On Mœrisia lyonsi, a New Hydromedusan from Lake Qurun.

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With Plates 22 and 23.

INTRODUCTION.

DURING the months of March, April, and May of last year Dr. Cunnington and I were engaged in making a biological survey of the Birket el Qurun, a large lake in the Fayûm province of Egypt.

It is situated on the edge of the Libyan desert only a few miles from the spot where the wonderful fossil mammals have recently been discovered.

Of late years much attention has been devoted to the geology and topography of this interesting district, but nothing was known of the invertebrate fauna of the lake; it was to furnish the desired biological information that we were invited by the Egyptian Survey Department to make an investigation in the spring of this year.

The Birket el Qurun has a very unique interest as the remains of the historic Lake Mœris which was used as an artificial regulator of the Nile floods by the monarchs of the twelfth Dynasty.

At the present day the lake, which is about the size and shape of the Lake of Geneva, communicates with the Nile by means of a network of canals which irrigate the Fayûm, but except during high Nile receives very little water. There is no outlet, the waters of the lake are therefore decidedly brackish. A general summary of the results of our investigations was published in a letter to 'Nature' last August. With the exception of the Hydromedusan which forms the subject of this paper, of Cordylophora, and of a ctenostomatous Polyzoan, resembling Victorella, which occurs in great abundance, the fauna seems essentially a freshwater one, composed probably of such inhabitants of the Nile as can accommodate themselves to the salinity of the water.

The hydroid stage of Mœrisia was obtained for the first time at the beginning of April. As medusa-buds were present on the hydranths we carefully watched for free-swimming medusæ; these, however, did not appear in our tow-nettings until May, when they first began to swarm.

Both stages were exhibited by me at the meeting of the Zoological Society of London held on June 18th, 1907, when the name Mœrisia lyonsi, gen. and spec. nn., was proposed for this new form.

I desire to take this opportunity to express our sense of deep gratitude to Captain H. G. Lyons, F.R.S., and his assistants at the Egyptian Survey Department, who spared no trouble to ensure the success of our expedition; Mr. Dowson, Mr. A. Lucas, and Mr. Dickinson were of the greatest assistance to us during our stay in Cairo, helping in the choice of servants and stores, and in the transport of our baggage to the Fayûm.

Mr. Dickinson, in addition, accompanied the expedition down to the lake, where his thorough knowledge of the district was invaluable and saved us much time and trouble.

Although commenced at Cambridge the greater part of this work was carried out in the Zoological Laboratory of the Oxford University Museum, and I wish to express here my sincere thanks to Professor G. C. Bourne for all the facilities which he afforded me.

I have also to acknowledge my indebtedness to Mr. C.

Martin who very kindly assisted me in making out the structure of the different forms of nematocysts.

To Professor Sir Ray Lankester I wish to convey my thanks for the interest he has shown in this publication, and for allowing me to engage a skilled artist for the preparation of one of my plates.

I. The Hydroid.

A. Anatomy.

The hydroid stage of Mœrisia was obtained on several occasions by means of a light dredge from the surface of the mud which covers the lake-bottom. Here at depths varying from six to fifteen feet it forms curious tangled-looking colonies usually growing on branches of Cordylophora (fig. 1).

The hydrorhiza is inconspicuous and consists of a short stolon-like tube of cœnosarc invested by a delicate perisarc which is slightly annulated and has a very dirty appearance, due to the inclusion in its substance of particles of mud and other foreign matter (fig. 2, *Per.*). From it are given off, indiscriminately in all directions, long, filiform branches which bear hydranths at their distal extremities and represent the hydrocaulus of the colony.

The free end of the hydrorhiza usually narrows out to form a slender stem also bearing a hydranth.

The proximal part of the branches are covered by the annulated perisarc; this is continued as a smooth, thin membrane which loses itself a short distance up; the remainder is quite naked.

The curious appearance of the colonies is due to this want of rigidity in the hydranth-bearing stems; the latter may attain the comparatively great length of over 1 cm., and become entangled both with neighbouring branches and with the Cordylophora on which the animal grows.

The hydranths attain a length of over 2 mm.; they may be described as claviform, but their shape varies according to the degree of elongation or contraction; older specimens, also, bearing medusa-buds often have a greater relative diameter than younger ones.

Distally the hydranth is provided with a prominent cylindrical hypostome which is not constricted at its base. At the summit is the large mouth-opening surrounded by a narrow lip. At the proximal end the body tapers off gradually and passes imperceptibly into the narrow stem.

Each hydranth bears a small number of long, filiform tentacles arranged in a circle around the broadest part of the body below the hypostome; they seem to develop singly. The number is very variable, and an individual may bear from 0 to 8 tentacles; the majority, however, possess 4 or 5.

When fully extended the tentacles are very slender, and may attain a length greater than twice that of the hydranths on which they are borne.

