eight rays, composed of elegant polygonal exoderm cells (figs. 5-9). The centre of this star is usually colourless. The pneumatocodon includes the thin-walled chitinous pneumatocyst. Its lower part is connected by a variable number of radial septa (usually eight or sixteen) with the pneumatocodon or the outer wall of the float (fig. 7, *p*).
**REPORT ON THE SIPHONOPHOREÆ.**

**Bracts** (Pl. XI. figs. 1, 2; Pl. XII. figs. 14–16).—The hydrophyllia, or bracts, which make up the main part of the nectosome, form an elegant corona around the pneumatophore, similar to a double rose, or other flower with numerous petals. Their number is usually between twenty and forty, sometimes more than sixty. They are always thick sickle-shaped scales of a more or less elliptical or lanceolate outline, strongly curved, and attached to the stem by a short pedicle. Sometimes these pedicles are rather broad lamellæ, similar to the pedicles of the nectophores in the Rhodaliæ (Pl. XII. figs. 7–9, **b**p). The inner or axial face of the bract is concave and smooth, the outer or abaxial face convex and armed with a variable number of longitudinal ribs or crests, which bear a series of cnidocysts. The thick and firm jelly-substance of the cartilaginous bract encloses a simple canal or phyllocyst, which runs near the inner surface in the median line, and ends blindly at the distal end (fig. 14, **bc**).

No doubt the bracts of the Anthophysidae are either parts of divided nectophores, or entire reduced nectophores which have lost the nectosac with the subumbrella and the four radial canals, but developed more strongly the jelly-substance of the umbrella, forming a firm protecting scale, or a "cartilaginous shield." The bracts of *Rhodophyse* still possess a small rudimentary nectosac at the distal end, similar to that of *Athoria*, and of the Athorula larvæ of many Physonectæ (Pl. XXI. figs. 5–12). The arrangement of the bracts in a simple corona, or in several concentric closely apposed circles (one over the other), is very similar to that exhibited by the simple or multiple corona of nectophores in the Rhodaliæ (Auronectæ). As in these latter, the apparent radial arrangement is at the same time bilateral, since the series of buds in the median ventral line (Pl. XII. figs. 7–9, **ib**) bisects the corona into two symmetrical halves. The corona of bracts in *Anthophysa* (Pl. XII. fig. 7, from the dorsal; fig. 8, from the left; fig. 9, from the ventral side) is distinguished by the peculiar bilateral arrangement of the arched ribs of the nectosome, which bear the pedicles of bracts (**b**p). Each ridge is composed of four parallel finer ribs; therefore four bracts are associated in a smaller group. This quadripartite structure may be perhaps explained by the supposition, that each bract is originally the quadrant of a quadripartite umbrella; the more so as the number of bracts is about four times as great as the number of siphons (the dislocated manubria?).

The bracts are organs of protection as well as of locomotion. They cannot change their form; but they can be elevated and depressed by means of a pedicular muscle, which is attached to their basal pedicle. When freely swimming at the surface of the tranquil sea, the corona of bracts is alternately closed and opened by slowly elevating and depressing the single bracts; the water protruded from the cavity surrounded by the bracteal corona (and comparable physiologically to the swimming cavity of Medusæ) propels the body in the apical direction, the pneumatophore forwards. But when the animal is alarmed the bracts are contracted closely together and surround a subspherical, nearly closed cavity, in which the retracted palpons, siphons, tentacles, and gonodendra are hidden.
Palpons (Pl. XI. figs. 1, q, 2, 4; Pl. XII. figs. 7–9, q).—The tasters of the Anthophysidae form a simple or multiple corona beyond that of the bracts; their number is very large but variable, and seems to correspond usually to that of the latter; it is possible that originally one taster belonged to each single bract, both together composing a medusome (?). The palpon in this case would be the manubrium, and the bract the appertaining umbrella of the medusome. The arrangement of the tasters, too, in the larger Anthophysidae, is very similar to that of the bracts, and the corona of both is bisected by the series of buds (fig. 9, is) placed in the median line of the ventral side.

The tasters are very long and thin, cylindrical or spindle-shaped tubules, widely protruding through the spaces left between the adjacent bracts when the latter are expanded (Pl. XI. fig. 1). They are very mobile and flexible, tasting like feelers on all sides. The proximal end of their simple cavity opens into the common stem-cavity, whilst the distal end is closed, and usually armed with a corona of large radial cnidocysts (fig. 4, qe). Sometimes a pigment-spot is visible at the lower side of the distal end, and in Anthorybia ocellata this eye-spot seems to surround a small lens or refracting body; it may be perhaps an ocellus (fig. 4, qe). When contracted, the palpons appear as spindle-shaped or ovate vesicles, hidden in the cavity surrounded by the corona of bracts. There are no palpaeces or tasting filaments at the base of the palpons.

Siphons (Pl. XI. figs. 1, s, 3; Pl. XII. figs. 7–9, s, fig. 10, longitudinal section).—The number of polypites or siphons in the Anthophysidae is always much smaller than that of the palpons and bracts; usually the number of the latter may be four to six times as great as that of the former. The smaller species of Anthophysidae have usually only three to six, the larger eight to twelve siphons. These occupy the basal part of the trunk, beyond and inside the corona of palpons, which are much smaller in size. The usual four segments in the body of the siphon are very distinct (figs. 3, 10, longitudinal section). The short pedicle (sp) opens by a narrow canal into the cavity of the trunk. The basigaster (sb) is very large and thick-walled, usually of a yellowish or reddish colour; the exoderm is much thickened and filled with innumerable cnidocysts. The true stomach (sm) is ellipsoidal, ovate or subspherical, and has a thin exoderm; but the entoderm-wall is very thick and protrudes inside in the form of numerous conical villi, which contain a variable number of vacuoles or glandular spaces (fig. 10, se). The proboscis (sr) is very large and extensile; in the contracted state (fig. 10, sr), its muscular wall is very thick, and the entoderm composed of high cylindrical epithelial cells; sometimes six or eight longitudinal ribs are visible (fig. 3, sr). The terminal mouth may be expanded in form of a large, delicate, polygonal suctorial disc, usually with six or eight triangular lobes (fig. 1, ss).

Tentacles (Pl. XI. fig. 1; Pl. XII. figs. 11–13).—Each siphon is provided at its base with a long tubular tentacle, which bears a series of tentilla or lateral branches. The form and composition of these tentilla exhibits in the different genera of Anthophysidae.
differences similar to those in the Agalmidae. The cnidodome of the tentillum includes a spiral band with a few turnings; the cnidobattery of this band is composed of very numerous small median cnidocysts and two opposite lateral rows of large spindle-shaped cnidocysts. It bears a simple terminal filament in the two genera *Rhodophusia* and *Melophyseus*, whilst it is trifid in the two genera *Athorybia* and *Anthophyseus*, divided into a median terminal vesicle and two paired lateral horns; usually these are coiled up spirally (Pl. XII. figs. 11–13). The distal part of the cnidodome is prolonged commonly on the dorsal side into a conical apophysis or a solid pointed spur, composed of large hyaline entoderm cells. Besides, the genus *Anthophyseus* is distinguished by the possession of a second, larger and rarer, kind of cnidodome, differing from the former in the development of two paired, dendritic or palmate apophyses on the dorsal side of the cnidosac.

**Gonostyles.**—Each cormidium of the siphosome (probably in all Anthophysidae) is monoclinie and bears two gonodendrea, a male and a female, attached to the base of the trunk, near to the insertion of the appertaining siphon. Sometimes the two brancheed gonostyles arise separately, each with a proper pedicle (Pl. XII. fig. 17, *gg*, male; fig. 18, *gg*, female); at other times both arise from a common pedicle, which also bears some small palpons or sexual hydrocysts (9, pl. ix. fig. 12). The gonophores arise clustered in variable number from the branches of the dendritic gonostyles; the males are usually coloured (reddish or white), the females colourless.

The androphores, or the male medusiform gonophores (fig. 17, *h*), have an oblong, club-shaped or even cylindrical umbrella, the narrow distal mouth of which is surrounded by a small velum; above this lies a small circular canal, which unites the four radial canals. The spermarium (*ks*) is a long spindle-shaped or cylindrical manubrium, with a central spadix (*hs*); it fills up the subumbrellar cavity and is often protruded from it.

The gynophores, or the female medusoid gonophores (fig. 18, *f*), develop only a single large ovule in the wall of the manubrium, and the central canal of the latter, growing around the surface of the ovule, and partly obliterating, forms a network of irregular, spadicean canals, not to be confounded with the four radial canals of the embracing umbrella.

**Synopsis of the Genera of Anthophysidae.**

Tentilla with a simple (naked or involucrate) cnidoband and a single terminal filament. [Bracts with a rudimentary nectosac at the distal end. Cnidoband naked. 58. *Rhodophusia*.]

Tentilla with an involucrate cnidoband and three to five terminal appendages. Bracts without nectosae.

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)

Tentilla tricornuate, of two different forms; the larger with two dendritic apophyses of the cnidosac, 61. *Anthophyseus*. Hhnh 35


Definition.—Anthophyidae with a rudimentary nectosae at the distal end of the bracts. Cnidodes of the tentacles simple, without involucre, with a naked cnidoband and a single terminal filament.

The genus *Rhodophysea* was constituted by Blainville (24) for the reception of the same three forms of Physonectae which Eschscholtz had united five years before in his genus *Athorybia.* This latter name therefore has the right of priority. Retaining here the name *Rhodophysea,* I employ it for those interesting, hitherto undescribed, forms of *Athorybidae,* which differ from the others in the possession of a small rudimentary nectosae at the distal end of the bracts. This structure is the same as is found in *Athoria* among the monogastric *Athoridae* (p. 201, Pl. XXI. figs. 5–10), and in the similar *Athorula-larvae* of some *Physonectae* (p. 200). It is of great morphological interest, as a proof that the bracts in this case are reduced nectophores.

A single specimen of *Rhodophysea* was observed by me in the Indian Ocean during my voyage from Ceylon to Aden (between the Maldives and Socotra) in March 1882. It was in general very similar to the well-known Mediterranean *Athorybia rosacea,* being also of the same light rose-colour, but differed in two essential points. Each bract exhibited at the distal end a small rudiment of a nectosae, similar to that of *Athoria larvalis* (Pl. XXI. figs. 5–10). Further, the tentilla possessed a naked spiral cnidotenia, with a single terminal filament, similar to the tentilla of *Athoria* and *Forskalia* (Pl. X. fig. 23). Unfortunately the single specimen of this remarkable *Rhodophysea corona* was destroyed before I could make a representation of it. It requires further examination.


*Melophysea,* Hkl., System der Siphonophoren, p. 42.

Definition.—Anthophyidae with simple bracts, without nectosae. Cnidodes of the tentacles simple, with an involucre and a single terminal filament.

The genus *Melophysea* comprises those Anthophyidae which have the general structure of the typical *Athorybia,* but differ from it in the singular form of the tentilla, or the cnidial knobs of the tentacles. Each tentillum bears a simple spiral cnidotenia, the basal half of which is enveloped by an involucre, and at its distal end a simple terminal filament; it is therefore similar to the tentilla of *Stephanomia* (9, pl. vi. fig. 8). Respecting this difference, *Melophysea* exhibits a relation to *Athorybia* similar to that which *Stephanomia* bears to *Crystallodes,* or *Halistemma* to *Agalmopsis.*

1 *Rhodophysea* = Rose-bladder, ρώδης, ρώδα.
2 *Melophysea* = Melon-vesicle, μέλος, μᾶλλον.
During my residence in the Straits of Gibraltar, in March 1867, I once encountered a small elegant Anthophysid, which at first glance I supposed to be a species of *Athorybia*. A closer examination, however, demonstrated that the form of the tentilla was quite different, each spiral cnidotænia being half enveloped by a campanulate involucre and ending with a single terminal filament (as in *Anthemodes*, Pl. XV.). The form of the bracts was very similar to that figured in *Athorybia melo*, which Quoy and Gaimard had observed in the Strait of Gibraltar forty years before (2, pl. ii. figs. 7–12). It is possible that these two forms are identical. The single specimen of *Melophysa melo* captured was lost before I could make a drawing of it.

**Genus 60. Athorybia,** Eschscholtz, 1829.


**Definition.**—Anthophysidae with simple bracts, without neotosae. Cnidonodes of the tentacles involucrate, trifid, with a median terminal vesicle and two lateral horns.

The genus *Athorybia*, the oldest and best known form of Anthophysidae, was founded by Eschscholtz for the reception of three closely allied species; the typical Mediterranean form described in 1775 by Forskål (11) as *Physophora rosacea*, and two species observed in the Strait of Gibraltar by Quoy and Gaimard, and named *Rhizophysa heliantha* and *Rhizophysa melo* (20). An accurate anatomical description of the Mediterranean *Athorybia rosacea* was first given in 1853 by Köllicker (4, p. 24, Taf. vii.). *Athorybia heliantha* from the Northern Atlantic seems to be closely allied to it; it differs, however, in the special form of the tentilla described by Gegenbaur (10, p. 82, Taf. xxxi. figs. 43, 44). Another form of tentilla is exhibited in the Canarian *Athorybia ocellata* described in the sequel, differing also from the former species the form of the bracts and the possession of ocelli on the palpons. Another species, distinguished by the form of the bracts as well as that of the cnidosac, is *Athorybia indica*, discovered by Huxley in the Indian Ocean and described under the name *Athorybia rosacea* (9, p. 86, pl. ix.). The gonodendra of this species are monostylic, while usually they are distylic. A number of different species of this genus seem to inhabit all warmer seas; they are, however, in general rare, and an accurate description illustrated by figures taken from the living animals is required to render their comparison and specific distinction possible. Special attention must be paid to the bilateral structure of the vesicular trunk, its ventral series of buds (Pl. XII. fig. 9, 1b, is), and the relation of the neostyle to the siphostyle. In some species of *Athorybia* the retracted pneumatophore is covered on its ventral side by the prominent euculate neostyle, as in *Anthophysa* (Pl. XII. figs. 7–9).

* Athorybia = Pacific, at•u•r•e•bi•a.
*Athorybia ocellata*, n. sp. (Pl. XI.; Pl. XII. figs. 10-18).

**Habitat.**—North Atlantic, Canary Islands (Lanzerote); January and February 1867 (Haeckel).

*Corm* (Pl. XI. fig. 1, lateral view; fig. 2, apical view).—The complete body of the elegant corm is in the contracted state, with retracted organs, nearly spherical, 10 to 12 mm. in diameter. In the expanded state, with distant bracts and elongated organs, it has the appearance of a rose or other double flower. The numerous palpons are then protruded between the distant bracts, and the siphons and tentacles more or less prominent. The colour of the entire corm is slightly roseate, the bracts somewhat bluish, the float purple, the centre yellow.

**Truncus.**—The common central stem is an ovate or slightly conical vesicle, 6 to 9 mm. in diameter. Its upper pointed part is the nectostyle, includes the pneumatocyst, and is surrounded by the corona of bracts. Its broader lower part is the siphostyle, and bears a corona of numerous slender palpons, and beyond these, in the central part of the base, four to eight large siphons, each provided with a tentacle and surrounded by two gonodendra, a male and a female. The conical top of the nectostyle (Pl. XI. fig. 1, *ib*) embraces sometimes the ventral side of the retracted pneumatophore (*p*) like a cowl, and the apex of the former is prominent over that of the latter.

**Pneumatophore** (figs. 1, *p*, and 5, lateral view; figs. 2 and 6, apical view).—The pneumatosac, which is formed by the invaginated upper half of the conical nectostyle, includes an ovate or urn-shaped pneumatocyst (figs. 5, 6). Its apex is colourless, surrounded by a pigment-star with eight pink lanceolate rays. Its basal part exhibits eight radial pouches, separated by eight vertical septa of the pneumatophore. The retracted float may be hidden completely between the bracts.

**Bracts** (Pl. XI. figs. 1, 2; Pl. XII. figs. 14-16).—The bracts or covering scales, thirty to fifty in number, form an elegant corona around the pneumatophore. They are arranged in three or four circles, closely placed one over the other; these circles may be regarded as parts of a symmetrical corona, bisected by the ventral series of buds. The bracts are elliptical or lanceolate, 6 to 9 mm. long, 2 to 3 mm. broad, inside concave and smooth, outside convex and armed with a variable number of cnidial crests, usually eight. The exodermal epithelium of the outside is composed of large polygonal cells, and includes near the lateral margin a number of scattered large cnidocysts (fig. 15, *b*), and at the margin itself, as well as in the prominent ribs (fig. 16, *bv*), patches of cnidocysts and dark pigment-granules. The simple canal of the bract runs along the median line of the inner concave face (fig. 14, *bc*), and ends blindly near to its apex. The jelly-substance of the bract is rather thick and firm.
Palpons (figs. 1, q, 2, 4).—The tasters are long and thin cylindrical, rose-coloured tubules; they seem to correspond in number and arrangement to the bracts, and are attached in a corona beyond the latter. When the corona of bracts is expanded (figs. 1, 2), the feelers are widely protruded through the clefts between them, tasting on all sides. The simple cavity of the thin-walled muscular palpons opens into the common stem cavity at the proximal end, whilst their distal end is closed and surrounded by a ring composed of larger thread-cells (fig. 4, qc). Somewhat above this ring is a pink pigment-spot placed at the lower side of the palpon; it may be regarded as an ocellus, since it is provided with a roundish refracting body, similar to a lens (fig. 4, qg).

Siphons (Pl. XI. figs. 1, s, 3; Pl. XII. fig. 10, longitudinal section).—The number of polyps in small, and did not exceed eight in the largest specimens observed; the smaller had only four or five. Their size is large; their colour rose. Their base is attached to the common stem beyond the corona of palpons. The short pedicle of each siphon (sp) bears a thick-walled basigaster (sb), the exoderm of which has a golden yellow colour and contains crowded masses of cnidocytes. The stomach (sm) exhibits inside numerous conical villi containing glandular bodies and vacuoles. The entoderm of the extensile proboscis is composed of high and slender cylindrical cells (fig. 10, sv). The distal mouth may be expanded in the form of a broad and delicate sectorial disc, which is sometimes distinctly polygonal, with six or eight short lobes (Pl. XI. fig. 1, ss).

Tentacles (Pl. XI. fig. 1).—To the pedicle of each siphon, close to its base, is attached a long tubular tentacle which bears a series of very numerous tentilla or lateral branches. Each tentillum (Pl. XII. fig. 11, from the ventral; fig. 12, from the dorsal; fig. 13, from the lateral, left side) bears upon a long pedicle (ts) an ovate enidose. The large enidobattery contained in it has one and a half or two spiral turnings and is composed of innumerable small paliform enidocytes, with a lateral row of large ensiform enidocytes (tk) on each side. From the distal end of the enidose arise four terminal appendages, two odd sagittal and two paired lateral. The latter are two cylindrical filaments, usually coiled up spirally, like two frontal horns (tc). Between these arises from the ventral side an ovate thin-walled vesicle or terminal ampulla (ta), and opposite to this from the dorsal side a conical solid spur, composed of large clear entoderm-cells (tc).

Gonophores.—Each cormidium is monoclinic, and bears on separate stalks, attached to the trunk of the siphosome close to the base of the siphon, two gonodendra composed of clustered gonophores, a male (fig. 17) and a female (fig. 18). The male gonophores (h) are rose-coloured and more oblong, with a club-shaped spermarium (hs). The female gonophores (f) develop only a single egg in the manubrium. The umbrella has in both sexes four radial canals and a marginal ring-canal.

*Anthophysa*, Mertens, MS. (Russian Acad.); Brandt, Prodrumus, &c., 1835, 25, p. 35.

Definition.—*Anthophysidae* with simple bracts, without nectosac. Cnidonodes of the tentacles involucrate, trisid, with a median terminal vesicle and two lateral horns; besides a part of the cnidonodes larger, with two dorsal dendritic apophyses.

The genus *Anthophysa* was established by Mertens in 1829 for a large and very interesting *Anthophysid*, which he observed living (May 12, 1828) in the Northern Pacific, north of the Bonin Islands (lat. 36° 30′ N., long. 214° 0′ W.). Brandt afterwards (in 1835) gave a short description of it (25, p. 35), and founded upon this genus and the closely allied *Athorybia* of Eschscholtz the family *Anthophysidae*. The excellent figures of it executed by Mertens were never published, but I have examined them and compared them with his manuscript. According to this, the vesicular trunca is pyriform and rather large, similar to a small *Alophota* or a young *Physalia*, about two inches in diameter (30 mm. long and 20 mm. high). The purple pneumatophore is surrounded by a corona of numerous sickle-shaped bracts; and beyond these twelve siphons are visible, each provided with a long articulate tentacle.

The structure of the tentacles in this *Anthophysa rosea* (Mertens) seems to be similar to that of a North Atlantic species which Fewkes described in 1882 under the name *Athorybia formosa*. This beautiful species differs from the true *Athorybia* in the possession of two kinds of cnidosacs on the tentacles, one of which is similar to that of the latter, the other distinguished by the addition of two dorsal dendritic apophyses.

A third species of *Anthophysa*, which seems to be closely allied to the two preceding, was found by me in a bottle in the Challenger collection (from Station 334, South Atlantic), and although the only specimen was incomplete and not very well preserved, I will give its description in the following paragraphs.

*Anthophysa darwinii*, n. sp. (Pl. XII. figs. 7–9).

Habitat.—Southern Atlantic; Station 334, March 14, 1876; lat. 35° 45′ S., long. 18° 31′ W.; surface.

Corm (Pl. XII. fig. 7, dorsal view; fig. 8, lateral view from left side; fig. 9, ventral view).—The complete body of the corm in the spirit specimen which I examined and figured was well preserved, although strongly contracted by the influence of the alcohol. All the parts of the single organs were present, with the exception of the bracts, the majority of which were detached, a few only remaining (fig. 9, b). The entire corm had

1 *Anthophysa* = Flower-shaped bladder, ανθοψά, ἀνθοψα.
3 Loc. cit., pl. vi. figs. 7, 8.
on the whole a flat conical form and a diameter of 10 mm. to 15 mm. The upper smaller
half (in the lateral view, fig. 8) is the nectosome, composed of the pneumatophore and
the corona of bracts. The lower larger half is the siphosome, with the palpons, siphons,
tentacles, and gonostyles.

**Nectosome.**—The superior half of the flatly conical corn is the nectosome, composed
of a large pneumatophore \( (p) \) and of a corona of numerous bracts. These latter were
nearly all detached and lost, except a few \( (\text{fig. } 9, b) \); but the lamellar pedicles of
the bracts and the basal ribs of their attachment to the nectosome \( (bp) \) were well
preserved, and exhibited the peculiar arrangement described above \( (p. 271) \). The
bilateral conical nectosome is bisected by the series of buds in the ventral median line.
The uppermost part of the nectostyle is prominent over the ventral side of the
pneumatophore and bears a cluster of very young buds \( (ib) \). From this blastocrene
(or the punctum vegetationis of the nectophores) diverge five or six pairs of radial
ridges, each of which is composed of four fine parallel ribs, bearing the pedicles of the
bracts. The youngest ribs are undulating, and placed on both sides of the ventral
median line vertically \( (\text{fig. } 9) \); the oldest ribs are straight, and run nearly horizontally
and perpendicular to the former, embracing the upper half of the pneumatophore like a
cowl.

**Pneumatophore** \( (\text{figs. } 7-9, p) \).—The float is an ovate vesicle, which occupies the upper
half of the conical trunk. Its dorsal side \( (\text{fig. } 7, p) \) is free and exhibits above the pigment-
star of the apex, below a corona of sixteen radial stripes (probably radial septa between
the pouches of the pneumatosae). The ventral side \( (\text{fig. } 9, p) \) and the greater part of the
lateral sides \( (\text{fig. } 8) \) are covered by the embracing cucullate nectostyle and by the corona
of bracts attached to it. \( (\text{Compare above.})\)

**Bracts** \( (\text{fig. } 9, b) \).—The bracts of this species are probably very numerous and attached
to the trunk of the nectosome in the peculiar order described above \( (p. 271) \). But
nearly all the bracts were detached and lost in the only observed spirit specimen. A
few only were preserved \( (\text{fig. } 9, b) \), and these were oblong or lanceolate leaves, with a basal
pair of lateral teeth beyond their lamellar pedicle. The concave inner or axial side of
the bract is smooth, the convex outer or abaxial side armed with a number of parallel
cnidal ribs \( (\text{six to eight}) \).

**Siphosome.**—The inferior half of the conical corn is the siphosome, composed of a
superior corona of very numerous palpons \( (q) \) and an inferior corona of cormidia, each of
which bears a siphon \( (s) \), a tentacle \( (t) \), a male and a female gonodendron \( (g) \). The
peculiar arrangement of these ordinate cormidia and their relation to the quadripartite
groups of bracts has been described above \( (p. 271) \). The full number of cormidia in the
specimen observed was probably ten or twelve, the youngest and smallest placed in the
ventral median line, the oldest and largest in the dorsal median line \( (\text{fig. } 8, \text{ lateral view,}
from the left side) \). The blastocrene of the bilateral siphosome, or the series of buds in
its ventral median line (fig. 9, is), bisected it so regularly that the cormidia were ordinate symmetrically right and left.

Siphons (figs. 7-9, s).—The size of the polypites, according to the ordinate bilateral arrangement just mentioned, increases from the ventral towards the dorsal side (fig. 8, s). They were ovate thick-walled sacs, strongly contracted in the only spirit specimen observed. The structure of the siphons is probably the same as in Athorybia (Pl. XII. fig. 10).

Tentacles.—The greatest part of the tentacles were detached and lost in the spirit specimen observed; a few fragments only remained. The tentilla were of two kinds, and apparently both of the same form as described and figured by Fewkes in his Athorybia formosa (loc. cit., p. 274, pl. vi. figs. 7–10). The smaller and more frequent form of endosac is similar to that figured in Athorybia ocellata (Pl. XII. figs. 11–13). The larger and rarer form exhibits besides two large dorsal dendritic appendages, which were dichotomously branched, of the same shape as in Anthophysa formosa (Fewkes, loc. cit., fig. 7, lateral view, from the right side, fig. 8, basal view).

Palpons (figs. 7–9, g).—The tasters were very large and numerous in the specimen observed, and composed a multiple corona beyond the corona of bracts. Their form is slender, spindle-shaped, tapering towards the attached basal and the closed distal ends.

Gonophores (g).—Close to the base of each siphon are attached to the siphosome two small branched gonodendra, a male and a female. Their structure is similar to that of Athorybia (Pl. XII.), the spermaria (fig. 17) as well as the ovaria (fig. 18).

LATER ADDITION TO THE ANTHOPHYSIDÆ.

Plaeophysa agassizii, Fewkes.


While correcting the proof of this sheet, I have received a paper by Mr. J. Walter Fewkes, published in May 1888 (loc. cit.), and entitled: On a New Physophore, *Plaeophysa*, and its Relationships to other Siphonophores. A comparison of the two figures representing it (drawn from two small spirit specimens from the Gulf Stream, found in a bottle from the "Albatross" Expedition, 1886), and of my figures of Anthophysa darwinii (Pl. XII. figs. 8, 9, printed in 1887), informs us that these two Anthophyseæ are very closely allied, or perhaps identical. *Plaeophysa* of Fewkes is an Anthophyseid (either Athorybia or Anthophysa) which has lost its bracts, and the pneumatophore of which, highly retracted, is embraced on the ventral side by the prominent enculate nectostyle. Fewkes calls this lamellar cowl-shaped nectostyle the hood, "and supposes it to be a new organ, elsewhere unknown among Physophores in this form" (p. 318). He even regards *Plaeophysa* as the type of a new family—Plaeophysidæ (p. 320).
Order IV. AURONECTE, Haeckel, 1888.
(Pls. I.-VII.)

*Auronecta*, Hkl., System der Siphonophorae, p. 43.

**Definition.**—Siphonophore with a large pneumatophore, a corona of nectophores, a peculiar aurophore, and a network of canals in the thickened trunk. Nectosome composed of a horizontal corona of nectophores beyond the voluminous spheroidal pneumatophore, and a singular pneumatenedia (the large subspherical aurophore), placed in the dorsal median line of the corona. Siphosome spheroidal, ovate or turnip-shaped, with a thick, bulbous, cartilaginous trunk, traversed by a dense network of anastomosing gastro-canals; its surface densely covered by numerous cornidia, each of which bears a single siphon with a tentacle, and one or more gonodendra.

The order Auronectae is represented by a few Siphonophore of the deep sea, which were discovered by the Challenger, and which differ so widely in their entire organisation from all other animals of their class, that it is impossible to place them in any of the four other orders. The large apical pneumatophore, of an enormous size, is similar to that of the Physalide among the Cystonectae; the corona of numerous nectophores (wanting in these latter) resembles that of some Physonectae (Cirralidae, Forskalidae); but the remarkable organ of the nectosome which we call aurophore is found in no other group of Siphonophore, and is exclusively peculiar to the Auronectae. The same holds good of the thickened bulbous trunk of the siphosome, which is traversed by a network of anastomosing canals, similar to the fleshy or cartilaginous ctenosome of the Aleyonidae.

The few species of Auronectae which I have examined were preserved in spirit in rather good condition, and seem to represent two different families of this order, Stephalidæ and Rhodalidæ. The smaller Stephalidæ (with the genera *Stephalia*, Pl. VII., and *Stephonalia*, Pl. VI.) seem to be allied to the Cirralidae among the Physonectae (*Circalia*, Pl. XXI. figs. 1-4). Their bulbous trunk exhibits an axial central canal, with a mouth at the distal end (Pl. VII. figs. 40, 48). The tentacles are simple, without tentilla. The second family contains the larger and more highly developed Rhodalidæ (*Rhodalia* and *Auralia*, Pls. I.-V.). The axial central canal of the bulbous trunk has here disappeared, or is replaced by a central cavity; its distal mouth-opening is lost (Pl. IV. fig. 15). The tentacles are compound, with a series of lateral branches or tentilla, similar to those of the Forskalidæ. The young larval forms of the Rhodalidæ seem to be little different from the adult Stephalidæ.

*Nectosome* and *Siphosome.*—The two main portions of the corm, swimming and feeding body, are both distinguished in the Auronectae by a peculiar development. The

(200L. CHALL. EXP.—PART LXXVII.—1888.)
nectosome, in the superior or apical half of the corm, is composed of three different portions: (1) a gigantic spheroidal or lenticular pneumatophore; (2) a horizontal corona of numerous radially arranged nectophores beyond the float; and (3) a pyriform or subspherical auropore placed in the dorsal median line of the corona, probably an enlarged pneumaedia. The siphosome, which occupies the inferior or basal half of the corm, is composed of a large bulbous axial trunk and of numerous peripheral cormidia, which cover its whole surface. Each cormidium bears upon a short common pedicle a single siphon with a tentacle and one or two monoclinic gonodendra, provided with one or more sexual palpons.

Pneumatophore (p, Pl. I. fig. 1; Pl. III. figs. 13, 14; Pl. IV. fig. 15; Pl. VI. figs. 32, 33; Pl. VII. figs. 39, 40, 48, 50).—The apical float filled with air is very voluminous, comparatively larger than in any other known Siphonophorae, with the sole exception of the Physalideae. It is about half as large as the bulbous siphosome and has the form of an inflated lens or a flattened spheroid, its vertical diameter (or central axis) being usually only half as long as the horizontal diameter (or the transverse axis); the former in the largest specimens of Rhodalia measures 10 to 11 mm., the latter 20 to 22 mm. The horizontal section of the pneumatophore (figs. 1, 16, p) is circular, the vertical section (figs. 15, 40, 50, p) elliptical. The greatest part of its surface is free and smooth. Only the lower surface is attached to the truncated proximal face of the stem and separated from it by the flat horizontal hypocystic cavity (figs. 15, aa, 40, ah). The dorsal side of the pneumatophore bears at its base the large auropore (l), whilst on the opposed ventral side the set of buds is placed (Pl. IV. fig. 15, i).

Although the development of the pneumatophore in the Auronectae is unknown, there can be no doubt that it originates in the same way as in the Physonectae and Cystonectae; it represents, as in these latter, the modified umbrella of a Medusa, the manubrium of which is the trunk of the siphosome (Pl. VII. figs. 40, 50). Since the large air-sac is produced by an invagination of the apical part of the tubular trunk or oecosome, its wall is hollow, and the cavity of the wall filled by nutritive fluid; the pericyastic cavity (Pl. V. fig. 24, ps) communicates below with the flat hypocystic cavity (Pl. IV. fig. 15, ao). This latter is a simple circular or lenticular cavity without septa. But the pericyastic cavity is traversed by a variable number of irregular trabeculae or radial septa, which connect the thicker outer wall (pneumatocodon) with the thinner inner wall (pneumatoseocus).

Pneumatocodon.—The outer wall of the float (Pl. V. figs. 24, 30, z) is rather thick, very firm and elastic, and is composed of five strata, viz.—(1) the outer exodermal epithelium (e); (2) a subjacent layer of longitudinal or radial muscles; (3) a thick fulcral plate (z); (4) a thin stratum of circular muscles; and (5) an inner exodermal epithelium (d). The exodermal cell-layer, or the epidermis, is a thin and flat pavement epithelium. The strong subjacent muscle-plate is composed of longitudinal fibres which diverge
radially from the apical centre of the float and surround it like meridional arches (fig. 40). Sometimes eight stronger equidistant radial muscles are developed (fig. 33). The fulcrum, or the supporting gelatinous plate, is a hyaline and structureless cartilaginous lamella 0·2 to 0·5 mm. thick; it is twice as thick in the peripheral as in the apical part of the float. The fulcrum is pierced (mainly in the basal periphery) by a variable number of simple or branched radial cords, which connect its inner and outer epithelium. They are partly solid apophyses of the entoderm (fig. 30, d), partly nutritive canals; sometimes these canals seem to open on the outer surface of the pneumatocodon. The stratum of ring-muscles which lies inside the fulcrum is thinner than the outer layer of radial or longitudinal muscles; but sometimes the circular muscles are also well developed, and effect a horizontal annulation of the float. *Stepholalia* (Pl. VI. figs. 32, 33), which exhibits outside eight strong radial muscle-bands, is distinguished also by a peculiar development of parallel muscle-rings on the inside of the pneumatocodon. The entodermal epithelium which lines the inside is always composed of large cylinder-cells (fig. 30, d).

*Pneumatosaccus.*—The air-sac, or the inner (originally invaginated) wall of the pneumatophore, is of the same form as the somewhat larger surrounding pneumatocodon (or the outer wall), separated from it by the pericystic cavity (fig. 24, ps), and connected with it by the above-mentioned numerous trabeculae. The inner wall is much thinner than the outer, and composed of three plates only, viz.—(1) the entodermal epithelium composed of high cylinder-cells (Pl. V. fig. 24, d); (2) a rather thin, but firm and elastic fulcrum (the structureless supporting plate, fig. 24, z); and (3) the exodermal epithelium composed of much smaller cells (fig. 24, e); this inner surrounds and produces the pneumatoceyst.

*Pneumatocyst.*—The air-flask of the Auronectæ is a thin but firm and elastic cuticle, secreted and surrounded by the pneumatosac, therefore of the same form and size. It has no apical stigma, as in the Cystonectæ, but is everywhere closed, except at the single basal opening, which we call auropyle (Pl. IV. fig. 16, li, seen from above; Pl. V. fig. 24, li, seen in the sagittal section). This auropyle lies excentrically in a small circular dimple on the dorsal base of the pneumatoceyst, in its sagittal axis. The periphery of this dimple (foveola auropyla) marks the internal boundary between the pneumatophore and the attached aurophore. The chitinous plate of the pneumatoceyst seems to be continued directly into the vagina pistillii (y'). Compare below.

*Aurophore* (Pl. IV. figs. 15, 16, l; Pl. V. figs. 24–28; Pl. VII. figs. 39, 40, 48, l).—The aurophore or air-bell of the Auronectæ is a peculiar and most remarkable organ, wanting in all other known Siphonophore; it seems to be the modified umbrella of a medusome, or a peculiar medusoid person, which was originally a modified nectophore, and adapted to the production and emission of the gas contained in the large pneumatophore. The form of the aurophore (l, Pl. I. fig. 1; Pl. III. figs. 13, 14; Pl. IV. figs. 15, 16) is roundish, nearly globular or somewhat pear-shaped; it is attached by a broad
base to the inferior part of the dorsal side of the pneumatophore and placed in the sagittal plane. In Stephalia (Pl. VII.) it is of the same size as a nectophore; in Rhodalia (Pl. III.) much smaller. The comparison of the vertical sagittal section (Pl. V. fig. 24; Pl. VII. fig. 40) and of the vertical frontal section (Pl. V. figs. 25, 26) proves that the aurophore possesses a singular medusoid structure; it is pierced by a cylindrical central canal, the auroductus (la) running in a nearly horizontal direction and opening inside into the cavity of the pneumatophore by the auropyle (figs. 16, 24, lb), outside by an external mouth, the aurostigma (figs. 15, 24, 40, lo). The auroduct or central canal is lined inside by a thick-walled peculiar tube, the pistillum; while it is surrounded outside by a number of radial chambers, which are separated by septa and communicate with the perieystic cavity of the pneumatosaeceus.

The remarkable structure of the single parts of the aurophore, compared with the corresponding parts of the nectophores and the pneumatophore, makes it probable that the aurophore is a modified nectophore, transformed into a pneumadenia; in this case it has the morphological value of a medusoid person. On the other hand, it is possible that it was originally only a secondary organ of the pneumatophore, a basal apophysis of the air-funnel (Pl. VII. fig. 50). Perhaps its outer opening corresponds to that which the Diseolabidae exhibit at the base of the pneumatophore.

The transverse section of the aurophore (Pl. V. fig. 25, in the proximal part; fig. 26, in the middle part) exhibits in its outer wall from outside to inside the following five strata:—(1) A simple exodermal epithelium (e) composed of rather flat small cells; (2) a muscular plate composed of longitudinal muscle-fibrillæ, which are probably direct prolongations of the epithelial cells; (3) a thin cartilaginous fulcral plate (z), much thinner than the same fulcrum of the pneumatophore, but very firm and elastic, consisting of structureless jelly, strongly stained by carmine; (4) a thin layer of ring-muscles; (5) a thick entodermal epithelium, composed of very large cylindrical cells.

The same five strata recur also in the inner wall of the aurophore, following, however, in the inverse order; the entoderm lying outside, the exoderm inside. The latter surrounds the central cavity of the aurophore, which is filled by the pistillum; between them is visible the vagina pistillii, a structureless tube (y') intensely stained by carmine; it seems to be a chitinous cuticular membrane, formed by a direct prolongation of the pneumatoeyst (pf).

The outer wall of the aurophore (exumbrella) and the inner wall (subumbrella) are connected by a variable number of radial septa; and by these are separated wide radial chambers (figs. 24–26, lb). These correspond probably to the radial pouches of the pneumatophore in the Physonectë, and to the radial canals of the medusoid uctophores; they are, however, much wider than the latter. Their number is variable; usually between eight and twelve. In the middle part of the aurophore (in transverse sections which cut the pistillum at right angles in its middle part) eight to twelve radial
chambers appear sometimes rather regular (fig. 26, b); but in other transverse sections (more proximal and oblique, placed nearer to the auropyle, fig. 25) the number, size, and form of the radial chambers is rather different, owing to the ramification and arrangement of the separating radial septa. Near the auropyle this arrangement is so symmetrical that the form of the transverse section is quite bilateral (fig. 25).

The fulcrum of the outer as well as of the inner wall of the aurophore arises between the radial septa in the form of numerous smaller and larger crests which project into the cavities of the radial chambers, and these crests are covered by high folds of the entoderm. The form of the canal-system of the aurophore becomes very complicated by further development of these entodermal folds, and in the largest specimens examined assumes the shape of a spongy system of irregular lacunae. The great internal surface of the entodermal epithelium, thus produced, together with the extraordinary size and glandular appearance of its high cylindrical cells (fig. 27, d), make it probable that the great mass of air contained in the pneumatophore is secreted by the lacunar system of the aurophore and conducted into the cavity of the pneumatocyst by pores, which pierce the inner wall of the aurophore.

Pistillum (Pl. V. figs. 24–26, lp).—The peculiar body, which fills up the cylindrical central cavity of the aurophore, and which we call provisionally pistillum, is a very remarkable organ, the true morphological signification of which cannot be fully recognised without knowledge of its development. It seems not to be comparable with any structure known hitherto in other Siphonophorae (except perhaps the tapetum endocystale of the Physonectae?), and is a singular production of the Auronectae. The comparison of the sagittal section of the aurophore (Pl. V. fig. 24) with the transverse sections (figs. 25, 26) informs us that the pistillum is a cylindrical tube, with a very thick wall and a narrow axial canal (la). Its wall is composed of three different strata, the inner of which is epithelial (le), the middle muscular (lp), and the outer cuticular (vagina pistillii, lP). The narrow axial canal of the aurophore (figs. 24–26, la) runs in its middle part nearly horizontally; its proximal or inner part is turned obliquely upwards and opens into the cavity of the pneumatophore by the auropyle (bl); its distal or outer part is turned obliquely downwards and opens externally by the aurostigma (lo). The simple epithelium (fig. 28, le) which lines the axial canal (la) is composed of small cubical cells, and seems to be a direct continuation of the exodermal epithelium; both are in continuity at the thickened lips of the aurostigma (fig. 24, lo). The main mass of the pistillum is composed of prolonged fusiform cells which have the greatest resemblance to spindle-shaped muscle-cells (fig. 28, ln). All these spindle-cells run parallel one to another and to the axis of the auroduct, and their oblong nuclei (fig. 28, ln) have also the same direction. The protoplasm of the spindle-cells is finely granulated, opaque, yellowish, and sometimes it seems to be transversely striated. Therefore the entire mass of the pistillum (besides the axial epithelium) seems to
be a bundle of parallel spindle-shaped muscle-cells, and is probably an inner prolongation of the exodermal muscle-stratum of the outer wall. The inner insertion of the pistillum forms a broad circular ring in the "foveola auropyla" of the pneumatophore. This foveola (fig. 16, pl) contains the auropyle or the inner opening which leads from the axial canal of the aurophore into the large cavity of the pneumatophore. The longitudinal muscle-fibres of the pistillum diverge here in a radial direction horizontally, and are inserted at the circular margin of the foveola, ending abruptly with a sharp boundary line on the pneumatocyst (fig. 24, lp').

Judging from these peculiar structures of the pistillum, we suppose that it acts as a strong muscle, by the contraction of which the aurophore is opened and the air contained in the pneumatophore expelled. Its morphological explanation is very difficult; one might suppose it to be a part of a modified stomach (manubrium) of the medusoid person; more probably, however, it is a secondary apophysis of the exoderm only (similar to the endocystic tapetum of the Physoneeta), grown inside from the spiraculum into the central cavity of the aurophore, which corresponds to the umbrella-cavity of the Medusa. In this case the margin of the aurostigma (lo) may be compared perhaps with the umbrella margin of the Medusa, and the pistillum with its velum turned inside into the umbrella cavity (?).

Nectophores (n).—The nectocalyces or swimming-bells form an elegant corona round the base of the pneumatophore. This corona is simple in Stephalia (Pl. VII. figs. 39, 40, 48) and in Auralia; it is multiple in Stephonalia and Rhodalia (Pl. I. fig. 1; Pl. II. fig. 6; Pl. III. figs. 13, 14). The circular corona is bisected in the sagittal plane of the body, on the dorsal side by the aurophore (l), on the ventral side by the set of buds (t). The nectophores are pyriform medusoid persons of equal size; their number is eight to sixteen in Stephalia, twenty to thirty in Stephonalia, fifty to eighty or more in Rhodalia.

Pedicles of the Nectophores.—The swimming-bells are attached on the periphery of the cylindrical nectosome (or the upper half of the bulbous trunk) by means of large lamellar pediciles, similar to mesenterial plates (Pl. III. figs. 13, 14). Each pedicle is a thin transparent lamella of quadrangular or nearly square form, and consists of a cartilaginous vertical jelly-plate placed in a meridional plane of the trunk. The thinner upper and the thicker lower margins of the pedicle are free; the inner or axial margin is thickened and arises by a broad base from the ccenosome; the outer or abaxial margin passes over into the conical apical part of the nectosphere (Pl. IV. fig. 16, np). A wide canal, the peduncular canal of the nectosphere (Pl. V. fig. 31, ns), arising from the network of canals in the ccenosome, and placed radially to its vertical main axis, runs horizontally along the thickened lower margin of each pedicle, and gives off at right angles a series of twenty to thirty small, lateral, vertically ascending branches. These branches, or the "secondary peduncular canals" (nt), are therefore directed parallel to one another and to the vertical main axis of the trunk; they are single, blind, slightly curved or undulating,
and decrease gradually in size from the axial to the abaxial margin of the pedicle. The distal or abaxial end of the horizontal main canal (ns) of the pedicle passes over into the canal-cross which is formed by the four radial canals of each nectophore. The jelly-lamella of the pedicle is covered on both sides by a strong muscular plate composed of horizontal parallel bundles of radial muscle-fibres, which run parallel to the upper and lower margins of the pedicle (fig. 31, nm). The surface of the muscular plate is covered by a flat pavement epithelium of the exoderm.

The arrangement of the nectophores around the trunk is different in the various genera of Auronectae. All the swimming-bells lie in a single horizontal plane, radially arranged, in Stephalia and Auralia (Pl. VII. figs. 39, 40, 48). But in Stephonalia and in the larger Rhodalia, where they are much more numerous, they compose probably three alternating horizontal rings, as is supposed in the semi-diagrammatic figures (Pl. III. figs. 13, 14). In the specimens preserved in spirit examined, the majority of the nectophores were detached from the cenosome and their form much altered by contraction. The remaining axial parts of their pedicles, however, densely placed parallel in regular narrow intervals, allowed their arrangement around the trunk to be recognised with great probability (Pl. I. fig. 1; Pl. III. figs. 13, 14). Therefore, this may be very similar to that of Forskalia among the Physonectae (Pl. VIII.), with this difference, however, that in Forskalia the common stem is much longer and more slender than in Rhodalia. Therefore, the spiral column of the nectophores in the cenosome is here much broader and not so high as in the former. The nectophores of the living adult Rhodalia compose probably three transverse series, disposed quincuncially, and so alternating, that those of the first and third transverse series are placed in the same meridional plane of the stem, whilst those of the second transverse series are interpolated between the first and third. But this quincuncial arrangement is only produced by mutual pressure and dislocation of the nectophores, the basal pedicles of which form a single corona (fig. 14). Probably the form of the pear-shaped nectophores is polyhedral by mutual compression in the living animal, whilst it is more roundish in the contracted spirit specimens.

Each nectophore is a medusiform bell, the pear-shaped umbrella of which is composed of a rather thick and firm jelly-plate. Its inside is covered by a strong muscular subumbrella, composed of circular fibres. The entrance (figs. 6, 16, w) into the wide cavity of the nectosac is closed in the periphery by a broad circular velum, which projects from the margin of the umbrella (figs. 13, 16, v). The entire surface of the nectophores, as well the outside (exumbrella) as the inside (subumbrella), is covered by a flat pavement epithelium. The main axis of the nectophores is radial to the vertical main axis of the trunk, and therefore horizontal in the middle transverse row of nectophores; it is somewhat ascending in a centrifugal direction in the upper row, and somewhat descending in the lower row (figs. 13, 14).

