a film, which formed on the surface of the solution, sometimes on the second day, generally during the first week, and occasionally not until the nineteenth day from the commencement of the experiment. The solutions consisted of mixtures of sugar and starch, with some albuminous matter, of the juice of beef sometimes filtered, and in other instances containing muscular fibre and vegetable substances. Five experiments were tried in flasks hermetically sealed at the beginning, and then immersed in boiling water, in all of which Infusoria were formed.

Four experiments were made with sealed flasks in a Papin's digester, two of them under a pressure of two, and two under five atmospheres. Infusoria were found in one of each.

The organisms consisted of Vibrio, Bacterium, Torula, minute Algæ, also of small, round or oval bodies, moving with vibrating cilia.

Dr. B. J. Jeffries presented his Annual Report as Curator of the department of Microscopy, which was accepted.

June 4, 1862.

The President in the chair.

The following communication was presented: —

On the Mode of Development of the Marginal Tentacles of the Free Medusæ of some Hydroids. By A. Agassiz.

The uniformity of the order of appearance of the partitions of Polyps, which was first pointed out by Milne-Edwards and Haime,* led me to suppose that something similar would be the case for the order of succession of the marginal tentacles of Hydroid Medusæ. As we have not in Acalephs new chambers, formed by additional tentacles, as is the case in Polyps, I have not used the term cycle of Milne-Edwards and Haime, but have employed instead of it the words *set of tentacles*, to denote those tentacles which are formed at the same time. For instance, a young Medusa just escaped from the reproductive calycle has four tentacles,— they are the tentacles of the first set; the tentacles which next make their appearance, — also four in number,— in the intermediate spaces, are those of the second set;

* Recherches sur la structure et la classification des Polypiers récents et fossiles, par MM. H. Milne-Edwards et Jules Haime, extrait des Annales des Sciences Naturelles, Paris, 1848–49.

the tentacles which then may make their appearance, at whatever point of the circumference it may be, and however irregularly they may divide the existing spaces between the tentacles, would be the tentacles of the third set, and so on for the other tentacles. Although in some of the families, as the *Laodiceæ* Ag., the *Eucopidæ* Gegenb., the *Nucleiferæ* Less., the *Melicertidæ* Ag., I have found that the order of appearance of the different tentacles coincided with the order of appearance of the chambers of Polyps; yet the exceptions to this law were numerous, as in the *Tubularidæ* Ag., the *Bougainvillidæ* Lütk, the *Nemopsidæ* Ag., the *Berenicidæ* Esch. In one and the same family we find genera in which the law holds good, while in closely-allied forms the order of development is materially modified, as is the case in *Clytia* and in *Tiaropsis*.

Another great difference between the Polyps and Acalephs is the great variety of numbers which are found in the tentacles of the first set in Acalephs, while in Polyps six is almost uniformly the number of chambers of the first cycle. In Acalephs, on the contrary, we find in some *Eucopidæ* sixteen, *Obelia* (fig. 5), in others, *Eucope* (fig. 7), twenty-four, and forty-eight (fig. 6), as the number of tentacles of the first set; in the *Oceanidæ* Esch., as limited by Agassiz, there are four in *Clytia* (fig. 14), *Eucheilota* (fig. 16), and *Tiaropsis* (fig. 10); in the *Laodiceæ*, there are four in *Staurophora* (fig. 1), and two in *Laphœa* (fig. 4). Among the *Berenicidæ* there are four (see *Willia*); the *Nemopsidæ* have sixteen (fig. 26), while the *Bougainvillidæ* have eight, as in *Bougainvillia* (fig. 24), or four as in *Lizzia* (fig. 28). In some of the Tubularians, as in *Corymorpha* (fig. 31), and *Hybocodon* (fig. 30), the first set has but one tentacle. This shows, among the few Medusæ which I have examined, a greater variety of modes of development than we find in the whole class of Polyps, as far as they are known.

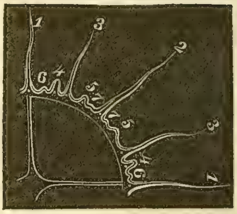
In *Staurophora laciniata* Ag., I have followed this succession of the sets of tentacles as far as the seventeenth set. The first set consists of four tentacles, and perhaps only of two if we may form conjectures from the young Medusa of *Laphœa* mentioned below. In fig. 1 we have a young *Staurophora*, measuring about $\frac{1}{20}$ of an inch across the circular tube, in which the second set of tentacles is developed. The digestive cavity hangs down as a short proboscis; there are no ovaries developed. The formula of the tentacles for a quarter segment, at the stage of growth of fig. 1, could be represented by T_1, t_2, T_1; — T_1, T_1, being the tentacles of the first set, placed in the prolongation of the chymiferous tubes,

Fig. 1.