The ectoderm of the hydranth consists chiefly of largish epithelial cells, the basal portions of which are provided with conspicuous longitudinal muscle processes. Small interstitial cells are to be found between the larger cells, and nematocysts occur in abundance. The ectoderm is deepest in the tentacle-bearing region of the body; in the hypostome it becomes much thinner, but again thickens around the mouth, where it forms the circular lip, crowded with large nematocysts. The ectoderm of the tentacles is continuous with that of the body; the cells are, however, less regular in shape, and form ring-like thickenings on which the thread-cells are borne.

The cells of the endoderm are by no means so uniform in structure as those of the outer layer. Roughly, three regions may be distinguished, corresponding well with those described by Hardy (1) in his paper on the histology of Myriothela phrygia. These regions are:

(1) An oral region, situated in the hypostome; here the endoderm presents four (rarely five) conspicuous longitudinal ridges formed by the greater elongation of certain of the

constituent cells, which are of two kinds:—(*a*) Elongated conical cells with finely granular protoplasm and a small nucleus situated in the tapering basal part; (*b*) narrow palisade-like cells, between the distal ends of which the former are wedged in; the protoplasm is clear and scarcely stains; their bases bear transverse muscle processes embedded in the mesoglœa.

(2) The second region is that from which the tentacles arise. The palisade cells are replaced by strongly vacuolated cells likewise arranged in longitudinal ridges; the latter are, however, less conspicuous than in the oral region, and are, moreover, far more numerous; as many as twenty may be counted in a transverse section of a large hydranth. Between the vacuolated cells are situated numerous very characteristic club-shaped gland-cells with large nuclei and coarsely-granular protoplasm.

The endoderm of the tentacles is continuous with that of the gastric cavity; in a transverse section of these organs we see five or six large clear cells surrounding a small but distinct tentacle cavity (fig. 8, *Tent. Cav.*). In this respect Mœrisia resembles Hydra and differs from all known colonial hydroids, for in these the long axis of the tentacle is occupied by a solid core of large vacuolated cells of so-called "notochordal" structure.

(3) In the third region, at the narrow base of the hydranth, we find cells very similar to those described as occurring in the tentacle zone. The ridges have, however, become quite inconspicuous and gland-cells are very rare.

As before mentioned, nematocysts occur scattered about in the whole of the ectoderm of the hydranths. Four kinds can be distinguished, similar in most respects to the forms which have been described in Hydra (2). They are:

(1) A large, oval, barbed nematocyst (fig. 9, *a*, *b*) found in great abundance on the body, hypostome and tentacles; most numerous in the ectodermal lip which surrounds the mouth opening. When everted the thread is seen to possess a thickened basal portion on which are developed a proximal

whorl of three large barbs and two or three distal whorls of much smaller ones.

(2) A smaller barbed form, similar in all respects to that just described, but attaining only half the size. It is found in the same positions as the larger kind.

(3) A cylindrical nematocyst of slightly greater length but same diameter as (1), without barbs. The thread before eversion is coiled round the imaginary longitudinal axis, forming several coils (fig. 9, *c*). This form differs from the corresponding nematocyst of Hydra in the character of the thread, which is thicker; the coils, moreover, are further apart and fewer in number. This nematocyst is rare, and I have only come across a few examples in the tentacles.

(4) A small pip-shaped form, devoid of barbs, occurring in large numbers, chiefly in the tentacles. The thread is thick and short; it differs from that of the cylindrical nematocyst in being coiled round the transverse axis of the organ (fig. 9, *d. e.*).

B. Medusa-buds.

On the larger hydranths medusa-buds are to be found scattered about the broadest part of the body, between and below the bases of the tentacles (fig. 6, 7, *Med.*). They arise in the usual manner as hollow outgrowths of the wall of the gastric cavity. Their development seems quite typical; the future umbrella cavity makes its appearance in the ectoderm at the apex of the bud, and by its growth causes the approximation of the endodermal walls of the latter. This leads to the formation of the endoderm lamella and the radial canals. Manubrium, velum, and other organs arise in the usual way. During the later stages of its development the medusa is borne on a short slender stalk.

The four-rayed symmetry so characteristic of the adult can be made out early, and the rudiments of the tentacle-bulbs are large and conspicuous. The tentacles themselves do not seem to be formed until after the liberation of the medusa.

c. Reproduction by Lateral Budding.

In addition to the young medusæ many of the hydranths bear a small number of oval buds attached by short peduncles to the parent body (figs. 2, 6, 7, *Lat. B*[1].). They are usually developed from the proximal region of the hydranth, but occasionally some may be found in a more distal position, either between the tentacles or at the base of the hypostome.

The buds arise as hollow outgrowths of ectoderm and endoderm, which later become constricted at their bases. The endoderm at the place where such a bud is formed is considerably modified, the cells becoming almost amorphous and charged with an enormous number of yolk-like granules, which probably form a reserve of nutritive substances. The mesoglœa in this region is thin and inconspicuous; the ectoderm, however, is not much modified, and contains numerous nematocysts.

