# COLLOTHECA VOLUTATA N. SP. A NEW BENTHIC ROTIFER FROM LAKE BALATON

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On the bottom of the Kis-öböl, a bay on the E shore of the Tihany peninsula, on top of the inorganic sediment, a layer of organic detritus accumulates, made of fragments of littoral macrovegetation *(Potamogeton, Myriophyllum, Phragmites)* and those of animal origin. This substance has a loose structure and is inhabited by organisms such as algae (mostly Diatoms) and various members of the microfauna. The whole mass, including detritus and living organisms, is subjected to wave action which disturbs the sediment layer, disperses its constituents into the water medium and occasionally throws part of it out of the water, thus forming detritus drifts on the shore (see SEBESTYÉN, 1949, in this volume).

On December 19th 1945, a tube- livig rotifer which was not fixed to any substratum was found in the bottom of the shallow shore water of the bay mentioned. When, in the late autumn of 1948, regular studies were begun concerning the conditions of life in the detritus sed iment and of the plant and animal associations inhabiting it (by SEBESTYÉN), this rotifer regularly appeared in the samples in considerable numbers. More collections were made, and having sufficient living material, a thorough investigation was carried out by both authors.*) During the course of these studies it was observed by L. VARGA that this *Collotheca* species differs markedly as to organization and mode of life from all other members of the genus known hitherto. We wish now to introduce it into the system by the name of *Collotheca volutata* n. sp. (volutare from the Latin, meaning to roll, to turn, etc.) (Fig. 1—2).

Ten species of *Collotheca* have hitherto been found in lake Balaton:

a) pelagic forms from the free waters: *C. Balatonica* VARGA (VARGA 1933/36), *C libera* ZACH., *C. mutabilis* HUDSON, *C. pelagica* ROUSS. (VARGA, 1932);

b) sedentary forms from the quiet littoral (a bay with dense reed growth) *C. ambigua* HUDSON, *C. cornuta* DOBIE, *C. coronetta* CUBITT, *C. ornata* EHRBG, *C. proboscidea* EHRBG. (Varga, 1939);

c) a sedentary form from the psammon: *C. wiszniewskii* VARGA, (VARGA, 1938).

* Times of collections when C. v. was found: 1945: Dec. 19, under ice; winter of 1948/49: Nov. 10, Dec. 8, 13, Jan. 5 (temperature of water under ice 0° C, pH 7.73—7.85), 8, 10, Febr. 21, March. 23 (only resting eggs in the tubes; temperature of water 5° C, pH<7.96, no ice).

It seems that the detritus sediment layer exposed to wave action in the shallow shore water is — at least during the cold season — the true habitat of this rotifer. It was rather unexpected to find a representative of the genus in such a locality, as was the case with *C. wiszniewskii* found in the psammon. The adaptability of the members of this genus to the conditions of the milieu seems to have a wider range than

