On Siphonophores
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The bracketed **[..]** and emboldened comments are Totton's marginalia.

In order to have the various anatomical parts which have been previously discussed, assembled, there must be a universal, basal part that is common to all. Such a part is the stem which, in most cases, is a slender tubular organ constructed with both inner and outer layers like a hydrozoan stem but it is sometimes extremely short, becoming almost indistinguishable. Its morphological change is extreme in some cases and diverse formation of parts are often observed. The gastrovascular system within the stem is linked with every part of the body and the only opening to the outside is the mouth of the siphons. However, some investigators claim that the existence of excretion pores at the lower section of the pneumatophore while others insist upon a terminal opening (mouth) of the palpon.

3. General structural aspects.

Without doubt the complexity of anatomical structures of siphonophores explains their numerous taxonomic classifications, and if a discussion of their comparative structures is to be undertaken, one must explore every minute phase of their taxonomy. Therefore, the author has decided to proceed with a discussion of their general structure at this time. To further minimise the unnecessary implication of the study, only a few general groups of siphonophores and their most commonly known scientific names have been used since many of them are differently classified by many investigators.

Ordinarily Calycophorae, which include many small species that can be collected by a surface net, may be said to have a simple form as Chun has stated, since the number of their structural parts are rather small, aside from their being primitive in form.

The family is generally devoid of either pneumatophores or palpons and its most conspicuous characteristic is the presence of one or several nectophores and its highest situated part is the grooved hydroecium on the dorsal section of a so-called subumbrella cavity (that is the nectosac) over which a somatocyst (oil-drop sac) occurs. This cavity is in a polygonal shape, filled with bubble-like cells in which a number of oil (fatty) drops that function as if bubbles are present. Although a long stem is suspended connected to the inner somatocyst of the hydroecium, the part near to the upper terminal of this stem is the budding one from which upward, the nectophore (many nectophores are present) and downward, the cormidia are being formed in orderly fashion. When two nectophores are present, they occur side by side or closely upward and downward. In the latter case the part comparable to the lower hydroecium transforms itself into a longitudinal groove and this sometimes becomes an imperfect (immature) canal as the lip-like ridges of the groove become higher and finally go in together, within which the stem is found. When either two nectosacs are situated side by side or several of them are aligned in two rows the primary nectophores resemble the secondary nectosac and all the rest in form, (but the secondary bell lacks) special structural arrangement to store the oil-drops (i.e. somatocyst). Unevenly distributed cormidia are found on the top of the stem which have one or several siphons, tentacles and gonophores, and which in many cases have bracts to protect these structural parts. The cormidia are those that matured early at the lower section of the stem and at its upper part the thickly growing immature cormidia can be always observed. These cormidia remain attached to the stem but they sometimes become separated, entering into a planktonic stage, called eudoxids. In cormidia special nectophores are sometimes provided in addition to the bracts, siphons, tentacles and gonophores. Consequently, within the eudoxids, the ersaea with special nectophores can be distinguished from the eudoxid, which lacks this special structural part.

Next in order of discussion is the suborder Physophorae which has a long slender form with a pneumatophore at the upper end and from which a long stem runs through the elongated body. Because this stem, the axis of the body, can be separated into the upper and the lower parts and because the former has nectophores either in two or several longitudinal rows, it is sometimes called the nectosome. On the other hand, the latter possesses evenly distributed cormidia which are either extremely short and inflated or elongated and suspended. In any case, the budding zone is present near the upper terminal of both upper and lower sections of the axis and the degree of growth of the nectophores and cormidia increases downward. Bracts, siphons, tentacles, palpons and the palpon filaments and gonophores comprise the cormidia though sometimes one or two of these anatomical parts are lacking.

With the suborder Auronectae which is thought to be comparable to the Physonectae, the stem changes into a large and short spongy mass, on upper section of which there is a pneumatophore under which a special aurophore is attached. Around the lateral parts of the stem many cormidia are present arranged in spiral fashion.

The pneumatophore of the family Rhizophysidae is exceeding large, having a duct connecting it to the outside on its upper terminal - which is its only locomotory organ. The stem of the Rhizophysidae is thread-like on which , at intervals, siphons tentacles and gonophores occur. In *Physalia*, on the lower side of the pneumatophore is the so-called stem [**side of float really**] from which the parts already mentioned are clustered inn a suspended manner.

Lastly species such as *Velella* and *Porpita* [**not siphonophores**] which are generally classified as Chondrophorae or Disconectae have an extremely large pneumatophore with many compartments (chambers) distributed in a concentric circle. Within the disc directly below the centre, a commonly called liver is present. On the underside of the stem, numerous siphons are suspended, around which the tentacles are suspended. The gonophores form on the outer wall at the root of the siphons and later separate into small medusoid forms, growing germ cells.