The buds occasionally develop one or two tentacles (fig. 6, *Lat. B.*); for this reason they may possibly represent much modified hydranths. Normally they become completely detached from the parent body. I have found several liberated buds of this type, some of which had secreted a gelatinous ectodermal investment; their fate I have been unable to ascertain.

Such a process of asexual reproduction is, I think, quite unique; the nearest approach to it seems to occur in Myriothela. In this genus, according to Hardy (**1**), oval buds are developed at the junction of stolon and body; occasionally an isolated one may be found higher up in the tentacle-bearing region.

Their development, as described by the above-named author, is also similar to that of the lateral buds of Mœrisia, and we find the same modification of the endoderm cells. In Myriothela, however, the buds develop directly into daughter-polyps before becoming detached, although connection with the cavity of the parent is lost at an early stage.

In Mœrisia we occasionally find a lateral bud developing in situ; it increases in size, and forms what must be a modified hydranth of very irregular shape, usually with one or two tentacles, but without mouth or hypostome (figs. 5 and 6, *Lat.* B^2.). From this are developed one or more hydrorhizal tubes with perisarcal investment, which produce lateral branches; at the extremities of these ordinary hydranths are borne (fig. 5, *Hydr.*). We thus get the curious appearance of a small colony growing from the body of a hydranth.

In some cases the lateral bud produces a hydranth without first forming a hydrorhiza (fig. 6).

D. Reproduction by Transverse Fission.

In Mœrisia we observe yet another kind of asexual reproduction, which may be regarded as a modification of the phenomenon of decapitation described in so many hydroids. Decapitation seems to be of frequent occurrence in the colonies of Mœrisia; the basal part of a hydranth becomes constricted off from the branch which bears it, and eventually falls off. Before this actually happens we can often notice that the branch has become considerably swollen below the constriction, and is on the way to becoming a new hydranth. This is probably repeated several times during a season; Dalyell (3), why first described the phenomenon, noticed that in Tubularia decapitation could occur as often as seven times in sixty-six days.

In several colonies of Mœrisia observed by me the whole process was being hurried over, and, even before the first hydranth was completely separated off, a series of constrictions had appeared on the stem below it, giving rise to a string of more or less spherical buds (fig. 7, *Strob. B.*). These, no doubt, become detached, and develop into new colonies.

Chun (4), discussing the phenomenon of decapitation, has suggested that it may represent a process of very unequal, transverse fission, perhaps analogous with the monodisc strobilisation which occurs in some members of the Acelephæ (e.g. Cotylorhiza). Polydisc strobilisation, he thinks, may have developed as a later modification. To quote his words : "Was bei den Tubularien über einen längeren Zeitabschnitt sich vertheilte das finden wir bei der polydisken Strobilisation zeitlich zusammengezogen und in dem Auftreten mehrerer Ringfurchen am oralen Pole ausgeprägt."

Chun's suggestion seems, therefore, to be a very happy one, for in Mœrisia we find strobilisation no doubt derived from a process of decapitation, and what was probably a phenomenon initiated as a method of getting rid of old hydranths has developed into a most efficient method of asexual reproduction.

Murbach (5) has observed a somewhat similar form of transverse fission in Hypolytus, a curious solitary hydroid from Wood's Holl, Mass., U.S.A. In this form, however, the strobilisation occurs at the aboral, free end of the unattached stem; the liberated buds develop directly into new hydroids.

II. The Medusa.

a. Anatomy.

The liberated medusa (figs. 3, 4) has a globular umbrella, the height of which is about equal to the diameter; this varies in the different individuals, but never much exceeds 4 millimetres.

The umbrella is eminently contractile, and serves as a powerful organ of locomotion, the medusa being propelled through the water by alternate dilatations and contractions of its cavity.

Except for four bright red ocelli situated on the tentacle bulbs the medusa is quite colourless and transparent; when swimming about in the water it is almost invisible.

The umbrella is thin in a young individual, but as the animal approaches maturity the jelly or mesoglœa increases in thickness, especially in the apical region where it may attain a depth equal to nearly one half the total height of the medusa. The ex-umbrellar surface is perfectly smooth and devoid of groups of thread-cells.

The velum is broad and muscular, and is a very conspicuous feature of the jelly-fish.

The digestive sac or manubrium varies in shape according to age; it is, however, always short, and even when fully extended never reaches much further than the middle of the umbrella cavity.

The mouth is approximately circular and is simple, being devoid of oral lappets or appendages such as occur in so many families of Anthomedusæ.

Sections of the distal portion of the manubrium show this organ to be approximately cylindrical in shape.

The endoderm is seen to form four very conspicuous ridges, inter-radially situated, extending along the whole length of the manubrium as far as the base of the stomach proper. In the oral region the individual cells are tall and narrow with abundant finely-granular protoplasm, and a basally situated nucleus.

These cells pass gradually into a second kind of endoderm-cell which lines the cavity of the central region of the manubrium; in these the nucleus occupies a central position, and divides the cell into a basal portion with clear protoplasm and a peripheral portion with finely granular contents which stain deeply. Wedged in between these cells are occasional club-shaped gland-cells with large nuclei and coarsely granular protoplasm.