The nutritive canal-system of each nectophore (Pl. IV. fig. 17, n) is, as usual,
composed of four equidistant simple radial canals (ur), which arise from the distal or abaxial end of the primary peduncular canal, run in the subumbrella to the margin of the jelly-bell, and are there united by a circular canal (ne), placed above the insertion of the velum (v). Compare Pl. VII. figs. 39, 48.

**Truncus.**—The common stem of the corm, or the ecmosarc, exhibits in the Auronectae a most remarkable form and structure, very different from that of all other Siphonophora. It is a large solid bulb of a cartilaginous consistence, sometimes subspherical (Pl. IV. fig. 15, a), at other times more spindle-shaped or truncately conical (Pl. VII. fig. 40, a). Its size is usually about equal to or double that of the pneumatophore. The solid mass of the cartilaginous trunk is structureless and colourless, hyaline, very similar to the hyaline fundamental substance of common cartilage. It is traversed everywhere by a dense network of innumerable small canals, anastomosing one with another, and with the large hypocystic cavity (Pl. V. fig. 24, ae). The network is very similar to that in the fleshy ecmosarc of the common *Aequonium*; but the numerous asteroidal connective cells, which are scattered in the fundamental substance of this latter between the vessels, are wanting in the Auronectae; exceptionally here a few mesenchymatous entoderm-cells step out from the vessels and remain isolated in the fundamental substance. The network of these nutritive vessels or gastro-canals forms on the surface of the trunk a superficial net, from which the canals of the cormidia arise. The entodermal epithelium which lines the canals is composed of high cylindrical cells, forming a single layer (Pl. V. fig. 29).

The *Stephalidae* (*Stephalia*, Pl. VII. fig. 40) differ from the larger Rhodalidae (*Rhodalia*, Pl. IV. fig. 15) in the possession of a wide, cylindrical, central canal (ca), which descends vertically in the main axis of the turnip-shaped trunk and opens at its distal pole by a mouth. This terminal mouth is sometimes much larger than the mouth-openings of all the other siphons (Pl. VI. figs. 32, 33, ap). There can be no doubt in my opinion that this important axial canal is the gastric cavity of the protosiphon, or the primary siphon of the larva, which is the manubrium of the original medusome. Its distal opening is the original Medusa-mouth. This explanation becomes evident by the comparison with the youngest larva observed (*Auronula*, Pl. VII. fig. 50). The entire siphosome is here represented by the single primary siphon. By thickening of its wall and development of nutritive canals in it arises the vascular bulbous trunk of the Auronectae. It corresponds to the basal protosiphon at the distal end of the Physalidæ, and to the sterile central siphon of the Disconectae.

**Cormidia.**—The entire surface of the bulbous trunk beyond the corona of nectophores is in all Auronectae densely covered with numerous cormidia. Their number is in the smaller Stephalidæ twenty to fifty or more, in the larger Rhodalidæ sixty to eighty, often more than one hundred, or even several hundreds. The cormidia are always monogastric and originally ordinate, arranged in regular circles or spiral coils
(Pl. IV. figs. 16, 17); but the intervals between the neighbouring cormidia, or the internodes of the stem, are so small, that the arrangement often appears to be more irregular, and the whole surface of the siphosome is like a bunch of cauliflower (Pl. II. fig. 6; Pl. III. figs. 13, 14). Each cormidium arises from the surface of the common trunk by a thickened base, which is sometimes a short conical protuberance, at other times a longer cylindrical pedicle, or a lateral branch of the trunk (Pl. IV. figs. 15, 16). Sometimes the cormidia seem to arise united in small groups from a common pedicle, and if we regard one of these groups as a single cormidium of higher order (or a main-branch of the trunk), we may say that the cormidia are polygastric (Pl. VI. figs. 34, 35). In some specimens (or perhaps in certain species?) the arrangement seems to be more irregular, and the cormidia more or less loose. The common pedicle of each cormidium is traversed by a network of anastomosing canals, often with a wider axial main canal.

Each cormidium is originally composed of the following four organs (Pl. VI. fig. 37): (1) a single siphon (s); (2) a long tentacle arising from its base (t); (3) a clustered monostylic gonodendron (y); and (4) a slender palpon arising from its distal portion (q). This regular composition of the monogastric and ordinate cormidia is obvious in the majority of the specimens examined. But in some specimens of larger size the two main branches of the very large gonodendron are so deeply divided, that two gonodendra arise separately from the common base of the cormidium (Pl. I. fig. 2). More rarely there are single cormidia, in which the two gonodendra (or only one of them) are again forked, so that three or even four gonodendra arise from separate pedicles.

Siphons (Pl. IV. figs. 19, 20, s; Pl. VI. figs. 32-38, s; Pl. VII. figs. 39-42, s).—The feeding polypites of the Auronectae exhibit in general the same form and structure as in the Physonectae. They are in the spirit specimens observed all more or less contracted, thick-walled, spindle-shaped or cylindrical tubes, tapering towards the basal as well as the distal end. Their length in the small Stephalidae is 2 to 4 mm., in the large Rhodalidae 8 to 10 mm.; their breadth in the former 0·6 to 0·8, in the latter 2 to 3 mm. In the expanded state they may reach double the size or more. The four usual segments of the siphons are often very distinct. The cylindrical pedicle (sp) which arises from the cormidium is a thick-walled cylindrical tube of variable length, opening inside in the main canal of the cormidium, outside in the basigaster. The transverse section of the pedicle is very similar to that of a gonostyle (Pl. I. figs. 4, 5); it exhibits a thick, structureless, cartilaginous fulcrum, from the convex outside of which arise numerous branched radial folds (z2). These bear the parallel fibres of the longitudinal muscles (ml), while the concave inside of the fulcrum is lined by a thin muscle-plate composed of circular fibres (mc). The entodermal epithelium, inside the latter, forms a single layer of high cylindrical cells (d), whereas the exodermal epithelium covering the outside is stratified, composed of three to six or more layers of polyhedral cells (e).

The second segment of the siphons is the basigaster (figs. 37, 38, sb), usually a hemi-
spherical or pyriform portion, the thickened exoderm of which is full of cnidocysts. From its base arises the single tentacle (figs. 35, 37, 42, t). The basigaster is separated from the pedicle as well as from the stomach by an annular constriction (sphincter). The basal sphincter is a very strong ring-muscle, and it is very probable that by its sudden contraction the three distal segments are frequently detached from the proximal pedicle. In my preliminary examinations of the large and well-preserved specimens of *Rhodalia miranda* collected by the Challenger, I could find in them neither siphons nor tentacles. I saw only the pedicles of the siphons attached to the cormidia, and judged them to be the highly contracted siphons, and their opening (the pylorus basalis) to be the true mouth. I was thus led into the same error as Gegenbaur thirty years before in *Stephanospira*. Some time afterwards I examined accurately the masses of horse-hair covering the bottom of the vessel in which the *Rhodalia* had been packed by the naturalists of the Challenger. There were entangled between the horse-hairs some irregular whitish lumps composed of interwoven long filaments and nodes. Further careful examination convinced me that the long coiled up filaments were the tentacles of *Rhodalia*, and the nodes were the detached siphons connected with the former (Pl. IV. fig. 20). A long time afterwards I received from Dr. John Murray the complete specimens of *Stephalia corona* taken in the “Triton” Expedition (1882), and in these the majority of the siphons and tentacles were still connected with the cormidia (Pl. VII.). Supported by this confirmation of my suggestions, I was able to restore the anatomy of *Rhodalia*, and to draw the entire corm with that completeness which is figured in Pl. III. At the same time this experience teaches afresh the lesson that much care and critical judgment must be employed in the anatomical examination of preserved specimens of Siphonophore, and of such specimens as come up in the tow-net or trawl from the deep-sea. Many parts of the corms, especially the nectophores and tentacles, but also often the siphons and palpons, are so easily detached, that they seem to be entirely wanting. I have no doubt that the “deep-sea Siphonophore, without tentacles,” which have been described by Studer (40), Fewkes (45), and by former authors, are corms which have lost the tentacles during capture.

The stomach (*sm*), as the third and largest portion of the siphons, is a long cylindrical or spindle-shaped tube, often ovate in the inflated state, and separated by an annular constriction from the two neighbouring segments, the proximal basigaster (*sb*) and the distal proboscis (*sr*). It is easily distinguished from both by the dark longitudinal livertripes, which extend parallel and equidistant in its whole length (Pl. IV. fig. 20, *sh* ; Pl. VI. figs. 35, 38, *sh* ; Pl. VII. fig. 42, *sh*). The number of these hepatic ridges seems to be variable, sometimes eight, at other times twelve or sixteen. After removal of the glandular cutoderm, the remaining exoderm of the stomach exhibits a large number of longitudinal parallel muscle-bands (Pl. IV. fig. 19, *ml*). No doubt the siphons are very expansible and contractile, as usual.
REPORT ON THE SIPHONOPHORÆ.

The proboscis, the fourth and last segment of the siphon, is in the spirit specimens examined usually short, highly contracted, and conical (Pl. IV. figs. 19, 20, sr; Pl. VII. fig. 42, sr). Often its proximal part is invaginated and turned over by the reflexed distal part (Pl. VI. figs. 35, 37, 38, sr). Sometimes four or eight strong longitudinal muscle-bands may be distinguished in the outer wall of the proboscis. The inner wall seems to be beset with peculiar glandular cells. The distal mouth is usually highly contracted, circular, with a thickened labial margin; often it shows a circle of radial folds or lobes, the number of which is sometimes four or eight, at other times twelve or sixteen (Pl. VI. figs. 35, 37, sr).

Tentacles.—Each siphon bears in the Auronectæ, as in all other Siphonanthæ, a single long tentacle, and this arises from the basigaster, near its basal part. As mentioned above (p. 290) the tentacle remains attached to the basigaster, when the siphon becomes separated from the cormidium by self-amputation (sudden contraction of the basal sphincter), whereas the pedicle of the siphon remains attached to the corm.

The tentacles of the Auronectæ appear in two different forms, characteristic of the two families of this order. The small Stephanidæ (Stephalia, Pl. VII., and Stephanalia, Pl. VI.) have simple, not branched tentacles, similar to those of the Apolemidæ and Linophysea. The large Rhodalidæ, however (Rhodalia, Pl. III.; Pl. IV. figs. 20–23), possess branched tentacles, like the majority of Physonectæ; each tentacle bears a series of very numerous tentilla or lateral branches; in form and structure (fig. 23) they are very similar to those of the Forskalidæ.

The simple tentacles of the Stephanidæ are long and thin cylindrical tubules, and arise from the dorsal side of the basigaster near its pedicle (Pl. VII. figs. 39, 40). They are usually very much contracted in the spirit specimens examined, and not much longer than the siphons; but in the expanded state and in the living animal they are probably very long, several times longer than the whole corm. The tentacles of Stephalia (Pl. VII. figs. 39, 40) are all of the same size and similar form, not annulated, with equally disposed cnidocysts. But Stephanalia (Pl. VI.) possesses two different kinds of tentacles, larger superior and smaller inferior. The thinner tentacles, much more numerous, agree with those of Stephalia. The thicker tentacles, only developed in the proximal part of the trunk, are far larger cylindrical tubules, and appear elegantly annulated when examined by a weak lens; each prominent annulus is composed of densely crowded cnidocysts, wanting in the small constricted interval between each two rings (Pl. VI. figs. 35, 37, 38, t). The distal part of these thicker tentacles has a peculiar structure; it represents a cylindrical, articulated terminal filament, composed of about a dozen segments, and bearing no annuli of cnidocysts (figs. 35, 37, t).

The branched tentacles of the Rhodalidæ have a similar but more complicated structure, and each bears a series of very numerous tentilla or lateral branches. The cylindrical tube, which is 1 to 1.5 mm. in diameter, may reach in the fully expanded state...
a length of 1 metre or more. It is annulated in the same manner as the simple tentacle of the Stephaliidae; but from the interval between each two annuli arises a tentillum or accessory filament (Pl. IV. figs. 20–22). The line in which these numerous tentilla are inserted is the dorsal median line of the cylindrical tentacle. From the opposite ventral median line arises a very thin and broad ligament, the suspensorium tentaculi (Pl. VII. fig. 42, tg); it is similar to the well-known suspensorium or tentacle-band of the Physalidæ; and as in these latter, the tentacle when contracted is coiled up spirally around this axial ligament. The transverse section of the tentacle, when magnified, shows us that the elastic ligament is composed of a solid lamellar apophysis of the cartilaginous fulcrum (Pl. IV. fig. 21, tl), and is covered by a single layer of exoderm-cells (e).

The structure of the tentacle visible in the transverse section (Pl. IV. fig. 21) is similar to that of other Siphonanthæ. The cylindrical central canal (c) is lined by a simple layer of large entoderm-cells (d), and this is surrounded by a thin muscular tube composed of circular fibres (wc). This entodermal plate is separated from the thicker exodermal wall by a strong gelatinous fulcrum of nearly cartilaginous consistence (s). The structureless fulcrum or supporting plate is surrounded in the transverse section by a corona of numerous (seventy to ninety) radii; they are the transverse sections of large longitudinal radial jelly-lamellæ which support the strong longitudinal muscle-fibres (ml). The latter appear in the transverse section regularly arranged on both sides of the lamella, like a pinnate leaf. The outer envelope of the exoderm (e) is very thick and composed of a stratified epithelium including may thread-cells. The circular annuli of the exoderm, composed of the radial supporting lamellæ and the parallel bundles of longitudinal muscles, are not quite complete, but interrupted on the ventral side by the broad elastic ligament of the tentacle or the suspensorium (tl).

_Tentilla_ (Pl. IV. fig. 23).—The accessory filaments or tentilla of the Rhodaliæ are simple lateral branches of the main tentacle, arranged in a single series in its dorsal median line. This series is opposed to the large, mesentery-like elastic ligament. The length of the lateral branches, which commence as very small bud-like elevations in the proximal part of the tentacle, increases gradually towards its distal end; the longest tentilla have a length of 5 to 10 mm. or more. The fully developed tentillum (Pl. IV. fig. 23) is very similar to that of _Forskalia_ (Pl. X. fig. 23). It consists of three cylindrical parts, viz., a short pedicle (tb), a spiral cnidoband (tk), and a slender terminal filament (tf). The short pedicle (tb) is inserted with narrow base in the interval between two thickened annuli of the main tentacle (fig. 22); its epithelium bears only very small cnidocytes. The cnidoband (tk) is armed with a strong cnidobattery, and is a thick-walled cylindrical tube coiled up in several leaotropic spirals. On its ventral or axial side are attached two strong parallel elastic ligaments (the so-called “angle-bands,” fig. 23, tl), and on both edges of these a series of very large bean-shaped or ensiform lateral cnidocytes (tk₁), whilst the convex dorsal side of the cnidobattery bears
a regular pavement composed of innumerable small paliform cnidocysts ($tk_1$). The strong cnidofilament protruded from the large bean-shaped cnidocysts is a rather thick and spirally convoluted thread (Pl. VII. fig. 43, a, b). The slender terminal filament of the tentilla (fig. 23, tf) is a simple cylindrical blind tube, scarcely half as broad as the battery, and armed with roundish cnidocysts of medium size.

_Gastro-canal System._—The system of nutritive vessels of the Auronectæ is more complicated than that of the other Siphonophoræ (with the exception of the Discoenteræ). It is composed of the following parts:—

1. The _central hypocystic cavity of the trunk_ (Pl. IV. fig. 15, aa; Pl. VII. fig. 40, ah); a large circular horizontal cavity of discoidal form, the apical wall of which is formed by the lower part of the pneumatophore, the basal wall by the uppermost part of the siphostome. (2) The _pericycstic cavity of the pneumatococcus_ (Pl. V. fig. 24, ps), enclosed between the thicker outer and the thinner inner wall of the pneumatophore; it gives off small irregular lateral branches which pierce the thick wall of the pneumatocon (fig. 30). (3) The _cavity of the aurophore_ (Pl. V. figs. 24–26, br), divided by numerous irregular, partly radial, partly branched septa into a spongy system of lacunar vessels and radial chambers; the basal part of the aurophore-cavity communicates on its upper side with the cavity of the pneumatophore (fig. 24, ps), on its lower side with the central main cavity. (4) The _reticulum of truncal canals_ (Pl. IV. fig. 15, ac; Pl. VII. fig. 40, ac), composed of a dense network of numerous irregularly branched and anastomosing vessels, which pierce the thick cartilaginous bulbs of the trunk in every direction; the centre of this truncal reticulum is in _Stephalia_ the axial central canal (fig. 40, ca) descending vertically from the centre of the main cavity towards the basal central siphon and opening through its mouth. (5) The _ventral budding canal_ (Pl. IV. fig. 16, ic), running from the ventral median line of the central hypocystic cavity to the ventral series of buds (i), and giving off a lateral branch to each bud. (6) The _nectocalycine ducts_, or the peduncular canals of the nectophores (Pl. V. fig. 31, ns), arising from the stem-cavity, running horizontally along the basal edge of the peduncle, and giving off a unilateral series of lateral branches which ascend vertically (fig. 31, nl). (7) The _four radial canals of each nectophore_ (Pl. IV. fig. 17, nr; Pl. VII. fig. 39); they arise crossed from the distal end of the peduncular canal, run along the subumbrella towards the margin of the nectophore, and are there united by a circular canal (fig. 39, cc). (8) The _central canal of each cormidium_, and the network composed of its anastomosing branches, often united by subregular elegant arches with the network of the neighbouring cormidia. (9) The _simple siphon cavity_ (Pl. I. fig. 4, c) composed of four segments (pedicle, basigaster, stomach, and proboscis); it arises from the superficial canal-network of the cormidium and gives off from the basigaster a lateral branch for the tentacle (tentacular canal, Pl. IV. fig. 21, c). (10) The _simple gonostyle canal_ (Pl. I. figs. 2, 3, c; Pl. II. figs. 7, 8; Pl. VII. fig. 49), arising from the superficial canal network of the
cornidia, and branching irregularly, giving off a special canal to each branch of the gonodendron and to each gonophore budding from it. (11) The palpon canal (Pl. IV. fig. 18, q), the simple blind cylindrical cavity of the gonopalpon, which arises from the distal end of each gonodendron. (12) The gonophore canal, running through the pedicle of each gonophore to the centre of its subumbrella, and dividing there into four radial canals which are united at the margin by a ring-canal. (13) The spermarial canal (Pl. VII. fig. 46), or the simple central cavity in the axis of each androphore (spadix), arising from the centre of its subumbrella and being the direct prolongation of the gonophore-canal. (14) The ovarial canal, arising from the centre of the subumbrella of each gynophore (as the prolongation of its pedicular canal), and running either in the axis of the ovarium as a simple spadix (Pl. II. figs. 9, 10, c), or forming an irregular network of spadice canals around the egg.

Gonodendra.—The corms of the Auronecæ are monoecious, the cornidia monodiclinic, and the gonodendra monostylic. Each cornidium bears in the small Stephalidæ a simple gonostyle with a single gonopalpon (g), a single androphore (h), and several gynophores (f), usually between ten and twenty (Pl. VI. figs. 32–38; Pl. VII. figs. 48, 49). The large Rhodalidæ, however, bear on each cornidium one or two clustered gonodendra, each branch of which corresponds to the small monostylic gonodendra of the Stephalidæ, and is composed of a few androphores and a greater number of gynophores; usually a single large gonopalpon is attached to each gonodendron (Pl. I. figs. 2, 3; Pl. II. figs. 6–12; Pl. IV. figs. 15, 18).

Gonostyles (Pl. I. figs. 2–5; Pl. II. figs. 7, 8; Pl. VII. fig. 49, ab).—The stems of the gonodendra, or the branched gonostyles, are in the Auronecæ very thick-walled cylindrical tubes, which arise from each cornidium near to the base of the siphon, on its axial side (fig. 48). The wide axial canal of the gonostyle (figs. 2–4, c) is convoluted spirally in the highly contracted spirit specimens examined, and surrounded by a strong muscular wall of remarkable thickness. The transverse section of this wall (Pl. I. figs. 4, 5) exhibits the same structure as the pedicle of the siphons. An inner thin layer of ring-muscles (me) and an outer thick layer of longitudinal muscles (ml) are separated by a thick elastic fulcrum (z). This fulcrum plate arises outside in the form of numerous branched radial lamellae. The stem must be very expansible and contractile in the living animal. The branching of the gonostyles is unilateral in the small Stephalidæ (fig. 49), dichotomous or irregular in the large Rhodalidæ (figs. 3, 7, 8, 15).

Gonopalpons (Pl. I. fig. 2, r; Pl. IV. figs. 15, r, 18, q; Pl. VI. figs. 37, 38, q).—The single form of palpons or tasters, which occur in the Auronecæ, are the sexual palpons or “gonopalpons.” Usually (or always?) a single tubular gonopalpon is attached to each cornidium, as a distal branch of its gonostyle; it is a simple cylindrical tube closed at the pointed distal end (fig. 18, q). The gonopalpons seem to be very contractile, but were for the most part detached and lost in the specimens examined.
Androphores (Pl. I. fig. 3, h; Pl. II. fig. 7; Pl. VII. figs. 46, 49, h).—The male gonophores are slender medusoid persons. Their form is more or less cylindrical, sometimes more spindle-shaped, at other times more club-shaped. The basal pedicle, or the male gonocoe, is much shorter than the female. The outer envelope, or the umbrella, is very thin walled, often armed at the distal end with four small groups of nematocysts (fig. 46, wo). The four radial canals (fig. 46, hr), which arise from the peduncular canal and run divergently in the subumbrella, are very narrow and difficult to observe, especially in adult persons; they are connected at the distal end of the umbrella by a small ring-canal (fig. 46, hc). The spermarium is formed by the thick-walled cylindrical manubrium. The sperm (fig. 46, hs) lies, as usual, between the thin exoderm of the manubrium and its thick entoderm, the axial spadix (hx), but separated from the latter by the fulcrum; it has been derived from the exoderm.

Gynophores (f).—The female gonophores are much more varied in shape and composition than the androphores. They are easily distinguished from these by their more rounded (usually pear-shaped) form and their longer stalks. There occur the following remarkable modifications:—A. Monovone gynophores.—Each female medusome develops only a single large ovum. (1) The gynophore develops a single very large ovum, surrounded by a double envelope; the inner envelope is the thin manubrial wall containing a smaller or larger blind spadicine cavity, sometimes a network of irregular spadicine canals; the outer envelope is the umbrella of the medusoid person, with four narrow radial canals and a small distal ring-canal connecting the latter; this is probably the normal and most frequent form of the ripe gynophore. (2) The same form, but with four blind radial canals (reduced in the distal half). (3) The same form (as 1 and 2), but with eight equidistant regular radial canals (fig. 12). (4) The same form (as 1 to 3), but with a variable number (five to ten) of irregular, branched and anastomosing, spadicine canals. (5) The same form (as 1 to 4), but without radial canals in the reduced umbrella. B. Polyovone gynophores.—Each female medusome develops an ovarium, composed of a variable number of ovules, placed in the wall of the modified manubrium. The umbrella seems to be usually reduced, very thin walled, without radial canals; often it has disappeared. (1) The gynophore is a medusome with rudimentary umbrella; the spadicine canal (or the original gastric cavity of the Medusa) is central, straight, and runs in the axis of the manubrium (Pl. II. figs. 9, 10); the ovules are regularly disposed around it. (2) The gynophore is a medusome with rudimentary umbrella; the spadicine canal is excentric, curved, and runs on one side of the manubrium; it embraces the ovarium as a crescent-shaped or semicircular blind canal. (3) The gynophore is a simple sporosae, the manubrium without umbrella; the ovules are arranged equally around the central spadicine canal. (4) The gynophore is a compound sporosae, without umbrella, two or three (rarely more, sometimes only one) buds developing from off the outside of the primary manubrium (Pl. II. fig. 11).
The buds or the secondary sporosacs contain either a single large ovum or a group of several small ovules; they have usually a long pedicle, and its canal arises from the base of the primary spadix.

The different remarkable modifications of gonophores here enumerated, exhibited in the adult spirit specimens examined, showed no regular distribution, but occurred in very variable number and association. A further accurate research on living and well-preserved specimens is required to make out their mutual relations and signification.

**Ontogeny.**—The development of the Auronectæ is quite unknown, but will probably offer interesting and valuable facts which explain the natural affinities of this interesting order. Among the few spirit specimens of *Stephalia corona* which I discovered in the collection of the "Triton" Expedition (1882), kindly forwarded by Dr. John Murray, two specimens exhibited gonodendra (Pl. VII. figs. 48, 49), whilst a third specimen possessed no trace of them (Pl. VII. figs. 39, 40). A very small medusome, found in the same bottle (Pl. VII. fig. 50), is probably a young larva of this *Stephalia*. This medusome is composed of a pneumatophore (*p*), an auropore (*l*), a siphon (*s*), and a simple tentacle (*t*l). Unfortunately this larva (*Auronula*) was not well preserved, which prevented further accurate examination.

**Synopsis of the Families of Auronectæ.**

Trunk of the siphosome with a permanent central canal and a distinct primary mouth.

Tentacles simple, without tentilla, ... ... ... ... ... ... 18. *Stephalidae*.

Trunk of the siphosome without permanent central canal and distinct primary mouth.

Tentacles branched, with a series of tentilla, ... ... ... ... ... ... 19. *Rhodalidae*.

**Family XVIII. STEPHALIDÆ, Haeckel, 1888.**

*Stephalidae*, Hkl, System der Siphonophoren, p. 43.

**Definition.**—Auronectæ with a permanent central canal in the axis of the bulbous trunk, opening at the basal pole by the permanent primary mouth. Tentacles simple, filiform, without lateral branches.

The family *Stephalidae* comprises the smaller and inferior forms of *Auronectæ*, with simple tentacles and a central permanent protosiphon, opening on the basal pole of the vertical axis by a permanent primary mouth. I was able to examine accurately only two genera and species of this interesting family, *Stephalia corona* (Pl. VII.) and *Stephonalia bathypophysa* (Pl. VI.).

The general composition of the corin, the structure of the nectosome and the siphosome, and the form of the single organs composing them, have been described above (p. 281). It is only necessary to add here the remark, that the *Stephalidæ*, regarded from
a phylogenetic point of view, represent the older and simpler forms of Auronectæ. They resemble the Cirealidæ in many respects (Pl. XXI. figs. 1–4); and especially the mono-gastric Auronula (Pl. VII. fig. 50) may be compared to Cirealia. This latter, however, possesses no trace of the aurophore. The central axial canal of the Stephalidæ (Pl. VII. fig. 40, ca) and its distal mouth (ao) are of special interest, as comparable on one hand with the terminal protosiphon in the basal cormidium of the Physalidæ, and on the other hand with the central sterile siphon of the Disconectæ. By the thickening of its wall, and the development of anastomosing nutritive canals in this, arises the characteristic trunk of the Auronectæ. Its terminal mouth remains permanently open in the Stephalidæ.

**Synopsis of the Genera of Stephalidæ.**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Simple</td>
<td>Stephalia, Hkl., System der Siphonophoren, p. 43.</td>
</tr>
<tr>
<td>All tentacles simple, of the same size and form,</td>
<td><strong>62a. Stephalia.</strong></td>
</tr>
<tr>
<td>Corona of nectophores double or multiple, A corona of proximal tentacles, annulated, much larger than the simple distal tentacles,</td>
<td><strong>62b. Stephonalia.</strong></td>
</tr>
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**Genus 62a. Stephalia, Haeckel, 1888.**

*Definition.*—Stephalidæ with a simple corona of nectophores, arranged in a single circle. Tentacles simple, all of the same form and equal size.

The genus *Stephalia* (Pl. VII.) is the simplest and oldest (phylogenetically) among the four different genera of Auronectæ which I have examined. Its corona of nectophores is simple, as in Auralia and Cirealia (Pl. XXI. figs. 1–4), all the nectophores being placed in one horizontal plane. The tentacles are simple, cylindrical, not annulated filaments, all of equal size and similar form. The gonodendra (Pl. VII. fig. 49), which, however, in the specimens examined were not fully developed, are smaller than in Stephonalia, and seem to want the large gonopalpon characteristic of that genus.

*Stephalia corona, n. sp. (Pl. VII.).*

*Habitat.*—North Atlantic, in the depth of the eastern Gulf Stream. Færoe Channel and Shetland Islands, August 22 and 24, 1882; depth, 640 and 516 fathoms ("Triton" Expedition, Dr. John Murray).

*Corm.*—Four different specimens of this interesting species were examined by me, all preserved in rather good condition. One of the corms (fig. 39, in profile; fig. 40, in

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sagittal section) was young and immature, the cormidia being without gonophores; but the
nectophores (ten in number) attached to the trunk, and the long tentacles (about thirty)
attached to the base of the siphons, were rather well preserved. This corm had a length
of 10 mm. and a breadth of 6 mm., two other corms (one of which is represented in fig.
48) were somewhat larger and bore a small clustered gonodendron (g) on each cormidium;
but the nectophores (except one or two) were lost, and the siphons with the tentacles
detached; the basal pedicle of the siphons only (s) had remained on the trunk. The
number of cormidia was forty to fifty. The length of these two corms was 16 to 20 mm.,
the breadth 10 to 15 mm. The trunk of one corm was similar to that shown in figs. 39
and 40, that of the other relatively smaller (fig. 48). The fourth specimen was the
interesting monogastric larva shown in fig. 50 (Auronula).

Auronula (fig. 50).—The remarkable larva—only a single specimen of which I could find,
after carefully examining the “Triton” collection—had a length of 4 mm. and a breadth
of 3 mm.; it represents a single medusome, the modified umbrella of which is the large,
flattly spheroidal pneumatophore (pww); the manubrium a single large central siphon (sc).
This protosiphon has a terminal mouth (ao), and bears attached to the dorsal side one single
tentacle (td), and above it a rather large aurophore (l). The relatively large size of this,
and the full development of its radial structure (lm), makes it perhaps probable that the
aurophore is not an independent medusoid person (a modified nectophore), but only a
separate basal organ of the pneumatophore. Besides some small buds on the ventral side,
no other organs were visible in this monogastric Auronula. Unfortunately it was not
well enough preserved to allow of a microtomic examination.

Nectosome (figs. 39 and 48, lateral view, from the right side; fig. 40, vertical
sagittal section).—The superior or apical half of the corm is occupied by the large spheroidal
pneumatophore (p) and the corona of nectophores (n). This is bisected in the sagittal
plane by the aurophore (l) in the dorsal median line, and by a series of buds (i) in the
ventral median line. The aurophore is in this species just the same size as each of the
nectophores; the number of these is ten to twelve. The structure of the aurophore
(l) and its axial pistillum (lm) is the same as in Rhodalia (Pl. V.).

Siphosome.—The inferior or basal half of the corm is occupied by the bulbous trunk of the
siphosome and the numerous cormidia attached to its outer surface. The cartilaginous
trunk (fig. 40, a), pierced by a dense network of anastomosing canals (ac), is sometimes
subspherical, at other times more like a spindle or a truncated cone. The axial canal (ca)
is twice as broad as its anastomosing irregular lateral branches, and opens below by the
primary mouth. Each cormidium bears a simple tentacle on the dorsal side of the
proximal base of the siphon (s), and in the mature corms a small gonodendron (fig. 49).
This is composed of a single androphore (h) and eight to twelve gynophores (j). The
gonopalpon seems to be rudimentary in this species.

**Definition.**—Stephalidæ with a double or multiple corona of nectophores, arranged in two or several circles. Tentacles of two different forms and unequal sizes, larger proximal and smaller distal.

The genus *Stepholalia*, represented by the remarkable deep-sea species figured in Pl. VI., is closely allied to the preceding genus, *Stepholia* (Pl. VII.), and was formerly confounded by me with it. But a closer examination and comparison of the two forms showed some peculiar differences between them, which now seem to me to possess a generic value. Firstly, the corona of nectophores, although very incompletely preserved, seems to be composed of two (or even three) circles; and if this be true then *Stepholalia* agrees in this point with *Rhodalia*, and bears to it the same relation as *Stepholia* does to *Auralia* (both with a single circle of nectophores). A second difference between *Stepholia* and *Stepholalia* seems to be in the shape of the tentacles. Whilst these are all quite simple and uniform in the former, they are of two different kinds in the latter. A third difference is found in the development of a large gonopalpon in each eormidium of *Stepholalia*, whilst this seems to be rudimentary in *Stepholia*. Finally, the muscles of the pneumatophore in the latter genus are equally disposed, whilst in *Stepholalia* eight strong radial muscles and corresponding meridional constrictions are marked regularly disposed at equal distances (Pl. VI. fig. 33).

*Stepholalia bathypsys*, n. sp. (Pl. VI.).

**Habitat.**—South Pacific, west of Cook’s Strait, New Zealand. Station 166, June 23, 1874; lat. 38° 50' S., long. 169° 20' E.; depth, 275 fathoms.

**Corm.**—Two specimens of this interesting Auroneet were found by me in the Challenger collection, both rather well preserved, although very much contracted and altered by the action of the alcohol. The first specimen (fig. 32, seen from the left side in profile; fig. 33, from the dorsal side) was pretty complete, and had a length of 20 mm., a breadth of 16 mm. The second specimen, somewhat larger, but incomplete, had lost the greater part of the nectosome as well as of the siphosome; but the upper third of the latter, with the corona of large-tentacled siphons, was better preserved than in the first specimen; its length was 24 mm., breadth 20 mm. (figs. 34–38).

**Nectosome.**—The large, flatly spheroidal pneumatophore (figs. 32, 33, p) is distinguished by an unusual development of the muscles in its thickened wall. Eight

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1 *Stepholalia* = Small marine corona, *sph特別, ἠχος.*
equidistant radial muscles run divergently from the apical centre to the basal periphery, and these are crossed by about a dozen strong circular muscle-rings of equal breadth. The subspherical aurophore (l) is about the same size as a nectophore. The number of nectophores in this species, judging from the insertions of their pedicles, may be twenty or thirty, and they seem to be arranged in a double corona, a superior and an inferior. But the majority of the nectophores were detached in the two specimens examined, and a more accurate examination of their arrangement is required.

*Siphosome.*—The complete siphosome, including the retracted appendages, is nearly spherical, and may be about the same size as the nectosome. The sagittal section is very similar to that of *Stephalia* (Pl. VII. fig. 40); but the central axial canal (ac) is wider, and the terminal protosiphon larger (figs. 32, 33, ap). The number of cormidia may be sixty to eighty, and they seem to be arranged in a condensed low spiral. The apical part of the trunk is surrounded by a corona of eight larger cormidia, distinguished by very large annulated tentacles, with a slender terminal filament (figs. 34–38). The other cormidia have slender simple tentacles, similar to those of *Stephalia*. Each gonodendron (q) bears a large palpon (q).

**Family XIX. Rhodalidæ, Haeckel, 1888.**

*Rhodalia*, Hkl., System der Siphonophoren, p. 43.

*Definition.*—Auronectæ without a permanent central canal in the axis of the bulbous trunk, and without a permanent primary mouth at its basal pole. Tentacles with a series of tentilla or lateral branches.

The family Rhodalidæ comprises the larger and superior forms of Auronectæ, with branched tentacles, without permanent protosiphon and primary mouth. I was able to examine accurately only a single genus and species of this interesting family, *Rhodalia miranda* (Pls. I.–V.). A second closely allied genus seems to be *Auralia*, differing from *Rhodalia* in the simple corona of nectophores, and in the possession of a large central cavity in the centre of the subglobular trunk of the siphosome. The general composition of the corrn, the structure of the nectosome and of the siphosome, and the form of the single organs composing them, have been described above (p. 281). It need only be added here, that the Rhodalidæ, regarded from a phylogenetic point of view, represent the younger and more highly developed forms of Auronectæ. The size of the whole corn, as well as of all its single parts, is far larger, and the number of the cormidia and their component persons and organs far more considerable, than in their ancestral forms, the preceding Stephalanidæ. The central axial canal of the latter, and its terminal mouth, have either disappeared, or they cannot be distinguished from the other siphonal cavities and mouth-openings. The tentacles produce a series
of numerous lateral branches or tentilla. The form of the latter, and some other characters of organisation, exhibit some similarity with the Forskalidæ (Forskalia, Pls. VIII.–X.).

Synopsis of the Genera of Rhodalidæ.

Corona of nectophores simple. Trunk of the siphosome with a large central cavity, 63. *Auralia*.

Corona of nectophores double or multiple. Trunk of the siphosome without large central cavity, 64. *Rhodalia*.


*Auralia*, Hkl., System der Siphonophoren, p. 43.

Definition.—Rhodalidæ with a simple corona of nectophores, arranged in a single circle. Trunk of the siphosome with a wide central cavity, surrounded by a peripheral reticulum of trunk-canals.

The genus *Auralia* may be regarded as the older and inferior form of Rhodalidæ, more closely allied to the preceding Stephalidæ than the succeeding *Rhodalia*. The corona of nectophores is simple, as in *Stephalia*, and the characteristic central canal of the trunk of the latter has left a remainder in the form of a wide central cavity, from which the peripheral network of anastomosing trunk-canals arises. But the basal prostoma (or the primary mouth) has disappeared, and the tentacles bear a series of tentilla, as in *Rhodalia*.

*Auralia profunda*, the single species of this genus which I have examined, was taken in the depths of the Tropical Atlantic, and will be described afterwards in my Morphology of the Siphonophore. Its external appearance is similar to that of *Stephalia corona* (Pl. VII. fig. 39); but the nectophores of the simple corona are more numerous and the tentacles are of the same shape as in *Rhodalia* (Pl. IV. figs. 20–23).

Perhaps belonging to this genus is another Siphonophore, from the depths of the Gulf Stream (1395 fathoms), which Fewkes has described under the name *Angelopsis globosa* (45, pt. xii. p. 972, pl. x. figs. 4, 5), and which he supposes to be a transition form between the Pectyllidæ and the Pneumatophorid (*Physalia*). The nectosome as well as siphosome of this form are subglobular and of nearly equal size. The vertical section (fig. 5) exhibits the flat hypocystic cavity (cav.), between the float-cavity (cav. p) and the central cavity of the trunk (cav. b). The "spherical bag-like structures," which Fewkes supposes to be "budding new individuals" (grm), are probably the necto-

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1 *Auralia* = Air-bubble of the sea, ἀέρα, θάλα. 
phores. Fewkes' description, however, is so inaccurate, and the examination so superficial, that it is impossible to identify with any certainty his Angelopsis and my Auralia.

Genus 64. Rhodalia, Haeckel, 1888.

*Rhodalia*, Hkl., System der Siphonophoren, p. 43.

**Definition.**—Rhodaliäe with a double or multiple corona of nectophores, arranged in two or several circles. Trunk of the siphosome without proper central cavity, traversed by an equal reticulum of trunk-canals.

The genus *Rhodalia*, represented by the wonderful South Atlantic *Rhodalia miranda* (Pls. I.–V.), differs from the preceding *Auralia* in two important characters. The nectosome is similar to that of *Forskalia*, composed of very numerous nectophores, which are not arranged in a simple corona, but in several circles or spiral rows. The trunk of the siphosome is a solid cartilaginous bulb, without central cavity, pierced everywhere by an equally developed network of trunk-canals. *Rhodalia*, therefore, represents the most highly developed genus of Auronectae.

*Rhodalia miranda*, n. sp. (Pls. I.–V.).

**Habitat.**—Western part of the South Atlantic, south-east of Buenos Ayres. Station 320, February 14, 1876; lat. 37° 17' S., long. 53° 52' W.; depth, 600 fathoms.

*Rhodalia miranda* was preserved in rather good condition in the Challenger collection, enclosed in a spirit bottle, the clear spaces of which were filled by horse-hair. Entangled in the latter were found the detached siphons and tentacles of the corms (compare p. 290), whilst the detached nectophores were found in great numbers on the bottom of the vessel. The corms themselves, as well as all their component parts, were very much contracted by the action of the strong alcohol. In the living and fully expanded state they are probably twice the size (or more) shown by the following list of dimensions (p. 303). But the state of preservation, even of the most delicate tissues, was very good, as is seen by comparing figs. 4, 5 (Pl. I.), figs. 7–12 (Pl. II.), and Pls. IV. and V.

**Size.**—The diameter of the entire corm was in three of the preserved specimens, on an average, between 40 and 50 mm., in the fourth smaller specimen 30 mm. The largest specimen preserved, which is figured in Pls. I. III., twice natural size, gave the following maximum dimensions in millimetres:

REPORT ON THE SIPHONOPHORA.  303

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Height of the corm (vertical axis), without nectophores and tentacles,</td>
<td>40</td>
</tr>
<tr>
<td>Breadth of the corm (greatest horizontal diameter),</td>
<td>60</td>
</tr>
<tr>
<td>Height of the pneumatophore (vertical),</td>
<td>11</td>
</tr>
<tr>
<td>Breadth of the pneumatophore (horizontal),</td>
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</tr>
<tr>
<td>Length of the aurophore,</td>
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<tr>
<td>Breadth of the aurophore,</td>
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</tr>
<tr>
<td>Length of the nectophores (with pedicles),</td>
<td>20</td>
</tr>
<tr>
<td>Breadth of the nectophores (diameter of the umbrella),</td>
<td>10</td>
</tr>
<tr>
<td>Diameter of the trunk (vertical and horizontal axes of the siphosome),</td>
<td>30</td>
</tr>
<tr>
<td>Length of the siphons (much contracted),</td>
<td>10</td>
</tr>
<tr>
<td>Breadth of the siphons (diameter of the stomach),</td>
<td>3</td>
</tr>
<tr>
<td>Length of the tentacles (on an average),</td>
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<td>Breadth of the tentacles,</td>
<td>1</td>
</tr>
<tr>
<td>Diameter of the gonodendra,</td>
<td>10</td>
</tr>
<tr>
<td>Diameter of the gonophores,</td>
<td>1</td>
</tr>
</tbody>
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**Figures.**—Figures 1, 6, 13, and 14, which represent the complete corm (1 from above, 6 from below, 13 from the left side, and 14 from the dorsal side), are semi-diagrammatic, inasmuch as the detached nectophores are placed in their probable position and form, and in fig. 13 the detached tentacles are added. Of course the form and position of the detached nectophores could not be recognized in the spirit specimens with full certainty, the soft jelly-substance being much contracted by the action of the alcohol. All the other figures are drawn exactly from the preparations.

**Nectosome** (Pl. I. fig. 1, apical view from above; Pl. III. fig. 13, superior half, lateral view from the left side; fig. 14, dorsal view from behind; Pl. IV. fig. 15, sagittal section).—The large pneumatophore (p) is a flattened spheroid, separated from the subjacent trunk of the siphosome by the flat circular hypocystic cavity (fig. 15, aa). The surrounding corona is composed of fifty to eighty (or more) nectophores (n), arranged in three alternating annular series (fig. 13); their high lamellar pedicles, however, form a single corona (figs. 14, 16). The corona of the nectosome is perfectly symmetrical, bisected by the vertical sagittal plane; in the ventral centre of this lies the series of buds (Pl. IV. fig. 16, i), in the dorsal centre the aurophore (l). For the peculiar structure of this latter, compare p. 283, and Pl. V., with explanation.

**Siphosome** (Pl. II. fig. 6, basal view; Pl. III. fig. 13, inferior half, lateral view from the left side; fig. 14, dorsal view; Pl. IV. fig. 15, sagittal section).—The solid cartilaginous trunk of the siphosome, traversed by a dense network of innumerable canals (fig. 15), is sometimes subspherical, at other times more like a truncated cone. Its entire surface is covered with very numerous, densely aggregated cormidia (fifty to eighty or more). Each cormidium is a conical cartilaginous bulb, and bears a single siphon (s) with a very long tentacle (t), and a clustered gonodendron; the gonostyle of the latter is originally simple (fig. 3), but often so deeply forked that two separated
gonodendra arise besides the siphon (fig. 2); more rarely three or even four gonodendra arise separately from one cormidium. The long tubular gonopalpon (Pl. I. fig. 2, r; Pl. IV. fig. 15, r, fig. 18, q), as the distal prolongation of the original stem of the gonostyle, seems to be always single in each cormidium.

All the corms examined had lost the nectophores, the siphons, the tentacles, and the gonopalpons, with a few exceptions. All these detached parts were found beside the corms in the bottle. But fortunately in some specimens one or two of these organs had remained in their natural attachment, so that it was possible to determine their probable natural position; so, e.g., a single nectophore (n) in Pl. IV. fig. 16, and a single gonopalpon in figs. 2 and 18. All the tentacles were attached to the basigaster of the siphons, which were separated by self-amputation from their pedicles remaining on the trunk (compare above, p. 290). On the structure of all separate parts compare the general description of Auroneetae (pp. 281–296).

Additional Note on the Deep-Sea Life of the Auroneetae.

The new and most interesting group of Auroneetae, which is one of the most splendid discoveries of the Challenger, and described in the preceding pages (pp. 281–304, Pls. I.–VII.), represents a new order which is adapted in a most remarkable manner to deep-sea life. The Auroneetae differ from all other Siphonophorae in the peculiar structure of the bulbous cartilaginous trunk traversed by a peculiar network of canals, in the singular shortening of the vertical main-axis, and prolongation of the horizontal transverse axis. Upon this vertical depression of the trunk depends the peculiar development of the densely crowded cormidia. But the most striking peculiarity is the extraordinary development of the swimming apparatus, the voluminous pneumatophore, the powerful horizontal corona of radially expanded nectophores, and particularly the singular aurophore, wanting in all other Siphonophorae, and acting probably as an important gas-secreting gland or a pneumadena. All these striking characters together make it very probable that the Auroneetae are permanent deep-sea Siphonophorae, which may move up and down within certain limits of depth, but never come to the surface.
Order V. CYSTONECTÆ, Haeckel, 1888.

(Pis. XXII.–XXVI.)

Pneumatophoridae, Chun, 1882, 86, p. 1168.
Cystonecta, Haeckel, 1888, 95, p. 44.

Definition.—Siphonophora with a large apical pneumatophore, without nectophores and without bracts. Nectosome represented only by the pneumatophore, which always bears an apical stigma. Siphosome either a single cormidium with one siphon (Monogastrice), or a tubular or vesicular trunk which bears numerous cormidia (Polygastrice) Gonodendra always monostylic, provided with gonopalpons.

The order Cystonectae comprises all Siphonanthae which possess neither nectophores nor bracts, the only organ of swimming being the large apical pneumatophore. They differ in this respect from the three preceding orders, and agree with the Disconanthae or Disconectæ; but the structure of the float, as well as the entire organisation, is in these latter perfectly different (compare above, pp. 25, 26). We unite in the order Cystonectæ five different families, three of which are new, viz., the monogastric Cystalidæ and the polygastric Epibulidæ and Salacidæ; the two other families, formerly known, and both polygastric, are the Rhizophysidæ (usually united with the Physonectæ) and the Physidæ; these two families have been united by Chun, in 1882, under the name Pneumatophoridae (86, p. 1168). All known Cystonectæ agree in the complete absence of nectophores and bracts, and in the possession of a large pneumatophore of peculiar structure, provided constantly with an apical stigma for the emission of air. All the genera of this order agree further in the peculiar composition of the monostylic gonodendra, the gymophores of which are detached from the trunk before ripening. In most other respects the Cystonectæ agree generally with the Physonectæ; they may be derived from this order by the loss of the nectophores.