4. General development.

In the previous pages, the formation of the various anatomical parts of siphonophores developed by budding has been clearly described. Thus the resultant gonophore (a sexual medusoid) produces male and [**or**] female gametes through whose generative functions the individual siphonophores are propagated. Where only the gonophores are separate from the stem as in the case of the Chondrophorae, the individual medusa (acalephe), a gonophore, may be identified as a sexual generation [**an adult**]. Or when the various parts constituting the cormidia separate themselves from the stem altogether as in the case of the Calycophorae, the eudoxids may be called a sexual generation. However, even if the cormidia remains attached to the stem, we can readily recognise the alternation of both sexual [**medusoid (adult)**] and asexual [**polypoid (larval)**] generations in the life history of siphonophores.

However, our knowledge of the embryonic development of siphonophores is in its early infancy and we may well say that no one, as yet, has traced completely the developmental changes from the larval stages to maturity. With numerous species of siphonophores known we have learned but a small part of the developments during their life history. This, perhaps, is because such biological procedures are carried on in the great depths of the ocean. For the sake of convenience in study, the order of growth is divided into two periods.

The first stage involves the time from the eggs to the larval form period, in which time, a very little difference can be found among the species already known today although with such families as Chondrophorae, Auronectae and Rhizophysidae, it is completely unknown. The siphonophore egg belongs to the plankton and as it is discharged into the water, fertilisation takes place. Its shape is generally ball-like having a diameter of 0.5 to 0.9 m. (Gegenbaur) with the egg membrane either lacking or extremely thin. At the vegetal pole many egg yolk granules are found and while floating in the water the animal pole is situated on its underside. Because of the extreme transparency of the structure, it is common to see the cell membrane and the cell nuclei clearly. The diameter of the cell membrane is generally about one tenth of the diameter of the zygote which after 24 to 36 hours [**authority**] following fertilisation completes the cleavage. Inasmuch as the procedure of this cleavage has not yet been clearly established, a few earlier cleavages are much like the similar morphological changes of other Coelenterata, it is simply a one-sided cleavage of the zygote. On about the 3rd day of development the egg-shaped planula slowly rotates around in the water by the movement of its ciliated ectoderm. About the 5th day of growth, the primitive nectophores and tentacles start to develop either on the upper terminal or one side, showing the larval characteristics of siphonophores. The larval form of all the species at this stage have a common structure but in the second stage each individual begins to show the structural characteristics of the genus.

First of all, in the larval Calycophorae, simultaneously with the growth of the primitive nectophores after the development of the bud-nucleus on a slight upper part of its side, the inferior end of the larva becomes a siphon by elongating itself and forming an opening at the end. The process developed on the underside of the basal part of the siphon and the primitive nectophores grows into a tentacle by again extending itself. The part between the siphon tentacle and the nectophores develops into the initial stem through elongation, around which numerous buds are subsequently formed. The larval form at this stage indicates the primitive nectophores at the superior end of the stem and the siphon tentacle at the inferior terminal. As the elongation of the stem continues, it develops the cormidia one by one. Finally a slender common muscle that is the stem, and the cormidia attached evenly on the top of the stem itself are completed.

The primitive nectophore is a temporary growth of a siphonophore which is subsequently replaced [**in some spp.**] by a structurally different permanent nectophore. This fact was first made known by Chun in 1881 and until then it was generally accepted that the siphonophore provided with a primitive nectophore belonged to some other species although it had been known that the period either as a eudoxid or with the permanent nectophores are the different generations of the same animal. However, although this fact has not been definitely established to be common with all species of Calycophorae, it is generally recognised to be acceptable [N**O**!]

As far as the permanent nectophores are concerned, they are limited to one in some species but there may be two or more. The number of nectophores seem to successively increase to more than two. Even when the growth terminates with two nectophores the regeneration of this body part can occur through the budding of new nectophores. Therefore, when some multiplication occurs one may well be sure that the old nectophores remain attached in the original place (without isolating themselves) as the new colony develops into a fixed (definite) size.

Next, the variation of Physonectae during this (second) period is still more complicated. That is, the bud which grows along the side and the superior terminal [**end**] of a larva that has just completed the first stage, does not become the primitive nectophore as in the other family but becomes the pneumatophore [**?**]. Although the growth of a siphon from the inferior terminal [**end**] of the larva, and the subsequent growth of the tentacles from its roots is quite similar to that in the Calycophorae, the difference between these suborders is that Physonectae grows one or several temporary bracts around the pneumatophore, which eventually isolate themselves after enclosing the larva for a short while. However, such a variation is only known in a few genera. Subsequently, the part attached to the underside of the pneumatophore elongates itself into a long stem whose upper half forms a nectosome developing nectophores in succession, while the lower half, simultaneously grows cormidia one by one pushing them downwards. Thus, finally a matured individual is completed.

