

NEW SPECIES OF AVIAN CESTODES.

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(Plates iv.-vi.)

CHOANOTÆNIA MELIPHAGIDARUM, n.sp.

(Plate iv.)

The small intestines of several species of birds belonging to the family *Meliphagidae* ("honey-eaters") more or less frequently harbour a thin, delicate, multi-segmented and relatively long cestode of about 45 mm. in length. This parasite has so far been found in the following species, in the Sydney and Hawkesbury districts, by Dr. J. B. Cleland and myself—*Meliornis novæ-hollandiæ* Lath., *Meliornis sericea* Gould, *Ptilotis leucotis* Lath., and *Ptilotis chrysotis* Lath., (Syn. *P. lewini* Swainson).

Scolex:—The scolex is very small, short and rounded in general form. A very slight constriction marks it off from the rest of the body. Its maximum breadth is at about the level of the posterior edge of the suckers, where it measures nearly 0.2 mm., whilst at the neck-constriction the width is 0.166 mm., immediately behind which the strobila again widens to about 0.2 mm. The rostellum is small and unarmed. The entire rostellar sac is a pyriform structure of about 0.097 mm. long, and having a maximum breadth of 0.042 mm. In a few of the specimens examined, the rostellum was seen to be protracted, and appeared to be a fairly prominent conical projection, whilst in others it was quite retracted. In fig.1, it is shown partly withdrawn. The organ in question shows a similarity to that in some unarmed species of *Hymenolepis*, e.g., *H. diminuta* from rats and mice.

The four suckers are rounded and cuplike, having a diameter of 0.058 to 0.068 mm. Their musculature is moderately developed, and the rather considerable depth of the cavity should tend to increase their efficiency. As will be seen from fig.1, they

do not project to any degree when viewed dorsoventrally, but in a specimen seen in end-view, the four suckers were seen to occupy the diagonals of the scolex, which here appeared in section to resemble a square with the corners rounded off. When examined laterally, these organs are seen to project prominently.

Strobila :—Segmentation is faintly recognisable at 0.312 mm. from the anterior end, the portion between this point and the head constituting a short unsegmented neck. The transverse septa separating adjacent proglottids are visible just behind this neck, and a short distance further back (0.6 mm. from the anterior end), the divisions may be recognised marginally by the presence of small indentations. In this part of the strobila the segments are about 0.174 mm. broad, by 0.052 mm. long, the ratio of breadth to length being about 3:1. The posterior edges are here well rounded. In front of this the ratio is 4:1. The segments increase gradually in width and considerably in length, the posterior edges becoming obtusely serrate. Well-developed genitalia appear in proglottids with a breadth of 0.71 mm., and a length of 0.45 mm., the ratio here being 8:5. The length continues to increase out of proportion to the breadth. In ripe segments the breadth is about 1 mm., the length 2.4 mm., the ratio now being 1:2.4. The final proglottids are only slightly connected with each other and readily separate. The anterior end is broadly rounded, the widest part of the segment now being anterior, just at about the level of the genital pore. Then there is usually a gradual narrowing, followed at the posterior end by slight widening. Some segments showed a considerable thickening at this end, due to the presence of a mass of muscle which is perhaps functional in accelerating their abstriction. Another fact worth noting is that the final segments are very thin, flat and semi-transparent.

Sex openings :—These alternate irregularly, the sequence in a typical part of the chain being L,L,R,R,R,R,L,L,R,R,R,L. The pore may or may not be located on a definite genital eminence. Its situation is marginal and anterior, being at or near the junction of the first and second fourth of the lateral margin. There is frequently a slight depression of the segment-edge, leading into

the genital cloaca, which is a relatively deep and narrow passage of 0.025 mm. long by 0.007 mm. broad. The male duct opens just below and in front of the female opening.

Body-wall, Musculature, etc.:—The cuticle when examined in a transverse section of a segment was seen to be rather thin and almost homogeneous, stratification being scarcely recognisable. It stained deeply. Immediately below it there could be distinguished a clearer zone representing the narrow basement-membrane. This was succeeded by the various subcuticular layers, the outermost of which was thin, and, though some structures could be just seen (using $\frac{1}{12}$ immersion lens) in it, their nature could not be made out. Probably, they represented the outer layer of circular muscle fibres mentioned by Blochmann.

The subcuticular cells were very well developed, and possessed the typical spindle-shape. They formed two or three indefinite rows. A deeply staining nucleolus was present. In addition to these cells and just internally to them, there were noticed several branching cells, which appear to represent the myoblasts shown in Blochmann's figures.

Between the subcuticular cells one could see the small bundles of the outer longitudinal muscles. The ring longitudinal muscles were located, as usual, in the cortex, and consisted of two concentric series of bundles near each other. The bundles contained few fibres, and were relatively weak, though those belonging to the series nearest the transverse muscles were much larger than those situated more externally. The transverse fibres enclosed a rather narrow medulla between them, the ovarian bridge bordering on the ventral layer and the upper series of testes on the dorsal layer. They were seen to pass out laterally beyond the nerve through the subcuticula for insertion. The dorso-ventral muscle-strands were moderately developed, but did not show any peculiarities.

