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Author(s)	UCHIDA, Tohru; NAGAO, Zen
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The Life-history of a Japanese Brackish-water Hydroid, *Ostroumovia horii*¹⁾

By

Tohru Uchida and Zen Nagao

(Zoological Institute,
Hokkaido University)

(Akkeshi Marine Biological
Station, Akkeshi, Hokkaido)

(With 36 Text-figures)

In 1929 a lacustrine hydroid, *Laccocoryne horii* was reported by T. Uchida and S. Uchida as a new form from the two brackish lakes, Kahokugata and Ochigata. At that time the hydroid was described as a member of the Corynidae but afterward entitled to the Moerisiidae by Uchida (1934). On the other hand, Hadži (1928) published a review on polyps of fresh-water and of brackish-water and instituted a new genus *Ostroumovia* for *Moerisia inkermanica* in the Black Sea. Valkanov who reported on *Ostroumovia inkermanica* in 1935 and 1936 published a review (1938) on the Moerisiidae and enumerated the following seven species; *Moerisia lyonsi*, *M. gallica*, *Caspionema pallasi*, *Ostroumovia inkermanica*, *O. maeotica*, *Laccocoryne horii* and *Halmomises lacustris* as valid. In this paper he made a detailed comparative study on *Ostroumovia inkermanica* and *Laccocoryne horii*, using specimens of the latter species sent to him by Uchida. Valkanov pointed out the similarity of polyps of the two species but kept them separate. In the same year Kramp and Paspaleff (1938) published a joint work on *Ostroumovia inkermanica*. In the work, Kramp studied the medusan stage and Paspaleff treated the polyp stage. At that time Kramp proposed the new suborder Limnomedusae in which are included most of fresh-water, brackish-water and some littoral medusae with the alternation of generation. The suborder includes two families; Moerisiidae and Olindiidae, the two families being mainly distinguishable by the lack or presence of marginal statocysts. The suborder has been generally adopted. From the morphology of *Ostroumovia* Kramp referred the genus to the Olindiidae, because the medusa has marginal statocysts and marginal tentacles arising from the exumbrella.

In 1948 Muto studied the polyp of *Laccocoryne horii* and came to the conclusion that the Japanese hydroid is to be eligible for the genus *Ostroumovia* because of the similarity of polyp stage. In 1951 Uchida made a report on medusae found in a concrete tank near Tokyo under the name of *Moerisia* sp. He surmised that the medusa had possibly set free from the polyp *Laccocoryne horii*. As the medusae have no statocysts and their tentacles are arising from

1) Contributions from the Akkeshi Marine Biological Station, No. 104.
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the bell margin, he suggested that *Ostroumovia* and *Laccocoryne* must be separated in the morphology of medusa. In 1951 Picard published the revision of the Moerisiidae and admitted three genera; *Halmomises*, *Odessia* and *Ostroumovia*. Among them the first two lack statocysts but the third one has marginal statocysts. In the next year he discussed on the systematic position of *Laccocoryne* and concluded that the hydroid possibly belongs to *Ostroumovia*.

As stated above, the polyp of *Laccocoryne* is closely allied to that of *Ostroumovia*, but the medusa is quite different from the latter in the lack of statocysts described by Kramp (1938). Recently Valkanov (1955) published the revision of *Ostroumovia inkermanica*, in which he denied the presence of statocysts in the medusa, even in the specimens examined by Kramp. He could not perceive the statocysts at all and pointed out that the statocyst found by Kramp is nothing but a nematocyst surrounded by the ectoderm cells. There remains still a query for the present. Therefore, it is the urgent necessary to work out in detail the *Ostroumovia inkermanica* and *Laccocoryne horii*.

At the beginning of September, 1958 Dr. M. Miyawaki in Kushiro wrote to the senior author at Naples that he found many hydromedusae in the Lake Harutori, a brackish lake near Kushiro. On the request of Uchida the junior author Nagao at once set in the study on the life-history of the hydroid and reared with success the polyps in the laboratory to give rise to young medusae. On returning home in November Uchida jointed with the work and completed this paper.

In the course of this study we are indebted to the kindness of Dr. M. Miyawaki of Kumamoto University, Mr. T. Shimomura of Niigata Fishery Station and also the gentlemen of Akita Fishery Office and Station in helping in various ways.

Habitat

The present study has been carried out mainly on the material from the lake Harutori and partly on that from the lake Hachirogata. The lake Harutori is situated in Kushiro city on the south-eastern coast of Hokkaido. The lake has rich plankton and there can be found several fishes such as *Carassius auratus*, *Gasterosteus aculeatus* etc. On the shore of the lake are growing the plants, *Scirpus Tabernaemontani*, *Phragmites communis*, *Beckmannia Syzganche* etc. The lake was brackish with the salinity of 0.56 ‰ and pH of 7.8–8.0 in September of 1958. The bottom is muddy and rich in methane gas and the water is highly spoiled. At the end of August, 1958, the water-temperature of the lake was approximately 19°C and the medusae of *Laccocoryne horii* were abundantly found. The polyps were found attached to the water-plant *Potamogeton pusillus* which was luxuriantly growing on the coasts of the lake. In the middle of September no medusa was found there but the polyps still bore both lateral buds and medusa buds. At that time water temperature was 17°–18°C in daytime.

The lake Hachirogata is located on the coast of the Japan Sea in the northern part

of Honshu. There was a report informing that in the lake numerous hydromedusae suddenly appeared in the summer of 1958 and owing to abundance of medusae the fishery was greatly interrupted. In September, 1959 the junior author studied the hydroid there. He collected many medusae and polyps of the same species as in the Harutori. The water showed pH of 5.8 and salinity of 0.17–0.21‰. The temperature was 25°C at that time. The polyps were found attached to *Potamogeton*.

Morphology of the polyp

1. *External structure*: The polyp is generally solitary but rarely a few polyps are found to form a small colony (Figs. 1, 2 and 5). In aggregated parts of many polyps, the hydrocaulus of old polyps becomes elongate extremely and entangles with hydrocauli of other individuals, showing a colonial appearance. The polyp is generally 5–8 mm in the whole length; 2–3 mm in young and 10–12 mm in well-developed specimens. It is divided into three parts; a conical hydranth, a long cylindrical hydrocaulus and a discoid hydrorhiza. The polyp attaches to a leaf or stem of *Potamogeton* by its discoid hydrorhiza which is very sticky and generally imbued with debris and mud. When many polyps are aggregated, a species of *Chironomus* larva was found to dwell in debris and mud. The hydranth and hydrocaulus are naked and extend above the debris and mud. The hydranth is 1–2 mm long and mostly furnished with pale yellow stripes on the surface. The peristome is cylindrical and at the whitish pale yellow tip has a mouth surrounded by a circular lip rich in nematocysts. The part lower than the

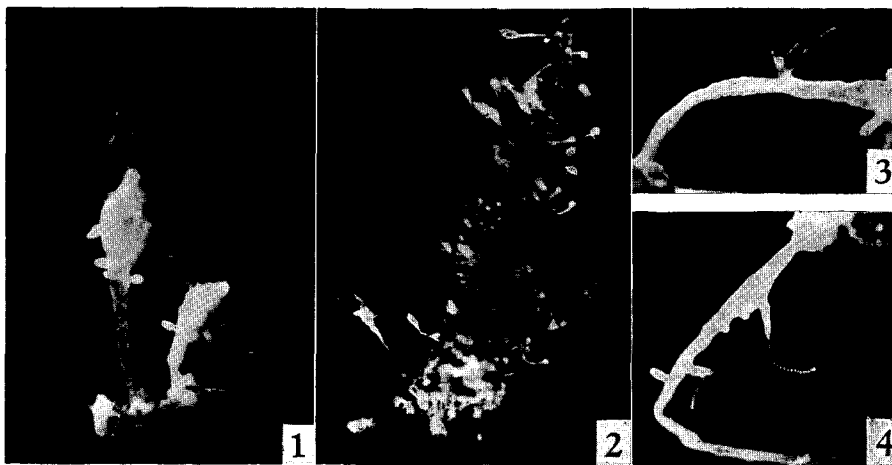


Fig. 1. Polyps bearing several lateral buds. $\times 6$.

Fig. 2. Aggregated polyps on a leaf of *Potamogeton*. $\times 2$.

Fig. 3. An abnormal hydranth on a hydrocaulus. $\times 7$.

Fig. 4. A few abnormal hydranths and an abnormal tentacle arising from a hydrocaulus. $\times 7$.

peristome is the broadest and 0.5mm in diameter in well-developed polyps. About the broadest part are distributed 10-15 tentacles in irregular order. The tentacles are filamentous, hollow, colour-less and with a slight enlargement at the tip. When well extended, they reach over twice the length of the polyp. In well-developed tentacles there can be seen 50-70 nematocyst rings in the shaft and a small spherical nematocyst knob at the tip. The nematocyst batteries of the tentacles form circular rings in the whole shaft except the proximal part, in which they are

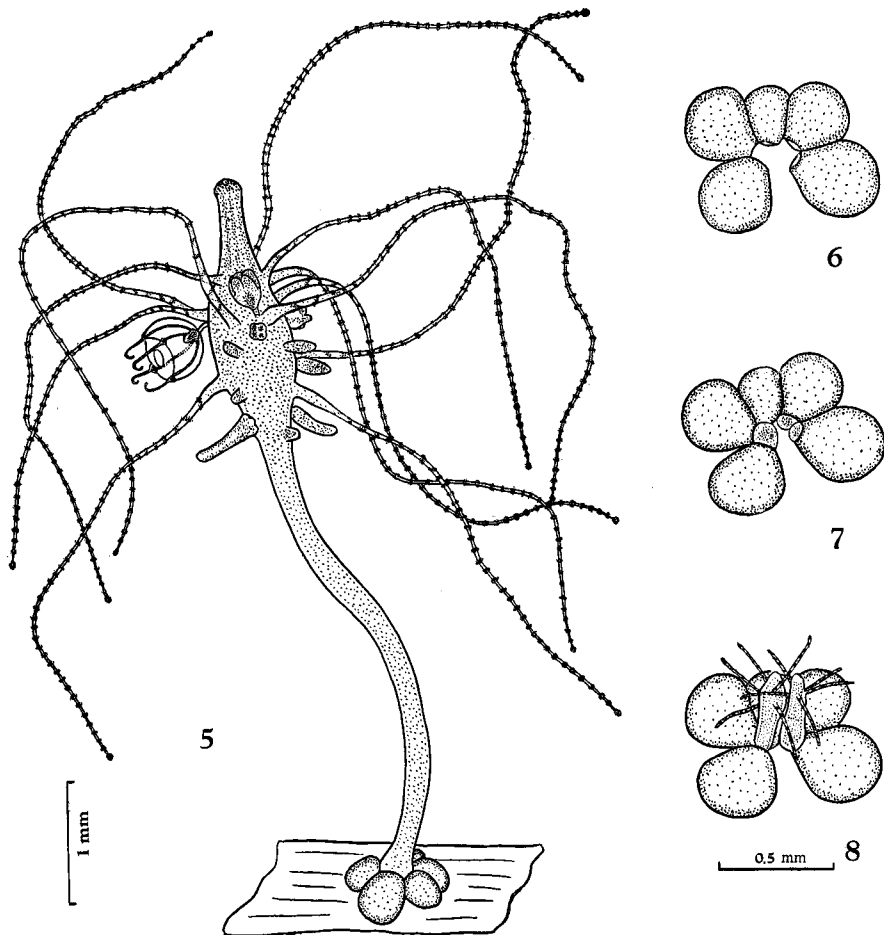


Fig 5. A well-developed polyp carrying several lateral buds and medusa buds.
Figs 6-8. Hydrorhizae (Podocysts).

