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TAXONOMIC STUDIES ON THE HYDRAS OF NORTH AMERICA

6. DESCRIPTION OF *HYDRA HYMANAE*, NEW SPECIES

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This hydra is given its specific name, *hymanae*, in recognition of the important contributions made by Dr. Libbie H. Hyman to the study and classification of the invertebrates. The authors gratefully acknowledge the helpful advice given them by Dr. Hyman in the preparation of this report.

The species was first found in the late spring of 1948, attached to the under sides of leaves in a mill pond in Little Falls, New Jersey. During the succeeding summer and fall it was also found in a variety of habitats in the vicinity of Little Falls. It occurs on the under sides of leaves and stones in ponds, and on the under sides of stones in rapidly flowing brooks, especially overflows from ponds or lakes.

GENERAL CHARACTERS

This hydra commonly remains partly contracted, with a stout-bodied appearance. Occasionally an individual extends to a very slender form. Well-fed specimens, in their usual, partly contracted state, often have a column length of 7 or 8 mm. Several individuals have been observed extending to a length of 12 mm. Those measured at 12 mm. did not show so slender a form as some smaller individuals observed. This may indicate that they were not extending fully or merely that in well-fed specimens the body wall is thickened by the presence of stored nutrients. The habit of

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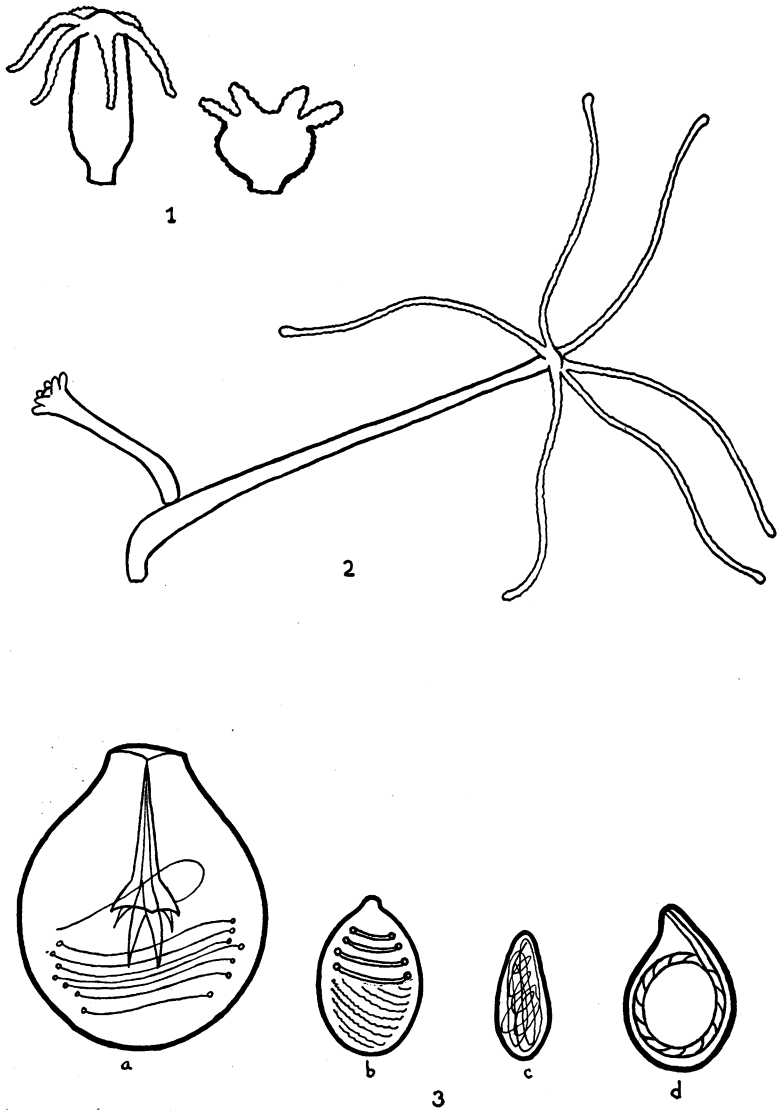


Hydra hymanae, new species

FIG. 1. Two contracted individuals.
FIG. 2. Asexual individual with bud.
FIG. 3. Nematocysts, ×2000. A. Penetrant. B. Large glutinant. C. Small glutinant. D. Volvent.

