

# STRIGEATA (TREMATODA) OF AUSTRALIAN BIRDS AND MAMMALS FROM THE HELMINTHOLOGICAL COLLECTION OF THE UNIVERSITY OF ADELAIDE

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## Summary

An important collection of Strigeata of birds and mammals has been made by the Department of Zoology of the University of Adelaide.

The present work records thirty species, of which seven are new. Descriptions of the new species with additional information on some of the others are given.

The new species from birds are: *Apatemon* (*Apatemon*) *vitelliresiduus* (from *Bizura lobata*), *Cardiocephaloides ovicorpus* (from *Phalacrocorax melanoleucos brevirostris* and *P. varius*), *Cotylurus* (*Cotylurus*) *magniacetubulus* (from *Cygnus atratus*), *Diplostomum* (*Diplostomum*) *parvulum* (from *Hydroprogne caspia* and *Pelecanus conspicillatus*), *Neodiplostomum* (*Neodiplostomum*) *lanceolatum* (from *Ninox novaeseelandiae*).

The new species from mammals are: *Neodiplostomum* (*Triloborchidiplostomum*) *diaboli* (a new subgenus, for which the diagnosis is given) (from *Sarcophilus harrisi*) and *Pharyngostomoides dasyuri* (from *Dasyurus viverrinus*).

## Résumé

Une importante collection de Strigeata d'Oiseaux et de Mammifères a été constituée au Département de Zoologie de l'Université d'Adelaide.

Le présent travail comprend la description ou la mention de 30 espèces, dont 7 sont nouvelles: *Apatemon* (*Apatemon*) *vitelliresiduus*, *Cardiocephaloides ovicorpus*, *Cotylurus* (*Cotylurus*) *magniacetubulus*, *Diplostomum* (*Diplostomum*) *parvulum*, *Neodiplostomum* (*Neodiplostomum*) *lanceolatum*, *Neodiplostomum* (*Triloborchidiplostomum*) *diaboli* (n. subgen., dont la diagnose est proposée) et *Pharyngostomoides dasyuri*. Ces deux dernières espèces sont parasites de Marsupiaux (*Dasyurines*), respectivement de *Sarcophilus harrisi* et de *Dasyurus viverrinus*.

## Introduction

An important collection of Strigeata from birds and mammals has been made by the Department of Zoology of the University of Adelaide. It consisted of 92 tubes with spirit specimens, and 3 slides.

Collections and identifications made before August, 1951, are the valuable contribution of the late Professor T. Harvey Johnston, to whose memory this work is dedicated. Since that time Mrs. P. M. Thomas (Patricia M. Mawson) has done most of the collecting. One of us (L.M.A.) collected the remainder. Dr. J. C. Pearson, of the University of Queensland, Brisbane, contributed 5 specimens (*Pharyngostomoides dasyuri*) from Tasmania.

Some of the specimens are valueless, either because of poor preservation or because young stages cannot be identified with adults.

The holotypes of all the new species described in this paper have been deposited in the South Australian Museum (SAM). Paratypes, where available, are in the South Australian Museum, and in the Helminthological

Collection of the Institute of Zoology, University of Neuchâtel (G.D.). Preparations of the rest of the material are deposited in the Universities of Adelaide and of Neuchâtel.

The present publication is a continuation of 3 previous accounts of Australian Strigeida (Dubois 1937; Dubois & Pearson 1965, 1967).

Thirty species are described or recorded. Seven, one of which belongs to a new subgenus, are new. Twenty-seven are recorded as avian parasites and the other three are from mammals.

## Family STRIGEIDAE Railliet

### Subfamily STRIGEINAE Railliet

*Apharyngostrixa simplex* (S. J. Johnston, 1904). Dubois, 1968: 35, figs. 19-21. Dubois & Pearson, 1965: 79, figs. 1-3. S. J. Johnston, 1904: 112, pl. 7, figs. 1-3. *Host and origin*: *Ardea novaehollandiae* Latham, from Tailem Bend, River Murray, S. Aust., 1.v.1940 and 9.xii.1940 (2 specimens); from the Australian Museum, date? (one specimen).

