

**THE ADULT STAGE OF
THE TREMATODE, *LEUCOCHLORIDIUM AUSTRALIENSE***

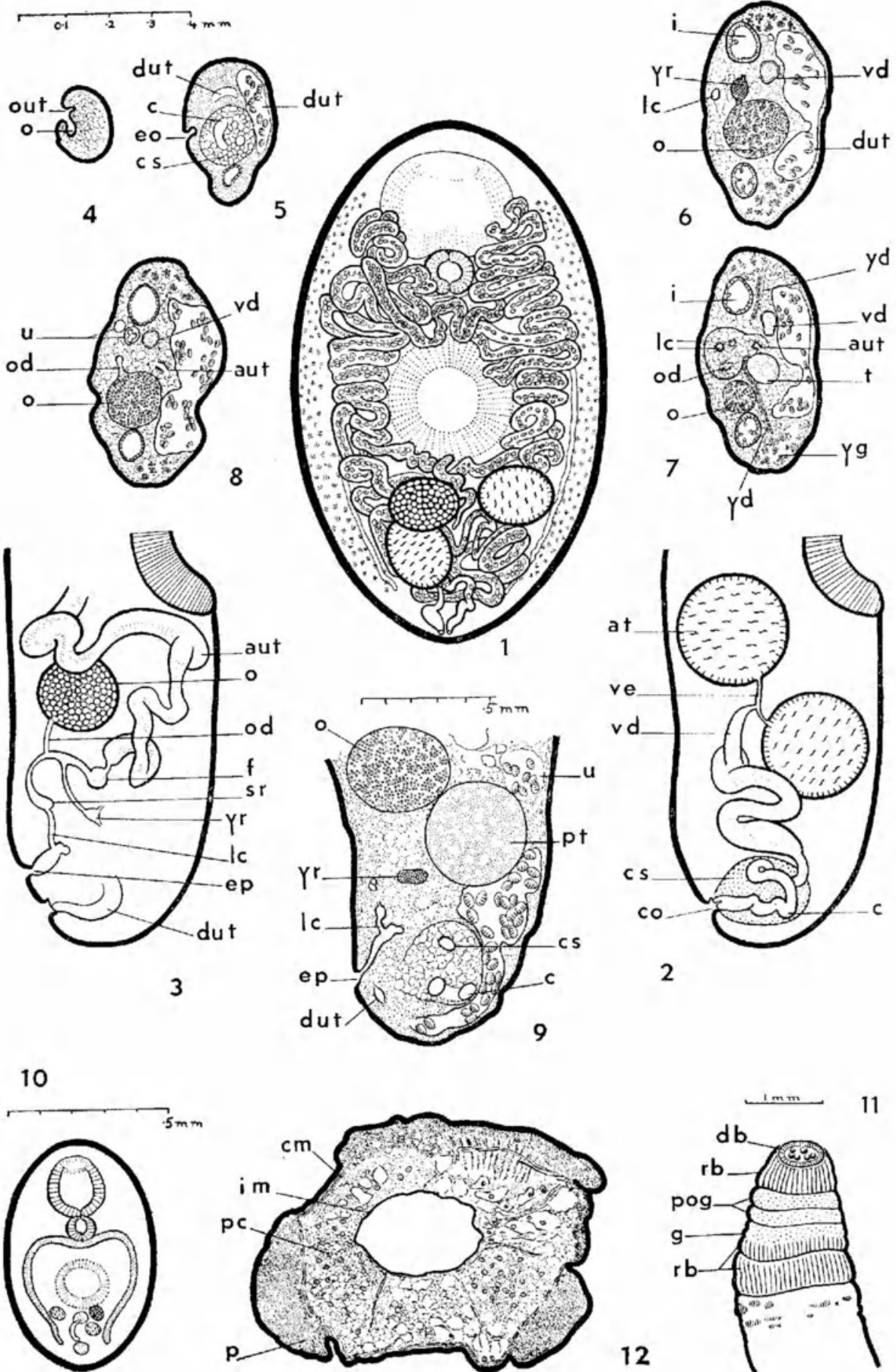
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[Read 13 June 1940]