Excretory System:—Only one pair of longitudinal excretory vessels is recognisable, these representing the ventral pair. Each has a very wide lumen, being about 0.06 mm. in diameter. These trunks are situated deeply in the parenchyma, at about half-way

between the middle and edge of the segment. Sometimes they approximate to one surface (the ventral) of the segment, here bordering on the transverse muscle-fibres, a narrow space being left between it and the dorsal transverse fibres. It is through this space that the genital ducts penetrate, while the uterus comes to pass on the other side.

The excretory trunks lie ventrally to the genital ducts, and arch downwards in passing under them. In mature proglottids, each vessel becomes very considerably widened, and instead of possessing a sinuous course, such as it has in younger parts of the strobila, forms a wide and low arch.

At the posterior end of each segment these main stems are connected by a wide transverse or commissural vessel, with a lumen of about the same diameter as that of the main tubes. On account of the approximation of the latter at the posterior end of the segments, the transverse vessels are rather short. In the riper portions of the strobila the constrictions between the proglottids become so deep, that the ventral trunks approach so closely as to make it difficult to distinguish a distinct commissural vessel.

Nervous System :—The only parts which could be made out were the rather large, longitudinal nerves. Each was seen in section as a strand lying laterally from the excretory vessel of the corresponding side, just at the edge of the medulla. The genital ducts pass dorsally to it.

Male Genitalia :—The testes occupy a compact, rounded zone lying between the main excretory vessel in the transverse plane, and between the female glands and the transverse excretory vessel longitudinally. There are about twenty vesicles, of a rounded or elliptical form, with an average size of from 0.036 to 0.047 mm. They are not all in one plane, but are arranged in two or three rows dorso-ventrally. Though they are generally bounded by the excretory vessels, sometimes vesicles occur laterally from these. In transverse section of a segment, these glands are seen to occupy the middle and upper portions of the medulla. In more mature portions of the strobila, they are surrounded by

the reticulated uterus. They appear very early (as will be mentioned later), and persist for a considerable time, being found in proglottids with eggs in a fairly advanced stage of development; but they are here already degenerating, and, by the time the oncospheres have been produced, no trace of the testes can be seen. In many of the segments one may see the individual testes surrounded by a cavity containing young embryos, this reminding one of what happens in many other cestodes, e.g., *Monopylidium*, *Dipylidium*, etc. The whole arrangement of the testes and of the female glands is very similar to that met with in these two genera, and in *Davainea*.

The vas deferens passes forwards along the midline at first as a more or less straight tube, above the testes, vitelline gland, receptaculum seminis, and the ovary. In front of the latter it becomes thrown into a series of folds and coils, and, in a transverse section of this part of the segment, the vas is seen as a rounded mass of coiled tubes occupying the central portion of the section. It extends forwards almost to the anterior end of the proglottid where it rather sharply turns laterally and backwardly in the direction of the genital pore. At about the point where the excretory vessel of the corresponding side passes ventrally to it, the cirrus-sac is entered. The walls of the vas deferens contain longitudinal muscle-fibres.

The cirrus-sac is an elongate tube of approximately equal diameter, extending from about the region of the excretory vessel to the genital pore in a fairly straight course, the length being from 0.12 to 0.13 mm., and the breadth 0.03 mm. Sometimes the sac is rather more spindle-shaped. In all cases the inner end is narrowed to become continuous with the vas deferens. The musculature of the wall is rather weak, the circular and longitudinal fibres being poorly developed.

The cirrus, which lies in a considerably coiled fashion within its sac, may be everted to a relatively considerable length, the longest specimens measured being about 0.13 mm., with a diameter of 0.011 mm. It is thus a filiform structure. This organ does not appear to possess any armature. In cases where it was

everted, a very prominent genital eminence was visible. Eversion was only seen in segments in which egg-formation had already begun, but it is probable that no significance is to be attached to this occurrence. A vesicula seminalis was not present.

The female organs consist of the usual glands and their associated ducts, the whole complex occupying the centre of the sexually mature segments, and lying just anteriorly to the testes.

The ovary is situated just in front of the middle of the proglottids lying symmetrically, and may attain a breadth of 0.19 mm., though it is generally rather less than this. It consists of two "wings" connected by a relatively long "bridge," above which pass the male and female ducts. Each wing or lobe is made up of several short, thick, slightly branched tubes. In a transverse section of the segment, the ovary appears as a horse-shoe-shaped body with the free ends widened, these being the ovarian lobes. The bridge is ventrally placed, lying adjacent to the ventral set of transverse muscles; while the lobes project upwards, their main mass lying in the middle of the medulla, and their extremities in the dorsal portion of the medulla, at about the same level as the testes. Some of the latter, however, lie still more dorsally, being located adjacent to the dorsal layer of transverse muscles. The ovarian cells are large, rounded and finely granular, with a large, round nucleus containing an eccentrically-placed deeply-staining nucleolus. From the middle of the ovarian bridge there passes off dorsally, the oviduct. This canal forms a small arch dorsally, and then passes ventrally for a very short distance to enter the fertilising duct immediately behind the ovarian bridge.