In the stomach or proximal region of the digestive sac the inter-radial ridges are less conspicuous, and the endoderm lower; the cells are much vacuolated, and many are modified as gland-cells.

In a medusa which has not long been liberated this proximal region is seen to be considerably swollen.

The swelling becomes accentuated in slightly older specimens, and examination shows this to be due to the formation of four deep longitudinal pouches (fig. 3) situated per-radially and giving this part of the manubrium the form of a cross when viewed from above or below.

From the top of the pouches four radial canals are given off which traverse the umbrella and terminate on the margin where their cavities become continuous with the cavity of the circular canal. These canals are lined by a very low epithelium consisting of very small, clear, cubical cells continuous with similar though slightly larger cells which cover the ex-umbrellar wall of the stomach.

The gonads are to be found on the walls of the stomach; the generative cells are distributed over the whole of the ectoderm of this region of the digestive sac, and attain their greatest thickness in the concavities between the per-radial pouches.

When we examine an adult medusa we find that the stomach has increased in size and has changed considerably in shape. The four per-radial pouches have become drawn out into long finger-shaped diverticula which extend more than half-way down the sub-umbrella (fig. 4).

Except at the distal extremities, the cavities of these diverticula are continuous with the cavities of the radial canals.

The gonads extend onto the walls of the diverticula and attain at this point a considerable thickness.

In the adult medusa we thus find an arrangement of the gastro-vascular system very similar to that described by Browne (6) in Willsia; as in that genus the study of immature forms proves the gonadial diverticula to be parts of the stomach. Sections (fig. 10) show that the outer or ex-umbrella walls of the diverticula are lined by small endoderm cells identical in all respects with those in the radial canals, whereas the remainder of the lining is formed by larger and taller cells directly continuous with and merging into the endoderm cells at the base of the stomach.

All the specimens examined by me were of the male sex;

it seems therefore probable that the female medusæ are liberated later in the year than the males.

The structure of the testis is quite typical, and in it the three tissue-zones described by the Hertwigs (7) are well developed. For a detailed description I must refer to the writings of these authors and to the paper by Günther (8) on Limnocodium, where a very clear account of the histology of the male organs is given.

As mentioned above, the tentacles, four in number in a normal individual, are given off from the umbrella edge at the terminations of the radial canals.

These tentacles are very slender and of great length when fully extended, the latter being equal to more than twice the umbrella.

At their bases the tentacles are swollen to form very conspicuous ocellar bulbs, each of which bears on its ex-umbrellar surface, a bright red ocellus. Each ocellus consists merely of a cup-shaped mass of pigmented sense-cells surrounding a number of clearer cells flush with the external surface of the bulb.

The tentacles are hollow, their cavities being continuous with that of the circular canal. The ectoderm forms wart-like thickenings arranged in transverse rings which become very conspicuous and almost bead-shaped when the tentacles are fully elongated (fig. 4).

All four kinds of nematocysts described as occurring in the hydroid were found also in different parts of the medusa. The barbed kinds are to be found scattered in the ectoderm of the whole of the manubrium, ocellar bulbs, and tentacles. In the manubrium they are especially numerous in the ectoderm around the mouth-opening, but they occur also in the more proximal parts, and are occasionally developed on the perradial gonadial pouches.

Sections of the manubrium revealed quite a large number of these nematocysts in the endoderm of the whole of that organ, situated always in the basal parts of the individual cells.

The two barbless kinds of nematocysts seem to occur chiefly on the ocellar bulbs and on the tentacles; as in the hydroid, the smaller pip-shaped kind was found in great abundance; the cylindrical form, on the other hand, was very rare.

The nematocysts of the hydroid and of the medusa were carefully examined and compared at the suggestion of Prof. Minchin; it seemed of great interest to find out to what extent these structures correspond in the two stages of a Hydromedusan. This is a subject which has been much neglected by students of the group, and I am not aware that any such comparison has previously been made. The fact that the nematocysts are identical in both stages of Mœrisia is somewhat important, and it would be interesting to know whether this is also the case in other genera. In the Hydromedusæ so little is known about the connection between the two stages and the assignment of medusæ to hydroids is often only a matter of inference; if it could be proved that the nematocysts are as a rule identical in the medusa and hydroid of the same species we would have a most excellent test to apply, and many interesting problems might be solved in this way.

B. Variation.

Dr. Cunnington and I were fortunately able to collect and preserve a large number of the medusæ, and on examination there proved to be much variation in the number of radial canals, gonads, and tentacles. I have counted these organs in 400 individuals, and of these 55, or nearly 14 per cent., differed from the type described above.

Of these abnormal specimens, eleven exhibited variation in the general symmetry of the medusa; one possessed only three radial canals, three gonads and three tentacles, nine had five, and one six of these structures.