6. Resting stage. 7. Beginning of budding.

8. Podocysts with two newly developed young polyps.

spirally arranged. In well-developed polyps several medusa-buds of various developmental stages are found among tentacle cluster (Fig. 5). The medusa-buds are variable in number, 10–15 in some individuals but 1–2 in others. The part lower than the tentacle region becomes narrow gradually and merges into the hydrocaulus. Some lateral buds are often found in this part. The lateral buds are various in their developmental stage and sometimes over ten in number (Figs. 1, 5). The hydrocaulus is represented by a simple slender tube and 0.2–0.3 mm in diameter, gradually widening toward the basal disc which is connected with a few hydrorhizas. The hydrorhiza is elliptical and convex in form, thick in the centre and thin on the periphery, with a flat base by which it attaches to the substratum. These hydrorhizas are connected with the hydrocaulus by a small pit of 0.05–0.1 mm and 0.25–0.5 mm in long diameter and 0.2–0.4 mm in short diameter. They are covered with chitinized periderm which extends to short distance above the hydrocaulus. The old ones are dull yellowish orange in the central part, transparent and dark yellowish brown in the peripheral portion. The hydrorhizas are formed by stolonization from the pedal disc and are arranged around the latter, generally 4–5 and sometimes 10 in number (Figs. 6, 14).

There were found some abnormal polyps: such as those with two hydranths or with aberrant tentacles arising from the hydrocaulus as Valkanov (1938) already reported (Fig. 4). In some polyps lateral buds appeared in the hydrocaulus and metamorphosed to hydranths *in situ* (Fig. 3).

2. *Internal structure*: The ectoderm is mainly composed of vacuolated cubical supporting cells, including nematocysts and interstitial cells. Nematocysts are thickly set in tentacles and are abundantly distributed near the mouth. Interstitial cells are intervening among supporting cells especially in tentacle bases, medusa buds and also in terminal portion of the hydrocaulus. But they are all but distributed in the peristome and most part of the hydrocaulus. The supporting cells of pedal disc are small and flat in shape.

The endoderm is different in portions of the polyp. In the peristome the endoderm is composed of two layers; the supporting cells of the inner layer are columnar and hyaline, containing no assimilated substance, while mucous gland cells of the outer layer are thickly disposed, forming a folded surface of the mouth cavity (Fig. 10). In the upper part of the hydranth with tentacles the endoderm includes narrow columnar supporting cells, among which conical gland cells are distributed. The gland cells produce rich basophilic secretion (Fig. 11). They decrease gradually toward the lower part of the hydranth with lateral buds and are only sparsely distributed in the upper part of the hydrocaulus. The supporting cells contain eosinophile granulated assimilated substance in the hydranth, especially in the lower half (Fig. 12). Those of the hydrocaulus are large in size and vacuolated, equipped with a nucleus generally near the cavity. These cells have scarcely assimilated substance, except the parts near the hydranth and also near the pedal disc (Fig. 13). In the pedal disc the supporting cells are represented by small flat cuboidal cells (Fig. 14).

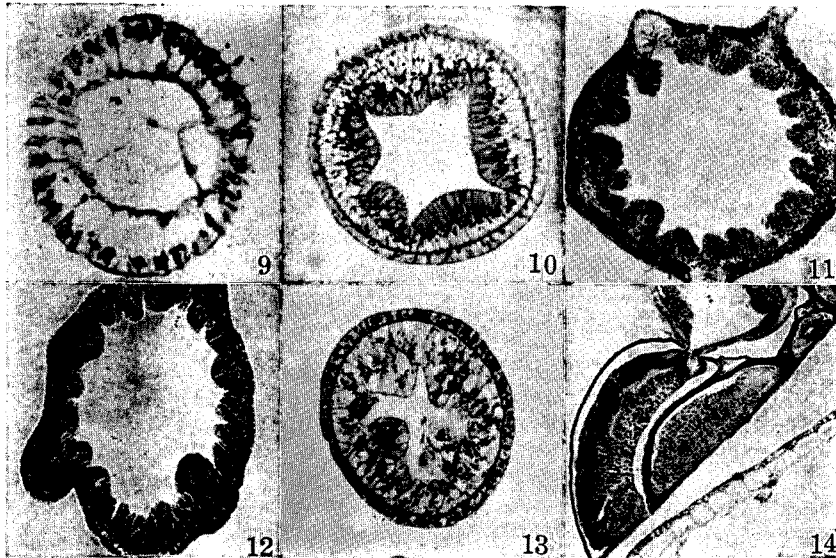


Fig. 9. Cross section through a nematocyst ring in tentacle of polyp. $\times 320$.
 Fig. 10. Cross section of peristome. $\times 150$.
 Fig. 11. Cross section through the tentacle zone of hydranth. $\times 75$.
 Fig. 12. Cross section through hydranth bearing lateral buds. $\times 75$.
 Fig. 13. Cross section of hydrocaulus. $\times 110$.
 Fig. 14. Longitudinal section of hydrorhiza (podocyst) and pedal disc. $\times 75$.

Between the ectoderm and the endoderm there can be seen a thin structureless mesolamella through which are running longitudinal muscle fibres beneath the ectoderm, especially well-developed in the hydrocaulus. The mesolamella of the peristome has well-developed circular muscle fibres along the base of the endoderm.

The tentacles are hollow and their canal is lined with large vacuolated endoderm cells of which the nucleus is generally situated in the axial portion of them (Fig. 9). The ectoderm contains numerous nematocysts. In the nematocyst rings the ectoderm is elevated, forming nematocyst batteries, accompanying a small number of stenoteles in lower part and many desmonemes on the surface. The nematocyst rings are each formed by several nematocyst batteries. The ectoderm free from the batteries is composed of flat cells. Under the ectoderm cells are found well-developed longitudinal muscle fibres running along the mesolamella.

The hydrorhiza is discoidal in shape and its surface is covered with a chitinous periderm. It is composed of three layers; ectoderm, mesolamella and endoderm, with a cavity which is connected with that of the mother polyp (Fig.

14). The ectoderm cells are higher than those of the polyp and their outer surface is obscure in outline. The endoderm cells are almost similar to those in the lower hydranth. The ectoderm and endoderm cells are both filled with their assimilated substance (nutritive substance) and then the boundary of these cells is hardly visible. The assimilated substance is basophilic and granulated in the ectoderm, but in the endoderm the cells contain eosinophilic granules of larger size. The mesolamella is highly thickened and circular in form at the mouth connecting with the cavity as reported by Kramp and Paspaleff (1938).

3. *Asexual development of polyyps*: New polyyps are generally budded off from mother polyyps and hydrorhizas (podocysts).

a. Development from lateral buds

Lateral buds (Planula buds) are formed in the lower part of the hydranth (Fig. 5). They appear at first as a hemispherical protuberance on the hydranth and each gradually elongate to form a bar-shaped bud in one or two days. When the buds become sausage-shaped, they are constricted at the base. Three days afterwards they become to have a slightly narrowed tip and slightly widened base around which the anlagen of tentacles appear as small elevations. About four days after the bud-formation, buds become set free from the mother polyp and attach to the substratum by the distal end. The buds just before the liberation are 0.5–0.8 mm long and 0.15–0.2 mm in diameter. The tentacles which appeared at first as bar-shaped processes become filamentous in a day. They are mostly 5–6 in number and are arranged in a circlet on the same level around the hydranth but afterwards one or two more are added to them in the upper part. After that they increase gradually and finally bear the appearance of irregular arrangement. The lateral buds are often formed in the hydrocaulus but they remain attached to it and form abnormal hydranths *in situ* (Fig. 3).

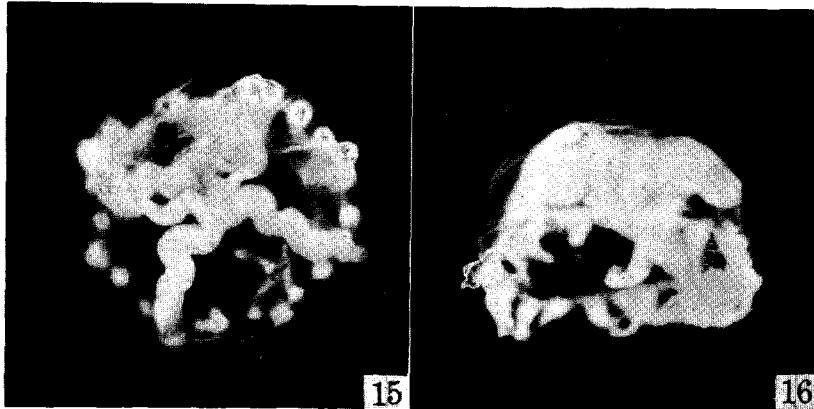
b. Development from podocysts

The hydrorhizas formed from the mother polyp are at first pale yellow likely as the mother polyp, but they become gradually darkened and covered with the periderm. While the polyp lives, these hydrorhizas act as adhesive organs to the substratum, but they survive on the substratum after the polyp died. When environmental condition becomes favourable, they give rise rapidly to new polyyps from the pit connected with the polyp (Figs. 7, 8). Young polyyps have mostly a circlet of 4–6 tentacles at first but the tentacles gradually increase afterwards. In the young tentacles nematocysts are sparsely distributed and do not form rings. The young polyp gradually develops and becomes to have podocysts around its pedal disc. The podocysts do not give rise to new polyp while the mother polyp is active.

Morphology of the Medusa

1. *External structure and development*: Bell dome-like, generally 4–6 mm high and slightly wider than high. Jelly very thick, especially at the apex of the

bell, with $\frac{1}{2}-\frac{1}{3}$ the length of the bell-height. Manubrium, $\frac{1}{3}$ the height of subumbrella, quadriangular, terminating in a four-sided mouth armed with many nematocysts. The proximal part of the manubrium forms an enlarged stomach which is connected with the radial canals. Four radial canals given off from the perradial corners of the stomach run straight and are connected with the



Figs. 15-16. Medusa of *Ostroumovia horii* from Hachirogata. $\times 12.5$.

15. Apical view. 16. Lateral view.

ring canal on the bell margin. The tentacles are 29 in the largest medusa, arising from the perradial, interradial, adradial and eradial parts. Among them, eradial ones are not well-developed and sometimes wanting. The adradial tentacles are mostly found to arise not in the precisely middle point between the perradial and interradial ones, but to shift slightly near the perradial ones. The tentacles are all hollow and their whole shaft is covered with nematocyst rings. When well extended the tentacles reach several times the length of the bell-height. Each tentacle arises from a pale yellow tentacle bulb which is located slightly upward along the bell margin. Therefore the old tentacles are more or less seen to arise from a short distance above the exumbrella. On the abaxial side of the bulb is present a dark red ocellus which is often obscure in eradial tentacles. In rare cases two tentacles arise from a single bulb. Gonads, white in colour, extend from the lateral side of the stomach along the radial canals and in well-developed state cover the whole length of radial canals, with enlarged sac-like terminal parts hanging down in the subumbrella (Fig. 19). In rather young medusae the gonads develop almost equally on the whole length of radial canals, making a few bendings, but in well-developed medusae the sac-like portion above mentioned develops. In sections the sac-like portion is revealed to have the central cavity (Fig. 25). The velum is very thin but well-developed.