The most widely known genus of the Rhizophysidae is *Physalia* whose larval stages are fundamentally unalike other siphonophores in some respects. It develops a medusa [**NO**] that differentiates a pneumatophore, a tentacle, and a siphon. However, the pneumatosac within the pneumatophore of this genus expands at an exceedingly early stage and practically fills the large and stubby stem. Simultaneously, it develops new polyps continuously on the central area.

(Of these parts) the initial siphon and the tentacle, situated at the posterior end of the body, develops numerous immature siphons, palpons and tentacle around it forming some sort of cluster. However, a larger cluster which grows later, collects near the slightly forward section and from this grow well developed tentacles and gonophores.

The embryonic development of Disconectae has not been definitely learned as yet. However, the author wishes, at this time, to discuss the developmental aspects of *Velella* which differs slightly from several species of siphonophores that have been previously discussed. First all the small medusae that develop on the external wall of the basal section of the siphon hatch a large reddish egg on its stalk after leaving the mother body. This zooid, however, descends to deeper water before maturing. Consequently, its embryonic changes during the first and the early part of the second stages are not all known yet to this author's knowledge. The larval form of the early conaria period that again ascends towards the surface from the sea bottom, has been caught at a depth of 1000 m. This larva has a ball-like bag of 1 mm from whose superior pole toward the middle cavity a reddish cone-shaped process is found. By having stored a oily substance within, it passively continues its upward movement. A new bud grows outwardly from the superior pole, which develops into the pneumatophore and by the time the larva reaches the surface it develops a skirt-like screen on the margin of the pneumatosac. The bag below the pneumatophore grows into a siphon making an opening at its inferior pole. The connecting part between the pneumatophore and the siphon finally becomes a nataria, extending sideways and growing a shelf-like part around it. The diameter of this part is approximately 1.5 mm which continues to grow reaching a diameter greater than the longitudinal dimension.

The pneumatophore forms linking compartments in concentric fashion one after another within the stem that has developed into a board-like shape. At the same time a conical process of the conaria develops the liver and other canal systems.

Around the siphons on the underside numerous additional siphons are seen to grow and further, when the tentacles in a ring are formed on the exterior, the body would have reached its maturity.

5. Change in interpretation of various structures of siphonophores.

We have thus far discussed the questions of the structure of siphonophores in their general development as well as what fundamental bearing these facts may have in the interpretation of siphonophores and their taxonomy. Let us, therefore, examine the structural change of various anatomical parts with time. The discussion as a whole was based primarily on previous observed facts; therefore, to present only the abstract conclusion may seem colourless and dry.

The tendency is not necessarily limited to the study of siphonophores but there are two questions which the investigator of the subjects in the past have endeavoured definitely to determine. The first question is whether the siphonophores is an individual organism or a colony and consequently just what relation it may have with the other coelenterates. The second is "how do various species of siphonophore differ from each other?", that is, how they should be classified taxonomically. These questions undoubtedly arise because of their mutual relation.

It is a well known fact that siphonophores have many different morphological and biological characteristics from other members of coelenterates. So much so that countless numbers of theories and reports have been presented in the past as to their adaptations and (anatomical) structures. Some investigators assert that this animal is one individual having exceedingly complex organs while others claim it to be a colonial body consisting of several individuals each having its own specific function resulting from the development of primitive functional division. Such controversial discussions have been carried on by many scientists for a long time. Even today the arguments are very much contested. However, inasmuch as the contentions of scientists differ fundamentally, the question can be generally segregated into two major groups - one "Polyorgan theory"; the other "Polyperson theory". [**BOTH WRONG. An oozoid larva bearing other larvae + adults as polypoid and medusoid buds.**]

Polyorgan theory

In 1821 Eysenhardt stated, by comparing *Rhizophysa* and the Acalephae, that the former is a result of inversion of the latter's umbrella, and the former's stem corresponds to the stalk of the latter. He also asserted, at the same time, that *Physalia* has a common pneumatophore resulting from the fusion of many pneumatophores of the *Rhizophysa* type [**What does this mean?**].

He is also the pioneer in advocating the existing relation between siphonophores and common medusae. From this he further stated in his theory on the taxonomy of siphonophores that *Rhizostoma* is an individual animal (later classified as a colonial body by Agassiz) *Physalia*, a colony, and *Rhizophysa* an intermediate form. A unique aftermath of this claim is that what had been considered as an individual and as a colony were found to be extremely closely related species. This interpretation by Eysenhardt was similarly presented by Metschnikoff almost 50 years later.