In 1938 we gave an account of the larval stages of *Leucochloridium australiense* from *Succinea australis* collected at Elwomple, near Tailem Bend (Johnston and Cleland, 1938). The anatomy of the cercariaeum was shown to resemble that of *L. insigne* (Looss) and of *L. macrostomum* (Rud.), as identified by Witenberg and other authors. Szidat (1936), however, has re-examined Rudolphi's type material and has shown that the true *L. macrostomum* has the testes and ovary arranged in a linear series instead of forming a triangle, as had been described for the fluke generally regarded as belonging to Rudolphi's species. Szidat also showed that *L. holostomum* (Rud.) was a valid species whose gonads possessed the triangular arrangement; consequently *L. macrostomum* of most authors really belonged to *L. holostomum* or perhaps to some related species. Hsü (1936) discussed the relationship of *L. insigne* (Looss) of Witenberg and of some other species.

In August, 1938, three adult specimens of *Leucochloridium* were found in the cloaca of *Pomatostomus superciliosus*, and, in the following month, four were taken from one out of four birds of the same species, all hosts having been collected by Mr. F. Jaensch at Elwomple, the same locality as that from which the larval stages had been obtained in 1937. *Succinea* shell fragments were abundant in the gizzard and intestine of most of the birds. Eggs from some of the flukes were used in an attempt to infect *Succinea*, but the latter soon died. In August, 1938, in a specimen of *Corcorax melanorhamphus* from the same locality, six minute *Leucochloridium* flukes were obtained, all of the same size and stage of development, agreeing in all particulars with the cercariae already described by us. These had apparently only just been liberated from a *Succinea* whose fragments were also present. The adults possessed the genital arrangement described in the larva, and we have no doubt that they belong to *L. australiense*, which is the first Australian digenetic trematode whose life cycle is known. The various stages in the life history of *Fasciola hepatica*, the liver fluke of sheep, in eastern Australia have been investigated by Bradley, McKay and Ross, but the species is not native to the Commonwealth and must have been introduced along with its domesticated hosts soon after the original settlement, as Rudolphi in 1819 recorded its occurrence in a kangaroo, *Macropus major*.

Adults of *L. australiense* measured (under coverglass but without pressure) 2.25 to 2.4 mm. long by 1.15 to 1.4 mm. wide; the anterior sucker 0.55 mm. long by .62 to .66 mm. broad, and the ventral sucker .60 to .61 mm. long by .55 mm. wide. The two suckers are thus subequal and about one-quarter the length of the



worms. The ventral sucker is nearly central, but rather more of it lies in the posterior than in the anterior half of the parasite. The pharynx is nearly circular, measuring $\cdot 19$ mm. long by $\cdot 2$ mm. wide. The oesophagus is extremely short. The narrow, slightly wavy, caeca lie near the margins and terminate just behind the level of the posterior border of the posterior testis and near the hindmost limit of the uterine coils.

The testes and ovary are arranged as a triangle, the latter lying very close to, or touching, the posterior testis. The testes measure about $\cdot 46$ by $\cdot 32$ mm. The anterior is separated from the ventral sucker by the descending uterus, and from its fellow by the fecundarium and by some loops of the descending uterus. The vasa efferentia form an oblique straight line. The vas deferens is rather wide and thrown into several loops as it travels back to enter the rounded cirrus sac within which it lies twisted when at rest. The sac measures about $\cdot 2$ mm. in diameter. The genital opening lies in a slight depression, somewhat dorsal, near the posterior extremity, the male duct terminating on a very slight prominence at its base. The male opening lies on the same side of the median line as the ovary; the female pore is on the other side of the depression. In one specimen the male apparatus is partly extruded, and if fully protruded the cirrus would probably measure about $0\cdot 125$ mm.