Young *Staurophora laciniata*, magnified 10 diam.

t_2, the tentacles of the second set, half-way between those of the first set. Fig. 2 is a more advanced stage of *Staurophora*, in which the tentacles of the third set are almost as large as those of the first and second sets, and the fourth, fifth, and sixth sets of tentacles can readily be distinguished. Using the same notation as above, the formula for the tentacles would be :

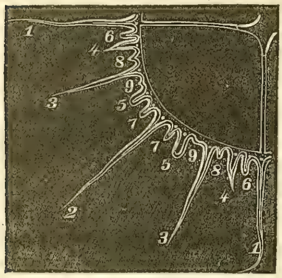
FIG. 2.



Young *Staurophora*, slightly older than fig. 1.

T_1, t_6, t_4, t_3, t_5, t_7, t_2, t_7, t_5, t_3, t_4, t_6, T_1. In fig. 3, the young *Staurophora* has a still greater number of sets of tentacles, the fourth and fifth sets having grown sufficiently large to be easily distinguished from one another by their difference in size; the eighth and ninth sets have made their appearance. The formula for this stage of growth is : T_1, t_6, t_4, t_8, t_3, t_9, t_5, t_7, t_2, t_7, t_5, t_9, t_3, t_8, t_4, t_6, T_1. The number of tentacles of the first set are four ($4\ T_1$) ; there are in the second set also four ($4 t_2$), using the same notation; there are in the third set $8\ t_3$; in the fourth set $8\ t_4$; in the fifth set $8\ t_5$; in the next set $8\ t_7$; then $8\ t_8$, and $8\ t_9$ in the ninth set. The number of tentacles which *Staurophora* may have at any particular time can easily be found, and the formulæ for the number of tentacles in figs. 1, 2, 3, would be:

FIG. 3.



Young *Staurophora*, still older than fig. 2.

$$\Sigma\,\mathrm{t} = 4\ T_1 + 4\ t_2 \text{; or 8 tentacles for fig. 1,}$$

Σ t denoting the sum of the different sets of tentacles round the circumference ;

$$\Sigma\,\mathrm{t} = 4\ T_1 + 4 t_2 + 8 t_3 + 8 t_4 + 8 t_5 + 8 t_6 + 8 t_7 \text{ for fig. 2,}$$

or forty-eight tentacles ; and, finally,

$$\Sigma\,\mathrm{t} = 4\ T_1 + 4 t_2 + 8 t_3 + 8 t_4 + 8 t_5 + 8 t_6 + 8 t_7 + 8 t_8 + 8 t_9,$$

or sixty-four tentacles in fig. 3 ; and so on as far as the seventeenth set. It becomes almost impossible to follow the development of the tentacles further, as they are then rather irregular in their growth, and often much more numerous in one quarter segment than in the adjoining one. In fig. 3, we have the first sign of the development of the ovaries, the corners of the digestive cavity extend, little by little, along the chymiferous tubes, and when the young Medusa has attained the size of an inch in diameter, the ovaries already reach half-way towards the circular tube. For a figure of the adult Medusa, see Agassiz (L.) in Mem. American Academy, Vol. IV. Plate 7. The only species of the *Laodiceæ* AG. which I have found young enough to show positively what the number of tentacles of the first set was, is the Medusa of *Laphœa cornuta* LAMX., fig. 4, in which the formula for the tentacles for half the circumference is, T_1, t_3, T_2, t_3, T_1; the presence of eight tentacles at that time is expressed by the formula $\Sigma t = 2 T_1 + 2 T_2 + 4 t_3 = 8 t$. This species is closely allied to *Atractylis repens* WRIGHT, and I am inclined to believe that both may prove to be the young of *Laodicea-like* Medusæ. It will be very interesting to see how this order of succession of the sets of tentacles is modified in *Laodicea calcarata* A. AG., in which we have cirri, and club-shaped bodies between the tentacles, as in *Thaumantias mediterranea* GEGENB. Unfortunately I did not succeed in finding any Laodicea calcarata young enough to throw any light on this subject; from the youngest specimen I met with, I am convinced that the first set of tentacles does not consist of more than four, or perhaps even only of two tentacles, specimens measuring one quarter of an inch in diameter having not more than seven tentacles between every two chymiferous tubes.

FIG. 4.

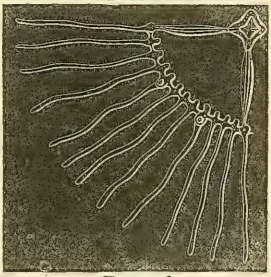
Free Medusa of *Laphœa cornuta*, magnified 15 dia.

In the *Eucopidæ* GEG. we find a much greater difference in the number of tentacles of the first set. In *Obelia commissuralis* McCR., fig. 5, there are sixteen tentacles in the first set. In *Eucope diaphana* AG. (see fig. 7), and in two other species closely allied to it, the first set consists of twenty-four tentacles; in another Hydroid belonging to this family we find a young Medusa escaping from the reproductive calycle with no less than forty-eight tentacles, as in fig. 6, which represents a quarter segment of a new species of *Eucope?* We know nothing of the adult condition of *Obelia*, fig. 5, and of the Medusa of fig. 6. But as we have no less than three species of *Eucope* on our coast, all escaping from the reproductive calycles with twenty-four tentacles, and as we now know several species of *Obelia*, all having sixteen tentacles in the first set, and still another, fig. 6, in which the first set has forty-eight tentacles, this difference in the number of tentacles of the first set would seem to be generic.