In 1874, however, Metschnikoff classified a comparative specimen as *Sarsia* instead of accepting it as *Rhizostoma*. That is, as *Dip[**u**]rena* having fully developed tentacles on the stalk, he has considered that such a unique anatomical development is common to siphonophores. Also he believed *Eucope polygastrica* which has numerous auxiliary stalks to be very closely related to *Physalia*. Further he has stated that the stalk of *Sarsia*, covered with many medusae buds, by greatly elongating, a hat-like bract, which grows in the larval form, is comparable to the umbrella of a medusa. This by once more overlapping itself becomes a pneumatophore when it is turned inside out. In addition among many species as a result of centres of secondary growth on the stalk there are such chrysomitra as gonophores or tentacles and umbrellas without medusae itself, either by changing the position or multiplying by overlapping. Therefore, he has reported that this changing of position and the overlappings is very similar to the buddings of stalks on *Eucope* that is commonly observed on any larval form which develops into an intricately constructed animal. Further, he stated that the superior cormidia which isolate themselves as eudoxids in Calycophorae compare to a medusa as a whole and that the bracts are formed from the transformation of the medusa umbrella and its siphon tentacles are comparable to the stalk tentacles. This interpretation of eudoxids coincides with that by P.E. Müller (1871) reported about the same time. A. Agassiz (1865) was, too, an advocate of a similar theory.

Condensing the interpretations by aforementioned investigators it is obvious that siphonophores as a whole are multi-form animals developed from an individual medusa and that from the stems comparable to the stalk, 2 generations bud as deformed medusae, of which one is the gonophore and the others are numerous medusa organs that develop be either changing the positions or overlapping [**meaningless ROT**].

Prior to this, there was also a similar report made by Huxley in 1859. His interpretation was based on various conditions of a fertilised egg as a whole, instead of implying the word "individual" for the typical form of each species or to different generations. Therefore, it is considered that a siphonophore, too, is an individual medusa that many parts, comprising the animal, are organs that could carry on the independent functions separately as they are attached to the animal body. That is, this theory is a step ahead of those previously cited by investigators, as far as the meaning of the individual organism is concerned. He, too, has concluded that such a part as the nectophore is, without doubt, a result of overlapping of the same organs, and further, since Huxley's theory most clearly advocates siphonophores as individual animals, his name is always identified with the "Polyorgan theory". There is, however, one point that should most carefully be borne in mind. Precisely, he alone interpreted the various parts of siphonophores to be all organs while P.E. Müller and Metschnikoff, etc., and also Haeckel, who were mentioned later, all concluded that of these body parts some represent the individual medusa and others the organs. Consequently, Delage has named Huxley's theory as the theory of "Mixed or combined medusoid".

In short, what "Polyorgan theory" advocates is the growth of various medusa organs by changing their positions or by overlapping. Therefore, Chun has written that this theory looks at siphonophores like multi-form Hindu Buddas. Actually, "seven-face or thousand-hand Goddess of Mercy" may be said to have a similar structural features as siphonophores according to this theory. (Continued in the next issue.)

明治四十一年

# 動物學雜誌

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# ●管水母に就て（承前）

川村多實二

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先きに述べた諸部分が相據り相集まると云ふには勿論共通なる幹の部分が無くては叶はぬ。此の幹部（Stem, Coenosome）は多くの場合に於ては丁度ヒドラの幹の如くに内外兩層よりなる細長い管であるが、時には甚だ短くて殆んど不分明なることもあり、又非常に形を變じ且つ種々の組織が發達して居ることもある。而して幹の中の内腔（Enteric, Gastra-vascular system）は體中の凡ての部分に連絡せるもので、其外界に開く所は唯營養體の口あるのみである。但し或學者は氣胞の下に排泄孔（Ex-erctionsporus）なるものがありとし、又先きに述べた如く或感觸體には末端に口があると云つて居る人もある。

## 三　構造の一般

言ふ迄もなく管水母の構造の多樣多態なる事が即管水母分類の據り所であつて、今眞に構造を比較詳論せんとすれば勢分類學の細末に亘らなければならないから、玆には單に一般に就て述べるの外はない。管水母を大別して幾個の部類とするかと云ふ事も、又其部類の名稱も學者によりて區々であるから、之れも比較的多く用ひらるゝ名稱に據るの外はない。

通常表面採集網で得られる小さな種類を包含する部類 Calycophorae は、系統發生上より原始的であるか否かは別問題として、體を構成する部分の尠い點よりしては、クーン氏の云ふ如く簡單なる形であると云ふて妨げない。此類は一般に氣胞も感觸體も無く最も著るしいものは一個又は數個存する所の泳鐘である。其中最上端に位するものは傘下腔即ち泳囊（Nectosac）の背側に幹鞘（Hydroecium, Funnel）と稱する一個の凹入があつて、其上端に接して寒天質中に油滴囊（Saftbehälter, Somatocyst, Aerocyst etc.）と稱する腔がある。腔は多角形な泡の樣な細胞にて充たされ上端に油滴を藏して居るが、此