History.—Eschschoitz in his fundamental work (1) described, in 1829, three genera and six species of Siphonophora which belong to our order Cystonectæ, viz., (1) the Mediterranean Rhizophyza filiformis, Lamk. (described already in 1775 by Forskål, 11, as Physophora filiformis), and the closely allied Rhizophyza planostoma, Péron (14, pl. xxix. fig. 3); (2) the Australian Epibulidæ chamissonis (figured in 1821 by Eysenhardt, 77, as Rhizophyza chamissonis); and (3) the well-known interesting genus Physalia with three species (the Atlantic Physalia caravella, the Indian Physalia pelagica, and the Pacific Physalia utriculus). Eschschoitz, as well as most following authors, united these three genera of Cystonectæ with the Physophoridae (our Physonectæ).

Brandt, in 1835, relying on the excellent (unfortunately hitherto unpublished) figures and descriptions of several new Cystonectæ by Mertens, established for them two different

(Zool. Chal. Exp.—Part lxxv.—1888.)
subfamilies with four genera: (1) the Rhizophysidae (with *Epibulia* and *Rhizophysa*), and (2) the Physalidæ (with *Alophota* and *Physalia*, p. 33, 36). The same two groups were accepted by Huxley, in his Oceanic Hydrozoa, 1859, as two separate families of Physophoridæ (9, p. 71).

*Physalia*, as the largest and most splendid of all Siphonophoræ, well known to all travellers and sailors in the Tropics, celebrated by its peculiar form and swimming locomotion, its brilliant colours and dangerous poison, has provoked a voluminous literature (compare Eschscholtz, 1, p. 159; Olfers, 79, p. 26; and Huxley, 9, p. 93). But the greatest part of it is without scientific value, full of errors, and not supported by accurate researches. Huxley rightly says, that “this department of zoological literature makes one long for the advent of a Caliph Omar, and produces a sort of unpleasant vertigo” (9, p. 99). Indeed, the knowledge of *Physalia*, although examined and described by numerous observers, has remained very insufficient up to our time.

I myself had an excellent opportunity of observing living Physalidæ, as well as Rhizophysidæ, during my residence in the Canary Island Lanzarote, in December 1866, and in January and February 1867. Among thousands of large *Physalia*, which appeared at Christmas 1866 in the harbour of Arrecife, there were some interesting, crestless, small, new forms, which are figured in Pl. XXVI. of this Report as *Alophota* jiltschiana and *Arethusa* challengeri. Pls. XXIII. and XXIV. reproduce the figures of two new genera of Rhizophysidae (*Cannophysa* with ordinate cormidia, and *Nectophsia* with loose cormidia, both sexually mature), which I had drawn from life in Arrecife in January 1867. But more interesting, as types of new families, may be the two remarkable forms of Cystonects which I observed in December 1881 and January 1882 in Ceylon, and which are figured in Pl. XXII. as *Cystalia monogastrica* and *Epibula vivicaria*.

The collection of the Challenger contains a number of *Physalia* collected in different parts of the Tropical Atlantic and Pacific, and besides some other Cystonects or fragments of them. Among these is a very interesting deep-sea form, from the Tropical Atlantic (Station 338), *Salacia polygastrica* (Pl. XXV.); it is the type of a new family, intermediate between the Rhizophysidae and Physalidæ.

Some other interesting new forms of Rhizophysidae, also inhabitants of the deep sea, were described in 1878 by Studer as different species of *Rhizophysa* (40, Taf. i.); they represent, in my opinion, two different genera, *Aurophysa inermis* and *Linophysa conifera*. The large form described by Studer as *Bathyphysa abyssorum* belongs probably to the Forskalidæ (compare p. 248).

Some similar deep-sea forms, described recently by Fewkes (45), are too incomplete and too insufficiently known to allow us to recognise their true position in the system.

Recently Chun has given some valuable contributions to our knowledge of the
Cystonectæ. He united in 1882 the Rhizophysidae and Physalidae under the name Pneumatophoridae, and separated them from the Physophoridae (our Physonectæ) (86, p. 1168). He pointed out as a common character the absence of nectophores and bracts, and the peculiar structure of the gonodendra. Chun further published the first accurate description of the peculiar structure of the pneumatophore in the Rhizophysidae and Physalidae, and of the metamorphoses of the young Physalia (48, 83, pp. 529, 557, 574).

The five different families of Cystonectæ which are described in the sequel, exhibit interesting relations to similar families among the Physonectæ. The monogastric Cystalidæ correspond to the simple Athoridæ. Two polygastric families with a very prolonged tubular trunk have analogous representatives in both orders; the Rhizophysidae (with monogastric cormidia) are comparable to the Agalmaidæ, the Salacidæ (with polygastric cormidia) to the Apolemidæ. Two other polygastric families possess a shortened and inflated vesicular trunk of the siphosome; of these the Epibulidæ are similar to the Discodabidæ, and the Physalidæ in some respects to the Anthophysidæ; the peculiar secondary development of the gigantic pneumatophore, however, and its consequences for their further divergent organisation, remove still more widely the Physalidæ from all other Siphonanthæ.

Nectosome and Siphosome.—The two different main portions of the corn, swimming and feeding portion, exhibit a very different relation in the various Cystonectæ. The nectosome, or the swimming body, is represented only by the large pneumatophore and corresponds to the modified umbrella of the original medusome. The siphosome, on the other hand, exhibits a different shape in the monogastric Cystalidæ, and the polygastric Cystonectæ of the four other families; it is composed in the Cystalidæ (Pl. XXII. figs. 1–5) of a single large siphon (the manubrium of the original medusome), and of various organs budding from its base (a tentacle, a corona of palpons, and a gonodendron). The single siphon of the Cystalidæ corresponds to the axial trunk of the four other families; from its ventral side arise numerous cormidia by budding. These secondary cormidia, composed of siphons, palpons, tentacles, and gonodendra, are sometimes ordinate, at other times loose; they are densely aggregated in the Brachystelminæ (Epibulidæ, Pl. XXII. fig. 6; and Physalidæ, Pl. XXVI.), with a shortened and inflated vesicular stem; they are loosely scattered and separated by long internodes in the Macrosterminæ (Rhizophysidae, Pls. XXIII., XXIV.; and Salacidæ, Pl. XXV.), which possess a long tubular stem. The nectosome and siphosome are usually separated by a constriction corresponding to that portion of the original medusome on which the manubrium is inserted into the centre of the subumbrella. Another structure, differing from that of all other Siphonophore, is exhibited by the peculiar Physalidæ. The hypertrophic pneumatophore extends here into the trunk of the siphosome, along its dorsal side, so that this side becomes the superior, and the opposite ventral the inferior side.
Cormidia.—The entire body represents in the monogastric Cystalidae (Pl. XXII. figs. 1-5) a single cormidium, composed of a large central siphon with a single tentacle, and at its proximal base (beyond the pneumatophore) a corona of palpons, and a single gonodendron. This solitary cormidium is similar to that of the Circalidae and Athoridæ (Pl. XXI.), but differs in the absence of nectophores and bracts. The four other families are polygastric, and therefore composed of a variable number of cormidia. These are sometimes ordinate, at other times loose. They exhibit a different shape in the two subfamilies of Rhizophysidæ, where the trunk is very long, tubular, and articulate; the cormidia are ordinate and separated by equal free internodes in the Cannophysidæ (Pl. XXIV.), where each cormidium is composed of a single siphon with its tentacle, and a single gonodendron at its base; whereas the cormidia are loose in the Linophysidæ (Pl. XXIII.), where the gonodendra are detached from the siphons, usually alternating with them regularly. The family Salaciæ (Pl. XXV.) is distinguished by polygastric ordinate cormidia; the long tubular stem bearing in regular free intervals numerous equal cormidia, each of which is composed of several siphons (with tentacles) and gononodendra. The shortened vesicular stem of the Physalidæ (Pl. XXVI.) bears clusters of loose cormidia, without regular arrangement; the cormidia of the Epibulidæ, however (Pl. XXII. fig. 6), seem to be ordinate, similar to those of the Discobolidæ.

Pneumatophore.—The hydrostatic apparatus or the swimming-bladder is in all Cystonecæ large, sometimes gigantic and larger than all the other parts of the body together; it is the more important, as it is the only organ of floating, the nectophores being entirely wanting. In Physalia it attains unusual dimensions (one or two decimetres and even more), and occupies a far larger volume than in any of the other Siphonophore. The general form of the pneumatophore is usually more or less ellipsoidal, ovate or pyriform, sometimes more irregular, oblongish round. Its longitudinal axis is usually not vertical (as in the majority of Physonecæ), but more or less obliquely inclined, and in Physalia nearly horizontal. The cavity of the pneumatocyst opens in all Cystonecæ by an apical stigma, or a permanent pore, by which the animal expels the included gas at will, when it will sink down. I have observed this emission of gas repeatedly in the Rhizophysidæ, Epibulidæ, and Physalidæ.

Pneumatocodon.—The outer wall of the pneumatophore, which we call pneumatocodon ("Luftschirm"), is in all Cystonecæ very thick and muscular, and capable of strong contraction. The strongest muscles are the longitudinal or meridional fibres, which lie immediately under the exoderm and diverge from the open apical pole to the equator, and then converge from the latter to the basal pole. They form around the apical stigma a strong musculus dilatator (like that of the pupil of the eye). But further the stratum of circular muscles of the entoderm, which is antagonistic, and separated from the former by the thick fulcrum, is well developed. It forms around the apical stigma a strong sphincter, or a circular musculus orbicularis, which closes its opening completely.
Pneumatosaccus.—The invaginated portion of the apex of the trunk, which forms the air-sac, hangs in all Cystonecctae freely in the pericystic cavity, or the wide interval between the inner and outer wall of the pneumatophore. These two walls are not connected by radial septa, as in most Physonectae, and are united only on the margin of the apical stigma. The uppermost portion of the air-sac, which surrounds this stigma, is usually intensely coloured (mostly red or brown), or covered by a hemispherical pigment-cap (mitra ocellaris). A ring-like constriction (the pylorus infundibuli, "Trichterpforte") separates incompletely the larger apical and the smaller basal portion of the air-sac. The former is the pericystic sac, which secretes the chitinous pneumatoeyst (or the cuticular air-flask); the latter is the hypocystic infundibulum or the pneumatochone (air-funnel, "Lufttrichter"), which together with the tapetum endocystale forms the air-secreting gland, or the pneumadenia. The basal or inferior opening of the pneumatoeyst (opposite to the superior or apical stigma) is often surrounded by an annular thickening of the cuticle, the annulus pylori (Pl. XXII. figs. 7, 8).

Pneumadenia.—The exodermal epithelium of the pneumatosac (or strictly speaking of its basal portion), which secretes the gas filling the float, in all Cystonecctae is a gas-gland or pneumadenia of considerable size. It exhibits the simplest shape in the monogastric Cystalidae (Pl. XXII. fig. 5); it is here a spheroidal vesicle of thickened glandular exoderm, which communicates by a proximal opening (the pylorus) with the cavity of the pneumatoeyst; this simple "air-funnel" is very similar to that of the Apolemidae among the Physonectae (50, Taf. xix. fig. 93). The pneumadenia of the Physalidae, the largest of all, is originally of the same simple shape as in the Cystalidae, but expands afterwards unilaterally, on the ventral side of the pneumatophore, and forms there a large circular or oblongish air-secreting plate ("Luftplatte," Chun, 83, p. 569); in Caravella maxima it reaches the extraordinary size of 100 to 150 mm. This peculiar growth along the ventral side of the float is effected by the extraordinary expansion, which the air-sac reaches in the Physalidae, growing downwards into the cavity of the trunk, along its dorsal side; and by the consequent asymmetrical development.

The three other families (Rhizophysidae, Pls. XXIII., XXIV.; Salaeidae, Pl. XXV.; and Epibulidae, Pl. XXII. figs. 6–8) agree in a peculiar structure of the pneumatophore and differ essentially from the two preceding (Cystalidae and Physalidae). The beginning of the structure is the same as in the latter; but afterwards the pneumadenia exhibits a further very remarkable development, firstly in the endocystic tapetum, and secondly in the hypocystic villi. The glandular exodermal epithelium of the primary spheroidal pneumadenia (or the air-funnel) grows in apical direction, passes through the pylorus into the cavity of the pneumatoeyst, and expands into its basal portion, lining its inside (in younger floats only one-third, in older more than two-thirds). The extraordinary development of the gas-gland in these Cystonecctae corresponds to its important physio-
logical function, since these Siphonophorae, which have no nectocalyces, descend into the depths of the ocean by expelling the gas, and ascend again by secreting gas and filling the float. We call this important new portion of the pneumatosae, which lines the inside of the air-flask (excepting its apical portion), tapetum endocystale (“Secundaeres exoderm,” Chun, 48, pp. 514, 530).

**Hypocystic Villi.**—The second peculiarity which distinguishes the air-sac of the Rhizophysidæ, Salaciaæ, and Epibulidæ, is the production of peculiar hypocystic villi (Pl. XXII. figs. 6–8, pv; Pl. XXIV. figs. 1–6, pv; Pl. XXV. figs. 1–3, pv). These remarkable apophyses of the air-funnel were first described in the Mediterranean *Rhizophysoa filiformis* by Gegenbaur (7, p. 44, Taf. xvi., fig. 6, c) and by Huxley (9, p. 6, pl. viii. figs. 14, 15); they occur not only in all Rhizophysidæ, but also in *Salacia* and *Epibulia*. From the hypocystic air-funnel, beyond the pylorus, arise eight radial bunches of clustered villi, which fill up the basal portion of the pericystic cavity, often more than half of it. The single villi, or the finger-shaped branches of the clustered bunches, are composed of a single or a few gigantic exoderm-cells (1 to 2 mm. in diameter) and of a ciliated epithelium of small endoderm-cells. Their function is probably mechanical, as an elastic cushion to protect the delicate pneumadenia and prevents its sudden compression. (Compare below the description of the float in the Rhizophysidæ, and also Chun, 47, p. 404; 48, p. 529.)

**Siphons.**—The feeding polypites or siphons in all Cystonectæ are relatively large, often of an extraordinary size. The four different segments of the siphon, which we could distinguish in most Physonectæ and Calyconectæ (pedunculus, basigaster, stomachus, proboscis), are also recognisable in many Cystonectæ, as in *Cystalia* (Pl. XXII. fig. 5) and *Salacia* (Pl. XXV. fig. 5). They are not distinguished, or at least not sharply separated, in most Rhizophysidæ, where usually each siphon is a simple cylindrical or fusiform tube, distally contractile and protractile, with strong muscular wall (Pl. XXIII. figs. 1, 2, 5; Pl. XXIV. figs. 1–3, s). Probably in all Cystonectæ the stomach, or the digestive middle part of the siphon, bears inside numerous hepatic villi, sometimes arranged in longitudinal series; but rarely there occur continuous hepatic stricte, as in *Linophysoa*. The glandular villi are often coloured brown or black by pigment-granules, especially in the Physalidæ (Pl. XXVI. fig. 6, sv). The stomach in these and in other Cystonectæ is rather distinctly separated from the proboscis, or the distal part of the siphon, without villi, with thickened muscular wall. Its distal mouth-opening may be expanded in the form of a large suctorial discus, usually of circular, more rarely of polygonal or quadrangular form. The basigaster or the basal cavity (Pl. XXVI. fig. 6, sb) is usually not separated from the stomach by a pyloric valve, and its exoderm is not strongly thickened; it passes over into the peduncle without a sharp boundary, and often this latter part is scarcely distinguishable. But sometimes the peduncle of the siphon is rather long and thin (bp). The monogastric Cystalidæ (Pl. XXII. figs. 1–5) possess only a single large siphon. All other Cystonectæ
are polygastric. The macrostelial Rhizophysidae (Pls. XXIII., XXIV.) bear a single siphon in each cormidium, as also do the brachystelial Epibulide (Pl. XXII. fig. 6). The Salaciae exhibit a bunch of several siphons in each cormidium (Pl. XXV. figs. 1–4). The Phyalide, finally, bear on the ventral side of the shortened vesicular stem a crowded group of numerous loose and polygastric cormidia, with a large number of clustered siphons; often larger and smaller polypites intermingled and arising from a common pedicle, but the smaller Physalide (Alolophota, Pl. XXVI. figs. 2, 3), and the young forms of the larger species, bear on the ventral side of the trunk a simple series of ordinate monogastric cormidia.

Protosiphon.—In many Cystonectae (or perhaps in all?) the primary manubrium of the larval medusome remains functional as the "primary feeding polypite," or the protosiphon. It is the single siphon in the Cystalidae. In all young Physalide the protosiphon, placed at the basal pole of the inflated trunk and opposed to the apical stigma, forms an independent cormidium (Pl. XXVI. figs. 2, 3, su); originally it is separated by a wide interval from the ventral group of the secondary cormidia, which arise on the ventral side of the trunk, and bear the metasiphons (or the secondary polypites). The latter alone afterwards produce gonodendra, not the former. So also in the Epibulide the protosiphon seems to remain as the basal siphon at the distal end of the trunk. Its comparison with the manubrium of the primary medusome, or the larva of the Cystonectae (Cystonula, Pl. XXII. figs. 1–4; Pl. XXVI. fig. 1), shows us that the axial trunk of the polygastric corms is only the basal part of the modified protosiphon, widely inflated in the Brachysteliace, extremely prolonged in the Macrosteliace.

Palpons.—All Cystonectae possess a great number of palpons (tasters, hydrocysts, or mouthless polypites). These are usually cylindrical or spindle-shaped tubes with a very contractile muscular wall, and a pointed and closed distal apex, often coloured. They occur in three different forms, as sexual palpons, coronal palpons, and tentacular palpons.

Gonopalpons or Sexual Palpons are generally distributed, occurring in the gonodendra scattered between the gonophores. Sometimes each branch of the clustered gonodendron bears a single gonopalpon (Pl. XXIII. fig. 8, gq); at other times several palpons (Pl. XXV. fig. 7, gq); those of the Physalide (Pl. XXVI. fig. 8, q) are distinguished by the possession of hepatic villi, which prove evidently that they are merely mouthless siphons.

Coronal Palpons occur only in two families of Cystonectae, in the monogastric Cystalideae and the polygastric Epibulide (Pl. XXII. figs. 5, 6). They form a corona around the base of the siphosome, beyond the pneumatophore, similar to that of the Discobolidae and Anthophysidae (Pls. XL, XIX.). As in these latter, the coronal palpons are not only organs of feeling and capturing, but also of protecting, and replace the absent bracts. Their pointed distal end is armed with enidocysts.

Tentacular Palpons are peculiar to one family only, the Physalide (Pl. XXVI. figs.
3–6, to), where each tentacle does not arise from the base of a siphon (as is usually the case in the Siphonanthæ) but from the base of a large palpon, which is connected by a common pedicle only with the base of the siphon. Huxley, therefore, calls these palpens not hydrocysts, but basal saes of the tentaeles (similar to the ampullæ of the ambulacral feet in Echinoderms). It may be that these basal ampullæ are only secondary diverticula of the base of the tentaele, and have the morphological value of a subordinate organ. On the other hand, it is possible that each cormidium of the Physalidæ originally bore two polypites each with a tentacle; one of these (the siphon) has preserved the mouth and the hepatic villi, but lost the tentaele; the other, conversely, has lost the former organs and preserved the latter (the palpon).

*Tentæles.*—The capturing filaments are arranged in the majority of Cystoneuctæ in the same manner as in all other Siphonanthæ, a single tentaele arising from the basal pedicle of each siphon. A single exception is formed by the Physalidæ, in which the tentaeles arise from the base of peculiar palpens, as has just been mentioned (Pl. XXVI. figs. 2–6). The tentaeles are generally long and vigorous, very musculæ tubules, sometimes simple, at other times branched. They are simple, not branched filaments in the genera *Linophyæa* (Rhizophysidæ) and *Salacia* (Salacidæ), and in all Physalidæ. In all the other genera the tentaeles are branched, and bear, usually, a single series of equidistant tentilla or lateral filaments. These latter are simple thin tubules, beset with scattered enidoblasts in the genera *Cystalia*, *Epibula* (Pl. XXII.), *Aurophyæa*, and *Nectophyæa* (Pl. XXIII.). The distal end of the tentillum is trifid (with a terminal ampulla and a pair of lateral horns) in the genera *Cannophyæa* (Pl. XXIV.) and *Pneumophyæa*. The genus *Rhizophyæa* is distinguished by the possession of two or three different kinds of tentilla; between the trifid forms being intermingled peculiar large hand-shaped or palmate tentaeles which bear an ocellus.

The enidoeysts of the tentaeles are spherical in most Cystalidæ (Pl. XXIII. fig. 7), and do not exhibit that variation in form seen in the Physonectæ. Their arrangement is variable in the various groups. Usually each tentillum bears a multiple series of enidoeysts on its dorsal side whilst the opposite ventral side is covered with palpoblasts (Pl. XXIII. fig. 6, tw). The simple tentaeles of the Physalidæ (Pl. XXVI. fig. 6, t) and of the Salacidæ (Pl. XXV. fig. 5, t) bear a long series of large reniform enidonodes on their dorsal side (compare Huxley, 9, pl. x. figs. 11, 12, &c.). Each enidonele embraces the tentacle with the concave ventral side, and bears on the convex dorsal side a cushion of enidoeysts. They develop in the same manner as the tentilla of branched tentaeles and contain a cavity, as a diverticulum of the tentacular canal. Each kidney-shaped enidonele, therefore, may be regarded as a very short and broad tentillum.

*Gonophores.*—All Cystoneuctæ possess monoeocious corms, monoeonic cormidia, and monostylic gonodendra, male and female gonophores arising from the same branched gonostyle. The peculiar form and composition of the clustered gonodendra seems to be
the same in all members of this order. The stem of the gonostyle is always richly ramified, and bears on each branch one or several sexual palpons (qq), a single gynophore or female medusome (f); and a great number of androphores or male medusomes (h). These latter become mature whilst attached to the gonodendra; they have ovate or club-shaped spermaria, with a more or less rudimentary umbrella (Pl. XXIII. fig. 8, h; Pl. XXV. fig. 7, h; Pl. XXVI. fig. 8, h).

The larger female gonophores, however, are probably always detached in the immature state from the stem, and become mature as free Anthomeduse. Their umbrella (f in the figures quoted) is well developed, campanulate or pyriform, with four radial canals and a ring-canal, and a broad velum around the ostium. The manubrium, in the wall of which the eggs ripen, seems to be developed usually after the detachment. It is not visible in the sessile gynophores, or forms only a small tubercle in the centre of the subumbrella (Pl. XXIII. fig. 8, f). The apex of the gynophore is attached to the branch of the stem by a large conical pedicle (Pl. XXIII. fig. 8, f). These pedicles remain attached to the stem of the gonodendra, when the ripe gonophores are detached. Some very large specimens of Caracella maxima, which I observed in the Bay of Algésiras (Straits of Gibraltar), in March 1867, bore voluminous gonodendra, the androphores of which were filled with ripe sperm. Some of their numerous branches possessed each a single medusiform gonophore (Pl. XXVI. fig. 8, f), whilst in other branches only its conical pedicle was visible, the campanulate umbrella having been detached (compare Chun, 86, p. 1168).

The Cystalidae, Epibulidae, and Rhizophysidæ seem to possess on each branch of the gonostyle a single sexual palpon only, corresponding to the single gynophore (Pl. XXIII. fig. 8); whilst the Salacidae and Physalidæ bear several gonopalpons on each branch. The gonopalpons of the Physalidæ are covered inside by the same black hepatic villi as the siphons, and thus prove to be modified mouthless siphons (Pl. XXVI. fig. 8, q). The sexual tasters of the Rhizophysidæ are often covered outside with peculiar cnidonodes (Pl. XXIII. fig. 8, qq).

Ontogeny.—The development of the Cystonectæ from the fertilised egg is up to this time quite unknown. The ripe eggs themselves have never been observed. The medusiform gonophores are detached early from the trunk, and the special forms of Anthomeduse, in which they produce ova, are not yet known. Very little is known also of the monogastric larvæ of the Cystonectæ (Cystonula), and of their peculiar metamorphosis. Those of Physalia were first described by Huxley (9, p. 102, pl. x. figs. 1, 2) and afterwards by Chun (83, p. 555). The Cystonula of the other families is hitherto unknown. Some light, however, may be thrown upon this complete darkness by a number of larval forms which I captured by means of the tow-net in December 1881, in Ceylon, and which are figured in Pl. XXII. figs. 1–4. Compare their description below, under that of the family Cystalidæ (p. 315).

(zool. chall. exp.—part lxxvii.—1888.)
Synopsis of the Families of Cystonectæ.

I. Suborder Cystonectæ monogastrice (Monostelinæ).

Corm with a single large siphon, representing one cormidium only. A single tentacle on the base of the siphon. A corona of palpæ around the base of the large pneumatophore. Pneumatosac without hypocystic villi.

II. Suborder Cystonectæ polygastrice.

Corm composed of numerous cormidia, each with one or more siphons and tentacles. Cormidia sometimes ordinate, at other times irregular. (Primary larva monogastric, Cystonectula.)

A. Macrosteniæe.

Trunk of the siphosome very long and thin, tubular, with prolonged internodes.

B. Brachysteiniæe.

Trunk of the siphosome short and wide, vesicular or bag-shaped, with short-ended internodes.

Cormidia monogastric, each with a single siphon and tentacle. (Pneumatosac with hypocystic villi).

Cormidia polygastric, each with several siphons and tentacles. (Pneumatosac with hypocystic villi).

Cormidia in a spiral corona around the vesicular trunk, beyond the base of the subvertical pneumatophore (with hypocystic villi).

Cormidia in a multiple series along the ventral side of the trunk, the dorsal side of which is occupied by the subhorizontal pneumatophore (without hypocystic villi).

Family XX. Cystalide, Haeckel, 1888.

Cystalide, Hkl., System der Siphonophoren, p. 44.

Definition.—Cystonectæ monogastrice, with a single large siphon and a single tentacle on the base of the large apical pneumatophore. Base of the siphon surrounded by a corona of palpæ. Pneumatosac simple, without radial septa and hypocystic villi.

The family Cystalidea comprises a single new genus of small, but very remarkable Cystonectæ, which differs from all other genera of this order in the monogastric structure of its corm. This interesting genus, Cystalia (Pl. XXII. fig. 5), exhibits therefore a relation to all the other polygastric Cystonectæ similar to that which the monogastric Circalia or Athoria (Pl. XXI.) bears to the polygastric Physonectæ.

During my residence in Ceylon I captured by the tow-net several times the elegant form, which I called in my System (95, 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.

At the first glance I had supposed that Cystalia larvalis might be only a young form.
or a monogastric larva of the polygastric *Epibulia ritteriana* (Pl. XXII. figs. 6–8). Indeed it is possible that this latter has been developed immediately from the former, or that *Cystalia* is a larva of *Epibulia*, which has reached sexual maturity only exceptionally (Paedogenesis). But comparing the structure of the pneumatophore in both similar forms, we find that the polygastric *Epibulia* possesses the eight radial clusters of hypocystic villi characteristic of the Rhizophyidae, whilst these are wanting in the monogastric *Cystalia*. In any case the fully developed state of the gonodendron in the latter justifies its position as an independent genus.

In the same month (December 1881) in which I captured *Cystalia larvalis* off the coast of Ceylon, I took by the tow-net a number of young larvae of *Siphonanthas*, which I supposed at the first glance to be the larvae of some Physonect, perhaps an Agalmaid. The most important stages of them are figured in Pl. XXII. figs. 1–4. Comparing them with the larvae of the Agalmaid *Cupulita*, which Metschnikoff has described as *Stephanomia pictum* (85, Taf. xii.), we find a great likeness between these larvae. The youngest larva observed (fig. 1) exhibits a spindle-shaped gastrula, composed of a large-celled entoderm (*d*) and a small-celled ciliated exoderm (*e*), with the invagination of the pneumatophore on the apical pole. In the second stage (fig. 2) the medusiform body is divided by a transverse annular constriction into a proximal and a distal portion; the superior portion is the rudimentary umbrella with the pneumatophore (already containing a gas-bubble); the inferior portion is the primary siphon, from the base of which arises a single tentacle. In the third stage (fig. 3) the distal mouth of the siphon is open, and from its base, opposite to the dorsal tentacle, arises in the ventral side the first bud (*f*), probably of a palpon. The fourth and last stage observed (fig. 4) exhibits the number of buds augmented (as the beginning of a corona of palpons?), and the single tentacle beset with a series of simple filiform tentilla (*ts*).

Since I was not able to recognise the origin of these pelagic larvae, nor to follow their further development, the question remains open, whether they were produced by a Physonect or a Cystoneect. In the latter case they may possibly have been derived either from *Cystalia* or from the closely allied *Epibulia*.

*Cormidium*.—The central or axial portion of the single cormidium, which represents the entire adult corn of *Cystalia*, must be regarded as an individual medusome, the modified umbrella of which is the pneumatophore (*p*) and the manubrium the siphon (*s*). The base of this latter bears a single tentacle on its dorsal side, a single large gonodendron (*gd*) on its ventral side. The short tubular pedicle of the siphon which connects it with the base of the float represents the axial trunk of the corn, and has produced by budding the corona of palpons, which are expanded between them. The gonodendron itself is the sexual portion of the single cormidium, composed of numerous male and female gonophores, each of which is a modified medusome.

Comparing the single parts of the corn with the similar parts of related Siphono-
phore, we find resemblances to different families. The pneumatophore resembles by its simple structure that of the Athoride and Apolemidae, and that of the young Physalidae (Alophota, Pl. XXVI. figs. 1, 2); the perieystic cavity is simple and has not the radial pouches of most Physonects, nor the hypocystic villi of the Rhizophysidae and Epibulidse. The corona of palpons between float and siphon is similar to that of Epibulia (Pl. XXII. fig. 6), and also to that of the Discolabidae and Anthophysidae. The single tentacle, with its series of simple filiform tentilla, resembles that of Epibulia and Nectophyse (Pl. XXII. figs. 5, 6). The structure of the single siphon, with its hepatic villi, and of the monoclinic gonodendron, is the same as in the Rhizophysidae and Physalidae.


Cystalia, Hkl., System der Siphonophoren, p. 44.

Definition.—Cystalia with a tentacle, which bears a series of simple filiform tentilla. A single large monostylid gonodendron is attached to the base of the single siphon.

The genus Cystalia, as the only known form of monogastric Cystalidae, exhibits the peculiar structure described above of this family. Supposing that other genera, belonging to it, may sometimes be observed, we assume as a generic character of Cystalia the structure of the single tentacle, which is similar to that of Aurophysa, Nectophyse, and Epibulia. It bears a series of simple lateral branches, which remain cylindrical filaments, without terminal appendages. On the medusiform larvae (Cystonula, Pl. XXII. figs. 1-4), which may perhaps belong to this genus, compare p. 315.

Cystalia monogastrica, n. sp. (Pl. XXII. figs. 1-5).

Cystalia larvalis et Cystalia challengeri, Hkl, 95, p. 44.

Habitat.—South Pacific; Station 288, October 21, 1875; lat. 40° 3' S., long. 132° 58' W.; surface.

Indian Ocean, Ceylon, Belligemma, December 1881 (Haeckel).

Corm (fig. 5).—The monogastric corm, represented in fig. 5 in the expanded state, has a length of 10 to 12 mm. It is to be regarded as a single cornidium, composed of a sterile axial medusome and two groups of peripheral medusomes, sterile palpons and fertile gonophores. The large axial medusome consists of a pyriform pneumatophore and a large spindle-shaped siphon, with a single tentacle; the siphon corresponds to the manubrium, and the float to the modified umbrella of the original Medusa. The short pedicle of the siphon, which connects it with the base of the float, may be regarded as the axial trunk of the corm, from which the corona of palpons as well as the large ventral

\footnote{Cystalia = Sea-bladder, *ὑφαντ, *φλώρ.}
gonodendron are produced by budding. Each branch of the gonostyle is a secondary cormidium, composed of a sterile distal palpon, a large female medusome, and a group of clustered small medusomes.

Pneumatophore (fig. 5, p).—The float is pyriform, 3 mm. long and 2 mm. broad, with a red pigment-cap in the apical third. The enclosed pneumatocyst is subspherical, 1-2 to 1-5 mm. in diameter; it fills the upper or apical portion of the air-sac, which is separated by an annular diaphragm (pylorus infundibuli) from the spheroidal lower or basal portion, the air-funnel. This is lined by the greenish hypocystic tapetum, which also enters by the pylorus into the cavity of the air-flask and lines its basal third as endocystic tapetum. No radial septa or villi arise from the air-funnel.

Siphon (fig. 5, s).—The single siphon of the monogastric cormidium is spindle-shaped, 6 to 9 mm. long and 2 to 3 mm. broad. Its ampullaceous basal portion (basigaster) is attached by a short pedicle to the base of the pneumatophore. The dilated middle portion, or the stomach, is covered inside with numerous yellowish-brown hepatic villi (sh). The thin tubular proboscis (sr) is very muscular and opens by a mouth, which may be expanded in the form of a circular sectorial disc (ss).

Tentacle (fig. 5).—The single tentacle (t) which arises from the base of the siphon, on its dorsal side, is a slender cylindrical tube, beset with a series of tentilla. These are simple cylindrical filaments, and bear on their dorsal side a multiple series of cnidocytes; the structure is similar to that of Nectophyusa (Pl. XXIII. figs. 5, 6).

Palpons (fig. 5).—The corona of rose-coloured tasters which protects the siphosome is attached to its base, immediately beyond the nectosome. It is composed of about thirty spindle-shaped palpons, besides the small buds of young ones. Their pointed distal end is closed, whilst the proximal end of their cavity communicates with the pedicular canal of the siphon.

Gonodendron (fig. 5, gd).—The single large clustered gonodendron, which is attached to the base of the siphon, on its ventral side, is similar to that of the Rhizophysidae. The gonostyle is richly branched, and each ultimate branch bears a single gonopalpon on its distal end (Pl. XXIII. fig. 8, gg), and above it a single medusiform gynophore (f) and a cluster of several (four to eight) ovate androphores (h).

Family XXI. Rhizophysidae, Brandt, 1835.

Rhizophysidae, Brandt, Prodromus descriptionis, &c., 25, p. 33.

Definition.—Cystonectae polygastricae, with a long tubular trunk of the siphosome, bearing in its ventral median line numerous monogastric cormidia, separated by free internodes. Each cormidium with a single siphon and a single tentacle. Pneumatosacs large, without radial septa and pericycstic radial pouches, but with eight or more radial groups of hypocystic villi.
The family Rhizophysidae comprises all Cystonecæ polygastricea with a long tubular stem, bearing numerous monogastric cormidia. The trunk of the corm is a prolonged and very contractile tube, as in the succeeding Salacidæ; but the cormidia of these latter are polygastric. Many different species, and mainly deep-sea forms of gigantic size, seem to belong to this interesting family; but only a few species have been described hitherto with sufficient accuracy. All species have been united up to this time in a single genus, *Rhizophysa*.

The oldest known form of Rhizophysidae is the Mediterranean *Rhizophysa filiformis*, described as early as 1775 by the first author on Siphonophora, Forskål, under the name *Physophora filiformis* (11, p. 120, Tab. xxxiii. fig. F). A similar species from the Atlantic was figured in 1807 by Péron and Lesueur under the name *Rhizophysa planostoma* (14, pl. xxix. fig. 3). A third species of the same genus was observed in 1827 by Mertens in the Northern Pacific, and described by Brandt in 1835 as *Epibulia mertensii* (25, p. 33). Unfortunately Mertens' excellent figure, drawn from life and exhibiting distinctly the characters of the genus *Rhizophysa*, has never been published. Brandt established for these forms the family Rhizophysidae (loc. cit., p. 33).

The first accurate anatomic description was that given in 1854 by Gegenbaur of the Mediterranean *Rhizophysa filiformis* (7, p. 324; 10, p. 78). It was afterwards supplemented by Huxley (9, p. 90), Fewkes (41, p. 292), and especially by Chun (47, p. 404; 48, p. 529; 86, p. 1169). Two new genera of this family, Cannophysa and Nectophysa (Pls. XXIII., XXIV.), were observed by me in 1866 off the Canary Islands. Two other genera, Aurophysa and Linophysa, both inhabiting the deep sea, were described in 1878 by Studer as species of *Rhizophysa* (40, p. 4, Taf. i.).

**Truncus.**—The common stem of the corm is in all Rhizophysidae a very long and slender cylindrical tube; its contractility is so great that, in the expanded state, it may be ten to twenty times as long as in the contracted state (compare Pl. XXIII. figs. 1–3 and Pl. XXIV. figs. 1–3). At the same time it is so sensitive that a slight touching of the stem is sufficient to effect suddenly its strongest contraction. The wall of the tubular trunk is rather thick, with a thin layer of circular muscles arising from the cutoderm, and a thick layer of longitudinal muscles arising from the exoderm; the latter are arranged, as usual, in parallel bundles along the radial folds of the fulerum, which separates the two layers. The exoderm is often coloured yellowish, rose, or brown.

**Cormidia.**—The numerous cormidia, which arise from the long tubular stem of the corm, exhibit in the Rhizophysidae (as in the Agalmidae) a double shape and arrangement, according to which two subfamilies may be separated, the Cannophysidae and Nectophysidae. The Cannophysidae (Pl. XXIV.) possess ordinate cormidia, which are separated by long, free, and naked internodes of equal length (similar to those of the Stephanomidae); each cormidium is composed of a siphon, a tentacle, and a gonostyle;
this latter is branched and bears numerous clustered gonodendra, each of which is again composed of a gonopalpon, a large female gonophore, and a variable number of smaller male gonophores. The Nectophyidae, on the other hand (Pl. XXIII.), have loose cormidia (similar to those of the Halistenmidae); the gonostyles are not attached to the trunk at the basal insertion of the siphons, but separated from them on the internodes; sometimes a single gonodendron in the middle between each two siphons (*Nectophyse, &c.*), at other times two to four or more gonodendra.

*Pneumatophore* (Pl. XXIII. figs. 1-4, p; Pl. XXIV. figs. 1-7, p).—The float filled with air is in all Rhizophyidae relatively large, much larger than in the Physonectae; its form is variable, usually ovate, ellipsoidal or pyriform. Its central axis is sometimes vertical, usually more or less inclined, at other times almost horizontal. The pneumatocodon, or the outer wall of the float (p), is separated from the pneumatosacculus, or the inner wall, by a wide cavity, which often occupies nearly the half of the pneumatophore, or even more. This pericystic cavity is closed above (where the two walls of the float are connected on its top), and opens below into the axial canal of the trunk; its greater part is filled up by clusters of large branched villi, the radial apophyses of the pneumadenia.

*Pneumatosacculus.*—The invaginated part of the exoderm, which we call pneumatosac, hangs freely in the pericystic cavity, and is not connected with it by radial septa (as in most Physonectae). It is connected with the pneumatocodon only at its top, where it opens by the apical stigma (po). The simple wall of the young pneumatosac (comparable to the invaginated entoderm of a gastrula) is divided in the adult Rhizophyidae into five different parts, viz.:—(1) A mitra ocellaris or an apical pigment-cap; (2) the pericystic sac, enclosing the air-flask; (3) the hypocystic funnel; (4) the hypocystic radial bunches of villi arising from the funnel; and (5) the endocystic tapetum ("secondary exoderm"). This latter lines the greater part of the inside of the chitinous pneumatoecyst.

*Pneumatoecyst.*—The chitinous air-flask or pneumatoecyst is originally the cuticle of the young pneumatosac. It is ovate, spindle-shaped or cylindrical, and opens at both poles of its longitudinal axis; the inferior opening is the pylorus infundibuli, which leads into the funnel-cavity of the pneumadenia; the superior opening is the apical stigma, through which the air may be emitted at will from the cavity of the pneumatoecyst (Pl. XXIII. fig. 3, x). This stigma, or the apical opening of the float (Pl. XXIV. figs. 4, 5, po), may be opened by a corona of radial muscles (pu) and closed by a sphincter composed of ring-muscles (pm).

*Mitra ocellaris.*—The pigment-cap of the float, or the mitra ocellaris (Pl. XXIII. fig. 3, pp; Pl. XXIV. figs. 4, 5, pp), occupies sometimes nearly the upper half, at other times only the uppermost third or fourth of the pneumatosac, and is composed of elegant polygonal pigment-cells, separated by colourless intervals. The colour is usually red or
brown, sometimes more orange, at other times more violet or even black. The inferior margin of the hemispherical or campanulate pigment-cap is usually separated by a sharp circular boundary-line from the colourless or yellowish middle portion of the air-sac (Pl. XXIV. fig. 5, pp).

Sacculus pericystalis.—The greater middle part of the pneumatosae is a simple layer of exodermal epithelium, and produces the pneumatozyst as a true cuticle; it ends, together with this latter, on the pylorus infundibuli, or the opening by which the air-flask communicates with the funnel-cavity; the terminal edge of the cuticle which surrounds this circular pylorus is usually a thickened chitinous ring (annulus infundibuli).

Pneumatozyst (infundibulum pneumatophori, “Lufttrichter,” Chun, 48, p. 512).—The distal or basal part of the original pneumatosae situated below the pylorus is the important pneumatozyst or the “hypocystic funnel.” The thickened glandular epithelium which lines its cavity is very different from that of the pericystic sac. It produces no cuticle, but is composed of several layers of polyhedral exoderm-cells, which have a rather dark granular protoplasm and a peculiar yellowish or more greenish appearance (Pl. XXIV. fig. 7). From this ovate, hemispherical, or nearly spheroidal “air-funnel” arises inside, the endoeystic tapetum, and outside, the clustered groups of hypocystic villi (Pl. XXII. fig. 7).

Tapetum endocystale (“secondary exoderm,” Chun, 48, pp. 514, 530).—The exodermal tapetum which lines inside the basal half of the pneumatozyst (in young Rhizophysidae the basal third, in adult more than two-thirds) is the direct continuation of the hypocystic funnel, and its function is, like that of the latter, the secretion of gas; both together represent the “pneumadenia,” or the gas-secreting gland. The stratified exoderm of the air-funnel grows upwards, passes through the chitinous ring of the funnel-pylorus into the cavity of the pneumatozyst and lines the greater part of its inside, with the exception of the apical part which is covered by the mitra ocellaris. The endoeystic tapetum is composed of several strata of the same peculiar granular and yellowish or greenish exoderm-cells, as those which line the funnel-cavity and are polyhedral by mutual compression (Pl. XXII. fig. 7, pd; Pl. XXIV. fig. 7, pd).

Villi hypocystales (Pl. XXIV. figs. 4, 5, pv, 6).—The basal portion of the pericystic cavity, and often its greater part (with the exception of the apical portion), is filled with bunches of clustered villi, which arise from the outside of the hypocystic funnel. They were first described by Gegenbaur (in 1854) as “caecal diverticula” of the pneumatozyst (“blinddarmähnliche Fortsätze,” 7, p. 326, Taf. xvii. fig. 6, c). Huxley (in 1859) described them as “elongated and more or less branched processes, which project from the distal surface of the pneumatozyst freely into the cavity of the pneumatophore; each process consists of a cellular axis, invested by the ciliated entoderm. The cells of the axis are clear and very large, and have an opaque oval
nucleus" (9, p. 6, pl. viii. figs. 14, 15). This good description of Huxley was not improved by later authors, who regarded the hypocystic villi as tubes or utriculi. Fewkes (in 1882) describes them as "finger-like pouches, which are sometimes bifurcated at their extremities and open at their distal ends, so that their cavities seem to freely communicate with that of the float" (44, p. 269, pl. vi. fig. 2). The most accurate description was afterwards given by Chun, who regards their physiological function as mechanical; they may serve as elastic cushions or bolsters, which protect the delicate pneumadenia covered by them, and prevent its sudden compression, when the stem is rapidly contracted (47, p. 404; 48, p. 529). My own observations on the structure and development of these interesting villi, made in Lanzerote (1887), and continued in Ceylon (1881), are in complete accordance with those of Chun. The hypocystic villi are always arranged in eight radial bunches which arise from the outside of the air-funnel; each villus, or each finger-like branch of the dichotomously-branched villi, consists of a single giant-cell, or a few (two to four, rarely more) giant-cells, which reach a diameter of one to two millimetres, and belong, therefore, to the largest cells of animal tissues; the nucleus of these vesicular and vacuolated exoderm-cells is ovate or cup-shaped, and has a diameter of 0·1 to 0·2 mm. The surface of the villi is covered with a vibratile epithelium, composed of small entoderm-cells with long cilia (Pl. XXIV. fig. 6). In the youngest Rhizophysidae there are only eight single club-shaped giant-cells, which arise from the pylorus infundibuli; they correspond to the base of the eight radial apophyses of the air-funnel, which pass into the radial septa dividing the cavity of the pneumatophore into eight radial pouches in many Physonectae (e.g., Discolabidae, compare above, p. 187). Afterwards arises a second corona of eight radial giant-cells from the distal base of the hypocystic funnel, and a third corona between the former and the latter (48, p. 530). By dichotomous ramification of these twenty-four giant-cells and further development of lateral branches arises the large elastic cushion, composed of numerous finger-like villi, which envelopes in the adult Rhizophysidae the greater part of the pericystic cavity and hangs down into the apical part of the stem-canal (Pl. XXIII. figs. 3, 4; Pl. XXIV. figs. 4, 5).

Siphons.—The feeding polypites are in the Rhizophysidae usually of considerable size, sometimes very large, 4 to 8 centimetres long, or more, in the expanded state. The four segments of the siphon which are usually distinct in the majority of Siphonophora are rarely evident in this family; in the majority they are not distinct or not recognisable at all, so that the whole siphon is a simple cylindrical or spindle-shaped tube (Pl. XXIII. fig. 5; Pl. XXIV. figs. 1–4). Sometimes, however, especially in the peculiar Linophysa, the four segments are distinctly marked:—(1) A small pedicel to which the tentacle is attached; (2) a large ovate basigaster, the exoderm of which is full of cnidocysts; (3) a wide stomach with coloured hepatic glands; and (4) a very contractile tubular proboscis, with the tubular mouth-opening (40, p. 9, Taf. i. fig. 4). The thick wall of

(zool. chall. exp.—part lxxvii.—1888.)
the tubular siphon is always very extensible and contractile, provided with strong longitudinal and circular muscles. The entoderm of the stomach usually bears very numerous and small hepatic villi, containing pigment-granules and clear glandular vacuoles; rarely the hepatic glands are arranged into eight or sixteen longitudinal series, and form coloured "liver-ridges," as in Linophysea. The distal mouth is always very dilatable, and may be expanded in the form of a large circular suckorial disc (Pl. XXIII. fig. 5; Pl. XXIV. fig. 1).

