

A commensalic hydroid from wood-boring molluscs

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Introduction

During the course of a detailed study of the parasites and associates of marine timber-destroying organisms of the Indian coasts, an interesting commensalic or semi-parasitic (?) hydroid has been found infesting the wood-boring bivalves. The hydroid occurs in the mantle cavity firmly attached to the ctenidia of the shipworms *Nausitora hedleyi*, *Teredo furcifer* and the pholad *Martesia striata* collected from the Cochin backwaters, south-west coast of India. The hydroid and the medusa are figured and described. The presence of the medusa free in the plankton in this area has not yet been detected.

Association between hydroids of the genus *Eugymnanthea* and bivalves has been reported earlier; Palombi (1935) established the genus while recording a new species *inquilina* within the mantle cavity of *Tapes decussatus* from Naples, Italy; Cerruti (1941) described *E. polimantii* from *Mytilus galloprovincialis* at Taranto, Italy; Mattox & Crowell (1951) reported in detail *E. ostrearum* from the mantle cavity of the oyster *Crassostrea rhizophorae* at Boqueron, Puerto Rico; and Yamada (1950) noted *E. japonica* in *Ostrea gigas* from Japan. No hydroid has hitherto been reported from any wood-boring bivalve. The taxonomic considerations of the genus *Eugymnanthea* and a report briefly summarizing the available information about this genus with additional information concerning its distribution, locomotion and asexual reproduction have been given by Mattox & Crowell (1951) and Crowell (1956) respectively.

While the hydroid considered here is recognizable as belonging to the same genus as *Eugymnanthea* we refrain at present from assigning it a specific name owing to uncertainties regarding the criteria for specific identification in this genus and gaps in our information regarding the details of the adult medusa.

Since our information about this unusual and interesting group of hydroids is far from complete (Crowell, 1956) we present here some observations on live material of the present form collected from the shipworm *Nausitora hedleyi*.

The possession of the following features strongly suggests the inclusion of this form under the genus *Eugymnanthea*. Athecate polyps lacking hydrorhizae and gonothecae, possessing a basal disk, a single whorl of tentacles, and producing from near the base, gonophores liberating medusae of the leptomedusan family Eutimidae. However, the present form differs from all other species hitherto described under the genus in the nature of the polyps which are not solitary but branched. Despite this conspicuous difference it seems justifiable to accommodate the present form also under *Eugymnanthea*.

Since *Eugymnanthea inquilina* has already indicated the beginning of a branching system, inclusion of this branching form also in this genus does not seem to be unjustifiable.