The vitelline gland is seen to be a compact organ, with a very coarsely granular appearance. It has an irregularly rounded or transversely elongate form, and is situated in the middle just behind the ovary. Its size is about 0.086 mm. broad, by 0.065 mm. long. When examined in transverse section, it is seen to be situated between the ventral limit and the middle of the medulla. It thus stands at about the same level as the ovarian bridge, but, on account of being thicker, its dorsal part lies at

the same level as the lower series of testes. The organ is also seen to be made up of relatively large rounded masses of yolk-matter. The duct passes directly dorsally and anteriorly, to enter the fertilising duct at the shell-gland complex.

This latter complex lies, in the form of a rosette, in the mid-line between the vitellarium and the ovarian bridge, its diameter being about 0·04 mm. In section the shell-gland is seen to border on the dorsal transverse muscle-fibres. Thus it lies dorsally to the plane of the ovarian bridge. The component cells are long and clubshaped, the broad rounded portion containing the nucleus embedded in granular protoplasm. A nucleolus is present. The remainder of the cell is long and narrow, serving as a duct. These cells are about 0·018 mm. long. They cover the walls of the fertilising duct for a very short distance. This duct penetrates the complex from its dorsal side.

The vagina opens externally, just behind and slightly below the cirrus-sac. It then travels inwards and slightly backwards as a narrow well-defined tube. Just after it passes over the excretory vessel of the corresponding side, it commences to widen gradually to form an elongate spindle-shaped, thin-walled receptaculum seminis, which narrows again as it approaches the ovarian bridge. Occasionally the receptaculum is more rounded on account of the contained mass of spermatozoa. Soon after passing below the ovary (between it and the vas deferens) the vagina or more correctly the fertilising duct, receives the oviduct; and then, after a very short course, passes downwards to enter the shell-gland complex. It is here that the vitelline duct joins in. Nothing of the nature of a swallowing apparatus was detected.

Situated on the walls of the vagina, in the neighbourhood of the excretory vessel, just where the receptaculum begins, and extending outwardly for about 0·05 mm., is a mass of unicellular glands. Each gland-cell is somewhat flask-shaped, the large, rounded end being nearer the middle of the segment; while the narrow end, which serves as a duct, is directed outwardly. Thus each cell is obliquely placed. The protoplasm is finely granular and homogeneous, the nucleus being large, rounded, not readily

staining, and situated in the wider part of the gland-cell. These cells were about 0.009 mm. in length, and were especially evident on that part of the vaginal wall immediately before it passes over into the thin-walled receptaculum seminis.

No bristling of the inner surface of the vaginal wall was recognised.

It may not be out of place to give a brief account of the order of development of the genitalia. The genital rudiments ("anlagen" of many authors) were just recognisable as a small medianly-situated, more deeply staining area, a very short distance behind the region where segmentation became recognisable laterally, that is, at about 0.1 mm. from the anterior end. At 2 mm. distance, the "spot" had lengthened somewhat, and the posterior end of it had become subdivided to form the rudiments of the testes, the anterior part still remaining undifferentiated. Further back, a transversely placed "streak" was seen to arise from the latter portion, and to develop laterally for a short distance. At this time the anterior portion had the appearance of being rather obliquely placed, whilst the testes were now small and numerous, but well defined, and occupied a compact zone in the middle of the hinder third of the segment. At 5 mm. from the scolex, the anterior mass was seen as a dense deeply-staining structure, rather sharply marked off from the testes. The lateral projection had now developed sufficiently to be seen under the excretory vessel, and shortly afterwards became differentiated more or less completely into the two genital ducts, the more anterior being the vas deferens. Lumina could now be detected. The anterior portion of the genital rudiment was now recognisable as the slightly coiled precursor of the much coiled portion of the male duct. This was traceable backwards along the middle of the segment, where it came into relation with the testes. The outer end of the lateral portion now became swollen and somewhat fusiform, this being destined to develop into the cirrus-sac. The ovary and vitelline glands developed later, and more slowly. The male glands had reached their full size, while the female glands were still small. Nevertheless, the latter had practically



reached their full development by the time that the vas deferens and vagina had established communication with the exterior. The shell-gland was recognisable fairly early as a glandular mass surrounding the inner end of the vagina (*sensu lato*).

The vas deferens, cirrus-sac, vagina, and receptaculum seminis persisted in segments containing ripe eggs, though all of these ducts were less prominent than in sexually mature segments. The most persistent of the genital organs were the shell-gland and vitelline gland, the former, or rather its débris, being seen in fairly ripe segments. The ovary was recognisable for only a short distance posteriorly from the point where the testes had disappeared.

The uterus originated on the ventral side of the shell-gland complex, and was recognised rather early as a reticulum surrounding the testes. It first occupied the same area as the testes, that is, the middle of the posterior third of the segment. Small eggs were seen lying in the uterine reticulum. As these developed and increased in size, the testes dwindled and finally disappeared. The uterus gradually invaded the rest of the parenchyma, passing forwards and outwards below the excretory vessels. Each lobe or pouch of the uterus contained several eggs, and retained its connection, though sometimes very slightly, with the other parts. The formation of separated egg-capsules lying embedded in the parenchyma, such as is found in the genera *Monopylidium* and *D. pylidium*, was not recognised. The eggs came to be arranged in single layer, spreading laterally from the subcuticular layer of one side to that of the other side, and from the anterior end of the segment to the transverse vessel.