Tentacles.—The long tubular tentacle which arises from the base of each siphon, on its superior or dorsal side, is rarely a simple, unbranched filament, similar to that of Apolemia, as in Linophysea (40, Taf. i. fig. 1). In all other known genera it is beset with a series of numerous equidistant tentilla or unilateral branches. These tentilla exhibit in the various genera of Rhizophysidae similar differences in form and structure to those seen in the Agalminae among the Phynseetidae, although a true enidosae (as in the latter) is not developed. The tentilla are simple tubular filaments, with a unilateral series of cnidocysts, in Awophysea and Neetophysea (Pl. XXIII. figs. 1–6); usually the axial or ventral side of the tentillum is beset with several rows of sensitive palpoblasts (fig. 6, tw), the abaxial or dorsal side with some series of spherical cnidoblasts (fig. 6, ke). The genera Cannophysea and Pneumophysea are distinguished by trifid tentilla (Pl. XXIV. figs. 8, 9); their distal end bears an odd terminal vesicle (fig. 9, ta) and two paired lateral horns (fig. 9, te); these are armed in different ways with cnidonodes or roundish groups of spherical endocyst. Rhizophysea, finally, is distinguished by the compound structure of the tentacles which bear two, three, or more different kinds of tentilla; these are partly simple, partly trifid or branched; and usually there are scattered between them a small number of very large and remarkable appendages, first described in the Mediterranean Rhizophysea filiformis by Gegenbaur (7, Taf. xviii. figs. 7–9). They are flat, palmate, or hand-shaped leaves, dichotomously branched at the free distal margin, each branch provided with a spherical endocyst. In the similar Atlantic Rhizophysea planostoma (Péron), I observed in December 1866 similar but larger appendages, which bore in the middle of their upper or outer side a large purple ocellus; a pigment-ring with a strongly refracting globule in the centre. I suppose that this globule is a lens, and the ocellus a true eye.

Gonostyles.—Each cormidium of the Rhizophysidae bears usually a single, clustered and monoedrine gonodendron only; this is attached to the node of the stem, immediately beyond the basal insertion of the siphon, in the ordinate cormidia of the Cannophysea (Pl. XXIV.); whilst it is attached to the internodes of the stem, between the siphons, in the loose cormidia of the Linophysea, where usually the siphons and gonodendra alternate regularly, in equal numbers (Pl. XXIII. figs. 1–3); but sometimes the number of gonodendra is augmented (in Rhizophysea), so that a variable number of gonostyles (two to four or more) arises from the internode between every two siphons; in some species
they are irregularly scattered. The gonostyle, or the axial stem of each gonodendron, is more or less branched, in the larger species with very numerous branches; each branch is monostylic and exhibits the same structure (Pl. XXIII. fig. 8), as is common to all Cystonectae (compare above, p. 313). The distal end of the branch bears a spindle-shaped palpon with numerous cnidocysts (fig. 8, gg), and at its base a single large medusiform gynophore (f) surrounded by a corona of club-shaped androphores (h).

Synopsis of the Genera of Rhizophysidae.

I. Subfamily Cannophysidae.

Cormidia ordinate, separated by free internodes. Gonostyles attached to the stem immediately on the base of the siphons.

{ Tentilla simple, not branched, . . . . 66. Aurophysa.

{ Tentilla trifid, with three terminal branches, . . . . 67. Cannophysa.

II. Subfamily Linophysidae.

Cormidia loose. Gonostyles attached to the internodes of the stem, scattered between the siphons.

{ Tentacles simple, without tentilla; or with simple, unbranched tentilla.

{ Tentacles always with a series of tentilla, all or some of which are branched.

{ Tentilla wanting, tentacles simple, . . . . 68. Linophysa.

{ Tentilla simple, unbranched, . . . . 69. Nectophyse.

{ Tentilla all trifid, with three terminal branches, . . . . 70. Pneumophysa.

{ Tentilla polymorphous, partly simple, partly branched or palmate, . . . . 71. Rhizophysa.


Aurophysa, Hkl., System der Siphonophoren, p. 44.

Definition.—Rhizophysidae with ordinate cormidia and free internodes of the stem, the gonostyles being attached on the base of the siphons. Tentilla simple, unbranched.

The genus Aurophysa comprises those Rhizophysidae which may be regarded as the oldest and simplest forms of that family. The long tubular stem is divided into numerous equidistant nodes; attached to each node is an ordinate cormidium, composed of a siphon with its tentacle and a monostylic gonodendron. The long internodes between the cormidia are naked, as in Apolemia and the polygastric Calyonecete. Aurophysa agrees in this important character with the following Cannophysa (Pl. XXIV.); both genera together represent the subfamily Cannophysidae. Aurophysa differs, however, from Cannophysa in the form of the tentilla, which in the former are simple cylindrical filaments (as in Nectophyse, Pl. XXIII.), in the latter trifid, with three terminal branches. I observed an interesting species of this genus, Aurophysa ordinata, in December 1881, in the Indian Ocean, on the coast of Ceylon (off Colombo);
the apical stigma of the pyriform pneumatophore was surrounded by a brown pigment-star with eight rays; the siphons were orange coloured, and the clustered gonophores, attached near to their base, yellowish, the long tentacles similar to those of *Nectophysea* (Pl. XXIII. figs. 5, 6). Very similar is *Rhizophysea incravis*, Studer (40, p. 13, Taf. i. figs. 3, 8, 9, 10), taken in the eastern part of the Indian Ocean, south of Sumatra (lat. 11° 18′ S., long. 120° 8′ E.). Studer tells us that this deep-sea form has no tentacles, but he describes and figures tentacles with a series of simple tentilla (fig. 10), apparently attached one to the base of each gonophore. I have no doubt that this was the usual tentacle, arising from the base of the siphon, strongly contracted and twisted around the base of the neighbouring gonophore.


*Cannophysa*, Hkl., System der Siphonophoren, p. 44.

**Definition.**—Rhizophysidae with ordinate cormidia and free internodes of the stem, the gonostyles being attached at the base of the siphons. Tentilla trifid, with three terminal branches.

The genus *Cannophysa* has the same ordinate cormidia as the preceding closely allied *Aurophysa*. It differs in the structure of the tentacles and the form of the tentilla, which are not simple lateral branches of the former, but each provided with three terminal appendages at the distal end. *Cannophysa*, therefore, bears the same relation to *Aurophysa* as in the following sub-family (Linophysidae) *Pneumophysea* has to *Nectophysea*. A beautiful species of this genus was observed by me in January 1867 in the Canary Island Lanzerote; it is described in the following pages (Pl. XXIV.) as *Cannophysa murrayana*, and dedicated to my honoured friend Dr. John Murray. A similar species, differing in the special form of the pneumatophore and the tentilla, was found in the Tortugas, near Florida, and described in 1882 by Fewkes as *Rhizophysea gracilis* (44, p. 269, pl. vi. figs. 1–6).

*Cannophysa murrayana*, n. sp. (Pl. XXIV.).

**Habitat.**—North Atlantic, Canary Islands, Lanzerote, January 7, 1867 (Haeckel).

**Corm.**—Two living specimens, both very movable and integral, were captured by me in a current off Puerto Arrecife; the smaller was a young specimen without gonophores, and is figured in the expanded state, swimming with snake-like motion, in fig. 3 (twice natural size); the larger was a fully developed specimen with ripe gonophores, and is figured in the contracted state with spirally coiled up stem in fig. 1 (in profile), and fig. 2 (from above), slightly enlarged. The fully expanded corm attained a length of

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1 *Cannophysa* = Tube-bladder, κάμης, κάμη. 
300 to 400 mm. or more, but when contracted measured only 20 to 30 mm. The long and slender stem is a cylindrical tube scarcely 1 mm. in diameter when contracted, 2 or 3 mm. when expanded. It bears a series of ten to twelve fully developed cormidia in the larger specimen, besides numerous buds of young ones on the top of the stem, below the float. The ordinate cormidia are separated by naked internodes of equal length, the colour of the stem and the gonodendra is bright yellow, of the siphons and tentacles rose.

Pneumatophore (figs. 1-3, p, fig. 4, in profile; fig. 5 from above).—The large ovate or pyriform float has when contracted a length of 6 mm. and a breadth of 3 mm.; in the expanded state more than double this. Its thick-walled pneumatocodon (or outer wall) is separated by a wide cavity from the pneumatosac (or inner wall); this cavity (the pericystic chamber) is closed above and opens below into the axial canal of the trunk; its greater part is filled up by clustered groups of finger-shaped villi, which arise from the hypocystic funnel (fig. 4, pv). The large exodermal giant-cells which compose these villi reach the enormous size of 1:5 to 2 mm.; the surface of the villi is covered with a simple layer of ciliated entoderm cells (fig. 6). The thin chitinous wall of the cuticular pneumatocyst is covered outside by the simple exoderm-layer of the pericystic pneumatosac, inside by the thick yellowish-green endocystic tapetum (fig. 4, pf); this is composed of several strata of polyhedral exoderm-cells, filled with greenish granules (fig. 7). The endocystic tapetum is wanting only in the uppermost third or fourth of the pneumatosac, which is covered outside by a hemispherical or cap-shaped mitra ocellaris (figs. 4, 5, pp). Above this mitra, which is composed of red polygonal pigment-cells, are visible the radial muscles (pm) and the circular muscles of the sphincter (pn), which closes the stigma, or the apical opening of the pneumatosac (fig. 5, po). (For the special structure of the pneumatophore, compare above, p. 308.)

Siphons (figs. 1-4, s).—The feeding polypites are large cylindrical tubes of rose-colour, which open outside by the distal mouth, inside by the small proximal pedicle into the trunk. The thick muscular wall is very extensible and contractile, as is also the mouth, which may be expanded in the form of a circular sectorial disc. Distinct segments are not visible on the siphon; the greater part of its inside is covered with small and very numerous hepatic villi.

Tentacles (fig. 8).—The large cylindrical and rose-coloured tentacle, which is attached to the base of each siphon on its dorsal side, bears a series of very numerous tentilla; their size increases gradually towards the distal third of the tentacle; this third is a simple, thick, cylindrical tube, spirally coiled up, more deeply coloured, and covered with small papille, but without tentilla. The lateral branches are small and simple in the proximal part of the tentacle, trifid in the middle part. Each fully developed tentillum bears at the distal end an odd thick median club (fig. 9, ta) with a short terminal filament (tf); and on both sides of it a pair of slender cylindrical lateral horns (te). Each of these three terminal appendages contains two rose-coloured cnidonodes, composed of
spherical cnidocysts, a proximal and a distal. The cnidocysts, which are contained in the middle ampullaceous dilatation of the odd median club (ta), are twice as large as those in the five other cnidodendrons. The three terminal branches of the tentillum are solid, rather rigid cylinders, composed of a single column of large hyaline entoderm-cells, with a thin exodermal envelope similar to those of many hydropolyps and of the Narcomeduse. The canal of the tentillum ends at the base, from which the three branches arise; its surface is covered with papillae (fig. 9, ts).

Gonodendra (figs. 1, 2, g).—The single large gonodendron, which is attached to each node of the stem, immediately beyond the insertion of each siphon, has a bright golden-yellow colour. It is like a group of clusters and is composed of numerous smaller gonodendra (of the second and third order), the gonostyle being richly ramified. Each smallest group (or secondary gonodendron) is composed, as usual, of a single medusiform gonophore and a corona of club-shaped androphores, with a distal (rose-coloured) palpon. (Compare Pl. XXIII. fig. 8, and pp. 313, 328.)

Genus 68. Linophysa,¹ Haeckel, 1888.

Linophysa, Hkl., System der Siphonophoren, p. 45.

Definition.—Rhizophysidae with loose cormidia, the gonostyles being attached to the internodes of the stem, between the siphons. Tentacles simple, without tentilla or lateral branches.

The genus Linophysa is represented by a single species only, inhabiting the depths of the Atlantic between 800 and 1600 fathoms, and captured several times by Studer, who described it under the name Rhizophysa conifera (40, p. 4, Taf. i. figs. 1, 2, 4, 7, 13–18). It differs from all other Rhizophysidae in the simple form of the long tubular tentacles, which bear no tentilla or lateral branches. The siphons possess sixteen black liver-ridges (while the other Rhizophysidae possess hepatic villi). The strobiliform gonostyless seem to alternate with the siphons, the cormidia being loose. Each gonostyle bears, like a fir-cone, a spiral row of imbricated gonodendra, each covered by a scale (gonopalpon?). These and other structures described by Studer are so peculiar that Linophysa conifera may be perhaps the type of a separate family—Linophysidae.

Genus 69. Neetophyusa,² Haeckel, 1888.

Neetophyusa, Hkl., System der Siphonophoren, p. 45.

Definition.—Rhizophysidae with loose cormidia, the gonostyles being attached to the internodes of the stem, between the siphons. Tentacles branched; tentilla simple, not branched.

¹ Linophysa = Filament-bladder, χύνα, φύσα.
² Neetophyusa = Swimming-bladder, ναύτης, φύσα.
REPORT ON THE SIPHONOPHORÆ.

The genus *Nectophysa* resembles *Aurophysa* in the structure of the tentacles, and has the same simple tentilla in the form of slender cylindrical filaments. It differs, however, in the composition of the cormidia, which are not ordinate, but loose; the gonostyles are not attached to the base of the siphons, but alternate with them and are scattered along the stem. A beautiful species of this genus was observed by me, in December 1866, in the Canary Island Lanzarote, and is described in the following lines (Pl. XXIII.) as *Nectophysa wyvillei*, dedicated to the memory of Sir Wyville Thomson. Another closely allied species seems to be *Rhizophysa eysenhartii*, described by Gegenbaur (10, p. 78, Taf. xxxi. figs. 46–49).

*Nectophysa wyvillei*, n. sp. (Pl. XXIII.).

*Habitat.*—North Atlantic; Canary Islands, Lanzarote, December 26, 1866 (Haeckel).

*Corm.*—The long cylindrical stem has a rose-coloured exoderm, a yellowish entoderm, and in the fully expanded state (figs. 1, 2) a length of 300 mm. or more and a thickness of about half a millimetre; in the contracted state, and spirally coiled upon itself (with a dexiotropic spiral, fig. 3), it is much thicker (2 or 3 mm.); but its length is only 10 to 20 mm. The circular as well as the longitudinal muscles are strongly developed. The specimen figured in fig. 2 bore about a dozen fully developed siphons, besides some younger ones on the apex; and regularly alternating with them, midway between each two siphons, a large gonodendron. The general colour of both is rose.

*Pneumatophore* (figs. 1–4, p).—The float exhibits the same structure as is described above of *Cannophysa murrayana* (compare pp. 308 and 325, and Pl. XXIV. figs. 1–7). In the fully expanded state it was pyriform or ellipsoidal, in the contracted state subspherical. As the corm was irritated, and the stem much contracted (fig. 3), the pneumatocyst was constricted in its equator, and a large air-bubble (fig. 3, a) escaped from the opened apical stigma (pv); the animal sank down to the bottom of the glass vessel, and some time afterwards was again expanded, the siphons being partly attached by a suctorial mouth-dise to the bottom (fig. 2). The apical half of the pneumatocoele is covered by a violet mitra ocellaris (fig. 3, pp), whilst the distal half of the large pericystic cavity was filled with numerous hypocystic villi (pv) arising from the air-funnel. In the highest state of contraction of the stem, after the total expulsion of air from the pneumatocyst, the clustered villi were all pressed downwards into the dilated apical portion of the stem (fig. 4, pv). (Compare p. 310.)

*Siphons* (figs. 1–4, 8, 5).—The feeding polypites are in the contracted state short rose-coloured spindles, in the expanded state cylindrical tubes 15 to 20 mm. in length, 1 to 2 mm. in breadth. Their thick muscular wall is very expansible and contractile, the inside covered with numerous small hepatic villi. No different segments
can be distinguished. The distal mouth is often expanded in the form of a large circular suctorial disc.

*Tentacles* (figs. 1, 2, 5, 7).—The long and very expansible tentacle which arises from the base of each siphon (on its upper or dorsal side) is a cylindrical tube of rose-colour, purple at the distal end, beset with a series of very numerous simple lateral branches; their length increases gradually from the proximal to the distal end. These tentilla are thin cylindrical filaments with a simple rounded distal apex. Their canal is excentric, since the thickened dorsal wall is filled with spherical endocysts (figs. 6, kc, 7), whilst from the thinner ventral wall arise numerous conical papillae, each of which bears a palpocil or a feeling bristle (fig. 6, tw).

*Gonodendra.*—The single gonodendron, which hangs down like a pediculate cluster of grapes from each internode, midway between each two siphons, is rose-coloured and composed of numerous secondary and tertiary gonodendra. Each of the latter (fig. 8) is composed of a single large medusiform gynophore (f) and a corona of five to ten (usually seven or eight) ovate androphores (h) around its base; the distal end is occupied by a large, very movable, spindle-shaped palpon (gg). Each branch of the gonostyle bears two or three pairs of opposite secondary branches.

Genus 70. *Pneumophysa.,* Haeckel, 1888.

*Pneumophysa,* Hkl., System der Siphonophoren, p. 45.

Definition.—Rhizophysidae with loose cormidia, the gonostyles being attached to the internodes of the stem, between the siphons. Tentacles branched; tentilla trifid, with three terminal branches.

The genus *Pneumophysa* differs from the preceding *Nectophyca* in the form of the tentilla, which are not simple tubular filaments, but provided with three terminal appendages similar to those of *Cannophysa* (Pl. XXIV. figs. 8, 9). The odd median appendage is larger and ampullaceous, whilst the two paired lateral horns are smaller and slender. The cormidia are not ordinate, as in *Cannophysa,* but loose, so that a single gonodendron is attached to each internode of the stem midway between two siphons (almost as in *Nectophyca,* Pl. XXIII. figs. 1–3). The single known species of this genus, *Pneumophysa gegenbauri,* was observed by me in December 1881 in the Indian Ocean, and will be described on another occasion. A second species, similar to this, was noticed in my System der Siphonophoren (95, p. 45) as *Pneumophysa mertensi* (= *Epibula mertensi,* Brandt, 25, p. 33). But a closer examination of the excellent figures which its discoverer, Mertens, has left of this species, taken in the Tropical Pacific, has convinced me that it belongs to the following genus, *Rhizophyca.*

1 *Pneumophysa* = Air-bladder, πνεύμα, έδρα.
Genus 71. Rhizophysea, Péron et Lesueur, 1807.

Definition.—Rhizophysidae with loose cormidia, the gonostyles being attached to the internodes of the stem, between the siphons. Tentacles branched; tentilla polymorphous, partly simple, partly branched.

The genus Rhizophysea is the oldest known form of Rhizophysidae, its Mediterranean type having been described as early as 1775, by Forskål, under the name Physophora filiformis (11, p. 120, Tab. xxxiii. fig. F). Péron afterwards, in 1807, figured a similar form, observed in the Atlantic, under the name Rhizophysea planostoma (14, pl. xxxix. fig. 3). Although this latter figure is very incomplete, it may be that it is identical with a similar Rhizophysea, a single specimen of which I captured in December 1866, in the Canary Island Lanzerote. The structure of this Atlantic species, for which I retain Péron's name, was very similar to that of the well-known Mediterranean form, the best description of which was published in 1854 by Gegenbaur (7, p. 324, Taf. xviii. figs. 5–11). The Atlantic Rhizophysea planostoma differed, however, in the peculiar coloration (the pneumatophore, the stem, and the tentacles being rose-coloured, the siphons violet), and in the special form of the tentilla; the majority of these were trifid, with an odd median club and two paired lateral horns (similar to those of Cannophysea murrayana), but scattered between them was a number of very large palmate tentilla, differing from those figured by Gegenbaur (loc. cit., fig. 8) mainly by a large purple ocellus on the convex outside; the peculiar calcarate tentilla, which Gegenbaur compared with a bird's head in the Mediterranean Rhizophysea filiformis (loc. cit., fig. 9), were absent. Compare also Fewkes (41, pl. ii.). A third species of the true Rhizophysea, different from the two former, is described by Brandt as Epibilia mertensi (25, p. 33). The excellent figure of it, drawn from nature by Mertens (but unfortunately not published), exhibits distinctly two different kinds of branched tentilla; the colour of the corm is yellowish-brown, the siphons rose. It was observed in the Northern Pacific in 1827.

Family XXII. Salaciæ, Haeckel, 1888.

Definition.—Cystonectæ polygastrice with a long tubular trunk of the siphosome, bearing in its ventral median line numerous polygastric cormidia, separated by free internodes. Each clustered cormidium composed of several siphons and several tentacles. Pneumatosaccus large, without radial septa and pericystic radial pouches, but with eight or more radial groups of hypocystic villi.

1 Rhizophysea = Root-bladder, μήσα, φώτιον.

(zool. chall. exp.—part lxxvii.—1888.)
The family Salaciae is an interesting group intermediate between two very dissimilar families of Cystonectæ, the macrostelious Rhizophysidæ (XXI.) and the brachystelious Physalidæ (XXIV.). It agrees with the former in the long tubular stem and the long naked internodes between the ordinate cormidia, and further in the peculiar structure of the pneumatophore, possessing hypocystic villi; on the other hand, it agrees with the Physalidæ (Pl. XXVI.) in the polygastric structure of the cormidia and the large size of the float, and with Physalia especially in the structure of the siphons and the simple tentacles, bearing a series of reniform cnidodones.

The remarkable species which represents this connecting family is figured in Pl. XXV. as Salacia polygastrica; it was taken by the Challenger in the Tropical Atlantic (Station 338), from a depth of 1990 fathoms. The single specimen examined was so well preserved that it was possible to staining and dissecting it to recognise the essential structure of all the different organs. The morphological relation which the polygastric cormidia of Salaciae bear to the closely allied monogastric cormidia of Rhizophysidæ is very similar to that which, among the Physonectæ, the Apolemidsæ bear to the Agalminæ. An Apolemia which has lost its nectophores and bracts would be very similar to a Salacia. The peculiar structure of the gonodendra, however, in this latter, and the structure of the large float, with eight radial bunches of hypocystic villi, leaves no doubt that they are most closely allied to the Rhizophysidæ.

Genus 72. Salacia, Haeckel, 1888.

Salacia, Hkl., System der Siphonophoren, p. 45.

Definition.—Salaciae with ordinate cormidia, each of which is composed of several siphons and monostylic gonodendra. The single tentacle, which arises from the base of each siphon, is a long simple tube, beset with a series of reniform cnidocysts.

The genus Salacia was established by Linné in 1746 for that very large Cystoné which was called Physalia by Lamarck in 1816 (compare 1, p. 158; 79, p. 24). Since the latter name is generally accepted, and the former (although seventy years older) entirely forgotten, I employ it for this new genus, instead of giving a new name. The characters of the genus Salacia, as the only known type of Salaciae, are the same as described above for that family. As a peculiar character of the genus may be pointed out the shape of the tentacles, which agree with those of Physalia. The species described in the sequel (Pl. XXV.) was discovered by the Challenger in the depths of the Tropical Atlantic (Station 338). Another species of the same genus seems to be the (incompletely known) North Atlantic form, which Fewkes described in 1886 as Rhizophysa uvaria (45, part xii. p. 967, pl. x. fig. 6).

1 Salacia, name of a sea-goddess, wife of Okeanos.
Salacia polygastrica, n. sp. (Pl. XXV.).

Habitat.—Tropical Atlantic; Station 338, March 21, 1876; lat. 21° 15' S., long. 14° 2' W.; depth, 1990 fathoms.

Corm.—The trunk of the single specimen observed had in the expanded state a length of 120 to 150 mm., and bore about eight developed cormidia, besides the same number of young and undeveloped ones in the proximal portion, beyond the apical float. The ordinate cormidia were separated by long naked internodes. The cylindrical trunk was filiform and had a diameter of only half a millimetre, but exhibited a high degree of firmness and elasticity. Although it was much contracted in the spirit bottle, it was possible, by softening it gradually with water, to make it so elastic that it could be extended to that degree which is figured in Pl. XXV. fig. 1.

Pneumatophore (fig. 1, lateral view; fig. 2, horizontal section, near the pylorus infundibuli; fig. 3, apical view, fore-shortened).—The large float is ellipsoidal, 10 mm. long, 6 mm. broad. Its apex is truncate, with a central dimple, which contains the stigma or the apical opening for the emission of gas (fig. 3, po). In the apical view (fig. 3) strong radial muscles (pm) are visible, which open the stigma; beyond them lie the circular muscles which compose the sphincter closing it. This eye-like sphincter is surrounded by a corona of eight roundish radial lobes, covered by dark pigment-granules. I could not make out the true nature of these lobes (fig 3, seen from above, and fig. 1, in profile). The uppermost part of the pericystic cavity appeared to be divided by eight radial septa into eight radial pouches opening below; but the dark pigment covering them (much richer than is represented in fig. 3) prevented their distinct recognition. The apparent septa may be only radial folds.

Pneumatocyst.—The chitinous air-flask is spindle-shaped and occupies the upper two-thirds of the float-cavity; it exhibits two openings on the two poles of its axis, the apical stigma for the emission of gas (fig. 3, po), and the basal pylorus infundibuli (fig. 2, py), through which the gas, secreted by the exodermal epithelium of the infundibulum, enters into the cavity of the air-flask. The outside of the cuticular pneumatocyst is covered by its matrix, the exodermal pneumatosae; this has an annular constriction round the pylorus (fig. 2, py), and forms beyond it a hemispherical cavity, the infundibulum or pneumatochone. From this arise eight radial bunches of hypocystic villi (figs. 1–3, pv), which fill up the greater part of the hypocystic cavity. Each villus is composed of a few colossal exodermal giant-cells (1 to 2 mm. in diameter) and of a ciliated epithelium of small entoderm cells covering them (as in Pl. XXIV. fig. 6).

Cormidia.—Each ordinate polyastric cormidium (fig. 4) is a botryoidal cluster composed of about ten to twenty siphons and gonodendra, each siphon provided with a long simple tentacle. Four to six siphons only seem to be fully developed in each
cormidium and possess a distinct mouth-opening and a tentacle; these are not recognisable in a greater number of smaller and thinner spindle-shaped tubes, which arise between the former; they may be either young and undeveloped siphons, or perhaps palpons which remain permanently mouthless. The difference between siphons and palpons in _Salacia_ does not seem to be sharp, as in _Physalia_. All the components of each cormidium arise from the node of the trunk so densely crowded that it is impossible to determine whether there is any close relation between the clustered gonodendra and the siphons.

_Siphons_ (figs. 4, 5, s).—The fully developed polypites are slenderly spindle-shaped, attain in the expanded state a length of 8 to 12 mm., a breadth of about 1 mm., and are very similar to those of _Physalia_ and _Alophota_ (Pl. XXVI.). The four usual segments are sometimes recognisable in the strongly contracted siphon (fig. 5). The short pedicle bears a subspherical basigaster with thickened exoderm (sb); from its base arises the tentacle (t). The wide stomach (sm) is covered inside with numerous pigmented hepatic villi (sv). The contractile proboscis (sr) opens at the distal end by a mouth which is often expanded in the form of a roundish or circular suctorial disc; its margin is armed with a ring of cnidocysts (fig. 4, so).

_Tentacles_ (t).—The single long tentacle which arises from the base of each fully developed siphon is very similar to those of _Physalia_, a simple cylindrical tube with an excenctric canal. The dorsal side of the tube bears a series of very numerous reniform cnidonodes, whilst the ventral side is naked (compare Pl. XXV. figs. 4, 5, t, and Pl. XXVI. figs. 1–6, t).

_Gonodendra_ (figs. 4, g, 7).—The clustered gonodendra, which arise from each node between the siphons, have a richly branched gonostyle. Each ultimate branch (Pl. XXV. fig. 7) exhibits essentially the same structure as in _Physalia_, and is composed (Pl. XXVI. fig. 8) of a single large gynophore (f, a medusiform umbrella with four radial canals, the manubrium of which develops after the detachment), a clustered group of smaller club-shaped androphores (h), and a number of gonopalpons (gp).

Family XXIII. **Epibulidea**, Haeckel, 1888.

**Definition.**—Cystonecete polygastrice with a short inflated trunk of the vesicular siphosome, which is spirally convoluted beyond the basal side of the large subvertical pneumatophore. Cormidia ordinate in a spiral ring, protected by a corona of palpons. Pneumatosaccus without radial septa and pericystic radial pouches, but with eight or more radial groups of hypocystic villi.

The family Epibulideae represents a new interesting group of Cystonecete, which was very imperfectly known up to this time. Two species only of _Epibulia_, both captured
in the North Pacific, have been incompletely described—*Epibulia chamussonis* by Eysenhardt (77, Tab. xxxv. fig. 3), and *Epibulia erythrophyse* by Brandt (25, p. 34). Unfortunately the excellent figure of the latter species, which Mertens in 1817 had drawn from life, has never been published. It is much to be lamented that this, as well as all the other wonderful drawings of Siphonophore, which Mertens had executed with the most admirable accuracy, have never found their way into literature. Comparing Mertens' figure of *Epibulia erythrophyse* with a similar splendid Cystonect which I myself observed in Ceylon (1882), I have no doubt that both species belong to one and the same genus. The accurate examination of this Indian *Epibulia ritteriana* (Pl. XXII. figs. 6–8), and their comparison with the closely allied Physalidæ, has led me to the opinion that this genus represents a new family, intermediate between the latter and the Rhizophysidæ. Another genus of this family may be perhaps *Angela cytherea* of Lesson, which, however, is too imperfectly examined (3, p. 496, pl. ix. fig. 1).

The Epibulidæ agree with the next allied Physalidæ in the bag-shaped form of the short and wide trunk of the siphosome. But the large pneumatophore does not extend along the dorsal side into the cavity of the vesicular trunk; it occupies rather the apical half of the corm, whilst the siphosome occupies its basal half. The Epibulidæ agree in this respect with the other Cystonectæ, and differ essentially from the true Physalidæ, with which I had united them (in 1887) in my System (95, p. 46, Genus 73). A further consequence of this important difference is that the main axis of the large pneumatophore stands subvertically or obliquely inclined in the Epibulidæ (as in the other Cystonectæ), whilst it is subhorizontal in the Physalidæ; the stigma, therefore (or the apical air-pore), occupies in the former the superior pole, in the latter the anterior pole of the floating corm. A further difference is, that the ventral line of the shortened trunk, from which the budding cormidia arise, is circular or rather spiral in the Epibulidæ, straight in the Physalidæ, and that a complete corona of palpons surrounds the base of the float in the former, but is wanting in the latter.

The whole form of the corm, as well as the structure of its single parts, is in the Epibulidæ very like that in the Cystalidæ (Pl. XXII. figs. 1–5); but the important difference between them is that the former are polygastric, the latter monogastric. It is very probable, however, that the Epibulidæ have arisen directly from the Cystalidæ (by secondary multiplication of the siphons and tentacles), as well from a phylogenetical as from an ontogenetical point of view (compare above, p. 315).

*Nectosome* (Pl. XXII. fig. 6, p; fig. 7, longitudinal section; fig. 8, transverse section).—The pneumatophore has in the Epibulidæ the same structure as in the Salacidae and Rhizophysidæ; it includes eight radial bunches of hypocystic villi. Its apex bears the stigma typical of all Cystonectæ. The living *Epibulia*, when it wishes to sink down, expels at will the gas through this apical pore; as I have observed in Ceylon. *The apical part of the pneumatocoe is intensely coloured by a pigment-cap (mitra ocellaris, pp)*.
**Siphosome.**—The composition of the siphosome, and especially the arrangement of the crowded cormidia along the median ventral line of the vesicular and spirally convoluted trunk, is in the Epibulidæ very similar to that in the Discolabidæ. If the nectophores of Physophora or of Discolabe were detached and the stem contracted, and if the apical float were inflated, the external appearance would be nearly the same as in Epibulia. The corona of large projecting palpons which surrounds the base of the nectosome and covers the siphosome is also very similar. It may even be that the composition of the ordinate cormidia, and their arrangement around the segmented shortened trunk, is very similar in both groups. But a closer examination informs us that this similarity is a mere analogy, not a true homology; the typical structure of the single persons and organs (mainly of the pneumatocæ and the gonodendra) is in the Epibulidæ very different from that in the Discolabidæ, and agrees with that in the other Cystonectæ.

**Synopsis of the Genera of Epibulidæ.**

<table>
<thead>
<tr>
<th>Tentilla simple, filiform, undivided,</th>
<th>Tentilla trifid at the distal end, with an odd median terminal ampulla and two paired lateral horns,</th>
</tr>
</thead>
<tbody>
<tr>
<td>73a. Epibilia.</td>
<td>73b. Angela.</td>
</tr>
</tbody>
</table>

**Genus 73a. Epibilia,1 Eschscholtz, 1829.**


**Definition.**—Epibulidæ with simple filiform tentilla, each representing an undivided lateral branch of the tentacle.

The genus *Epibilia* was founded by Eschscholtz (1, p. 148) for the reception of two very different Cystonectæ, viz., (1) the Mediterranean *Rhizophysa filiformis*, Lamarck (described by Forskål in 1775 as *Physophora*), and (2) *Rhizophysa chamissonis*, Eysenhardt, from the North Pacific (77, p. 40, Tab. xxxv. fig. 3). Since the name *Rhizophysa* is now generally accepted for the former, we retain the name *Epibilia* for the latter. Another species, closely allied to this, was afterwards described by Brandt as *Epibilia erythropis* (25, p. 34). The excellent figure of this Pacific species, which Mertens had painted from life, but which, alas, was never published, leaves no doubt that it belongs to this genus, and that it is closely allied to the new Indian species which I myself observed living in Ceylon, and which is described in the sequel as *Epibilia vittoriana*, dedicated to the highly esteemed protector of phylogenetic science, Dr. Paul von Ritter of Basel (Pl. XXII. figs. 6–8).

Considerable confusion in the nomenclature of this genus (as also of other genera

1 *Epibilia* = Artful, ἐπιβίλεως.
of Siphonophore) was introduced by Carl Vogt (6), who in 1854 gave the name *Epibulia aurantiaca* to a Calyconect, which had been named *Galeolaria* by Blainville seventeen years before (24, p. 139). Compare our Genus 26. Since also many succeeding authors had retained the name *Epibulia* in the sense of Vogt, I followed their example in my System, and had called the above mentioned species of Brandt, &c., *Arethusa* (95, p. 35). But considering now more accurately the rules of priority, I find it much more justifiable to employ the name *Epibulia* in the sense of the older authors, Eschscholtz and Brandt.

*Epibulia ritteriana*, n. sp. (Pl. XXII. figs. 6–8).

*Arethusa brachysoma*, Hkl, System der Siphonophoren, p. 46.

**Habitat.**—Indian Ocean, Ceylon, off Belligemma, January 1882 (Haeckel).

*Corm.*—The complete corm of this beautiful Cystonect, which I captured in the living state, off Belligemma, Ceylon, and which is figured in Pl. XXII. fig. 6, four times enlarged, had in this fully expanded state a diameter of 30 mm. to 40 mm., in the contracted state scarcely one-fourth of that size. All parts of the body were splendidly coloured, the large ovate pneumatophore light red, with a purple pigment-cap in the apical third; the corona of palpons rose, the siphons and the tentacles yellow, and the gonodendra purple. The vivid motions of this delicate Siphonophore, the variable play of the tasting palpons, the feeding siphons, and the capturing filaments, offered a most splendid aspect. The number of cormidia composing the corm was eight; four siphons and tentacles, and four large gonodendra were fully developed, two others (smaller) half developed, and two very small and young. The number of palpons, however, which composed the corona beyond the apical pneumatophore, was very large, forty to sixty or more, beside many young buds, so that six to ten palpons may belong to each cormidium. All these parts of the siphosome were so arranged around its vesicular axial trunk, that the palpons occupied the proximal, the siphons the distal part of the cormidium, and the gonodendra were attached between them (as in the Anthophysiidae and Discolabidae); but usually the siphons were more or less protruded, so that the gonodendra appeared to occupy the central base of the corm. Unfortunately, I was not able to examine closely the form of the central trunk of the siphosome, and the mode of attachment to the cormidia; probably it is similar to that of the Anthophysiidae, Discolabidae, and Nectalidae; all that I could observe of the trunk was that it represented a shortly conical or ovate bladder, coiled up in a spiral, with a single dexiotropic turning.

*Pneumatophore* (Pl. XXII. fig. 6, p, in profile; fig. 7, in vertical section through the axis; fig. 8, transverse section).—The great float filled with air is ovate, and has a diameter of 10 to 12 mm. in the expanded state; in the contracted state, however,
after the emission of gas through the apical pore, it represented a depressed spheroid of 3 to 4 mm. only. The pneumatochone, or the outer wall of the pneumatophore (fig. 7, \( pw \)), is separated from the inner wall, or the pneumatosaccus (fig. 7, \( ps \)), by a wide cavity (\( pc \)). This pericystic cavity opens below into the stem-cavity of the siphosome (\( at \)), whilst it is closed above, surrounding like a ring the apical pore (\( po \)) where both walls are connected. The distal or inferior half of the pericystic cavity is filled by the numerous finger-shaped hypocystic villi (\( pe \)), arising in eight radial bunches from the air-funnel (\( pi \)).

**Pneumatocyst** (figs. 6–8, \( pf \)).—The chitinous air-flask is an ovate bladder, suspended from the apex of the surrounding pneumatophore, and hanging down freely into its cavity. Its cuticular wall has two opposite openings on the poles of its axis. The superior or proximal opening is the apical stigma (\( po \)) serving for the emission of gas when the animal wishes to sink down; it may be closed by the sphincter stigmatis, a strong ring-muscle, the antagonist of which is a corona of radial muscles, opening the stigma. The inferior or distal opening of the air-flask is the pylorus infundibuli (\( pp \)), by which its cavity communicates with the subjacent air-funnel (\( pi \)). The convex outside of the pneumatocyst is covered by the simple exodermal epithelium of the pneumatosac (\( ps \)), and in the upper third by the mitra ocellaris, a purple hemispherical cap composed of elegant polygonal pigment-cells (\( pp \)). The concave inside of the air-flask is naked in the upper third (covered by the ocellar mitra, \( pp \)); it is lined in the two lower thirds by the endocystic tapetum (\( pd \)), a stratified glandular epithelium composed of the same yellowish-green exoderm cells as line the cavity of the subjacent spheroidal air-funnel (infundibulum, \( pi \)). The greenish glandular epithelium is the important pneumadenia and secretes the gas.

**Hypocystic Villi.**—The air-funnel (infundibulum or pneumatochone, \( pi \)), which forms the blind distal portion of the air-sac, is surrounded by a regular corona of eight radial clusters, composed of numerous branched hypocystic villi. Each villus is composed of a few colossal giant-cells of the exoderm (arising from the outside of the pneumadenia) and covered by a vibratile epithelium of small ciliated endoderm-cells (Pl. XXIV. fig. 6). The diameter of the vesicular giant-cells is 1 to 2 mm., and their nuclei, when stained by carmine, are visible to the naked eye. The further structure and the physiological function of these parts are the same as in the Rhizophysidae, (described above, pp. 310, 320).

**Siphons** (fig. 6, \( s \)).—The large feeding polypites are 10 to 15 mm. long, very movable spindle-shaped tubes with a thick muscular wall. The short basal pedicle bears the tentacle on its dorsal side. The largest part is the dilated stomach, covered inside with numerous yellow hepatic villi. The distal proboscis is very muscular; its mouth-opening may be expanded in the form of a circular suctorial disc, the margin of which is divided into sixteen lobes.
REPORT ON THE SIPHONOPHORÆ.

Tentacles.—The single tentacle which arises from the base of each siphon is a long cylindrical tube, in the fully expanded state 80 to 120 mm. long or more. It is beset with a series of very numerous tentilla or lateral branches. These are simple, cylindrical filaments, of the same shape as in *Nectophyæa wyvillei* (Pl. XXIII. figs. 5, 6). The concave ventral side of the tentilla bears sensible papillæ, the convex dorsal side is armed with spherical cnidocysts.

Palpons.—The corona of tasters, which occupies the uppermost part of the siphosome, immediately beyond the float of the nectosome, is very similar to that of the Discolabidae (*Physophora*). The palpons (*q*) are slender, very movable, cylindrical tubes with a thick muscular wall. Their cavity opens at the proximal end into the vesicular trunk, whilst the closed distal end is armed with cnidocysts and a purple ocellus. Their function is not only sensory, but also protective and capturing, as in the Discolabidae.

Gonodendra.—Each cormidium is monoclinic and bears a very large gonodendron, attached by a short pedicle to the periphery of the vesicular trunk, between the superior palpons and the inferior siphon. The gonostyle is richly branched, and each ultimate branch, similar to that of the Salacidæ (Pl. XXV. figs. 6, 7), bears a large, distal, medusiform gynophore and a bunch of club-shaped androphores with small gonopalpons scattered between them.

*Epibulia ritteriana*, observed in the living state, with its vivacious movements, belongs to the most beautiful and elegant forms of Siphonophoræ; at the same time it is of a peculiar morphological and phylogenetic interest. I dedicate, therefore, this splendid Indian form to my honoured friend, Dr. Paul von Ritter of Basel, the magnanimous founder of the "Paul von Ritter’sche Stiftung für phylogenetische Zoologie an der Universität Jena."

Genus 73b. *Angela*, Lesson, 1843.

*Angela*, Lesson, Acalèles, p. 496.

Definition.—Epibulidæ with trifid tentilla, each lateral branch of the tentacles being divided at the distal end into a terminal ampulla and two lateral horns.

The genus *Angela* was established by Lesson (*loc. cit.*, p. 496, pl. ix. fig. 1) for a Siphonophore, a figure of which, drawn from life, had been given to him by Rang, without description. Comparing this figure with our *Epibulia* (Pl. XXII. fig. 6), I suppose that *Angela cytherea* (from the Tropical Atlantic?) may have been a true Epibulid. The base of the large, depressed, spheroidal pneumatophore is surrounded by a corona of numerous palpons, and inside of it depend eight very long tentacles, provided with a series of numerous tentilla. Each tentillum is divided into three

1 *Angela*, a female angel.
terminal branches, an odd median ampulla and a pair of lateral horns (fig. 1, a). If this explanation be right, *Angela* would bear the same relation to *Epibulia* as *Canophysa* does to *Aurophysa*.

Family XXIV. **Physaliidae**, Brandt, 1835.

*Physaliida*, Brandt, Prodromus descriptionis, &c., 25, p. 36.

**Definition.**—Cystonectæ polygastricæ with a short inflated trunk of the vesicular siphosome, which is horizontally expanded along the ventral side of the subhorizontal gigantic pneumatophore. Cormidia in a multiple series along the ventral side of the trunk, usually loose. Pneumatococceus very large, sometimes with a chambered dorsal crest, without radial septa and hypocystic villi.

The family Physaliidae comprises the largest and most interesting Cystonectæ, which surpass all the other Siphonophore in the enormous size of the inflated pneumatophore and the vigorous tentacles, the splendid colours of the peculiar siphosome, and the dangerous poisons of the urticating organs. Since some forms of this interesting family, and especially the largest of all, the Atlantic *Caravella maxima*, occur in great swarms floating on the surface of the ocean, they have been well known to travellers and sailors for a long time. In many voyages they are mentioned under the popular names "Caravella, Galera, Fregatta, Ship of Guinea, Portuguese Man-of-War," &c. Nevertheless the natural history of the Physaliidae has hitherto been very imperfectly studied, and there remains much to be done towards a complete knowledge of them.

The genus *Physalia*, generally accepted as the only one of this family, was established in 1816 by Lamarck (90) for those *Caravelle* which O. F. Müller and Gmelin in the preceding century had described as *Medusa caravella*, Linné, or *Holothuria physalis*. Neither the name *Salacia*, employed for them by Linné in a few editions of his Systema naturæ (1756, 1, p. 158), nor the name *Arcehisa*, proposed by Patrick Browne in 1789, have yet any application (compare above, p. 330, and below, p. 349). While Lamarek distinguished five different species, with very insufficient definitions, Eschscholtz accepted only three, the common Atlantic *Physalia caravella* (the largest of all, with numerous large tentacles), the smaller *Physalia pelagica* (from the Southern Atlantic and Indian Oceans), and the larger *Physalia utriculus* from the Pacific; the two latter species have only a single large tentacle, and differ mainly in the form of the pneumatophore. Recently Chun, in the latest paper on *Physalia* (83, p. 557), unites these two latter forms, accepting two species only of this genus—*Physalia caravella*, with many large main-tentacles, from the Atlantic, and *Physalia utriculus* (including *Physalia pelagica*) from the Indo-Pacific Ocean. All recent authors have accepted the genus *Physalia* as the only type of this family.
The family Physalidae was established in 1835 by Brundt (25, p. 36). He first distinguished two different subgenera in the genus Physalia, viz., (1) Selacia (or Physalia proper), with a chambered dorsal crest of the float; and (2) Alothota, without crest. This distinction, although not accepted by later authors, is very important, since the crestless state of the pneumatophore, regarded from a phylogenetic point of view, must necessarily precede the crested state. There still exist also to-day small Physalidae which reach sexual maturity in the crestless state. We establish for these the subfamily Alothotidae, and oppose it to the crest-bearing subfamily Caravellidae. Among the small Alothotidae, as well as among the large Caravellidae, occur two different forms which may be distinguished as genera; one of these (Alothota and Physalia) bears only a single large main tentacle, besides numerous small accessory tentacles; the other group (Arethusa and Caravella) bears numerous large main tentacles of nearly equal size (besides the small accessory tentacles).

The distinction of species in these four genera of Physalidae is a very difficult task, since the entire family is transformistic, and all the so-called "good species" are connected by Darwinian intermediate forms. Nevertheless there exist a number of "geographical species" as local forms in the different seas. In the majority of the numerous descriptions the species of Physalidae are founded upon slight differences in the variable coloration, or different states of contraction of the very variable pneumatophore and other parts (compare Huxley, 9, p. 99, and Chun, 83, p. 557). A better and more natural distinction of "relatively good species" will be got when the future observers carefully regard the following anatomical structures:—(1) the grouping and composition of the monogastric or polygastric cormidia; (2) the relation of the basal protosiphon (at the distal end of the float) to the secondary siphons (or metasiphons) on its ventral face; (3) the difference in structure and form of the pneumatophore, mainly at its apical and basal poles; (4) the structure of the crest, the number of its chambers, &c.

Cystonula-Larvae.—The organisation of the large adult Physalidae, with their complicated structure and composition of hundreds of polymorphous parts, is so difficult to conceive, and seems to be so widely different from that of other Siphonophore, that it has led most authors to many erroneous opinions. To arrive at its true understanding, it is indispensable to regard carefully and compare critically the smallest and simplest forms of this peculiar family, and especially the youngest larvae with a very simple structure (Cystonula, Pl. XXVI. figs. 1, 2). The first larvae of a very young stage were described in 1859 by Huxley (9, p. 102, pl. x. figs. 1, 2). I myself had in 1866, in Lanzerote, the opportunity of observing living a number of similar larvae and by comparing them with the simplest and oldest genus of the family, Alothota (Pl. XXVI. fig 3), and with the more highly developed Arethusa (figs. 4–8). Recently Chun has published some interesting notes on young Physalidae (83, p. 553).

The smallest and youngest Cystonula, which I observed in December 1866, is figured
in Pl. XXVI. fig. 1; it had a length of 4 mm. in the expanded, 2 mm. in the contracted state, and was very similar to the youngest larva figured by Huxley (9, pl. x. fig. 1). This young larva is a simple medusome, composed of an ovate pneumatophore (the transformed umboila) and a spindle-shaped siphon with a distal mouth (the manubrium of the original Medusa); from the vesicular pedicle of the siphon, which connects it with the base of the pneumatophore, arises a single long tentacle; this is a simple cylindrical filament, beset on the dorsal side with a series of reniform cnidodones, of the same structure as in the adult Physalidae. The ovate pneumatosacculus (fig. 1, pf) exhibits an apical stigma (po), or a simple pore on the proximal pole of the longitudinal axis; this is the permanent opening of the original invagination. The cavity between the outer and inner walls of the pneumatophore (closed above around the stigma) is below in open communication with that of the pedicle, and by this with the cavities of the siphon as well as the tentacle. The inside of the siphon is covered with numerous black hepatic villi (se); the margin of the mouth (expanded in fig. 1 as a square sectorial disc) armed with a series of cnidocysts (ss).