The ovary is about $\cdot 32$ mm. broad by $\cdot 23$ mm. long. It touches the posterior testis and the fecundarium but is separated from the posterior sucker by loops of the ascending and descending uterus. The oviduct arises from the inner surface, travelling inwards, backwards and slightly dorsally to enter the fecundarium, in whose vicinity it joins the long Laurer canal. The anterior part of the latter is rather wider, forming a seminal receptacle, the remainder being narrow with a strongly chitinized wall. This canal passes back near the dorsal midline, above or near the posterior testis, to enter the dorsal aspect of the very small excretory bladder just as the latter receives its two longitudinal canals, these junctions lying just above or in front of the anterior part of the cirrus sac. The fertilizing duct travels in a coiled course through Mehlis' gland (fecundarium) which occupies a median position between the ovary and the two testes, coming into contact with

EXPLANATION OF FIGURES

Fig. 1, adult; 2, adult, male system, lateral view; 3, adult, female system, lateral view (figs. 2 and 3 constructed from series of longitudinal sections); 4, T.S. at level of genital apertures; 5, T.S. region of excretory pore; 6, T.S. at level of yolk reservoir; 7, T.S. showing yolk ducts; 8, T.S. across region of oviduct; 9, longitudinal section, nearly median; 10, cercariaeum; 11, sporosac; 12, T.S. pigmented band of sporosac.

References to Lettering—at, anterior testis; aut, ascending uterus; c, cirrus; cm, circular muscle; co, cirrus opening; cs, cirrus sac; db, dark brown band; dut, descending uterus; ep, excretory pore; f, fecundarium; g, green band; i, intestine; im, inner membrane; lc, Laurer's canal; o, ovary; od, oviduct; out, opening of uterus; p, pigment; pc, pigment cells; pog, pale olive green band; rb, red brown band; sr, seminal receptacle; u, uterus; vd, vas deferens; ve, vas efferens; yd, yolk duct; yr, yolk reservoir.

the three organs. The uterus passes forwards between the ovary and anterior testes and may overlie parts of these glands. It then travels between the ovary and the posterior sucker and forwards, its coils occupying most of the zone between the latter and the crura, sometimes underlying the crura. It extends forwards as a massive structure, reaching at least the mid-level of the anterior sucker and then its folds cross between the pharynx and the posterior sucker below the crura to become strongly coiled on the other side of the worm, where it extends about as far forwards as on the opposite side. Just in front of the anterior testis it crosses to the opposite side, just behind the posterior sucker and below the ascending limb of the uterus. It forms a series of loops laterally from the ventral sucker, ovary and posterior testis, lying ventral to the level of the two latter organs, and then travels below the ovary across to the opposite side of the worm to occupy the region between the anterior testis and the cirrus sac. Its terminal portion lies beside the cirrus sac and opens beside the male pore. Sometimes uterine loops lie above the crura as well as below them, and also above some of the inner vitelline follicles.

The vitellaria form a long series of rather large, irregularly shaped, closely arranged follicles lying ventrally and ventro-laterally from the intestinal crura. Posteriorly they extend almost to the end of the crura or they may reach the end on one side only. Their limit lies at about the level of the hinder border of the posterior testis. In front they reach at least half-way along the oral sucker, approximately to the same level as the foremost loops of the uterus, or they may do so on one side, being shorter on the other. As in the case of the uterus, they extend considerably in front of the crura. Each transverse yolk duct passes inwards above the corresponding ascending excretory canal and below the crus, then upwards to meet its fellow to form a yolk reservoir. One vitelline duct lies between the ovary and the posterior testis and the other behind the anterior testis. The common yolk duct travels obliquely forwards to join the oviduct near the origin of Laurer's canal. Eggs measure 22 by 13.5-14 μ .

The excretory pore is dorsal, in front of the genital apertures, and leads downwards and forwards, very soon entering a small excretory bladder into which enter almost transversely the two main collecting canals. The bladder lies above the anterior part of the cirrus sac or just in front of it. The canals pass outwards, forwards, and slightly ventrally above the descending uterus and then below and close to the crura. They travel forwards ventro-laterally from the latter, but above and inwardly from the vitellaria. Each canal extends forwards to the vicinity of the pharynx, then curving back to lie above and laterally from the ascending canal. In the posterior region the latter, as well as the descending canal lie almost directly ventrally from the corresponding crus. A delicate canal, probably the anterior branch, lies above the corresponding crus.