FIG. 5.

Obelia commissuralis

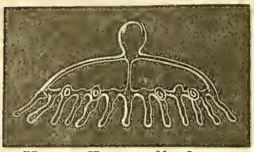
FIG. 6.



Eucope ?

Eucope diaphana Ag. is the only one of this family which I have followed from the time of its escape from the calycles to the adult state. The young Medusa is liberated with twenty-four tentacles, fig. 7; its formula would be $T_1, t_1, t_1, t_1, t_1, t_1, T_1$, or, for the number of tentacles of the first set:

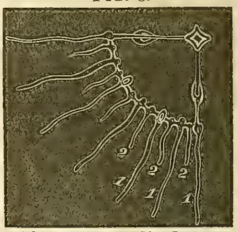
Fig. 7.



Young *Eucope diaphana.*

$\Sigma\,t = 4\,T_1 + 20\,t_1 = 24\,t$. In fig. 8, we have the same Medusa at the time when the second set is developed. The formula of fig. 8 is, therefore,

Fig. 8.



Older *Eucope diaphana.*

$$T_1, t_2, t_1, t_2, t_1, t_2, t_1, t_2, t_1, t_2, t_1, t_2, T_1,$$

or, for the whole number of tentacles:

$$\Sigma\,t = 4\,T_1 + 20\,t_1 + 24\,t_2 = 48\,t,$$

and so on, as far as the fifth set of tentacles, fig. 9.

The formula for the third set is:

$$\Sigma\,t = 4\,T_1 + 20\,t_1 + 24\,t_2 + 48\,t_3 = 96\,t;$$

that of the fourth set:

$$\Sigma\,t = 4\,T_1 + 20\,t_1 + 24\,t_2 + 48\,t_3 + 48\,t_4 = 144\,t;$$

that of the fifth set (fig. 9):

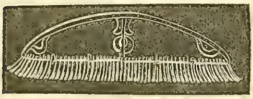
$$\Sigma\,t = 4\,T_1 + 20\,t_1 + 24\,t_2 + 48\,t_3 + 48\,t_4 + 48\,t_5 = 192\,t.$$

The formula for the arrangement of the tentacles for this last set being (fig. 9),

$$T_1, t_4, t_3, t_5, t_2, t_5, t_3, t_4, t_1, t_4, t_3, t_5, t_2, t_5, t_3, t_4, t_1, t_4, t_3, t_5, t_2, t_5, t_3, t_4, t_1, \ldots\ldots\ldots\ldots\ T_1.$$

Fig. 9 is an adult *Eucope diaphana* Ag., measuring one quarter of an inch in diameter; at the stage represented in fig. 7, it is not much larger than a pin's head.

Fig. 9.

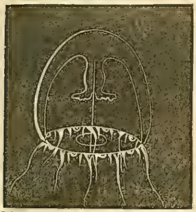


Adult *Eucope diaphana.*

In the *Oceanidæ* Esch., the presence of eyes between the tentacles, and the development of cirri at the base of the tentacles in some of the genera, modify the uniformity of the order of succession of the sets of tentacles.

In *Tiaropsis diademata* Ag. (Mem. American Academy, Vol. IV. Plate 6), we find two compound eyes between every two chymiferous tubes, the eyes being placed at the same distance from the chymiferous tubes as that at which they are placed one from the other. In the youngest *Tiaropsis* which I have found, fig. 10, there were already twenty-four tentacles, four long tentacles in the prolongation of the chymiferous tubes, four slightly shorter in the middle of the space between the eyes, and two pairs of small tentacles, one pair for each eye. So that we should have for the formula of the tentacles of fig. 10:

FIG. 10.



Young *Tiaropsis diademata.*

T_1, t_3, e, t_3, t_2, t_3, e, t_3, T_1; e being the compound eye. The third set, which would have fallen on the spot occupied by e, consists of a pair of tentacles, instead of a single one only, as in the former cases.

Fig. 11 is a diagram of the arrangement of the tentacles, between two chymiferous tubes, in the stage of growth of fig. 10. When we come to the next stage, represented in fig. 12, the order of succession is not interfered with by the eyes, and we have for the formula of the arrangement of the tentacles:

FIG. 11.

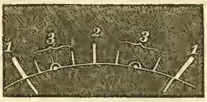
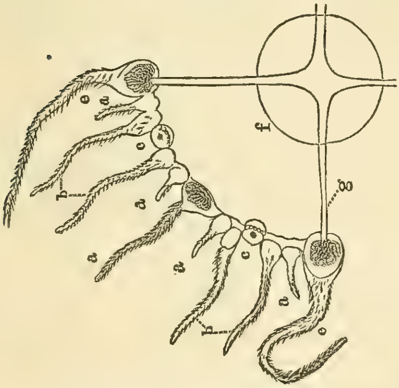


FIG. 12.