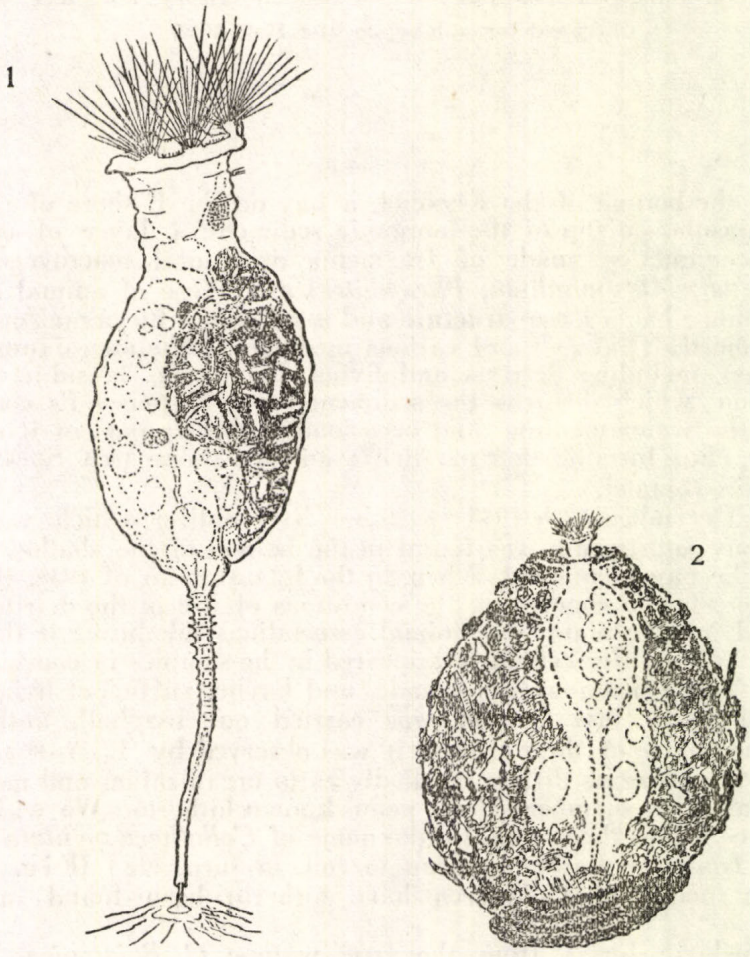


Fig. 1. Collotheca volutata n. sp. ♀ extended. The tube is not shown.
Fig. 2. Tube of Collotheca volutata n. sp. The front of the tube left without detail, in order the inhabitant to be seen. About the foot three parthenogenetic eggs in different stages of development.

was previously suspected. Both species show an intimate relation to the characteristics of their peculiar habitats.

Description of the female.

The tube. The animal when withdrawn inside the tube has a cystlike appearance, with a rather transparent and colorless outer coat and a core of a pinkish shade. The shape and size of the tube vary: in

general it has the shape of a barrel or sack, with a darker base and a narrow opening. (Figs. 2, 5, 12—15). The axis running through the center of the base of the tube and its opening is curved somewhat. It is made of a gelatinous substance, secreted by the rotifer, and is more adhesive than the cases of other members of the genus.

The substance of the base (sole) of the tube seems to be more compact than that of the side walls, and has a rather indefinite spiral structure. It continues toward the inside of the tube in a small mound, to the upper surface of which the rotifer is attached. (Figs. 5, 12.) The more or less cylindrical wall is made up of a more delicate material in which empty valves of Diatoms are imbedded in abundance, they — very likely — originate from the excretum of the rotifer. Such elements are lacking both in the sole and the mound. Around the opening of the tube, which is usually an irregular circle, the wall seems to be more delicate. The diameter of the opening is much smaller, than that of the tube or the base, but large enough to allow the animal a comfortable passage through it. Minute particles both of organic and inorganic material adhere to the surface of the tube. When treated with hydrochloric acid, the inorganic particles disappear and the valves of Diatoms become visible, demonstrating their abundancy and variety. Not infrequently a bunch of Diatoms may be found in the cavity of the tube, still exhibiting the characteristic brown color of the algae. The origin of such masses has not as yet been discovered. A few indefinite circular rings on the wall might be due to periodicity in manufacturing the case. (Fig. 5.)

As mentioned, the animal is attached by its foot to the upper surface of the mound, this being the only place of attachment. When drawn inside, the body is surrounded on all sides by the cavity of the tube, this being the case with members of the *Melicerta* and *Limnias* genera too. In this sense our animal differs definitely from all the other tube-living *Collotheca* species known, because, they being attached to the opening of the tube too, the proximal part of the tube turns inward on contraction and when extending, it turns inside out. The large size of the tube in proportion to that of the body is also characteristic, together with the presence of empty valves of Diatoms in the substance of the wall. These minute but rigid particles give firmness to the tube, while the elasticity of the wall is due to the gelatinous secretion of which the tube is made. Both properties of the tube, viz. firmness and elasticity, have some advantage since this rotifer, being unattached to any firm substratum, is exposed to various disturbances caused by frequent wave action. It might be rolled and tossed about among the detritus particles or dispersed in the water, to sink again without any damage being done either to the tube or to its inhabitant. The tube protects the resting egg too, after the mother's death and provides for the distribution of the species, through the above-mentioned properties, amidst the peculiar dynamic vicissitudes of the habitat. (Figs. 13—15.)