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*Habitat*: upper intestine.

*Description*: These specimens, taken from the type-host, measure 2.8–3.0 mm; eggs 92–99 by 61–68  $\mu$ m.

***Parastrigea repens*** (Chase, 1921), Dubois, 1968: 68, fig. 51, Chase, 1921: 500, fig. 1 and pl. 26, figs. 1–5.

#### FIGS. 1, 2

*Host and origin*: *Circus approximans* Peale, from Tailem Bend, S. Aust., 10.iv.1950 (18 adult and 1 immature specimen) and Dec. 1938 (10 young specimens).

*Habitat*: duodenum.

Chase (1921) found three specimens of this strigeid in the intestine of *Notophox novae-hollandiae* (Latham) from Terrigal, N.S.W. The holotype, which is registered in the Australian Museum (W544), was re-examined by Dr. J. C. Pearson (see Dubois 1968, p. 68, footnote 1). On the basis of this examination, the species was removed from the genus *Apharyngostrigea* Ciurea to *Parastrigea* Szidat.

*Description*: The smallest specimens with few eggs in the uteri measure 1.6–2.2 mm. Fully mature worms are 5–6 mm long. Suckers weakly developed: oral sucker marginal, 60–115  $\mu$ m in average diameter; ventral sucker 92–165  $\mu$ m, near oral sucker. Average ratio of the oral to the ventral sucker nearly 2 : 3. Length of forebody from 9–19 (average 14) times that of oral sucker. Proteolytic gland elongated, oval or fusiform, 190–220 by 80–110  $\mu$ m, composed of closely aggregated lobules and lying between the two concentrations of the vitelline follicles.

Ovary kidney-shaped and testes multi-lobed, occupying second half of the hindbody. Vitellaria of forebody extending dorsally up to ventral sucker, concentrated in lateral semi-cordiform expansions of dorsal lip of triboecytic organ. (No follicles in ventral lip, which is as long as forebody). Scattered follicles in wall of segment, extending further forward dorsally than ventro-laterally. In hindbody, vitelline follicles concentrated in front of ovary, absent dorsally over the gonads, and extending ventro-laterally to the bursa copulatrix. Ejaculatory duct joining with uterus at entrance to genital cone. Eggs numerous, 90–105 by 60–68  $\mu$ m.

*Relationships*: *Parastrigea repens*, *P. intermedia*<sup>1</sup> Tubangui, 1932, and *P. flexilis* (Dubois, 1934) are closely related apharyngeal strigeids;

in the absence of pharynx they are distinguishable from all known members of the genus. Their normal hosts are birds of prey (Falconiformes). *P. intermedia* (from the Philippines) differs from *P. repens* in that the small suckers are subequal, and in the size of the eggs (100–112 by 71–79  $\mu$ m). *P. flexilis* is distinguished from the Australian species by having fewer eggs, and by a geographical distribution restricted to the holarctic zone of Europe and Asia.

#### ***Parastrigea* sp.**

*Host and origin*: *Threskiornis molucca* (Cuvier), from Queensland, 26.vi.1911 (4 contracted specimens, collected by A. Breinl).

*Habitat*: unknown.

*Description*: Body length 1.4–2.4 mm. Forebody 0.88–1.08 by 0.94–1.15 mm (dorso-ventral diam.), with two well-developed lateral expansions. Hindbody 0.75–1.40 by 0.81–1.05 mm. Bursa copulatrix small.

These worms exhibit a striking similarity to *P. robusta* Szidat.

A specific diagnosis is reserved until better specimens are obtained.

***Strigea baylisi*** Dubois, 1937: 1968: 82, figs. 60–61.

*Hosts and origin*: *Threskiornis molucca* (Cuvier), from Tailem Bend, S. Aust., 28.iii.1942 (one specimen), *Platalea flavipes* Gould, from Tailem Bend, 24.ii.1943 (23 specimens) and 10.xii.1947 (6 specimens).