The eggs were rounded or elliptical, the outermost shell measuring 0.05 to 0.07 mm. in diameter, more usually about 0.06 mm. This shell was thin, delicate, and not resistant. The embryo was elliptical, with a diameter of 0.028-0.039 mm., and invested very closely by a delicate shell. This inner shell was in turn surrounded by an irregular loose (albuminous?) envelope. The embryonal hooklets were 0.015 mm. in length, one half being curved and pointed, the other being straight and obtusely rounded.

The ripe segments of this parasite are capable of movement, as I have seen them creeping about in the intestine of a bird which had just been shot. The progression, viewed with the naked eye, appeared to be the result of peristaltic muscular action. Several ripe proglottids showed the presence of a considerable thickening, due to muscular activity at the posterior end. This may be connected with the movement of such segments, or it may serve the purpose of throwing off the succeeding ripe segment while both are connected with the parent strobila.

Systematic Position.—As mentioned above, the four species of birds in which this cestode has been found, all belong to a peculiarly Australian Order, the *Meliphagidæ* or "Honey-eaters." No parasites, excepting *Hæmoprotozoa** and *Filariae*† had been recorded as occurring in members of this family, until I‡ mentioned the presence of these cestodes under the name of *Choanotænia* sp.; though, at the same time, certain differences between this tapeworm and typical members of that genus were noted. A more detailed study of the worm has emphasised the importance of these differences.

The genus *Choanotænia* was founded by Railliet, in 1896, with *Tænia infundibulum* Bloch (syn. *T. infundibuliformis* Goeze) as its type-species. The diagnosis given by Prof. Fuhrmann||, in a recent work, is as follows:—Scolex small, rostellum bearing a single circlet of hooks; strobila consisting of many segments, the last often longer than broad; genital

* Cleland, J. B., and Johnston, T. H., "Description of New Hæmoprotozoa from Australian Birds," Journ. Proc. Roy. Soc. N. S. Wales, xliii., 1909, pp.75-96; *Id.*, "The Hæmatozoa of Australian Birds," Trans. Roy. Soc. South Australia, xxxiv., 1910, pp.100-114.

Johnston, T. H., "On Australian Avian Entozoa," Journ. Proc. Roy. Soc. N. S. Wales, xliv., 1910, pp.100-112.

† Bancroft, T. L., Proc. Roy. Soc. Queensland, vi., 1889, pp.58-62. Johnston, T. H., *l.c.*, xliv., 1910, pp.110-112.

‡ Johnston, T. H., *l.c.*, xliv., 1910, pp.110-111.

|| Fuhrmann, O., "Die Cestoden der Vogel," Zool. Jahrb. Suppl. Bd., x. Heft 1, 1908, p.54.

pores alternating irregularly; sex-ducts passing between the excretory vessels; testes situated at the posterior end of the segment; uterus sac-like. He goes on to state*, amongst other things, that *Choanotænia infundibulum* had been shown, by Cohn and by Clerc, to possess characters which he regarded as sufficient to justify its inclusion in his genus *Monopylidium*, the type of which is *M. musculosum* Fuhrmann. He, therefore, considered that a new type should be taken for *Choanotænia*, and selected *C. galbulæ* Zeder. Railliet and Henry† then pointed out that, if the type of *Choanotænia* possesses the features of the more recently erected genus *Monopylidium*, then the latter must be a synonym of the former. Moreover, a type-species, when once designated for a genus, cannot be replaced by another in that genus. They then proposed the name *Icterotænia* for the remaining species included by Fuhrmann in his genus *Monopylidium*.

Ransom‡ has recently given a summary of the discussion, but he has retained both *Choanotænia* and *Monopylidium*, though he has given a fuller diagnosis of the former. His reason for maintaining both genera is that, in the former, true egg-capsules do not occur, as far as is known; whilst in the latter genus, they do. He therefore restores *T. infundibulum* to *Choanotænia*, but leaves the other species in *Monopylidium*. As he had studied *C. infundibulum* in detail||, he has been able to give a more extended diagnosis of this genus¶ the following details being either substituted for, or added to, some of those given above:—Genital pores

* Fuhrmann, O., *l.c.*, p.54, p.66, footnote.

† Railliet, A., and Henry, A., "Les Cestodes des Oiseaux," *Rec. Med., Vet. Paris*, lxxxvi., 1909, pp.337-8. Quoted by Ransom, B. H., "The Tænioid Cestodes of North American Birds." *Bull. 66, U. S. Nat. Mus.*, 1909, p.74.

‡ Ransom, *l.c.*, p.74.

|| Ransom, *Ann. Rep. Bur. Animal Industry*, xxi., 1904(1905), pp.277-78.

¶ Ransom, *Bull. 69, U. S. Nat. Mus.*, 1909, p.74.

irregularly alternate near the anterior border of the segment; genital canals passing between the longitudinal excretory vessels, and dorsally to the nerve; vas deferens coiled, vesicula seminalis absent; "uterus persistent, sac-like but may be subdivided into numerous, small communicating chambers incompletely separated by partitions infolded from the wall of the uterus, so that in some cases the eggs appear almost as if isolated in the parenchyma."

