Some Observations on Leucochloridum paradoxum (= macrostomum) Rud. 1802, from the Snail Succinea putris L.

by

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An exceptionally well-preserved specimen of *Succinea putris* L., infected with *Leucochloridium paradoxum* (= *macrostomum*) was put at my disposal by Mr. L. J. M. BUTOT for investigation. The snail had been collected by him in the South-Holland Biesbosch in 1958 and forms the basis of the following observations.

BRIEF HISTORICAL SURVEY

Leucochloridium has been known for a long time and has usually been recorded from *Succinea* spp., although one record is from *Planorbis* sp. (but WESENBERG-LUND (1931) was unable to confirm this). The most complete studies on the parasite are by HECKERT (1899), MÖNNIG (1922) and WESENBERG-LUND (1931), to which the reader is referred for detailed descriptions and literature. A key to species known at that time was erected by MCINTOSH (1932). WESENBERG-LUND was able to examine some 150 specimens of this parasite, but unfortunately gave no detailed measurements of either sporocysts or cercariaea, although he described the morphology and ecology in some detail.

Records of this parasite were brought together by VENMANS (1951), to whose list this find by Mr. L. J. M. BUTOT must now be added.

MORPHOLOGICAL EXAMINATION OF SUCCINEA PUTRIS

The snail, length of shell 1.94 cm and width 1.02 cm, was characterised by swollen, ovoid tentacles which increased markedly in size (and especially in diameter), when the side or sole of the foot was lightly pressed. After the removal of the shell and dissection, three large sporocysts were found, one on the left hand side of the body and two on the right hand side. The entire visceral mass was permeated with the finer terminations of the sporocysts, making it dif-

ficult at times to separate host and parasite tissues. Figure 1 shows the appearance of the three sporocysts in the body cavity of the snail, after the removal of surrounding tissue.

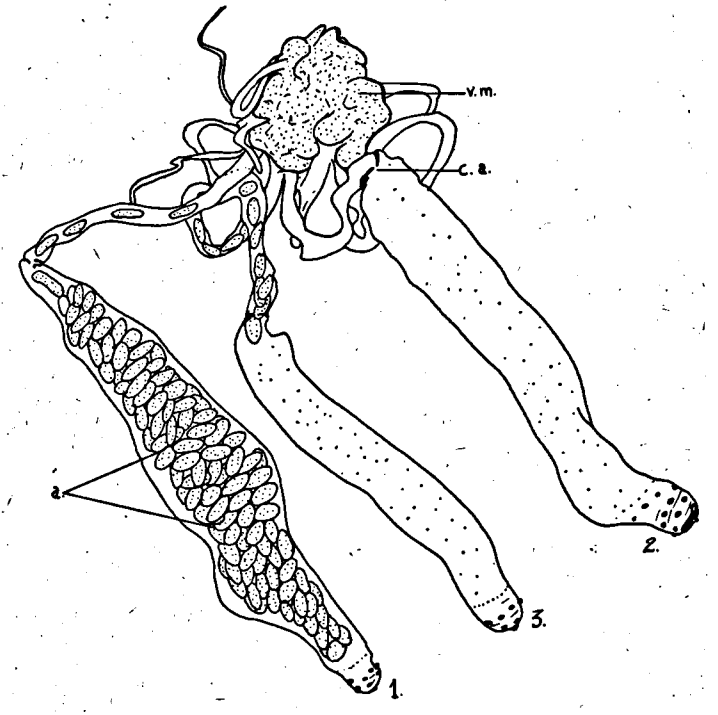

Figure 1. Three sporocysts from the body cavity of *S. putris*. The numbering is followed in the text. Only sporocyst 1 shown with its full complement of agamodistomes. Abbreviations: v.m., visceral mass; c.a., closing mechanism; a, agamodistomes.

THE SPOROCYSTS

The three sporocysts were examined separately by detaching just below the closing mechanism of the large sporocyst itself. Mr. BUTOT had observed that in the living state, the sporocysts were of the „green-sac" variety and this was confirmed by the type and distribution of pigment which was „clumped" as shown in Figure 2. In the case of „brown" sacs the pigment is more even distributed with occasional raised areas.

The pattern followed by the pigment is a spiral round the long axis of the sporocyst but mostly confined to the cap region and the number of larger pigment clumps in the case of sporocyst no. 1 was 47, with many smaller spots on the wall of the sac, overlapping the