*Habitat*: intestine.

*Relationships*: *Strigea baylisi*, which appears to be a parasite of *Plataleidae*, is distinguishable from *S. promiscua* Nicoll by its smaller size, the smallness and the weakness of the pharynx (50–60 by 37–47  $\mu$ m), the extension of the vitellaria to nearly as far as the posterior extremity, and the absence of follicles from the ventral wall of the anterior segment.

***Strigea glandulosa*** Dubois, 1937: 244, fig. 9; 1968: 101, figs. 82–84. Dubois & Pearson, 1965: 82, figs. 4–5.

*Strigea falconis* Dubois, 1937: 247, fig. 10 (not Szidat, 1928).

*Hosts and origin*: *Circus approximans* Peale, from Tailem Bend, S. Aust., 15.xii.1938 (2 young specimens). *Haliastur sphenurus* (Vieillot), from Tailem Bend, Dec. 1938, (1

<sup>1</sup>One of us (G.D.), having examined three syntypes of *P. intermedia*, has not found any trace of a pharynx.

specimen) and 18.vi.1941 (2 macerated specimens). *Falco subniger* Gray from Meningie, S. Aust., 6.v.1945 (4 specimens). *Habitat*: intestine.

*Description*: Body up to 2.8 mm in length (when extended). The smallest specimen, with eggs in the uterus, measures only 1.4 mm. Oral sucker terminal, often prominent, 120–140 by 90–125  $\mu$ m; pharynx rounded, very muscular, 95–105 by 90–105  $\mu$ m; ventral sucker 160–190 by 150–175  $\mu$ m; proteolytic gland well developed, oval, strongly lobulated, 145–210 by 170–250  $\mu$ m, lying at base of forebody.

Ovary reniform. Mehlis' gland intertesticular, well developed. Eggs 89–102 by 57–69  $\mu$ m, very numerous in mature specimens, in which the uterus may be distended into sinuous or tortuous curves and even into loops.

*Relationships*: *Strigea glandulosa* differs from *S. falcensis* Szidat in its small size and in the great development of the proteolytic gland relative to the length of the body.

***Strigea nicolli*** (Dubois, 1937). Dubois, 1968: 114, figs. 101–102.

*Strigea sutoni* Dubois, 1937: 237, figs. 5–7.

*Host and origin*: *Gymnorhina tibicen* (Latham) from Canberra, A.C.T., April 1969 (4 specimens) and 27.vii.1960 (1 specimen; collected by R. Mykutowycz).

*Habitat*: duodenum and intestine.

*Description*: Length 1.40–1.62 mm. Oral sucker 120–162 by 155–177  $\mu$ m; pharynx 85–105 by 75–90  $\mu$ m; ventral sucker 190–230 by 215–230  $\mu$ m. Eggs 108–115 by 65–72  $\mu$ m.

*Relationships*: *Strigea nicolli* resembles *S. baylisi* Dubois in general anatomy, but differs in the sizes of the suckers and the pharynx, which are definitely larger, and in the minor development of the atrial ring-shaped musculature.

***Strigea promiscua*** Nicoll, 1914: 347. Dubois, 1968: 119, figs. 107–108. Dubois & Pearson, 1967: 186.

*Hosts and origin*: *Ninox novaeseelandiae* (Gmelin) (syn. *N. boobook*) from Yalkuri, S. Aust., 24.viii.1957 (1 specimen, described below). *N. strenua* (Gould) from Eidsvold, Qld., 1.vi.1919 (22 specimens, very contracted; collected by M. J. Bancroft).

*Habitat*: intestine.

On June 9, 1965, Dr. J. C. Pearson collected the species from the small intestine of *Ninox novaeseelandiae* in Brisbane, Qld. The species

has now been found four times, always from the same host genus.

*Description*: Length 2 mm. Body very contractile, nearly as wide as long when strongly contracted (as in 1.vi.1919 material). Oral sucker 160 by 185  $\mu$ m, pharynx 115 by 105  $\mu$ m, ventral sucker 230 by 210  $\mu$ m; proteolytic gland 190 by 215  $\mu$ m, multilobed.