In *Monopylidium*, there may be a single or a double crown of hooks, the genital pores alternate irregularly, and the ducts either pass* between the longitudinal vessels or dorsally to them. The other features are the same as those in *Choanatenia*, with the exception of the uterus, which is here strongly branched, and finally breaks down into capsules which usually contain one egg.

We are now able to compare our parasite with these two related genera. The scolex is unarmed in the species under review, but is armed in the representatives of the two genera. The male and female genitalia conform to the same general plan in all three, and the genital pores are similarly arranged. Besides this, the genital ducts pass dorsally to the nerve and the ventral excretory vessel. In *Choanatenia* they pass between the dorsal and ventral vessels; in *Monopylidium* they pass either between them or dorsally to both; whilst in our species there is only one vessel—the ventral—present, and, as already mentioned, they pass dorsally to it. The uterus in this cestode arises as a reticulum surrounding the testes, very similar to that seen in *Monopylidium passerinum* Fuhrm.† Ripe segments become filled with eggs, so that, at first sight, one might be led to regard the uterus as being sac-like; but in section, it was seen to be made up of a large number of chambers, which maintained their communication

* Ransom, 1909, *l.c.*, p.76.

† Fuhrmann, O., Centr. f. Bakt., Orig., 1, xlv., 1908, p.528. Johnston, T. H., Journ. Proc. Roy. Soc. N. S. Wales, xliii., 1909, p.405.

with each other. The formation of separated egg-capsules was not recognised. The uterus thus arises as it does in *Monopylidium*, but reaches a condition similar to that seen in the typical species of *Choanotænia*.

The type-slide of *Choanotænia meliphagidarum*, taken from *Ptilotis leucotis* Lath., has been deposited in the Australian Museum, Sydney.

ANOMOTÆNIA RHINOCHETI, n.sp.,

from the Kagu,

Rhinochetus jubatus Verr. & Des Murs.

(Plate v.)

Mr. H. E. Finckh, of Mosman, Sydney, was kind enough to hand over to me, for examination, a specimen of this rare New Caledonian bird, which had died after having been in captivity at his home for six months. As this bird belongs to a very aberrant group, and is fast approaching extinction, its intestinal fauna is worthy of some attention. In it, I found numerous very small tapeworms, and abundance of tiny, thin, free segments. The maximum length of the specimens in my possession is 3.7 mm., but, as the final segments readily fall away, and as the parasites were already dead when I obtained them, the length of the strobila may have been a little greater. The terminal segments, however, contained fully developed oncospheres. The chain consists of a relatively powerful scolex, and a comparatively small number of segments.

The Scolex.—Situated at the anterior end of the cestode, is the rounded scolex, which is only slightly wider than the succeeding, short, unsegmented neck. The maximum width is about 0.27 mm. The four suckers are large, and well provided with musculature, the breadth being 0.014 mm. The openings are directed laterally, and slightly anteriorly. On the apex of the scolex is situated a rather long, retractile rostellum, a cylindrical organ of 0.065 mm., in width, excepting at the free end, where it becomes swollen to form a knob

0.086 mm. broad. This knob bears the double row of hooks. The rostellum may be everted to a distance of 0.12 mm. in front of the scolex, or it may be completely retracted into the strongly muscular rostellar sac, which has a length of about 0.22 mm. The hooks are arranged in two rows, each consisting of about ten. In most of the specimens these structures have fallen off, but in the few cases in which they remain in position, one can readily distinguish the presence of two series. The hooks of both circlets are large, being 0.062 mm. long, and possess the form shown in Fig.4. The anterior attachment is long and thin, the ventral root prominent and distinctly bifid, and the claw long and pointed. A few hooks were seen measuring only 0.050 mm. in length, with a much more prominent ventral root than that figured.

The Strobila.—The scolex is followed by a short, unsegmented region having a width of 0.21 mm., and a length of 0.07 mm. The segments nearest the neck are very narrow, but are well differentiated laterally, the margins being acutely serrate. There is an increase in width and length as the segments pass backwards, the posterior angles becoming more projecting; the ratio of length to breadth of the segment is about 7:1 in the anterior part of the chain, whereas in segments with mature genitalia it is only 3:1, the breadth at the posterior end of these segments being about 0.50 mm., and the length 0.174 mm. In ripe (*i.e.*, egg-bearing) proglottids these dimensions are 0.46 and 0.165 mm. respectively, the ratio thus being nearly the same as in mature portions of the chain. In egg-bearing segments the form is somewhat different, the posterior border being relatively shorter, and the edges much less pronounced. The corners are more rounded-off, and there is less projection beyond the anterior edge of the succeeding joint. There is very little overlapping in this portion of the strobila, and the parts are readily detached. The genital pores, which alternate fairly regularly, are situated on a prominent papilla at about the middle of the edge of each segment. The male

opening lies just in front of the female pore. The genital atrium is insignificant.