A second stage of Cystonula, 6 mm. in length, which I found recently in a preparation in the Challenger collection, and could not figure in Pl. XXVI. (already printed), is intermediate between figs. 1 and 2 of that Plate. It differed from the youngest stage (fig. 1) in the production of a pair of buds from the ventral side of the dilated siphon-pedicle (a), opposed to the dorsal tentacle (t). The posterior bud of this pair develops into the first secondary siphon, the anterior into the first palpon (or basal sac) with its tentacle. The dilated cavity between float (pf) and stomach (sv), from which the buds arise, becomes now much larger and corresponds to the common stem or trunk (a).

The third stage of Cystonula observed is figured in Pl. XXVI. fig. 2; its length in the expanded state was 8 mm. It is similar to the second form figured by Huxley, 10 mm. in length (9, pl. x. fig. 2). The slender pyriform trunk, with strongly inclined axis, encloses in its proximal (anterior) half the pneumatosac, filled with air (pf), and bears on its distal (posterior) end the protosiphon (the primary siphon or the manubrium of the original medusome, with its tentacle). This is separated by a wide interval from the central group, composed of three subequal cormidia which are attached to the middle third of the ventral median line of the vesicular trunk; each cormidium is composed of two sterile persons arising from a common stem, a siphon (with hepatic villi, sv, and a terminal mouth), and a mouthless palpon (or basal ampulla, with a long tentacle). Regarded from the standpoint of our Medusome Theory, this Cystonula is a primary medusome, which has produced by budding from its ventral side three pairs of secondary medusomes; these arise from the middle third of the trunk, or from that portion which is the enlarged pedicle of the protosiphon (fig. 1, a). The growing pneumatophore, which originally occupied the apical part of the primary larva, extends now more and more over its dorsal side, descending in a basal direction. The longi-
tudinal axis, originally subvertical, becomes in this way inclined more and more, and finally lies subhorizontally.

The further development of the Physalideae is determined mainly by the multiplication of the cormidia on the ventral or inferior side of the vesicular trunk, and by the progressive extension of the pneumatosaccus along its dorsal or superior side. In Allophota and Physalia, where the single large main tentacle is much longer than all the others, usually the two groups of cormidia (the larger ventral and the smaller basal) remain separated, and their further development is different. The smaller basal group, at the posterior or distal end of the trunk, produces merely a series of small siphons and palpons, placed before the protosiphon, and is provided with a single tentacle only; it always remains sterile and never produces gonophores. The larger ventral group produces early a very large main tentacle, with a gigantic main palpon, much longer and stronger than all the others. The number of cormidia in this ventral group is much larger, and the siphons as well as the palpons and the accessory tentacles become very numerous in the larger species. Some of them afterwards produce gonodendra. In Arethusa and Caravella, on the other hand, the number of main tentacles increases, and usually the two groups of cormidia (smaller basal and larger ventral) are early united into a single large mass of crowded appendages. The succession and composition of the cormidia seem to follow, however, somewhat different laws in the various species of Physalideae.

The further development of the pneumatophore in the larvae of Physalideae has recently been described by Chun (83, p. 559). The inferior or basal third of the invaginated pneumatosaccus becomes separated from the superior larger portion by an annular constriction. The cylinder-epithelium of the former is the pneumadenia, which afterwards expands in the form of a gas-secreting "basal plate" ("Luftplatte"). Physalia and Caravella afterwards develop the dorsal crest which is wanting in the float of Allophota and Arethusa.

Trunnus.—The marked peculiarity in which the Physalideae differ from all other Siphonophorae, is the strange development of the hypertrophic pneumatophore along the dorsal side of the common trunk. The nectosome, therefore, occupies in this family the entire dorsal half of the corm, whereas the siphosome takes the ventral half; the main axis of the trunk becomes subhorizontal, whilst it is vertical in the other Siphonophorae; the nectosome occupies in these latter the apical or proximal, the siphosome the basal or distal, part of the corm. The naked dorsal face of the trunk, which bears no appendages but includes the float, is in all Physalideae much larger than the ventral face which bears the cormidia of the siphosome. The cavity of the trunk is wide, and when the gas is expelled through the stigma of the contracted float, the trunk appears as a voluminous sac filled with nutritive fluid. The trunk in the Physalideae is never coiled up spirally as in the allied Epibulideae.

Pneumatophore.—The gigantic float of the Physalideae determines by its excessive
unilateral development along the dorsal side of the trunk, the peculiar form and the strange character of this family. Nevertheless the young larvae (Cystonula, Pl. XXVI. fig. 1) are not essentially different from those of other Cystonectae (e.g., Cystalida, Pl. XXII. figs. 1-5). The float is here a relatively small ovate or ellipsoidal vesicle in the apical part of the primary medusome, connected by the inflated pedicle (a) with the basal protosiphon (sa). The stigma on its apical pole (po) is the permanent opening of invagination, from which the simple pneumatosae (or the inner float-wall) depends freely into the pneumatocodon (or the outer float-wall). Chun tells us that the float of these young larvae has a complete radial structure (“ein völlig radialer gebauter ovaler Luftsaek,” 83, p. 559); but I have never found in the Physalidae (neither the youngest larvae, nor older forms) any trace of radial structure; they possess neither the eight radial bunches of hypocystic villi which are found in the Epibulidæ (Pl. XXII. figs. 6-8), the Salacidae (Pl. XXV. figs. 2, 3), and the Rhizophysidæ (Pl. XXIV. figs. 1-5), nor the corona of radial septa and pouches which is obvious in most Physonectae. The pneumatosae of all Physalidæ lies freely in the voluminous cavity of the large pneumatocodon, and is connected with the latter only at the apical pole, by the sphincter of the stigma. The pericystic cavity, therefore, is as simple as in the Cystalidae, Athoridæ, and Apolemidæ. The outer wall of the float is very thick and muscular, with an outer layer of strong, parallel, longitudinal fibres and an inner layer of circular ring-fibres. By compressing the float voluntarily, the animal can extrude the included air through the apical stigma, and sink down. After a short time has elapsed it can rise again, secreting a great mass of gas by the pneumadenia, and filling the float. I often observed this process repeated, in December 1866, off the Canary Islands. The lamellar pneumadenia, or the glandular “air-plate” (“Luftplatte,” Chun, 83, p. 569), which corresponds to the endocystic tapetum of the other Cystonectæ (p. 309), is a thin distal layer of exodermal glandular cylinder-cells, placed originally in the basal portion of the pneumatosæ. It grows afterwards more towards the ventral side and extends forwards. It has a diameter of 4 mm. in a float 20 mm. in diameter. But in the adult Caravella maxima it reaches 100 to 150 mm. in diameter, and occupies nearly the ventral half of the pneumatophore.

Asymmetry of the Corm.—The fundamental form of the bilateral corm is in all mature Physalidæ more or less asymmetrical, either the left or the right side being more developed and organised differently from the opposite side. This asymmetry is less expressed in the crestless Arcthusidae (Alophota, Arcthusa); it is much more prominent in the crest-bearing Caravellidae (Physalia, Caravella). But the young monogastric larva (Cystonula, Pl. XXVI. fig. 1) is monaxonal, and only the tentacle arising from the ventral median line marks the bilateral symmetry. As soon as the budding of the secondary cormidia on the ventral side of the primary medusome commences, the subvertical axis of the latter becomes more and more inclined, and finally subhorizontal. The first trace of the asymmetrical development is then marked by the situation of the
different buds, the siphons on one side, and the palpons and tentacles on the other side; afterwards all the gonodendra lie on one side (right or left, figs. 3, 4). The more the trunk becomes inflated by the hypertrophied float, the more it lies on one side of the body. On the opposite side is developed the crest of the Caravellidae, acting the part of a sail, similar to that of the Vellellide. As in these latter, the unilateral situation of the sail (right or left) is accidental, and is not constant in the single species; but usually in each species (as with the eyes of the Pleuronectide) the majority have the crest on the same side (compare Chun, 83, p. 576). The largest siphons and palpons, and the main tentacles, lie on this side (the lophopleura), while the gonodendra develop on the opposite side (the hypopleura). Compare L. Agassiz, 36, p. 335. The different growth of the two antimeres (or body-halves) is in some Physalia (e.g., Physalia utriculus, 77, Tab. xxxv. fig. 2) so striking, that the median plane of the dorsal crest lies more horizontally than vertically, and the usual ovate or pyriform shape of the float becomes triangular; the distance between the anterior stigma (on the apical pole of the main axis) and the posterior protosiphon (on its basal pole), seen from above, is in this case often scarcely half as great on the lee-side, or the hypopleura (which bears the gonodendra), than on the windward-side or the lophopleura (which bears the crest). It must be remembered, however, that the free edge of the comb-like crest is always originally the dorsal median line of the asymmetrical trunk, and the line in which the cormidia bud the ventral median line. The anterior stigma marks constantly the apical pole of the longitudinal main axis, and the mouth of the posterior protosiphon its basal pole.

Crest of the Float.—The remarkable polythalamous comb-like crest of the pneumatophore, which is usually regarded as the most striking peculiarity of this family, is developed only in the larger Caravellidae (Physalia and Caravella); it is wanting in the smaller Arethuside, which, because of their much smaller size and simpler form, have usually been overlooked (Alophota and Arethusa, Pl. XXVI.). It is wanting, also, in the younger larvae of the Caravellidae. The crest, therefore, is a secondary organ, got by adaptation to the sailing locomotion of the hydrostatic float. Regarded from a morphological point of view, it is nothing more than a simple longitudinal fold in the dorsal median line of the trunk. It becomes divided afterwards by a number of transverse septa into a series of triangular air-chambers. These have often been compared with the chambers in the polythalamous pneumatocyst of the Disconectae. But this comparison is only a remote analogy, not a true homology. The morphological affinity which is suggested by most authors between Physaliide and Vellellide does not exist at all. On the structure of the crest and its relation to the float, compare Leuckart (81, p. 192), L. Agassiz (36, p. 335, pl. xxxv.), and Chun (83, p. 576). The number of the primary chambers in the crest of young Caravellide is three or four, in the older six to eight or more. These become divided by smaller transverse septa into secondary chambers, and these again by smaller
tertiary septa into chambers of the third (sometimes even of the fourth) order (compare Olfers, 79, fig. 1; Leuckart, 81, fig. 2; L. Agassiz, 36, fig. 1, &c.). Possibly the number of these chambers corresponds to that of the cormidia, which arise in metamic succession from the opposite ventral side of the trunk; it is different in the various species. The Physalidae are able to compress the float and the crest in a very variable manner, and to change their form in a most extraordinary degree. The external form of these hydro-
static organs, therefore, is of little value for the distinction of species.

_Cormidia._—The numerous groups of polymorphous persons and organs which compose the corn of the Physalidae are usually loose, and represent, especially in the larger species, a clustered mass of crowded parts, which seem to be aggregated without any regular order. A comparative examination, however, of the younger stages and larvae, and especially of the small mature _Alophota_ (Pl. XXVI. figs. 1–3), informs us that at the very beginning the cormidia are here also more or less ordinate. A single series of a few cormidia (four in _Cystonula_, fig. 2; six in _Alophota_, fig. 3; eight to ten in _Arethusa_, fig. 4) is here attached along the ventral median line of the trunk, and usually each of these cormidia (excepting the basal group at the distal end) is composed of a siphon, a palpon, and a tentacle; and in mature corals also of a gonodendron. The internodes of the trunk, or the free intervals between the succeeding cormidia, are very distinct in the smaller and younger forms (figs. 2, 3), whilst they disappear in the larger and older forms (figs. 4, 5). The cormidia of the former are originally monogastric (as in the Rhizophysidae), whilst they become polygastric in the latter (as in the Salacidae).

_Basal Cormidium._—The distal end of the trunk, which is the posterior in the usual position of the corn (with horizontal main axis), bears in all Physalidae a separate cormidium of special interest (figs. 3, 4, su). We call it the "basal cormidium," since it is placed at the base or the distal pole of the main axis, opposite to the apical stigma on its proximal pole (po). This primary or basal cormidium remains always sterile, and has a different morphological and physiological value from the numerous secondary cormidia which arise from the ventral side of the trunk and afterwards produce gonodendra. In the simplest case (fig. 3) the basal cormidium consists of a single siphon (su), a palpon (g), and a tentacle. The siphon placed at the very distal end, in the prolongation of the horizontal main axis, has the greatest morphological interest; it is the primary siphon of the youngest larva (fig. 1), and therefore the original manubrium of the primary medusome, the umbrella of which is the float; we call it the protosiphon or primary siphon, in order to distinguish it from all the other siphons, secondarily produced, or the metasiphons. The primary tentacle (fig. 1, t) which belongs to the protosiphon, remains either as the single tentacle of the basal cormidium, or it is afterwards lost; but I have never seen secondary tentacles developed in this distal group; usually it is composed afterwards of a series of small secondary siphons or palpons (twelve to twenty or more). The interval between the basal cormidium and the larger group of
ventral cormidia is in most Physalidæ permanent, sometimes larger, at other times smaller, than in Alophota giltschiana, fig. 3, Physalia pelagica (77, Tab. xxxv. fig. 2), &c.; it is lost afterwards in those species, in which the number of cormidia is exceedingly augmented, and all are confluent in a single crowded mass (as in Arethusa challengeri, figs. 4, 5, in Caravela maxima, and in Physalia megalista).

Ventral Cormidia.—The numerous secondary cormidia which compose the large main group of appendages, on the ventral side of the trunk, exhibit a great variety in number, size, composition, and arrangement. Possibly these differences are constant in different localities and possess therefore a systematic value; but they require a far more accurate anatomical examination than has been employed hitherto. Originally each secondary cormidia (in most species at least) seems to be monogastric, composed of a single siphon, a palpon, and a tentacle, and in small mature corms of a gonodendron (fig. 3); but usually the common pedicle of these medusomes afterwards branches, and produces a variable number of tertiary cormidia. Generally a single tentacle and the appertaining palpon, in the middle of the ventral group, becomes early much larger than all the others; this predominant main tentacle remains single in Alophota and Physalia, whilst a variable number of similar gigantic main tentacles (usually ten to twenty) is afterwards produced in Arethusa and Caravela. Many secondary cormidia remain sterile in most Physalidæ, and a small number only (usually eight to twelve) develop a large gonodendron. It may be, perhaps, that in the crest-bearing Physalidæ (Physalia and Caravela) the number of large primary air-chambers in the crest (usually eight to twelve) and their metameric succession often correspond to the segments of the trunk, from which arise the primary groups of ventral cormidia.

Siphons.—The feeding polypites exhibit in all Physalidæ the same shape, and are very similar to those of the Epibulida (Pl. XXII. fig. 6) and Salacidæ (Pl. XXV. fig. 5). The protosiphon (or the primary polypite of the basal cormidium) does not differ in structure from the numerous metasiphons (in the secondary cormidia of the large ventral group). The young siphons are simple spindle-shaped tubes, whilst the fully developed exhibit distinctly three or four different segments (Pl. XXVI. fig. 6). The two proximal segments, viz., the thin pedicle (sp) and the vesicular basigaster (sb), are usually small, and often confluent; the two distal segments, however, are always large and distinct. The stomach is a very dilatable sac, inside covered with numerous black hepatic villi (sv); the proboscis is a very muscular cylindrical tube, very contractile and expansible, and opens by a mouth, which may be expanded in the form of a circular or polygonal (often square) suctorial disc (fig. 1, ss); its margin is armed with a series of cnidocysts (compare on the structure of the siphons, Leuckart, 81, Huxley, 9, &c.).

Palpons.—All Physalidæ possess, intermingled with the mouth-bearing siphons, a larger number of mouthless palpons. These are of two kinds. The first kind exhibits the same structure as the siphons and differs only in the absence of a distal mouth-opening.

(zool. chall. exp.—part lxxvii.—1888.)  

Hhhh 44
They arise partly from the pedicles of the cormidia, partly from the branches of the gonodendra; it may be that many of the former (or perhaps all?) are young siphons, which afterwards get a mouth-opening. Those which arise constantly from the branches of the gonodendra may be distinguished as gonopalpons (fig. 8, q). The second kind of palpon is connected with the tentacles, so that always a single tentacle (fig. 6, t) arises from a common pedicle with a single palpon (fig. 6, to). These tentacular palpons are simple, very contractile, cylindrical tubes, closed at the pointed distal end, whilst their proximal end opens into the common pedicle; they do not possess the hepatic villi of the first kind. Eschscholtz even compared them with the ampullae of the ambulacral feet in Echinoderms (1, p. 158); Leuckart calls them "Tentakel-Bläschen" (81, p. 197), and Huxley describes them as basal sacs (9, p. 103). The physiological function of these basal ampullae is, indeed, the same as those of the ambulacral ampullae in the Echinoderms. The morphological value, however, is very difficult to make out. It may be that they are only secondary organs developed from the base of the tentacles, which originally belong to the siphons. On the other hand it is possible that originally a pair of siphons has arisen from a common pedicle; the first siphon has lost the tentacle and preserved the hepatic villi and the mouth; the second siphon, on the other hand, has lost the latter organs and preserved the tentacle. The incipient basal ampulla (fig. 7, to) is much larger than the young tentacle arising from its base (t).

Tentacles (figs. 1, 3, 6, t).—The long tentacles exhibit in all Physalidae the same structure, accurately described by Huxley (9, p. 103, pl. x. figs. 11, 12). They are slender moniliform filaments, or rather ribbon-shaped tubes, and agree essentially with those of Salacia (Pl. XXV. fig. 5, t). Only the primary tentacle (fig. 1, t) arises directly from the base of the protosiphon; all the other (secondary) tentacles arise from a common pedicle with a siphon and a palpon (fig. 6); or more correctly speaking, the tentacle (t) and the tentacular palpon (to), closely united, have a common pedicle, which arises from the same stalk of the cormidium as the siphon. As stated above, the palpon (the basal sac or basal ampulla, to) bears to the tentacle the same physiological relation as the ambulacral ampullae of Echinoderms to their feet. In form and structure the numerous slender accessory tentacles are the same as the single large main tentacle, which arises from the middle of the ventral group and surpasses the former ten to twenty times in thickness; its breadth reaches 3 to 6 mm. or more. Its length is usually more than a metre, but it may reach in the expanded state ten to twenty metres or even more, as in Caravella maxima. The ventral side of each tentacle bears a muscular suspensorium (similar to a ribbon-shaped mesentery), whilst the dorsal side is beset with a series of very numerous reniform cnidodendrites. Each of the latter may be regarded as a kidney-shaped tentillum or lateral branch, since it contains a diverticulum of the tentacular canal. The thick dorsal wall of this cavity is filled with innumerable spherical cnidocytes.

Gonodendra (Pl. XXVI, figs. 3, 6, g, 8).—The corms of all Physalidae are monocious
and the cormidia monoclinic; each ultimate branch of the clustered gonodendra is monostylic, since it bears upon the same stalk a single female (f) and numerous male gonophores (h), intermingled with some gonopalpons (q). The structure of these single persons is the same as in the other Cystoneecte (compare above, p. 313). The number of gonodendra is usually four to six in the smaller, eight to twelve or more in the larger species, they are very richly branched, and arise from a common stalk with the siphons and palpons (fig. 6). In the largest species each gonodendron bears some thousands of gonophores. (Compare Huxley, 9, p. 105, pl. x, figs. 14, 15, and Chun, 86, p. 1168.) The club-shaped androphores (Pl. XXVI. fig. 8, h) come to sexual maturity whilst sessile on the stem, whilst the larger medusiform gynophores (fig. 8, f) become detached and produce ova as free-swimming Anthomeduse.

Synopsis of the Genera of Physalidae.

I. Subfamily Arethuidae.

Pneumatophore simple, without polythalamous dorsal crest.

A single large main tentacle, . . . 74a. Alophota.

Several large main tentacles, . . . 74b. Arethusa.

II. Subfamily Caravellidse.

Pneumatophore provided with a dorsal crest, which is divided into a series of chambers by transverse septa.

A single large main tentacle, . . . 75a. Physalia

Several large main tentacles, . . . 75b. Caravella

Genus 74a. Alophota, Brandt, 1835.


Definition. — Physalidae with a simple vesicular pneumatophore, without dorsa. polythalamous crest. Siphosome with a single large main tentacle.

The genus Alophota and the following Arethusa compose together the subfamily Arethuidae, differing from the following subfamily Caravellidse in the absence of the peculiar polythalamous dorsal crest of the pneumatophore. This characteristic crest is also wanting in the young larvae of the large-sized Caravellidse; the small Arethuidae, therefore, may be regarded as the ancestors of the former, or also as young Caravellidse, which have reached sexual maturity in the larval form (Paedogenesis). In every case a crestless genus of Arethuidae must have preceded in older times the crested Caravellidse, much in the same way as the crestless Rataria has preceded the crested Velella. The crest of the pneumatophore, as an adaptation subservient to sailing, is a secondary acquisition of later times.

The genus Alophota was established by Brandt (25, p. 37) for a small crestless Physalid from the Tropical Atlantic. Comparing the good figure which Mertens has left

1 Alophota = Without crest, αλωφοτα.
of it, I find that it differs from two other forms which I have myself observed living, Alopheota giltschiana, from the Canary Islands (Pl. XXVI. figs. 1-3), and Alopheota mertensii, from the Indian Ocean. The description of the latter will be published in my Morphology of the Siphonophore.

*Alopheota giltschiana*, n. sp. (Pl. XXVI. figs. 1-3).

*Habitat.*—North Atlantic; Canary Islands, Lanzarote, December 25, 1866 (Haeckel).

*Corm* (fig. 3, lateral view of the mature corm, from the right side; fig. 1, a young, monogastric, larva; fig. 2, an older, polygastric, larva).—The largest corms observed which possessed gonodendra at the base of the siphons had a diameter of 15 to 20 mm., and were of a greenish-blue colour. The common trunk and the basal ampullae of the tentacles were light greenish, the pneumatosaccus, the siphons, and the tentacles blue, the siphons with numerous black patches—the hepatic villi. The colour of the ripe gonodendra (placed on the right side) was yellowish. The body of the young larva, without gonodendra (figs. 1, 2), was entirely blue-coloured, or with a few greenish portions here and there. The smallest larva observed (fig. 1) was monogastric, 4 mm. long and 1 mm. thick, and had a pneumatophore 1 mm. in length. This *Cystonula* was in the contracted state very similar to that figured by Huxley of *Physalia* (9, pl. x. fig. 1).

*Pneumatophore.*—The expanded float of the ripe corm (fig. 3) is ovate, with sub-horizontal axis. The apical or anterior pole is pointed and bears the stigma or the opening for the emission of gas (fig. 3, po). The opposite basal or posterior pole is rounded and bears the protosiphon, or the primary polypite of the larva (su), and attached to its base a single tentacle with a basal ampulla. This distal or primary cormidium is separated by a broad interval (the basal internode) from the ventral group of ordinate cormidia, which form a single series in the ventral median line of the pneumatophore; they occupy only the middle third of its ventral side, whilst the anterior third and the posterior third (or the basal internode) are naked and free, without appendages.

*Cormidia.*—The number of secondary cormidia which compose the ventral group is in the specimen figured (fig. 3) four, besides a young one undeveloped. Each cormidium (fig. 6) is composed of four different organs, arising from a common pedicle, viz., (1) a blue siphon, with black hepatic villi and a terminal mouth; (2) a long blue tentacle (t); (3) a light greenish spindle-shaped basal ampulla (to) arising from its base; and (4) a small clustered monostylic gonodendron (g). The structure of all these parts is the usual one, as described above (pp. 345-347). The second tentacle and ampulla (counting from the apex) are far larger than those of the other cormidia. The size of this main tentacle and of the appertaining central siphon was in a second specimen (bearing six mature cormidia) comparatively much larger.
Definition.—Physalidae with a simple vesicular pneumatophore, without dorsal polythalamous crest. Siphosome with several large main tentacles of about equal size.

The genus Arethusa was established a century ago (in 1789) by Patrick Browne, for that gigantic Physalid of the Tropical Atlantic, which is known to the sailors as the "Portuguese Man-of-War," and which O. F. Müller and Gmelin had called Medusa caravella (afterwards Salacia), the type of our genus Caravella (Genus 75b). Since the generic name Arethusa was afterwards given up and replaced by Lamarck's name Physalia, we employ here the former for the designation of those Physalidae which agree with Caravella in the possession of numerous large main tentacles, but differ from it in the absence of a polythalamous crest on the pneumatophore. Arethusa exhibits, therefore, the same relation to Caravella as the crestless Alophota bears to the crested Physalia.

Two different species of Arethusa were observed by me; the first, Arethusa thalia (from the Indian Ocean), is similar to Alophota giltschiana (Pl. XXVI. fig. 3), and exhibits a free interval between the single basal cormidium at the distal end of the trunk and the central group of loose cormidia on its ventral side. The second species (inhabiting the Atlantic, and figured in Pl. XXVI. figs. 4–8) does not exhibit that interval, but all the cormidia form together a single large group in the posterior half of the ventral side of the trunk.

Arethusa challenger i, n. sp. (Pl. XXVI. figs. 4–8).

Habitat.—North Atlantic, Station 354, May 6, 1876; lat. 32° 41' N., long. 36° 6' W.; surface.

Canary Islands, Lanzarote; December 1866 (Haeckel).

Corm (fig. 4, lateral view of the mature corm from the right side, in the expanded state; fig. 5, from the left side, in the contracted state).—The largest corms observed which possessed gonodendra at the base of the siphons had a length of 40 mm. to 50 mm. The colour of the corm was greenish-blue; the common trunk and the basal ampullae light greenish, their tops often reddish; the siphons dark blue, with black villi, their proboscis often reddish; the tentacles partly blue, partly purple. The clustered gonodendra (placed on the right side) had a reddish colour.

Pneumatophore (figs. 4, 5, p).—The float filled with air occupies the greatest part of the trunk; it exhibits as usual very different forms, according to the variable state of contraction. The longitudinal axis is subhorizontal. The outer wall (pneumatoecodon) is separated from the inner wall (pneumatocodon) by the cavity of the trunk, which is rather wide and sacciform in the posterior half, and especially on the ventral side. The

1 Arethusa = Arethusa, a Nymph, daughter of Nereus.
apex of the float (or the anterior top) exhibits a beak-shaped, very mobile apophysis, the apical rostrum; and at the upper side of its base is the stigma, or the air-pore (po).

Cormidia.—The posterior half of the ventral side of the trunk bears a continuous series of densely clustered cormidia, of the same shape as in the younger and smaller forms of Caravella maxima. Each fully developed cormidium (fig. 6) bears on a common short cylindrical pedicle (ap) four different organs, viz., (1) a blue siphon with black hepatic villi (sv) and a distal mouth (so); (2) a long blue or red tentacle beset with a series of reniform cnidonodes (t); (3) a slenderly spindle-shaped, light greenish basal ampulla (to) arising from its base; and (4) a clustered, yellowish or reddish, monostylic gonodendron of the usual composition (p. 313). The structure of all these parts is the same as in the other Physalidee, as described above (pp. 345–347).

A variable number of main tentacles (usually six to eight) are far larger than the others, besides the young and undeveloped ones. The primary basal siphon (or the protosiphon, fig. 4, sw), at the distal end of the trunk, is of the same form and size as the secondary siphons (in the ventral side), but is sterile and bears no gonodendron. Between it and the lowermost (oldest) secondary siphon is a group of small pyriform palpons (without tentacles). This group fills the interval (or the basal internode), which is free and naked in Alophota (Pl. XXVI. fig. 3).

Genus 75a. Physalia,1 Lamarck, 1816.


Definition.—Physalidee with a polythalamous crest on the dorsal side of the large vesicular pneumatophore. Siphosome with a single large main tentacle.

The genus Physalia and the following Caravella make up together the subfamily Caravellidee, differing from the preceding subfamily Arethuside in the possession of that peculiar dorsal crest of the pneumatophore, which is divided by numerous vertical transverse septa into a series of air-filled triangular chambers. All Physalide belonging to the Caravellide attain a far larger size and bear a far greater number of organs in their loose cormidia than the preceding Arethuside. The genus Physalia, in the stricter definition here offered, comprises the greater number of species hitherto described. It bears only a single large main tentacle, much longer and thicker than the numerous accessory tentacles, and differs by this constant character from the following Caravella, provided constantly with a greater number of subequal strong main tentacles (usually ten to twenty or more). Physalia bears therefore the same relation to Caravella as the crestless Alophota does to Arethusa.

The accurate distinction and sharp definition of the numerous species of Physalia which have been described is a very difficult task, owing partly to the numerous transitional

1 Physalia—Sea-bladder, ♀♂ a, ♂♂ a.
forms, which connect the different "good species" of this transformistic group, partly to the great confusion of the voluminous literature on this subject. Most authors have founded their specific distinctions upon slight differences in the variable form of the very contractile pneumatophore and insignificant varieties of colour. The accurate anatomical examination of the siphosome, the composition of the cormidia, and the relations of the different clustered medusomes has been much neglected, and requires a further more critical comparison (compare Huxley, 9, p. 99, and Chun 83, p. 557). Judging from the extended observations of numerous Physalae collected in different seas which I have been able to compare recently, I think that the following four species of Physalia may be distinguished provisionally:—(1) Physalia pelagica (South Atlantic); (2) Physalia cornuta (Indian Ocean); (3) Physalia utriculus (Pacific); and (4) Physalia megalista (Indian Ocean and South Atlantic).

Physalia megalista, Lamk. (Péron, 14, pl. xxix. fig. 1), differs from the three other species in the complete union of all the cormidia, as in Caravella maxima; there is wanting here the free interval which separates the small basal cormidium (on the distal end of the trunk) from the main mass of clustered cormidia on the ventral side of the pneumatophore. This interval between the two groups of cormidia (the smaller posterior and the larger anterior), as well as the composition of these cormidia, is different in the three other species of Physalia; the structure, too, of the pneumatophore, the number of chambers in its crest, and the mode of attachment of the appendages to the trunk, seem to offer marks for a more accurate distinction of these species. (Compare the figures of the Southern Atlantic Physalia pelagica by Eysenhardt, 77, p. 45, Tab. xxxv. fig. 2; of the Indian Physalia cornuta by Tilesius, 76, p. 42; and of the Pacific Physalia utriculus by Eschscholtz, 1, p. 163, Taf. xiv. figs. 2, 3; and in Cuvier's Règne Animal Illustré, Zoophytes, pl. 58, fig. 4.)

Genus 75b. Caravella, 1 Haeckel, 1888.

Definition.—Physalidæ with a polythalamous crest on the dorsal side of the large vesicular pneumatophore. Siphosome with several large main tentacles of about equal size.

The genus Caravella comprises those Physalidæ which agree in the possession of a polythalamous crest on the dorsal side of the large pneumatophore with the preceding true Physalia (s. restr.), but differ from them in the possession of numerous large main tentacles, besides a great number of small accessory tentacles (or palpacles). Caravella exhibits therefore the same relation to Physalia which the crestless Arethusa bears to Alophota. The cormidia are in Caravella polygastric and loose; the number of siphons

1 Caravella, the old name of Physalia as usually employed by the Italian and Spanish sailors (Medusa caravella, Linnae).
and tentacles very great; usually ten to twenty very large tentacles are intermingled with forty to sixty or more small ones. The size, too, of the pneumatophore is in this genus larger than in all other Physalidae and in all Siphonophore in general; its length attains in the largest specimens, fully expanded, 20 to 30 cm. or even more, its greatest breadth 8 to 10 cm.; the largest tentacles, fully expanded, attain a length of 20 to 30 metres or even more (40 to 50 feet, L. Agassiz, 36, p. 336).

Two species only of Caravella may be distinguished in our present incomplete knowledge of this genus, both inhabiting the Atlantic Ocean. The smaller species is Caravella gigantea (= Physalia gigantea, Bory, Physalia cystisoma, Lesson, partim); it occurs sometimes in the Southern Atlantic, and seems to be transported from there occasionally by westerly winds into the Indian Ocean. Captain Rabbie collected it between Madagascar and the Cape of Good Hope. All parts of the body are smaller and more delicate than in the following species. The number of large main tentacles is four to eight, rarely more. But the principal difference is found in the isolated position of the basal cormidium, which is placed at the distal end of the trunk. It is isolated by a wide interval from the voluminous main mass of clustered cormidia, which occupies the smaller posterior half of the ventral side of the trunk. The predominant colour seems to be in Caravella gigantea more purple and violet, in Caravella maxima more blue and greenish; it is subject, however, to many variations.

The larger species, and the largest of all the Physalidae, is the well-known Caravella maxima, which inhabits in great numbers the Tropical and Subtropical Atlantic, and especially the Gulf Stream. I observed it in great numbers during my residence in the Canary Islands, in December 1866 and January 1867, and also returning from there, in the Straits of Gibraltar, particularly in the Bay of Algesiras (in March 1867). It is also occasionally driven by westerly winds into the Mediterranean, which it seems not to inhabit permanently; several specimens are observed in single years on the shores of Italy (Naples, Messina, &c). Caravella maxima has been described as Medusa caravella by O. F. Müller and Gmelin, as Physalia caravella by Eschscholtz (1, p. 160, Taf. xiv. fig. 1). Numerous later authors have figured it under the name Physalia arethusa, as for example Tilesius, Chamisso, Olfers (79, Taf. i., ii.), and L. Agassiz (36, pl. xxxv.). Lamareck and Lesson (3, pl. xi.) call it Physalia pelagica. (For the synonymy and history of this celebrated species, compare Olfers and Lesson, loc. cit.) Caravella maxima is easily distinguished from the allied Caravella gigantea by the union of the basal cormidium with the other cormidia, all forming together a single clustered mass of crowded appendages, which covers the greater (posterior) half of the ventral side down to its basal apex. On its motions and habits, compare Olfers (79) and L. Agassiz (36, p. 336). The young larvae of Caravella maxima, which I observed at Christmas 1866 in Lanzerote, are very similar to those figured in Pl. XXVI. figs. 1, 2 (Cystonula).
BIBLIOGRAPHY OF THE SIPHONOPHORÆ.

A. Larger works, treating of the whole class or a great part of the different families; all of high systematic importance and permanent historical value:—

5. 1853. Leuckart, Rudolf, Die Schwimmpolypen, eine Zoologische Untersuchung, 95 pp.; with 3 plates.

B. Older works, with scattered observations on single forms, all before Eschscholtz (1775-1829):—

C. Works treating of different single parts of the class, or of its general organisation,
all after Eschscholtz (1830-1838):—

24. 1834. Blainville, Ducrotay de, Manuel d'Actinologie ou de Zoophytologie, pp. 111-140.
38. 1869. Haeckel, Ernst, Uber Arbeitsleistung in Natur und Mänschenleben. (Antho-entœ cannænænsis.)
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D. Monographs and smaller papers on single Disconectæ:—


E. Monographs and smaller papers on single Calyconectæ:—

63. 1830. LESSON, R. P., Centuries Zoologiques, pls. iv.--lvi. (Diphytes).


67. 1851. BUSCH, WILHELM, Beobachtungen über Anatomie und Entwicklung einiger wirbellosen Seethiere (Berlin).


F. Monographs and smaller papers on single Physocetae:—

G. Monographs and smaller papers on single Cystonectae:—

H. Ontogeny; Papers on the individual development of Siphonophore:—

I. Manuals and other Works respecting Siphonophore:—
91. 1817. Cuvier, G., Le règne animal, ed. 1, 1817, part iv.
92. 1870. Grenbaurn, Carl, Grundzüge der vergleichenden Anatomie, p. 117, &c.
95. 1888. Haeckel, Ernst, System der Siphonophoren, auf phylogenetischer Grundlage entworfen. Jenaische Zeitschrift, Bd. xx. p. 1. (A separate edition of this paper, the general part of which is translated as the Introduction to this Report, was published in December 1887.)
LIST OF FAMILIES, GENERA, AND SPECIES.

N.B.—This list is a complete catalogue of all the genera and species of Siphonophore 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.

Order I. DISCONECTÆ, Haeckel (System, 95, p. 29).

Family I. DISCALIDEÆ, Haeckel (System, 95, p. 29).

Genus 1. Discalia, Hkl. (95, p. 29).

Genus 2. Disconalia, Hkl. (95, p. 30).
5. Disconalia ramifera, Hkl. (?) (= Porpita ramifera, Eschscholtz?, 1, p. 178, Taf. xvi. fig. 3). Tropical Pacific (?).

Family II. PORPITIDÆ, Brandt (25, p. 40).

Genus 3. Porpalia, Hkl. (95, p. 30).
7. Porpalia globosa, Hkl. (= Porpita globosa, Esch., 1, p. 178, Taf. xvi. fig. 4). Tropical Atlantic (near the Cape Verde Islands).


16. *Porpita umbella*, Esch. (1, p. 179 =*Porpita gigantea*, Péron, 14, pl. xxxi. fig. 6). Tropical Atlantic (†).
19. *Porpita pacifica*, Lesson (22, pl. vii. fig. 3). Tropical Pacific (near Peru) (†).


22. *Rataria mitrata*, Esch. (1, p. 168, Taf. xvi. fig. 2). Tropical Atlantic, off the Cape Verde Islands (†).


REPORT ON THE SIPHONOPHORÆ.


30. *Velella cyanea*, Lesson (22, p. 54, pl. vi. figs. 3, 4). South Pacific (?).


32. *Armenista sigmoides*, Hkl. (Report, p. 84, Pl. XLIII). Tropical Atlantic and South Atlantic, Station 346.

33. *Armenista indica*, Hkl. (=*Velella indica*, Esch., 1, p. 175, Taf. xv. fig. 5). Indian Ocean.


Order II. CALYCOnectÆ, Haeckel (System, 95, p. 31).

Family IV. Eudoxiæ, Hkl. (System, 95, p. 32).


40. *Eudoxella didyma*, Hkl. (Morph. Siphon.). Tropical Atlantic, Station 343 (?)..


Genus 12b. **Cucullus**, Lesson (3, p. 458).


56. *Amphiroa alata*, Hxly. (9, p. 64, pl. v. fig. 1). Indian Ocean and Tropical Pacific.

57. *Amphiroa angulata*, Hxly. (9, p. 64, pl. v. fig. 2). South Pacific (?).

Genus 15. **Sphenoides**, Huxley (9, p. 61).


64. *Aglaisma elongata*, Hxly. (9, p. 61, pl. iv. fig. 3). Tropical Pacific.
REPORT ON THE SIPHONOPHORÆ.

Family V. Erseideæ, Haeckel (95, p. 33).


65. Ersea gaimardi, Esch. (1, Taf. xii. fig. 4). Mediterranean (?)?
67. Ersea dispar, Hkl. (= Endoxia bojani, Esch., 1, p. 125, Taf. xii. fig. 1). Tropical Pacific (?)?


68. Lilea medusina, Hkl. (Morph. Siphon.). Indian Ocean.

Family VI. Monophyideæ, Claus (70, p. 29).

Subfamily 1. Spheronectideæ, Huxley (9, p. 50).

Genus 18. Monophyes, Claus (70, p. 29).

70. Monophyes hydrorhous, Hkl. (= Spheronectes hydrorhous, Hkl., 95, p. 34). Tropical Atlantic (?)?
71. Monophyes diptrus, Hkl. (= Monophyes gracilis, larva, Chun, 87, Taf. ii. fig. 5). Mediterranean (?)?
72. Monophyes irregularis, Claus (70, p. 29, Taf. iv. figs. 16–18). Mediterranean.

Genus 19. Spheronectes, Huxley (9, p. 50).

73. Spheronectes kollikeri, Hxly. (9, p. 50, pl. iii. fig. 4). Indian Ocean and Tropical Pacific.
74. Spheronectes gracilis, Hkl. (= Monophyes gracilis, Claus, 70, p. 29, Taf. iv. figs. 8–14; Chun, 87, Taf. ii. figs. 1, 2). Mediterranean.

Genus 20. Mitrophyes, Hkl. (95, p. 34).


Subfamily 2. Cymbonectideæ, Hkl. (95, p. 34).

Genus 21. Cymbonectes, Hkl. (95, p. 34).

77. Cymbonectes mitra, Hkl. (= Diphyes mitra, Huxley, 9, p. 36, pl. i. fig. 4). Indian Ocean.
78. Cymbonectes cymba, Hkl. (Morph. Siphon.). Tropical Atlantic (?) (zool. Chall. exp.—part lxxvii.—1888.)

81. *Muggisea chamissonis*, Hkl. (=*Diphyes chamissonis*, Hxly., 9, p. 36, pl. i. fig. 3). Tropical Pacific.


Family VII. **Diphyidae**, Esch. (1, p. 122).

Subfamily 1. **Prayaide**, Kölliker (4, p. 33).


98. *Galeolaria australis*, Blainv. (24, p. 139; Huxley, 9, p. 38, pl. iii. fig. 5). Indian Ocean.


100. *Diphyes acuminata*, Leuck. (5, Taf. iii. figs. 11–19, and 8, Taf. xi. figs. 11–13). Mediterranean.


103. *Diphyes elongata*, Hyndman (64, p. 166). North Atlantic (?).

104. *Diphyes appendiculata*, Esch. (1, Taf. xii. fig. 7). Pacific Ocean.


Subfamily 3. ABYLIDE, L. Agassiz (36, p. 372).


112. *Abyla alata*, Hkl. (= *Abyla trigona*, Hxly.; 9, pl. iii. fig. 1). Indian and Tropical Pacific.

113. *Abyla leuckarti*, Hxly. (9, p. 49, pl. iii. fig. 2). South Pacific.


118. *Calpe pentagona*, Quoy et Gaim. (20, p. 11, pl. ii. A. figs. 1–7; =*Abyla pentagona*, Esch.).

Accurate description and figures by Kolliker (4, Taf. x.); Leuckart (5, Taf. iii. figs. 1–10; 8, Taf. xi. figs. 1–10); Gegenbaur (10, Taf. xxix.). Mediterranean.


Family VIII. *Desmophyidae*, Hkl. (95, p. 36).


Family IX. *Polyphyidae*, Chun (86, p. 12).


Genus 33. *Hippopodius*, Quoy et Gaim. (20, tom. x.).


124. *Hippopodius squamatus*, Hkl (Morph. Siphon.). South Atlantic (?).


Genus 34. *Polyphyses*, Hkl. (95, p. 36).


Order III. Physonect.æ, Haeckel (95, p. 38).

Family X. Circalidæ, Hkl. (95, p. 38).

Genus 36. Circalia, Hkl. (95, p. 38).


132. Circalia haphrhiza, Hkl. (=Physophora alba, Quoy et Gaim., 2, pl. i. figs. 1—9; =Haplorhiza alba, L. Agassiz, 36, p. 368). South Atlantic.

133. Circalia papillosa, Hkl. (=Agalma papillosum, Fewk., 44, pl. v. figs. 5, 6). Tropical Atlantic (?).

Family XI. Athoridæ, Hkl. (95, p. 38).


Genus 38. Athoralia, Hkl. (95, p. 39).


Family XII. Apolemidæ, Hxly. (9, p. 70).


138. Apolenia uvaria, Esch. (4, Taf. vi. figs. 6—9; 7, p. 319, Taf. xviii, figs. 1—4; 8, Taf. xii. figs. 8—11, &c.). Mediterranean.

Genus 40b. Apolemopsis, Brandt (25, p. 36).


Family XIII. Agalmyde, Brandt (25, p. 34).


Genus 41. Stephanomia, Péron et Lesueur (14).

141. Stephanomia amphitrites, Péron et Lesueur (14, pl. xxix. fig. 5; 9, p. 72, pl. vii.). Tropical Pacific.


Genus 42. Crystallodes, Hkl. (84, p. 43).


Genus 43. Phyllophysa, L. Agassiz (36, p. 369).

147. Phyllophysa squamacea, Hkl. (Morph. Siphon.). (=Stephanomia amphitrites, Hxly., 9, pl. vii.). South Pacific (?).

148. Phyllophysa foliacea, L. Agassiz (=Stephanomia foliacea, Quoy et Gaim., 2, pl. iii. figs. 8–12). Tropical Pacific (?).

Genus 44. Agalma, Esch. (21, p. 743; 1, p. 150).

149. Agalma okeni, Esch. (1, Taf. xiii. fig. 1; 21, Taf. v. fig. 17). North Pacific.

150. Agalma breve, Hxly. (9, p. 75, pl. vii.). South Pacific.


152. Agalma polygonata, Hkl. (=Crystallomia polygonata, Dana, 73, p. 459). North Pacific (?).


Subfamily 2. Anthemodinæ, Hkl. (95, p. 40).

Genus 45. Anthemoedes, Hkl. (38, p. 36).


156. *Cuneolaria incisa*, Eysenhardt (16, p. 369, pl. xxxiii. fig. 5). North Pacific (?).
157. *Cuneolaria imbricata*, L. Agassiz (=Stephanonia imbricata, Quoy et Gaim., 2, pl. iii. figs. 13–15). South Pacific (?).


159. *Halistemma punctatum*, L. Agassiz (36, p. 369; =Agalmopsis punctata, Koll., 4, Taf. iv.). South Mediterranean (?).


166. *Cupulita tergestina*, Hkl. (=Halistemma tergestinum, Claus, 74, Taf. i.–v.). Adriatic.


Family XIV. Forskalidæ, Hkl. (95, p. 42).

Genus 50. Strobalia, Hkl. (95, p. 42).

178. Forskalia atlantica, Hkl. (=Stephanomia atlantica, Fewk., 44, pl. v. fig. 1). Tropical Atlantic.


183. Bathypbyusa gigantea, Hkl. (Morph. Siphon.). South Atlantic, Station 323 (?)

Family XV. Nectaliidæ, Hkl. (95, p. 41).

Genus 54a. Nectalia, Hkl. (95, p. 41).

Genus 54b. Sphyrophysa, L. Agassiz (36, p. 368).
185. Sphyrophysa intermedia, L. Agassiz (=Physophora intermedia, Quoy et Gaim., 2, pl. i. figs. 10–18). Tropical Atlantic (?)

Family XVI. Discolabidæ, Hkl. (95, p. 41).

Genus 55. Physophora, Forskål (11, p. 119).
186. Physophora hydrostatica, Forskål (11, p. 119; Claus, 34, Taf. xxv.–xxvii.). North Mediterranean.
REPORT ON THE SIPHONOPHORÆ.

190. Physophora disticha, Lesson (22, pl. xvi. fig. 3). Tropical Pacific (?) 191. Physophora myzonema, Péron et Les. (14, pl. xxix. fig. 4). Tropical Atlantic (?)

193. Discolabe tetrasticha, Hkl. (Morph. Siphon.). North Atlantic (?)

Genus 57. Stephanospira, Ggbr. (10, p. 67).
195. Stephanospira insignis, Ggbr. (10, p. 67, figs. 53–56). Tropical Atlantic (?).

Family XVII. Anthophysidæ, Brandt (25, p. 35).
(Athorybidæ, Huxley, 9, pp. 71, 85).