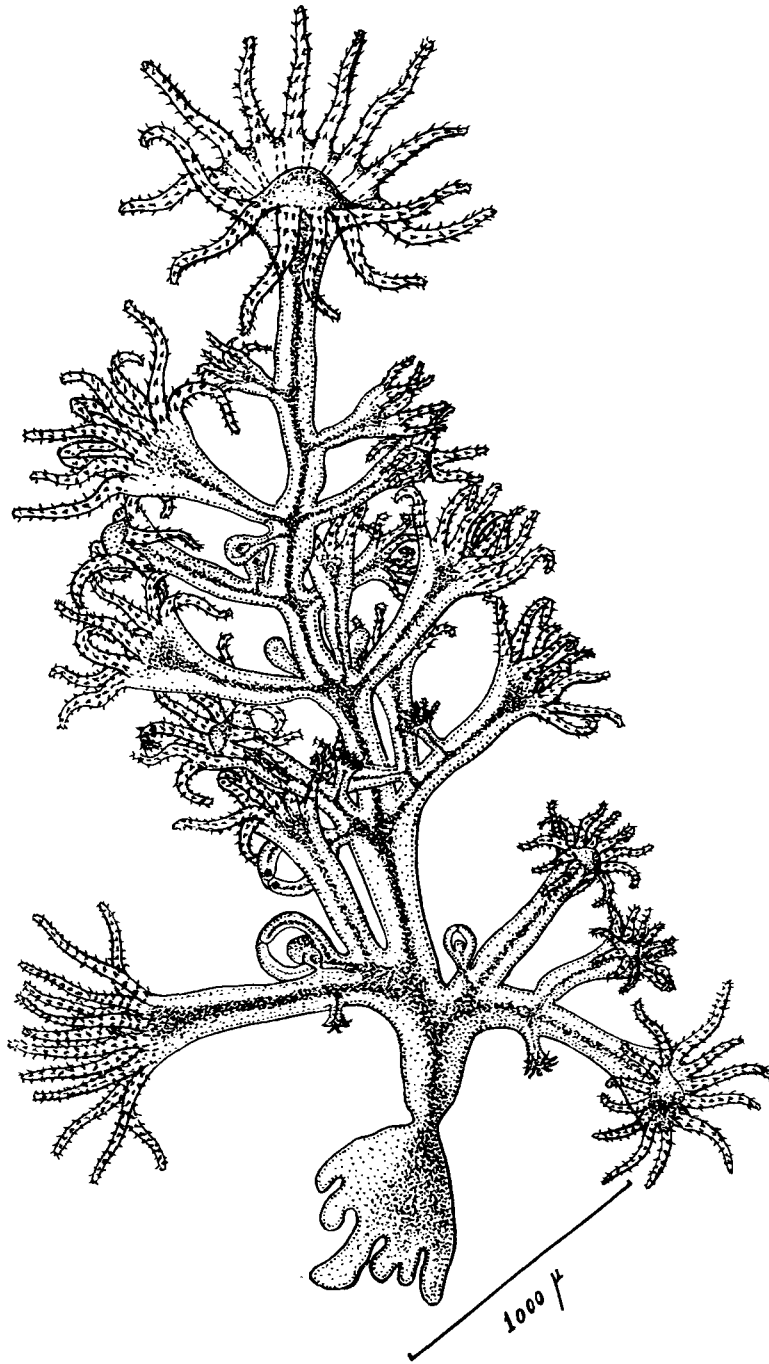


FIG. 1. *Eugymnanthea* sp. A colony pulled out from the etenidium of *Nausitora hedleyi*, showing the nature of branching, the basal disk, the polyps and the gonophores.

Description of the hydroid

(All the measurements have been taken from live material.)

Length of the polyps	225 to 1219 μ
Diameter of the polyps	44 to 125 μ
Length of the tentacles	94 to 500 μ
Diameter of the tentacles	18 to 25 μ
Width of the inter-tentacular membrane	12 to 62 μ
Height of the hypostome	25 to 81 μ
Diameter of the basal disk	125 to 689 μ
Number of tentacles	6 to 20
Diameter of the gonophores	112 to 258 μ
Length of the gonophores	162 to 219 μ
Length of the stalk of gonophores	18 to 44 μ

The pale, straw coloured hydroid colonies are seen planted in the lamellae of the ctenidia of the molluscs. The growth of the hydroid is monopodial, the hydrocaulus zig-zags with an angle at the origin of each branch. Each colony possesses a well-defined large and conspicuous basal disk which is embedded in

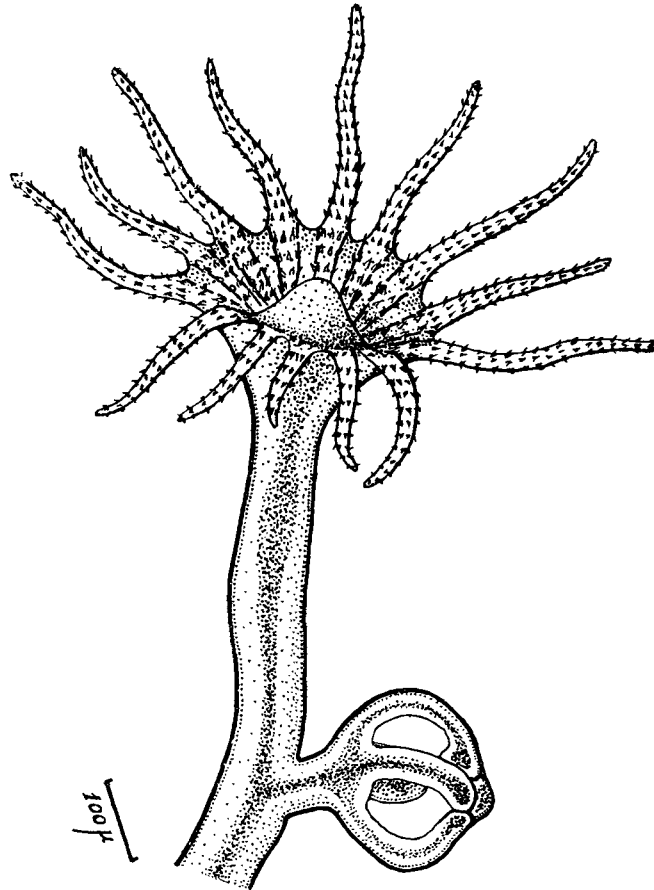


FIG. 2. *Eugymnanthea* sp. A single polyp enlarged to show the hypostome, the inter-tentacular membrane and a gonophore budding out from the base of the polyp.

the tissue of the ctenidium facilitating an effective and fairly intimate attachment of the hydroid to the host. In addition the attachment seems to be further strengthened with the help of a number of small bud-like protuberances which arise from the basal disk. Perisarc is not evident, apparently wanting, since chitosan tests carried out on a colony gave negative results. The polyps, which taper slightly towards the base, undergo branching. The hypostome is an elevated cone and does not extend beyond the limits of the inter-tentacular membrane.