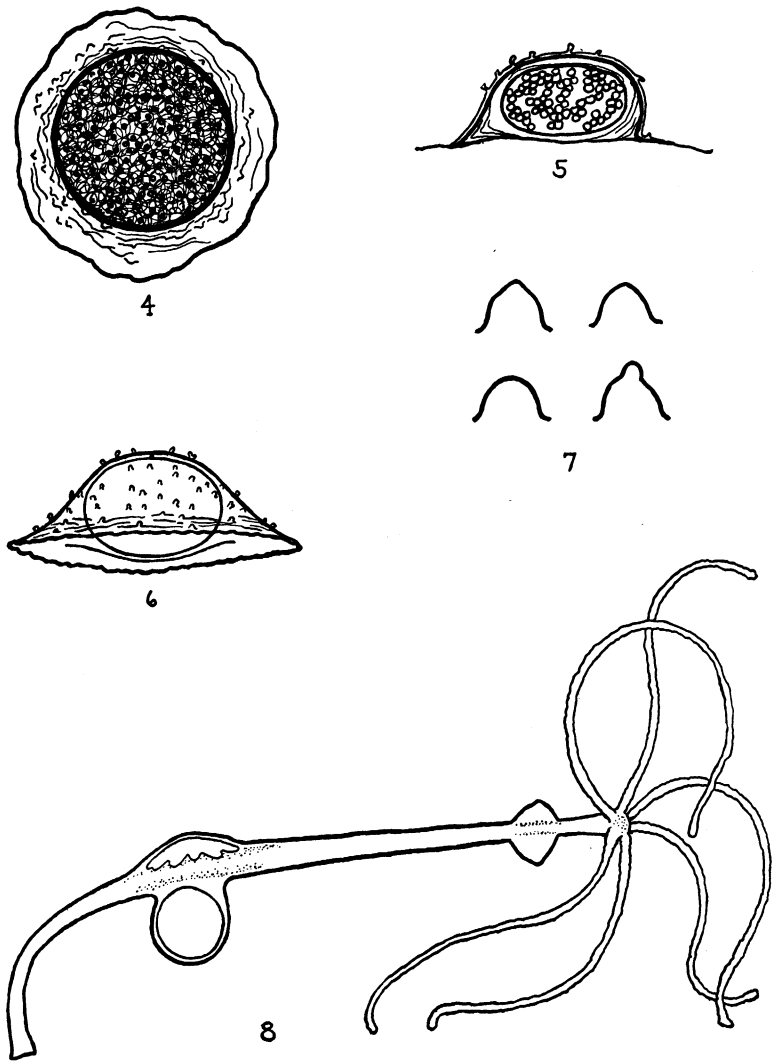
remaining partly contracted was observed over a period of several months of culture in the laboratory. Sexual forms were particularly reluctant to extend. The tentacles, though short, are usually extended, and therefore the relative length of column and tentacles is exceedingly variable. The tentacles almost always appear shorter than the column, usually slightly less than half the length of the fully extended column. Several individuals have shown a tentacle length of 5 mm. The tentacles are not held stiffly but in drooping positions characteristic of longer tentacled species. The column does not show a division into body and stalk, though this is suggested by the appearance of strongly contracted individuals (fig. 1). The basal end of the column commonly shows a distinct curve or hook, by means of which the hydra assumes an almost horizontal position, approximately parallel with the substratum. It rarely stands erect. The most common number of tentacles found is six, though there may be five or seven. The tentacles on buds appear to form simultaneously and to maintain an equal rate of growth. The color of the animal varies from grayish white to pinkish orange to brown. Under laboratory conditions it feeds reluctantly on *Daphnia* and shows a slow rate of bud formation. This hydra seems unusually sensitive to adverse environmental conditions. It could be cultured successfully only when kept very cold and frequently supplied with clean dishes and fresh, filtered water obtained from its natural habitat. Only one animal with more than one bud was observed. It had two buds, which appeared to be directly opposite each other.

NEMATOCYSTS

This species is characterized by the broadly oval form of its large glutinants and by the large size of its penetrants and volvents. The measurements that follow were derived from nematocysts occurring on the tentacles.