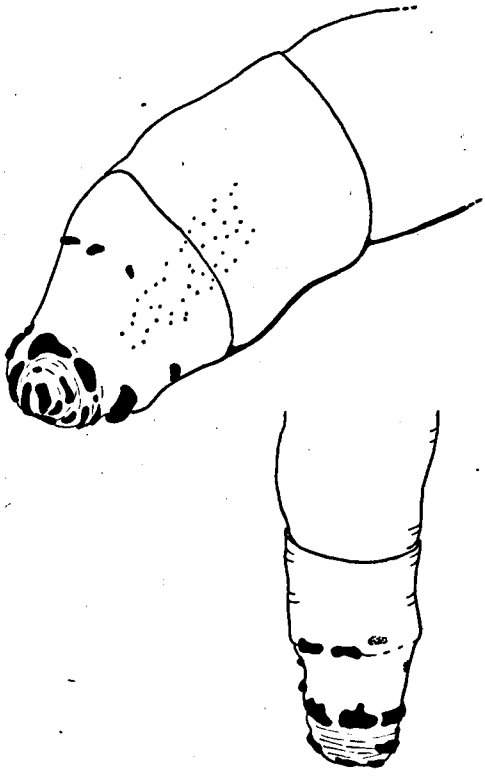

Figure 2. Distribution of pigment clumping on the caps of sporocysts 1 and 3 (see Fig. 1). It will be seen that the pigment follows a more or less spiral pattern.

first and second segments. MÖNNIG (1922) first developed the idea that light stimulus on the pigmentation stimulates muscular contractions and causes the characteristic „pumping" of the sacs. This probably accounts for the concentration of the pigment on the cap of the sporocyst, and for its clumping for it is just the cap of the sporocyst that protrudes under the edge of the snail in the natural expanded condition. In addition, spirally running musculature can

be seen below the pigment groups and these are probably first activated by the light stimulus.

Table 1

Sporocyst/Measurement	Length	Breadth	Number of cercariaea	
1	9.20	1.60	61	270
2	9.41	1.23	97	
3	12.03	0.98	112	

all measurements in mm.

The sporocysts were opened individually in separate watchglasses, where they were measured and the cercariaea were also released and counted. The results are shown in Table 1 above. Although a total of 270 cercariaea (or agamodistomes) is recorded, more were found in the finer ramifications of the sporocysts, bringing the total to something like 360. WESENBERG-LUND states that from 100 to 200 agamodistomes could be found per ripe sac, so this would suggest that we have to deal here with sacs that are not fully ripe.

To gain an idea of the ripeness of the sacs, in a very approximate but comparative manner, we can divide the volume V of each sporocyst by the number N of agamodistomes present, when we have:

Table 2

Sporocyst	1.	2.	3.
V/N	303	110	81

in μ^3

It will be shown in the section dealing with the agamodistomes that they are all of the same order of size, so that the decreasing value of V/N above is not an expression of the decreasing volume used by any one cercariaeum, but is an indication of the density of crowding of the agamodistomes. Thus they are nearly three times as tightly packed in sporocyst 2 as in sporocyst 1 and so forth.

If we accept the figures given by WESENBERG-LUND (1931) as to the number of cercariaea in a fully ripe cyst, the results in Table 2 agree with this. In sporocyst 3 there are the most larvae present (112), and there is the least room for them (81 μ^3). This gives an idea of the tension and swelling of the sacs which finally leads to their bursting and thus distribution of their contents.

THE AGAMODISTOMES

The number of agamodistomes was given in Table 1, per sporocyst. Groups of 30 were taken at random from these and a series of measurements made. These are tabulated below; all measurements are in μ.

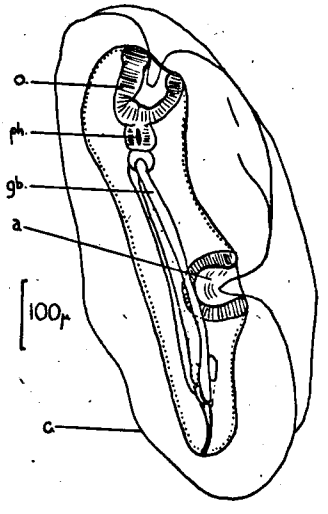

Figure 3. Agamodistome (cercariaeum) seen in lateral view. The well-developed cuticle (c) is seen to have finger-like projections into both oral and ventral suckers. Abbreviations as in Figure 4.

Table 3

From Sporocyst	1	2	3
Length	813	779	806
Breadth	264	287	285
Oral sucker	186×165	204×184	200×178
Acetabulum	160	161	170
Pharynx (diam)	91	90	93
Length/Breadth	3.08	2.83	2.71

The agamodistomes are surrounded by a thick, very transparent cuticle (shown in Figures 3, 4, and 5). This acts as a protective membrane for the larva within the sac, and can become very hard and thickened in older specimens. In order to see finer details, chloral-lactophenol was used in this case to soften and clear the

parasites. Although this cuticle completely surrounds the agamodistome, there is a connecting channel between the suckers and the surface of the cuticle, suggesting that the larvae may in fact feed on neighbouring larvae, as is the case with many rediae. In Figure 4 small rounded bodies, three in number are indicated in the hind end of the body. These are the A n l a g e n of the reproductive organs of the adult, for the larva, so-called, is really a small edition of the adult trematode to be found in many birds, except for the further development of certain organ systems and their proportions to one another.