This type of meristic variation is known to occur frequently among Medusæ, and I must refer the reader to the papers of Agassiz (9) and Browne (**10**) for further information on this subject.

The remaining forty-four abnormal individuals had the typical number of radial canals and gonads, but possessed additional tentacles in various positions on the umbrella edge. In most cases these additional tentacles were so arranged as not to destroy the radial symmetry of the medusa; ten individuals had four inter-radial as well as the four per-radial tentacles, whilst as many as twenty-eight possessed, in addition, eight adradial ones, thus making a total of sixteen tentacles.

The remaining six individuals were asymmetrical, the asymmetry being due to the development of an incomplete number of adradial and subradial tentacles.

I have given below in tabular form a detailed account of the number and arrangement of the radial canals in the 400 individuals examined.

VARIATION IN THE MEDUSA.

Table Showing the Number and Arrangement of the Radial Canals and Tentacles in 400 Individuals.

Number of Individuals.	Number of Radial Canals.	Number of Tentacles.				
		Per-radial.	Inter-radial.	Adradial.	Subradial.	Total
1	3	3	—	—	—	3
345	4	4	—	—	—	4
1	4	4	1	—	—	5
1	4	4	1	2	—	7
1	4	4	—	1	—	5
2	4	4	2	4	—	10
10	4	4	4	—	—	8
28	4	4	4	8	—	16
1	4	4	4	8	6	22
9	5	5	—	—	—	5
1	6	6	—	—	—	6
Total 400						

It is a well-known fact that many medusæ which in the adult condition possess a large number of tentacles commence life with only four per-radial ones; in such cases the number of tentacles would increase with the age, and therefore with the size of the individuals. This certainly is not the case with the medusæ which I have been describing, for in these they are chiefly the smaller individuals which possess supernumerary tentacles, the percentage of variability being very different in the smaller and larger specimens.

In order to show this point I divided the medusæ which I examined into two groups:—(*a*) With an umbrella-diameter varying from ½ to 2 mm., and (*b*) with a diameter measuring from 2½ to 4 mm.

Group (*a*) contained 278 individuals, of which 39, or about 14 per cent., had supernumerary tentacles, whereas of the 122 larger forms belonging to group (*b*) only 5 possessed such structures.

I think the figures show clearly that the multi-tentacular forms must be considered as exceptional varieties; from such small numbers it would not be fair to argue that some sort of natural selection is in progress.

III. Systematic Position.

The systematic position of Mœrisia lyonsi, unlike that of the other known lacustrine medusæ, presents no difficulty. The globular shape and four-rayed symmetry of the umbrella, the manubrial gonads, and the absence of otocysts refer the medusa to the Order Anthomedusæ.

The gymnoblastic hydroid stage confirms this position. The simple mouth, the four unbranched tentacles, and the narrow radial canals are a combination of characters which exclude Mœrisia from Haeckel's (**11**) families Tiaridæ, Margelidæ, and Cladonemidæ, and refer it to the only remaining family, that of the Codonidæ, to certain genera of which (e.g. Sarsia) it bears a striking resemblance.

The arrangement of the gonads in the adult is rather different to that of the typical members of the family. The study of young individuals, however, removes this difficulty, for in them we find the generative cells regularly distributed over the whole of the base of the digestive sac.

It is a more difficult matter to find a position for the hydroid stage among the numerous families of the Gymnoblastea, certain of the characters, for instance the hollow tentacles and the methods of asexual reproduction, being quite unique among colonial Hydrozoa.

On the whole the family to which it bears the greatest resemblance is that of the Bougainvilliidæ, the points of similarity being the single circlet of filiform tentacles and the cylindrical hypostome not constricted off from the body of the hydranth.

The new genus may be defined as follows :—

"Hydrocaulus consisting of long unbranched stems rising at short intervals from a small horizontal hydrorhiza, the latter invested by a delicate annulated perisarc continued onto the bases of the stems.

"Hydranths claviform with a small number (commonly four or five) of hollow filiform tentacles arranged in a circlet around the thickest part of the body.

"Hypostome cylindrical, not constricted at its base. Asexual reproduction by budding and transverse fission.

"Medusa developed from the body of the hydranth; when liberated globular with four unbranched radial canals and tentacles. Mouth simple. Manubrium very short; the stomach region provided with per-radial pouches which in the adult are produced into finger-shaped diverticla extending down the sub-umbrella. Gonads developed on the whole surface of the stomach and its diverticula."

IV. Conclusions regarding Origin.

The occurrence of a new medusa in the waters of the Nile system is of great interest. It is true that the water of Lake Qurun is decidedly brackish, and that therefore the term freshwater medusa cannot with strict accuracy be applied to

Mœrisia, yet the salinity is known to have varied greatly even in historic times, and at the time when great cities such as Dimeh were constructed on the north side of the lake there is little doubt that the Birket el Qurun contained fresh water. Even at the present day, although the amount of salt is sufficient to make the water unpalatable, an analysis showed that at the west end of the lake (where the concentration is greatest owing to the distance of the feeder canals) the total salts amounted to only 1·34 per cent., of which ·92 per cent. was sodium chloride.[1]

At present, excluding Mœrisia, only three genera of medusæ have been described from the freshwater systems of the different continents. These are: Limnocodium, originally described from the tanks in the Regent's Park Botanical Gardens; Limnocnida, from Central Africa; and last the medusa of Microhydra recently found in North America.