油滴が此部類では恰も氣胞の如き作用をなすのである。幹鞘の奥油滴嚢に續いて長い一本の幹が垂下して居るが、此幹の上端に近い部分が出芽部（Knospungszone）で、此所より上には順次に泳鐘を作り（若し多數の泳鐘ある塲合には）、下には順次に分群（Stammgruppen, Cormidia）を作りつゝある。二個の泳鐘がある塲合には、二つは相併びて又は上下に相接して存し、上下に配列する塲合には下の泳鐘の幹鞘に比すべき部分は形を異にして縦の溝となり、時には溝の左右が唇狀に延びて相擁し不全なる管を形つくり、幹が其中を走るのである。二個の泳鐘が相併ぶ塲合又は數個の泳鐘が二列に配列する塲合には、第一の泳鐘は第二以下泳鐘と全く同樣の形をなし、別に油滴を含める裝置がない。幹の上に等距離に配置せらるゝ、分群は、各一個又は數個の營養體觸手生殖體より成り、又多くの塲合には此等を被護する保護葉がある。分群は幹の下部にあるものが早く生じたもので、幹の上端には分群の若いものが密集して形成せられつゝあることが常に見らるゝ。此分群は幹に附着した儘に止まることもあるが、幹より分離して獨立に水中に浮游することがあつて之れをユードキシ體（Eudoxids）と呼ぶ。分群中に保護葉營養體觸手生殖體の外に更に一個の特別泳鐘（Special Nectophore）なる部分を備ふる事があつて、從て生じたるユードキシ體にも特別泳鐘を有するエルセエア（Ersaea）と、之れを缺げるユードキシア（Eudoxia）とを區別することが出來る。

次にPhysonectaeと呼ばるゝ部類では、概ね細長い形を有し、體の上端に一個の氣胞があつて、氣胞の下より體を一貫して縦に走る細長い幹がある。此幹即ち體の中軸は上下の二部分に區分することを得るので、上部は二列又は數列の縦の列に並ぶ泳鐘を有するから、體の上半部を泳鐘柱（Schwimmsäule, Nectosome）と呼ぶこともある。幹の下部は等距離に配置された分群を備へて居るが、此部分は甚だ短く且つ膨れて居ることもあれば、長く延びて垂れて居ることもある。幹の上下部共に上端に近く出芽部があるから、泳鐘も分群も上より下に至るに從つて發達の度を增して居る。分群をなすものは保護葉營養體

觸手感觸體及び其觸絲と生殖體であるが、時には其一二を缺いで居る。Physonectae に屬せしむ可きものと見做され、又は之に對すべきものと見做さる、Auronectae の部類では、幹は太く短かき組織の海綿狀の塊に變じ、上端に一個の大きな氣胞を擔ひ、氣胞の下部を圍んで特別の Aurophores なるものが附着して居り、幹の側部周圍には澤山の分群が螺旋狀に附着して居る。

Rhisophysaliae の部類では保護葉泳鐘は全く其痕を留めないが、氣胞は非常に大きく且つ上端に外界と交通する氣孔を有し、唯一の運動器官である。幹は Rhisophysa では甚だ細長い糸狀で之れに所々に營養體觸手生殖體が附着して居るが、Physalia では氣胞體の下面が即ち幹部で、上記諸部分は氣胞體の下面に群がつて垂下して居る。最後に Chodrophoræ 又は Disconectæ と總稱せらるゝカツヲノカムムリ(Velella)ギンカクラゲ(Porpita)の類では、甚だ大きな氣胞は多數の同心環形に區劃せられた室を有し、盤狀をなせる幹中に入りて存し、幹の中心部即ち氣胞體の直下には俗に肝臓と稱せらるゝ組織があり、幹の下面には無數の營養體が垂下し、營養體の外圍を取卷いて觸手が垂下して居る。生殖體は營養體の根部外側壁に生じて、後に小さな水母體となつて分離し、生殖素を發達せしむるのである。

## 四　發生の一般

旣に前篇に於て明なる如く、管水母體中の諸部分は出芽の方法によりて形成せらるゝものであつて、斯くして生じた水母體の一なる生殖體が生殖素を作り、兩雌雄生殖素の合一によりて別個の管水母體が形成せらるゝのである。Chondrophoæ に於ける如くに生殖體のみが母體と分離する場合には、生殖體なる一個の水母を有性世代と見做すことが出來るし、又 Calycophoræ に於ける如くに分群を成せる諸部分が相伴つて母體を去る場合には、ユードキシ體を有性世代と言ふことも出來るが、分群が分離せずして幹に附着して留まる場合にあつても、要するに管水母の輪換的發生の間に於て有性無性兩世代の交番のあることは認めらるゝのである。

