**A CONTRIBUTION TO THE MORPHOLOGY OF CERCARIA
OF *NOTOCOTYLUS MAGNIOVATUS* YAMAGUTI, 1934
(NOTOCOTYLIDAE, TREMATODA)**

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The monostome cercaria from fresh water snails, *Semisulcospira* spp. in Japan has often been observed briefly by many Japanese investigators (Osafune, 1899; Miyagawa, 1911; Nakagawa, 1915; Kobayashi, 1922; Ueno *et al.*, 1930; and Yokogawa *et al.*, 1934). This monostome cercaria had been known to encyst on a slide glass or in a glass container and develop to a member of Notocotylidae. Later on Kurokawa (1935) infected fowl or duck with its metacercaria, and succeeded in obtaining the adult form, which was erroneously identified as *Notocotylus attenuatus* (Rudolphi, 1809). After that, the above mentioned Kurokawa's error was pointed out and corrected by Yamaguti (1938), according to whom the monostome cercaria from *Semisulcospira* spp. developed to *Notocotylus magniovatus* and not *N. attenuatus*.

In spite of many such reports, no detailed morphology of this cercaria had been described. The author has obtained one species of monostome cercariae from the snails, *Semisulcospira* spp. in several areas in Japan. This monostome cercaria encysted easily in a glass container. Twenty days old many metacercariae were given to a fowl, and 15 adult worms were discovered from its caecum two weeks after infection. They were identified as *N. magniovatus* as shown by Yamaguti (1938).

In the present paper a detailed morphology of this cercaria is presented.

GEOGRAPHICAL DISTRIBUTION OF THE CERCARIA

More than thirty thousands of snails, *Semisulcospira* spp. were examined during the years from 1946 to 1958. Infection rates of the monostome cercaria were rather low (Table 1). A comparatively detailed survey was carried on about snails in Shizuoka Prefecture, in which the distribution of the cercaria seemed to be limited to some localities. At the suburbs of Shizuoka City, snails from a small ditch harboured the cercaria in about fifty percent, though the reason was not known.

Table 2 shows the infection rate of this cercaria in relation to the size of snail hosts, which indicates that the maximal infection rate was seen in snails of middle size, and the rather low infection rate was observed in snails of large size as well as in that of small size.

Table 1. Geographical distribution of cercaria of *Notocotylus magniovatus* in Japan

Locality	Snail host	Date	Number of snails examined	Number of snails infected	Percentage
Edo River Tokyo	<i>Semisulcospira reiniana</i>	1946-1948	1488	0	0
Nameri River Kanagawa	<i>S. libertina</i>	1950	130	0	0
Nakakoma-Gun Yamanashi	<i>S. libertina</i>	1947-1951	1892	2	0.11%
Hatta-Gun Kochi	<i>S. japonica</i>	1950	882	23	2.61%
Ehime Pref.	<i>S. japonica</i>	1949	546	6	1.09%
Shizuoka Pref.	<i>S. libertina</i>	1948-1958	34060	133	0.39%
<i>Details in Shizuoka Prefecture</i>					
Drainage of the Kano River		1948-1958	13384	23	0.2%
Numazu City Area		1956-1958	2605	0	0
Yoshiwara City Area		1956-1957	3465	82	2.4%
Shizuoka City Area		1955-1958	1043	12	1.2%
Drainage of the Seto River		1956-1958	4409	16	0.4%
Drainage of the Kiku River		1957-1958	3915	0	0
Drainage of the Oota River		1957	1378	0	0
Iwata City Area		1956-1958	3861	0	0

Table 2. Correlation of infectivity rate of cercariae of *Notocotylus magniovatus* with the length of snail host

Length of snail host	Number of snails examined	Number of snails infected	Percentage
Under 10 mm	400	0	0
11-15 mm	2571	10	0.38%
16-20 mm	5930	38	0.64%
21-25 mm	8334	37	0.44%
26-30 mm	6041	26	0.43%
31-35 mm	3142	7	0.22%
36-40 mm	1010	3	0.30%
41-45 mm	280	0	0

MORPHOLOGY OF REDIA AND CERCARIA

Redia (Fig. 3) — Parthenitae are rediae which are yellowish in colour and possess a pair of foot appendices at the posterior part of cylindrical body. The body fixed by 10 % hot formalin without cover pressure measures 0.85-1.55 mm in length and 0.19-0.34 mm in width. The anterior part of body surface, especially around the mouth opening, is beset with many minute sensory hairs. The muscular spheroidal pharynx,

43-55 $\times$ 40-49 μ in size, is followed by a long intestine reaching to the level of foot appendices. A birth pore is situated at the slightly posterior surface from the anterior tip of body. In the middle part of body wall is one pair of excretory pores, each of which communicates to an anterior and a posterior flame cell with a long collecting tube respectively. Less than ten cercariae are contained in a redia together with the several number of germ balls.