An admirable summary of the structure of these forms has recently appeared in the 'Quarterly Journal of Microscopical Science,' vol. 50, to which I must refer for more detail (**13**).

Other medusæ have from time to time been recorded from lagoons in close proximity to the sea, but such forms, e.g. von Kennell's Halmomises (**14**) from Trinidad, and Annandale's Irene (**15**) from the Ganges Delta, cannot be regarded as belonging to the true freshwater fauna.

As in the case of the above-mentioned medusæ, the question arises: How did a marine organism like Mœrisia find its way into Lake Qurun?

Before attempting to solve this question a little more detail of the topography and geology of the Fayûm must be given.

Lake Qurun measures at the present day approximately twenty-five miles by six; it lies in a depression on the border of the Libyan desert, its waters being nearly 140 feet below the level of the sea.

The Fayûm depression is separated from the Nile Valley

[1] Quoted by Beadnell from a note by Schweinfurth in Willcock's 'Egyptian Irrigation.'

by a desert ridge varying in width from one and a half to six miles.

The Lake is connected with the Nile by means of the Bahr Yusuf; this is a canal about 200 miles long, which leaves the river near Assiut, and, passing through a break in the desert ridge, flows into the Fayûm where it divides into numerous branches, some of which discharge their superfluous water into the Birket el Qurun.

At the present day Lake Qurun is situated about 150 miles to the south of the Mediterranean Sea; the Nile is a fast flowing river, and it is highly improbable that a medusa could have made its way upstream as far as the Fayûm; it is far more likely that Mœrisia is a relic of the sea, which in past times is known to have covered that part of Egypt in which the Lake is situated.

The geology of Lower Egypt has fortunately been most carefully worked out in recent years, and on perusal of what has been written on the subject it is not difficult to imagine how this can have happened.[1]

In early Pliocene times the valley of the Nile and the Red Sea were not yet in existence, and the Mediterranean covered the whole of Egypt to a little further south than Cairo.

At a slightly later period violent dislocations took place in the position of the future Nile Valley, and a marine fjord was formed in that district reaching as far south as the 24° of latitude. Into this fjord opened several rivers coming from the east over what is now the Arabian Desert, and there is no doubt that its waters were brackish.

The Fayûm depression was formed separately towards the same period, i. e. late Pliocene, and was occupied by a large brackish lake connected with the Mediterranean on the one hand, and with the fjord of the Nile Valley on the other. It seems probable that at this time Mœrisia, as well as

[1] The following account of the geology of Egypt has been compiled chiefly from the works of Beadnell and Blanckenhorn; references to these are given in the bibliography at the end of this paper.

Cordylophora and the Polyzoon, first established themselves in this brackish lake.

The course of events in Pleistocene times is at present rather obscure; it is thought, however, that this large prehistoric lake became disconnected both from the sea and from the Nile fjord, and that the greater part of it gradually evaporated, leaving probably only a small lake on the site of the present Fayûm depression, the latter already separated from the Nile fjord by a rocky ridge.

In later Pleistocene times, probably in consequence of slight elevation, the fjord became gradually silted up, and the early Nile cut itself a channel through the lacustrine beds.

The Nile at this period Beadnell (**16**) supposes to have been flowing about 20 metres higher than at present; in some way or other its waters must have broken through the dividing ridge and the Fayûm depression again became converted into a large lake.

When this occurred there must have necessarily been a mingling of the fauna of the old brackish lake and that of the early Nile; most probably the greater part of the former was exterminated by the influx of fresh water, Mœrisia, Cordylophora, and the ctenostomatous Polyzoon being among the few survivors.

This new lake was the Lake Mœris of the ancients, and must have occupied an enormous area; Beadnell has estimated the latter to have been about 2250 square kilometres, or about ten times the area of the present Lake Qurụn. The small size of the lake at the present day is due partly to evaporation, but chiefly to the reclamation of the land carried out during historic times by the different rulers of Egypt since the twelth dynasty.

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EXPLANATION OF PLATES 22 AND 23,

Illustrating Mr. Boulenger's paper on "Mœrisia lyonsi."

EXPLANATION OF LETTERING.