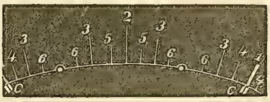


Tiaropsis, having forty tentacles.

$$T_1, t_4, t_3, e, t_3, t_5, t_2, t_5, t_3, e, t_3, t_4, T_1.$$

The fourth and fifth sets consist only of eight tentacles each, and not of sixteen, as the third set. When we come to the next set, the sixth, we find that it has sixteen tentacles, and that two pairs of tentacles are formed, one for each eye, as is shown in the diagram, fig. 13, and so on; every set which would have come in the space occupied by an eye being always formed in pairs, as was the case with the third and the sixth sets. The formula for this figure (fig. 13) would be:

FIG. 13.



$$T_1, t_4, t_3, t_6, e, t_6, t_3, t_5, t_2, t_5, t_3, t_6, e, t_6, t_3, t_4, T_1,$$

The formula for the number of tentacles of fig. 10 is:

$$\Sigma\, \mathrm{t} = 4\, \mathrm{T}_1 + 4\, t_2 + 16\, t_3 = 24\, t.$$

For fig. 12 the formula is:

$$\Sigma\, \mathrm{t} = 4\, \mathrm{T}_1 + 4\, t_2 + 16\, t_3 + 8\, t_4 + 8\, t_5 = 40\, t.$$

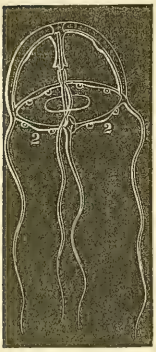
For fig. 13 the formula becomes:

$$\Sigma\, \mathrm{t} = 4\, \mathrm{T}_1 + 4\, t_2 + 16\, t_3 + 8\, t_4 + 8\, t_5 + 16\, t_6 = 56\, t.$$

The presence of eyes does not always modify in such a remarkable manner the order of succession of the sets of tentacles. For instance, in *Clytia bicophora* AG. (see also NOTE A, p. 95), we have two eyes between every two chymiferous tubes, and yet the order of succession is as regular as if the eyes had not been present. Fig. 14 is a young *Clytia*, just escaped from the calycle, having four long tentacles and four rudimentary ones, 2 (fig. 14), and the eyes placed on each side of the middle tentacle; the formula for the arrangement of the tentacles is:

$$\mathrm{T}_1, \quad e, \quad t_2, \quad e, \quad \mathrm{T}_1.$$

FIG. 14.

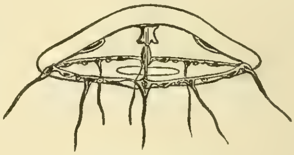


Clytia bicophora.

In fig. 15, the tentacles of the third set having made their appearance, the formula becomes:

$$\mathrm{T}_1, t_3, e, t_2, e, t_3, \mathrm{T}_1.$$

FIG. 15.



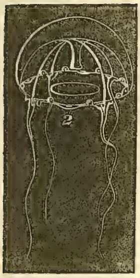
Young *Clytia bicophora.*

The formulæ for the number of tentacles for figs. 14 and 15 are respectively:

$$\Sigma\, \mathrm{t} = 4\, \mathrm{T}_1 + 4\, t_2 = 8\, t, \text{ and } \Sigma\, \mathrm{t} = 4\, \mathrm{T}_1 + 4\, t_2 + 8\, t_3 = 16\, t.$$

This Medusa has not been traced farther. I am unable, therefore, to say whether the succession of the following sets is regular or not. In the genus *Eucheilota* of McCrady, in which we have eyes and cirri, the following is the order which has been observed: the youngest *Eucheilota* (probably *Eucheilota ventricularis* McCR.; for figure of the adult see McCrady, Proc. Elliot Soc., Plate XI. fig. 3) had four long tentacles, and resembled the young of *Clytia*, fig. 14, so closely that it was at first mistaken for it. More advanced

FIG. 16.



Young *Euchei-lota.*

specimens, fig. 16, showed at the base of the large tentacles slight swellings, which soon developed into short cirri as seen in fig. 17, in which the cirri of the second set of tentacles are also slightly developed. The formula for the youngest *Eucheilota* thus far seen is:

FIG. 17.

Eucheilota, more advanced than fig. 16.

$$T_1, \quad e, \quad t_2, \quad e, \quad T_1.$$

The formula of fig. 16 is:

$$\overbrace{T_3, \ T_1, \ T_3}, \ e, \ t_2, \ e, \ \overbrace{T_3, \ T_1, \ T_3},$$

and that of fig. 17 is:

$$\overbrace{T_3, \ T_1, \ T_3}, \quad e, \quad \overbrace{t_4, \ t_2, \ t_4}, \quad e, \quad \overbrace{T_3, \ T_1, \ T_3},$$

the third and fourth sets of tentacles being the cirri of the tentacles of the first and second set; so that the cirri are developed before any additional sets of tentacles are added, the formulæ for the number of tentacles of these successive stages being:

$$\Sigma\, t = 4\, T_1 + 4\, t_2 = 8\, t.$$

$$\Sigma\, t = 4\, T_1 + 4\, t_2 + 16\, T_3 = 24\, t.$$

$$\Sigma\, t = 4\, T_1 + 4\, t_2 + 16\, T_3 + 16\, t_4 = 40\, t.$$

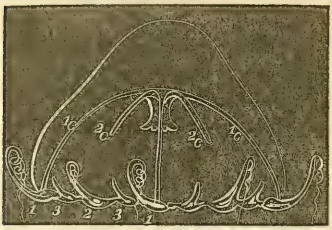
Among the *Geryonopsidæ* AG. I have found our *Tima formosa* AG., with sixteen long tentacles and sixteen shorter ones, the formula being probably:

$T_1, \ t_4, \ t_3, \ t_5, \ t_2, \ t_5, \ t_3, \ t_4, \ T_1$; as *Tima* never has many tentacles it is possible that the young *Tima* have not more than four, or perhaps two tentacles in the first set. The *Æquoridæ* will give us the best means of ascertaining the order of development of the chymiferous tubes, and of the tentacles in connection with numerous eyes between the tentacles, as these Medusæ attain quite a large size before the chymiferous tubes become numerous. From what I have seen in the *Berenicidæ* ESCH., the *Melicertidæ* AG., and the *Æquo-*

NOTE A.—The genus *Wrightia* has but two tentacles when the Medusa escapes from the calycles. I have traced the Medusa of our young *Wrightia*, mentioned by Prof. Agassiz on p. 354 of his 4th vol. of Contributions to the Natural History of the United States, through all the stages intermediate between *Wrightia* and *Oceania*, and have ascertained that our *Wrightia* is only the young of *Oceania languida* A. AG. described in p. 353 of the same volume. It has at first two long tentacles, then four, in the prolongation of the chymiferous tubes, then eight, sixteen, and finally thirty-two tentacles. The eyes are developed independently of the tentacles; one pair of eyes making its appearance for each tentacle.

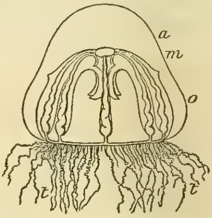
ridæ Esch., it appears that the new chymiferous tubes are always formed from the base of the digestive cavity towards the circular tube, the tentacle which is eventually placed in the prolongation of the chymiferous tube being always first developed, before any trace of the chymiferous tubes can be found, so that the new chymiferous tube strikes the tentacle, instead of the tentacle arising from the tube. Fig. 18 is a young *Melicertum Campanula* Per. et Les., of which fig. 19 is the adult. In fig. 18 there are only four of the eight chymiferous tubes which reach the circular tube; the others, ${}^2c$, ${}^2c$, only extend a short distance, while the tentacles 2, which will, in later stages of growth, be found in the prolongation of these tubes, ${}^2c$, are quite well developed. The formula for the tentacles of fig. 18 is: T_1, t_3, t_2, t_3, T_1, which soon becomes T_1, t_4, t_3, T_2, t_3, t_4, T_1; the chymiferous tubes ${}^2c$, ${}^2c$, having reached the circular tube at the point 2, fig. 18. The mathematical accuracy of the meeting of the tentacle and its chymiferous tube is still more striking in Willia. In a young *Willia ornata* McCr. there are four straight chymiferous tubes which do not branch, four long tentacles in the prolongation of these chymiferous tubes, and four tentacles which are not placed in the middle of the space between two adjoining chymiferous tubes, but always in such a position that, either to the right or the left, the distance to the nearest chymiferous tube is one-third of the space between two adjoining chymiferous tubes. In fig. 20 the simple tube is sending off a small branch, ${}^2c$, which will, in the end, strike the circular tube at the point where the tentacle 2 is placed. The formula for the tentacles in fig. 20 being: T_1, t_2 T_1, and after the branch of the chymiferous tube has reached the margin it will become: $\widehat{\mathrm{T}_2\ T_1}$, $\widehat{T_1\ \mathrm{T}_2}$ for half the circumference; T_1 indicating the tentacle in the prolongation of the main tube; T_2 the tentacle of the first branch; the $\frown$ joining the two letters T_1 T_2 shows that the branch T_2 is a part of the same chymiferous tube

Fig. 18.



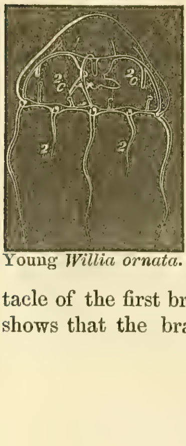
Young *Melicertum Campanula.*

Fig. 19.



Melicertum Campanula.

Fig. 20.



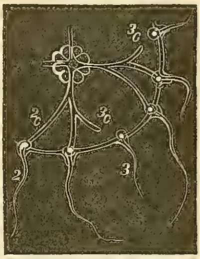
Young *Willia ornata.*

with T_1; the same applies to T_3. Soon after the tentacles of the third set make their appearance, and in fig. 21 the formula is:

$$t_3,\ \overbrace{T_1,\ \mathrm{T}_2},\ t_3,\ \overbrace{T_1,\ \mathrm{T}_2},\ \text{or, } \Sigma\,\mathrm{t} = 4\,\mathrm{T}_1 + 4\,\mathrm{T}_2 + 4\,t_3 = 12\,t;$$

a branch ${}^3c$ is then set off in the opposite direction to ${}^2c$, which soon reaches the circular tube at the point where the third set of tentacles has already been formed. The last formula becoming for this stage:

FIG. 21.