Ovary reniform, 170 by 260  $\mu$ m. Testes roughly lobed, the anterior measuring 285 by 390  $\mu$ m, the posterior 320 by 400  $\mu$ m. Vitellaria extending from cephalic margin to level of equator of genital cone. The latter is robust, well differentiated, larger than the ovary, 260  $\mu$ m in diam. when retracted. Genital atrium spacious, 180 to 240  $\mu$ m in depth, with ring-shaped musculature well developed. Eggs 104–115 by 75–80  $\mu$ m, 6 in number.

As at present known, it seems that *Strigea promiscua* is restricted to the Strigiformes, especially to the oriental type *Ninox*.

***Apatemon (Apatemon) vitelliresiduous*** n.sp.

FIG. 3

*Host and origin*: *Biziura lobata* (Shaw) from Tailm Bend, S. Aust., 10.xii.1937 and 9.xii.1940 (35 specimens); Sandgate, Qld., 22.ix.1918 (1 specimen); Purnong and Caloot, R. Murray, S. Aust., 20.vi.1958 (10 specimens, obtained from two hosts) (type material).

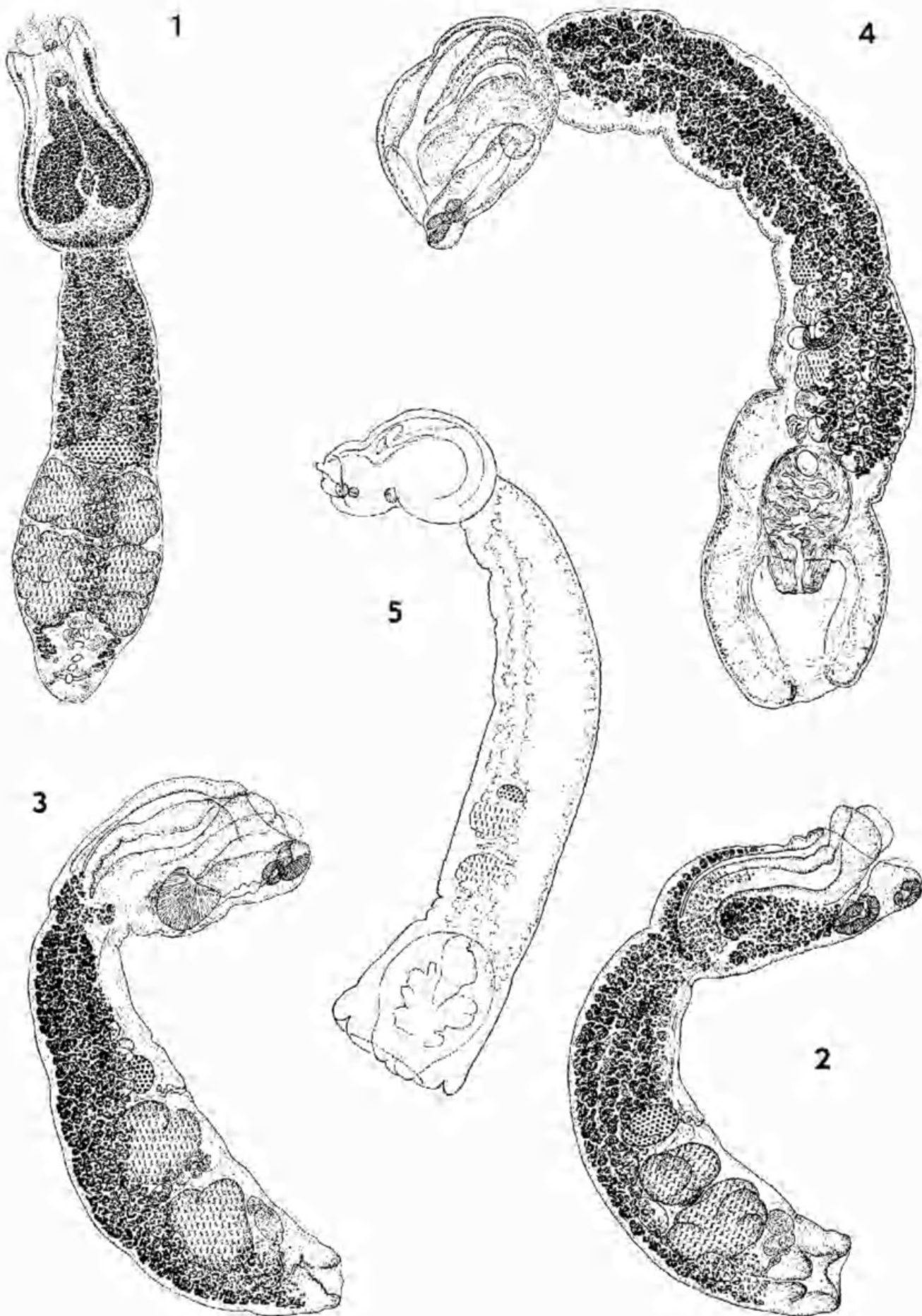
*Habitat*: intestine.