併し管水母の發生に關する吾人の智識は未だ甚だ幼稚で

あつて、卵より成體に至る間の變化を完全に追蹤し得たるものは殆んど無いと云つてもよいので、多くの種類に於て吾人は僅に其輪換的發生の中途の一部を窺ひ知れるに過ぎないのである。蓋し之れは管水母の發生が深海に於て行はるゝが爲めであらう。今便利の爲めに發生の順序を二期に分つ。

第一期は卵より幼蟲に至る迄の間で、Chondrophoræ, Auronectæ, Rhizophysaliæ では全く不明であるが、今日知れたる種類に於ては孰れの種類でも大差ない樣である。管水母の卵はプランクトンに屬し、水中に放出せられて受精するものである。其形概ね球形で直徑〇、五乃至〇、九ミメ(ゲーゲンバウル氏に據る)、卵膜を缺げるもあれば甚だ薄い膜を被れるものもある。卵の植物極は澤山の卵黄質があつて海中に浮游する時は動物極は下面に位置して居る。甚だ透明であるから胚胞胚點は明らかに見ゆるを常とし、胚胞の直徑は大約卵の直徑の十分の一である。卵は受精後二十四乃至三十六時間で完全卵割を遂げる。卵割の徑路は未だ詳でないが、初めの數回の分裂は他の腔腸動物に於けると全樣に、一側に偏した分割である。三日目位に卵圓形なプラヌラ幼蟲となり、其外層に生じた纖毛の運動によつて、徐々に水中に回轉しつつある。更に五日目位になると其上端又は一側に原始的泳鐘及び觸手等が出來かけて、管水母幼蟲である特徴を表はすに至るのである。此狀態の幼蟲は凡ての種類にて全く同樣なる構造を示すが、之れより以後即ち第二期になると各の屬に特有な部分の出來かけが表はれる。

先づ Calycophoræ では幼蟲の一側稍上方に偏して生じた芽核 (Bud-nucleus) が發達して原始的泳鐘 (Primitive Nectocalyx) を作ると同時に、幼蟲の下端が延びて口を開いて營養體となり、營養體の基部原始的泳鐘の下側に生じた突起は延びて觸手となる。營養體觸手と泳鐘との間が延びて最初の幹を作り、此部に澤山の芽が表はれる。此時の幼蟲の形は、幹の上端は原始的泳鐘があり、下端には營養體觸手を有するものとなる。幹が延びるに從て順次に分群を作り、遂に細長い共肉即ち幹と其上に等距離に附着する分群とが出來上る。原始的泳鐘は一時

的のもので、後に之れとは形を異にした永久的泳鐘(Permanent Nectophore)に依りて置換される。此ことはクーン氏が始めて千八百八十一年に發見したことで、其時迄はユードキシ體並びに永久的泳鐘を具へた時代が全一の動物の異なつた世代と云ふことは知れて居たが、原始的泳鐘を具有する時代は別の種類と見做されて居た。但し凡ての Calycophræ に於て確かめられたのではないが一般に通ずることゝ認められて居る。永久的泳鐘は或種類では一個に止まるが、他の種類では第二第三と順次に數を增して二個以上の泳鐘を見る。二個に止まる場合にも新らしき泳鐘が出芽して、泳鐘の新陳代謝することも見られるから、泳鐘が多數となる場合は、新らしい泳鐘が發達して一定の大さに達した時、古い泳鐘が脱離し去ることなく依然舊位置に附着すると見做してもよいのである。

次に(Physonectæ)に於ける此期の變化は一層複雜である。即ち第一期の變化を終つた幼蟲の上端又は側方に偏して生ずる芽核は、此部類では原始的泳鐘とはならないで、永久的の氣胞となるのである。而して幼蟲の下端が營養體となること及び其根部から觸手の表はれることは先きの Calycoporae 場合と同樣であるが、異なる所は氣胞の周圍に一個又は數個の一時的の保護葉を生ずることで、此保護葉は暫時幼蟲を被護した後、脱離し去るのである。尤も此邊の變化は僅かに數屬に於て確かめられたのみである。そこで氣胞の下部に接する所が延びて長い幹を作り、其上半は順次に泳鐘を作つて泳鐘柱を形成すると同時に、下半は順次に分群を作つて下に押し下げ、遂に成體に見る構造に達するのである。