198. Melophysa melo, Hkl. (=Athorybia melo?), Quoy, 2, pl. ii. figs. 7–12). Mediterranean (?)


Genus 61. Anthophysa, Mertens (25, p. 35).

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)

Hhhh 47
Order IV. AURONECTAE, Haeckel (95, p. 43).
Family XVIII. STEPHALIDÆ, Hkl. (95, p. 43).

Genus 62a. Stephalia, Hkl. (95, p. 43).


Family XIX. RHODALIDÆ, Hkl. (95, p. 43).

Genus 63. Auralia, Hkl. (95, p. 43).

209. Auralia globosa, Hkl. (=Angloopsis globosa, Fewk., 45, p. 972, pl. x. figs. 4, 5).  Tropical Atlantic (?).

Genus 64. Rhodalia, Hkl. (95, p. 43).


Order V. CYSTONECTAE, Haeckel (95, p. 44).
Family XX. CRYSTALIDÆ, Hkl. (95, p. 44).

Genus 65. Cystalia, Hkl. (95, p. 44).

211. Cystalia monogastrica, Hkl. (Report, p. 316, Pl. XXII. figs. 1–5).  Indian Ocean; South Pacific, Station 288.

Family XXI. RHIZOPHYSIDÆ, Bdt. (25, p. 33).

Subfamily I. CANNOPHYSIDÆ, Hkl. (95, p. 44).

Genus 66. Aurophysa, Hkl. (95, p. 44).

214. Aurophysa inermis, Hkl. (=Rhizophysa inermis, Studer, 40, p. 13, Taf. i. figs. 3, 8, 9, 10).  Indian Ocean.
REPORT ON THE SIPHONOPHORÆ.

Genus 67. *Cannophysa*, Hkl. (95, p. 44).


Genus 68. *Linophysa*, Hkl. (95, p. 45).

Genus 69. *Nectophysa*, Hkl. (95, p. 45).

Genus 70. *Pacumophysa*, Hkl. (95, p. 45).

222. *Rhizophysa planostoma*, Péron (14, pl. xxix. fig. 3). Tropical Atlantic.

Family XXII. *Salacidæ*, Hkl. (95, p. 45).


Genus 73b. Angela, Lesson (3, p. 496).

229. Angela cytherea, Less. (3, p. 496, pl. ix. fig. 1). Tropical Atlantic (?).

Family XXIV. Physalidæ, Brdt. (25, p. 36).


234. Arethusa thalia, Hkl. (Morph. Siphon.). Indian Ocean (?).


235. Physalia pelagica, Rose (Eyshlt., 77, p. 45, Tab. xxxv. fig. 2). South Atlantic.

236. Physalia cornuta, Til. (76, p. 42, Tab. i. figs. 15, 16). Indian Ocean (?).


238. Physalia megalista, Lamk. (Péron, 14, pl. xxix. fig. 1), Mertens (?) South Atlantic and Indian Ocean.


239. Caravella gigonera, Hkl. (=Physalia cystisoma, Lesson, partim; =Physalia gigonera, Bory; Postels et Mertens, Icon.). Tropical and Southern Atlantic.

240. Caravella maxima, Hkl. (=Physalia caravella, Esch., 1, Taf. xiv. fig. 1; =Physalia arethusa, Olfers, 79, Taf. i., ii.; L. Agassiz, 36, pl. xxxv.). Tropical and Northern Atlantic.
GLOSSARY.

N.B.—The signification of the characters is the same in all the Plates.

<table>
<thead>
<tr>
<th>Latin Scientific Term</th>
<th>English Term</th>
<th>German Term</th>
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<tbody>
<tr>
<td>a Truncus (Comosarc).</td>
<td>Common stem.</td>
<td>Stamm.</td>
</tr>
<tr>
<td>aa Apex trunci.</td>
<td>Top of the stem.</td>
<td>Scheitelpunkt.</td>
</tr>
<tr>
<td>ac Canales trunci.</td>
<td>Vessels of the trunk.</td>
<td>Stamm-Canäle.</td>
</tr>
<tr>
<td>ad Linea dorsalis trunci.</td>
<td>Dorsal line of the stem.</td>
<td>Stamm-Rückenlinie.</td>
</tr>
<tr>
<td>ai Internodia trunci.</td>
<td>Internodes of the trunk.</td>
<td>Stamm-Zwischenknoten.</td>
</tr>
<tr>
<td>ae Siphosoma (truncus nutritivus).</td>
<td>Nutritive body.</td>
<td>Nährkörper.</td>
</tr>
<tr>
<td>at Tubus trunci centralis.</td>
<td>Axial tube of the stem.</td>
<td>Axenrohr.</td>
</tr>
<tr>
<td>av Linea ventralis trunci.</td>
<td>Ventral line of the stem.</td>
<td>Stamm-Bauchlinie.</td>
</tr>
<tr>
<td>az Fulcrum trunci.</td>
<td>Supporting plate of the stem.</td>
<td>Stamm-Stützplatte.</td>
</tr>
<tr>
<td>ba Facies exumbrales bracteae.</td>
<td>Exumbrellar face of the bract.</td>
<td>Deckstück-Mantel.</td>
</tr>
<tr>
<td>bd Margo dorsalis.</td>
<td>Dorsal edge of the bract.</td>
<td>Rücken-Kante.</td>
</tr>
<tr>
<td>bl Margo sinister.</td>
<td>Left-hand edge.</td>
<td>Linke Kante.</td>
</tr>
<tr>
<td>bc Margo dexter.</td>
<td>Right-hand edge.</td>
<td>Rechte Kante.</td>
</tr>
<tr>
<td>c Canales (cana nutritiva).</td>
<td>Vessels.</td>
<td>Canälle.</td>
</tr>
<tr>
<td>cb Canalis bractealis</td>
<td>Canal of the bract.</td>
<td>Deckstück-Canal.</td>
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<tr>
<td>Latin Scientific Term</td>
<td>English Term</td>
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</tr>
<tr>
<td>cc Canalis circularis</td>
<td>Annular marginal vessel</td>
<td>Ring-Canal (am Schirmrande)</td>
</tr>
<tr>
<td>cd Canalis dorsalis</td>
<td>Dorsal radial vessel</td>
<td>Rücken-Canal</td>
</tr>
<tr>
<td>ce Canales palliales</td>
<td>Mantle-vessels</td>
<td>Mantel-Canäle</td>
</tr>
<tr>
<td>cf Canalis ovarii</td>
<td>Ovarial vessel</td>
<td>Eierstocks-Canal</td>
</tr>
<tr>
<td>cg Canalis gonophorae</td>
<td>Gonophoral vessel</td>
<td>Sexual-Canal</td>
</tr>
<tr>
<td>ch Canalis spermarii</td>
<td>Testicular vessel</td>
<td>Hoden-Canal</td>
</tr>
<tr>
<td>ci Canalis gemmali</td>
<td>Bud vessel</td>
<td>Knospen-Canal</td>
</tr>
<tr>
<td>cl Canales centreniae</td>
<td>Vessels of the central gland</td>
<td>Canäle der Centraldrüse</td>
</tr>
<tr>
<td>cm Canales hepatici</td>
<td>Left-hand radial vessel</td>
<td>Linker Radial-Canal</td>
</tr>
<tr>
<td>cn Canalis neotorphae</td>
<td>Nectocalycine duct</td>
<td>Leber-Canäle</td>
</tr>
<tr>
<td>co Canalis oleophorus</td>
<td>Oleocyst</td>
<td>Schwimmglocken-Canal</td>
</tr>
<tr>
<td>cp Canalis pedunculi</td>
<td>Pedicular vessel</td>
<td>Öhle</td>
</tr>
<tr>
<td>cq Canalis palponis</td>
<td>Hydrosystic vessel</td>
<td>Stiel-Canal</td>
</tr>
<tr>
<td>cr Canales radiales</td>
<td>Radial vessels</td>
<td>Taster-Canal</td>
</tr>
<tr>
<td>cs Canalis somatoyctis</td>
<td>Acrocyst or somatocyst</td>
<td>Radial Canäle</td>
</tr>
<tr>
<td>ct Canalis tentaculi</td>
<td>Tentacular vessel</td>
<td>Schirm-Canäle</td>
</tr>
<tr>
<td>cu Canales umbrellae</td>
<td>Vessels of the umbrella</td>
<td>Bauch-Canal</td>
</tr>
<tr>
<td>cv Canalis ventralis</td>
<td>Ventral radial vessel</td>
<td>Nieren-Canäle</td>
</tr>
<tr>
<td>cw Canales renales</td>
<td>Kidney-vessels</td>
<td>Rechter Radial-Canal</td>
</tr>
<tr>
<td>cx Canalis dexter</td>
<td>Right-hand radial vessel</td>
<td>Spadicin-Canäle</td>
</tr>
<tr>
<td>cy Canales spadecini</td>
<td>Spadicine vessels</td>
<td></td>
</tr>
<tr>
<td>cz Canalis coronalis</td>
<td>Coronal vessel of the subumbrella</td>
<td>Kranz-Canal</td>
</tr>
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<thead>
<tr>
<th>Latin Scientific Term</th>
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<tbody>
<tr>
<td>d Entoderma</td>
<td>Entoderm</td>
<td>Darmblatt</td>
</tr>
<tr>
<td>e Exoderma</td>
<td>Exoderm</td>
<td>Hautblatt</td>
</tr>
<tr>
<td>f Gynophorus (Gonophorus femininas)</td>
<td>Female Medusae</td>
<td>Weibchen</td>
</tr>
<tr>
<td>fe Canalis centralis gynophorae</td>
<td>Canal of the ovisac</td>
<td>Eierstocks-Canal</td>
</tr>
<tr>
<td>fm Ovarium (manubrium medusae)</td>
<td>Ovisac</td>
<td>Eierstock</td>
</tr>
<tr>
<td>fo Acini ovulorum</td>
<td>Egg-clusters</td>
<td>Eier-Trauben</td>
</tr>
<tr>
<td>fp Pedunculus gynophore</td>
<td>Pedicle of the gynophore</td>
<td>Weibchen-Stiel</td>
</tr>
<tr>
<td>fu Umbrella gynophore</td>
<td>Gynocalyx</td>
<td>Eierstocks-Schirm</td>
</tr>
<tr>
<td>fc Spadix feminina</td>
<td>Gynospadix</td>
<td>Eierstocks-Spadix</td>
</tr>
<tr>
<td>g Gonophorus (Medusae Sexuales)</td>
<td>Sexual Medusae</td>
<td>Geschlechts-Personen</td>
</tr>
<tr>
<td>ga Gonodendron (gonocormus)</td>
<td>Sexual cluster</td>
<td>Geschlechts-Traube</td>
</tr>
<tr>
<td>gb Cornugia sexualia</td>
<td>Branches of the sexual cluster</td>
<td>Geschlechts-Trauben-Aeste</td>
</tr>
<tr>
<td>gc Canalis centralis gynophore</td>
<td>Central canal of the gynophore</td>
<td>Canal der Geschlechts-Person</td>
</tr>
<tr>
<td>gf Gonodendron femininum</td>
<td>Female cluster</td>
<td>Weibliche Traube</td>
</tr>
<tr>
<td>gh Gonodendron masculinum</td>
<td>Male cluster</td>
<td>Männliche Traube</td>
</tr>
<tr>
<td>gk Cnidodes of the gonophores</td>
<td>Urticating nodes of the sexual Medusae</td>
<td>Nesselknoten der Geschlechts-Personen</td>
</tr>
<tr>
<td>gm Manubrium (gonales)</td>
<td>Gonoaceae</td>
<td>Geschlechts-Drißse</td>
</tr>
<tr>
<td>gp Pedunculus gonophore</td>
<td>Pedicle of the gonophore</td>
<td>Stiel der Geschlechts-Person</td>
</tr>
<tr>
<td>gq Gonopalpon (palpo sexualis)</td>
<td>Sexual taster</td>
<td>Geschlechts-Taster</td>
</tr>
<tr>
<td>gs Gonostylus (truncus gonodendri)</td>
<td>Stem of the sexual cluster</td>
<td>Stamm der Geschlechts-Traube</td>
</tr>
<tr>
<td>Latin Scientific Term</td>
<td>English Term</td>
<td>German Term</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>g₁ Gonuumbrella.</td>
<td>Umbrella of the gonophore.</td>
<td>Schirm der Geschlechts-Person.</td>
</tr>
<tr>
<td>h Androphorae (Gonophorae masculinae).</td>
<td>Male Medusæ.</td>
<td>Männchen.</td>
</tr>
<tr>
<td>h₅ Canalis centralis androphoræ.</td>
<td>Canal of the sperm-sac.</td>
<td>Hoden-Canal.</td>
</tr>
<tr>
<td>h₇ Pedunculus androphoræ.</td>
<td>Pedicle of the androphore.</td>
<td>Männchen-Stiel.</td>
</tr>
<tr>
<td>h₈ Sperma.</td>
<td>Sperm.</td>
<td>Samen.</td>
</tr>
<tr>
<td>k₃ Cnidoblasti grandiæ.</td>
<td>Large thread-cells.</td>
<td>Große Nessel-Zellen.</td>
</tr>
<tr>
<td>k₄ Cnidoblasti laterales.</td>
<td>Lateral thread-cells.</td>
<td>Seßliche Nessel-Zellen.</td>
</tr>
<tr>
<td>k₅ Cnidoblasti mediales.</td>
<td>Median thread-cells.</td>
<td>Mittlere Nessel-Zellen.</td>
</tr>
<tr>
<td>l₂ Basis aurophoræ.</td>
<td>Base of the aurophore.</td>
<td>Luftglocken-Grund.</td>
</tr>
<tr>
<td>l₉ Aurostigma (ostium externum).</td>
<td>Mouth of the auroduct.</td>
<td>Luftglocken-Mündung.</td>
</tr>
<tr>
<td>l₁₀ Pistillum.</td>
<td>Pistil of the aurophore.</td>
<td>Luftglocken-Stempel.</td>
</tr>
<tr>
<td>l₁₂ Septa radialis.</td>
<td>Radial septa (between them).</td>
<td>Radial-Septen.</td>
</tr>
<tr>
<td>l₁₃ Fulcrum aurophoræ.</td>
<td>Supporting plate.</td>
<td>Stützplatte der Luftglocke.</td>
</tr>
<tr>
<td>m Musculi.</td>
<td>Muscles.</td>
<td>Muskeln.</td>
</tr>
<tr>
<td>Latin Scientific Term</td>
<td>English Term</td>
<td>German Term</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>n Nectophora (nectocalyx)</td>
<td>Swimming-bells.</td>
<td>Schwimmglocken.</td>
</tr>
<tr>
<td>na Apex nectophora.</td>
<td>Top of the swimming-bell.</td>
<td>Schwimmglocken-Scheitel.</td>
</tr>
<tr>
<td>nd Ala dorsalis nectophoru.</td>
<td>Dorsal wing of the bell.</td>
<td>Rückenflügel der Schwimmglocke.</td>
</tr>
<tr>
<td>nk Margo coryphalis (crista sagittalis).</td>
<td>Sagittal crest of the nectocalyx.</td>
<td>Scheitel-Kante der Schwimmglocke.</td>
</tr>
<tr>
<td>nl Ala sinister nectophoru.</td>
<td>Left wing of the swimming-bell.</td>
<td>Linker Flügel der Schwimmglocke.</td>
</tr>
<tr>
<td>nm Musculi pedunculi.</td>
<td>Muscles of the pedicle.</td>
<td>Stiel muskel.</td>
</tr>
<tr>
<td>nn Nectophora specialis (Calycnecte).</td>
<td>Special nectophore.</td>
<td>Special-Schwimmglocke.</td>
</tr>
<tr>
<td>no Ostium nectophoru.</td>
<td>Mouth of the nectosac.</td>
<td>Schwimmhöhlen-Mündung.</td>
</tr>
<tr>
<td>np Pediculus nectophoru.</td>
<td>Pedicle of the nectophore.</td>
<td>Schwimmglocken-Stiel.</td>
</tr>
<tr>
<td>ns Canalis peduncularis.</td>
<td>Pediculal canal.</td>
<td>Frontal-Septum der Schwimmglocke.</td>
</tr>
<tr>
<td>nt Septum frontale nectophoru.</td>
<td>Septum between nectosac and hydrocricum.</td>
<td>Schirm-Gallerte.</td>
</tr>
<tr>
<td>nw Ala ventralis nectophoru.</td>
<td>Ventral wing of the bell.</td>
<td>Schwimm sack.</td>
</tr>
<tr>
<td>nxz Ala dextra nectophoru.</td>
<td>Right wing of the swimming-bell.</td>
<td>Zahnflügel der Schwimmglocke.</td>
</tr>
<tr>
<td>nz Ala dentata nectophoru.</td>
<td>Toothed wing of the bell.</td>
<td>Eier.</td>
</tr>
<tr>
<td>o6 Lecythus germinativus.</td>
<td>Protoplasma of the egg.</td>
<td>Schwimmblase.</td>
</tr>
<tr>
<td>pb Basis (pediculus) pneumatophoru.</td>
<td>Basal pedicle of the float.</td>
<td></td>
</tr>
</tbody>
</table>
REPORT ON THE SIPHONOPHORES.

LATIN SCIENTIFIC TERM.  
ENGLISH TERM.  
GERMAN TERM.


ph Cameræ concentrice pneumatochoe.  Ring-chambers of the float (Disconectae).  Ring-Kammern der Luftflasche.


pm Musculi longitudinales.  Radial muscles of the float.  Längs-Muskeln der Schwimmblase.


pr Septa radiales.  Radial septa (between them).  Luftrohren.

ps Pneumatoconus.  Circular muscles of the float.  Luftschirm.

pt Trachæ.  Air-tubules (Disconectae).


q Palpons (Hydrocystae).  Tasters (Feelers).  Trichter-Tors der Luftflasche.

qa Apex palponis.  Top of the taster.  Taster.

qb Basis palponis.  Base of the taster.  Taster-Basis.


qo Ocellus palponis.  Eye of the taster.  Taster-Auge.

qp Pedunculus palponis.  Pedicle of the taster.  Taster-Stiel.


sb Sipho centralis (Disconectarum).  Central polypite.  Central-Sipho.


se Fissurae gastrales.  Openings of the radial canals.  Gastral-Ostien.


so Osseum.  Mouth.  Mund.

sp Pedunculus siphonalis.  Pedicle of the polypite.  Sipho-Stiel.


ss Discus suctorialis.  Suctorial disc of the mouth.  Saugscheibe.

st Tabula gastrobasalis (Disconectarum).  Gastrobasal plate (between centralia and central siphon).  Magengrund-Platte.

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)
<table>
<thead>
<tr>
<th>Latin Scientific Term</th>
<th>English Term</th>
<th>German Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>tv</td>
<td>Tentacle</td>
<td>Fangfaden</td>
</tr>
<tr>
<td>ta</td>
<td>Ampullae tectill.</td>
<td>Terminal vesicle of the tentillum.</td>
</tr>
<tr>
<td>tl</td>
<td>Tactillum primarium.</td>
<td>Larval tectillum.</td>
</tr>
<tr>
<td>tf</td>
<td>Filum terminale tectill.</td>
<td>Terminal filament of the tentillum.</td>
</tr>
<tr>
<td>th</td>
<td>Involucrum mollis.</td>
<td>Mantle of the sacculus.</td>
</tr>
<tr>
<td>ti</td>
<td>Internalia tectill.</td>
<td>Internodes of the tectillum.</td>
</tr>
<tr>
<td>to</td>
<td>Nodi tectill.</td>
<td>Nodes of the tectillum.</td>
</tr>
<tr>
<td>tv</td>
<td>Pedunculus tectill.</td>
<td>Pedicle of the tectillum.</td>
</tr>
<tr>
<td>tz</td>
<td>Annulli tectill.</td>
<td>Rings of the tectillum.</td>
</tr>
<tr>
<td>tr</td>
<td>Tentilla (tactillae rami laterales).</td>
<td>Lateral branches of the tectillum.</td>
</tr>
<tr>
<td>tv</td>
<td>Insertio subumbilalis tectill (Disconectarum).</td>
<td>Insertional base of the tectillum.</td>
</tr>
<tr>
<td>tw</td>
<td>Illa tectill.</td>
<td>Insertional facets of the tectillum.</td>
</tr>
<tr>
<td>va</td>
<td>Apex umbrellae.</td>
<td>Top of the umbrella.</td>
</tr>
<tr>
<td>vb</td>
<td>Basis umbrellae.</td>
<td>Base of the umbrella.</td>
</tr>
<tr>
<td>wd</td>
<td>Facies dorsalis umbrellae.</td>
<td>Dorsal face.</td>
</tr>
<tr>
<td>we</td>
<td>Exumbrellae.</td>
<td>Convexity of the umbrella.</td>
</tr>
<tr>
<td>wg</td>
<td>Facies basalis umbrellae.</td>
<td>Basal face of the umbrella.</td>
</tr>
<tr>
<td>uh</td>
<td>Hepar (Disconectarum).</td>
<td>Liver (of the centralia).</td>
</tr>
</tbody>
</table>
REPORT ON THE SIPHONOPHORA.

<table>
<thead>
<tr>
<th>LATIN SCIENTIFIC TERM</th>
<th>ENGLISH TERM</th>
<th>GERMAN TERM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ul Facies sinistra umbrellae.</td>
<td>Left-hand face.</td>
<td>Linke Schirmfläche.</td>
</tr>
<tr>
<td>uu Nephros (Disconectarum).</td>
<td>Kidney (of the centralia).</td>
<td>Niere (der Central-Drüse).</td>
</tr>
<tr>
<td>un Ostium umbrellae.</td>
<td>Mouth of the umbrella.</td>
<td>Schirmhöhlen-Mündung.</td>
</tr>
<tr>
<td>up Pedunculus umbrellae.</td>
<td>Pedicle of the umbrella.</td>
<td>Schirm-Stiel.</td>
</tr>
<tr>
<td>vs Plicae radiales umbrellae (Disconectarum).</td>
<td>Radial folds of the umbrella.</td>
<td>Stern-Falten des Oberschirmes.</td>
</tr>
<tr>
<td>uu Limbus umbrellae.</td>
<td>Limb of the umbrella.</td>
<td>Schirm-Saum (der Disconecten).</td>
</tr>
<tr>
<td>us Facies ventralis umbrellae.</td>
<td>Ventral face.</td>
<td>Bauchfläche.</td>
</tr>
<tr>
<td>ue Cavitas umbrellae.</td>
<td>Concavity of the umbrella.</td>
<td>Unter-Schirm.</td>
</tr>
<tr>
<td>uv Facies dextra umbrellae.</td>
<td>Right-hand face.</td>
<td>Rechte Schirmfläche.</td>
</tr>
<tr>
<td>x Organa indefinita.</td>
<td>Undetermined organs.</td>
<td>Unbestimmte Organe.</td>
</tr>
<tr>
<td>z Fulcrum (Lamina fulcralis).</td>
<td>Supporting plate.</td>
<td>Stützplatte.</td>
</tr>
</tbody>
</table>
APPENDIX.

Statistical Synopsis of the numbers of families, genera, and species of Siphonophores enumerated in this Report:

<table>
<thead>
<tr>
<th>Orders</th>
<th>Plates of the Report</th>
<th>Pages of the Report</th>
<th>Families</th>
<th>Genera</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecte</td>
<td>XI-III.</td>
<td>26-88</td>
<td>3</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>II. Calycomete</td>
<td>XXVII-XXIII.</td>
<td>89-183</td>
<td>6</td>
<td>29</td>
<td>94</td>
</tr>
<tr>
<td>III. Physonete</td>
<td>VIII-XXI.</td>
<td>184-280</td>
<td>8</td>
<td>29</td>
<td>75</td>
</tr>
<tr>
<td>IV. Auronete</td>
<td>I-VII.</td>
<td>281-304</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>V. Cystonete</td>
<td>XXII-XXVI.</td>
<td>305-352</td>
<td>5</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>24</td>
<td>85</td>
<td>210</td>
</tr>
</tbody>
</table>
PLATE I.

Order **AURONECTÆ**.

Family **RHODALIDÆ**.

*Rhodalia miranda.*
PLATE I.

Rhodalia miranda, n. sp. (p. 302).

Fig. 1. Apical view of the corn (from above). The large spheroidal pneumatophore (p) is surrounded by the corona of pyriform nectophores (n). This corona is bisected in the sagittal axis by the aurophere (l) on the dorsal side, and by the series of buds (i) on the ventral side. v, Velum; w, opening of the nectosac. \( \times 2 \)

Fig. 2. A single cormidium, composed of a very contracted cylindrical siphon (s) and two gonodendra. One gonostyle bears a long sexual palpon (r). sh, Striae hepaticae; sr, proboscis; so, mouth. \( \times 15 \)

Fig. 3. A single gonodendron, with two main branches, bearing clusters of numerous pear-shaped ovaria (f) and scattered spindle-shaped spermaria (h). c, Spirally twisted canal of the contracted gonostyle. \( \times 15 \)

Fig. 4. Transverse section through a gonostyle, or the stem of a gonodendron. The transverse section through the basal pedicle of a siphon exhibits nearly the same structure. c, Central canal; d, entoderm; e, exoderm; z, structureless, cartilaginous, supporting plate; z', its radial branched apophyses covered outside by the transverse sections of longitudinal muscles (ml). Inside, between it and the entoderm, a thin layer of ring-muscles (命题). \( \times 70 \)

Fig. 5. A fragment of the same transverse section. Characters as in fig. 4. \( \times 200 \)
PLATE II.

Order AURONECTÆ.

Family RHODALIDÆ.

Rhodalia miranda
PLATE II.

*Rhodalia miranda*, n. sp. (p. 302).

Fig. 6. Basal view of the corm (from below). The tentacles are detached and the siphons highly contracted. The whole convex basal surface of the corm is covered by radish-shaped cormidia, each of which is usually composed of a siphon (s) and one or two gonodendra (g). The nectophores (n) form a peripheral corona. v, Velum; w, opening of the nectosac (compare p. 290). \( \times \) 2

Fig. 7. A single branch of a clustered gonodendron, with numerous pear-shaped gynophores and single, scattered, spindle-shaped androphores. \( \times \) 50

Fig. 8. A single branch of a gonodendron, with two monovonian and two polyovonian gynophores. \( \times \) 50

Fig. 9. Longitudinal section through a polyovonian gynophore. c, Gastral cavity; d, entoderm; e, exoderm; o, ovules; o', nucleolus (germinal spot); o^2, nucleus (germinal vesicle); o^3, protoplasm of the egg-cell (germinal yolk). \( \times \) 150

Fig. 10. Transverse section through a polyovonian gynophore. Characters as in fig. 9. \( \times \) 150

Fig. 11. A pyriform polyovonian gynophore, from the outside of which arise two secondary monovonian gynophores. \( \times \) 50

Fig. 12. An ovate monovonian gynophore, the umbrella of which exhibits eight distinct radial canals (instead of the usual four). \( \times \) 50
PLATE III.

Order AURONECTÆ.

Family RHODALIDÆ.

Rhodalia miranda.
PLATE III.

Rhodalia miranda, n. sp. (p. 302).

Fig. 13. Lateral view of the corm (from the left side), somewhat diagrammatic. The triple corona of nectophores may exhibit in the living animal a somewhat different form; all the nectophores of the spirit-specimens examined were strongly contracted and altered by the action of the alcohol; the majority, too, were detached from the stem. The siphons and tentacles were all detached from the trunk, also very highly contracted, and it is probable that they exhibit in living specimens a larger size and a more peculiar form. The upper half of the figure exhibits the nectosome from the left side; most nectophores in the right half of the figure are removed, in order to show the high insertions of their lamellar pedicles. Beyond the cap-shaped apical pneumatophore the dorsal aurophore is visible on the right hand. The lower half of the figure exhibits the siphosome, densely covered with numerous cormidia, each with a contracted siphon, a long tentacle, and a clustered gonodendron (compare p. 290), \( \times 2 \).

Fig. 14. Dorsal view of the same corm. The majority of the nectophores are removed from the trunk of the nectosome, the high insertions only of their lamellar pedicles being visible. A few nectophores remain on the right and left. Beyond the cap-shaped apical pneumatophore is visible in the median dorsal groove of the trunk the spheroidal aurophore, with its external opening, the aurostigma. The trunk of the siphosome (in the lower half of the figure), and the numerous cormidia covering it, are highly contracted; all the tentacles are detached; between the clustered gonodendra are visible the strongly retracted siphons, \( \times 2 \).
RHODALIA  MIRANDA.
PLATE IV.

Order AURONECTÆ.

Family RHODALIDÆ.

*Rhodalia miranda.*
PLATE IV.

*Rhodalia miranda*, n. sp. (p. 302).

Fig. 15. Sagittal section through the complete corm, in the vertical median plane. *p*, Pneumatophore; *pa*, its wide cavity filled with air; *f*, aurophore; *lm*, its pistil; *to*, its external opening (aurostigma); *i*, ventral series of buds; *n*, young ventral nectophore; *np*, peduncle of a dorsal nectophore; *a*, cartilaginous bulb of the trunk; *ac*, reticulum of the trunk vessels; *aa*, large flat hypocystic cavity of the trunk, beyond the pneumatophore; *ab*, cormidia; *g*, gonodendron; *r*, gonopalpon; *s*, siphon, . . . . . . . . . \( \times 2 \)

Fig. 16. Apical view of the corm (from above), after removal of the nectophores and the greatest part of the pneumatophore; the horizontal section lying somewhat above the bottom of the float (*pa*). The corona of white rays, which surrounds it, represents the transverse sections of the pedicels of the nectophores (*np*), and this is surrounded by the peripheral corona of cormidia (*g*). The auroduct (or the central canal of the aurophore, *la*) opens inside by the auropyle (*li*), outside by the aurostigma. *pl*, Foveola; *f*, aurophore (in the median line of the dorsal side); *br*, radial chambers of the aurophore; *i*, series of buds (in the median line of the ventral side); *v*, dorsal canal of the trunk (for the buds); *np*, peduncle of the nectophore; *g*, corona of the gonodendron. A single nectophore (*n*) remains. *v*, Velum; *w*, ostium of the subumbrella.

Fig. 17. Series of buds on the ventral side of a young corm (blastocrene of the siphosome), immediately beyond the pneumatophore. *n*, Young nectophore; *nc*, its ring-canal; *v*, velum; *vbr*, subumbrella; *ab*, cormidia, or groups of buds, developed in a spiral; each group being composed of a siphon (*s*) and a gonodendron (*g*). . . . . . . . \( \times 5 \)

Fig. 18. A young gonodendron, with two branches, one of which bears a long cylindrical palpon (*g*). *yn*, Gonostyle; *yc*, its canal; *y*, gonopores, . . . . . . . \( \times 10 \)

Fig. 19. A single siphon. *ps*, Pedicle; *ml*, longitudinal muscles of the stomach; *sh*, remnants of the hepatic stripes; *sr*, proboscis; *m*, mouth, . . . . . . . \( \times 1 \)

Fig. 20. A detached siphon, connected with its tentacle. *sp*, Pedicle of the siphon; *sh*, hepatic ridges; *sr*, proboscis; *t*, tentacle; *ts*, tentilla (compare pp. 290 to 292), . . . . . . . \( \times 5 \)

Fig. 21. Transverse section of a tentacle. *c*, Central canal; *d*, entoderm; *mc*, ring-muscles; *z*, fulcrum; *ml*, longitudinal muscles; *e*, exoderm (compare p. 292), . . . . . . . \( \times 100 \)

Fig. 22. A portion of a tentacle with the insertions of the tentilla (*ts*). *tr*, Rings of the tentacle, . . . \( \times 20 \)

Fig. 23. A single tentillum. *th*, Basal pedicle; *thb*, cnidoband; *tkl*, large lateral cnidocysts; *tkp*, small median cnidocysts; *tl*, elastic ligament (angle-band); *tf*, terminal filament, . . . \( \times 200 \)
RHODALIA MIRANDA.
PLATE V.

Order AURONECT.E.

Family RHODALIDÆ.

Rhodalia miranda.

PLATE V.

All the figures of this Plate, except figs. 30 and 31, represent different sections through the aurophore.

**Rhodalia miranda, n. sp.** (p. 302).

Fig. 24. Sagittal section through the aurophore and the neighbouring parts of the pneumatophore. The thick wall of the pyriform medusoid aurophore contains a lacunar system of wide irregular canals (e), separated by radial, irregularly branched septa. The auto-stigma (la), or the distal opening of the aurophore, leads into a narrow central axial canal (la), and the proximal end of this auroduct, the aurople (lf), opens into the large cavity of the pneumatocyst (pa). The auroduct is placed in the axis of a muscular cylinder, the pistil (lf), which fills up the subumbrellar cavity of the medusoid aurophore. The pistil is surrounded by a thickened cylindrical cuticular vagina (lf), seemingly the distal prolongation of the pneumatocyst (pf). ps, Pericycistic cavity (between outer, z, and inner, z', wall of the pneumatophore); ac, gastric canals of the trunk, traversing its hyaline cartilaginous jelly-substance (z); z, fulcrum; d, entoderm; e, exoderm, x 1

Fig. 25. Frontal section (or vertical transverse section) through the basal part of the aurophore of another specimen. la, Axial canal of the pistil; le, its lining epithelium (exodermal); l/ps, longitudinal muscles of the pistil (seen in transverse section); uf, vagina pistillii (cuticular tube); e 3, exoderm of the inner wall of the aurophore (subumbrella?); e 2, exoderm of its outer wall (exumbrella?); d, entoderm; z, fulcrum; l/r, radial pouches and lacunar canals, with radial septa between them. The upper part of the figure exhibits the insertion of the aurophore at the dorsal base of the pneumatophore. pf, Pneumatocyst; ps, cavity of the pneumatocyst, x 15

Fig. 26. Frontal section through the middle part of the aurophore of the same specimen. The characters are the same as in fig. 25, x 15

Fig. 27. A small fragment of the exumbrella (or the outer wall) of the aurophore, taken from the transverse section, fig. 26. Two inner folds of the exumbrella are seen in vertical section (through their lateral axis). e, Exoderm; z, fulcrum; d, entoderm, x 150

Fig. 28. A small portion of a longitudinal section through the pistil of the aurophore. la, Axial canal (auroductus); le, its epithelium; l/r, bundles of parallel, longitudinal, spindle-shaped cells (apparently muscle-cells); lu, their nuclei; outside is the vagina pistillii (cuticular tube, compare fig. 24), x 300

Fig. 29. Transverse section through a canal (ac) of the reticulum of the trunk; the entodermal epithelium (e) of the canal is simple, and surrounded by the hyaline structureless fundamental substance of the cartilaginous support, x 150

Fig. 30. A small portion of a vertical section through the pneumatooodon (or the exumbrella of the pneumatophore). One of the simple or forked bands of entoderm-cells (c), which traverse the cartilaginous fulcrum (e), connects the entoderm of the exumbrella (d) with its exoderm (c), x 150

Fig. 31. Lateral view of the inferior part of the lamellated peduncle of a nectophore. The fine parallel stripes (vertical in the figure) are horizontal (or radial) muscle-fibrilles (um). A strong peduncular canal (uc), arising from the trunk, runs along the inferior free horizontal margin of the peduncle (right hand of the figure), and gives off a series of twenty to thirty small, simple, secondary canals (um). These ascend vertically; their size decreases from the inner (axial) towards the outer (abaxial) margin of the peduncle, x 15
PLATE VI.

Order AURONECTÆ.

Family STEPHALIDÆ.

*Stephania bathyphysa.*
PLATE VI.

Stephonia bathyphysa, n. sp. (p. 299).

N.B.—Since this species was formerly confused by me with Stephalia corona, it bears the name of this species on the Plate.

Fig. 32. Lateral view of the corm, from the left side.  p, Pneumatophore;  t, aurophore;  n, nectophore;  s, siphons;  t, tentacles;  g, gonodendra;  ap, protosiphon.  × 4

Fig. 33. Dorsal view of the same corm. Characters as in fig. 32.  lo, Aurostigma.  × 4

Fig. 34. Apical portion of the siphosome of another corm, exhibiting the spiral series of young cormidia, which are developed immediately beyond the pneumatophore (p). The single cormidia are isolated and more highly magnified in figs. 35–38.  s, Siphons;  t, tentacles;  g, gonodendra;  n, nectophores.

Fig. 35. A group of six cormidia, arising from a common pedicle (ab). The numbers I.–VI. mark the succession in age and size;  I. is the youngest, VI. the oldest cormidium.  s, Siphons;  sch, stomach (with eight to twelve dark liver-stripes, sh);  sr, proboscis;  s′, the same reflexed;  t, the annulated tentacle;  tf, its terminal filament;  g, gonodendra.  × 20

Fig. 36. A very young cormidium, with a few buds.

Fig. 37. A single isolated cormidium. Characters as in fig. 35.  sp, Pedicle of siphon;  sh, basigaster;  g, gonopalpon.  × 20

Fig. 38. A single, well-developed cormidium, to the basal pedicle of which is attached a cluster of very young, incipient cormidia.  × 20
PLATE VII.

Order AURONECTÆ.

Family STEPHALIDÆ.

Stephalia corona.

Figs. 42, 46, Rhodalia miranda.)

(200L CHALL. EXP.—PART LXXVII.—1888.)—Hhhh.
**PLATE VII.**

*Stephalia corona*, n. sp. (p. 297).

Fig. 39. Lateral view of a young corm (in profile, from the right side).  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>P, Pneumatophore</td>
<td></td>
</tr>
<tr>
<td>t, aurophore</td>
<td></td>
</tr>
<tr>
<td>lo, auropyle</td>
<td></td>
</tr>
<tr>
<td>n, corona of neoporphes</td>
<td></td>
</tr>
<tr>
<td>wo, ostium of the nectosae</td>
<td></td>
</tr>
<tr>
<td>cr, ring-canal</td>
<td></td>
</tr>
<tr>
<td>s, siphons</td>
<td></td>
</tr>
<tr>
<td>t, tentacles</td>
<td></td>
</tr>
<tr>
<td>Below, central siphon (basal opening of the trunk)</td>
<td>( \times 10 )</td>
</tr>
</tbody>
</table>

Fig. 40. Sagittal section through the same corm; signification of the characters the same as in fig. 39. Beyond the pneumatophore (\( p \)) is visible the hypoeystic cavity (\( ah \)), and on its dorsal side the aurophyre (\( t \)). From the centre of the hypoeystic cavity arises the central axial canal (\( eo \)); it passes through the ventral axis of the cartilaginous trunk (\( e \)), giving off numerous anastomosing branches (\( ec \)), and opens through the mouth of the central siphon (\( ap \)).  
\( i \), Ventral series of buds. Each siphon (\( s \)) bears a simple tentacle (\( t \)) on the dorsal side of its base, but no gonodendron.  
Diam.

Fig. 41. The distal end of another corm.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>ao, The prostoma, or the basal mouth-opening of the primary siphon (afterwards the axilary canal, ( ca ), of the trunk, ( ap ))</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 42. A single siphon of *Rhodalia miranda*, with a tentacle.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
</table>
| sp, Pedicle; sh, basigaster; sq, stomach;  
| sl, hepatic ridges; sr, proboscis; so, mouth; tr, rings of the tentacle; tsh, its suspensorium;  
| tl, insertions of the tentilla (\( ts \)); these are lost in the distal part (at the right hand) | \( \times 10 \) |

Fig. 43. Two large ensiform cnidocytes, from the lateral series of the tentillum; \( A \), closed; \( B \), opened, with protruded enido-filament.  
Diam.

Fig. 44. Bud of a neotroph, in longitudinal section.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>np, Peduncle; vr, subumbrellar cavity; v, incipient velum; c, gastric cavity; d, entoderm; e, exoderm; z, fulerum</td>
<td>( \times 100 )</td>
</tr>
</tbody>
</table>

Fig. 45. Bud of a neotroph, in transverse section. Characters the same as in fig. 44. The four radial canals (\( nr \)) are visible, between the eanthamma (\( d \)).  
Diam.

Fig. 46. A mature androphore of *Rhodalia miranda*.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>hs, Spermarium; h, spadix; kr, radial canals of the umbrella; wo, ostium of the umbrella</td>
<td>( \times 50 )</td>
</tr>
</tbody>
</table>

Fig. 47. Muscle-epithelium of the outside of the pneumatophore.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>e, Exoderm-cells</td>
<td>( \times 300 )</td>
</tr>
</tbody>
</table>

Fig. 48. Lateral view of a corm of *Stephalia corona* (from the right side).  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>P, Pneumatophore</td>
<td></td>
</tr>
<tr>
<td>l, aurophore</td>
<td></td>
</tr>
<tr>
<td>n, neotrophes</td>
<td></td>
</tr>
<tr>
<td>np, their pedicles; vr, velum; s, siphons; so, their mouth-openings; g, gonophore-buds; ap, protosiphon</td>
<td>( \times 5 )</td>
</tr>
</tbody>
</table>

Fig. 49. A single cormidium of another specimen.  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
</table>
| ah, Common pedicle of the cormidium; s, siphon;  
| so, its mouth; pa, gonostyle; f, gyneophores; e, eggs; h, androphore; | \( \times 50 \) |

Fig. 50. A young larva (*Aurorula*).  
Diam.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Magnification</th>
</tr>
</thead>
</table>
| pa, Cavity of the pneumatophore; l, aurophore; lm, its pistil;  
| lo, aurostigma; ap, primary siphon; sc, its cavity; ao, its mouth; e, exoderm; d, entoderm; | \( \times 10 \) |
PLATE VIII.

Order PHYSONECTÆ.

Family FORSKALIDÆ.

Forskalia tholoides.
PLATE VIII.

_Forskalia tholoides_, n. sp. (p. 244).

Fig. 1. Lateral view of a complete corm, drawn by me from life in Lanzarote, in December 1866. The cupola-shaped neetosome bears on the top a small red pneumatophore, and is composed of very numerous neetophores, arranged like the scales of a fir-cone in a leiotropic spiral series. The siphosome exhibits numerous siphons which are attached to the axial stem by long radial pedicles, and arranged in a dexiotropic spiral series. The stomachs of the siphons are red. Each siphon bears on its base a long tentacle, beset with a series of numerous tentilla; the cnidobands of the latter are also pink. The whole surface of the siphosome is covered with large dentate bracts.

Figs. 2–5. Lateral view of four isolated neetophores (2 and 3 fully developed, 4 and 5 young ones). _np_, Triangular pedicle; _nb_, its base of insertion into the trunk; _ns_, canal of the pedicle; _nr_, four radial canals; _nc_, ring-canal; _v_, velum.
PLATE IX.

Order PHYSONECTÆ.

Family FORSKALIDÆ.

Forskalia tholoides.
PLATE IX.

*Forskalia tholoides*, n. sp. (p. 244).

Fig. 6. Apical view (from above) of a complete corm (without nectophores and bracts), preserved in spirit, in a state of extreme contraction. All the nectocalyces and the hydrophyllia are detached. The nectosome exhibits beyond the pneumatophore \( (p) \) a multiple series of small tubercles, the basal insertions of the pedicles of the detached nectophores \( (n) \). The shortened trunk of the siphosome \( (\alpha) \) is vesicular and inflated. The siphosome exhibits the dextrotropic spiral line in which the loose cormidia are arranged. \( s \), The contracted siphons; \( t \), tentacles; \( q \), palpons; \( r \), palpacles; \( i \), buds.

Fig. 7. A single loose cormidium, attached to the articulated trunk, with a single siphon and a single tentacle. The long extended pedicle of the siphon \( (sp) \) is covered by some denticulate bracts or hydrophyllia \( (b) \). From the thickened basal part of the siphon \( (sb) \) there arises the long articulated tentacle bearing numerous tentilla, each with a spiral cnidoband \( (k) \). The dilated stomach of the siphon \( (sm) \) exhibits sixteen longitudinal hepatic ridges \( (sh) \), eight longer alternating with eight shorter. \( sr \), Proboscis; \( so \), mouth. A pediculate gonopalpon \( (q) \) bears on its base a thin palpacle \( (r) \) and a clustered monostylic gonodendron, composed of proximal gynophores \( (f) \) and distal androphores \( (h) \). \( qp \), Pedicle of the palpon; behind the gonopalpon is a cyston; \( b \), bract; \( an \), nodal constrictions of the trunk, from which all the appendages arise; \( ai \), internodes; \( ac \), red central canal of the trunk.

Fig. 8. A single siphon, highly contracted. \( so \), Mouth; \( sl \), sixteen radial folds of the reflexed proboscis; \( sm \), stomach with sixteen red hepatic ridges; \( sb \), four square cnidal plates of the basigaster; \( sp \), pedicle of the siphon; \( t \), tentacle (arising in the constriction between pedicle and basigaster).

Fig. 9. Two cnidal nodes of the mouth-opening; from each arise two longitudinal glandular ridges, running between the muscles inside the proboses.
FORSKALIA THOLOIDES.
PLATE X.

Order PHYSONECTÆ.

Family F O R S K A L I DÆ.

Forskalia tholoides.
PLATE X.

Forskalia tholoides, n. sp. (p. 244).

Figs. 10–18. Different forms of detached hydrophyllia or bracts.

Fig. 10. Lateral view of a small bract.
Fig. 11. Facial view of the same.
Fig. 12. Lateral view of another small bract.
Fig. 13. Facial view of the same.
Fig. 14. Dorsal view of another bract.
Fig. 15. Lateral view (profile) of the same.
Fig. 16. Transverse section of the same.
Figs. 17, 18. Two larger bracts of different forms.

Fig. 19. An isolated cyston (q), with its palpacle or tasting filament (r). qp, Pedicle, compare p. 246.

Fig. 19—A, B, C. Three different states of contraction of the palpacle (fig. 19).

Fig. 20. A single palpon, separated from its pedicle by a basal cnidoring (qb) (p. 247).

Fig. 21. A single pediculate gonodendron. q, Gonopalpon or sexual palpon, bearing on its base a pair of crescentic cnidonodes (qb); ga, cluster of gonophores; f, gynophores; h, androphores; qp, gonostyle (common pedicle of the palpon and the gonodendron).

Fig. 22. An isolated androphore. wo, Umbrella aperture; hx, spadix; hs, spermarium; hp, pedicle.

Fig. 23. A single tentillum, arising from a nodal constriction of the tentacle (tn). ts, Pedicle; tk, cnidoband; tf, terminal filament.

Fig. 23—A, B, C, D. Four different stages of contraction of the terminal filament (tf; fig. 23).

Fig. 24. Apex of the pneumatophore, with four pairs of pigment radii (p. 244).
PLATE XI.

Order PHYSONECTÆ.

Family ANTHOPHYSIDÆ.

Athorybia ocellata.

(ZOOL. CHALL. EXP.—PART LXXVII.—1888)—IIIhh.
PLATE XI.

The figures of this Plate were painted by me from living specimens, which I observed in the Canary Island Lanzarote, December 29, 1866.

Athorybia ocellata, n. sp. (p. 276).

Fig. 1. Lateral view of the complete corn, in an expanded state, quietly floating at the surface of the sea ($xy$). The pneumatophore ($p$) bears a red pigment-cap and is surrounded by a corona of crescentic elegantly ribbed bracts ($b$). Between these are numerous prominent palpons ($q$), with a red ocellus on the apex ($qo$). Below depend five siphons and tentacles; $ss$, suetorial disc of the mouth.

Fig. 2. Apical view of the same corn (from above).

