The metachromatic mucoid glands in various cercariae have been studied morphologi-
cally and histochemically by Kruidenier (1951, 1953 a-d), Yokogawa and Yoshimura
(1956) and Ito and Watanabe (1957, 1958 a,b).

The present authors had an opportunity of getting the cercaria of Notocotylus
magniovatus from the suburbs of Shizuoka City. No report of the mucoid gland of
this cercaria has ever been published by any of the investigators. So the present paper
deals with our observations about the mucoid glands of the cercaria.

MATERIALS AND METHODS

The cercariae and the rediae of Notocotylus magniovatus were obtained by crushing the snail
host, Semisulcospira libertina (Gould) which were collected from the region of Shizuoka City. They
were smeared on a slide glass with egg albumin and fixed with Bouin’s and Schaudinn’s fluid.
Serial sections of cercariae and rediae were also made in the studies. It was difficult to observe
the mucoid glands when the isolated cercariae were mounted flat on either dorsal or ventral
surface. To avoid such unsuitable condition, totally fixed preparations of the rediae including the
inherent cercariae were beneficially employed for observing these glands. Dilute, aqueous toluidin
blue solution, and also thionin solution were employed to differentiate the mucoid substance in
all of the cercariae.

OBSERVATIONS

Six pairs of large, irregular-shaped body glands are, in general, distributed in two
longitudinally paralleled rows on either side of the mid-line, along the dorsum of the
mature cercariae (Figs. 1, 2, and C in Fig. 4), whereas they are not found in the
extremely immature cercariae (Fig. 3, and A in Fig. 4). They extend from the level
of posterior margin of oral sucker, to the region of excretory bladder. The first and
the sixth pairs of such mucoid glands are somewhat smaller in general than those of
the other mesial body glands. All are moderately dendritic or stellate in shape. Rarely,
an extra metachromatic gland appears to be present in the dorsum. It would be one
of the dorso-lateral glands mentioned below.

There are another dorso-lateral mucoid glands which are paired and lie in a paralleled
series along the dorso-lateral margin of the body (Fig. 6). They are four pairs ex-
tending from the side of oral sucker to the side of excretory bladder, though the first
one is very difficult to find on account of the surrounding pigments. These glands
are longitudinally elongated, and the size of them is smaller than those of the above mentioned mesial body glands. They penetrate very deeply into the cercarial tissues as clearly indicated in sectioned materials. Sometimes the strand of pigments is observed along the dorso-lateral glands (Fig. 6).

The nuclei of glands are stained very poorly in toluidin blue solution. If the material is stained by the more concentrated dye, the mucoid substance is so deeply coloured that the nucleus appears only as a clear vesicle within the mass of secretion.

Additional glands are present in the body. One pair of small crescent, metachromatic unicellular glands is located in both corner pockets (Fig. 7). They are apparently homologous with other glands. These glands can not often be observed in some individuals, though the reason is not known. Further investigation may clarify this point.

About fifteen pairs of caudal glands extending from the base of tail to its tip are observed. These pairs are often so connected longitudinally with each other that it seems to be in two spiral strings (Fig. 8).

Above mentioned several groups of mucoid glands can not be observed in the very young cercariae (A in Fig. 4). Initial appearance of the gland is observed after developing the lateral eye spots as well as the surrounding pigments (B in Fig. 4). At first the body glands except the first and the last sixth pairs, and the dorso-lateral glands develop. These are soon followed by appearance of the anterior mesial and then the posterior mesial pairs in general.

Metachromatic glands seem to begin to secrete their substances in the period when the cercaria approaches to maturity, or when the median eye spot becomes to form (D in Fig. 4). As the discharging of substances progresses, the mucoid glands begin to disappear. Such disappearances of glands are observed at first on the caudal glands, then on the body glands. These discharged mucoid substances from the glands form a thin film on all over the body surface of cercaria. This film is also highly metachromatic to toluidin blue and thionin following fixation. As shown in sectioned materials (Figs. 9 and 10), the film on the dorsal surface is thicker than that of ventral one. Cercariae of these conditions are only observable within the redia from which they will soon emerge. In the free emerging cercariae as well as in the encysted ones, no indication of the mucoid gland can be observed.

DISCUSSION

Morphological differences of the mucoid glands exist certainly even among the closely related cercariae. There are some similarities in the general feature and development of the mucoid glands among the cercaria of Notocotylus magniovatus, that of Nudacotyle novicia and Cercaria urbanensis Cort, 1914, but certain differences in some respects (See Kruidenier, 1953). In the classification of cercariae, this variation may be much important.

(Figs. 1-8 are of whole mounts, and Figs. 9-10 are sectioned preparations)

Figs. 1 and 2. Completely developed mucoid glands of the cercaria of Notocotylus magniovatus.

Fig. 3. Mucoid glands were not yet found in the immature cercaria.

Fig. 4. The formation of mucoid glands in the various developmental stages of cercariae within the redia.

A: Mucoid glands were not yet found.

B: Early developmental stage of the mucoid glands.
C: Well developed mucoid glands.

D: Matured but non-emerged cercaria showing the mucoid film on the body surface instead of the mucoid gland in the body.

Fig. 5. Abnormal number of the mucoid glands.

Fig. 6. The dorso-lateral mucoid glands.

The following abbreviations are used:
AM; Corner pocket mucoid gland. CG; Caudal mucoid gland. D; Dorsal surface. DG; Dorsal mucoid gland. ES; Eye spot. LG; Lateral mucoid gland. MS; Mucoid substance. Pi; Pigment. V; Ventral surface.
According to Kruidenier (1953b), ten pairs of caudal glands were described in the tail of cercaria of *Nudacotyle novicia*, and six pairs of such glands in the tail of *Cercaria urbanensis*. According to our observations on the cercaria of *Notocotylus magniovatus*, not less than ten to fifteen pairs of the tail glands could be detected, though it is difficult to count their number because of their shape being in two spiral strings. Furthermore, Kruidenier (1953b) observed the four pairs of glands lying outside
of the oral sucker in *C. urbanensis*, but such glands could not be found in the present species.

Anyhow, the tail glands have never been described in the other groups of cercariae, such as Xiphidio-, Opisthorcoid-, Paragonimus-, etc. Moreover, the mucoid glands of many other groups of cercariae are generally located in the ventral side of cercariae, on the contrary, those of the present species are situated more dorsally. It may have some meaning in the function of mucoid glands of this species or of this group concerning the life cycle.

**SUMMARY**

The general feature and the developmental process of metachromatic mucoid glands were studied in the cercaria of *Notocotylus magniovatus*. Totally, six pairs of body glands, four pairs of dorso-lateral glands, one pair of corner pocket glands, ten to fifteen pairs of caudal glands and some strands were detected. These glands did not yet appear in very young cercariae prior to the formation of eye spots, and already disappeared in the emerged cercariae. So it was only observable in cercariae within the redia by means of the staining with metachromatic dyes, such as toluidin blue or thionin.

**REFERENCES**