*Holotype*: length 2.6 mm. SAM, E927 (with 3 paratypes, E928, on same slide).

*Description*: Body cambered dorsally, 2.2–2.6 mm long. Forebody ovoid or cup-shaped, 0.71–0.90 mm in length by 0.51–0.64 mm in dorso-ventral diam., delimited by constriction from hindbody. Hindbody twice as long, banana-shaped, with small bursal region slightly delineated, 1.48–1.70 mm long by 0.50–0.56 mm in diam. at the level of the testes. Ratio of hindbody to forebody ranging from 1.9–2.1. Oral sucker 115–160 by 110–127  $\mu$ m, terminal in position; pharynx smaller, 85–93 by 70–75  $\mu$ m; ventral sucker postequatorial, relatively large, 190–210 by 165–180  $\mu$ m. Proteolytic gland small, rounded and lobed, situated dorsally near base of forebody, 65–80 by 60–70  $\mu$ m.

Ovary 140–150  $\mu$ m long, 180–190  $\mu$ m thick, located at anterior third (27–36/100, average 33/100) of hindbody. Testes large, approximately equal in size (first, 260–330 by 240–300  $\mu$ m, second 300–370 by 260–300  $\mu$ m), ovoid, roughly lobed, obliquely orientated with





lobes directed forward. Vitellaria are confined ventrally in hindbody, especially well developed in front of gonads, extending to near posterior extremity of worm, but not masking bursa copulatrix laterally; erratic follicles extend more or less far into ventral wall of forebody, but do not go beyond acetabular level. Vitelline reservoir lies in intertesticular space. Mehlis' gland is situated dorsally and a little anteriorly. Genital cone of medium size, 190–200 by 150–180  $\mu\text{m}$ , not well differentiated. Vesicula seminalis S-shaped and voluminous, lying postero-dorsal to second testis. Sinuous ejaculatory duct opens into terminal part of uterus at entrance to cone, to form a rectilinear, not pleated, hermaphroditic canal. Eggs 87–95 by 58–67  $\mu\text{m}$ , average 92 by 63  $\mu\text{m}$ .

**Relationships:** This new species closely resembles *Apatemon* (*A.*) *fuligulae* Yamaguti, 1933, in general morphology, but differs essentially in the presence of erratic vitelline follicles in the ventral wall of the anterior segment. This remnant appears to constitute an archaic character. In *A. fuligulae*, the eggs are larger (100–120 by 60–66  $\mu\text{m}$ ).

**Apatemon** (*Australapatemon*) *intermedius* (S. J. Johnston, 1904). S. J. Johnston, 1904: 109, pl. v, figs. 7–10. Dubois, 1968: 169, figs. 162–164. Dubois & Pearson, 1965: 85, figs. 6–7. Johnston & Angel, 1951: 66, figs. 1–28.