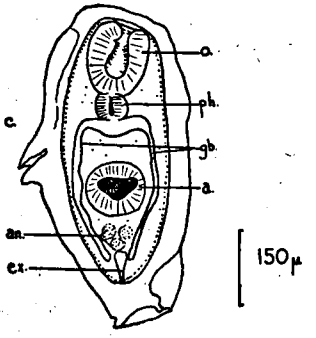

Figure 4. Agamodistome viewed ventrally. The cuticle has been damaged by the fixation and mounting of the specimen. Key to abbreviations: o., oral sucker; a., acetabulum; ph., pharynx an., Anlagen of gonads; ex., excretory bladder; gb., gut branches.

The problem still remains for the field biologist and for the laboratory worker, as to how the *Leucochloridium* gains entry into its final hosts, which include non-carnivorous, seed-eating birds. Although it is generally accepted that birds peck off the swollen tentacles and thus become infected, none of the many experiments that have been carried out to prove this have been positive. In any case, this does not explain how seed-eating birds become infected. There would seem to be two possibilities worth investigating both in the field and in the laboratory, first that agamodistomes which have been „exploded" from a ripe sac on to leaves, stems, and so forth, encyst in some way so that noncarnivorous birds also have the chance of being infected, and secondly that some other intermediate host can be involved under certain circumstances, as was shown by KRULL & MAPES in the case of *Dicrocoelium dendriticum* (1952).

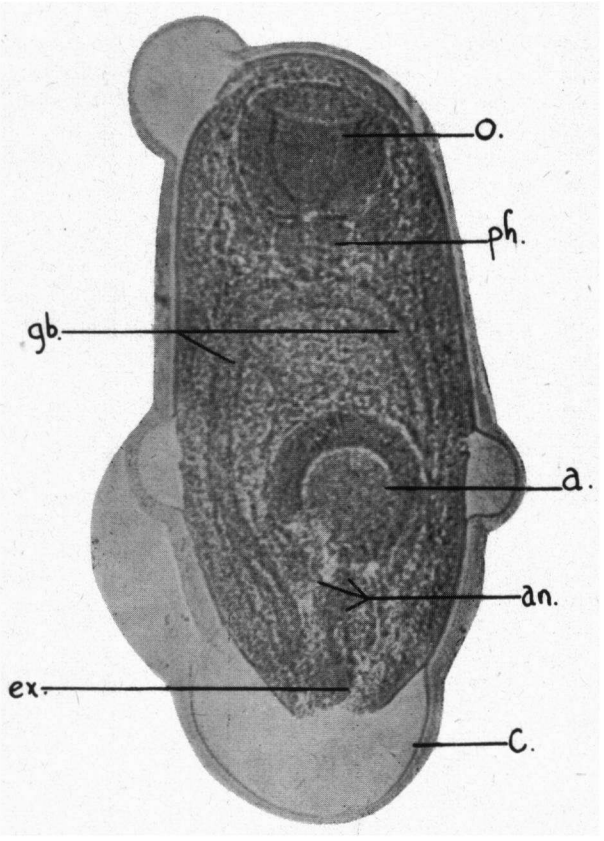

Figure 5. Photomicrograph of agamodistome from sporocyst 2, showing elaborations of the enclosing cuticle and general appearance of the cercariaeum under the microscope. Abbreviations as in Figure 4.

LITERATURE

KRULL, W. H., & C. MAPES, 1952. Studies on the biology of *Dicrocoelium dendriticum* (Rud. 1819) Looss, 1899 (Trematoda: Dicroeliidae), including its relation to the intermediate host, *Cionella lubrica* (Müller). Part VII: The second intermediate host of *Dicrocoelium dendriticum*. The Cornell Vet., vol. 42, pp. 603-604.

MCINTOSH, A. 1932. Some new species of trematode worms of the genus *Leucochloridium* Carus, parasitic in birds from Northern

Michigan, with a key and notes on other species of the genus. Journ. Parasit., vol. 19, pp. 32-53.

MÖNNIG, H. O. 1922. Über *Leucochloridum macrostomum* (L.) (*paradoxum* Carus) ein Beitrag zur Histologie der Trematoden. Monograph, Jena. 61 pp.

WESENBERG-LUND, C. 1931. Contributions to the development of the Trematoda Digenea. Part I. The biology of *Leucochloridium paradoxum*. D. Klg. Dansk. Vidensk. Selsk. Skrifter., Naturw. Math. Afd., Raekke 9, Vol. 4 (3) pp. 90-142.

For a full bibliography of the parasite, the reader is referred to the last mentioned publication.

SUMMARY

An account is given of *Leucochloridium paradoxum* (= *macrostomum*) Rudolphi, 1802 from *Succinea putris* L., found in the South-Holland Biesbosch. A description is given of the sporocysts and their contents and some speculations over the unsolved problem of the entry of the parasite into its definitive host.

SAMENVATTING

In dit artikel worden enkele morphologische gegevens besproken betreffende een exemplaar van *Leucochloridium paradoxum* (= *macrostomum*) Rudolphi, 1802 in de slak *Succinea putris* L. van de Zuidhollandse Biesbosch.

De maten van sporocysten en agamodistomen (cercariaea) en het aantal agamodistomen per sporocyst worden gegeven.

Een theoretische beschouwing over het probleem van de besmetting van de eindgastheer besluit het artikel.