Fig. 3. A single siphon. $sp$, Pedicle; $sb$, basigaster; $sm$, stomach; $sr$, proboscis; $so$, mouth (p. 277).

Fig. 4. A single palpon. $qp$, Pedicle; $qo$, ocellus (with a lens?); $qc$, terminal corona of cnidocysts.

Fig. 5. Lateral view of the isolated pneumatophore.

Fig. 6. Apical view of the same, with the octoradate pigment-cap (mitra ocellaris).
ATHORYBIA OCELLATA
PLATE XII.

Order PHYSONECT.E.

Family ANTHOPHYSIDE.

Figs. 7-9. Anthophysa darwinii.
Figs. 10-18. Athorybia ocellata.
PLATE XII.

Figs. 7-9. Anthophysa darwini, n. sp. (p. 278).

Fig. 7. Dorsal view of the complete corm, after the detachment of the bracts. The ovate pneumatocyst (p) exhibits above an octoradiate pigment-star, below a corona of sixteen radial septa. bp, Basal insertions of the lamellar pedicles of bracts; ib, buds of bracts, on the top of the nectostyle; below, trunk of the nectosome; q, palpons.

Fig. 8. Lateral view of the same corm, without bracts (from the left side). Characters as in fig. 7. The ventral side of the pneumatophore is embraced by the cucullate nectostyle (am); (compare p. 279).

Fig. 9. Ventral view of the same corm. Characters as in fig. 7. Two bracts only (b, at the left hand) are preserved. is, Ventral series of buds of cormidia (in the median ventral line of the siphostyle, p. 270).

Figs. 10-18. Athorybia ocellata, n. sp. (p. 276, Pl. XI.).

Fig. 10. Longitudinal section through a contracted siphon. sp, Pedicle; sb, basigaster; sm, stomach; sv, hepatic villi; sr, proboscis; so, mouth.

Fig. 11. Ventral view of a tentillum. ts, Pedicle; tk, cnidosac; tc, lateral horns; ta, terminal ampulla.

Fig. 12. Dorsal view of a tentillum; tz, dorsal spur. Characters as in fig. 11.

Fig. 13. Lateral view of a tentillum (left side). Characters as in figs. 11, 12. (For the right hand ta read tz.)

Fig. 14. Transverse section of a bract. bc, Bracteal canal; bk, cnidal ribs on the dorsal side.

Fig. 15. Exodermal epithelium of the margin of a bract. br, Cnidal marginal band, with pigment; k, cnidocysts.

Fig. 16. Exodermal epithelium of a dorsal rib of a bract. bk, Patches of pigment and cnidocysts.

Fig. 17. A male gonodendron. gp, Its pedicle; h, androphores; hp, their pedicles; hx, spadix; hs, spermarium; wo, ostium umbrelle.

Fig. 18. A female gonodendron. gp, Its pedicle; f, gynophores; fp, their pedicles; o, eggs; wo, ostium umbrelle.
ATHORYBIA OCELLATA
PLATE XIII.

Order PHYSONECTÆ.

Family NECTALIDÆ.

Nectalia loligo.
\textit{Nectalia loligo,} n. sp. (p. 252).

Fig. 1. Lateral view of the complete corm. The trunk of the nectosome bears an apical pneumatophore ($p$), with pneumatocyst ($pf$), and two opposite rows of nectophores ($n$). The shortened trunk of the siphosome bears a corona of bracts, and beyond it siphons ($s$), palpons and tentacles ($t$); $in$, buds of nectophores.

Fig. 2. The same corm in the contracted state, after the detachment of the nectophores. $pf$, Pneumatocyst; $in$, buds of nectophores; $s$, buds of siphons; $sb$, Basigaster; $sm$, stomach; $sr$, hepatic villi; $sr$, proboscis; $so$, mouth; $pb$, cystoms; $yo$, their distal opening (anus?).

Fig. 3. The trunk alone, after the detachment of the appendages (lateral view from the left side). $am$, Necto-style (trunk of the nectosome); $p$, pneumatophore; $pf$, pneumatocyst; $in$, buds of nectophores; $as$, vesicular siphostyle (trunk of the siphosome); $is$, buds of siphons and palpons.

Fig. 4. The pneumatophore (much contracted in spirit). $px$, Apex; $pb$, basis; $pf$, pneumatocyst; $pr$, four radial septa; $ps$, pouches between them; $in$, buds of nectophores, $am$, trunk of the nectosome.

Fig. 5. A young nectophore, from the ventral side.

Fig. 6. An adult nectophore, from the dorsal side. $w$, Subumbrella; $cl$, left canal; $cr$, right canal; $cp$, pedicular canal; $v$, velum.

Fig. 7. Basal view of a nectophore. $no$, Ostium; $v$, velum; $ce$, ring-canal.

Fig. 8. Lateral view of a nectophore, from the left side. $cl$, Left canal; $cp$, pedicular canal.

Fig. 9. Ventral view of a sagittal bract. $bb$, Basal pedicle; $cb$, ventral canal of the bract.

Fig. 10. Lateral view of an intermediate (diagonal) bract. Characters as in fig. 9. $bc$, Dorsal crest.

Fig. 11. Dorsal view of a lateral bract. Characters as in figs. 9, 10.

Fig. 12. Lateral view of the same lateral bract.

Fig. 13. A siphon. $sb$, Basigaster; $sm$, stomach, with hepatic villi ($vr$); $sr$, proboscis; $so$, mouth.

Fig. 14. A tentillum (lateral branch of a tentacle). $ts$, Pedicle; $tk_{1p}$, basal ampulla; $tk_{1v}$, cnidoband; $tk_{1t}$, cnidose; $tk_{11p}$, terminal ampulla; $tf$, terminal filament.

Fig. 15. Two small paliform cnidocysts, from the distal portion of the cnidoband.

Fig. 16. Two large ellipsoidal cnidocysts, from the basal portion of the cnidoband.
PLATE X XIV.

Order PHYSONECTÆ.

Family AGALMIDÆ.

Anthemodes ordinata.
Fig. 1. The complete corm, in the expanded state. The nectosome (seen from the lateral side) is composed of a small apical pneumatophore and two opposite rows of nectophores. The long tubular trunk of the siphosome is densely covered with prismatic bracts, and bears numerous ordinate and equidistant cormidia, each composed of a siphon, a tentacle, a cyston, and two gonodendra, a male and a female. (Compare Pl. XV. fig. 5.)

Fig. 2. The nectosome of the same corm, seen from the ventral (or dorsal) side.

Fig. 3. A single nectophore, dorsal view (from above and outside).

Fig. 4. A single nectophore, lateral view (from the left side).
PLATE XV.

Order PHYSONECTÆ.

Family AGALMIDE.

_Anthemodes ordinata._
Anthemodes ordinata, n. sp. (p. 229).

Fig. 5. A single cormidium. s, Siphon; sm, stomach; sr, proboscis; ss, suctorial disc; t, tentacle; y, cyston; yo, its mouth (anus); b, bracts; cb, bracteal canal; h, androphores; f, gynophores.

Fig. 6. A single cormidium, attached to the trunk (a), without gonodendra. Characters as in fig. 5; ts, tentilla; k, cnidosac; so, mouth of the siphon.

Fig. 7. A single siphon. sp, Pedicle; sm, stomach; sr, hepatic villi (in four rows); sr, proboscis; so, mouth; t, tentacle; k, cnidosac.

Fig. 8. A single cyston. yp, Pedicle; y, excretory vesicle; ye, concretions; yo, mouth.

Fig. 9. Distal end of a cyston, with opened mouth, or rather anus (yo).

Fig. 10. Edges of a bract, with their rows of cnidocysts.

Fig. 11. A single tentillum. ts, Pedicle; tv, its villi; kq, large proximal cnidocysts; km, median paliform cnidocysts; below, distal pyriform cnidocysts; tf, terminal filament.

Fig. 12. A young tentillum with involucere. Characters as in fig. 11.

Fig. 13. A young tentillum without involucere. Characters as in fig. 11.

Fig. 14. A single androphore; hu, umbrella; hx, spadix; hc, central canal; hs, spermarium.

Fig. 15. A single gynophore. fp, Pedicle; cp, its canal; fu, umbrella; xm, network of spadicine canals; o, ovule; o₁, germinal spot; o₂, germinal vesicle; o₃, germinal yolk.
ANTHEMODES ORDINATA.
PLATE XVI.

Order PHYSONECTÆ.

Family AGALMIDE.

Lychnagalma vesicularia.
PLATE XVI.

Drawn by me from life in Ceylon, December 1881.

Lychnogalma vesicularia, n. sp. (p. 253).

Fig. 1. The complete corm in a living state, quietly floating on the surface, with expanded stem and tentacles. The biserial nectosome is composed of a small apical pneumatophore \((p)\), and ten pairs of opposite nectophores \((n)\). The long siphosome (the lower part of which is truncated) is densely covered with bracts and bears numerous loose cormidia. The hydrostatic terminal ampullae of the tentilla are directed upwards.

Fig. 2. The same corm, half dead, in a highly contracted state, after the detachment of most of the appendages; slightly magnified. \(a\), Trunk; \(i\), buds of nectophores; \(p\), pneumatophore; \(b\), bracts; \(s\), siphons; \(q\), palpons; \(t\), tentacles.

Fig. 3. A portion of the siphosome; slightly magnified. \(a\), Trunk; \(b\), bracts; \(sm\), siphons; \(ss\), suctorial disc of the mouth; \(g\), gonodendra.

Fig. 4. Pneumatophore. \(pp\), Pigment-cap \((mitra ocellaris)\); \(py\), pylorus infundibuli; \(pq\), radial pouches of the pericystic cavity; \(pr\), radial septa between them; \(i\), buds of nectophores; \(a\), trunk.

Fig. 5. Lateral view of a nectophore \((from the left side)\). \(np\), Pedicle; \(cl\), left radial canal; \(w\), subumbrella.

Fig. 6. Dorsal view of a nectophore. \(v\), Velum; \(k\), four cnidonodes on its basal insertion \((rudimentary tentacles)\).

Fig. 7. Lateral view of a bract \((in profile)\). \(bc\), Bracteal canal.

Fig. 8. Dorsal view of a bract \((from above)\). \(bc\), Bracteal canal.

Fig. 9. A single tentillum. \(ts\), Pedicle; \(th\), involucre; \(tk\), cnidoband; \(ta\), hydrostatic terminal ampulla; \(x\), oil-globule in its apex; \(te\), corona of eight \((contracted)\) radial filaments around its base.
PLATE XVII.

Order PHYSONECTÆ.

Family AGALMIDÆ.

*Crystallodes vitrea.*
PLATE XVII.

Drawn from life by me in Ceylon, in January 1882.

*Crystallodes vitrea*, n. sp. (p. 222).

Fig. 1. Lateral view of the complete corm (from the left side), whilst quietly floating on the surface, with horizontal trunk. The pneumatophore ($p$) is directed upwards. One series of nectophores ($n$) is dorsal, the opposite ventral. Five cormidia depend in the ventral median line of the siphosome, which is entirely covered with bracts ($b$), $\times 2$

Fig. 2. Dorsal view of the same corm. Characters as in fig. 1, $\times 2$

Fig. 3. Ventral view of the same corm. Characters as in fig. 1, $\times 2$

Fig. 4. A single cormidium. $sm$, Siphon; $sh$, liver; $sr$, proboscis; $m$, muscles; $so$, mouth; $t$, tentacles; $q$, palpons; $b$, bracts; $h$, androphores; $f$, gynophores, $\times 20$

Fig. 5. A single tentillum. $ts$, Pedicle; $th$, involucre; $tk$, cnidoband; $kg$, large basal cnidocysts; $km$, small paliform cnidocysts; $tc$, lateral horns; $ta$, terminal ampulla, $\times 200$

Figs. 6–13. Different views of nectophores, $\times 4$

Fig. 6. Dorsal view of two opposite nectophores. $a$, Trunk (in transverse section); $cf$, dorsal canal; $cl$, left canal; $cr$, right canal.

Fig. 7. Apical view of a nectophore. $np$, Pedicle of insertion.

Fig. 8. Basal view of a nectophore. $v$, Velum.

Fig. 9. Oblique ventral view of a nectophore.

Fig. 10. Oblique dorsal view of a nectophore.

Fig. 11. Apical view of a young nectophore.

Fig. 12. Lateral view of a young nectophore. $w$, Subumbrella.

Fig. 13. Oblique lateral view of a nectophore.

Figs. 14–16. Different views of bracts. $bc$, Bracteal canal, $\times 4$
PLATE XVIII.

Order PHYSONECTÆ.

Families APOLEMIDE et AGALMIDE.

Figs. 1–7. Dieymba diphyopsis.
Figs. 8–17. Agalma eschscholtzii.

Fig. 1. The entire corm, drawn from life, with expanded trunk, and twelve fully developed ordinate cormidia. *p*, Pneumatophore; *n*, neotophores; *w*, subumbrella; *v*, velum; *a*, axial trunk.

Fig. 2. A single cormidium. *s*, Siphon; *sh*, its four hepatic ridges; *sr*, proboscis; *sh*, basignaster; *t*, tentacle; *y*, cyston; *q*, palpons; *r*, palpacles; *b*, bracts; *h*, androphores; *f*, gynophores; *a*, trunk of the corm.

Fig. 3. A female gonodendron.

Fig. 4. A single female gonophore. *fu*, Umbrella; *o*, ovarium with a single egg, surrounded by a network of spadicine canals (*cy*); *uy*, ocelli of the margin; *cr*, radial canals.

Fig. 5. A male gonodendron.

Fig. 6. A single male gonophore. *hu*, Umbrella; *km*, spermarium; *cr*, radial canals.

Fig. 7. Transverse section through the trunk. *at*, Axial canal of the trunk; *d*, entoderm; *m*, longitudinal muscles; *e*, exoderm; *i*, bud in the ventral median line; *ad*, nerve in the dorsal median line.

Figs. 8-17. *Agalma eschscholtzii*, n. sp. (p. 226).

Fig. 8. The entire corm, drawn from life. The nectosome is composed of an apical pneumatophore (*p*) and four pairs of neotophores (*n*). The subcircular siphosome is densely covered with bracts (b); from its axial cavity issue below a number of siphons (e) and tentacles, palpons (q) and palpacles (v).

Fig. 9. A single neotophore, from the dorsal side. *w*, Subumbrella; *uy*, ocelli.

Fig. 10. A trilobate bract, from the dorsal side. *be*, Bracteal canal.

Fig. 11. A quinquelobate bract, from the dorsal side.

Fig. 12. A trilobate bract, in profile.

Fig. 13. A quinquelobate bract, in profile.

Fig. 14. A single tentillum. *tp*, Pedicel; *th*, involucrum; *th*, enidolaud; *ta*, terminal ampulla; *te*, paired lateral horns.

Fig. 15. A female gonodendron. *fu*, Umbrella of the gynophores; *o*, egg; *a*, trunk.

Fig. 16. A single gynophore. *fu*, Umbrella; *cr*, its four radial canals; *cr*, circular canal; *cy*, spadicine canals of the manubrium (around the egg); *o*, ovule.

Fig. 17. A male gonodendron. *a*, Trunk; *hu*, umbrella of the androphores; *km*, spermarium.
PLATE XIX.

Order PHYSONECTÆ.

Family DISCOLABIDÆ.

Discolabe quadrigata.
PLATE XIX.

Figs. 1-4 were drawn by me from life in Ceylon, in December 1881.

*Discolabe quadrigata*, n. sp. (p. 263).

Fig. 1. The complete corm, living and floating quietly on the surface of the sea. *p*, Pneumatophore; *n*, nectophores; *q*, palpons; *r*, palpacles; *s*, siphons; *t*, tentacles; *g*, gonodendra.

Fig. 2. Lateral view of a nectophore, from the right side. *np*, Pedicle; *cx*, right radial canal; *cc*, ring-canal.

Fig. 3. Dorsal view of a nectophore. *cl*, Left canal; *cx*, right canal; *no*, ostium of the nectosae.

Fig. 4. Basal view of a nectophore, from the outside. *np*, Pedicle on the ventral side; *cc*, ring-canal.

Figs. 5–8. Different larval stages (*Physonula*). Compare pp. 261, 262.

- Fig. 5. A young medusiform larva, with incipient tentacle (*t*). *b*, Umbrella (or bract); *p*, pneumatophore (pneumadenia of the umbrella); *s*, siphon; *so*, mouth.

- Fig. 6. A somewhat older larva, with sessile cnidodendron on the tentacle (*t*). Characters as in fig. 5. *s*, Cnidodendron on the distal end of the pedicular canal; *be*, bracteal canal; *q*, palpons.

- Fig. 7. An older larva, with pediculate tentilla on the tentacle (*t*). Characters as in figs. 5 and 6.

- Fig. 8. *Physonula* with two opposite primary nectophores (*n*), similar to *Dicyrula* (Pl. XVIII. fig. 1). The pedicle (*am*) of the single siphon (*s*) represents the trunk of the incipient polygastric corm. Characters as in figs. 5–7.
PLATE XX.

Order PHYSONECTÆ.

Family DISCOLABIDÆ.

Discolabe quadrigata.
PLATE XX.

Discolabe quadrigata, n. sp. (p. 263).

Figs. 9–13. Different views of the vesicular trunk, after detachment of the nectophores, palpons, siphons, and tentacles.  
- *p*, Pneumatophore; *pp*, pigment-cap (mitra ocellaris); *pr*, radial septa between the eight pouches of the pericystic cavity; *an*, spindle-shaped trunk of the nectosome; *ap*, convoluted longitudinal fold on its ventral median line, where the pedicles of the nectophores have been attached; *in*, buds of nectophores; *as*, discoidal trunk of the siphosome, spirally twisted in the form of a subcircular inflated bag; *af*, quadrangular facettes on the peripheral margin of the trunk of the siphosome, each facette corresponding to the insertion of a large palpon, and the small opening in its centre (*cq*) to the small canal which connects the cavities of the palpon and of the vesicular trunk. Attached to the inferior margin of each facette are two distylic clustered gonodendra; a larger proximal female cluster (*f*), composed of very numerous ovate gynophores; and a smaller distal male cluster (*h*) with a single large spindle-shaped gonopalpon (*gp*). The pedicles of the detached siphons are visible in the basal view (fig. 12, *sp*).

Fig. 9. Apical view of the trunk (from above).
Fig. 10. Lateral view of the trunk (from the left side).
Fig. 11. Ventral view of the trunk (from before).
Fig. 12. Basal view of the trunk (from below).
Fig. 13. Ventral view of a smaller trunk. A single siphon (*s*) and tentacle (*t*) have remained in this younger specimen attached to the stem.

Fig. 14. A single tentillum. *tp*, Distal portion of the inflated pedicle; *th*, vesicular involucrum; *ty*, ocellus in its wall; *tk*, spiral cnidoband.

Fig. 15. Apical view of the nectosome, exhibiting the cruciform arrangement of the four rows of nectophores (*n*) around the central pneumatocyst (*p*).

Fig. 16. A single complete cormidium, in the usual natural position of its component organs. *q*, Palpon (horizontal); *af*, facette of the trunk where the proximal base of the palpon is inserted; *cp*, canal of the palpon in the centre of the facette; *r*, palpacle; *gf*, clustered female gonodendron; *gh*, smaller male gonodendron; *gg*, its large gonopalpon; *hp*, insertions of pedicles of detached androphores; *s*, siphon (vertical); *so*, its distal mouth; *t*, tentacle; *ts*, tentilla; *ks*, cnidosacs.
PLATE XXI.

Order PHYSONECTÆ.

Families C IR C A L I DÆ et A TH O R I DÆ.

Figs. 1–4. Circalia stephanoma.
Figs. 5–8. Athoria larvalis.
Figs. 9–13. Larva Physonectarum.

(ZOOL. CHALL. EXP.—PART LXXVII.—1888.)—Hhhh.
Figs. 1-4. *Circalia stephanoma*, n. sp. (p. 198).

Fig. 1. The entire monogastric corm, drawn from life. *p*, Pneumatophore; *pf*, pneumatocyst; *pp*, pigment-cap; *pi*, pneumatocyst; *n*, corona of eight nectophores; *v*, velum; *gk*, male gonodendron; *gf*, female gonodendron; *q*, palpons; *r*, palpacles; *t*, tentacle; *s*, siphon; *sh*, liver-ridges; *sr*, proboscis; *ss*, suctorial mouth.

Fig. 2. Apical view of the half corm. Characters as in fig. 1.

Fig. 3. Basal view of the half corm. *ss*, Suctorial mouth; *h*, androphores; */, gynophores.

Fig. 4. Horizontal section through the pneumatophore. *pf*, Cavity of the pneumatocyst; *pq*, radial pouches of the pneumatophore; *ji*, radial septa between the pouches.

Figs. 5-8. *Athoria larvalis*, n. sp. (p. 202).

Fig. 5. The entire monogastric corm, drawn from life. *p*, Pneumatophore; *b*, corona of bracts; *q*, palpons; *r*, palpacles; *t*, tentacle; *s*, siphon; *ss*, suctorial disc of the mouth.

Fig. 6. Vertical frontal section through the axis of the corm (semi-diagrammatic). *p*, Pneumatophore; *pf*, pneumatocyst; *pc*, pericyastic cavity; *pi*, pneumatocyst; *at*, cavity of the trunk; *b*, bracts; *bc*, bracteal canal; *bs*, rudimentary nectosac of the bract; *cr*, its radial canals; *h*, cnidonodes on its mouth; *q*, palpon; *r*, palpacle; *h*, androphores; *f*, gynophores; *t*, tentacle; *ts*, tentilla; *sh*, basi-gaster; *sw*, stomach; *sr*, its hepatic villi; *sr*, proboscis; *ss*, suctorial mouth.

Fig. 7. A single bract. *bc*, Bracteal canal; *bs*, subumbrella; *h*, cnidonodes on its mouth.

Fig. 8. A single tentillum. *ts*, Pedicle; *tk*, spiral cnidoband; *lf*, terminal filament.

Figs. 9-13. Larvae *Physonectarum* (pp. 195, 200).

Fig. 9. Larva with a single bract (*b*). *p*, Pneumatophore; *s*, siphon; *so*, mouth; *t*, tentacle; *i*, buds.

Fig. 10. Larva with two opposite five-edged bracts (*b*). Characters as in fig. 9. *bs*, Nectosac.

Fig. 11. Larva with four cruciate trifid bracts (*b*) seen from the apex. *p*, Pneumatophore; *i*, buds; *h*, cnidonodes.

Fig. 12. Larva with a corona of five-edged bracts (*b*). Characters as in figs. 9, 10.

Fig. 13. Rudimentary tentillum. *ts*, Pedicle; *tk*, cnidosacs.
14 CIRCALIA STEPHANOMA. 513 ATHORIA LARVALIS
PLATE XXII.

Order CYSTONECTAE.

Families Cystalidae et Epibulidae.

Figs. 1–5. Cystalia monogastrica.
Figs. 6–8. Epibulia ritteriana.
The figures of this Plate were drawn by me from life in Ceylon, in December 1881 and January 1882.

Figs. 1-5. *Crystalia monogastrica*, n. sp. (p. 316).

Fig. 1. Larva of an early stage, near to the gastrula. The spindle-shaped body is composed of a small-celled ciliated exoderm (e) and a large-celled entoderm (l). The incipient pneumatophore (p) is a simple invagination of the apical pole.

Fig. 2. Larva of a second stage. The medusiform body is divided by a transverse constriction into an apical and a basal half; the former includes the pneumatophore (containing an air-bubble), and is homologous with the umbrella; the latter includes the gastric cavity (sc), and is the primary siphon. From the constriction arises a simple tentacle (t). The distal end of the siphon has a mouth-opening (so). ps, Pneumatocoele; pf, pneumatocyst.

Fig. 3. Larva of a third stage, differing from the preceding (fig. 2) in the formation of a bud (palpon), which arises from the ventral side of the transverse constriction (d), opposite to the dorsal tentacle (t). Characters as in figs. 1, 2.

Fig. 4. Larva of a fourth stage. A corona of buds (palpons) arises from the base of the siphon below the float. The tentacle (t) bears a series of simple filiform tentilla (As).

Fig. 5. A mature corm of *Crystalia monogastrica*, representing a single cormidium. p, Pneumatophore; pf, pneumatocyst filled with air; pi, pneumatochone; q, palpons; sh, basigaster; sh, hepatic villi of the stomach; sr, proboscis; ss, mouth; t, tentacle; gd, monostylic gonodendron.

Figs. 6-8. *Epibulia ritteriana*, n. sp. (p. 335).

Fig. 6. A mature corm of *Epibulia ritteriana*. p, Pneumatophore (compare the sections in figs. 7 and 8); q, palpons; eo, ocelli; s, siphons; sh, hepatic villi; ss, mouth; t, tentacles; ts, tentilla; gd, gonodendra.

Fig. 7. Vertical section through the axis of the pneumatophore. po, Apical ostium; pu, pneumatoeodon; ps, pneumatoeoaecus; pp, pigment-cap (mitra ocellaris); pf, pneumatocyst; pf, pylorus infundibuli; pi, infundibulm (pneumatocoele); pe, pericystic cavity; pd, endocystic tapetum; ps, hypocystic villi; at, cavity of the trunk.

Fig. 8. Horizontal section through the pneumatophore. Characters as in fig. 7.
1-5. Cystalia monogastrica. 6, 8. Epibula Ritteriana.
PLATE XXIII.

Order CYSTONECT.E.

Family RHIZOPHYSID.E.

Nectophyes wyvillei.
The figures of this Plate were drawn by me from living specimens in the Canary Island Lanzerote, December 26, 1866.

*Nectophyse wyvillei*, n. sp. (p. 327).

Fig. 1. A complete corm, in the expanded state, quietly floating on the surface. 
\( \rho, \) Pneumatophore; \( \rho o, \) its apical stigma; \( \rho v, \) hypoeystic villi; \( a, \) trunk: \( s, \) siphons; \( t, \) tentacles; \( ga, \) gonodendra, . . . . nat. size

Fig. 2. A complete larger corm, in the expanded state, with twisted trunk, reposing on the bottom of the glass vessel. The suctoriel mouth-discs of the lower siphons are attached to the wall of the vessel. Characters as in fig. 1, . . . . . . . . . . . nat. size

Fig. 3. A complete corm (the same as fig. 1) in the contracted state, with shortened and thickened trunk, coiled up in a dextrotrropic spiral. An air-bubble (\( x \)) is being expelled through the apical stigma (\( po \)) of the pneumatophore; \( pf, \) pneumatoecyst; \( pp, \) pigment-cap (mitra ocellaris); \( pv, \) hypoeystic villi, . . . . . . . \( \times 4 \)

Fig. 4. Uppermost portion of the fully contracted trunk. The pneumatoecyst (\( pf' \)) is nearly evacuated and the greatest part of the gas expelled through the apical stigma (\( po \)). The hypoeystic villi (\( pv \)) are thrown into the vesicular inflated apical portion of the trunk (\( a \)); \( i, \) buds; \( ga, \) gonodendra; \( s, \) siphons, . . . . . . . . \( \times 10 \)

Fig. 5. A single siphon, with its tentacle (\( t \)) attached to the trunk (\( at \)); \( ts, \) tentilla, . . . . . . . . . . . . . . . . \( \times 20 \)

Fig. 6. A small portion of a tentillum. \( kc, \) Cnidocysts; \( tw, \) palpoblasts, . . \( \times 300 \)

Fig. 7. A single cnidocyst with the included cnidofilament, . . . . . . . . \( \times 900 \)

Fig. 8. A single branch of a gonodendron. \( gg, \) Gonopalpon; \( h, \) androphores; \( ke, \) spadix; \( hs, \) sperma; \( f, \) gynophore; \( fm, \) its rudimentary manubrium; \( uw, \) subumbrellar cavity, . . . . . . . . \( \times 50 \)
PLATE XXIV.

Order CYSTONECTÆ.

Family RHIZOPHYSIDÆ.

Camophysa muirayana.
The figures of this Plate were drawn by me from living specimens in the Canary Island Lanzerote, January 7, 1867.

*Cannophysa murrayana*, n. sp. (p. 324).

Fig. 1. An adult corm, with large ripe gonodendra of a golden colour attached to the yellow trunk near the base of the rose-coloured siphons. The cylindrical trunk is twisted in a dextriotropic spiral. The apical pneumatocyst is rather expanded. The animal reposes quietly on the bottom of the glass vessel.

Fig. 2. The same corm, in the highly contracted state, seen from above. *p*, Pneumatocyst; *g*, gonodendron; *s*, siphon.

Fig. 3. A young corm, without gonodendra, in the expanded state. The rose-coloured siphons arise from the yellow trunk at equal distances. *a*, Trunk; *p*, pneumatophore; *s*, siphons; *t*, tentacles.

Fig. 4. The pneumatophore. *po*, Apical stigma; *pp*, pigment-cap (mitra ocellaris); *pf*, pneumatocyst filled with gas; *pd*, tapetum endocystale; *pr*, hypocystic villi; *i*, buds; *s*, siphons.

Fig. 5. Oblique apical view of the same pneumatophore. *po*, Apical stigma, open; *pp*, mitra ocellaris; *pm*, radial fibres of the muscular dilatator; *pm*, circular fibres of the muscular sphincter; *pz*, hypocystic villi; *p*, pneumatocodon.

Fig. 6. A group of hypocystic villi. Each villus consists of a few gigantic exoderm cells and a covering epithelium of numerous small ciliated entoderm cells (*pz*).

Fig. 7. Three greenish exoderm cells of the pneumadenia, taken from the endocystic tapetum.

Fig. 8. A single tentacle, arising from the base of the siphon (*s*). *ts*, Tentilla; *tc*, simple terminal appendage of the tentacle (without tentilla); *a*, stem.

Fig. 9. A single tentillum. *ts*, Villi of the pedicle; *tu*, terminal ampulla; *tf*, its distal appendage; *tc*, lateral horns.
CANNOPHYSA MURRAYANA
PLATE XXV.

Order CYSTONECTÆ.

Family SALACIDÆ.

Salacia polygastrica.

Fig. 1. A complete corm. The large ovate pneumatophore exhibits the enclosed pneumatocyst and the hypocystic villi. The long tubular trunk bears a series of numerous ordinate polygastric cormidia, separated by free naked internodes, \( \times 4 \)

Fig. 2. Transverse section through the pneumatophore in the equatorial plane. 
- \( p\text{ii} \), Pneumatochone (infundibulum pneumaticum); 
- \( p\text{y} \), pylorus infundibuli; 
- \( p\text{v} \), hypocystic villi; 
- \( p\text{u} \), pneumatocondon (umbrella pneumatica), \( \times 8 \)

Fig. 3. Apical view of the pneumatophore (from above). 
- \( p\text{o} \), Central stigma (apical ostium); 
- \( p\text{m} \), radial muscles (dilatator stigmatis), round which is seen the mitra ocellaris (corona of eight radial pigment-lobes); 
- \( p\text{v} \), hypocystic villi, \( \times 8 \)

Fig. 4. A single (polygastric and monoclinic) cormidium, attached to the stem. 
- \( s \), Siphons; 
- \( s\text{o} \), suctorial disc; 
- \( t \), tentacle; 
- \( g \), gonodendron, \( \times 8 \)

Fig. 5. A single siphon with its tentacle (\( t \)) attached to the trunk. 
- \( g \), Gonostyle; 
- \( s\text{b} \), basigaster; 
- \( s\text{m} \), stomach; 
- \( s\text{v} \), hepatic villi; 
- \( s\text{r} \), proboscis; 
- \( s\text{o} \), mouth, \( \times 20 \)

Fig. 6. A single (monostylic) gonodendron, attached to the stem (\( a \)) and exhibiting the ramification of the gonostyle (\( g\text{s} \)). The majority of the numerous branches and gonophores have been removed. 
- \( f \), Gynophores; 
- \( h \), androphores; 
- \( g\text{q} \), gonopalpons, \( \times 20 \)

Fig. 7. A single branch of the (monostylic) gonodendron. Characters as in fig. 6, \( \times 50 \)
PLATE XXVI.

Order CYSTONECTÆ.

Family PHYSALIDÆ.

Figs. 1–3. Alophota Giltschiana.
Figs. 4–8. Arethusa Challengeri.
The figures of this Plate were painted by me from living specimens in the Canary Island Lanzarote, December 1866.

**Figs. 1–3. Alophota giltschiana, n. sp. (p. 348).**

Fig. 1. A young larva (*Cystonula*) 2 to 4 mm. in length. The complete body represents a single medusome, the modified umbrella of which is the pneumatophore (*pf*), the manubrium is the siphon (*s*). From the pedicle of the siphon (or the incipient trunk, *a*) arises a tentacle (*t*). The inside of the siphon bears hepatic villi (*sv*), and its terminal mouth forms a square suetorial disc (*ss*). The apex of the float opens by a stigma (*po*), \(\times 20\).

Fig. 2. An older larva 8 mm. in length. The trunk (*a*) of the small corm encloses an ovate pneumatosac (*pf*) in its apical half, and bears the primary siphon (or protosiphon, *sv*) on the distal pole of the sub-horizontal main axis. From the middle third of its ventral side arise three small cormidia, each of which is composed of a secondary siphon, a palpon, and a tentacle; *po*, apical stigma, \(\times 8\).

Fig. 3. A mature corm of *Alophota giltschiana*, seen from the right side. The pneumatosac (*pf*) fills the greatest part of the vesicular trunk. *po*, The apical stigma (on the anterior end). The basal (or posterior) end of the trunk bears the primary siphon (*sv*) with a palpon and a tentacle; *sv*, mouth of siphon. The ventral side of the trunk bears an ordinate series of five cormidia, each composed of a secondary siphon (*s*), a palpon (*bo*), a tentacle (*t*), and a gonodendron (*g*), \(\times 4\).

**Figs. 4–8. Arethusa challengeri, n. sp. (p. 349).**

Fig. 4. Lateral view of a mature corm, from the right side. The oblongish pneumatosac (*pf*) fills only two-thirds of the vesicular trunk. *po*, Apical stigma. The sterile protosiphon (*sv*), at the basal or distal pole of the horizontal axis, is separated by a group of small palpons from the ventral series of fertile metasiphons (*s*); the larger of these bear on the right side a rose-coloured gonodendron (*g*), \(\times 2\).

Fig. 5. Lateral view of a larger corm, in a much contracted state, from the left side. The pneumatosac (*pf*) strongly contracted, with an annular constriction, expels gas through the apical stigma (*po*). The numerous tentacles are spirally coiled up, \(\text{nat. size}\).

Fig. 6. A single cormidium, isolated. The simple common pedicle (*ap*), arising from the ventral side of the trunk, bears a large tentacle (*t*), with a basal ampulla (*to*), a clustered gonodendron (*g*), and a contracted siphon with four segments; *sp*, siphalonal pedicle; *sh*, basigaster, *sv*, stomach with black hepatic villi; *sr*, proboscis; *st*, mouth, \(\times 10\).

Fig. 7. A very young tentacle (*t*) with its basal ampulla (*to*), \(\times 40\).

Fig. 8. A single branch of a gonodendron. *gs*, Gonostyle; *g*, gonopalpons; *h*, androphores (male medusomes); *f*, gynophore (female medusome), \(\times 20\).
ALOPHOTA GILTSCHIANA.
PLATE XXVII.

Order CALYCONECTÆ.

Family MONOPHYIDÆ.

Figs. 1–12. Cymbonectes huxleyi.
Figs. 13, 14. Monophyes princeps.
PLATE XXVII.

Figs. 1–12 of this Plate were drawn by me from life in Ceylon, in December 1881.

Figs. 1–12. *Cymbonectes huxleyi*, n. sp. (p. 134).

Fig. 1. The entire corn with expanded stem. From the hydroecial groove of the single nectophore proceeds a long tubular stem, which bears eight or nine well-developed dicyclic cormidia, alternating males and females. The signification of the characters is the same as in figs. 2–4.

Fig. 2. Dorsal view of the nectophore. *co*, Somatocyst; *co*, oleocyst; *cx*, right canal; *cl*, left canal; *w*, subumbrella; *ad*, dorsal edge of the umbrella.

Fig. 3. Ventral view of the nectophore. *a*, Apical part of the trunk; *wa*, right wing; *nl*, left wing of the ventral side of the exumbrella, protecting the hydroecial canal.

Fig. 4. Horizontal transverse section through the middle part of the nectophore. *w*, Subumbrella; *wec*, its cavity; *cl*, dorsal canal; *cr*, right canal; *ad*, dorsal edge of the exumbrella; *wa*, right ventral wing; *nl*, left ventral wing; *mi*, hydroecial canal; *a*, trunk of the siphosome.

Fig. 5. A single female cormidium. *b*, Bract; *bc*, phyllocyst; *co*, oleocyst; *a*, trunk; *s*, siphon; *sb*, basigaster; *sm*, stomach; *sr*, proboscis; *ss*, suctorial disc; *f*, gynophore; *cr*, its radial canals; *o*, ovary, *n*, ovarium, *p*, part.

Fig. 6. A single male cormidium. *b*, Bract; *bc*, phyllocyst; *co*, oleocyst; *a*, trunk; *s*, siphon; *l*, tentacle; *h*, androphore; *hs*, spadix; *hs*, spermarium; *mo*, ostium umbrella.

Fig. 7. Longitudinal section through a single siphon, in a highly contracted state, with the neighboring parts. *bc*, Phyllocyst; *co*, oleocyst; *l*, tentacle; *ts*, tentilla; *sb*, basigaster; *sm*, stomach; *sr*, proboscis; *mo*, mouth.

Fig. 8. A single tentillum. *ts*, Pedicle; *tk*, cnidosac; *k*, small reniform lateral cnidocysts; *km*, small paliform median cnidocysts; *kp*, small pyriform distal cnidocysts; *tf*, terminal filament.

Figs. 9–12. Four different larval stages (*Calycocata*) of *Cymbonectes huxleyi*, arising from the fertilized egg. Each larva is a single medusome, the manubrium of which (or the primary siphon, *) has been protruded through the ventral fissure of the umbrella (or the primary nectophore, *n*). *s*, Exoderm; *d*, entoderm; *l*, tentacle; *w*, subumbrella; *v*, velum.


Fig. 13. Lateral view of the nectophore, from the left side. *co*, Somatocyst; *co*, oleocyst; *cl*, dorsal canal; *cl*, left canal; *cr*, right canal; *co*, ventral canal; *v*, velum; *as*, trunk.

Fig. 14. Horizontal transverse section through the middle part of the nectophore. Characters as in fig. 4.
PLATE XXVIII.

Order CALYCONECTÆ.

Family MONOPHYIDÆ.

Mitrophyes peltifera.
Mitrophyes peltifera, n. sp. (p. 131).

Fig. 1. The complete corm, with expanded stem; the apical bract (b) and the nectophore half in dorsal, half in lateral view (from the right side). cr, Ventral canal; cd, dorsal canal; cx, right canal; cb, bracteal canal; v, velum. The trunk of the dioecious siphosome is fully expanded and bears numerous ordinate cormidia. x 10

Fig. 2. The same corm, with contracted siphosome (a); the apical bract (b) is reflected to show its pedicle and the union with the nectophore (n). Characters as in fig. 1. ab, Cormidia; x 10

Fig. 3. A single female cormidium. a, Trunk; b, bract; s, siphon; sm, stomach; sr, proboscis; so, mouth; kc, cnidocytes; t, tentacle; f, gynophore; o, eggs; v, velum; w, subumbrella. x 100

Fig. 4. A gynophore, with the included ovarium, isolated. o, Eggs; wo, ostium umbrellae; v, velum. x 150

Fig. 5. A single male cormidium. Characters as in fig. 3. b, Androphore; wo, ostium of the umbrella; sb, basigaster. x 100

Fig. 6. An androphore, with the included spermarium, isolated. bx, Axial spadix; bs, sperma; wo, ostium umbrellae. x 150

Fig. 7. Apical portion of the trunk, with the connection of the apical bract (b) and the nectophore. bp, Pedicle of the bract; cb, bracteal duct; cs, somatocyst; wi, rudimentary hydreaicum; a, trunk; i, buds of cormidia; cn, nectophoral duct; cr, ventral canal; cd, dorsal canal; cx, right canal; cl, left canal. (Compare fig. 2). x 40

Fig. 8. A single tentillum. kg, Large lateral cnidocytes; m, small median cnidocytes; kp, distal pyriform cnidocytes; tf, terminal filament, spirally coiled up. x 300
PLATE XXIX.

Order CALYCONECTÆ.

Family POLYPHYIDÆ.

Figs. 1–8. *Polyphyes ungulata*.
Figs. 9–14. *Vogta köllikeri*.

PLATE XXIX.

Figs. 1–8. *Polyphyes unguilata*, n. sp. (p. 179).

- **Fig. 1.** The complete corm. *an*, Trunk of the nectosome; *n*, nectophores; *s*, siphons; *ss*, suctorial mouth; *t*, tentacles; *h*, androphores; *f*, gynophores. (Lateral view of the nectosome).
  - *Diam* × 4

- **Fig. 2.** Lateral view of a nectophore (from the right side). *np*, Pedicle; *ce*, pallial canal; *w*, subumbrella.
  - *Diam* × 4

- **Fig. 3.** Apical view of a nectophore. *np*, Pedicle; *nx*, right wing, *nl*, left wing of the ventral groove; *ce*, pallial canal; *cc*, ring canal; *cv*, ventral canal; *cv”*, ventral sinus; *w*, subumbrella; *v*, velum.
  - *Diam* × 4

- **Fig. 4.** Basal view of a nectophore. Characters as in fig. 3.
  - *Diam* × 4

- **Fig. 5.** Basal view of two united nectophores. *an*, Trunk with buds.
  - *Diam* × 4

- **Fig. 6.** Dorsal view of a nectophore.
  - *Diam* × 4

- **Fig. 7.** The isolated trunk of the corm, after detachment of the appendages. *an*, Trunk of the nectosome; *in*, its blastocrene (buds of nectophores); *as*, trunk of the siphosome; *is*, its blastocrene (buds of siphons); *x*, free interval between the two blastocrenes (or points of vegetation); *cn", canal of the nectophore; *ce*, its pallial canal.
  - *Diam* × 4

- **Fig. 8.** A single tentillum. *tp*, Pedicle; *ts*, cnidosac; *tk*, cnidotenia; *kl*, large lateral cnidocysts; *km", small median cnidocysts; *tf", terminal filament.
  - *Diam* × 200

Figs. 9–14. *Vogtia kollikeri*, n. sp. (p. 182).

- **Fig. 9.** Lateral view (from the right side).
- **Fig. 10.** Oblique lateral view (half dorsal, half right side).
- **Fig. 11.** Basal view of a young nectophore; *an*, trunk with buds.
- **Fig. 12.** Basal view of an adult nectophore.
- **Fig. 13.** Ventral view.
- **Fig. 14.** Dorsal view.

Figs. 9–14. Different views of nectophores. *ud*, Dorsal face of the umbrella; *ux*, right-hand face; *ul", left-hand face; *nx", right wing of the ventral groove; *nl", left wing; *w", subumbrella; *v", velum; *ce", pallial canal; *cc", ring-canal; *cv", ventral canal; *cv”", ventral sinus.
PLATE XXX.

Order CALYCONECTÆ.

Family DESMOPHYIDÆ.

*Desmophyes annectens.*
PLATE XXX.

Drawn by me from life in Ceylon, in December 1881.

Desmophyes connectens, n. sp. (p. 170).

Fig. 1. The complete corm, with six nectophores and numerous diclinic cormidia, males and females alternating. 

Fig. 2. Lateral view of a single female cormidium (from the right side). b, Bract; bc, phyllocyst; cv, ventral canal; cd, dorsal canal; cx, right canal; cl, left canal (see fig. 3); a, trunk; s, siphon; sr, its proboscis; t, tentacle; wn, special nectophore; w, sub-umbrella; v, velum; t, rudimentary tentacles; uy, ocelli; ce, ring-canal; cr, radial canals; f, gynophore; o, eggs. 

Fig. 3. Lateral view of a single male cormidium (from the left side); the special nectophore, and the bunch of androphores (represented in fig. 4), which fill up the ventral half of the bracteal cavity, have been detached. Characters as in fig. 2. sb, Basigaster; sh, hepatic ridges in the stomach; sr, proboscis; ss, suctorial disc. 

Fig. 4. A bunch of androphores (h) detached from the male cormidium, fig. 3. u, Umbrella; cr, its four radial canals; ce, ring-canal; hm, spermarium; hx, spadix; hs, sperma. 

Fig. 5. A bunch of gynophores (f) detached from a female cormidium. u, Umbrella; cr, its four radial canals; v, velum; ce, ring-canal; o, eggs; o1, germinal spot; o2, germinal vesicle; o3, germinal yolk. 

Fig. 6. A special nectophore, detached from a male cormidium. w, Sub-umbrella; v, velum; t, rudimentary tentacles; uy, ocelli; ce, ring-canal; cr, radial canals; cp, penduncular canal. 

Fig. 7. A small portion of the umbrella margin of the special nectophore, fig. 6, more enlarged. ce, Ring-canal; t, rudimentary tentacles; uy, ocellus. 

Fig. 8. A single tentillum. tt, Pedicle; to, distal ampulla of the pedicle; tk, cnidosac; kl, large lateral cnidocysts; km, small median cnidocysts; kp, distal pyriform cnidocysts; tf, terminal filament.
DESMOPHYES ANNECTENS.
PLATE XXXI.

Order CALYCONECTÆ.

Family DIPHYIDÆ.

Praya galea.
All the figures of this Plate were drawn by me from living specimens in the Canary Island, Launzerote, February 17-20, 1867.

The characters have the same signification in all the figures:

- na. Apical nectophore.
- nb. Basal nectophore.
- ni. Hydrcecial groove enclosed between two wings (nx, left wing; nl, right wing).
- np. Pedicle of the nectophore.
- cp. Pedicular canal.
- cs. Ascending pallial canal.
- cs'. Descending pallial canal.
- cv. Ventral canal.
- cd. Dorsal canal.
- ex. Right canal.
- cl. Left canal.
- cc. Ring-canal.
- a. Trunk.
- v. Umbrella.

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Praya galea, n. sp. (p. 146).

Fig. 1. A complete living corm. The nectosome is composed of two large opposite nectophores. The siphosome, in the perfectly expanded state about two feet long, bears a series of forty to fifty cormidia, separated by regular, equal, free internodes.

Fig. 2. The two nectophores, seen in their natural junction, from the dorsal side of the first (smaller) bell.

Fig. 3. The two nectophores, seen in their natural junction, from above (from the apex). For "no" read "nb."

Figs. 4a, 4b. The two nectophores, in the same view as in fig. 3, but separated one from the other. The two lateral wings (nx right, nl left), which arise from the ventral side of each bell, include an open hydrcecial groove (ni), and in the median ventral line of this latter arises the pedicle of the nectophore (np).

Fig. 5. The first or apical nectophore, in lateral view (from the left side).

Fig. 6. The second or basal nectophore, in lateral view (from the right side).

Fig. 7. The second or basal nectophore, in ventral view (from the axial side). The open hydrcecial groove is visible between the two ventral wings of the bell (nx right, nl left wing).
PRAYA GALEA.
PLATE XXXII.

Order CALYCONDUCTAE.

Family DIPHYIDÆ.

Eudoxella galea.

(Monogastric generation of Praya galea.)
PLATE XXXII.