**Hosts and origin:** *Oxyura australis* Gould, from Tailem Bend, S. Aust., 15.i.1941 and 28.i.1941 (11 specimens). *Accipiter fasciatus* Vigors & Horsfield from Mallala, S. Aust., March 1965 (20 small ovigerous specimens). (Johnston & Angel (1951) found this species in 5 of 11 *Cygnus atratus* (Latham) from Tailem Bend).

**Habitat:** unknown.

**Description:** Body length 1.5–2.8 mm (specimens from *Oxyura australis*). This species is characterised by the structure and size of the genital cone; this organ measures 240–320 by 160–200  $\mu\text{m}$  when retracted, thus being about one fifth the total length of worm. A wide strongly folded hermaphrodite duct passes through the cone. Laurer's canal descends from

oviduct where the latter leaves the ovary, and reaches the dorsal surface on a level with anterior testis. Eggs 94–99 by 60–68  $\mu\text{m}$ .

The specimens from *Accipiter fasciatus* (possibly an abnormal host) measure 1.2 to 1.9 mm. Eggs 90–95 by 55–63  $\mu\text{m}$ .

**Cardiocephaloides hilli** (S. J. Johnston, 1904). Dubois, 1968: 180, figs. 175, 176; 1970: 722. S. J. Johnston, 1904: 110, pl. VI, figs. 1–8.

#### FIGS. 4, 6

**Host and origin:** *Larus novaehollandiae* Stephens, from Glenelg, S. Aust., 2.iii.1939 (20 specimens, from 2 hosts); West I., S. Aust., 14.vi.1968 (4 specimens); St. Kilda, S. Aust., 5–19.ix.1951 (2 specimens, from intestinal residues of four birds).

**Habitat:** duodenum, intestine.

The only previous record of this strigeid is that of S. J. Johnston (1904) who described it from the Australian gull, *Larus novaehollandiae* from Jervis Bay, N.S.W. There is only one syntype (deposited in the Helminthological Collection of the London School of Hygiene and Tropical Medicine (No. 244)) known. The following description is based on the examination of 15 specimens, slightly smaller than those of Johnston, from the Glenelg material.

**Description:** Body length 3.5–6.2 mm (6.9–8.2 mm according to Johnston). Forebody ovoid in lateral view, subcordiform in ventral view, with feebly developed lateral expansions, 0.74–1.12 mm long, 0.55–0.70 mm thick. Hindbody elongated, cylindrical and usually flexed dorsally, with bursal region set off from remainder by a more or less definite constriction, 2.80–3.18 mm long, 0.52–0.80 mm in diam. at level of testes, 0.65–0.76 mm in bursal zone. Ratio of hindbody to forebody ranging from 2.9–3.8, averaging 3.4. Oral sucker terminal or subterminal, of medium size, 95–117 by 85–106  $\mu\text{m}$ ; pharynx smaller, spherical, 80–95 by 75–95  $\mu\text{m}$ ; caeca extending back close to genital cone (fig. 6); ventral sucker, 95–130 by 115–145  $\mu\text{m}$ , lying usually just in front of middle of forebody.

- Figs. 1, 2. *Parastrigea repens*, from *Circus approximans*. Fig. 1.—Length 5.5 mm, flattened mature specimen. Fig. 2.—Length 1.8 mm, young specimen with two eggs.  
Fig. 3. *Apatemon* (*Apatemon*) *vitelliresidus* n.sp., from *Bizura lobata*. Holotype: length 2.6 mm.  
Fig. 4. *Cardiocephaloides hilli*, from *Larus novae-hollandiae*. Length 3.64 mm.  
Fig. 5. *Cardiocephaloides musculus*, from *Hydroprogne caspia*. Outline. Length 6.6 mm. Neuch. Univ. (G.D.) No. V17.