Our species belongs to the same group as *L. holostomum*, as figured by Szidat in regard to the arrangement of the gonads, but in that species the uterine loops are limited anteriorly by the caeca. The uterine disposition in

L. australiense resembles that in *L. macrostomum*, as illustrated by Szidat, who gave as synonyms of the latter, *L. insigne* Witenberg, 1925 (*nec* Looss), as well as *L. paradoxum* Carus of Zeller, 1874, and of Heckert, 1889, *L. insigne* (Looss) being quoted (along with *L. turanicum*) as a synonym of *L. holostomum*. If McIntosh's key (1932) be followed, our species would be placed beside *L. icteri* McInt., 1927, but the latter is a more elongate parasite, with its suckers smaller in relation to the length of the worm, and has much shorter vitellaria, a circular ovary, and gonads more remote from the ventral sucker. *L. australiense* differs from *L. actitis*, *L. varia* and *L. cyanocittae* mainly in regard to the posterior extension of the intestinal crura, vitellaria and uterine loops. McIntosh (1932, 39) referred to the similarity between *L. actitis* and *L. insigne* of Witenberg (*nec* Looss). *L. australiense* somewhat resembles *L. dasylophi* Tubangui (1928), but differs in regard to the distribution of the yolk glands and the forward extension of the uterine loops.

LEUCOCILORIDIUM FROM SUCCINEA AUSTRALIS

In a snail collected in May, 1938, at Elwomple, there were found two pulsating sacs, one in each antenna. In strong sunlight the pulsation and the coloured bands could be seen through the snail's tissues. One sac measured about 7.5 mm. long and 1.4 mm. broad. The banding was different from that occurring on sporocysts previously described by us. The coloured bands on the distal third of the sac consisted of an irregular ring of brown wart-like processes proximally; then two complete reddish-brown rings, a green band occupying the more distal part of the second brown ring; then two green bands; a bright reddish-brown band; and a narrow dark brown band; and a series of six brown warts arranged at the free extremity. The other sac was similar, except that there were fewer warts in the proximal row, the colouration of the second green band was irregular, and the dark brown ring was interrupted on one side to form wart-like processes. One sac was sectioned and the structure of a coloured band (fig. 12) was seen to be similar to that described by Mönnig (1922). The cercariae (fig. 10) resembled those of *L. australiense* in all features. The anterior sucker was 2.21 mm. long by .19 mm. broad, and the posterior .15-.17 mm. in diameter. Some of the worms were fed to a canary, but adult stages were not obtained.

The presence of both brown and green sacs in European *Succinea* has been referred to by authors and slight differences in sucker ratio in their cercariae seem to exist (Johnston and Cleland, 1938, 32). Mönnig (1922) described and figured both kinds of sporocysts and tabulated the measurements of the organs of the cercariae from each type, stating that the differentiation of them as specifically distinct could not be justified. His figure of the cercariaeum of *L. macrostomum* shows it to be *L. holostomum*.

Hsü (1936) described green sporocysts with brown apical spots from *Succinea putris* in Germany and fed the cercariae to five species of birds, obtaining infection in a canary, a charadriid (*Paroncella pugnax*), and sparrows.

Various stages in development were figured. Variation in the relation of the vitellaria to the termination of the crura was observed, and similar variation was found in natural infections. The structure of the vitelline follicles, as well as their lateral extension appeared to afford specific characters, as also did the relation of the uterine loops to the crura. He reported that the species which he obtained by feeding green sporocysts, was that erroneously identified by Witenberg as *L. insigne* and was possibly the same as that described by Zeller in 1874 as *L. paradoxum*, but was different from that described by Heckert in 1889 under the latter name. Heckert's sporocyst was green with bright red apical flecks and probably belonged to a species found by Hsü in *Vanellus*, the species being related to *L. holostomum* and being most probably *L. sine* Yamaguti. Witenberg's *L. insigne* appeared to be without a correct name. We may point out that McIntosh (1932, 39) considered Witenberg's species to be distinct from *L. insigne* Looss, but closely related to *L. actitis*. As the differences mentioned by McIntosh seem to be very slight, it is likely that the correct name for Witenberg's form may be *L. actitis*.

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