The body. (Fig. 1.) As to the main features, the female *C. volutata* resembles the other members of the genus in general, though it seems to be more delicate. The body is slightly bent ventrally, its main axis exhibiting a curve similar to the tube. The cuticle is delicate and transparent. Folds and creases appear in great numbers on the surface of the body, resulting in a warty outline. However, these wrin-

kles are apt to disappear soon. A few ringlike folds are frequently seen on the neck. The folds and creases on the foot are permanent. The division of the body into head, neck, trunk and foot is distinct. The proportion of the head + neck : trunk : foot is about 2.5 : 5 : 3.

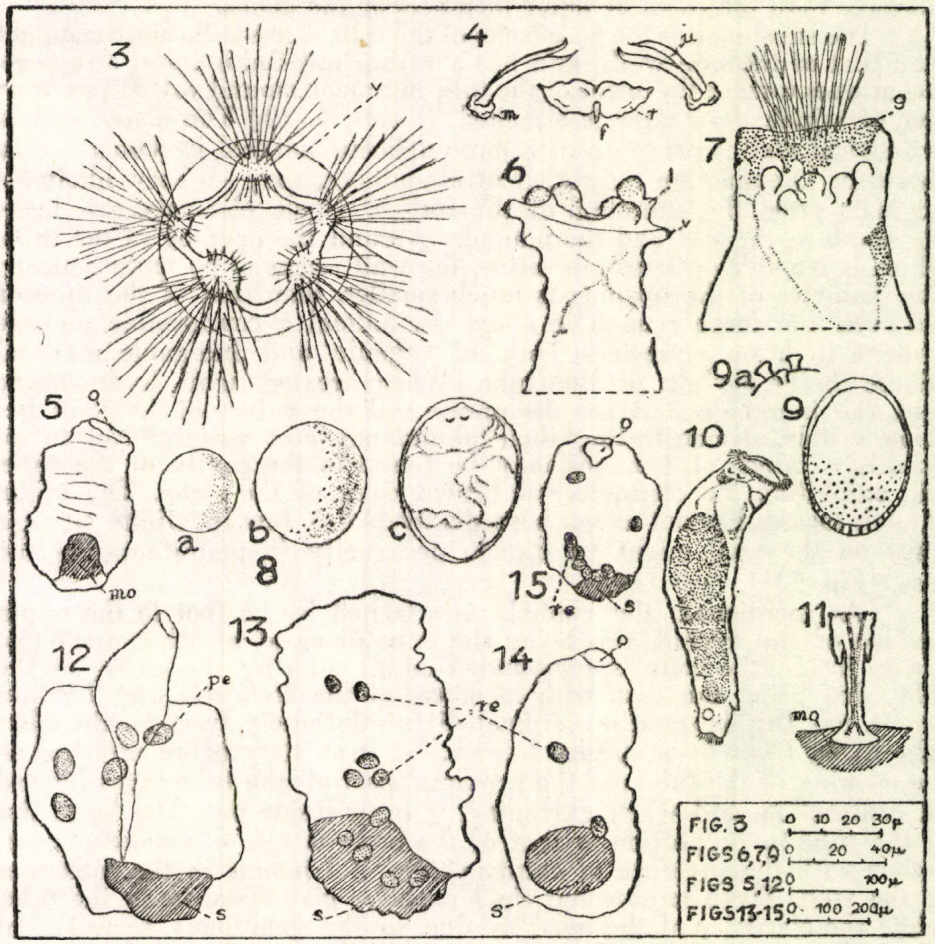


Fig. 3—15. Collotheca volutata n. sp. Fig. 3. The corona with the velum from above, Living individual. Fig. 4. Parts of the throphi. Fig. 5. Sketch of a tube, 8th. Dec. 1948. Fig. 6. Upper part of the body; lateral view, showing the membrane of the dorsal coronal lobe. Living individual. Fig. 7. The neck with the partly contracted corona. The bristles forming one unit; outline of the lobes showing through the cuticle. On the top of the neck and on the side are minute subcuticular granules. Fig. 8. Parthenogenetic eggs in different phases of development: a = within the body; b = attached to the tube; c = just before hatching. Fig. 9. Resting egg showing both membranes; the projections of the inner coat but partly drawn. Surface view. 8th January, 1949. Fig. 9a. Few projections with larger magnification. Fig. 10. Male specimen, alive. Fig. 11. Pedunculus attached to the surface of the mound by means of the disc. Fig. 12. Sketch of a female specimen within the tube in extended condition. In the tube there are parthenogenetic eggs. Detail of the corona is not depicted. Living individual. 8th Dec. 1948. Figs. 13—15. Sketches of uninhabited tubes with resting eggs, 25th March, 1949. Explanation of signes: d = dorsal lobe of the corona; e = eye spot; f = fulcrum; g = granules; l = lateral membrane of dorsal lobe; mo = mound; m = manubrium; o = opening of the tube; pe = parthenogenetic eggs; re = resting eggs; 3 = ramus; s = sole of the tube; u = unci; v = velum.

The head. (Figs. 3, 6.) At the base of the corona a delicate circular membrane, the velum, is present. (Figs. 3, 6; v) The disc forms five semiglobular lobes arranged regularly. The dorsal one, nearly a complete sphere, is drawn out a bit above the others, owing this position to the presence of a very short stalk, contrary to the other ones which sit immediately on the disc. The dorsal lobe is halfway enveloped by a delicate membrane reaching only halfway lengthwise and not extending above the lobes into the coronal net, as in the case of *C. cornuta*. This lobelike membrane lacks both cilia and „bristles". (Figs. 6).