Tentacles are slender with nematocysts distributed throughout their length. The number of tentacles vary from 6 to 20 forming a single whorl around the base of the hypostome, longer and erect tentacles alternating with shorter ones (fig. 2).

Colony formation

New polyps arise in the form of a small bulb from the base of the stem of a well formed polyp (fig. 3). Within a day, there appear on the distal end of the bulb, tentacle buds which sprout into distinct tentacles. The bud thus transforms into a small polyp bearing six tentacles. Additional tentacles are added on usually one at a time between two tentacles. The newly formed tentacles are smaller, being about half the length of the first formed ones. About this time the inter-tentacular membrane also begins to appear. The number of polyps in a colony is never constant and some specimens collected during November had as many as 39 polyps and 20 gonophores. Each medusa bud

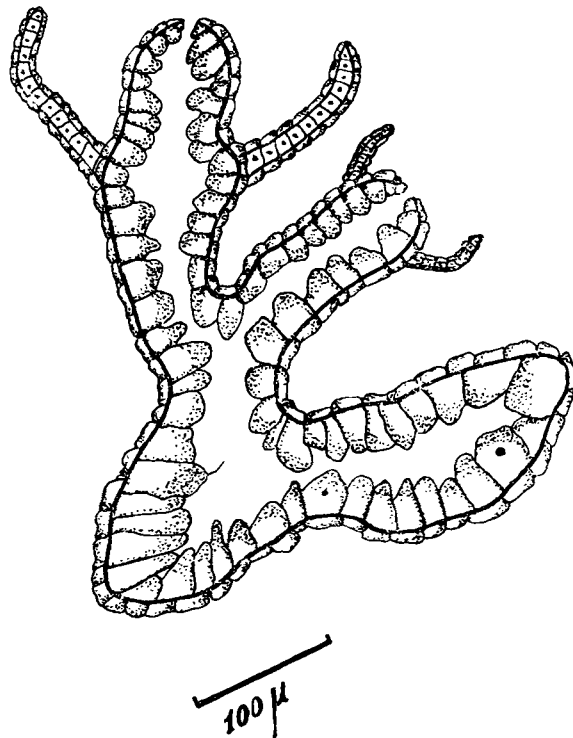


FIG. 3. Section of a polyp showing the formation of a new polyp.

is large and pear-shaped, borne on a small stalk and completely enclosed in a sheath.

Medusa buds arise from the base of the hydranth, usually one or two, rarely three to each hydranth. If more than one is present, they may be seen around the stem of the polyp; they develop as small knob-like dilatations which later enlarge to assume a pear shape. The manubrium of the medusa is discernible even in the early stages of development. During the early stages of formation of the medusa the mantle covering is thick, but before long the mantle becomes thin and at the time of liberation of the medusa it becomes membraneous and almost transparent. Although the exact time taken for the development of the medusa has not been precisely ascertained, a full grown one took not less than 20 hours to liberate the contained medusa. In order to stretch out the tentacles at the time of liberation the medusa effects pulsating movements. These movements are rhythmic and are seen at intervals of 30 to 80 sec. The whole colony also exhibits general contractile movements. When the medusa is liberated, the original stalk of the gonophore remains with the hydrocaulus as a stump for some time. Each gonophore gives rise to a single medusa.

A peculiar behaviour has been noticed in certain colonies. Protrusions may be given off from the basal disk of a normal colony and these may develop into club-like structures from the dilated end of which a different type of polyp is given off in the form of a bud. From the distal end of the bud arises two to four unusually long tentacles which are very slender and studded with certain nodular structures unlike the tentacles of the normal polyp. After about two days this peculiar polyp (fig. 4) is seen changing its shape through a reduction of the length of the tentacle, and by the formation of the inter-tentacular membrane and hypostome. The stem of the polyp itself also gets shortened and thickened, thus transforming into a normal polyp of the colony. Up to four such polyps have been noticed arising from one basal disk of a colony.

Rare specimens consisting of two or three polyps without a basal disk have also been noticed free in the mantle cavity (fig. 5). An interesting mode of healing up of the wound has also been noticed in this hydroid. When a polyp has been nipped out from the parent colony the separated portion was found to have the ability of rapidly healing up the wounded end. This freed portion of the polyp was observed to stand upside down and executing slow movements with the help of the tentacles.