The majority of penetrants are large, ranging in length from 16μ to 23μ. The latter figure is the largest reported for any American hydra. Some smaller penetrants were found, the smallest measuring 8.25μ.

The large glutinants are broadly oval, somewhat similar in form to those of *H. americana* (Hyman, 1929) and *H. utahensis* (Hyman, 1931), but more slender. They are predominantly 10.5μ in length, but range from 8.6μ to 11.6μ. The pointed end shows a



Hydra hymanae, new species

FIG. 4. Dorsal view of the whole embryo.
FIG. 5. Embryo in vertical section.
FIG. 6. Side view of the detached whole embryo.
FIG. 7. Various shapes of testes.
FIG. 8. Sexual individual in its usual posture, showing an ameboid egg and a second, more mature egg.

distinct, beak-like projection. The thicker end of the nematocyst thread is usually arranged in four regular transverse or oblique coils. The thinner portion is more irregularly disposed but tends to form roughly parallel coils at an angle to the four thicker coils (fig. 3b).

The small glutinants are narrowly oval, more pointed at one end, with an irregularly coiled thread which loosely fills the nematocyst (fig. 3c). They are quite variable in length, ranging from about 6.8μ to about 10.8μ. They differ markedly in length in different individuals, both in the most frequently occurring size and in the range of sizes.

The volvents strongly resemble the large glutinants in both size and shape. The volvents, however, taper more sharply to a somewhat oblique point. The majority of volvents are 10.5μ in length, with a range of 7.5μ to 11.2μ. The volvents as well as the penetrants of this species are larger than those reported for any other American hydra. The thread of the volvent is noticeably thick, and frequently shows distinct spiral markings, probably indicating spination (fig. 3d).

SEX ORGANS

This species is hermaphroditic. In general, both sets of sex organs develop simultaneously, although testes may be distinguished a short time before recognizable ovaries have appeared and may persist for some time after the ovaries have become inactive. All those individuals producing eggs were found also to have testes, although an occasional individual was found with numerous testes and no visible ovaries.

In most cases the testes occur as a single pair just under the tentacles. Less commonly, three or four testes occur near the distal end. In a few instances as many as a dozen testes have been seen scattered up and down the column, with some as far down as the budding zone. The testes are roughly hemispherical in general form, but taper to a blunt point. Occasionally a testis is observed bearing a distinct nipple (fig. 7).

The ovaries are proximal and produce a succession of eggs in the same individual. Frequently two eggs are visible simultaneously but at different stages of development. The eggs are a light pinkish orange in color. The pinkish color often shown by this hydra appears to be concentrated in its eggs. In the earlier stages the eggs are flattened and ameboid, developing to a fully spherical

form before rupturing the ovary wall. After fertilization and several cleavage stages have been completed, the embryo is deposited by the parent. It becomes attached to the substratum enclosed in a theca that is flat below and convex above. Approximately at the time of deposition, the surface of the embryo is marked by highly active pseudopodia like those described for *H. circumcincta* (Schulze, 1917). These probably take part in the formation of the embryonic theca. The parent animal contributes to the deposition of the embryo by contracting the column or by extending horizontally to bring the embryo in contact with the substratum. When first deposited the embryo is ameboid, but it soon attaches and becomes flattened. The characteristic spiny theca then appears.

In the laboratory, 24 hours or more elapsed between the first appearance of the ameboid egg and the completion of the embryonic theca. The egg was usually extruded in less than three hours from the time when it could first be distinguished in the ovary, but a much longer time was required for fertilization, cleavage, and deposition. Usually several hours after extrusion of the egg, a two-celled stage could be discerned with the naked eye. Further cleavage proceeded slowly, as did deposition and attachment. When first deposited the embryo was of a pinkish color, but it took on a darker yellowish color and a definitely shiny appearance as the theca developed. In its earlier stages the theca seemed softer and more delicate than when mature. In this condition it often showed few or poorly developed spines, its upper surface having a cobblestone appearance, as though made up of bulging plates. In some areas each plate bore a knob or spine. Such plates were not distinguishable in the thecae of mature embryos with well-developed spines.