The coronal lobes carry the delicate long rod-like cilia („bristles") which do not beat and are peculiar to the genus. The length of the longest bristles is about equal to the diameter of the disc. (Fig. 3).

The withdrawal of the corona happens quickly, and when but incompletely done, the bristles form one unit resembling a paint-brush. (Fig. 7). The upper part of the bunch remains outside and is visible, while the lower part, hidden in the infundibulum, could not be detected, though the outline of the coronal lobes shows through the cuticle. When in extension, which is a slow, a gradual — one might say a cautious — process, the situation just described recurs, very soon the disc bearing the lobes unfolds, the five bunches of delicate bristles spread out, and the appearance of the velum marks the end of the process. The velum, though but a very delicate membrane, seems to take part in the stiffening of the corona.

The edge of the disc between the lobes carry a row of minute cilia, the presence of which is characteristic of our species. On other members of the same genus they are missing, with the exception of *C. coronetta*. The surface of the infundibulum is also covered with cilia, especially the ventral part. By the beat of these cilia a current propels the food towards the mouth. The cilia covering the inner surface of the lobes take part in the same process.

Minute granules in the subcuticular plasma below the corona could distinctly be seen through the transparent and colorless cuticle of the neck (Fig. 7). These granules, uniform in size, have a high degree of refraction and are in constant motion. Inside the neck the cone-shaped infundibulum is situated, its narrow basal opening continues into the wide vestibulum, at the posterior end of which the mouth is located. The opening of the mouth falls below the neck, on the anterior part of the trunk.

Eyes are lacking on the adult female, though a pair of hemispherical purple-red eye-spots, without lenses, could be seen through the egg-shell of the embryo (Fig. 8 c). The dorsal antenna with a few short setae is situated on a minute mound on the neck, just above the brain, which in turn has an elongated pear-like shape.

When the body is extended usually only the corona and part of the neck can seen outside the tube. (Fig. 12).