Rhizophysaliæ の中で最もよく知られたのはフイサリアであるが、其幼蟲の構造は一般管水母のそれと根本的に異なる所がない。即ち一個の氣胞となるべき水母體一個の觸手及び一個の營養體とを生ずるが、此屬では氣胞内の氣嚢は早くから著しく膨大して太短い幹の殆全部を充たすと同時に、幹の腹側に續々新らしい水螅體を作る。其中最初の營養體及び觸手は體の後端にあつて、其周圍にあまり強く發達しない澤山の營養體感觸體觸手を生じ

て茲に一小群を作るが、之れより後れて生ずる大群は之れよりも稍前方に集團をなし、其群中より強く發達した觸手も出れば、生殖體も出來るのである。

Disconectae の發生も未だ詳でないが、前の諸部類とは少しく異なつて居る Velella に就て述べると、營養體の根基部外側壁に生じた小さな水母體(之れをChrysomitraといふ)は、母體を謝して後其柄部に一個の大きな赤色の卵を生ずる。併し此水母は成熟に先ちて海面を去つて海中深く降り行くのである。從て此卵の第一期及び第二期の初めの變化は全く不明であるが、吾人の知れる最も早い期のコナリャ時期(Conaria)は、幼蟲が海底より再び海面に向つて出發したのを海中千米突の深さに於て獲たのである。此幼蟲は一ミメ大の球狀の袋が、其上極より中腔に向つて赤色な圓錐形な突起があつて、此部分に油の如き物質を分秘包藏して居るから、幼蟲は之れに仍つて消極的に水面に向つて上りつゝあるのである。上の極の外方に向つて更に一個の芽を生ずるが、之れが氣胞を作るので、幼蟲が表面に達する頃には、氣嚢の外側に垂直な衝立狀の褶を生じ、氣胞の下の袋は下極に口を開いて營養體となり、氣胞と營養體との間の部分は横に延びて、周圍に棚の形に褶を生じ、ラタリャ時期(Rataria)となる。此ものは直徑一、五ミメ内外であるが、之れから横の褶が益延びて縱の高さよりも横の徑の方が長くなり、氣胞は盤狀となつた幹中に順次同心環形の室を作り、コナリャの圓錐形突起は肝臟其他の管系統を作り、下面の營養體の周圍に多數の營養體を生じ、更に外側に觸手の環列を作るときは、即ち成體に見る構造となるのである。

## 五　管水母解釋の變遷

以上管水母構造及び發生の一般を述べ終つたが、此等の事實が管水母の解釋並びに分類に對し如何なる基礎を與へるかと云ふことは頗る興味あることであるから、茲に吾人は再び眸を歷史の方面に轉じて、時代と共に變遷し來つた構造の解說を吟味して見やう。但し此議論は凡て觀察した事實を根據として表はれたものであるから、今抽象的に結論のみを擧げる爲めに、無味乾燥に終るのは甚だ相濟まない譯である。

之れは强ち管水母に限つたことではないであらうが、從來の管水母に關する研究が、其結論に於て決定しやうと勉めた問題が二つある。其第一は管水母は果して一個蟲であるか、群體であらうか、從つて管水母は他の腔腸動物に對して如何なる關係を保つものであらうかの問題で、第二は管水母種類相互の間の異同如何、即ち管水母は如何に分類すべきかの問題である。勿論二つの問題は相關聯して起るものである。

何人も知る通り、管水母は其形態生理其他種々の點に於て他の腔腸動物と趣を異にすることが尠くないので、其性質構造に關しては、古來幾多の學説が顯はれ、或學者は此動物は甚だ復雜なる機官を有する一個蟲であると主張し、或學者は分業法の發達したる結果個々特別な官能を享有した個蟲の若干が集合して、一個の群體を成したものであると主張し、頗る議論を鬪はしたもので、今日と雖も未だ全く乾かぬ有樣である。多數學者の見解は各其論據を異にして居るが、概括して多數機官説と多數個蟲説との二つとすることが出來る。

○多數機官説(Polyorgan-theory)

一千八百二十一年アイゼンハルト氏はリゾフィサ(Rhizophysa)をAcalephaeのリゾストマ(Rhizostoma)に比較して、前者は後者の傘が裏返つて傘の外側が内に傘の下側が外に向ふ樣になつたもので、前者の幹は後者の柄部に相當するものだとした。同時に又管水母の中でリソフィサとカツヲノエボシ即ちフィザリア(Physalia)とを比較してリゾフィサが多數束の如くに集つて、氣胞が癒合して一個の共同の氣胞を作つたものがフィザリアに當ると述べた。管水母と普通の水母との關係を主張したのは氏を以て嚆矢とする、同氏は此考に基づいて管水母を分類して、リゾストマは單一の個蟲で(但し後に至りエー、アガシー氏により群體だと說明せられたが)、フィザリアは群體、リゾフィサは兩者の中間を示す形であるとした面白いことは此時一は個蟲なりとし一は群體なりとせられた二つの管水母が後に至つて非常に近い種類であることが知られたことである。