Willia, more advanced than fig. 20.

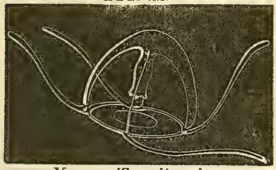
$$\overbrace{\mathrm{T}_3,\ T_1,\ \mathrm{T}_2},\ \overbrace{\mathrm{T}_3,\ T_1,\ \mathrm{T}_2},$$

$$\text{or, } \Sigma\,\mathrm{t} = 4\,\mathrm{T}_1 + 4\,\mathrm{T}_2 + 4\,\mathrm{T}_3 = 12\,t.$$

We have thus in *Willia* a very peculiar order of development in the first three sets, modified by the manner of branching of the chymiferous tubes.

In other genera of the Tubularians, as *Turritopsis* McCr., and *Turris* Less,* we find again the same regularity as in *Staurophora* and *Eucope;* the sets of tentacles making their appearance in the same order. In fig. 22, we have a young *Turritopsis nutricula* McCr., having only four tentacles. For a figure of the adult, see McCrady, Proc. Elliot Soc., Plates 4 and 5. Fig. 23 is the same species with sixteen tentacles. The formula of fig. 23 is:

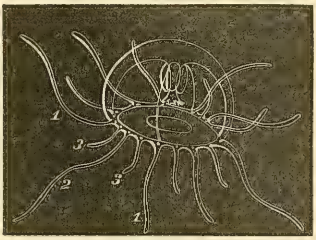
FIG. 22.



Young *Turritopsis*.

$\mathrm{T}_1,\ t_3\ t_2,\ t_3,\ \mathrm{T}_1$. In the *Nemopsidæ* Ag. and *Bougainvillidæ* Lütk., in which the tentacles are found arranged in clusters, we have an entirely different mode of development. In *Bougainvillia superciliaris* Ag. (for a figure of the adult see Agassiz (L.) in Mem. Am. Acad., Vol. IV. Plate 1) the young Medusa, at the time when it separates from the Hydra, has two tentacles in the prolongation of each chymiferous tube, as in fig. 24; the next sets are

FIG. 23.

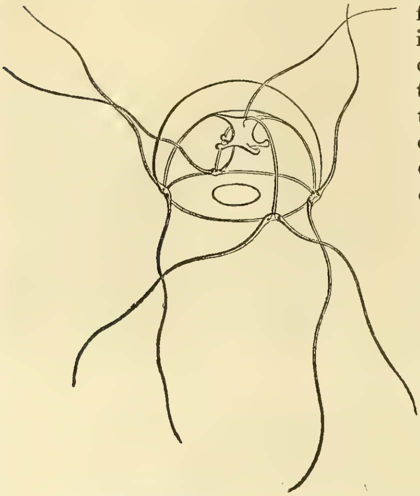


Young *Turritopsis nutricula*.

* The *Turris* which occurs at Nahant is probably the *Medusa digitalis* Fab. As the name *Turris digitalis* is pre-occupied for an English species, I would propose the name of *Turris vesicaria* for the species found on our coast.

developed in pairs, one tentacle on each side of those of the first set, as in fig. 25, which is one cluster of tentacles at the time when the fourth set of tentacles is developed. The formula of fig. 24 is:

FIG. 24.



Young *Bougainvillia superciliaris.*

FIG. 25.

$$\overbrace{2\,T_1,}\qquad\overbrace{2\,T_1,}$$

$$\text{or, } \Sigma\,t = 8\,T_1 = 8\,t.$$

That of fig. 25 is:

$$\overbrace{T_4\;T_3\;T_2\;T_1\;T_1\;T_2\;T_3\;T_4}$$

for each chymiferous tube,

$$\text{or, } \left\{\begin{matrix} 2\,T_1 & 2\,T_1 \\ 2\,T_2 & 2\,T_2 \\ 2\,T_3 & 2\,T_3 \\ 2\,T_4 & 2\,T_4 \end{matrix}\right\}$$

$$\text{or, } \Sigma\,t = 8\,T_1 + 8\,T_2 + 8\,T_3 + 8\,T_4 = 32\,t.$$

In *Nemopsis Bachei* AG. the tentacles are developed in pairs, on each side of the chymiferous tube, as in *Bougainvillia;* the only difference being that, in *Nemopsis,* the first set of tentacles consists of four, instead of two tentacles, as in the former genus. In fig. 26 we have a young *Nemopsis* with the tentacles of the first set; its formula is: $4\,T_1$, $4\,T_1$. In fig. 27 there are two additional sets formed, and the formula is:

FIG. 26.