The trunk. The neck widens abruptly to the voluminous trunk, which is dorsally somewhat swollen. In its upper part — as has been mentioned — the mouth is located. This opens into the slender oesophagus. On the bottom of the mastax, the rather degenerated trophi are found: on the upper part of the fulcrum, which is minute and rod-shaped, there are the two leaf-like rami. To the manubrium, which has

the shape of a disc, the unci are attached. These being slightly bent, have the form of a dart and are joined at their base. (Fig. 4). The rigid valves of the Diatoms could not be ground by the delicate trophi, the rôle of the jaws being rather to push forward the food into the succeeding parts of the alimentary canal. Both the mastax and the stomach lie immediately under the subcuticular plasma layer, and are in most cases stuffed to their highest capacity with Diatoms of various sizes and shapes, so that they extend mostly to the base of the neck, right into the neighbourhood of the brain. The globular salivary glands are located on both sides of the upper edges of the stomach, as usual.

The short and wide intestine generally contains empty valves in abundance. The rectum, also a short and wide part, presses the bulk of the valves through the anus out of the body into the inside of the tube. The anus is located dorsally above the foot as usual. The great bulk of food enclosed by the stomach exhibits the characteristic brown color of Diatoms. Through the cuticle the outline of the valves could be distinctly seen.

The tubules of the excretory organ could be detected from the middle of the trunk on, on the ventral side. The contractile vesicle is rather voluminous. The excretum is expelled through the cloaca into the cavity of the case.

The globular ovaries with the yolk-gland lie ventral to the intestine. Sometimes 3—4 parthenogenetic eggs — in different phases of development — could be seen in the body. After being discharged they keep the globular shape for a while (Fig. 8a-c). Their content seems to be compact. Since the development of the embryo begins within the mother's body, no nuclei could be seen. The eggs are attached to the wall of the tube, in contrast to most of the other members of the genus, where they are attached to the foot of the female. (Figs. 2, 12). The eggs soon assume an oval shape and their contents are no more homogeneous. It has been mentioned that the developing embryo has a pair of eye-spots.

The oval-shaped resting eggs have a deep yellow color, are enveloped by a thick membrane, on the surface of which minute projections with blunt ends are scattered in regular distribution. On the outer surface of the resting eggs, freshly discharged, a second membrane could be seen laying close to the projection; however the ends of the latter are not fixed to the membrane. (Fig. 9). Later on this membrane disappears. Its rôle might be the protection of the oviduct, etc., during the passage of the egg, against the injuries which might be caused by the rough surface. No such outer membrane has been described of any other rotifers. The number of resting eggs — in contrast to all other members of the genus — is high. This fact perhaps has something to do with the structure of the egg, viz. the presence of the outer membrane. From the sample collected on March 25th, 1949, ten tubes including only resting eggs were separated, their numbers being the following: 2, 2, 3, 3, 5, 5, 7, 9, 10, 10, the mean value being 5.6! The resting eggs on most of the rotifers are not released by the female, but are set free after ist death. It has been established of this species that the female produces several resting eggs which find protection in the tube after the mother's death. (Figs. 13—15).

The very slender and short foot is clearly marked off from the rest of the body. The upper portion has several deep folds and creases,

the lower portion has but a few shallow ones (Fig. 1). Two muscles appear distinctly through the cuticle. The contractibility of the foot seems not to be very great. Several bends of the foot are, however, possible. Between the foot and the pedunculus there is a joint. The toes could be observed only with difficulty and rarely. On the posterior end of the pedunculus there is a disc which assures firm attachment of the organism to the base of the tube (Fig. 11). It is almost impossible to sever the body from the mound. It seems that this firm attachment makes possible the frequent, energetic and quick contraction of the body.

The male (Fig. 10).

One male specimen was found by VARGA in a sample on Jan. 5th 1949 collected from under a 20 cm thick ice-layer. It is very active, small in size, and thoroughly transparent. The body is nearly cylindrical, widening somewhat about the middle. Toward the anterior and posterior ends it is slightly bent. The posterior part of the body has a few slight folds and creases but they disappear when the animal swims in an extended attitude. On the anterior end an uninterrupted wreath of cilia is present, the center of the wreath projecting forwards. Both velum and corona are missing. On the edge of the well-developed disc-shaped brain two sickle-shaped eye-spots could distincly be seen. Slight traces of the infundibulum might be observed. No alimentary canal. The minute contractile vesicle located on the posterior end of the body represents vestiges of the excretory organ. The voluminous testis with its great mass of spermatozoa fills the whole body of the male. Penis is lacking. There is a bunch of hair at the end of the very short and cone-shaped foot. We could not observe the process of copulation, it very likely takes place within the tube.