The polyp gives rise to medusa-buds which are mostly distributed in the hydranth, especially in the region of tentacles (Fig. 5). The buds appear at first as spherical bodies and enlarge gradually along with formation of tentacles, manubrium, radial canals and ocelli. In a week the medusa-buds liberate from the mother polyp as young medusae (Fig. 17). These young medusae have a spherical bell, 1 mm both in height and diameter, and four perradial tentacles. Jelly $\frac{1}{4}$ – $\frac{1}{5}$ the thickness of the bell height. Manubrium $\frac{1}{5}$ – $\frac{1}{6}$ the length of the subumbrella-height. The tentacle bulbs are not well-developed and cone-shaped, each with an ocellus on its abaxial side. There are present 30–40 nematocyst rings on each tentacle shaft. The manubrium is cylindrical, destitute of differentiated stomach region and attaches to the exumbrella. The radial canals are very obscure at first but become distinct, when the interradial tentacles begin to appear. In this stage the manubrium becomes four-sided, separated from the exumbrella and the stomach gradually differentiates. The young medusa immediately after liberation has nematocysts sprinkled on the exumbrella, but they disappear gradually. In the medusa 4–5 days after liberation the interradial tentacles are fairly elongated and are furnished with 7–15 nematocyst rings. In the medusa 8 days after separation from the polyp, 1.6–2.5 mm high and 1.8–2.7 mm in diameter, adradial tentacles begin to appear and perradial tentacle bulbs become large and elongate above the exumbrella from the ring canal. In this stage the interradial tentacles are not completely developed but are each provided with an abaxial ocellus. The adradial tentacles are not located precisely on the

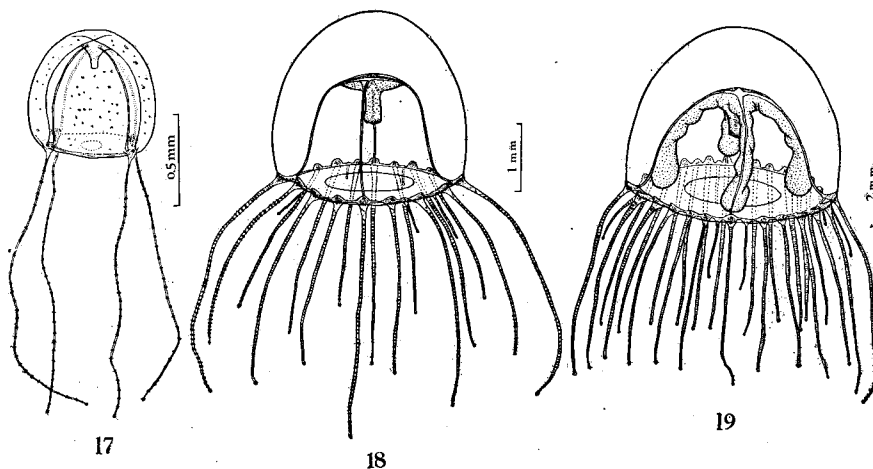


Fig. 17. Young medusa immediately after liberation from polyp.

Fig. 18. Medusa, ten days after liberation.

Fig. 19. Adult medusa with well developed gonads.

adradial but slightly nearer to the perradial. The medusa 2 weeks after liberation is approximately 2.5 mm both in bell height and bell diameter, and has eradial tentacles just beginning to appear, has well-developed interradial tentacle bulbs and adradial ocelli. The former tentacles, perradial, interradial and adradial, are formed simultaneously in each radii but the eradial ones appear not at the same time; in most cases they appear at first between the adradial and interradial tentacles and then irregularly between the adradial and the perradial ones. Therefore, there can be seen several intermediate individuals with tentacles numbering 16-32. The tentacle bulbs are at first cone-like but gradually become cushion-like extending over the exumbrella. The gonads a week after liberation develop from the outer side of stomach wall and gradually increase their thickness and subsequently form a slightly bent cruciform body. After that they extend along the radial canals and finally cover the whole canals. On closer examination on living specimens no statocysts were observed through the whole stage of the medusa.

2. *Internal structure*: The ectoderm covering the bell is very thin, composed of a layer of flat epidermal cells which are attached to the jelly and have obscure boundaries each other. The subumbrella consists of a layer of flat ectoderm cells, a thin mesolamella and a thin endoderm cell layer; these three layers are in close contact and underlying the innerside of bell. The manubrium (Fig. 24) has vacuolated cuboidal ectoderm cells of which the nucleus is found at the distal end of them. Around the mouth part there are distributed nematocysts, especially stenoteles. The mesolamella beneath the ectoderm has numerous well-developed longitudinal muscle fibres. The gastrodermis is made of high columnar supporting cells and glandular cells of two kinds; one sort of glandular cells is of mucous type, containing minute granules well stained by aniline blue in Azan, while the other is of granular type, containing more coarse granules than those of the former, which are well-stained by azocarmine. These two cells are specific in distribution: the former are thickly set on the surface of gastrodermis around the mouth, while the latter are distributed in the stomach region distant from the mouth. With the exception of the oral part, the endoderm cells contain granulated assimilated substance just similar to those in the polyp. The endoderm also contains many nematocysts, especially stenoteles in the inner part of the manubrium. The cross section through the radial canal (Fig. 22) shows that the ectoderm is composed of a layer of rather high cubic subumbrellar cells, a thin mesolamella with longitudinal muscle fibres runs just below the ectoderm and the endoderm is composed of cuboidal cells regularly arranged in a row. The radial section through the ring canal (Fig. 23) indicates that the endoderm consists of a layer of small cuboidal cells, of which those on the exumbrellar side being higher than those facing the thick mesogloea. The ectoderm just corresponding to the exumbrella is specially thickened, containing numerous nematocysts. The tentacle bulbs (Fig. 20) extend from the subumbrella to the exumbrella, with the

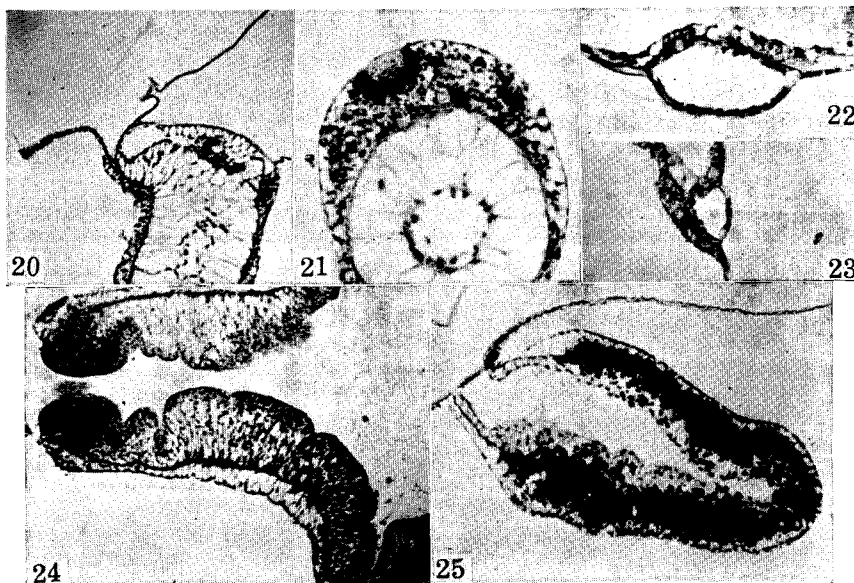


Fig. 20. Longitudinal section of tentacle bulb of medusa. $\times 100$.
 Fig. 21. Horizontal section of tentacle bulb with ocellus. $\times 210$.
 Fig. 22. Cross section of radial canal. $\times 240$.
 Fig. 23. Radial section of ring canal. $\times 220$.
 Fig. 24. Longitudinal section of manubrium. $\times 100$.
 Fig. 25. Cross section of gonad. $\times 100$.

ring canal near the subumbrellar side. In the perradial bulbs the radial canal is connected with the ring canal. The tentacle bulbs are demarcated from the mesogloea of bell margin by a thin mesolamella. The bulbs have each a cavity in them, which is surrounded by cubic cells on the upper wall and by columnar cells on the lateral and lower walls. These cells are all vacuolated and provided with a nucleus at their distal end facing to the cavity. The ectoderm of the bulbs is made of cubic cells irregularly disposed and containing numerous nematocysts. The abaxial surface of the ectoderm is especially thickened, showing an irregular mass of cells. On the surface is found an ocellus imbedded there (Fig. 21). The ocellus is composed of the outer thin membrane, an elliptical lens and a pigment goblet surrounding the lens. The tentacles are similar to those of the polyp in structure. The velum is composed of the thin inner mesolamella and two layers of flat ectoderm cells surrounding it. In the gonads both the ectoderm and endoderm cells are extremely vacuolated and very thickened, containing numerous germ cells of different stages. The radial canal widens and forms the gonadal cavity (Fig. 25).

Nematocysts

The species has both in the medusa and polyp the following three kinds of nematocysts; stenoteles, basitrichous isorhizas and desmonemes. The size of capsules of them is as follows:

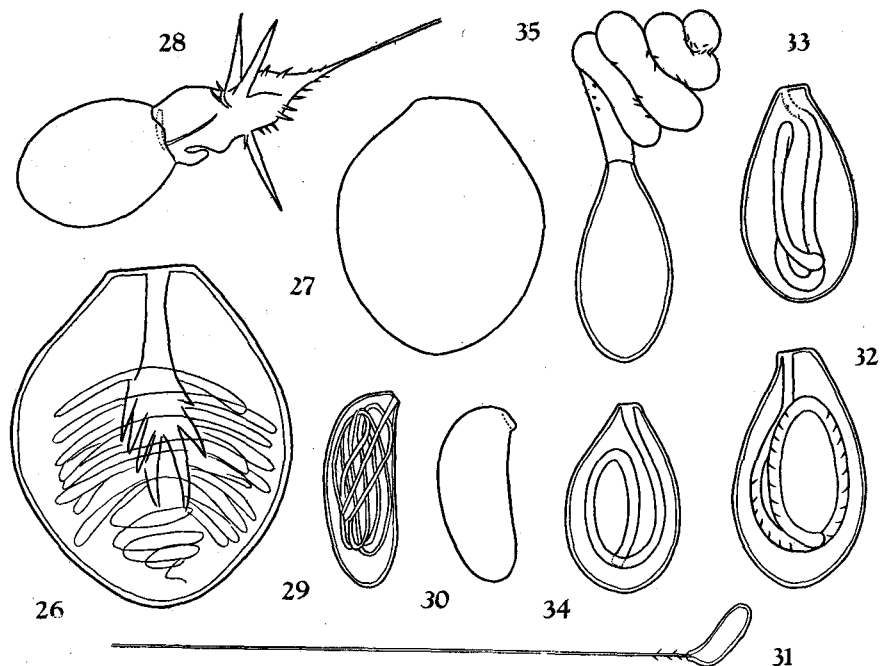
		Polyp		Mean value
Stenoteles	{length	8.2 μ -15.4 μ		10.8 μ
	{width	6.7 μ -12.5 μ		8.8 μ
Desmonemes	{length	5.8 μ - 8.6 μ		7.2 μ
	{width	2.9 μ - 4.8 μ		3.6 μ
Basitrichous isorhizas	{length	5.8 μ - 8.6 μ		6.9 μ
	{width	1.9 μ - 3.8 μ		2.5 μ
		Medusa		Mean value
Stenoteles	{length	6.7 μ -10.6 μ		8.2 μ
	{width	5.3 μ - 8.6 μ		6.7 μ
Desmonemes	{length	5.0 μ - 7.9 μ		6.7 μ
	{width	2.9 μ - 4.8 μ		3.5 μ
Basitrichous isorhizas	{length	4.8 μ - 7.7 μ		6.3 μ
	{width	1.9 μ - 3.8 μ		2.7 μ

The capsule of stenoteles is pyriform and the widest in the middle part (Figs. 26, 27). The operculum is large and tongue-like as shown in Fig. 28 showing the discharged state. The butt is of a blunt cone with a shallow constriction in the middle part. Around the constriction are present three stylets. More than a dozen small spines are arising from the bases of stylets and terminal portion of the butt. The butt gradually terminates to the tube. The stenoteles of young medusae are slightly smaller than those of polyps.

The capsule of basitrichous isorhizas is long rice-shaped (Figs. 29, 30). The tube is coiled longitudinally but irregularly 5-10 times within the capsule in undischarged state (Fig. 29). In discharged state the tube extends 35 μ -45 μ in length, emitting straight with a definite angle to the capsule (Fig. 31). Near the base of the tube are found several small spines. The capsule of polyps (Fig. 29) seems to be slightly more slender than that of medusae (Fig. 30).

The capsule of desmonemes is long-pyriform and the tube makes one and half coils in it (Figs. 32-34). The tube has minute thorns arranged in a row and coils 3-4 times in discharged state (Fig. 35).

Localities of nematocysts: In the hypostome of polyps basitrichous isorhizas are mainly found and stenoteles are also in fair numbers but desmonemes are scarcely found. In general part of hydranth and hydrocaulus the three kinds of nematocysts are universally distributed. In the tentacles desmonemes are extremely numerous and stenoteles are also abundant, but no basitrichous isorhizas are observed. The distribution of the nematocysts will be summarized in the following.



Figs. 26 & 28. Stenoteles of polyp; 26. $\times 3700$; 28. $\times 1850$.
 Fig. 27. Stenoteles of medusa. $\times 3700$.
 Figs. 29 & 31. Basitrichous isorhiza of polyp; 29. $\times 3700$; 31. $\times 1850$.
 Fig. 30. Basitrichous isorhiza of medusa. $\times 3700$.
 Figs. 32, 33 & 35. Desmonemes of polyp. $\times 3700$.
 Fig. 34. Desmonemes of medusa. $\times 3700$.