Ovary, 130–150 by 190–200  $\mu\text{m}$ , situated at about mid-length of hindbody, in front of relatively small testes (160–190 by 210–250  $\mu\text{m}$ ), which are ovoid and roughly lobed. Vitellaria confined to this segment, where they appear profusely developed up to gonads, then restricted to ventro-lateral field; they do not penetrate bursa copulatrix. Vitelline reservoir lies in intertesticular space. Dilatable bursa copulatrix large, quite often larger than forebody; occupying last third or quarter of hindbody, and enclosing powerfully built genital cone, which measures 520–740 by 340–500  $\mu\text{m}$ ; inner wall of cone, when retracted, thrown into a number of folds delimiting sinuous spaces. Uterus and muscular ejaculatory duct, the walls of which are 5–10  $\mu\text{m}$  thick, enter the cone, proceed side by side and unite to form a very short hermaphroditic canal which discharges into large genital atrium. There are two sphincters, one at orifice of cone, the other surrounding aperture of bursa. The numerous eggs measure 115–125 by 75–84  $\mu\text{m}$ , average 119 by 80  $\mu\text{m}$ ; shell thin (3–4  $\mu\text{m}$ ).

**Cardiocephaloides musculosus** (S. J. Johnston, 1904). S. J. Johnston, 1904: 112, pl. VII, figs. 4–9. Dubois, 1968: 188, fig. 185.

#### FIGS. 5, 7

*Hosts and origin:* *Chlidonias hybrida* (Pallas), from Taillem Bend, S. Aust., 27.x.1948 (6 specimens). *Hydroprogne caspia* (Pallas), from Townsville, Qld., 20.viii.1968 (1 specimen).

*Habitat:* small intestine.

The only Australian record of this strigeid is that of S. J. Johnston (1904), who described it from the crested tern, *Sterna bergii* Lichtenstein, from Broken Bay, N.S.W. The type material collected by Dr. J. P. Hill cannot be found. As a result of the examination of these new specimens, some additional structures have been seen.

*Description:* Body up to 6.8 mm long. Forebody short and cordiform, or pear-shaped (seen side view), with large lateral expansions in last two thirds, 1.43–1.57 mm long, 1.60–

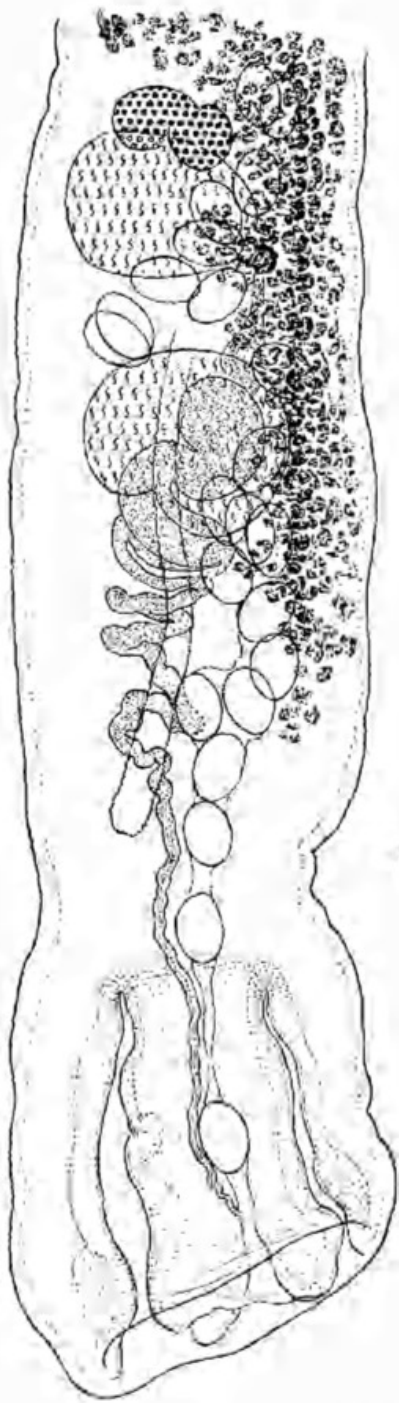
1.65 mm wide, 0.69–0.87 mm thick across the cephalic cupule, 0.95–1.15 mm at level of expansions. Hindbody elongated, subcylindrical and slightly flexed dorsally, gradually increasing in diam. towards posterior end where it is truncated, especially just in front of bursa copulatrix, 4.4–5.2 mm long, 0.72–0.87 mm in diam. anteriorly, 1.05–1.25 mm posteriorly. Ratio of hindbody to forebody from 3–3.5. Oral sucker spherical, of medium size, measuring 130–160  $\mu\text{m}$  in diam.; pharynx smaller, 125  $\mu\text{m}$ ; ventral sucker, 130–140  $\mu\text{m}$ , lying much in front of middle of forebody (about at one-third its length), where latter begins to dilate. Caeca extending laterally to level of genital atrium.