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Measurements: length of female, extended, 240—280 $\mu$; length of tubes 350—420 $\mu$ (November—January), 400—800 $\mu$ (March, containing only resting eggs); length of parth. eggs 40—45 $\mu$; length of resting eggs 50—70 $\mu$; length of male 100—105 $\mu$.

Mode of life.

C. volutata is both a current - and filter-feeder, being monophagous too. It selects its food, which consists of various species of Diatoms (*Navicula, Pinnularia, Cymbella* etc.) some of them of considerable size. Such algae grow abundantly among the particles in the detritus layer. The food is consumed in great quantity, and the empty valves, to wich but very slight damage has been done, when passing through the alimentary canal, are used to make the tube. The construction of the tube was not observed.

This rotifer, as far as it could be established, is a semi-sessile organism in the sense that the body of the animal is attached exceedingly firmly to its self-made case, which is a non-living matter, but animal and tube forming one unit, are unattached to any substratum. This unit — as any other constituent of the detritus layer: living organisms or lifeless matter — moves about passively or lies quietly at the bottom, according to the dynamic conditions of the milieu. In favourable circumstances, which means quiet water, the animal emerges partially from its case, and with its delicate corona spread out sets to feeding. On the slightest

mechanical disturbance the body contracts and, thus hidden in the tube, it finds protection against the various unfavourable conditions of its surroundings. It seems that both in organisation and mode of life *C. volutata* adapts itself in a high degree to the peculiar conditions of the habitat. *C. volutata* seems to favour cold water and is very likely a stenothermous form.

Life cycle.

The life cycle of *C. volutata* could be only established partly because the observations were limited to the cold season (November to end of March). Parthenogenetic eggs are produced constantly in the first part of the cold season (Nov.—Jan.). Following the appearance of the males fertilized eggs appear late in the cold season. This last phenomenon marks the turn of the kinetical phases of life to the akinetical one. In a March collection a few tubes were found including, beside the resting eggs, the extended body of a dead female, the stomach of which contained Diatoms, but the corona was missing.

Interrelationship with other members of the genus.

*C. volutata* are in the closest relation to *C. cornuta*. However, there are many differences between these two forms, especially as to the structure of the corona and the proportions of the various parts of the body. The dorsal lobe of the corona of *C. cornuta* is long and has a long, active, fingerlike lateral lobe. Rudiments of such lobe are present on *C. volutata*, but it envelops the dorsal lobe only halfway both length - and crosswise. The edge of the coronal disc between the lobes is free from cilia on *C. cornuta*. The extensive corona of this latter species is nearly as long as the trunk. Its foot is longer than any other parts of the body added together. Its whole length (580—635 $\mu$. COLLIN. 1912, p. 39) is about twice that of *C. volutata*. Its two eyes are hardly detectable. The tube — which is attached to varions littoral plants — is voluminous, hyaline, and the body is attached to its upper edge.

*C. volutata* might be brought in some sense into interrelationship with the psammobiont *C. wisznievskii* too. They are about of equal size, the structure of the corona is similar, however the lateral membrane on the dorsal lobe, the cilia between the lobes on the edge of the disc, and velum are missing on the latter species. Its neck exhibits no wrinkles, its foot is less delicate. The tube — being attached to grains of sand — is gelatinous, being free of any foreign substance, with the exception of a very few particles sticking to the surface.

If these three forms were arranged in order of succession, *C. wisznievskii* with its simple organisation might be at the end, followed by *C. volutata* and C. *cornuta* with the most differentiated organisation, would take the place at the top.