Maintaining this hydroid in the laboratory in small bowls containing sea water on their natural substratum namely the ctenidia was not successful despite sufficient aeration at regular intervals. Care was taken to maintain the salinity at a constant level. The temperature during the time of observation fluctuated between 24° and 28°C. Though the hydroid continued to live apparently normally for a period of about 2 days, signs of stress could be noticed by about the end of this period. There was not only a cessation of the production of the polyps but some of the already well-formed polyps were regularly resorbed and by about the fifth day the colony transformed itself into a stunted, distorted and highly reduced structure entirely devoid of the typical polypoid components. This curious shapeless resorbed hydroid was watched for a period of seven days. Mattox and Crowell (1951) and Palombi

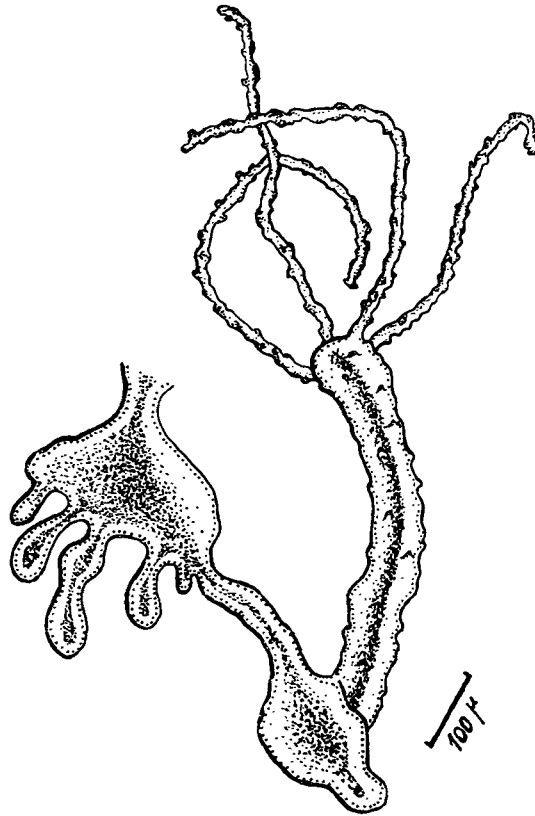


FIG. 4. The formation of the 'peculiar polyp' from the basal disk. Note the bud-like protuberances which arise from the basal disk.

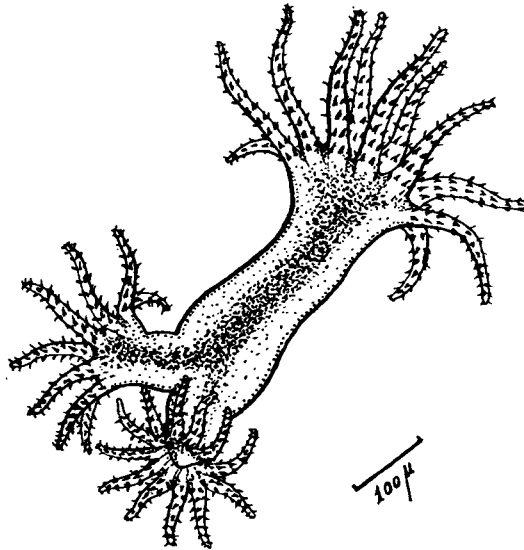


FIG. 5. A specimen consisting of three polyps without any basal disk seen occasionally free in the mantle cavity of the host.

(1935) have noticed a striking reduction in the size of the polyp during the late stage of development of the medusa. As in the present case, these authors also noticed the hydroid losing its tentacles by resorption and the body diminishing greatly in size. However, it may be pointed out that in the present case the reduction of the hydroid was not consequent on the formation of the medusoids but as a result of adverse environmental conditions. A very similar phenomenon has been noticed in other coelenterates. Under adverse conditions such as transport from nature to the laboratory, etc. the coenosarc was found to abandon one part of a colony and flow into other portions and in certain marine hydroids a curious state described as 'depression' has been reported wherein "tentacles and body shortened progressively, their cells detach and pass into the stem where they are digested and the whole hydranths 'melt' into the coenosarc". In hydras this process has been found to continue until the entire animal is reduced to a rounded mass (see Hyman, 1940, p. 487).

Description of the medusa (figs. 6 and 7)

(All the measurements have been taken from live material.)

Height of medusae	412 to 438 μ
Diameter of medusae	438 to 500 μ
Number of tentacles	2
Number of tentacle bulbs	2
Number of marginal vesicles	8
Number of marginal swellings	4
Number of spiral lateral cirri	8

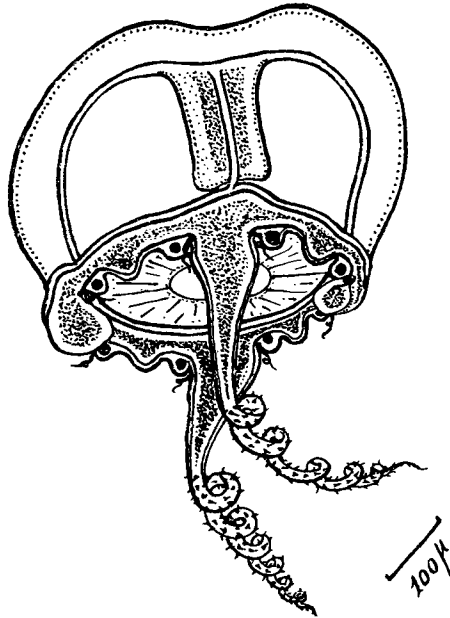


FIG. 6. Side view of a medusa just after liberation from the colony. Note the manubrium, tentacles, tentacle bulbs, marginal vesicles and marginal swellings and spiral lateral cirri.