	Stenoteles	Basitrichous isorhizas	Desmonemes
Hypostome	+	++	-
Hydranth excluding hypostome & hydrocaulus	++	+++	++
Tentacles	++	-	+++

These nematocysts are all found in young medusae. Out of them desmonemes are the most numerous, stenoteles next to them and basitrichous isorhizas are rather few in number. The observations on the nematocysts were done by dint of phase-contrast microscope.

Distribution in Japan

Since the first discovery of the hydroid in the two lakes, Kahokugata and Ōchigata (Uchidas, 1929), Itô found the polyp in two brackish lakes near

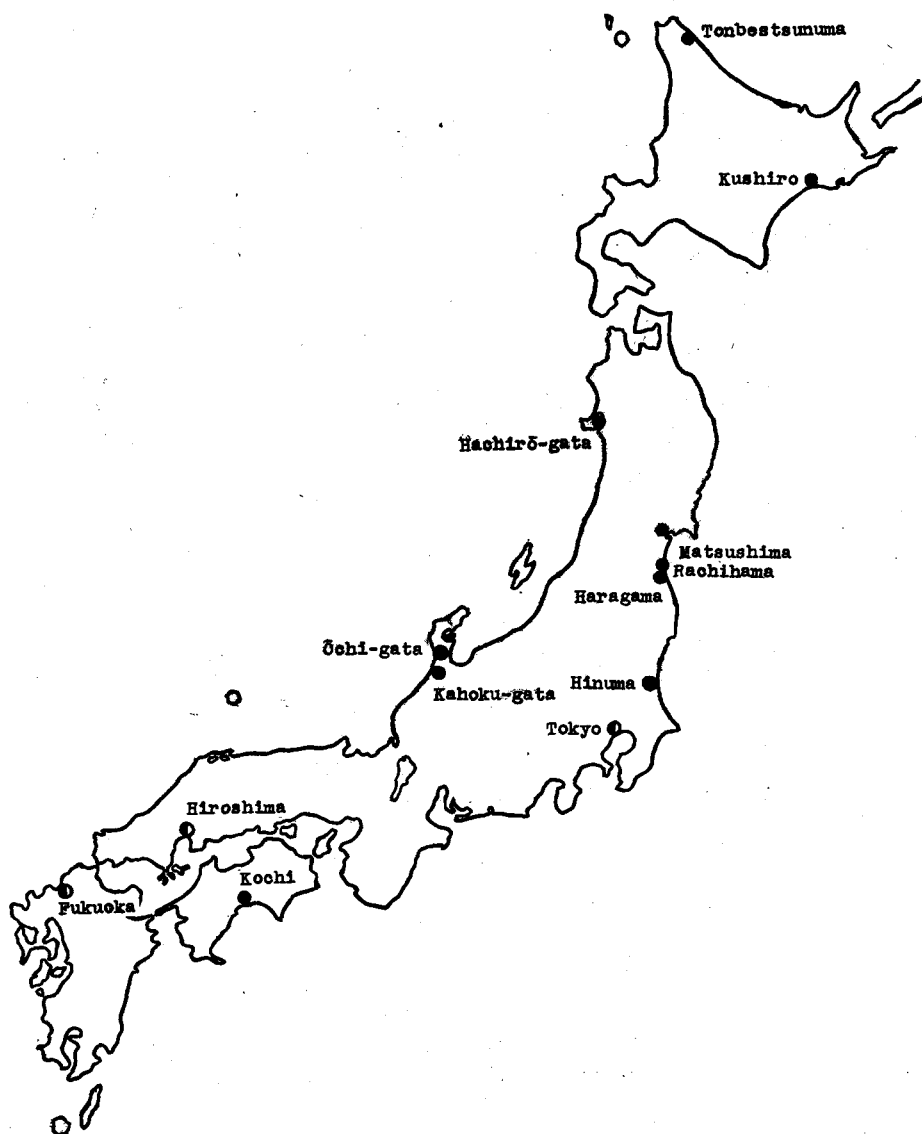


Fig. 36. Distribution of *Ostroumovia horii* in Japan.

- Sedentary locality.
- Temporary occurrence.

Matsushima in 1942, in the next year from Tombetsunuma in Hokkaido, Rachihama, and Haragama in the northern part of Honshu, also in Kochi City (in Shikoku) and Fukuoka City (in Kyūshū), and in 1951 in Hiroshima City on the coast of the Inland Sea (Itô, 1953). In these localities the hydroid was found always in brackish-water and the polyp alone has been reported. In 1951 Uchida reported a medusa collected in a concrete tank containing brackish-water in Tokyo. The medusa agrees with the medusae set free from the polyps of *Laccocoryne horii*. According to H. Kikuchi of Ibaragi University, a similar medusa was collected in the brackish lake, Hinuma near Mito City. In 1958 Miyawaki collected several medusae in Harutori lake in Hokkaido and then we collected in the same lake many polyps which were reared in our laboratory to get medusae. In 1959 we collected many polyps and medusae at the same time in Hachirogata. As stated above the hydroid is widely distributed in brackish lakes almost on all coasts of Japan. It was also found in a temporary brackish-water as in the concrete tank washed by flood. The species seems to be very euryhaline, and is not only found in brackish-waters of different salinities but also can be reared in fresh-water. Except some northern lakes which are frozen in winter, the hydroid can be found almost all year round (Itô, 1953), though decreased in number during January-March. The polyp is found attached to water-plants, decayed leaves or twigs submerged in water. The medusae seem to appear once in a year, from the end of August to the middle of September. It was reported that in the summer of 1958 the fishery of Hachirogata was seriously injured on account of abundant occurrence of the medusae.

Systematic part

The suborder Limnomedusae proposed by Kramp (1938) for the two families, Moerisiidae and Olindiidae are now generally in vogue. The writers agree for the adoption of the system. In the suborder, the Moerisiidae includes brackish hydroids of which the medusae have no statocysts and gonads develop from the manubrium along the radial canals. The genus *Ostroumovia* was referred to the Olindiidae by Kramp, because he observed statocysts in the medusa. Picard (1951) adopted Kramp's system, but he divided the Moerisiidae into two groups; one without statocysts and the other with statocysts. In his revision *Ostroumovia* is entitled to the second group of the Moerisiidae, because the polyp of the genus is closely related to those of the Moerisiidae and is different from those of the Olindiidae. According to Valkanov (1955) the medusa of *Ostroumovia inkermanica* lacks statocysts at all. He made close observations not only on his own preparates but also on that figured by Kramp being sent by the latter investigator and concluded that „Das, was Kramp als Statocyste angesehen hat, stellt nichts anderes als aufgelockertes Ektoderm dar, das in diesem Bezirk zufälligerweise eine im Querschnitt getroffene blasenförmige Auftreibung dieser Zellschichte vortäuscht. Der Statolith dieser „Statocyste“ ist lediglich als eine grosse Knide (Penetrante)

anzusprechen, die mit ihrer Längsachse vertikal zu der Schnittfläche gestellt und getroffen ist". Kramp personally wrote to Uchida that "I think I have seen statocysts in *Ostroumovia* (though in sections only)." From these facts it is clear that the statocysts could hardly be observed in preserved specimens (also in living specimens?). And it is possible whether the statocyst observed by Kramp (1938) was not really the statocyst or it was the statocyst of abnormal case. So far as our observations go, the adradial tentacles in young medusae of the Japanese species do not appear precisely in the middle part between the perradial and interradial ones but appear nearer to the perradial ones. Such a mode of arrangement of tentacles is generally seen in the Olindiidae with statocysts. On account of the presence of statocysts the arrangement of tentacles is in such a way altered. We are of opinion that the medusa of *Ostroumovia* has normally no statocysts. But it is probable that vestigial statocysts may abnormally occur in the medusa with tentacles of such an arrangement.

The polyp of *Laccocoryne horii* is closely related to that of *Ostroumovia* as described by Muto (1948) and Picard (1952). So far as the present writers' observations go, the medusa of Japanese hydroid lacks statocysts at all throughout all stages of living medusae and also in all sections made from them. The medusa is almost similar to that of *Ostroumovia inkermanica*. Therefore, the genus *Laccocoryne* must be united to *Ostroumovia*.

The Japanese hydroid, though closely related, is still to be specifically separated from *Ostroumovia inkermanica* as will be described in the following:

	<i>O. inkermanica</i>	<i>O. horii</i>
Size of adult polyps	24 mm (44 mm in maximum)	5-8 mm
Colour	rose in young polyps brickred in old polyps	yellowish white in young polyps, slightly brown in old polyps
Tentacle number	8-12	often over 12
Podocysts	5 in maximum	10 in maximum
Periderm	distinct	not so distinct

Besides the characters above mentioned the nematocysts are more or less different in form as stated by Valkanov (1938) and the nematocysts clusters on the exumbrella of young medusae seem to be more distinct in *O. inkermanica*. Moreover, the distribution is so different in the two hydroids.

Summary

I. The morphology and life-history of the Japanese hydroid formerly described as *Laccocoryne horii* were studied.

2. The hydroid is widely distributed in brackish lakes on the coast of Japan and gives rise to the medusa in August-September.
3. The hydroid has been here named as *Ostroumovia horii* (T. Uchida & S. Uchida).

Literature

- Boulenger, C.L. 1908. On *Moerisia lyonsi*, a new hydromedusa from Lake Qurun. Quart. J. micr. Sci., 52: 357-377.
- Hadži, J. 1928. Knidarijer des brackischen und des süßen Wassers. Bull. Trav. Class. Sci. Math. Natur. Acad. Sci. et Art. d. Slaves d. Sud. d. Zagreb, 22: 34-44.
- Itô, T. 1953. Hydrozoa in Japanese inland waters, their collection and cultivation. (5) Collecting and Breeding, 15: 262-266. (In Japanese).
- Kramp, P.L. 1938. Die Meduse von *Ostroumovia inkermanica* (Pal-Ostr.) und die systematische Stellung der Olindiiden. Zool. Anz., 122: 103-108.
- Kramp, P.L. & G.W. Paspaleff 1938. Über die Polypen- und Medusenform von *Ostroumovia inkermanika* (Pal.-Ostr.). Arbeiten aus der Biologischen Meeresstation am Schwarzen Meer in Varna, Bulgarien, 7: 27-68.
- Kramp, P.L. 1955. Hydromedusae in the Indian Museum. Rec. Indian Museum, 53: 339-376.
- Muto, Y. 1948. Über *Laccocoryne horii*, eine Brackwasser-hydrozoa. Seibutu, 3: 221-223. (In Japanese with German résumé).
- Paltschikowa-Ostroumova, M.W. 1925. *Moerisia inkermanica* n. sp. Zool. Anz., 62: 273-284.
- Picard, J. 1951. Contribution a l'étude des méduses de la Famille des Moerisiidae. Bull. de L'Institut Océanographique, No. 994: 1-16.
- 1952. Nouvelle Contribution a l'étude des Moerisiidae (Hydrozoa). Recueil des Travaux de la Station Marine d'Endoume, Fas. 4, Bull. no 1: 53-55.
- Uchida, T. & S. Uchida 1929. Occurrence of a new lacustrine hydroid in Japan. Proc. imper. Acad., 5: 157-158.
- Uchida, T. 1934. Medusae in inland waters. Botany and Zoology, 2: 1149-1169. (In Japanese).
- 1951. A brackish-water medusa from Japan. J. Fac. Sci. Hokkaido Univ. Ser. VI (Zool.), 10: 161-162.
- Valkanov, A. 1936. Notizen über die Brackwässer Bulgariens. 2. Versuch einer hydrographischen und biologischen Erforschung derselben. Jahrb. Univ. Sofia, physiko-math. Fakul., 32, 1935/1936: 209-341.
- 1938. Übersichte der Hydrozoenfamilie Moerisiidae. Jb. d. Univ. Sofia, physiko-math. Fakul., 34: 251-320. Pl. 1.
- 1955. Revision der Hydrozoenfamilie Moerisiidae. Arbeiten aus der Biologischen Meeresstation in der St. Stalin, 18: 33-47.