The figures of this Plate were drawn by me from living specimens, in the Canary Island Lanzarote, February 17-20, 1867, except the bract, fig. 9, and the tentillum, fig. 14, which were found in a bottle in the Challenger collection from Station 352.

*Eudoxella galea*, n. sp. (pp. 108, 148).

(Monogastric generation of *Praya galea*, Pl. XXXI.)

Fig. 8. A single cormidium or eudoxome, sessile on the stem (*a*), composed of two medusomes or medusoid persons. The sterile medusome is composed of a helmet-shaped or reniform bract (*b*), a siphon (*s*), and a tentacle (*t*). The fertile medusome is a male gonophore (*h*), attached to the ventral side of the siphon (*s*). The latter exhibits eight yellow hepatic ridges (*sh*) in the wall of its stomach. The mouth (*so*) is closed. The bract (*b*) exhibits the four radial canals of a medusome-umbrella, bilaterally developed, dorsal (*cd*), ventral (*cv*), right (*ex*), and left (*el*). They are connected by the bracteal canal (*ea*) with the stem (*a*). The long tentacle (*t*) is articulated and beset with numerous tentilla.

Fig. 9. A single bract, with its four radial canals. Characters as in fig. 8; *w*, subumbrella.

Fig. 10. A female gonophore. The ovarium (*f*) is suspended in the apex of the subumbrella (*w*). The bilateral umbrella exhibits a very large dorsal wing (*nd*) and a smaller ventral wing (*nv*); *v*, velum.

Fig. 11. A siphon, doubly invaginated. The basigaster (*sh*) is strongly expanded and has taken into it the retracted stomach (*sh*); the cavity of the latter again contains the basal part of the invaginated proboscis (*sr*). The mouth (*so*) is closed.

Fig. 12. A tentillum, seen from the convex dorsal side. *km*, Small median cnidocysts; *bd*, large lateral cnidocysts; *kp', kp'', pyriform distal cnidocysts; *ts*, pedicle; *tf*, terminal filament.

Fig. 13. A tentillum seen from the left side. Characters as in fig. 12.

Fig. 14. A tentillum, strongly contracted, from the right side. Characters as in fig. 12.

Fig. 15. The first or apical nectophore of a young corm, with a bunch of numerous buds (*i*).
PRAYA GALEA.
PLATE XXXIII.

Order CALYCONECTÆ.

Family Diphydae.

Diphyopsis compressa.
PLATE XXXIII.

The figures of this Plate were drawn by me from living specimens in the Canary Island Lanzerote, December 28–30, 1866.

Diphyopsis compressa, n. sp. (p. 153).

Fig. 1. A complete living corm, with expanded siphosome. The first (apical) nectophore is seen from its left side, the second (basal) from its right side. cs, Somatocyst of the superior or proximal nectophore; cp, coryphal canal; w, subumbrella; ni, hydrcecium; nb, ventral face of the umbrella; nd, pedicle of the inferior or distal nectophore; nl, its overlapping left wing; nd, dorsal edge, × 3

Fig. 2. The two nectophores, united, seen from the ventral side of the first. cs, Somatocyst; cp, coryphal canal; w, subumbrella; nf, hydrcecial canal (infundibular furrow); nf1, its superior fissure; nf2, its inferior fissure; ni, hydrcecium of the first nectophore; a, the included stem, × 3

Fig. 3. The two nectophores, united, seen from the dorsal side of the first. Characters as in fig. 2. The second nectophore exhibits distinctly the left mantle-lobe of its umbrella (nl) overlapping the inferior part of the hydrcecial canal, × 3

Fig. 4. The basal (distal or second) nectophore, seen from its right side. np, Pedicle, with the apical canal (cp); nf1, superior, and nf2, inferior fissure of the hydrcecial canal; w, subumbrella; nd, odd dorsal tooth; n1–n6, three pairs of basal teeth, two of which (n1–n3) surround the ostium of the umbrella, × 3

Fig. 5. Apical part of the same nectophore, seen from its ventral side, exhibiting the bridge (ub) between the two fissures of the hydrcecial canal (nf1, nf2), and the overlapping left mantle-lobe (nl), × 3

Fig. 6. Basal ostium of the apical (proximal or first) nectophore, seen from below; v, velum; nd, odd dorsal tooth; n1, left, n2, right, lateral teeth; n3, left, n4, right, ventral teeth; cr, ring-canal, × 6

Fig. 7. Basal part of the same nectophore, seen from its dorsal side. Characters as in fig. 6, × 6

Fig. 8. Basal view of the same nectophore, exhibiting the rectangular mouth of the hydrcecium or the infundibular cavity, in which is hidden the contracted siphosome (a). Characters as in fig. 6.
Diphyopsis Compressa
PLATE XXXIV.

Order CALYCONECTÆ.

Family DIPHYIDÆ.

Ersea compressa.
(Monogastric generation of Diphyopsis compressa.)
PLATE XXXIV.

*Erssea compressa*, n. sp. (p. 123).

(Monogastic generation or free Eudoxia of *Diphyopsis compressa*, Pl. XXXIII.)

Fig. 9. A sessile young cormidium (or an immature *Erssea*) attached to the stem (a) of *Diphyopsis compressa*. The cormidium is composed of two sterile medusomes, the first consisting of the bract (b), the siphon (c), and the tentacle (f); the second representing a "special nectophore" (m); cr, radial canals of the latter; so, mouth of the siphon; sb, basigaster; ce, phyllocyst; cc, oleocyst.

Fig. 10. A somewhat older cormidium than that shown in fig. 9, with larger nectophore (m) and smaller bract (b) detached from the stem. Characters as in fig. 9: w, subumbrella of the nectophore; r, its velum; wo, ostium of the umbrella (a). The bract (b) of this specimen is rudimentary, and its apical cucullate part (with the phyllocyst) is cut off; tk, cnidosacs of the tentacle.

Fig. 11. A mature and fully developed male *Erssea*, detached from the stem of *Diphyopsis compressa*, and swimming freely. The cormidium is composed of four persons, two sterile medusomes and two male gonophores (b). The first sterile medusome consists of a bract (b), a siphon (c), and a tentacle (t). The second sterile medusome is represented by a large "special nectophore" (m). bs, Superior, cucullate part of the bract, with the phyllocyst (cs) and the oleocyst (co); b2, inferior, manille-shaped or funnel-shaped, part of the bract, with four basal lobes; so, mouth of the siphon; sb, basigaster; tk, cnidosacs of the tentacle (l); hr, cavity of the spadix; km, spermarium.

Fig. 12. An isolated ripe androphore. km, Spermarium; hx, cavity of the spadix; u, umbrella; wo, its ostium.

Fig. 13. An isolated ripe gynophore. The manubrium (jm) is filled with large ovules. 0', Nucleolus; 0", nucleus; 0", protoplasm of the ovule; fp, pedicle; w, subumbrella; u, umbrella; wo, its ostium.

Fig. 14. An older gynophore, the manubrium (jm) of which contains only four large ovules. cr, Circular canal which connects the four radial canals (cr); fp, pedicle of the gonophore; cp, peduncular canal. The other characters as in fig. 13.

Fig. 15. A portion of a radial canal (cr) and of the ring-muscles of the subumbrella (w) of a gonophore.

Figs. 16, 17. Denticulate edges of the umbrella of a gonophore.

Fig. 18. A single tentillum, highly magnified. ts, Pedicle; tl, elastic ligament of the cnidosac; kpl, large lateral cnidocysts; km, small median cnidocysts; kpl, distal pyriform cnidocysts; tf, terminal filament.
Diphyopsis Compressa
PLATE XXXV.

Order CALYCONECTÆ.

Family D I P H Y I DÆ.

Abyla carina.
Drawn from life by me in the Canary Island Lanzarote, February 11, 1867.
The signification of the characters is the same in all the figures:

- nd. Dorsal edge of the nectophore.
- nx. Right wing.
- nl. Left wing.
- ns. Dorsal face.
- nw. Ventral face.
- nw1. Transverse frontal crest.
- nw2. Ostium of the umbrella.
- nw3. Hydroecium.
- nw4. Subumbrella (Nectosac).
- cs. Somatocyst (Acrocyst).
- cd. Dorsal canal.
- cv. Ventral canal.
- cx. Right canal.
- cl. Left canal.
- nq. Articular condyle of the second nectophore.
- as. Trunk of the siphosome.
- v. Velum.

**Abyla carina**, n. sp. (p. 156).

Fig. 1. The complete living corm, in its natural position, floating with subhorizontal main axis on the level of the sea. A bunch of tentacles issues by the basal opening of the hydroecial canal. The first and smaller (apical) nectophore is seen from the right side, the second and larger (basal) nectophore from the left side, x 3

Fig. 2. The same corm, in the same natural position, seen from the apical face, x 3

Figs. 3–7. Different views of the first (proximal or apical) nectophore, x 6

Fig. 3. Apical view of the first nectophore; the nectosac (w1) appears through its dorsal apical facet. (For "ch" read "cl." )

Fig. 4. Basal view of the first nectophore; in the ventral half of the base is visible the opening of the hydroecium (nw1), including the siphosome (as); in the dorsal half the ostium of the nectosac (w2).

Fig. 5. Lateral view of the first nectophore, from the right side. w1, Nectosac; wi, hydroecium; cs, somatocyst.

Fig. 6. Ventral view of the first nectophore, with the somatocyst (cs).

Fig. 7. Dorsal view of the first nectophore, with the nectosac (w1).

Figs. 8–11. Different views of the second (distal or basal) nectophore, x 4

Fig. 8. Ventral view of the second nectophore, with the siphosome (as) enclosed in the hydroecial canal.

Fig. 9. Lateral view of the second nectophore, from the left side. w1, Nectosac.

Fig. 10. Lateral view of the basal part of the second nectophore, from the right side.

Fig. 11. Basal view of the second nectophore, from below, with the five teeth surrounding the basal ostium.
PLATE XXXVI.

Order CALYCONECTÆ.

Family DIPHYIDEÆ.

Amphiroa carina.
(Monogastric generation of Abyla carina.)
PLATE XXXVI.

The signification of the characters is the same in all the figures:

- **b.** Bract.
- **bc.** Phyllocyst.
- **ca.** Right canal of the phyllocyst.
- **cd.** Left canal of the phyllocyst.
- **cp.** Coryphal canal.
- **wa.** Apical face of the bract.
- **wd.** Dorsal face of the bract.
- **s.** Siphon.
- **so.** Its mouth.
- **t.** Tentacle.
- **hc.** Androphore.
- **hk.** Spermarium.
- **f.** Gynophore.
- **fw.** Ovarium.
- **sw.** Subumbrella.
- **ny.** Asymmetrical ventral wing of the gonophore.
- **nz.** Dentate asymmetrical (external) dorsal wing of the gonophore.

*Amphiroa carina*, n. sp. (p. 114).

(Monogastric generation or free Eudoxia of *Abyla carina*, Pl. XXXV.)

Fig. 12. Lateral view of a complete immature Eudoxia, attached to the stem of *Abyla*, from the right side. The monogastric corm is composed of two medusomes, a male gonophore (w) and a sterile person (with a bract, a siphon, and a tentacle). \( \times 10 \)

Fig. 13. Lateral view of a similar immature Eudoxia, attached to the stem, from the left side. \( \times 8 \)

Fig. 14. Ventral view of a mature Eudoxia, with a single female gonophore. \( \times 6 \)

Fig. 15. Dorsal view of the same Eudoxia. \( \times 6 \)

Fig. 16. Apical view of the same Eudoxia (from above). \( \times 6 \)

Fig. 17. Basal view of the same Eudoxia (from below). \( \times 6 \)

Fig. 18. Lateral view of a monoclinic Eudoxia, from the left side, with a larger androphore and a smaller gynophore. \( \times 6 \)

Fig. 19. Ventral view of a monoclinic Eudoxia. \( \times 6 \)

Fig. 20. Apical view of an isolated bract (from above). \( \times 6 \)

Fig. 21. Ventral view of a sterile medusome (with bract, siphon, and tentacle). \( \times 6 \)

Figs. 22–25. Different views of the gynophores, exhibiting the peculiar asymmetrical development of the pentagonal umbrella (compare p. 115). In fig. 22, for "fs" read "fo." \( \times 6 \)

Fig. 26. A single tentillum, much enlarged. **tp.** Pedicle; **tk.** Enidosae; **kq.** Large, lateral, ensiform enidocysts; **ka.** Small, median, paliform enidocysts; **kp.** Small, distal, pyriform enidocysts; **tf.** Terminal filament.
ABYLA CARINA (AMPHIROA)
PLATE XXXVII.

Order CALYCONECTÆ.

Family DIPHYIDÆ.

Bassia obeliscus.

(zool. chall. exp.—part lxxvii.—1888.)—Hhhh.
PLATE XXXVII.

Drawn by me from living specimens in the Canary Island Lanzarote, in February 1867.

The signification of the characters is the same in all the figures:

- Lateral view of the complete corm. The main axis of the smaller (apical) nectophore is nearly horizontal, and perpendicular to the vertical main axis of the larger (distal) nectophore; the former is seen from the left side, the latter from the right side. The sipho-

- Lateral view of the complete corm, from the opposite side. The first nectophore is seen from the right side, the second from the left side.

- Ventral view of the complete corm. The smaller (proximal) nectophore is seen from its basal side, the larger (distal) nectophore from its ventral side.

- Oblique view of the complete corm. The smaller (proximal) nectophore is seen from the apical edge (nk), the larger (distal) nectophore half from the left, half from the dorsal side.

- Different views of the first (proximal or apical) nectophore.

- Ventral view of the first nectophore. The somatocyst (cs) is visible in the upper half, the hydroceum (cs) with the siphosome (a) in the lower half. The nectosac (cs) is visible in the upper half, the nectosac (cs) in the lower half.

- Apical view of the first nectophore (cs), Somatocyst.

- Basal view of the first nectophore. Aperture of the nectosac; An, Aperture of the nectosac;

- Basal view of the second (distal or basal) nectophore. The nectosac with its small circular aperture, the velum (v), and the four radial canals are visible in the left-hand (dorsal) half of the figure; the opening of the funnel-canal (wii) and the included siphosome (a) in the right-hand (ventral) half. (For "u" read "cs").

- Apical portion of the second nectophore, exhibiting the coryphal apophysis or the articular condyle, through the opening of which the siphosome (a) enters into the hydroceal canal (wii).

- Apical nectophore of a variety (?), or another species (?).
BASSIA OBELISCUS
PLATE XXXVIII.

Order CALYCONECTÆ.

Family DIPHYIDÆ.

*Sphenoides obeliscus.*

(Monogastric generation of *Bassia obeliscus.*)
PLATE XXXVIII.

_Sphenoides obeliscus_, n. sp. (p. 116).

(Monogastric generation or free Eudoxia of _Bassia obeliscus_, Pl. XXXVII.)

Fig. 12. A complete Eudoxia, attached to the stem (u) of the polygastric generation, _Bassia obeliscus_, seen from the left side. The bilateral bract (v) is beset with scattered groups of cnidocysts, and exhibits twelve prominent pyramidal teeth (characters _u^1–u^12_ as in fig. 13). Its large phyllocyst contains an apical oleocyst (co). The siphon (s) is placed between the dorsal tentacle (t) and the ventral male gonophore (h). The numerous tentilla (tk) are partly expanded (below), partly coiled up (above).

Fig. 13. Bract of a young sessile Eudoxia, attached to the stem (a), seen from the right side. The twelve prominent three-sided pyramidal teeth have denticulate edges and the following names:—_u^1_, odd ventral apical tooth; _u^2_, _u^3_, ventro-lateral apical teeth; _u^4_, _u^5_, ventro-lateral basal teeth; _u^6_, _u^7_, dorso-lateral basal teeth; _u^8_, odd dorsal basal tooth; _u^9_, odd dorsal cristal tooth; _u^10_, _u^11_, dorso-lateral teeth; _u^12_, odd dorsal apical tooth. _bh_, Cavity of the bract; _v_, its subumbrellar wall; _bc_, phyllocyst; _cd_, its basal caecum (dorsal canal); _co_, oleocyst.

Fig. 14. Bract of an adult free Eudoxia, seen from the right side. Characters as in figs. 12 and 13.

Fig. 15. An isolated female gonophore. _cp_, Peduncular canal; _gp_, pedicle of the umbrella; _a_, ovarium; _w_, subumbrella; _cr_, radial canals; _cc_, circular canal.

Fig. 16. A single tentillum. _ts_, Pedicle; _kg_, large basal cnidocysts; _km_, small median cnidocysts; _kp_, pyriform distal cnidocysts; _tf_, terminal filament.
BASSIA OBELISCUS (SPHENOIDES)
PLATE XXXIX.

Order CALYCONECTÆ.

Family Diphyidae.

Calpe gegenbauri.
Drawn from life by me in the Canary Island Lanzerote, February 1867.
The signification of the characters is the same in all the figures:

- ud. Dorsal face of the nectophore.
- ve. Its ventral face.
- v. Infundibulum.
- c. Vellum.
- cc. Somatocyst.
- ur. Oleocyst.
- cv. Dorsal canal.
- cl. Ventral canal.
- ex. Right canal.
- cl. Left canal.
- cr. Circular ring-canal.
- ab. Orificial edge of the umbrella.
- ad. Dorsal edge of the umbrella.
- n1, n2. Left edges.
- n3, n4. Right edges.
- n5. Right wing of the hydrosial canal.
- n6. Left wing of the hydrosial canal.
- al. Trunk of the siphosome.

_Calpe gegenbauri, n. sp._ (p. 164).

Figs. 1–4. The entire corra, with the two nectophores in their natural junction, and the enclosed siphosome, seen from four different sides, x 6

- Fig. 1. Ventral view of the second, right lateral view of the first nectophore.
- Fig. 2. Dorsal view of the second, left lateral view of the first nectophore.
- Fig. 3. Right lateral view of the second, oblique basal view of the first nectophore.
- Fig. 4. Left lateral view of the second, oblique apical view of the first nectophore.

Figs. 5–8. The first (proximal or apical) nectophore alone, seen from four different sides, x 12

- Fig. 5. Apical view of the first nectophore. The nectosac (v) shines through the dorsal, the somatocyst (cc) through the ventral half.
- Fig. 6. Dorsal view of the first nectophore, with the nectosac (v) shining through.
- Fig. 7. Ventral view of the first nectophore; the somatocyst (cc) is visible in the upper half; the hydrosium and the included siphosome (as) in the lower half.
- Fig. 8. Lateral view of the first nectophore, from the left side. _w_, Nectosac; _cs_, somatocyst; _as_, siphosome.

Figs. 9–12. The uppermost part of the second (distal or basal) nectophore, with the upper opening of the hydrosial canal (_w_), seen from the ventral side, x 12

- Fig. 9. The same, seen from above, from the apical side, x 12
- Fig. 10. Horizontal transverse section of the second nectophore. _nh_, Its swimming cavity; _as_, siphosome, x 6
- Fig. 11. Basal view of the second nectophore, from below. _no_, Ostium of the nectosac; _v_, vellum; _wi_, basal opening of the hydrosial canal, x 6
PLATE XL.

Order CALYCONECTÆ.

Family Diphyidæ.

_Aglaisma gegenbauri._
(Monogastic generation of_Calpe gegenbauri._)
Aglaisma gegenbauri, n. sp. (p. 119).

(Monogastric generation or free Eudoxia of Calpe gegenbauri; Pl. XXXIX.)

Fig. 13. Lateral view of a diclinic (female) cormidium, from the right side (and somewhat from behind). *ua*, Apical face of the umbrella; *ud*, dorsal face; *ux*, right face; *ui*, subumbrella (funnel or bracteal cavity); *bc*, phyllocyst; *co*, oleocyst; *ce*, ventral canal; *cd*, dorsal canal; *cx*, right canal; *cl*, left canal; *s*, siphon; *ss*, suctorial disc of the mouth; *t*, tentacle; *f*, gynophore; *fm*, ovarium, . . . . . . . . × 100

Fig. 14. Lateral view of a hermaphrodite (monoclinic) cormidium, from the left side, and somewhat from before. Characters as in fig. 13; *uv*, ventral face; *ul*, left face. At the right hand of the siphon (s) is placed the larger androphore (*h*), at the left hand the smaller gynophore (*f*), . . . . . . . . × 100

Fig. 15. Basal view of the bract (from below). *cd*, Dorsal canal; *ce*, right canal; *cl*, left canal, . . . . . . . . × 50

Fig. 16. Apical view of the bract (from above). Characters as in fig. 15; *co*, oleocyst, . . . . . . . . × 50

Fig. 17. Oblique dorsal view of the bract (somewhat from above and left hand). Characters as in figs. 15, 16; *ce*, ventral canal, . . . . . . . . × 50

Fig. 18. Oblique ventral view of the bract (somewhat from above and right hand). Characters as in figs. 15–17, . . . . . . . . × 50

Fig. 19. A single tentillum, in a highly contracted state, much enlarged. *tp*, Pedicle; *kg*, large lateral enidocysts; *km*, small median enidocysts; *tf*, terminal filament, spirally coiled up, . . . . . . . . × 300

Fig. 20. A single tentillum, in a highly expanded state, much enlarged. *tp*, Pedicle; *tl*, elastic ligament (angle-band); *tk*, enidobattery; *tf*, terminal filament, . . . . . . . . × 300
PLATE XLI.

Order CALYCONECTÆ.

Family MONOPHYIDÆ.

Cymsa crystallus.
PLATE XLI.

Drawn by me from living specimens in the Canary Island Lanzarote, February 1867.
The signification of the characters is the same in all the figures:—

\[ \begin{array}{ll}
  \text{cs. Somatocyst.} & \text{co. Dorsal canal.} \\
  \text{co. Olocyst.} & \text{cs. Ventral canal.} \\
  \text{w. Hydrcecium.} & \text{cc. Right canal.} \\
  \text{w. Trunk of the siphosome.} & \text{cl. Left canal.} \\
  \text{s. Basal.} & \text{uc. Circular ring-canal.} \\
  \text{v. Velum.} & \text{For the other characters, compare the special} \\
  \text{w. Subumbrella.} & \text{description, pp. 139, 140.} \\
\end{array} \]

*Cymba crystallus*, n. sp. (p. 138).

**Fig. 1.** Basal view of the complete corm (from below). The quinquententate mouth of the nectosae (\( \text{n} \)) is visible in the centre of the figure, and beyond it the quadridentate aperture of the hydropium (\( \text{w} \)); in the latter is hidden the retracted siphosome (\( \text{a} \)).

**Fig. 2.** Apical view of the complete corm (from above). The superior or proximal half of the nectophore is visible, divided by four serrate, cruciate, perradial edges into four nearly equal quadrants. In the middle of each quadrant descends an interradial apophysis. The apex of the nectosae (\( \text{w} \)) appears in the centre of the figure through the upper (dorsal) half of the nectophore, the apex of the hydropium (\( \text{w} \)) through its lower (ventral) half.

**Fig. 3.** Dorsal view of the nectophore, with its subumbrellar nectosae (\( \text{w} \)).

**Fig. 4.** Ventral view of the complete corm (anterior side). The hydropium with its basal mouth (\( \text{w} \)) and the included siphosome, above it the somatocyst (\( \text{cs} \)), and at its apex the olocyst (\( \text{co} \)), appear through the pentagonal ventral face of the nectophore. This is surrounded by four interradial faces, two smaller apici-lateral (\( \text{wa}'' \) right, \( \text{wa}' \) left) and two larger basi-lateral (\( \text{ux} \) right, \( \text{ul} \) left).

**Fig. 5.** Lateral view of the complete corm, from the left side. The nectosae with its mouth (\( \text{n} \)) appears through the dorsal half of the nectophore, the hydropium with the included siphosome (\( \text{i} \)) through the ventral half, above it the somatocyst (\( \text{cs} \)) and the olocyst (\( \text{co} \)).

**Fig. 6.** The nectosae (\( \text{w} \)) and the hydropium (\( \text{w} \)) in lateral view, from the right side. The retracted siphosome (\( \text{i} \)) is included in the hydropium, above it the somatocyst (\( \text{cs} \)), and at its apex the olocyst (\( \text{co} \)).

**Fig. 7.** The mouth of the nectosae (with five teeth), and beyond it the mouth of the hydropium (\( \text{w} \)) with the included siphosome (\( \text{a} \)). Basal view of the central portion of the nectophore.

**Fig. 8.** Lateral view of the mouth of the nectophore (from the right side).
PLATE XLIII.

Order CALYCONECTÆ.

Family MONOPHYIDÆ.

Cuboïdes crystallus.
(Monogastric generation of Cymba crystallus.)
Drawn by me from living specimens in the Canary Island Lanzarote, in February 1867.
Figs. 9–14 are eight times enlarged, figs. 15–17 more highly magnified.
The signification of the characters is the same in all the figures:

* b. Bract (cuboidal hydropyllium).
* co. Its apical face.
* ci. Dorsal face.
* cu. Ventral face.
* cr. Right face.
* cl. Left face.
* cs. Funnel-cavity (subumbrella of the bract).
* ce. Phyllocyst.
* cu. Oleocyst.
* s. Siphon.

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*Cuboides crystallus*, n. sp. (p. 112).

(Monogastric generation or free Eudoxia of *Cymoa crystallus*, Pl. XLII.)

Fig. 9. Dipersonal corm, in lateral view, from the right side. The infundibulum (ci) (or the subumbrellar cavity of the cuboidal bract) includes the siphon (s) with its tentacle (t), and on its ventral side a male gonophore (h).

Fig. 10. Tripersonal corm, in dorsal view. Two male gonophores are placed in the ventral half of the bracteal cavity (ci), whilst its dorsal half is occupied by the single siphon and its dorsal tentacle. The phyllocyst exhibits its two pyriform lateral lobes (cs right, cs' left), and above them the yellow oleocyst (co).

Fig. 11. Dipersonal corm, in oblique lateral view (from the left and somewhat from the dorsal side). A large male gonophore (h) occupies the bracteal cavity (ci) on the ventral side of the siphon (s).

Fig. 12. Dipersonal corm, in dorsal view. The siphon (s) occupies the posterior, the gonophore (h) the anterior part of the bracteal cavity (ci). Above this lies the phyllocyst with its two lateral lobes (cs'' right, cs'' left), and above them the oleocyst (co).

Fig. 13. Tripersonal corm, in basal view. Two male gonophores (h and h') are visible beyond the siphon (s).

Fig. 14. Tripersonal corm, in apical view. The two lobes of the phyllocyst (cs'' right, cs'' left) are visible, and between them the apical oleocyst (co).

Fig. 15. The oleocyst (co) of an older Eudoxia, with an apical accumulation of entoderm-cells (cs''). The direction of the circulation of the fluid in the median part of the somaticcyst is indicated by small arrows.

Fig. 16. A single tentillum. ts, Pedicle; kg, large lateral cnidocytes; km, small median cnidocytes; tf, terminal filament.

Fig. 17. A single female gonophore. The radial canals (cr) appear elegantly pinnulate. o, Ovary; v, velum; su, subumbrella; cp, peduncular canal; cr, ring-canal.
PLATE XLIII.

Order DISCONNECTÆ.

Family VELELLIDÆ.

Armenista sigmoides.
**PLATE XLIII.**

*Armenista sigmoides*, n. sp. (p. 84).

Diam.

Fig. 1. Apical view of the corm (from above). The diagonal crest of the pneumatophore divides the exumbrella into an antero-dextral and a postero-sinistral half. The limb of the umbrella is octolobate, .... nat. size

Fig. 2. Basal view of the corm (from below). The large sterile central siphon is surrounded by a corona of numerous small sexual siphons, and these by a double corona of filiform tentacles, nat. size

Fig. 3. Half lateral, half superior view of the corm. Numerous filiform tentacles are prominent beyond the limb of the umbrela. The vertical diagonal crest of the pneumatophore exhibits the branched canals of the exumbrella, .... nat. size

Fig. 4. Frontal section through the corm (or vertical transverse section). ph, Central chamber of the pneumatocyst (pH); ce, canals of the umbrela; uu, limbus umbrela; us, glands of the umbrela margin; uh, centradenia; uh, hepatic vessels; ur, renal vessels; t, tentacles; gs, gonostyles (sexual siphons); g, gonophores; sa, sterile central siphon; sf, longitudinal folds of its inside; so, the octolobate mouth, .... nat. size

Fig. 5. Pneumatocyst of a young corm, seen from above. Concentric ring-chambers with their pores of communication (pneumothyra, pq); pw, their external openings (stigmata), .... x 4

Fig. 6. Central part of the pneumatocyst of a young corm, seen from below, highly magnified. The central chamber (pH) is confluent with eight radial chambers (pq), each of which bears below a branched trachea. The surrounding concentric ring-chambers (ph) are connected by pores of communication (pneumothyra, pq), .... x 20

Fig. 7. Basal view of the isolated centradenia (uc) and the central siphon (sa), from below. cm, Gastro-canal system of the subumbrela; so, month, .... x 2

Fig. 8. A single gonostyle or sexual siphon. gs, Its stomach; g, gonophores; ku, cnidonodes; so, mouth, .... x 20

Fig. 9. A medusiform gonophore, detached from the stem (*Discomitra*), highly magnified. w, Subumbrela; ce, radial canals accompanied by yellow cells (xanthella); t, rudimentary tentacles; s, the incipient manubrium, .... x 100

Fig. 10. A branched trachea of the pneumatocyst.
PLATE XLIV.

Order DISCONECTÆ.

Family VELELLIDEÆ.

Rataria cristata.
PLATE XLIV.

Rataria cristata, n. sp. (p. 79).

Fig. 1. Apical view of the corm (from above). uf, Vertical sail; pq, octolobate central disc of the pneumatocyst; ph, its concentric ring-chambers; um, margin of the umbrella; gs, gonostyles (shining through); t, tentacles, \( \times 20 \).

Fig. 2. Basal view of the corm (from below). so, Mouth-opening of the central sterile siphon; gs, sexual siphons (gonostyles); um, margin of the umbrella; t, tentacles, \( \times 20 \).

Fig. 3. Half lateral, half superior view of the corm, swimming in the expanded state. uf, Vertical sail; pf, pneumatocyst; ph, its central chamber; uc, centradenia; um, margin of the umbrella; t, tentacles; gs, gonostyles; sa, central siphon; so, its mouth, \( \times 12 \).

Fig. 4. Lateral view of the corm, in the contracted state. Characters as in fig. 3, \( \times 12 \).

Fig. 5. Frontal section through the corm (or vertical transverse section). Characters as in figs. 1 and 3. sl, Gastrobasal plate; em, hepatic vessels; ce, pallial vessels; g, gonophores, \( \times 20 \).

Fig. 6. Horizontal section through the corm, somewhat oblique. The median part of the section exhibits the centradenia (uc), with the hepatic vessels (em). The right (inferior) half of the figure shows the transverse sections of the gonostyles (gs) and tentacles (t); the left (superior) half the peripheral ring-chambers of the pneumatocyst (ph), \( \times 20 \).

Fig. 7. Horizontal section through the corm, in a transverse plane more highly situated than fig. 6. pf, Pneumatocyst; ph, its concentric ring-chambers; wc, centradenia; em, hepatic vessels; ce, pallial vessels of the umbrella margin, \( \times 20 \).

Fig. 8. Pneumatocyst of another corm, isolated, seen from above. po, Central stigma; p'c, anterosinistral stigma; p", postero-dextral stigma; pq, octolobate periphery of the central disc; ph, concentric ring-chambers, \( \times 20 \).

Fig. 9. The same pneumatocyst, seen from below. ph, Concentric ring-chambers; pt, trachee, \( \times 20 \).

Fig. 10. Margin of the umbrella; highly magnified.
RATARIA CRISTATA
PLATE XLV.

Order DISCONNECTÆ.

Family Porpita Porpita fungia.
Porpita fungia, n. sp. (p. 67).

PLATE XLV.

Fig. 1. Vertical meridional section through the corim. \(\mu\), Pneumatocyst; \(\mu k\), its central chamber; \(\mu k\), concentric ring-chambers; \(\mu l\), tubercles of the upper surface; \(\mu r\), thickened chitinous layers of the upper wall; \(\mu s\), septa between the ring-chambers; \(\mu t\), under surface of a high radial fold; \(\mu c\), stigmata; \(\mu h\), hepatic vessels of the centradenia; \(\mu n\), its renal vessels; \(\mu w\), limbus umbrella; \(t\), tentacles; \(g h\), gonostyles; \(s o\), their mouth; \(g f\), gonophores; \(s t\), tabula gastrobasalis; \(s m\), stomach of the central siphon; \(s f\), its basal fissures (ostia of the radial canals); \(sr\), proboscis; \(s s\), mouth.

Fig. 2. A portion of the exumbrella; highly magnified. \(se\), The radial folds; \(ce\), pallial canals; \(ce\), radial rows of stigmata.

Fig. 3. Basal view of the centradenia, isolated by maceration. \(un\), The white annular kidney; \(sh\), the brown liver; \(sl\), central star composed of hepatic vessels; \(se\), basal insertions of the sexual siphons; \(cr\), radial canals.

Fig. 4. Basal view of the central siphon, the walls of which are highly contracted and the octolobate mouth widely opened. In the fundus of the stomach are visible right pairs of fissures (\(sf\)), the gastral openings of sixteen radial canals. \(se\), Radial folds; \(sl\), thickened labial margin of the mouth.

Fig. 5. A radial segment of the pneumatocyst (\(pf\)) of another Porpita (umbella). The upper surface of the float exhibits numerous radial rows of stigmata (\(pe\)) in the back of prominent ridges. \(pk\), Concentric ring-chambers; \(ph\), central chamber.

Fig. 6. A small portion of the centradenia in horizontal section; highly magnified. \(sa\), Central siphon; \(sw\), radial folds of its inside; \(d\), entoderm; \(e\), exoderm; \(m\), muscles; \(st\), lamina gastrobasalis; \(pt\), tracheae; \(kb\), cnidoblasts; \(ka\), auroblasts (air-secreting cells).

Fig. 7. A small portion of the kidney (\(un\)), in horizontal section; highly magnified. Characters as in fig. 6. 

\(cm\), Hepatic vessels.

Fig. 8. A small portion of the kidney (\(un\)) and a sexual siphon (\(se\)) in vertical section. Characters as in figs. 6, 7. \(e 1\), Exoderm of the subumbrella; \(e 2\), inner apophyses of it, piercing the fulcrum (\(z\)); \(e 3\), air-secreting exoderm. Some tracheae (\(pt\)) pierce the fulcrum and pass into the exoderm of the sexual siphon (\(se\)).
PLATE XLVI.

Order DISCONECTAE.

Family Porpitidae.

Porpitella pectanthis.
PLATE XLVI.

Porpitella pectanthis, n. sp. (p. 64).

Figs. 1, 2. The complete corm, seen from above in the right half (1), from below in the left half (2). In the centre is visible the mouth of the sterile central siphon, surrounded by a corona of sixteen small gonostyles (or sexual siphons). The right half of the figure (1) shows the half of the radiate pneumatocyst, with eight marginal lobes. The margin of the umbrella is beset with a series of glands (dark points) and surrounded by a corona of numerous tentacles, composed of sixteen radial bunches.

Fig. 3. Vertical meridional section through the lenticular biconvex umbrella and its appendages. ph, Central chamber of the pneumatocyst; pq, one of the eight radial chambers; pk, concentric ring-chambers; um, limbus umbrellae; t, tentacles; uc, centradenia; cm, hepatic vessels; st, gastrobasal plate; sa, central siphon; so, its mouth.

Fig. 4. Radial segment of the pneumatocyst, seen from above; highly magnified. po, Central stigma; pe, peripheral stigma; ph, central chamber; pq, radial chamber; pk, concentric ring-chambers; pq, pneumothyre (pori communicantes).

Fig. 5. Radial segment of the pneumatocyst, seen from below; highly magnified. ph, Central chamber; pq, eight radial chambers; pe, their stigmata (shining through); pt, tracheæ; pk, concentric ring-chambers.

Fig. 6. Vertical section through the centre of the umbrella. Characters as in figs. 3, 4. pt, Tracheæ.

Fig. 7. Vertical section through the peripheral part of the umbrella. Characters as in figs. 3, 4. uc, Subumbrella; pt, tracheæ; us, muciparous glands of the umbrella-margin.

Fig. 8. A portion of a single trachea.
PLATE XLVII.

Order DISCONECTÆ.

Family Porpitidæ.

Porpema medusa.

PLATE XLVII.

Porpema medusa, n. sp. (p. 61).

Diam.

Fig. 1. The medusiform corn, seen from the exumbrellar or superior face. The central part of the exumbrella exhibits the radial rows of stigmata in the pneumatocyst, whereas in the peripheral part the forked branches of radial pallial canals are visible. The numerous tentacles of the surrounding submarginal corona are smallest in the uppermost row, \( \times 10 \)

Fig. 2. Lateral view of the same corn in profile. (Compare figs. 3 and 4), \( \times 10 \)

Fig. 3. Lateral view of the same corn, after removal of the tentacles. \( \text{x} \), Limbus umbrella; \( \ell \), the uppermost row of small tentacles; \( \text{ls} \), polygonal facets where the numerous tentacles have been attached to the subumbrella; \( \text{sex} \), sexual siphons; \( \text{sh} \), central siphon; \( \text{sr} \), proboscis; \( \text{so} \), mouth, \( \times 10 \)

Fig. 4. Vertical meridional section through the same corn. \( \text{ph} \), Central chamber of the pneumatocyst; \( \text{ph} \text{p} \), its concentric ring-chambers; \( \text{v} \), gastrobasal plate; \( \text{uc} \), centradenia; \( \text{v} \text{n} \), subumbrella; \( \text{t} \text{n} \), tentacles; \( \text{sex} \), sexual siphons; \( \text{sh} \), central siphon; \( \text{sr} \), proboscis; \( \text{so} \), mouth, \( \times 20 \)

Fig. 5. Central portion of the subumbrella, seen from below. \( \text{zh} \), Central siphon; \( \text{so} \), its mouth; \( \text{sex} \), sexual siphons; \( \text{y} \), gonophores, \( \times 20 \)

Fig. 6. Horizontal transverse section through the middle portion of the corn. \( \text{cm} \), Centradenia; \( \text{cm} \text{b} \), its hepatic vessels; \( \text{cr} \), radial canals, running between eight chambered radial portions of the pneumatocyst; \( \text{cz} \), coronal canal; \( \text{tu} \), insertions of the tentacles, \( \times 20 \)

Fig. 7. Central portion of the pneumatocyst, seen from above. \( \text{ph} \), Central chamber; \( \text{ph} \text{p} \), eight radial chambers; \( \text{ph} \text{b} \), two concentric ring-chambers; \( \text{px} \), radial furrows; \( \text{pr} \), eight peripheral stigmata, \( \times 20 \)

Fig. 8. Horizontal transverse section through the pneumatocyst and the uppermost portion of the centradenia (in the height of \( \text{x} \) in fig. 4). Characters as in figs. 6 and 7, \( \times 20 \)

Fig. 9. Horizontal transverse section through the lowermost portion of the centradenia (uc). \( \text{sf} \), Ostia gastralia (openings of the eight radial canals into the central siphon), \( \times 20 \)

Fig. 10. Horizontal transverse section through the central siphon, with eight radial folds. \( \text{d} \), Endoderm; \( \text{v} \), fulcrum; \( \text{e} \), exoderm; \( \text{v} \text{n} \), gastric cavity, \( \times 20 \)

Fig. 11. Two muciparous glands of the umbrella-margin, \( \times 400 \)

Fig. 12. A small portion of the umbrella-margin. \( \text{cr} \), Radial canals; \( \text{us} \), muciparous glands, \( \times 200 \)
PLATE XLVIII.

Order DISCONECTÆ.

Family PORPITIDÆ.

Porpalia prunella.
PLATE XLVIII.

Porpalia prunella, n. sp. (p. 58).

Fig. 1. The medusiform corm, seen from the superior or exumbrellar face. The radiate pneumatocyst shines through the central part of the exumbrella, which exhibits numerous radial ribs and rows of stigmata. The margin of the umbrella is beset with glands and surrounded by a corona of tentacles arranged in eight radial bunches. 

Fig. 2. Lateral view of the same corm in profile. A deep subumbrellar circular furrow separates the margin of the umbrella (wm) from the multiple corona of tentacles (t). Many tentacles are detached and their insertions only visible (tu); w, subumbrella; we, exumbrella. The large central siphon (sa), with a long proboscis and octolobate mouth (ss), is surrounded by a corona of eight peripheral smaller siphons (sx) bearing numerous medusiform gonophores (g). 

Fig. 3. Vertical meridional section through the main axis of the same corm. The central air-chamber (ph) of the campanulate pneumatocyst is separated by the subspherical centradenia (uc) from the base of the central siphon (sh); so, central mouth; st, lamina gastrobasalis. Two smaller sexual siphons (sx) bearing gonophores (g) are visible beyond the corona of tentacles (t). The other characters as in fig. 2. 

Fig. 4. Apical view of the pneumatocyst (from the superior side), with radial marginal lobes expanded. 

Fig. 5. Basal view of the pneumatocyst (from the inferior side), with numerous simple tracheae. 

Fig. 6. A radial segment of the pneumatocyst (fig. 5), from the inferior side. ph, Central chamber; pk, concentric chambers; pt, simple tracheae. 

Fig. 7. A radial segment of the centradenia, from the superior side, taken from Porpita fungia (Pl. XLV.). The numerous dentate radial lamellae, which arise from the upper surface of the central gland, fit into corresponding radial furrows between the crests arising from the lower side of the pneumatocyst. 

Fig. 8. Radial section through the middle portion of the pneumatocyst, exhibiting three concentric air-chambers (pk). pf, Pneumothyrse (pori communicantes); pc, stigmata; pt, tracheae.
The Voyage of H.M.S. Challenger

Siphonophorae Pl. LXVIII.

PORPALIA PRUNELLA
PLATE XLIX.

Order DISCONNECTÆ.

Family DISCALIDÆ.

Figs. 1–6. Discalia medusina.

Figs. 7–12. Disconalia gastroblasta.

(zool. chall. exp.—part lxxvii.—1888.)—Hhh.
PLATE XLIX.

Figs. 1–6. Discalia medusina, n. sp. (p. 46).

Fig. 1. Basal view of the medusiform octoradial corn (from the inferior or subumbrellar face). The central siphon, with an octolobate mouth, is surrounded by a corona of eight palpons which bear numerous small medusiform gonophores on their basal pedicle. A corona of eight simple perradial tentacles, bearing a terminal cnidosphere, is placed between the palpons and the octolobate limbus umbrella, which is beset with a band of glands.

Fig. 2. Exumbrella (apical view of the corn). po, Central stigma; pe, corona of eight peripheral stigmata; uu, the eight marginal lobes; t, tentacles.

Fig. 3. Lateral view of the corn, in profile; the tentacles (t) are bent downwards. po, Central stigma; pe, peripheral stigmata; uu, margin of the flat octolobate umbrella; gc, gonopalpons; g, gonophores; sa, central siphon; s, its mouth.

Fig. 4. Meridional section through the same corn. pb, Central air-chamber of the pneumatocyst; p2, radial air-chamber; t, tentacles; wc, centradenia; st, gastrobasal plate. Other characters as above.

Fig. 5. Meridional section through the pneumatocyst alone. pb, Central chambe; po, its stigma; p9, two of the eight radial air-chambers; pe, their stigmata; pe, tracheae.

Fig. 6. Vertical section through the limb of the umbrella (uu). cr, Radial canal; cc, circular canal; sa, marginal muciparous gland.

Figs. 7–12. Disconalia gastroblasta, n. sp. (p. 48).

Fig. 7. Exumbrella (apical view of the umbrella, from above), with the octoradial system of the superficial exumbrellar canals. Eight perradial main vessels arise from the small ring which surrounds the apical stigma, and branch dichotomously. Their anastomosing branches unite in an octagonal coronal vessel, from which the simple peripheral radial canals of the limb arise. The octolobate margin is beset with a corona of glands.

Figs. 8, 9. Octoradial chamber-system of the air-filled pneumatocyst; fig. 9, superior or apical view (right half of the figure); fig. 8, inferior or basal view (left half). The central air-chamber is surrounded by a regular corona of eight interradial air-chambers (p9), and these by a peripheral octolobate corona which is composed of numerous concentric ring-chambers (pb). pe, Stigmata of the upper face; pd, tracheae of the lower face; pg, interradial pneumothyre (pori communicantes).

Fig. 10. Apical view of the octagonal centradenia (from above), with the brown “liver-star,” or the system of eight radial, dichotomously branched hepatic vessels.

Fig. 11. Horizontal transverse section through the basal portion of the central siphon (uu), and the surrounding centradenia (wc). The octolobate margin of the umbrella exhibits the transverse sections of the basal portions of the tentacles (in a double row).

Fig. 12. Horizontal transverse section of the umbrella, somewhat above the plane of fig. 11. In the centre is visible the half of the gastrobasal plate (with four gastric ostia). ca, Hepatic canals.
I-6 DISCALIA MEDUSINA. 7-12 DISCONALIA GASTROBLASTA
PLATE L.

Order DISCONECTÆ.

Family DISCALIDÆ.

Disconalia gastroblasta.
Discomalia gastroblasta, n. sp. (p. 48).

Fig. 1. Basal view of the medusiform octoradial corn (seen from the subumbrella). The central sterile siphon exhibits an octolobate mouth-opening, and is surrounded by a corona of sixteen reddish-yellow palpons which bear numerous medusiform gonophores on their basal portion. An octoradial corona of numerous tentacles, arranged in eight equidistant bunches, is placed between the corona of palpons and the octolobate margin of the umbrella. Each tentacle bears three longitudinal rows of tentilla, or of pedunculate cnidospheres, two paired lateral and one inferior row.

Fig. 2. A fertile palpon, beset in the red distal half (q) with eight longitudinal rows of cnidonodes (k), in the yellow proximal half with clusters of medusiform gonophores (Discomitra, q).

Fig. 3. The octolobate mouth of the large central siphon; its labial margin is armed with a series of cnido-nodes.

Fig. 4. A group of tentacles (three larger and four smaller) and their insertion into the subumbrella.

Fig. 5. A single tentacle, with its three rows of tentilla (an odd inferior and two paired lateral rows).

Fig. 6. A single tentillum. d, Axial column composed of large discoidal entoderm-cells; e, exodermal epithelium; z, fulcrum between them; k, terminal cnidosphere.

Fig. 7. Apical view of a Discomitra (or a medusiform gonophore). u, Exumbrella; w, subumbrella; cr, four crossed radial canals.

Fig. 8. Lateral view of the same Discomitra, in profile. cr, The four radial canals; cc, ring-canal of the umbrella margin.

Fig. 9. Apical view of a young Discanula (octoradial medusiform larva of Discomalia). The pneumatocyst (yellow) appears through the central portion of the (blue) exumbrella. ph, Central air-chamber; pe, its stigma; pp, eight radial air-chambers; ps, their peripheral stigmata; us, muciparous glands of the umbrella-margin; t, tentacles; k, cnidospheres.

Fig. 10. Basal view of a somewhat older Discanula. The octolobate mouth of the central siphon and the corona of eight (red) incipient palpons are visible in the centre of the subumbrella. Each tentacle bears a terminal bunch of four tentilla (k). Characters as in fig. 9. (Compare on these larvae, pp. 39, 45, 56, and Discalia, p. 46, Pl. XLIX. figs. 1–6.)