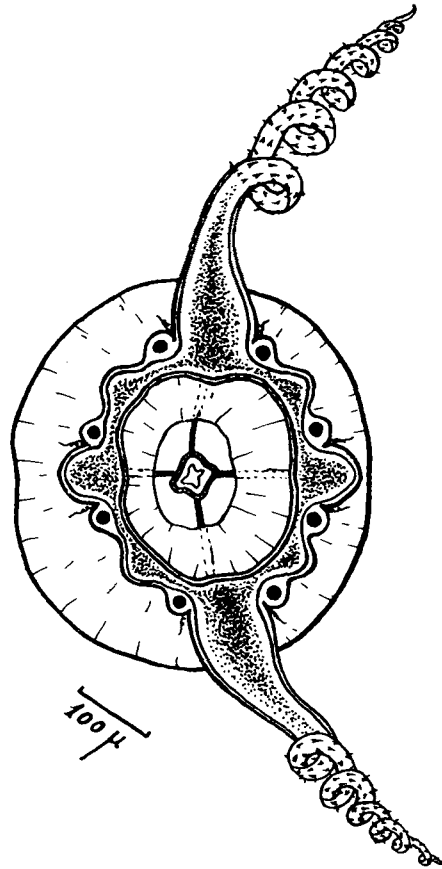


FIG. 7. Ventral view of the medusa.

The umbrella is hemispherical with a median depressed area dividing the exumbrella into two portions. The velum is narrow, the stomach is short with four simple lips at the cones of the mouth, and is broader at the base than distally. The four radial canals are straight and narrow. The two opposite marginal tentacles are present with distinct dilatations at their bases. The tentacles are seen spirally coiled except at their swollen bases and are covered with nematocysts. In between the two marginal tentacles and disposed along the other two perradii are two marginal tentacle bulbs. There are four inter-radial marginal swellings. Eight spiral lateral cirri are present on either side of each of the marginal tentacles as well as on the tentacle bulbs. Eight closed marginal vesicles are present in four pairs, the members of each pair placed on the outer sides of the spiral lateral cirri, i.e. they are adradial in position. The manubrium, the tentacle bulbs and the basal swollen portion of the marginal tentacles are reddish-brown in colour.

The liberated medusa does not swim actively. Any particle of food captured with the help of the tentacles is conveyed to the mouth through a general contraction of the umbrella and in this process the height of the medusa is apparently reduced and the mouth is brought closer to the velar opening facilitating the passage with ease of the prey into the mouth. A comparison of the present medusa with others of the genus *Eugymnanthea* as well as *Eucope parvigastra* is presented in table 1.

Table 1
A comparison of the present medusa with others of the genus *Eugymnanthea* and with *Eucope parvigastra*
(based on Mattox & Crowell 1951)

<i>Eugymnanthea inquilina</i>	<i>Eugymnanthea polimantii</i>	<i>Eucope parvigastra</i>	<i>Eugymnanthea ostrearum</i>	Present form
Naples, Italy	Taranto, Italy	Tortugas, Florida	Boqueron, Puerto Rico	Cochin, India
Polyp in mantle cavity of <i>Tapes</i>	In mantle cavity of <i>Mytilus</i>	Polyp unknown	In mantle cavity of <i>Crassostrea</i>	In mantle cavity of <i>N. hedleyi</i> , <i>T. furcifera</i> and <i>M. striata</i> attached to the ctenidia
Medusa of 0-55 mm Sphaero-conical	1.2 mm Same	1.0 mm 'Half egg-shaped'	3.0 mm Same	0.5 mm Hemispherical
Eight adradial otocysts	Same	Same	Same	Same
Not reported	Three otoliths, sometimes one or two rarely four	Single spherical	Two to six otoliths	?
Four simple radial canals	Same	Same	Same	Same
Four perradial tentacle bulbs	Four perradial bulbs	Four perradial bulbs	Four well developed perradial tentacles on large bases, four inter radial bulbs, eight small adradial bulbs	Two perradial tentacle bulbs, two perradial tentacles
Gonads on radial canals. Large oval, shedding gametes before or soon after liberation	Same position. Same size as <i>E. inquilina</i> , hence relatively smaller shedding gametes after liberation	Same position. Small	Same position. Not developed at time of liberation	Not evident at time of liberation
Manubrium lacking	Mouth lacking	Mouth present	Mouth present	Manubrium and mouth present
Lips lacking	Lips lacking	Four simple lips	Four simple lips	Four simple lips Eight lateral cirri present