凡そ五十年の後、此アイゼンハルト氏の考へが(殆んと

同樣なる形でメチユニコフ氏によりて公にせられた。(一八七四)但しメチユニコフ氏は比較物をリゾストマに取らないで、ザーシア(Sarsia)に取つた。即ち氏はヂプレナ(Dipurena)といふ水母で、柄部に完全に發育した觸手を有することを見て、管水母では此異狀が普通となつたものと信じ、又補助的の柄部を澤山に有するユーコーペ(Eucope polygastrica)を以て、管水母のカツヲノカムムリに甚だ近いものであると思つた。又管水母の一種フイゾホラ(Physophora)の幹は、ザーシアの柄部が非常に延びて澤山の水母の芽にて被はれ居るもので、幼蟲に表はれる帽子形の保護葉は水母の傘に相當し、傘が今一つ重復して生じて、之れが裏返つたものが氣胞であるといひ、其他の柄部にある附屬物の中に、生殖體の樣な水母體もあれば、水母其ものは表はれないで其柄部、觸手、傘等の機官が、位置を變じたり、重複して數を增したりして表はれるので、此變位重復はユーコーペの柄部が幾重にも芽出することに相似なことで、甚だ複雜なる動物となる幼蟲には常に見る所であるといつた。又Calycophore に於てユードキシ體として分離する幹上群は、全體で一個の水母に相當するもので、其保護葉は水母の傘が變形したもので、其營養體觸手は水母の柄部觸手等に當るものとした。此ユードキシ體の解釋は同時代に發表せられたピー、イー、ミユラー氏(一八七一)の考へとよく一致して居るので、エー、アガシー氏(一八六五)も此說を主張したる人である。

上記諸氏の解釋を一括して云へば、管水母は全體として一個の水母より起つた所の多形の動物で、柄部に相當する幹から二つの世代が異形な水母として芽出する。其一は生殖體で、他は變位重複をなして表はるゝ水母の諸機官であるとするのである。

之れと似た解釋は今少し早く千八百五十九年に、ハツクスレー氏に依りても發表せられた。同氏は個蟲なる語の意義を一つ一つの種類の代表者又は世代に向つて用ひないで、一個の受精した卵から生ずる諸狀態を總括して言つたから、管水母も一個の水母で、之れを組立てゝ居る種々の體は附着した儘に止まると分離して獨立の生活を

營むと論なく皆機官であるといつた。即ちハックスレー氏の說は個蟲なる語の意義からして、前記諸氏の說を一歩進めたものであるが、氏も亦管水母體中の諸部分に於て多形を認めたので、泳鐘の如きは矢張同一機官が重複したものであると考へた、ハックスレー氏の說は最明瞭に管水母は一個の動物であると主張したものであるから、多數機官說は氏の名を冠するを常として居る。併し茲に深く注意しなければならぬ事は、管水母體中の諸部分を皆機官に相當するものとしたのは、前後唯ハックスレー氏あるのみで、前に述べたピー、イー、ミユラー、メチユニコフ其他の人々並びに後に述べるヘッケル氏等の解釋は、孰れも體中の諸部分の或ものは一個の水母に相當し、他のものは機官に相當するものと解說したのである。故にデラージ氏はハックスレー氏の說を多數機官水母形說と名づけて、其他の多數機官說者の說をば混合水母形說と名づけて居る。

要するに多數機官說の常に主張することは、水母の機官が變位重複して表はれると云ふことであるから、クーン氏は此說は管水母を恰も印度の佛像の如くに見做したと書いて居る。實に七面觀世音や千手觀世音は此說に依ると、丁度管水母と同樣な構造を有すると云ふ可きものである。而して此說は常に比較を水母に求めたもので、主として英米の學者に採用されて居た。

## ●蟹の足は何故にもげるや

(明治四十一年三月三十日受領)

理學士 谷津直秀

岩多き海岸にて潮干の際水溜りの底を窺へば、背に棘を有するか或は石灰藻を荷へる蟹の海草の森の中に靜坐するを發見せん、又石を反轉すれば其下には比較的に背の滑なる蟹を見出さん、此面白き動物の習性構造等を實驗塲裡にて緩る〳〵と研究せんと、ピンセットにて足を挾み上げバケツに入れんとするに、不思議や足は根元よりもげて不幸なる採集者に殘り蟹は雲を霞と石の下に消へ失せたり、又次の蟹を同樣に所分するに同じ結果に來る。是に於て足を殘して逃げ去る事に深き意味あるらしく思