EMBRYONIC THECA

The embryonic theca is plano-convex: flat below and convex above. The shape varies from an almost hemispherical form to a much more flattened one. The embryonic theca completely encloses the embryo and attaches it to the substratum (fig. 5). It is composed of two layers, both of which appear laminated. The outer layer of the theca is extended and flattened peripherally against the substratum. When viewed from above, the embryo is thus seen to be surrounded by a transparent, yellowish, irregularly shaped border (fig. 4). The theca appears to be at-

tached to the substratum only at its periphery, and thus it is easily detached from stone or leaf with a needle. The convex outer surface is thicker and less flexible under pressure than is the surface normally flattened against the substratum. The curved upper surface of the outer layer of the theca is set with small slender spines. These spines are usually rounded at the tips, bearing a definite knob, but they may be truncated or branching. A few are merely knobs on the surface and do not have the appearance of spines at all.

There is considerable variation in the spination of the theca. Embryos formed in nature, particularly those collected from running water, showed the most clearly developed spines as well as the greatest flattening of the embryo against the substratum. A few embryos developing in laboratory dishes showed only a few abortive spines, though others developed in the laboratory showed well-developed spines.

In nature embryos were found attached to the under sides of leaves in still or slowly moving water, and on the under sides of stones in very rapidly moving water. In the laboratory embryos were deposited in large numbers on the bottoms of culture dishes. They were never found on the sides of dishes, as were the deposited embryos of *H. utahensis* (Hyman, 1931).

The diameter of the entire theca ranges from about 0.56 mm. to about 1.0 mm., depending on the degree of flattening. The greatest diameter of the enclosed embryo is usually close to 0.5 mm. The thickness of the entire embryo is about 0.45 mm. or less, depending on the degree of flattening. The spines were commonly 0.00875 mm. in length.

PERIOD OF SEXUAL ACTIVITY

Sex organs were first observed in individuals collected from running water in Little Falls on October 10. Other animals of this species were collected on October 11 and 12 in a rapidly flowing brook in Little Falls, in a pond in Verona, New Jersey, and in Lake Valhalla, New Jersey. It was apparent from these collections that the period of sexuality was of recent origin. A majority of individuals collected on October 13 and 25 bore both testes and ovaries, but collections made on November 7 included individuals no longer developing eggs but with testes still in evidence. Succeeding collections yielded many embryos but showed a rapid decrease in the number of adults. This observation, coupled with

the fact that the species has been more difficult to find at other times of the year, suggests that this animal may emerge from retirement only to deposit embryos on a suitable substratum. It is possible that its common habitat is mud, and that in this respect it resembles the similar species, *H. circumcincta* (Schulze, 1917). Such a habit could explain the failure of other investigators to make earlier identification of this species.

Although the sexual period in nature appeared to be brief, specimens in the laboratory continued to show testes for weeks after collection, and an occasional embryo was deposited as late as early January. These individuals were kept in an unheated room.

A few individuals collected from leaves on January 22 showed no signs of sex organs and no buds.

DIFFERENTIAL DIAGNOSIS

Hydra hymanae closely resembles *H. americana* (Hyman, 1929) in color, in length of column and tentacles, and in the shape and dimensions of the nematocysts. *H. americana* differs from the present species, however, in that it is only occasionally hermaphroditic, has conical testes with well-developed nipples, and develops a spherical embryo with long, branching spines.

A second American species of hydra that resembles *H. hymanae* is *H. utahensis* (Hyman, 1931). Like *H. hymanae*, it is hermaphroditic and develops a flattened embryo, but the embryonic theca is spineless, and the testes are of different shape. The nematocyst measurements of the two species do not agree.

A species with flattened eggs was incompletely described by Downing in 1904, but it has not been definitely identified.

Among the European species, at least two with flattened embryos have been described. One species, *braueri* (Bedot, 1912), is described as having a distinct stalk and has been classified in the genus *Pelmatohydra*. This form is clearly distinguished from *H. hymanae* by its longer tentacles, club-shaped testes, and different nematocyst measurements, although its embryo bears a strong resemblance to that of *H. hymanae*.