The Life-history of a Japanese Brackish-water Hydroid, *Ostroumovia horii*¹⁾

By

Tohru Uchida and Zen Nagao

(Zoological Institute,
Hokkaido University)

(Akkeshi Marine Biological
Station, Akkeshi, Hokkaido)

(With 36 Text-figures)

In 1929 a lacustrine hydroid, *Laccocoryne horii* was reported by T. Uchida and S. Uchida as a new form from the two brackish lakes, Kahokugata and Ochigata. At that time the hydroid was described as a member of the Corynidae but afterward entitled to the Moerisiidae by Uchida (1934). On the other hand, Hadži (1928) published a review on polyps of fresh-water and of brackish-water and instituted a new genus *Ostroumovia* for *Moerisia inkermanica* in the Black Sea. Valkanov who reported on *Ostroumovia inkermanica* in 1935 and 1936 published a review (1938) on the Moerisiidae and enumerated the following seven species; *Moerisia lyonsi*, *M. gallica*, *Caspionema pallasi*, *Ostroumovia inkermanica*, *O. maeotica*, *Laccocoryne horii* and *Halmomises lacustris* as valid. In this paper he made a detailed comparative study on *Ostroumovia inkermanica* and *Laccocoryne horii*, using specimens of the latter species sent to him by Uchida. Valkanov pointed out the similarity of polyps of the two species but kept them separate. In the same year Kramp and Paspaleff (1938) published a joint work on *Ostroumovia inkermanica*. In the work, Kramp studied the medusan stage and Paspaleff treated the polyp stage. At that time Kramp proposed the new suborder Limnomedusae in which are included most of fresh-water, brackish-water and some littoral medusae with the alternation of generation. The suborder includes two families; Moerisiidae and Olindiidae, the two families being mainly distinguishable by the lack or presence of marginal statocysts. The suborder has been generally adopted. From the morphology of *Ostroumovia* Kramp referred the genus to the Olindiidae, because the medusa has marginal statocysts and marginal tentacles arising from the exumbrella.

In 1948 Muto studied the polyp of *Laccocoryne horii* and came to the conclusion that the Japanese hydroid is to be eligible for the genus *Ostroumovia* because of the similarity of polyp stage. In 1951 Uchida made a report on medusae found in a concrete tank near Tokyo under the name of *Moerisia* sp. He surmised that the medusa had possibly set free from the polyp *Laccocoryne horii*. As the medusae have no statocysts and their tentacles are arising from

1) Contributions from the Akkeshi Marine Biological Station, No. 104.
Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool. 14, 1959.

the bell margin, he suggested that *Ostroumovia* and *Laccocoryne* must be separated in the morphology of medusa. In 1951 Picard published the revision of the Moerisiidae and admitted three genera; *Halmomises*, *Odessia* and *Ostroumovia*. Among them the first two lack statocysts but the third one has marginal statocysts. In the next year he discussed on the systematic position of *Laccocoryne* and concluded that the hydroid possibly belongs to *Ostroumovia*.

As stated above, the polyp of *Laccocoryne* is closely allied to that of *Ostroumovia*, but the medusa is quite different from the latter in the lack of statocysts described by Kramp (1938). Recently Valkanov (1955) published the revision of *Ostroumovia inkermanica*, in which he denied the presence of statocysts in the medusa, even in the specimens examined by Kramp. He could not perceive the statocysts at all and pointed out that the statocyst found by Kramp is nothing but a nematocyst surrounded by the ectoderm cells. There remains still a query for the present. Therefore, it is the urgent necessary to work out in detail the *Ostroumovia inkermanica* and *Laccocoryne horii*.

At the beginning of September, 1958 Dr. M. Miyawaki in Kushiro wrote to the senior author at Naples that he found many hydromedusae in the Lake Harutori, a brackish lake near Kushiro. On the request of Uchida the junior author Nagao at once set in the study on the life-history of the hydroid and reared with success the polyps in the laboratory to give rise to young medusae. On returning home in November Uchida jointed with the work and completed this paper.

In the course of this study we are indebted to the kindness of Dr. M. Miyawaki of Kumamoto University, Mr. T. Shimomura of Niigata Fishery Station and also the gentlemen of Akita Fishery Office and Station in helping in various ways.

Habitat

The present study has been carried out mainly on the material from the lake Harutori and partly on that from the lake Hachirogata. The lake Harutori is situated in Kushiro city on the south-eastern coast of Hokkaido. The lake has rich plankton and there can be found several fishes such as *Carassius auratus*, *Gasterosteus aculeatus* etc. On the shore of the lake are growing the plants, *Scirpus Tabernaemontani*, *Phragmites communis*, *Beckmannia Syzganche* etc. The lake was brackish with the salinity of 0.56 % and pH of 7.8–8.0 in September of 1958. The bottom is muddy and rich in methane gas and the water is highly spoiled. At the end of August, 1958, the water-temperature of the lake was approximately 19°C and the medusae of *Laccocoryne horii* were abundantly found. The polyps were found attached to the water-plant *Potamogeton pusillus* which was luxuriantly growing on the coasts of the lake. In the middle of September no medusa was found there but the polyps still bore both lateral buds and medusa buds. At that time water temperature was 17°–18°C in daytime.

The lake Hachirogata is located on the coast of the Japan Sea in the northern part

of Honshu. There was a report informing that in the lake numerous hydromedusae suddenly appeared in the summer of 1958 and owing to abundance of medusae the fishery was greatly interrupted. In September, 1959 the junior author studied the hydroid there. He collected many medusae and polyps of the same species as in the Harutori. The water showed pH of 5.8 and salinity of 0.17–0.21‰. The temperature was 25°C at that time. The polyps were found attached to *Potamogeton*.

Morphology of the polyp

1. *External structure*: The polyp is generally solitary but rarely a few polyps are found to form a small colony (Figs. 1, 2 and 5). In aggregated parts of many polyps, the hydrocaulus of old polyps becomes elongate extremely and entangles with hydrocauli of other individuals, showing a colonial appearance. The polyp is generally 5–8 mm in the whole length; 2–3 mm in young and 10–12 mm in well-developed specimens. It is divided into three parts; a conical hydranth, a long cylindrical hydrocaulus and a discoid hydrorhiza. The polyp attaches to a leaf or stem of *Potamogeton* by its discoid hydrorhiza which is very sticky and generally imbued with debris and mud. When many polyps are aggregated, a species of *Chironomus* larva was found to dwell in debris and mud. The hydranth and hydrocaulus are naked and extend above the debris and mud. The hydranth is 1–2 mm long and mostly furnished with pale yellow stripes on the surface. The peristome is cylindrical and at the whitish pale yellow tip has a mouth surrounded by a circular lip rich in nematocysts. The part lower than the

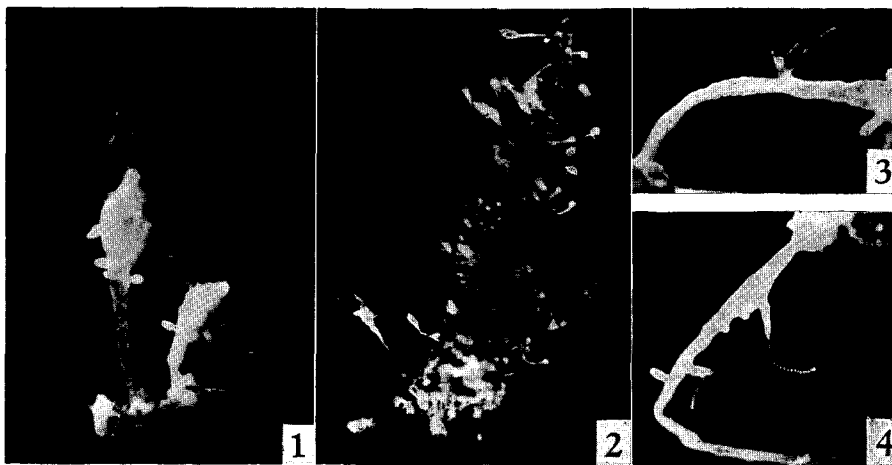


Fig. 1. Polyps bearing several lateral buds. $\times 6$.

Fig. 2. Aggregated polyps on a leaf of *Potamogeton*. $\times 2$.

Fig. 3. An abnormal hydranth on a hydrocaulus. $\times 7$.

Fig. 4. A few abnormal hydranths and an abnormal tentacle arising from a hydrocaulus. $\times 7$.

peristome is the broadest and 0.5mm in diameter in well-developed polyps. About the broadest part are distributed 10-15 tentacles in irregular order. The tentacles are filamentous, hollow, colour-less and with a slight enlargement at the tip. When well extended, they reach over twice the length of the polyp. In well-developed tentacles there can be seen 50-70 nematocyst rings in the shaft and a small spherical nematocyst knob at the tip. The nematocyst batteries of the tentacles form circular rings in the whole shaft except the proximal part, in which they are

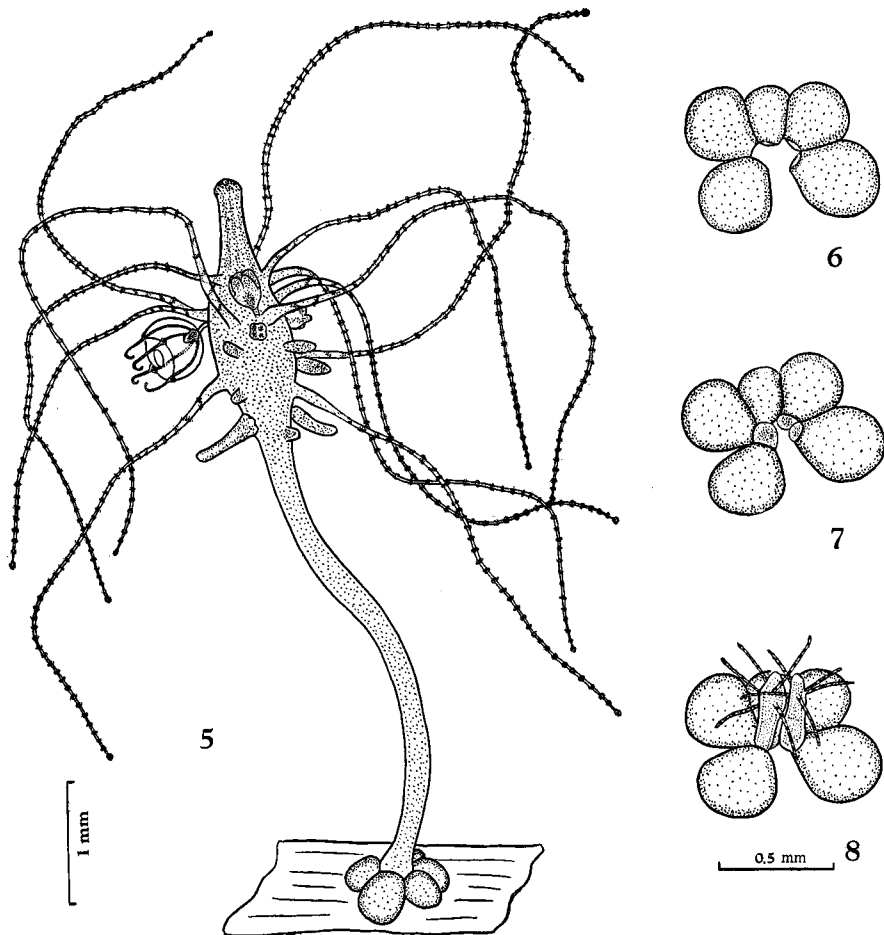


Fig 5. A well-developed polyp carrying several lateral buds and medusa buds.
Figs 6-8. Hydrorhizae (Podocysts).