Movements of the hydroid

Hydroids attached to the ctenidia showed apparently no locomotor movements except the usual contraction and extension of the colony in response to disturbance by outside agencies etc. Tentacles are often active, executing the usual feeding movements such as contraction, extension, etc. Detached colonies while lying in a container were observed to cover a distance of about

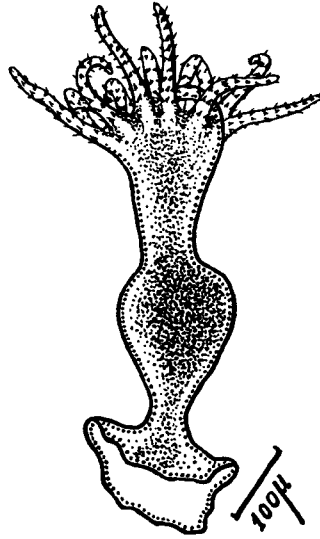


FIG. 8. The first polyp of the colony with the basal disk in typical feeding posture.

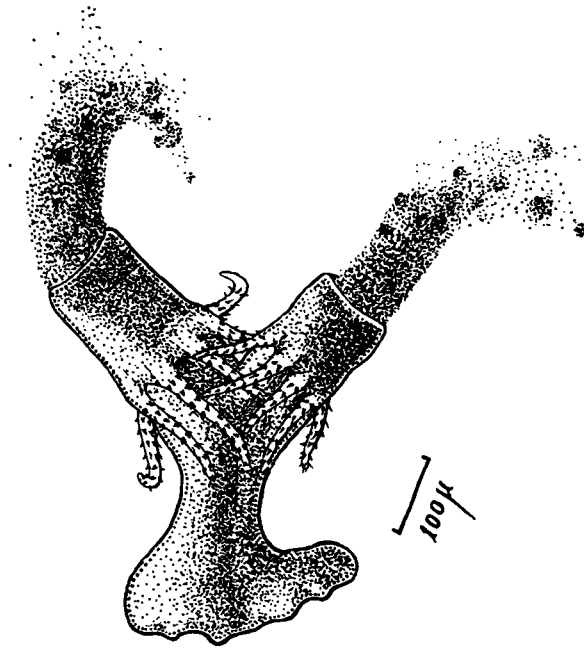


FIG. 9. Two polyps regurgitating the undigested food materials.

375 μ within a period of 10 to 15 min as a result of a series of rhythmic and rapid contractions and relaxations of the entire colony. The colony was unable to stand erect on the basal disk if detached from the ctenidium and placed in a glass container. The individual polyps showed the ability to perform swaying movements. When undisturbed the body was extended fully and the tentacles were spread out; contractions and relaxations occurred at intervals without apparent cause, and the tentacles were always active, so long as the animal was in good condition. The typical feeding reactions consisted of the bending of the tentacles to convey food towards the mouth (fig. 8). The undigested material can be seen regurgitated by the hydroid as shown in fig. 9.

The environment of the host bivalve (*N. hedleyi*) is a typical estuarine one in this locality, with the salinity fluctuating between 0.65 and 33.38‰ during a year's cycle. The hydrographic data concerning this estuarine area are given in table 2. This area receives the full benefit of the south-west monsoon during the period May to August as well as some precipitation from the north-west monsoon during October to December. Of the total annual rainfall more than half falls during the four months from May to August.

Table 2
Hydrographic and meteorological data for the period May 1964 to May 1965

Month	Atmospheric temperature °c		Rainfall in mm	Relative humidity % at 08.30 hrs	Ernakulam channel		
	Maximum	Minimum			Temperature	Salinity	Oxygen mg atom/l.
May 1964	32.4	25.6	111.3	82	30.3	33.38	4.6
June	29.9	23.8	441.0	88	28.7	25.71	3.7
July	28.6	23.4	1036.0	91	27.2	2.77	4.5
August	29.0	23.5	408.8	87	28.2	0.65	5.6
September	28.8	23.4	514.1	88	27.8	2.34	*
October	29.7	23.5	415.7	83	28.6	3.32	*
November	29.9	22.9	118.8	82	27.8	16.2	4.2
December	31.1	21.5	13.7	71	27.5	29.74	4.9
January 1965	31.2	21.0	59.8	70	30.2	31.98	*
February	31.7	22.8	14.1	73	27.5	32.22	6.2
March	32.3	24.2	25.5	72	29.8	32.92	5.7
April	32.5	24.9	174.1	74	30.0	32.88	5.0
May	31.5	24.9	431.0	82	31.1	31.66	6.9

* Data not available.