Fig. 1. A matured cercaria of *Notocotylus magniovatus*.

Fig. 2. The internal structure of cercaria, omitting the cystogenous material.
OS, oral sucker; SH, sensory hair; ES, eye spot; FC, flame cell;
EC, excretory concretion; In, intestine; EB, excretory bladder;
CP, corner pocket.

Fig. 3. A matured redia of *Notocotylus magniovatus*.

Cercaria (Figs. 1 and 2) — The cercaria is a typical monostome type. Measurements made on ten specimens fixed with 10 % hot formalin are as follows;

Body	263-336 (av. 293) $\times$ 126-147 (av. 132) μ
Tail	242-453 (av. 319) $\times$ 52- 84 (av. 65) μ
Oral sucker.....	26- 37 (av. 33) $\times$ 32- 37 (av. 34) μ

The body is of a large size, ellipsoidal in shape, its posterior part being more blunt than its anterior. The body surface is provided with no spine but five pairs of sensory hairs locating at its anterior part. The postero-lateral margin of body is modified as one pair of corner pockets which may serves as an adhesive organ when the cercaria creeps.

The body is strongly opaque due to the densely compacted cystogenous material in the whole space of body cavity except the anterior one fifth part and the corner pockets mentioned above. At the antero-ventral end of body is a mouth opening which is followed by a well developed spherical oral sucker. A pair of long caeca is connected with the oral sucker by a short prepharynx. No pharynx is observed. Three prominent eye spots are situated at the anterior part of body, among which one pair of lateral eye spots is at the shoulder of excretory collecting tube, and the other median one is at the just dorsum of prepharynx. The median eye spot is smaller than the lateral one even in fully developed cercariae. In young cercariae this median eye spot is rudimentary and sometimes overlooked.

An anepithelial small excretory bladder is situated at the median posterior end of body. A pair of main excretory collecting tubes is given off from the right and the left antero-lateral corner of bladder. It runs forwards along the caeca to the level of lateral eye spots respectively, and joins with each other at the median part of body. A short median branch is hardly observed from the above mentioned anastomosis to the posterior end of oral sucker along the dorsal side of prepharynx, though it is difficult to detect because of obstruction by many pigmented granules and the median eye spot. These collecting tubes, including a short median branch, are compacted with many strongly refractile excretory concretions measuring about 2.5μ in diameter. A secondary collecting tube is branched off from the middle part of main collecting tube respectively. Each secondary collecting tube divides in a short distance into an anterior and a posterior collecting tube. The anterior collecting tube receives four flame cells grouping in two, and the posterior one also does so. Thus, the flame cell formula is demonstrated as $2[(2+2)+(2+2)]=16$.

The whole body cavity beneath the cuticle is densely compacted with a great many rod-like cystogenous material, except the anterior part of body and the posterior corner pockets. These materials make the body strongly opaque as mentioned already, but as soon as the cercariae encyst in a glass container, these materials are discharged from the body surface to make the body transparent.

The tail has the strong power of extension and contraction as the body does so. It is connected with a deep groove to the ventral posterior end of the body, though it is easily detachable from the body. It is provided with strong longitudinal and circular muscles beneath the smooth cuticle. The central part of tail is filled with a loose connective tissue in which a caudal excretory tube runs backwards from the excretory bladder and divides at the middle part of the tail.

SUMMARY

Fresh water snails, *Semisulcospira* spp. are parasitized with one species of monostome cercariae. The cercariae encyst in a glass container without any second intermediate host. Fully matured metacercariae develop to *Notocotylus magniovatus* Yamaguti, 1934, in the intestine of the fowl. The present paper dealt with a detailed morphology of the cercaria.

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