6. Resting stage. 7. Beginning of budding.

8. Podocysts with two newly developed young polyps.

spirally arranged. In well-developed polyps several medusa-buds of various developmental stages are found among tentacle cluster (Fig. 5). The medusa-buds are variable in number, 10–15 in some individuals but 1–2 in others. The part lower than the tentacle region becomes narrow gradually and merges into the hydrocaulus. Some lateral buds are often found in this part. The lateral buds are various in their developmental stage and sometimes over ten in number (Figs. 1, 5). The hydrocaulus is represented by a simple slender tube and 0.2–0.3 mm in diameter, gradually widening toward the basal disc which is connected with a few hydrorhizas. The hydrorhiza is elliptical and convex in form, thick in the centre and thin on the periphery, with a flat base by which it attaches to the substratum. These hydrorhizas are connected with the hydrocaulus by a small pit of 0.05–0.1 mm and 0.25–0.5 mm in long diameter and 0.2–0.4 mm in short diameter. They are covered with chitinized periderm which extends to short distance above the hydrocaulus. The old ones are dull yellowish orange in the central part, transparent and dark yellowish brown in the peripheral portion. The hydrorhizas are formed by stolonization from the pedal disc and are arranged around the latter, generally 4–5 and sometimes 10 in number (Figs. 6, 14).

There were found some abnormal polyps: such as those with two hydranths or with aberrant tentacles arising from the hydrocaulus as Valkanov (1938) already reported (Fig. 4). In some polyps lateral buds appeared in the hydrocaulus and metamorphosed to hydranths *in situ* (Fig. 3).

2. *Internal structure*: The ectoderm is mainly composed of vacuolated cubical supporting cells, including nematocysts and interstitial cells. Nematocysts are thickly set in tentacles and are abundantly distributed near the mouth. Interstitial cells are intervening among supporting cells especially in tentacle bases, medusa buds and also in terminal portion of the hydrocaulus. But they are all but distributed in the peristome and most part of the hydrocaulus. The supporting cells of pedal disc are small and flat in shape.

The endoderm is different in portions of the polyp. In the peristome the endoderm is composed of two layers; the supporting cells of the inner layer are columnar and hyaline, containing no assimilated substance, while mucous gland cells of the outer layer are thickly disposed, forming a folded surface of the mouth cavity (Fig. 10). In the upper part of the hydranth with tentacles the endoderm includes narrow columnar supporting cells, among which conical gland cells are distributed. The gland cells produce rich basophilic secretion (Fig. 11). They decrease gradually toward the lower part of the hydranth with lateral buds and are only sparsely distributed in the upper part of the hydrocaulus. The supporting cells contain eosinophile granulated assimilated substance in the hydranth, especially in the lower half (Fig. 12). Those of the hydrocaulus are large in size and vacuolated, equipped with a nucleus generally near the cavity. These cells have scarcely assimilated substance, except the parts near the hydranth and also near the pedal disc (Fig. 13). In the pedal disc the supporting cells are represented by small flat cuboidal cells (Fig. 14).

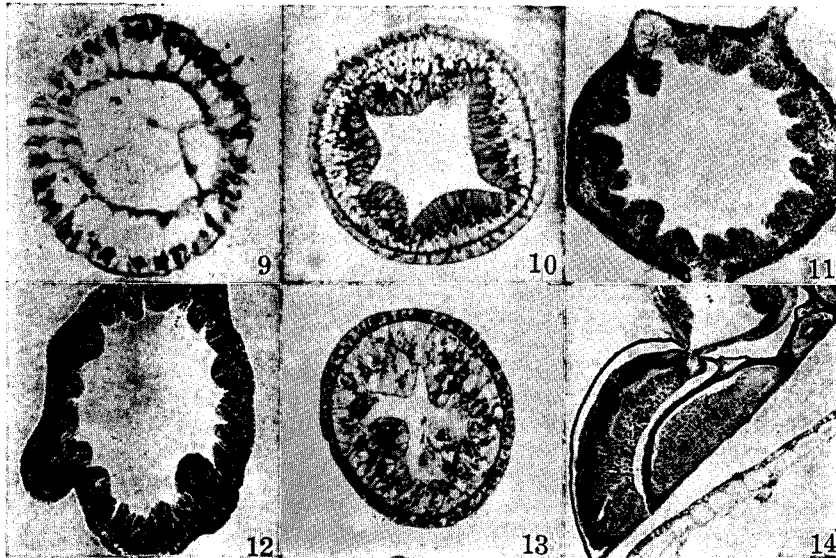


Fig. 9. Cross section through a nematocyst ring in tentacle of polyp. $\times 320$.
 Fig. 10. Cross section of peristome. $\times 150$.
 Fig. 11. Cross section through the tentacle zone of hydranth. $\times 75$.
 Fig. 12. Cross section through hydranth bearing lateral buds. $\times 75$.
 Fig. 13. Cross section of hydrocaulus. $\times 110$.
 Fig. 14. Longitudinal section of hydrorhiza (podocyst) and pedal disc. $\times 75$.

Between the ectoderm and the endoderm there can be seen a thin structureless mesolamella through which are running longitudinal muscle fibres beneath the ectoderm, especially well-developed in the hydrocaulus. The mesolamella of the peristome has well-developed circular muscle fibres along the base of the endoderm.

The tentacles are hollow and their canal is lined with large vacuolated endoderm cells of which the nucleus is generally situated in the axial portion of them (Fig. 9). The ectoderm contains numerous nematocysts. In the nematocyst rings the ectoderm is elevated, forming nematocyst batteries, accompanying a small number of stenoteles in lower part and many desmonemes on the surface. The nematocyst rings are each formed by several nematocyst batteries. The ectoderm free from the batteries is composed of flat cells. Under the ectoderm cells are found well-developed longitudinal muscle fibres running along the mesolamella.

The hydrorhiza is discoidal in shape and its surface is covered with a chitinous periderm. It is composed of three layers; ectoderm, mesolamella and endoderm, with a cavity which is connected with that of the mother polyp (Fig.

14). The ectoderm cells are higher than those of the polyp and their outer surface is obscure in outline. The endoderm cells are almost similar to those in the lower hydranth. The ectoderm and endoderm cells are both filled with their assimilated substance (nutritive substance) and then the boundary of these cells is hardly visible. The assimilated substance is basophilic and granulated in the ectoderm, but in the endoderm the cells contain eosinophilic granules of larger size. The mesolamella is highly thickened and circular in form at the mouth connecting with the cavity as reported by Kramp and Paspaleff (1938).

3. *Asexual development of polyyps*: New polyyps are generally budded off from mother polyyps and hydrorhizas (podocysts).

a. Development from lateral buds

Lateral buds (Planula buds) are formed in the lower part of the hydranth (Fig. 5). They appear at first as a hemispherical protuberance on the hydranth and each gradually elongate to form a bar-shaped bud in one or two days. When the buds become sausage-shaped, they are constricted at the base. Three days afterwards they become to have a slightly narrowed tip and slightly widened base around which the anlagen of tentacles appear as small elevations. About four days after the bud-formation, buds become set free from the mother polyp and attach to the substratum by the distal end. The buds just before the liberation are 0.5–0.8 mm long and 0.15–0.2 mm in diameter. The tentacles which appeared at first as bar-shaped processes become filamentous in a day. They are mostly 5–6 in number and are arranged in a circlet on the same level around the hydranth but afterwards one or two more are added to them in the upper part. After that they increase gradually and finally bear the appearance of irregular arrangement. The lateral buds are often formed in the hydrocaulus but they remain attached to it and form abnormal hydranths *in situ* (Fig. 3).

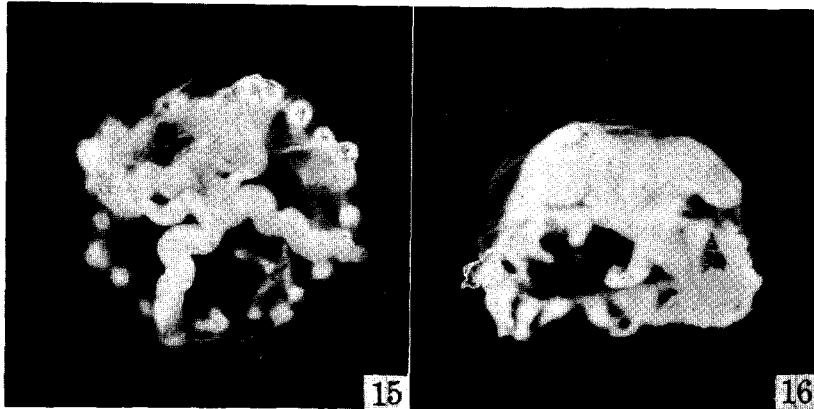
b. Development from podocysts

The hydrorhizas formed from the mother polyp are at first pale yellow likely as the mother polyp, but they become gradually darkened and covered with the periderm. While the polyp lives, these hydrorhizas act as adhesive organs to the substratum, but they survive on the substratum after the polyp died. When environmental condition becomes favourable, they give rise rapidly to new polyyps from the pit connected with the polyp (Figs. 7, 8). Young polyyps have mostly a circlet of 4–6 tentacles at first but the tentacles gradually increase afterwards. In the young tentacles nematocysts are sparsely distributed and do not form rings. The young polyp gradually develops and becomes to have podocysts around its pedal disc. The podocysts do not give rise to new polyp while the mother polyp is active.

Morphology of the Medusa

1. *External structure and development*: Bell dome-like, generally 4–6 mm high and slightly wider than high. Jelly very thick, especially at the apex of the

bell, with $\frac{1}{2}-\frac{1}{3}$ the length of the bell-height. Manubrium, $\frac{1}{3}$ the height of subumbrella, quadriangular, terminating in a four-sided mouth armed with many nematocysts. The proximal part of the manubrium forms an enlarged stomach which is connected with the radial canals. Four radial canals given off from the perradial corners of the stomach run straight and are connected with the



Figs. 15-16. Medusa of *Ostroumovia horii* from Hachirogata. $\times 12.5$.

15. Apical view. 16. Lateral view.

ring canal on the bell margin. The tentacles are 29 in the largest medusa, arising from the perradial, interradial, adradial and eradial parts. Among them, eradial ones are not well-developed and sometimes wanting. The adradial tentacles are mostly found to arise not in the precisely middle point between the perradial and interradial ones, but to shift slightly near the perradial ones. The tentacles are all hollow and their whole shaft is covered with nematocyst rings. When well extended the tentacles reach several times the length of the bell-height. Each tentacle arises from a pale yellow tentacle bulb which is located slightly upward along the bell margin. Therefore the old tentacles are more or less seen to arise from a short distance above the exumbrella. On the abaxial side of the bulb is present a dark red ocellus which is often obscure in eradial tentacles. In rare cases two tentacles arise from a single bulb. Gonads, white in colour, extend from the lateral side of the stomach along the radial canals and in well-developed state cover the whole length of radial canals, with enlarged sac-like terminal parts hanging down in the subumbrella (Fig. 19). In rather young medusae the gonads develop almost equally on the whole length of radial canals, making a few bendings, but in well-developed medusae the sac-like portion above mentioned develops. In sections the sac-like portion is revealed to have the central cavity (Fig. 25). The velum is very thin but well-developed.