The second European form with flattened embryos, *H. circumcinta* (Schulze, 1917), presents special difficulties in the evaluation of the present species. Unfortunately, there appears to be a lack of uniformity in the descriptions of *H. circumcincta* by different authors and even by the same author. In 1917 Schulze described

H. circumcincta and *H. stellata* (Schulze, 1914) as separate species, and in 1927 he redescribed them. In each paper he provided drawings to show the size, structure, and proportions of the nematocysts. In spite of the fact that no two of the sets of descriptions were in agreement and the embryo of *stellata* had not been seen, he suggested synonymizing the two species.

Following Schulze's suggestion, in 1948 Hansen-Melander described a hydra from Sweden and Denmark, giving it the name *H. circumcincta* because it most closely resembled *H. stellata* as described by Schulze in 1917. In size and general appearance this hydra agrees with the description of *stellata*, and it is described as developing an embryonic theca indistinguishable from that described by Schulze for *circumcincta*. The nematocyst measurements given by Hansen-Melander vary only slightly among the individuals which she collected from various sources. They do not agree, however, in either absolute or relative dimensions with the nematocyst sizes given by Schulze for either *H. stellata* or *H. circumcincta*.

In 1933 Kuwabara described a hydra from Japan, identifying it as *H. circumcincta* without having seen the embryo. Although he made no record of the small glutinants, his scale drawings of the other nematocysts are in fair agreement with the nematocysts of *H. hymanae*. They are like none of the descriptions of the nematocysts of *stellata* or of *circumcincta*. Hansen-Melander (1948), in discussing Kuwabara's findings, likens the nematocysts of this hydra to those of *H. americana*.

In 1947 Ito described a hydra which he believed to be identical with that described by Kuwabara as *circumcincta* but which he named as a new species, *H. parva*. His nematocyst measurements differ markedly from those given by Kuwabara. They also differ from all those previously given for *circumcincta* and for *stellata*, with the exception of those described for *circumcincta* by Hansen-Melander, with which they agree very well. He describes the embryo as definitely different from that of *circumcincta*, yet his drawing of the embryo shows a plano-convex theca with short spines. The proportions of the theca fall within the limits of variation shown by some thecae of *H. hymanae*.

Still another species, *H. ovata*, was described by Boecker in 1920. Boecker's description of *H. ovata* was incomplete, but he took pains to note differences between this hydra and *H. stellata*. Other investigators have offered the opinion that *H. ovata* and *H.*

TABLE 1

Species	Column Length in Mm.	Tentacles 1/2 Column or Less	Hermaphroditic	Tentacle Origin Simultaneous	Large Glutinant Broadly Oval with "Beak"	Flattened Embryo Spinous
hymanae	12	x	x	x	x	x
americana	10	x	Sometimes	"Almost"	x	Spherical spinous
circumcincta (Schulze, 1917)	5	x	x	x	Beak omitted in 1927	x
circumcincta (Hansen-Melander, 1948)	10	x	x	x	x	x
circumcincta (Kuwabara, 1936)	5	x	x	x	Beak not shown	Not observed
parva	5	x	x	x	x	x
stellata (Schulze, 1927)	10	x	x	x	x	Not observed
ovata	Very small	x	Not observed	x	x	Not observed
Hancock's hydra	12	x	x	x	Not described	x
braueri	20	Longer	x	Successive	Beak absent	x
utahensis	10	1 1/2 times	x	x	Beak not distinct	Without spines

circumcincta may be identical, although Boecker's description resembles *circumcincta* less than it does *stellata*. *H. ovata* is described as having nematocysts with proportions roughly like those of *H. stellata* as described by Toppe (1909). The dimensions vary somewhat from those given for *stellata*. The embryo of *ovata* was not seen.

From this evidence it can be seen that a number of types of hydra have been described that are very similar in most respects but that also have certain distinct differences, particularly in respect to the nematocysts. We must conclude that either (1) the absolute and relative sizes of the nematocysts may vary so widely within a species that these characteristics have no dependable diagnostic value in determining a new species; or (2) there are many closely related species of hydra.