The musculature is weak. The fibres belonging to the longitudinal muscles are arranged in two concentric series of bundles. Owing to the smallness and fragility of the parasite, I was unable to make satisfactory sections, and consequently cannot give much information relating to the subcuticular structures, the musculature, and the nervous system. The transverse fibres were recognised, lying ventrally just below the developing uterus, and dorsally above the male glands and ducts. The longitudinal nerve was seen to lie laterally beside the main longitudinal excretory vessel. The latter is a well defined tube, with a lumen of 0.006 mm., lying laterally near the junction of the medulla and cortex. Each forms an arch with the concavity inwards, approximately limiting the outer edges of the medulla. A narrow, transverse vessel lying close to the posterior border of each proglottid, connects the main or ventral vessels of each side. A dorsal, longitudinal stem was not seen. The genital ducts pass dorsally to the nerve and excretory trunk of the corresponding side.

Male Genitalia.—The testes are from 17 to 22 in number, and may be recognised, at about 0.4 mm. from the front of the scolex, as a number of small, round, deeply staining bodies arranged in a definite line at the posterior edge of the segment, and extending from the ventral vessel of one side to that of the other side. They rapidly increase in size, and then are seen to be arranged, in surface-view, in two or three overlapping rows, which are at different dorsoventral levels. They lie behind the female glands, though they may somewhat overlap the vitellarium. Their position is distinctly dorsal, the uppermost series bordering on the dorsal transverse muscle. Each vesicle is approximately spherical, having a diameter of from 0.0028 to 0.035 mm. From each of these passes off a large prominent vas efferens, which joins its fellows to form the large, dorsally placed vas deferens. This

passes forwards, and then laterally towards the pore-bearing edge. It very soon becomes thrown into an extensive system of coils, occupying a very large part of the mature segment, and lying in the antero-lateral corner of the medulla. Some of the coils may be seen in the middle of the anterior part of the proglottid. In a section of this portion, the vas is seen to fill fully one-quarter of the medulla, and to extend from the dorsal almost to the ventral transverse muscle-layer. At about the mid dorsoventral level of the convoluted mass, the vas passes laterally above the excretory vessel and nerve, to terminate in the weak cirrus-sac. This portion of the vas deferens lies in front of, and approximately parallel to, the vagina. Contrary to the condition usually met with in Cestoda, the testes persist, and may be distinctly recognised in segments containing hexacanth embryos, though they do not appear to be any longer glandular. The vasa efferentia and the vas deferens also remain, the latter being very considerable in dimensions. In fact, the persisting male structures occupy about one-half of the medulla in ripe proglottids.

The cirrus-sac is a long, thin, cylindrical or fusiform structure about 0.07 mm. in length, and 0.016 mm. in width. Its musculature is poorly developed. The cirrus, when everted, is seen to be about 0.004 mm. long, and 0.006 mm. wide; and to be densely covered with minute spines.

Female Genitalia.—The female complex is not situated in the middle of the segment, but lies rather nearer to the pore-bearing edge. The ovary, which is about 0.16 mm. in breadth, is approximately transverse in position, lying immediately posteriorly to the coiled mass of the vas deferens, and in front of the testes and vitellarium. It is a bilobed organ, each lobe or wing consisting of comparatively few ovarian tubes. The lobe which lies near the pore side is situated more ventrally than the other. The bridge connecting the lobes lies more ventrally than these, but anteriorly and slightly dorsally to the shell-gland. A narrow oviduct passes

backwards from the "bridge" in a small arch, towards the shell-gland. The vitellarium lies just behind the middle of the ovary, and, like it, lies asymmetrically, being displaced towards that margin which bears the genital cloaca. The organ is about 0.062 mm. broad, by 0.02 mm. long. In general shape it somewhat resembles a lobulated kidney, the hilum being directed antero-laterally. The posterior border is divided to form a few lobes. Its duct passes forwards towards the shell-gland, a small organ lying between it and the ovarian bridge. The vitelline gland is the most ventrally placed of the female organs, the ovary being the most dorsal. The shell-gland lies antero-dorsal to the yolk-gland. The vagina passes inwards from the female pore posteriorly to the cirrus-sac and vas deferens, dorsally to the ovarian lobe of the corresponding side, to take up the oviduct just behind the bridge near the shell-gland. A receptaculum seminis was not observed. The mature uterus is a flat, sac-like organ which fills almost the whole ventral portion of the medulla. It lies below the vas deferens and the remnants of the testes, these structures being present in ripe segments, and occupying a large part of the dorsal region of the medulla. The eggs are circular, the outer delicate shell being 0.035 mm. in diameter, the inner more resistant covering 0.027 mm., and the oncosphere about 0.020 mm. The embryonal hooklets are very delicate, and measure 0.310 mm. in length.

Systematic.—This parasite has been recorded by me* as *Amæbotænia* sp., mention being made of the presence of well developed suckers, an armed rostellum, and somewhat irregularly alternating genitalia. A more careful examination shows that there are two circlets of hooks in this species, whereas members of the genus *Amæbotænia* have only a single row. It seems to come near *Anomotænia* Cohn, and *Laterotænia* Fuhrm., but differs from the latter in the disposition of the testes. I am, consequently, placing it under Cohn's genus.

The type-slide of *Anomotænia rhinocheti* will be deposited in the Australian Museum, Sydney.