The polyp gives rise to medusa-buds which are mostly distributed in the hydranth, especially in the region of tentacles (Fig. 5). The buds appear at first as spherical bodies and enlarge gradually along with formation of tentacles, manubrium, radial canals and ocelli. In a week the medusa-buds liberate from the mother polyp as young medusae (Fig. 17). These young medusae have a spherical bell, 1 mm both in height and diameter, and four perradial tentacles. Jelly $\frac{1}{4}$ – $\frac{1}{5}$ the thickness of the bell height. Manubrium $\frac{1}{5}$ – $\frac{1}{6}$ the length of the subumbrella-height. The tentacle bulbs are not well-developed and cone-shaped, each with an ocellus on its abaxial side. There are present 30–40 nematocyst rings on each tentacle shaft. The manubrium is cylindrical, destitute of differentiated stomach region and attaches to the exumbrella. The radial canals are very obscure at first but become distinct, when the interradial tentacles begin to appear. In this stage the manubrium becomes four-sided, separated from the exumbrella and the stomach gradually differentiates. The young medusa immediately after liberation has nematocysts sprinkled on the exumbrella, but they disappear gradually. In the medusa 4–5 days after liberation the interradial tentacles are fairly elongated and are furnished with 7–15 nematocyst rings. In the medusa 8 days after separation from the polyp, 1.6–2.5 mm high and 1.8–2.7 mm in diameter, adradial tentacles begin to appear and perradial tentacle bulbs become large and elongate above the exumbrella from the ring canal. In this stage the interradial tentacles are not completely developed but are each provided with an abaxial ocellus. The adradial tentacles are not located precisely on the

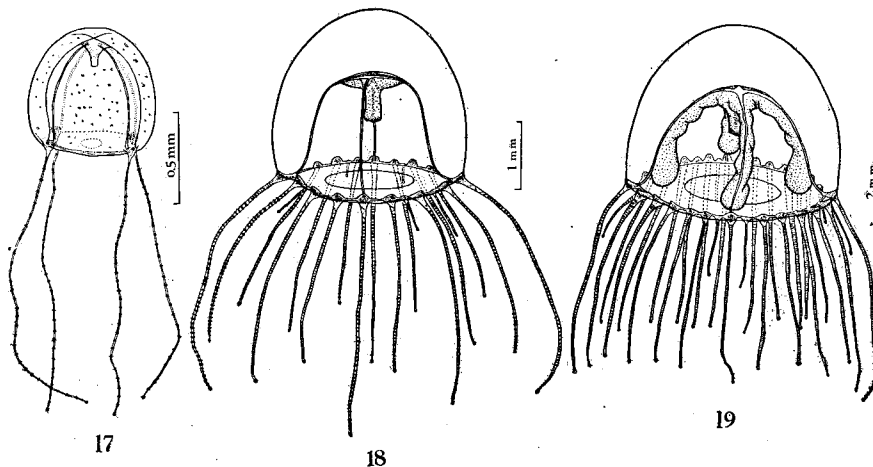


Fig. 17. Young medusa immediately after liberation from polyp.

Fig. 18. Medusa, ten days after liberation.

Fig. 19. Adult medusa with well developed gonads.

adradial but slightly nearer to the perradial. The medusa 2 weeks after liberation is approximately 2.5 mm both in bell height and bell diameter, and has eradial tentacles just beginning to appear, has well-developed interradial tentacle bulbs and adradial ocelli. The former tentacles, perradial, interradial and adradial, are formed simultaneously in each radii but the eradial ones appear not at the same time; in most cases they appear at first between the adradial and interradial tentacles and then irregularly between the adradial and the perradial ones. Therefore, there can be seen several intermediate individuals with tentacles numbering 16-32. The tentacle bulbs are at first cone-like but gradually become cushion-like extending over the exumbrella. The gonads a week after liberation develop from the outer side of stomach wall and gradually increase their thickness and subsequently form a slightly bent cruciform body. After that they extend along the radial canals and finally cover the whole canals. On closer examination on living specimens no statocysts were observed through the whole stage of the medusa.

2. *Internal structure*: The ectoderm covering the bell is very thin, composed of a layer of flat epidermal cells which are attached to the jelly and have obscure boundaries each other. The subumbrella consists of a layer of flat ectoderm cells, a thin mesolamella and a thin endoderm cell layer; these three layers are in close contact and underlying the innerside of bell. The manubrium (Fig. 24) has vacuolated cuboidal ectoderm cells of which the nucleus is found at the distal end of them. Around the mouth part there are distributed nematocysts, especially stenoteles. The mesolamella beneath the ectoderm has numerous well-developed longitudinal muscle fibres. The gastrodermis is made of high columnar supporting cells and glandular cells of two kinds; one sort of glandular cells is of mucous type, containing minute granules well stained by aniline blue in Azan, while the other is of granular type, containing more coarse granules than those of the former, which are well-stained by azocarmine. These two cells are specific in distribution: the former are thickly set on the surface of gastrodermis around the mouth, while the latter are distributed in the stomach region distant from the mouth. With the exception of the oral part, the endoderm cells contain granulated assimilated substance just similar to those in the polyp. The endoderm also contains many nematocysts, especially stenoteles in the inner part of the manubrium. The cross section through the radial canal (Fig. 22) shows that the ectoderm is composed of a layer of rather high cubic subumbrellar cells, a thin mesolamella with longitudinal muscle fibres runs just below the ectoderm and the endoderm is composed of cuboidal cells regularly arranged in a row. The radial section through the ring canal (Fig. 23) indicates that the endoderm consists of a layer of small cuboidal cells, of which those on the exumbrellar side being higher than those facing the thick mesogloea. The ectoderm just corresponding to the exumbrella is specially thickened, containing numerous nematocysts. The tentacle bulbs (Fig. 20) extend from the subumbrella to the exumbrella, with the

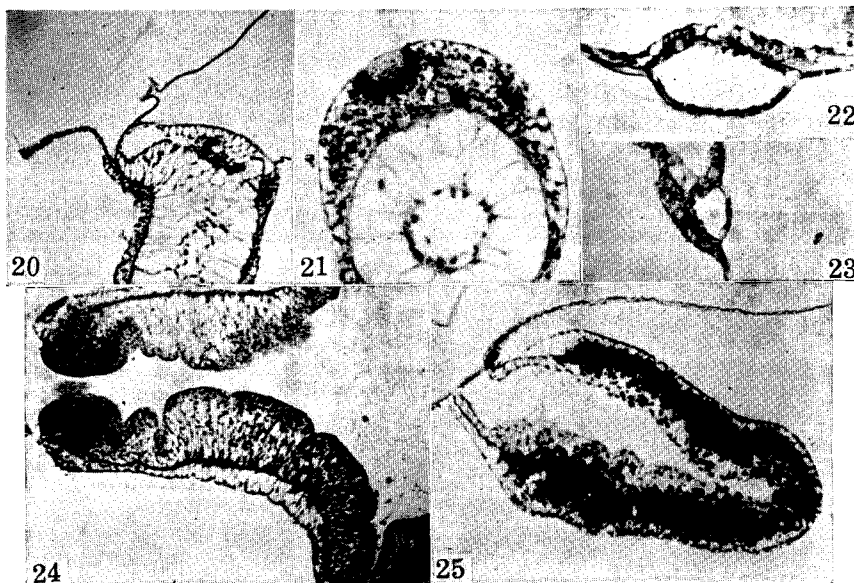


Fig. 20. Longitudinal section of tentacle bulb of medusa. $\times 100$.
 Fig. 21. Horizontal section of tentacle bulb with ocellus. $\times 210$.
 Fig. 22. Cross section of radial canal. $\times 240$.
 Fig. 23. Radial section of ring canal. $\times 220$.
 Fig. 24. Longitudinal section of manubrium. $\times 100$.
 Fig. 25. Cross section of gonad. $\times 100$.

ring canal near the subumbrellar side. In the perradial bulbs the radial canal is connected with the ring canal. The tentacle bulbs are demarcated from the mesogloea of bell margin by a thin mesolamella. The bulbs have each a cavity in them, which is surrounded by cubic cells on the upper wall and by columnar cells on the lateral and lower walls. These cells are all vacuolated and provided with a nucleus at their distal end facing to the cavity. The ectoderm of the bulbs is made of cubic cells irregularly disposed and containing numerous nematocysts. The abaxial surface of the ectoderm is especially thickened, showing an irregular mass of cells. On the surface is found an ocellus imbedded there (Fig. 21). The ocellus is composed of the outer thin membrane, an elliptical lens and a pigment goblet surrounding the lens. The tentacles are similar to those of the polyp in structure. The velum is composed of the thin inner mesolamella and two layers of flat ectoderm cells surrounding it. In the gonads both the ectoderm and endoderm cells are extremely vacuolated and very thickened, containing numerous germ cells of different stages. The radial canal widens and forms the gonadal cavity (Fig. 25).

Nematocysts

The species has both in the medusa and polyp the following three kinds of nematocysts; stenoteles, basitrichous isorhizas and desmonemes. The size of capsules of them is as follows:

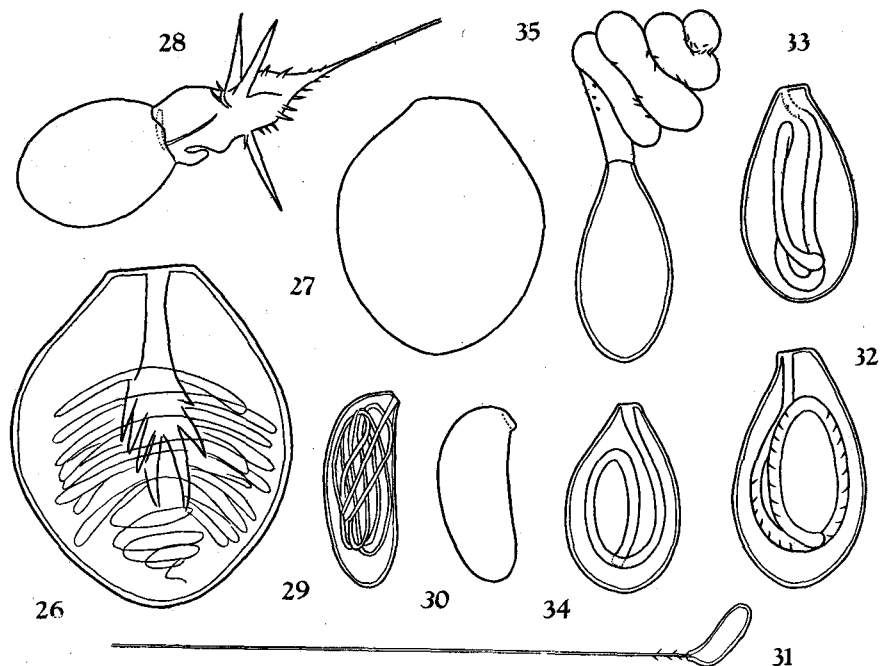
		Polyp		Mean value
Stenoteles	{length	8.2 μ -15.4 μ		10.8 μ
	{width	6.7 μ -12.5 μ		8.8 μ
Desmonemes	{length	5.8 μ - 8.6 μ		7.2 μ
	{width	2.9 μ - 4.8 μ		3.6 μ
Basitrichous isorhizas	{length	5.8 μ - 8.6 μ		6.9 μ
	{width	1.9 μ - 3.8 μ		2.5 μ
		Medusa		Mean value
Stenoteles	{length	6.7 μ -10.6 μ		8.2 μ
	{width	5.3 μ - 8.6 μ		6.7 μ
Desmonemes	{length	5.0 μ - 7.9 μ		6.7 μ
	{width	2.9 μ - 4.8 μ		3.5 μ
Basitrichous isorhizas	{length	4.8 μ - 7.7 μ		6.3 μ
	{width	1.9 μ - 3.8 μ		2.7 μ

The capsule of stenoteles is pyriform and the widest in the middle part (Figs. 26, 27). The operculum is large and tongue-like as shown in Fig. 28 showing the discharged state. The butt is of a blunt cone with a shallow constriction in the middle part. Around the constriction are present three stylets. More than a dozen small spines are arising from the bases of stylets and terminal portion of the butt. The butt gradually terminates to the tube. The stenoteles of young medusae are slightly smaller than those of polyps.

The capsule of basitrichous isorhizas is long rice-shaped (Figs. 29, 30). The tube is coiled longitudinally but irregularly 5-10 times within the capsule in undischarged state (Fig. 29). In discharged state the tube extends 35 μ -45 μ in length, emitting straight with a definite angle to the capsule (Fig. 31). Near the base of the tube are found several small spines. The capsule of polyps (Fig. 29) seems to be slightly more slender than that of medusae (Fig. 30).

The capsule of desmonemes is long-pyriform and the tube makes one and half coils in it (Figs. 32-34). The tube has minute thorns arranged in a row and coils 3-4 times in discharged state (Fig. 35).

Localities of nematocysts: In the hypostome of polyps basitrichous isorhizas are mainly found and stenoteles are also in fair numbers but desmonemes are scarcely found. In general part of hydranth and hydrocaulus the three kinds of nematocysts are universally distributed. In the tentacles desmonemes are extremely numerous and stenoteles are also abundant, but no basitrichous isorhizas are observed. The distribution of the nematocysts will be summarized in the following.



Figs. 26 & 28. Stenoteles of polyp; 26. $\times 3700$; 28. $\times 1850$.
 Fig. 27. Stenoteles of medusa. $\times 3700$.
 Figs. 29 & 31. Basitrichous isorhiza of polyp; 29. $\times 3700$; 31. $\times 1850$.
 Fig. 30. Basitrichous isorhiza of medusa. $\times 3700$.
 Figs. 32, 33 & 35. Desmonemes of polyp. $\times 3700$.
 Fig. 34. Desmonemes of medusa. $\times 3700$.