Young *Nemopsis Bachei.*

$$\overbrace{T_3\;\;T_2\;\;T_1\;\;T_1\;\;T_1\;\;T_1\;\;T_2\;\;T_3},\text{ for each chymiferous tube;}$$

$$\text{or, } \left\{\begin{matrix} 4\,T_1 & 4\,T_1 \\ 2\,T_2 & 2\,T_2 \\ 2\,T_3 & 2\,T_3 \end{matrix}\right\} \text{ or, } \Sigma\,t = 16\,T_1 + 8\,T_2 + 8\,T_3 = 32\,t;$$

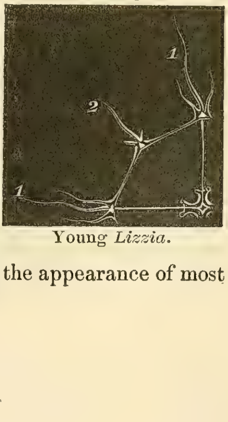
FIG. 27.

Young *Nemopsis Bachei.*

all the sets except the first having the same number of tentacles. For figures of the adult, see Agassiz (L.), Mem. American Academy, Vol. IV. p. 289; and McCrady, Proc. Elliot Soc., Plate 10, under the name of *Nemopsis Gibbesii.* In *Lizzia,* where there are secondary clusters of tentacles between the chymiferous tubes, the development is not isochronous in the tentacles in the prolongation of the chymiferous tubes and those between them. It is particularly easy to trace the order of succession of the different sets of tentacles in *Lizzia,* as the Medusæ buds are formed on the proboscis, and develop with great rapidity; from these young Medusæ, in their turn, buds are formed which become free Medusæ in three or four days; so that in the course of a week there may be as many as three successive generations swimming in a jar, which, a short time before, contained but a single Medusa. I at first supposed that the young specimens of *Lizzia,* which I found subsequently in my jars, had escaped my attention; but I became satisfied that this was not the case by isolating several specimens of our *Lizzia* with buds on the proboscis, for on examining them, at frequent intervals, I saw the buds upon their proboscis rapidly enlarge, and a few days afterwards I invariably found five or six free *Lizziæ* nearly as large as the one which had been isolated at first. The same experiment was repeated with the Medusæ which had thus been developed; they were isolated with the same result.

In the young buds of our Lizzia, *Lizzia grata* A. AG., there are at first four large patches of pigment cells in the prolongation of the chymiferous tubes; the intermediate clusters then make their appearance. The tentacles in the prolongation of the chymiferous tubes are first developed. We have one long tentacle for each tube. Soon afterwards the intermediate tentacles are formed, one tentacle between every two chymiferous tubes; next a pair of tentacles makes its appearance, one on each side of the long tentacle in the prolongation of the tubes; the next set consists of a similar pair for the intermediate tentacle; when the tentacles of the young *Lizzia* assume the appearance of fig. 28. In this state they remain apparently until all the tentacles have become equally developed. This is the appearance of most

FIG. 28.



Young *Lizzia.*

FIG. 29.

Adult *Lizzia grata*.

of the specimens found. It is not till then that we find a second pair of tentacles added on each side of the cluster of tentacles in the prolongation of the chymiferous tubes, as is seen in fig. 29, which represents an adult male *Lizzia grata;* the size of this Medusa is one quarter of an inch in height. The following formulæ would represent these different stages of growth:

$$T_1,\ T_1, \text{ or, } \Sigma\, t = 4\, T_1 = 4\, t;$$

$$\text{then, } T_1,\ t_2,\ T_1, \text{ or, } \Sigma\, t = 4\, T_1 + 4\, t_2 = 8\, t;$$

$$\text{next, } \left.\begin{matrix} T_1 \\ 2\,T_3 \end{matrix}\right\} \quad \left.\begin{matrix} t_2\,,\ T_1 \\ 2\,T_3 \end{matrix}\right\} \text{ or, } \Sigma\, t = 4\, T_1 + 4\, t_2 + 8\, T_3 = 16\, t,$$

$$\left.\begin{matrix} T_1 \\ 2\,T_3 \end{matrix}\right\} \quad \left.\begin{matrix} t_2 \\ 2\,t_4 \end{matrix}\right\} \quad \left.\begin{matrix} T_1 \\ 2\,T_3 \end{matrix}\right\} \text{ or, } \Sigma\, t = 4\, T_1 + 4\, t_2 + 8\, T_3 + 8\, t_4 = 24\, t,$$

(fig. 28.)

$$\left.\begin{matrix} T_1 \\ 2\,T_3 \\ 2\,T_5 \end{matrix}\right\} \quad \left.\begin{matrix} t_2 \\ 2\,t_4 \end{matrix}\right\} \quad \left.\begin{matrix} T_1 \\ 2\,T_3 \\ 2\,T_5 \end{matrix}\right\} \text{ or, } \Sigma\, t = 4\, T_1 + 4\, t_2 + 8 T_3 + 8\, t_4 + 8 T_5 = 32\, t,$$

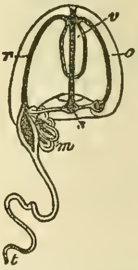
(fig. 29.)