Cord. Stem of Cordylophora. *Ect.* Ectoderm. *End.* Endoderm. *End. Div.* Endoderm of the stomach diverticulum. *End. L.* Endoderm lamella. *E. U. Ep.* Ex-umbrella epithelium of the medusa. *Hydr.* Hydranth. *Hyp.* Hypostome. *Lat. B^1.* Lateral bud. *Lat. B^2.* Lateral bud at a later stage. *Med.* Medusæ in various stages of development. *Mes.* Mesoglœa. *Nem.* Nematocyst. *Per.* Perisarcal investment. *R. Can.* Radial canal of the medusa. *R. Can. End.* Endoderm of radial canal. *Strob. B.* Buds formed by strobilisation. *S. U. Ep.* Sub-umbrella epithelium. *Tent.* Tentacles of the hydranth. *Tent. Cav.* Internal cavity of the tentacle. *Tent. L. B.* Tentacles of the lateral bud. *Test.* Testis.

FIG. 1.—The tangled colony of the hydroid growing on Cordylophora (*Cord.*). × 2.

FIG. 2.—A young colony to show the hydrorhiza with its perisarcal investment, the latter extending on to the proximal part of the branches and their growing points. The larger of the two hydranths bears an asexual bud. × 30.

FIG. 3.—A young medusa with contracted tentacles; the stomach is provided with four per-radial pouches. × 10.

FIG. 4.—An adult medusa with extended tentacles; the diverticula of the stomach extend a considerable distance down the sub-umbrellar surface. × 10.

FIG. 5.—Outline sketch of a hydranth bearing a lateral bud; the latter has become of very irregular shape, and has given rise to a small colony without becoming detached. Note the two tentacles on the bud. × 30.

FIG. 6.—Similar to the previous figure. The lateral bud has grown to a considerable size, and has given rise to a large hydranth without forming a hydrorhiza. The hydranth bears several developing medusæ and a small lateral bud with two tentacles. × 30.

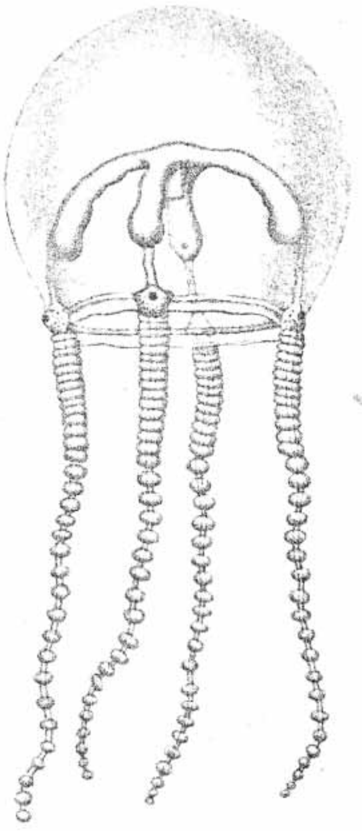
FIG. 7.—Outline sketch to illustrate the formation of buds by transverse fission. A process of strobilisation at the base of a hydranth has given rise to a number of nearly spherical buds. × 30.

FIG. 8.—Transverse section of a tentacle from a hydranth. Seven large endoderm cells are seen surrounding a small but distinct cavity. × about 200.

Fig. 9.—The three types of nematocysts:—*a.* The large oval form in the unexploded condition. *b.* The same with the thread everted, only two of the three large barbs can be seen. *c.* The cylindrical nematocyst with spirally coiled thread. *d.* The pip-shaped form, unexploded, to show thread coiled round the transverse axis. *e.* The same with thread everted. Zeiss obj. F, oc. 2.

Fig. 10.—Transverse section through a stomach diverticulum and part of the umbrella of an adult medusa. The cavities of the diverticulum and radial canal are continuous, but the endodermal linings of the two structures are quite distinct. × about 60.

Fig. 11.—Similar to Fig. 10, but the section is cut through the distal extremity of the diverticulum where its cavity is separate from that of the radial canal.



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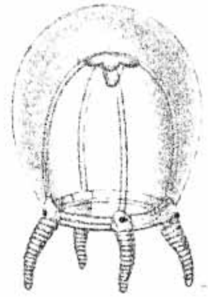

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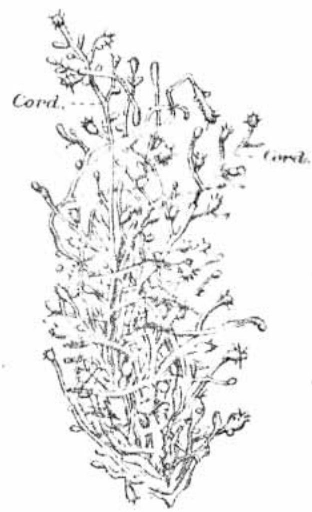