	Stenoteles	Basitrichous isorhizas	Desmonemes
Hypostome	+	++	-
Hydranth excluding hypostome & hydrocaulus	++	+++	++
Tentacles	++	-	+++

These nematocysts are all found in young medusae. Out of them desmonemes are the most numerous, stenoteles next to them and basitrichous isorhizas are rather few in number. The observations on the nematocysts were done by dint of phase-contrast microscope.

Distribution in Japan

Since the first discovery of the hydroid in the two lakes, Kahokugata and Ōchigata (Uchidas, 1929), Itô found the polyp in two brackish lakes near

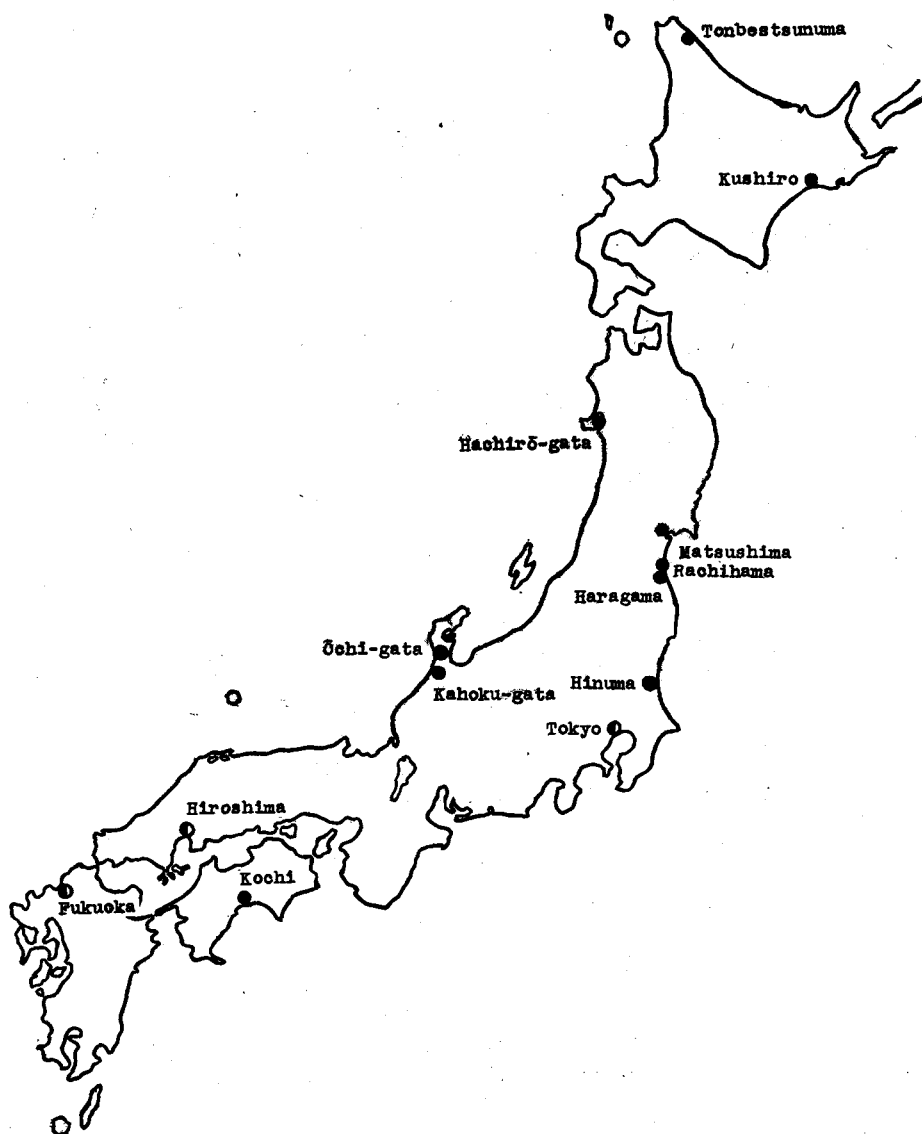


Fig. 36. Distribution of *Ostroumovia horii* in Japan.

- Sedentary locality.
- Temporary occurrence.

Matsushima in 1942, in the next year from Tombetsunuma in Hokkaido, Rachihama, and Haragama in the northern part of Honshu, also in Kochi City (in Shikoku) and Fukuoka City (in Kyūshū), and in 1951 in Hiroshima City on the coast of the Inland Sea (Itô, 1953). In these localities the hydroid was found always in brackish-water and the polyp alone has been reported. In 1951 Uchida reported a medusa collected in a concrete tank containing brackish-water in Tokyo. The medusa agrees with the medusae set free from the polyps of *Laccocoryne horii*. According to H. Kikuchi of Ibaragi University, a similar medusa was collected in the brackish lake, Hinuma near Mito City. In 1958 Miyawaki collected several medusae in Harutori lake in Hokkaido and then we collected in the same lake many polyps which were reared in our laboratory to get medusae. In 1959 we collected many polyps and medusae at the same time in Hachirogata. As stated above the hydroid is widely distributed in brackish lakes almost on all coasts of Japan. It was also found in a temporary brackish-water as in the concrete tank washed by flood. The species seems to be very euryhaline, and is not only found in brackish-waters of different salinities but also can be reared in fresh-water. Except some northern lakes which are frozen in winter, the hydroid can be found almost all year round (Itô, 1953), though decreased in number during January-March. The polyp is found attached to water-plants, decayed leaves or twigs submerged in water. The medusae seem to appear once in a year, from the end of August to the middle of September. It was reported that in the summer of 1958 the fishery of Hachirogata was seriously injured on account of abundant occurrence of the medusae.

Systematic part

The suborder Limnomedusae proposed by Kramp (1938) for the two families, Moerisiidae and Olindiidae are now generally in vogue. The writers agree for the adoption of the system. In the suborder, the Moerisiidae includes brackish hydroids of which the medusae have no statocysts and gonads develop from the manubrium along the radial canals. The genus *Ostroumovia* was referred to the Olindiidae by Kramp, because he observed statocysts in the medusa. Picard (1951) adopted Kramp's system, but he divided the Moerisiidae into two groups; one without statocysts and the other with statocysts. In his revision *Ostroumovia* is entitled to the second group of the Moerisiidae, because the polyp of the genus is closely related to those of the Moerisiidae and is different from those of the Olindiidae. According to Valkanov (1955) the medusa of *Ostroumovia inkermanica* lacks statocysts at all. He made close observations not only on his own preparates but also on that figured by Kramp being sent by the latter investigator and concluded that „Das, was Kramp als Statocyste angesehen hat, stellt nichts anderes als aufgelockertes Ektoderm dar, das in diesem Bezirk zufälligerweise eine im Querschnitt getroffene blasenförmige Auftreibung dieser Zellschichte vortäuscht. Der Statolith dieser „Statocyste“ ist lediglich als eine grosse Knide (Penetrante)

anzusprechen, die mit ihrer Längsachse vertikal zu der Schnittfläche gestellt und getroffen ist". Kramp personally wrote to Uchida that "I think I have seen statocysts in *Ostroumovia* (though in sections only)." From these facts it is clear that the statocysts could hardly be observed in preserved specimens (also in living specimens?). And it is possible whether the statocyst observed by Kramp (1938) was not really the statocyst or it was the statocyst of abnormal case. So far as our observations go, the adradial tentacles in young medusae of the Japanese species do not appear precisely in the middle part between the perradial and interradial ones but appear nearer to the perradial ones. Such a mode of arrangement of tentacles is generally seen in the Olindiidae with statocysts. On account of the presence of statocysts the arrangement of tentacles is in such a way altered. We are of opinion that the medusa of *Ostroumovia* has normally no statocysts. But it is probable that vestigial statocysts may abnormally occur in the medusa with tentacles of such an arrangement.

The polyp of *Laccocoryne horii* is closely related to that of *Ostroumovia* as described by Muto (1948) and Picard (1952). So far as the present writers' observations go, the medusa of Japanese hydroid lacks statocysts at all throughout all stages of living medusae and also in all sections made from them. The medusa is almost similar to that of *Ostroumovia inkermanica*. Therefore, the genus *Laccocoryne* must be united to *Ostroumovia*.

The Japanese hydroid, though closely related, is still to be specifically separated from *Ostroumovia inkermanica* as will be described in the following:

	<i>O. inkermanica</i>	<i>O. horii</i>
Size of adult polyps	24 mm (44 mm in maximum)	5-8 mm
Colour	rose in young polyps brickred in old polyps	yellowish white in young polyps, slightly brown in old polyps
Tentacle number	8-12	often over 12
Podocysts	5 in maximum	10 in maximum
Periderm	distinct	not so distinct

Besides the characters above mentioned the nematocysts are more or less different in form as stated by Valkanov (1938) and the nematocysts clusters on the exumbrella of young medusae seem to be more distinct in *O. inkermanica*. Moreover, the distribution is so different in the two hydroids.

Summary

I. The morphology and life-history of the Japanese hydroid formerly described as *Laccocoryne horii* were studied.

2. The hydroid is widely distributed in brackish lakes on the coast of Japan and gives rise to the medusa in August-September.
3. The hydroid has been here named as *Ostroumovia horii* (T. Uchida & S. Uchida).

Literature

- Boulenger, C.L. 1908. On *Moerisia lyonsi*, a new hydromedusa from Lake Qurun. Quart. J. micr. Sci., 52: 357-377.
- Hadži, J. 1928. Knidarijer des brackischen und des süßen Wassers. Bull. Trav. Class. Sci. Math. Natur. Acad. Sci. et Art. d. Slaves d. Sud. d. Zagreb, 22: 34-44.
- Itô, T. 1953. Hydrozoa in Japanese inland waters, their collection and cultivation. (5) Collecting and Breeding, 15: 262-266. (In Japanese).
- Kramp, P.L. 1938. Die Meduse von *Ostroumovia inkermanica* (Pal-Ostr.) und die systematische Stellung der Olindiiden. Zool. Anz., 122: 103-108.
- Kramp, P.L. & G.W. Paspaleff 1938. Über die Polypen- und Medusenform von *Ostroumovia inkermanika* (Pal.-Ostr.). Arbeiten aus der Biologischen Meeresstation am Schwarzen Meer in Varna, Bulgarien, 7: 27-68.
- Kramp, P.L. 1955. Hydromedusae in the Indian Museum. Rec. Indian Museum, 53: 339-376.
- Muto, Y. 1948. Über *Laccocoryne horii*, eine Brackwasser-hydrozoa. Seibutu, 3: 221-223. (In Japanese with German résumé).
- Paltschikowa-Ostroumova, M.W. 1925. *Moerisia inkermanica* n. sp. Zool. Anz., 62: 273-284.
- Picard, J. 1951. Contribution a l'étude des méduses de la Famille des Moerisiidae. Bull. de L'Institut Océanographique, No. 994: 1-16.
- 1952. Nouvelle Contribution a l'étude des Moerisiidae (Hydrozoa). Recueil des Travaux de la Station Marine d'Endoume, Fas. 4, Bull. no 1: 53-55.
- Uchida, T. & S. Uchida 1929. Occurrence of a new lacustrine hydroid in Japan. Proc. imper. Acad., 5: 157-158.
- Uchida, T. 1934. Medusae in inland waters. Botany and Zoology, 2: 1149-1169. (In Japanese).
- 1951. A brackish-water medusa from Japan. J. Fac. Sci. Hokkaido Univ. Ser. VI (Zool.), 10: 161-162.
- Valkanov, A. 1936. Notizen über die Brackwässer Bulgariens. 2. Versuch einer hydrographischen und biologischen Erforschung derselben. Jahrb. Univ. Sofia, physiko-math. Fakul., 32, 1935/1936: 209-341.
- 1938. Übersichte der Hydrozoenfamilie Moerisiidae. Jb. d. Univ. Sofia, physiko-math. Fakul., 34: 251-320. Pl. 1.
- 1955. Revision der Hydrozoenfamilie Moerisiidae. Arbeiten aus der Biologischen Meeresstation in der St. Stalin, 18: 33-47.