The hydroid was present in samples collected during the period November to May but was absent during the rest of the year. This seasonal incidence and the fluctuating nature of the salinity of the medium in its habitat prompted an enquiry into its salinity tolerance. Transfer of the colonies from normal sea water to distilled water resulted in a general contraction of the entire colony. All movements apparently ceased, and the polyps underwent a process of disintegration. The outline became hazy, the body lost its shape and form and the colony became invisible, probably owing to a dissolution of the substance that composed it.

Similarly, transfer of the hydroids into high salinities such as 35‰ (during the time of experiments the salinity of the ambient water showed considerable

fluctuation and ranged between 20 and 27‰) the whole colony showed great contraction followed by the disintegration of the polyp which started after about one hour in the new medium. Within 24 hours disintegration and dissolution were almost complete. A series of tests using different grades of sea water showed that low salinities and high salinities were both apparently unsuitable for this hydroid. For example, while a salinity range between 15 and 30‰ had apparently no ill effect, the hydroids failed to survive in grades above and below this range. Another noteworthy feature observed during the present study was that an acclimatization for some time in a particular grade seemed to influence considerably the range of tolerance of this species. Thus, hydroids acclimatized to a salinity of about 30‰ may be able to tolerate a lower range of 15‰ and may even live in 13‰ for some time. But hydroids acclimatized to a salinity of 17 to 20‰ may be able to survive in much lower salinity than 13‰. This suggests that this hydroid is capable of acclimatizing to some extent to the fluctuations of salinity of the ambient water and is capable of surviving if the salinity changes are not very drastic and rapid. The great and prolonged stress of a very low salinity during June to September in this area probably accounts for its absence during this period.

Further, a correlation between size and shape of the colony and polyp and the salinity of the medium was also apparent during the present study. Table 3 shows representative data from a large number of observations regarding the size of the colony and measurements of the zooid and their correlation with the average salinity during the respective months.

The commensal relationship

This commensalic hydroid, as stated already, was apparently seasonal in its occurrence, collection and examination of the hosts *Teredo*, *Martesia* and especially the large shipworm *Nausitora* revealed the interesting fact that the occurrence of the hydroid was confined to the period November to May with nearly 100% infection in shipworms collected during the period December to March. This infestation is remarkably high when compared with earlier observations. Palombi found on an examination of nearly 3000 *Tapes* that the percentage of infection was about 2 to 8%, while Crowell (1956) noted it to be 16%. In *Cardium edule* the infection was 50%. The colonies were found attached to the lamellae of the ctenidia, either closely together throughout the length of the ctenidia or in isolated patches. There was considerable variation in the number of colonies in the host, the range being from 1 to 80. The colonies of this hydroid have been found attached only to the ctenidia and not to any other part of the body, whereas, according to Crowell (*loc. cit.*), the hydroids in *Tapes* were attached most often to the body wall dorsal to the foot and median to the gills and were occasionally found on the mantle or palps but not on the gills themselves. The hydroid is attached to the host by the basal disk which is implanted entirely within the tissue of the ctenidium (fig. 10). This attachment seems to be further strengthened with the help of the protrusions or holdfasts that project from the basal disk into the tissue of the ctenidium. This situation is very different from that in the species of *Eugymnanthea* previously studied (Mattox & Crowell, 1951) where attachment is effected by suction achieved through the muscular activity of the cell layers.

Table 3
The relation between size and shape of the colony and polyp and the salinity of the ambient water

Month	Average salinity ‰	Number of colonies examined	Range in number of polyps	Range in number of gonophores	Length of the polyp	Diameter of the polyp	Length of the tentacle	Height of the hypostome	Width of inter-tentacular membrane	Diameter of basal disk
November 1965	15.92	18	1-39	1-20	1218.75 μ	112.5 μ	500 μ	81.25 μ	62.5 μ	688 μ
December	22.41	20	1-34	1-9	968.75 μ	112.5 μ	343.75 μ	37.5 μ	37.5 μ	375 μ
January 1966	28.01	17	1-14	1-3	725 μ	112.5 μ	325 μ	31.25 μ	31.25 μ	375 μ
February	30.17	16	1-9	1-2	437.5 μ	112.5 μ	187.5 μ	31.25 μ	25 μ	312.5 μ
March	31.62	18	1-6	1-2	375 μ	93.75 μ	137.5 μ	25 μ	25 μ	312.5 μ
April	32.04	16	1-4	One gonophore	375 μ	93.75 μ	125.5 μ	25 μ	25 μ	312.5 μ