* Johnston, T. H., Journ. Proc. Roy. Soc. N. S. Wales, xliv., 1910, p. 122.

DAVAINEA HIMANTOPODIS, n.sp.

from *Himantopus leucocephalus* Gould.

(Plate vi.)

My colleague at the Bureau, Dr. Cleland, recently collected some entozoa from a White-headed Stilt, *Himantopus leucocephalus* Gould, shot at Tailem Bend, Murray River, South Australia. Amongst them, were a few very small cestodes, measuring a little over 1 mm. in length. Amongst the intestinal contents of the bird, I found several ripe, free segments belonging to the same species.

The Scolex.—The scolex is rounded in general shape, and is marked off from the rest of the strobila by a constriction, almost immediately behind which segmentation begins. The dimensions are: length (excluding rostellum) 0.115 mm.; breadth 0.146 mm., the broadest part being behind the suckers. Situated in the anterior portion, are the suckers, which are only moderately developed, having a diameter of about 0.03 mm. The openings are directed anteriorly or antero-laterally. Around the margin of each there is arranged a row of small hooks, 0.005 mm. long, which are readily lost in dead specimens. Their form could not be clearly distinguished. On the apex of the scolex there is a cuplike depression in which there lies a protractile rostellum. The rostellum is 0.034 mm. long, and has a broader, rounded, free extremity carrying the hooks, connected with the scolex by a narrower, short, stalk-like portion. The maximum breadth of the rostellum is 0.03 mm. Surrounding it there is a double row of small hooks about 0.007 mm. in length (*i.e.*, from the ventral to the dorsal root), and possessing the hammer-form typical in the genus *Davainea*. The claw is relatively powerful. There are about 25 hooks in each row (Fig.3).

Strobila.—As previously mentioned, segmentation follows almost immediately behind the head, consequently an unsegmented neck is practically absent. Most of the tapes examined possessed seven or eight segments. Their general form

is shown in Fig.1. The first proglottid is about 0.017 mm. long, and 0.18 mm. broad, the ratio being 1:10. As the length increases much more rapidly than the breadth, this ratio decreases. In the fourth, the length is 0.08 and the breadth 0.273 mm., the ratio being 1:3.4. In the sixth segment, where a marked increase in length, accompanied by full sexual maturity occurs, the length is 0.130 and the breadth 0.283 mm., the ratio being nearly 1:2. In the seventh segment the difference is about equalised, the segment being rounded, the length reaching 0.243 and the breadth 0.291 mm., the ratio now being 5:6. The next segment is frequently much broader, and slightly shorter, being 0.40 by 0.227 mm. It is at this part of the strobila, where egg-formation is actively proceeding, and where the segments themselves seem to be thrown off, as each end of this and succeeding segments (if any) is strongly contracted. Some free proglottids were measured with the following results:— (a) Length 0.390, breadth 0.468 mm.; (b) length 0.437, breadth 0.65 mm. This seems to indicate, either that there is a very considerable increase in growth after the separation of the ripening segments, or (more probably) that those which are ripe are so feebly connected with the rest of the strobila, that they readily become detached.

It will be noticed that, in no case, do the posterior edges of the segments project, but that the lateral margins are convex outwardly.

The genital pores alternate regularly, as a rule, very few exceptions being detected. It is only in the larger proglottids that the pores are present. They are located in the anterior third of the lateral margin. There is no genital papilla, even in cases where the cirrus is everted. The genital cloaca is relatively deep and narrow.

Calcareous corpuscles were not detected, nor was any part of the nervous or excretory system. The longitudinal musculature is seen to be well developed, and to consist of a number of powerful bundles which may be traced from one

end of the parasite to the other. They lie rather deeply in the parenchyma. Transverse fibres are well developed at each end of the ripening segments, and probably are functional in bringing about their separation.

Genitalia.—Traces of the male genitalia are to be recognised in the first segment, the rudiments becoming much more distinct in the second, and fairly well developed in the third. In the fifth, sixth, and seventh, both male and female glands are present, the latter very rapidly increasing in size, in passing back from the fifth to the seventh, where they are fully mature. In the sixth and seventh the cirrus-sac and vas deferens are at their maximum development, though male sexual maturity may be reached in the fifth segment. In the latter, the receptaculum seminis may be somewhat distended by the contained spermatozoa. In the succeeding two proglottids, this structure was greatly swollen. In the next, the male and female organs, excepting the cirrus-sac, the vas deferens, and part of the vagina, have disappeared; and, in segments containing ripe eggs, the cirrus-sac is the only other structure recognisable. In some instances there were indications that self-fertilisation takes place, as the end of the cirrus appeared to be bent round to enter the lateral part of the vagina.

Male genitalia.—There are four testes, of a rounded or elliptical form, being from 0.043 to 0.060 mm. in diameter. Three are situated behind the ovary, the other being lateral to it on the side remote from the genital pore. The vas deferens is a wide, coiled tube lying just behind and internally from the cirrus-sac. It ultimately enters the inner end of the sac as a narrow tube, the greater part of it being thin-walled, and thrown into a few long loops. It then passes back again to enter the cirrus, which, in the state of rest, is about 0.11 mm. long.