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## COLLOTHECA VOLUTATA N. SP.
## НОВАЯ КОЛОВРАТКА БЕНТОСА ОЗЕРА БАЛАТОНА

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### РЕЗЮМЕ

В осадке детрита воды побережья озера Балатона обнаружен новый член рода Mollotheca и мы называем его C. volutata n. sp.

Эта коловратка прикреплена ко дну своей трубы лишь посредством pedunculus, а край трубы является свободным. Труба состоит из студенистого секрета, в который вкладываются пустые скорлупы диатомей.

Труба не прикреплена ни к какому субстрату и может свободно перемещаться, соответственно динамическим условиям среды.

Самая характерная черта C. v. структура венца, который снизу охвачен нежной оболочкой (velum). Кутикула нежная, бесцветная и прозрачная. Иногда она образует повсюду складки и морщины. Складки, встречающиеся на ноге, постоянные.

Если что-нибудь беспокоит C. v. она внезапно сокращается и может совершенно скрыться в объемистой трубе. В вытянутом состоянии большая часть тела, за исключением головы и части шеи, остается скрытой. Животное вытягивается очень осторожно.

C. v. питается посредством фильтрования текущей воды. Кроме того она является монофагом. Она питается многочисленными диатомеями разной величины и формы, встречающимися в окружающей среде.

Пустые выделенные скорлупы включаются в состав трубы. Мы обнаружили присутствие как партеногенетических, так и постоянных яиц. Последних можно определить — по истечении короткого времени — по наличию внешнего слоя, окутывающего внутренную оболочку, на которой имеются мельчайшие выступы. Этаже самка может выбрасывать несколько постоянных яиц. Эти яйца после смерти матери все еще находят приют в трубе. Самца мы наблюдали только один раз. Нам не были обнаружены ни молодые формы, ни процессы образования труб.

Во время холодного периода года были найдены некоторые женские экземпляры C. v., по всей вероятности вида stenotermus. Их организм, а также и их образ жизни хорошо приспособляются к динамическим условиям окружающей среды.

Систематически C. v. может быть помещен между C. wizniewskii Varga и C. cornuta Dobie.

### ТЕКСТ К РИСУНКАМ

1. рис. Collotheca volutata n. sp. ♀. В вытянутом состоянии, трубы не видно.
2. „ труба Collotheca volutata n. sp. Передняя поверхность трубы без деталей, чтобы показать ее жителя. Около ноги 3 партеногенетических яиц в разных стадиях развития.

3—15 рис: Collotheca volutata n. sp.

3. рис. венец с оболочкой сверху. живой индивидиум.
4. „ часть trophi.
5. „ набросок трубы (8. дек. 1948 г.)
6. „ верхняя часть тела, вид сбоку. Видна оболочка задней доли венца.
7. „ Стянутый венец. Реснички образуют единую форму. Через кутикули видны очертания долей. На шее и на боку имеется мельчайшая подкутикулярная грянуляция.
8. „ Партеногенетические яйца в разных стадиях развития. а = внутри тела, б = прикрепленные к трубе, в = непосредственно перед вылуплением.

9. „ постоянное яйцо с обоими оболочками. Выступы внутренней оболочки нарисованны только частично. Вид поверхности. 8. января 1949 г.
9/a „ несколько выступов в большом увеличении.
10. „ живой самец.
11. „ Reduncul[illegible] прикреплено к поверхности рта с помощью диска.
12. „ Набросок самки внутри трубы в вытянутом состоянии. В трубе видны 4 патеногенетических яйца. Подробности венца не нарисованы. Живой индивид. 8. дек. 1948 г.
13—15 рис.: наброски необитаемых труб с постоянными яйцами .25. марта 1949 г

Условные обозначения:

d = задняя доля венца
e = глазное пятно
f = fulcrum
g = грануляция
l = боковая оболочка задней доли
mo = рот
o = отверстие трубы
p = партеногенетические яйца
r = постоянные яйца
z = ramus
s = подошва трубы
u = unci
v = velum
m = manubrium