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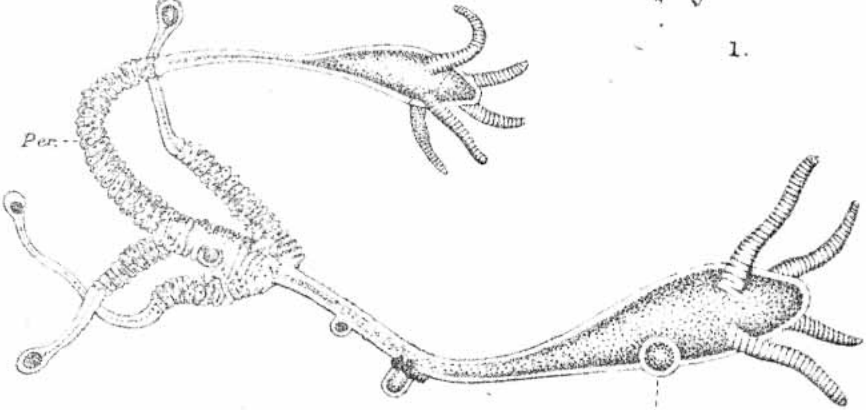
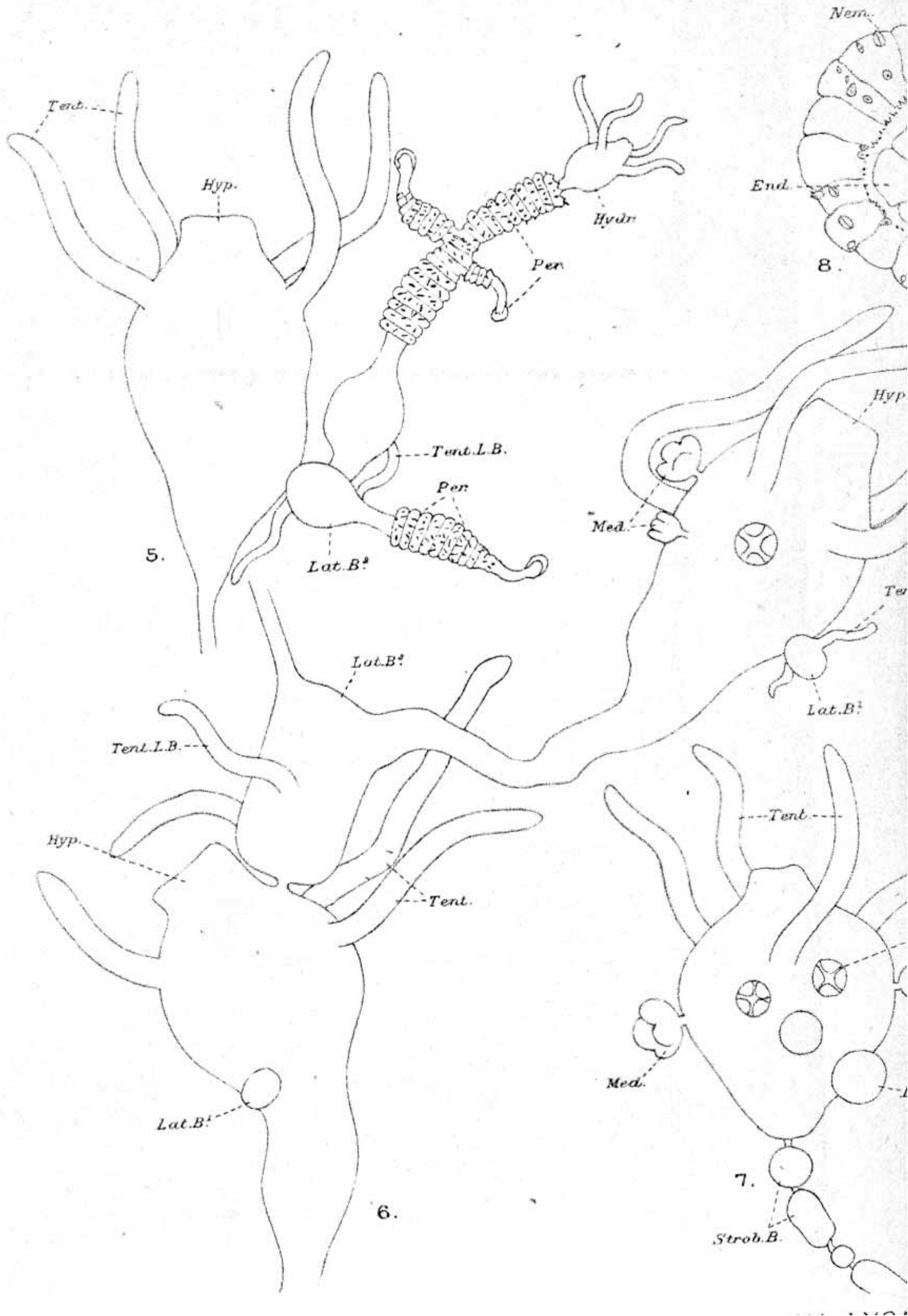


2.

C. Berjeau, del.

Bath, Lith. London

MOERISIA LYONSI.



Nem.
Tent.
Hyp.
Hydr.
Per.
End.
8.
Hyp
Tent.L.B.
Per.
Med.
Lat.B²
5.
Lat.B²
Lat.B¹
Tent.L.B.
Tent.
Hyp.
Tent.
Med.
Lat.B¹
7.
6.
Strob.B.