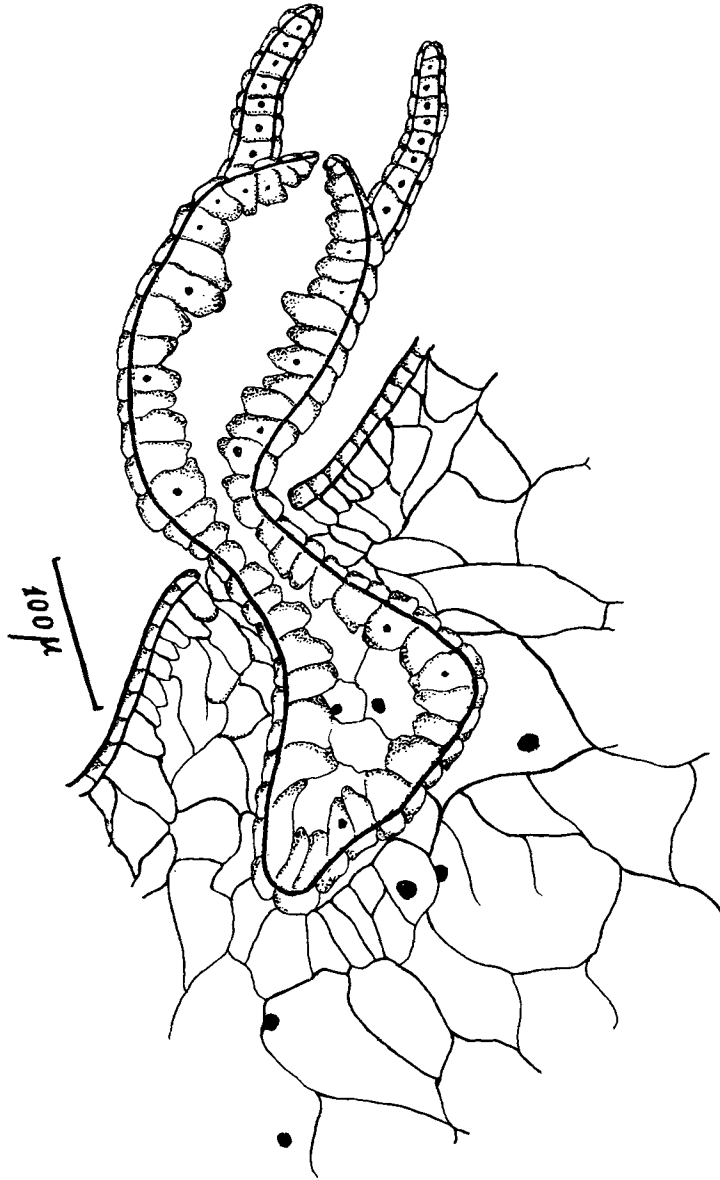


FIG. 10. Longitudinal section through a polyp showing the nature of attachment to the ctenidium of the host.

It has further been reported (Mattox & Crowell, 1951) that in living oysters the polyps sometimes get detached and have the ability to re-attach at other sites. In the present case the hydroid is incapable of either detaching itself or re-attaching at other sites. When removed from the ctenidium of the host, the colony was found to lie flat at the bottom of the container. Even replacement of the hydroid over a fresh fragment of ctenidium did not lead to even a superficial re-attachment or to fresh implantation to the host tissue. Thus the present species is especially remarkable owing to its more intimate relationship with the host leading to an almost permanent and firm attachment

involving the tissue of the host. Removal of the hydroid invariably leads to damage of the tissues of the ctenidium.

The exact nature of the association between the hydroid and the host is not clear from the present observations. No evidence of damage to the host tissue was noted in any specimen. Despite heavy infestation of the hydroid the host specimens apparently were healthy and normal. The members of the genus *Eugymnanthea* have evolved in a direction to effectively exploit the several advantages available within the mantle cavity of bivalves. This is especially so in the present case since excellent protection is afforded within the tubular mantle cavity and in these boring bivalves there is additional protection on account of the boring habit of the hosts. The constant flow of the medium facilitates a steady and continuous supply of oxygen for respiration and suspended food particles. These are all of great advantage for the hydroid. The more intimate nature of the association and the tendency towards colony formation are two additional points specially noteworthy in this species.

An important development during the evolution of *Eugymnanthea* has been the formation of the basal disk to circumvent difficulty of holding on to its substratum in a strong current of water in the mantle cavity of the host. While in the other species of *Eugymnanthea* this basal disk functions through a suction device, in the present form a more advanced condition is attained in the sense that the attachment has become permanent by penetration into host tissue leading to a more intimate association between the host and this associate.

Summary

The occurrence of a commensalic hydroid of the genus *Eugymnanthea* has been noted in the wood-boring molluscs such as *Nausitora hedleyi*, *Teredo furcifera* and *Martesia striata*. Both the polyp and the young medusa are described. The mode of formation of the colony, movements of the hydroid and preliminary observations on the general ecology are noted and the nature of the relationship indicated.

Acknowledgments

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