The cirrus-sac is a large, elongate, fusiform organ situated in the antero-lateral corner of the segment. Its walls are moderately muscular. From the inner end there pass off

retractor muscle-fibres. The whole sac is situated well within the segment, there being a narrow, canal-like, genital cloaca (0.046 mm. long) leading from the male and female openings to the exterior. The male aperture lies just in front of the female. When the sac is contracted, and the cirrus therefore everted, the former appears as a small, pyriform body with rather thick, muscular walls. The everted cirrus, which is about 0.098 mm. long and 0.015 mm. broad, projects through the common genital pore for a distance of 0.062 mm. It possesses a very characteristic armature, represented in Fig. 5: at, and near the free end, there is a large number of long, delicate, stiff, hyaline spines (0.031 mm. to 0.047 mm. in length), which gradually taper. These come to project backwardly. In the figure, many are seen with their points directed forwards, the cirrus evidently not being fully everted. Just behind these, the tube is covered externally by a great number of very small thornlike spines, but just at the base of the eversible portion, these become replaced by a third kind. These last are much fewer in number, and larger in size, and project more prominently than the last-mentioned. They have a much wider base.

Female genitalia.—The female complex is situated at about the middle of the segment, though it is generally slightly displaced towards the pore-bearing margin. The ovary, when mature, is a large bilobed organ, the wings being connected by a short ovarian bridge which is not readily recognisable. Each lobe is a rounded mass, not differentiated into egg-tubes. The diameter of each is about 0.07 mm., the total breadth of the organ being nearly 0.14 mm. A short oviduct passes backwards from the middle of the ovary. The position of the gland in relation to the testes has already been mentioned. It lies antero-dorsally to the vitellarium, which is the most ventrally placed of all the reproductive glands. The latter is a compact round organ of 0.046 mm. diameter, situated near the midline, just behind and between the ovarian wings. From it the vitello-duct passes forwards. A shell-gland was not observed, nor was the

point of junction of the vagina and the other female ducts made out.

The vagina is a wide, short tube leading from the female pore inwards, to become greatly widened to form a rounded receptaculum seminis lying between the ovarian lobe of that side and the cirrus-sac. A short continuation of the canal passes inwards and backwards below the middle of the ovary. Its course could not be followed further.

The uterus does not persist, as the eggs in segments which have just passed sexual maturity, are found in great numbers in the parenchyma. The eggs are rounded, having a diameter of 0.0234 mm., the shells closely investing the oncospheres. The embryonal hooklets are very delicate, and are only 0.008 mm. in length.

Systematic.—The only other species of *Davainea* described from birds belonging to the *Charadriiformes*, is *D. minuta* Cohn* from *Tringa totanus* (from North Germany), a host-name which Fuhrmann † has not been able to find. *D. himantopodis* and *D. minuta* show very close resemblance in regard to the form of the strobila, the characters of the scolex, and the general disposition of the genitalia as given in Cohn's figure. A comparison of the two accounts shows that the former differs from the latter in the following points - the smaller scolex, the possession of fewer testes, and the much earlier appearance of both male and female genital organs. Cohn's account is short and incomplete, as he had only immature specimens.

The type-slide of *D. himantopodis* will be presented to the Trustees of the Australian Museum, Sydney.

EXPLANATION OF PLATES iv.-vi.

Plate iv.

Choanotania meliphagidarum.

Fig. 1.—Scolex.

Fig. 2.—Segment showing genitalia.

Fig. 3.—Female organs, etc.

Fig. 4.—Egg.

* Cohn, L., Nova Acta, etc., lxxxix., 1901, p. 414.

† Fuhrmann, Zoolog. Jahrb. Suppl. Bd. x., 1, 1908, p. 119.

Plate v.

Anomotænia rhinocheti.

- Fig. 1.—Anterior part of strobila, rostellum everted.
 Fig. 2.—Anterior part of strobila, rostellum retracted.
 Fig. 3.—Segments, showing anatomy.
 Fig. 4.—Hook from rostellum.

Plate vi.

Davainea himantopodis.

- Fig. 1.—Entire strobila, with some free segments in addition.
 Fig. 2.—Scolex.
 Fig. 3.—Hook from rostellum.
 Fig. 4.—Mature segment showing genitalia.
 Fig. 5.—Portion of segment, showing everted cirrus bearing the characteristic spines.

Reference letters.

c., cirrus—*c.h.*, cirrus-hooks—*c.s.*, cirrus-sac—*e.*, eggs—*g.e.*, genital eminence—*r.h.*, rostellar hook—*n.*, longitudinal nerve—*o.d.*, oviduct—*ov.*, ovary—*r.s.*, receptaculum seminis—*s.g.*, shell-gland—*t.*, testes—*tr. v.*, transverse excretory vessel—*v.* vagina—*v.c.*, gland-cells on vaginal wall—*v.d.*, vas deferens—*v.g.*, vitelline gland—*v.e.v.*, ventral excretory vessel—*y.d.*, yolk-duct.



Johnston, T. Harvey. 1911. "New species of avian cestodes." *Proceedings of the Linnean Society of New South Wales* 36, 58–80.

<https://doi.org/10.5962/bhl.part.21893>.

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