which, to show the arrangement, might be written thus:

$$\overbrace{T_5\ \ T_3\ \ T_1\ \ T_3\ \ T_5}, \quad \overbrace{t_4\ \ t_2\ \ t_4}, \quad \overbrace{T_5\ \ T_3\ \ T_1\ \ T_3\ \ T_5}.$$

In those Tubularians in which the Medusæ are not symmetrical, as in *Hybocodon* AG. and in *Corymorpha* SARS (*Euphysa* FORBES ?), the order of development is still different from what we have found in any of the preceding species. In a young *Hybocodon prolifer* AG., fig. 30, the first set consists of one tentacle only. In *Corymorpha pendula* AG., fig. 31, the first set consists of one tentacle also, the second set of two, which are formed in the prolongation of the two chymiferous tubes on each side of the first tentacle, and the third set consists again of only one tentacle, developed in the prolongation of the chymiferous tube opposite the first tentacle. In fig. 31, the tentacles of the different sets are numbered according to their order of development. The formulæ for the above stages of *Corymorpha* are for the whole cir-

FIG. 30.



Hybocodon prolifer, magnified.

FIG. 31.

? *Corymorpha pendula* Ag., magni'd.

cumference, if O denotes that no tentacle has been developed in the prolongation of the chymiferous tube:

$\Sigma t = T_1 = 1\,t$; or $O + O + T_1 + O$, for the first set.

$\Sigma t = T_1 + 2\,T_2 = 3\,t$; or $O + T_2 + T_1 + T_2$ for the second set.

$\Sigma t = T_1 + 2\,T_2 + T_3 = 4\,t$; or $T_3 + T_2 + T_1 + T_2$ (fig. 31),* for the third set.

Figures 12, 15, 19, 24, 30, have been lent to me by my father, from the wood-cuts of the fourth vol. of his Contributions to the Natural History of the United States. Fig. 31 has been copied from a drawing lent to me by Prof. H. J. Clark. The other figures are copied from drawings made by me during the last two years at Nahant, Beverly, and Naushon. It was not till the appearance of the fourth volume of the Contributions of Prof. Agassiz that it became possible to trace the intermediate stages of growth of the many Hydroids of our coast, the relations of which to our free Medusæ had been traced during the investigations necessary for its publication.

On the subject of the present paper, the above-mentioned work contains only a few facts relating to *Tiaropsis*, and a general inference, derived from isolated facts, that the distinction of species, based upon the number and arrangement of the tentacles, can no longer be considered valid. See, for instance, the modifications which have been proposed in the tabular view of the Hydroids, in Vol. IV. of the Contributions to the Natural History of the United States, with reference to the numerous species of Forbes and of Gegenbaur.

Professor Agassiz mentioned that the Museum at Cambridge had recently received a cast of the great Megatherium of the British Museum. This cast had been sent by Joshua Bates, Esq., of London, to whose munificence the Museum was indebted for this valuable addition to their collections. He had taken this opportunity of comparing the bones of the South American species with some fragments of Megatherium bones which he found several years ago near Savannah,

* Owing to the great difficulty of distinguishing the free Medusæ of *Corymorpha* (which has only been discovered this spring) and that of *Hybocodon*, I have marked the Medusa of the former as doubtful.

Georgia, and with additional pieces sent to him by Dr. Habersham. As the North American Megatherium had, upon theoretical grounds, been described from a few fragments as a distinct species from the South American one, by Dr. Leidy, it was an interesting question to ascertain how far this theoretical distinction was well founded. Fortunately, the fragments, which had been found by Professor Agassiz and Dr. Habersham, were exceedingly characteristic, and included portions of bones which enabled Professor Agassiz to satisfy himself of the specific difference of the Patagonian and of the North American Megatherium. He then exhibited to the Society a portion of the ulna and radius with the perfect articulating surface of the elbow. The ulna of the two species is about the same size, the North American being somewhat shorter and blunter, while the olecranon is very prominent in the South American species. The articulating surfaces of the radius were very different, showing a much greater power of rotation in the northern species, while the great development of the articulating surface must have restricted the rotation in the southern species to much narrower bounds; and other minor differences between the heel-joints and the spinous processes, which all tend to prove that the North American Megatherium must have been more flexible than the southern species. The question then arises how far it is possible for these two animals to have been generically distinct, as the differences which have thus far been pointed out are structural differences. Professor Agassiz was inclined to believe that the differences which he had pointed out were not simply specific, but that they were generic. This view he supported by making a short revision of the Edentata, and showing that the three groups into which Owen had subdivided them were of such a character that he considered them as suborders. The Megatheroids would be divided into two families, as the presence of a trunk indicated by the structure of the anterior portion of the skull in Megatherium would warrant its separation, as a separate family, from Megalonyx, in which we have a short snout. This subdivision into families would simply be applying to the Edentata the same principles of classification which are adopted in the Pachyderms.

In reply to a question of Dr. C. Pickering, Prof. Agassiz stated that he had no satisfactory conclusive evidence in regard to the exact geological age of the deposits in which the North American Megatherium is found.

Dr. Pickering said that he had seen the deposits of the Rio Negro, where the South American Megatherium was discovered, and was inclined to consider them as belonging to the age immediately preceding our own.