TABLE 2

NEMATOCYST MEASUREMENTS IN MICRONS

Species	Penetrant	Large Glutinant	Small Glutinant	Volvent
hymanae	8.2–23.0	8.6–11.6	6.8–10.8	7.5–11.2
americana	13.0–21.0	7.5–10.0	6.5– 7.3	8.3– 9.5
circumcincta (Schulze, 1917)	18.0[a]	13.0[a]	8.0[a]	6.0[a]
circumcincta (Hansen-Melander, 1948)	14.4–15.0	9.1– 9.3	7.5– 7.7	6.9– 7.1
circumcincta (Kuwabara, 1936)	15.4[a]	11.4[a]	—	11.1[a]
parva	9.0–19.0	7.5– 9.5	6.0– 8.0	6.0– 8.0
stellata (Schulze, 1917)	25.0[a]	18.0[a]	14.0[a]	11.0[a]
stellata (Schulze, 1927)	23.0[a]	12.0[a]	7.0– 9.0[a]	8.0– 9.5[a]
ovata	18.7–22.1	10.8	7.24	6.8
Hancock's hydra	—	—	—	—
braueri	14.5[a]	8.5[a]	8.0[a]	7.0[a]
utahensis	9.0–16.0	8.0– 9.0	6.4– 7.2	6.0

[a] Figures derived from scale drawings.

Tables 1 and 2 emphasize this evidence with respect to those species that resemble *H. hymanae*. Some have been described as separate species, and some are descriptions of the same species by different authors. It is not the intention of the present authors to correct or revise the classification of any of these forms. We do, however, wish to suggest that they seem to form a closely knit group, somewhat distinct from the other species of hydra classified to date. It is possible that some or all are merely varieties of one

species. Until this is proved, however, we are following precedent in describing *H. hymanae* as a distinct species rather than a subspecies.

In tables 1 and 2 the only hydra included that does not have flattened embryos is the American form *H. americana*. The fact that this form in all other respects bears the closest resemblance to *H. hymanae* seems to support the theory that there may be a group of closely related species, rather than subspecies; unless, of course, the shape and spination of the embryonic theca prove to be invalid as criteria for differentiating species.

HABITAT AND DISTRIBUTION

Although this hydra has been found in a variety of habitats, it occurs most often and most abundantly in rapidly moving water. For example, many individuals were found attached to the under sides of stones in a sluiceway that drains a pond in Little Falls, New Jersey. Again, this form was taken on the under sides of stones in rapid water below the dam at Yantecaw Pond, Delawanna, New Jersey. In a third instance, it was found on the under sides of stones in rapid water at the outlet of a pond in Verona, New Jersey. This habitat strongly resembles that described for *H. littoralis* (Hyman, 1938). Even when found in ponds in Little Falls and Verona, it was invariably located close to moving water, as in an entering stream, outlet, or channel through the pond. Its reluctance to feed on such swimming forms as *Daphnia* in laboratory culture may be associated with its natural tendency to depend upon the fauna of swiftly running streams. Although these hydra, at the height of the sexual season, were found in fair abundance, at no time did they occur massed in dense groups, in the fashion described for *H. littoralis*. Instead it was found that individuals were somewhat regularly and sparsely distributed.

This species is widespread and abundant in the limited area of New Jersey from which collections were made. Additional information concerning its distribution is not available. If it is identical with the hydra described by Hancock (1850), it also occurred in the Northumberland lakes.

TYPE

Type and cotype specimens showing sex organs and mount of thecated embryo have been deposited in the American Museum of Natural History (A.M.N.H. No. 3272).

SUMMARY

Hydra hymanae, new species, is a hydra of medium size, with short tentacles. It is usually found in very rapidly moving water. Its identifying characters are: column 7 to 12 mm. in length, not differentiated into body and stalk but with base bent in the form of a hook; habit of standing partly contracted, with the main portion of the column approximately parallel with the substratum; tentacles usually six in number, about one-half the length of the column, extended in drooping positions; broadly oval, large glutinants with a beak-like projection at the pointed end; unusually large penetrants and volvents; hermaphroditic; testes few, roughly hemispherical, with or without nipples; season of sexual activity October, November, December; embryo flattened and enclosed in a plano-convex, spined theca attached to the substratum; habitat occasionally still water, more often rapidly moving water. The type locality is Little Falls, New Jersey. Other localities are Verona, Delawanna, Lake Valhalla, all in New Jersey.

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