The ovary and the testes—the latter lobed and approximately equal in size (300–350  $\mu\text{m}$  long, and wider than long)—occupy about the middle third or third quarter of the hindbody. Vitellaria confined to hindbody, profusely developed in small follicles, obscuring the contents, down to the gonads, then restricted to two ventro-lateral fields, and extending down to cap of the genital cone, laterally beyond its equator. Vitelline reservoir between testes. Large bursa copulatrix a truncated cone, occupying a little less than last quarter of hindbody, delineated by a slight constriction, gradually increasing in diam., with wide open terminal aperture; enclosing a powerfully built ovoid genital cone, 1250–1600 by 950–1060  $\mu\text{m}$ , clearly defined by its own musculature. When withdrawn, its walls are thrown into a number of folds surrounded by parenchyma and muscle fibres, and delimiting sinuous spaces. A slack sphincter surrounds orifice of cone. Uterus entering cone anteriorly and connecting with ejaculatory duct. Eggs, numerous in both ascending and descending limbs of uterus, measure 110–122 by 73–80  $\mu\text{m}$ ; shell thin (3–4  $\mu\text{m}$ ).

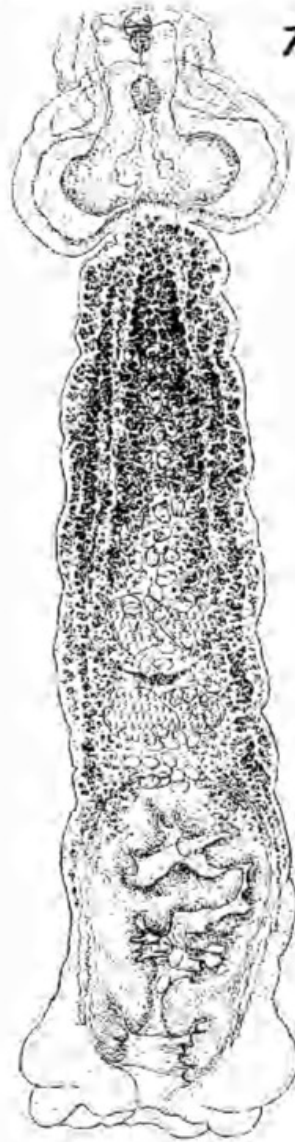
*Relationships:* *Cardiocephaloides musculosus* differs from *C. hilli* (Johnston) in the strongly muscular nature and bulk of the genital cone, and in the presence of "very strong bands of longitudinal muscle" in the hindbody (S. J.

- Fig. 6. *Cardiocephaloides hilli*, from *Larus novaehollandiae*. Second half (measuring 2.1 mm) of posterior segment.  
 Fig. 7. *Cardiocephaloides musculosus*, from *Chlidonias hybrida*. Length 6.3 mm, ventral view.  
 Figs. 8–11. *Cardiocephaloides ovicorpus* n.sp. Fig. 8.—From an unknown host. Holotype: length 5.4 mm, ventral view. Fig. 9.—Sketch of an unmounted specimen, from *Phalacrocorax varius*. Length 3.6 mm, dorsal view. Fig. 10.—Sketch of an unmounted specimen from an unknown host. Paratype: length 6.7 mm, lateral view. Fig. 11.—From an unknown host. Sagittal section of posterior region of a paratype.

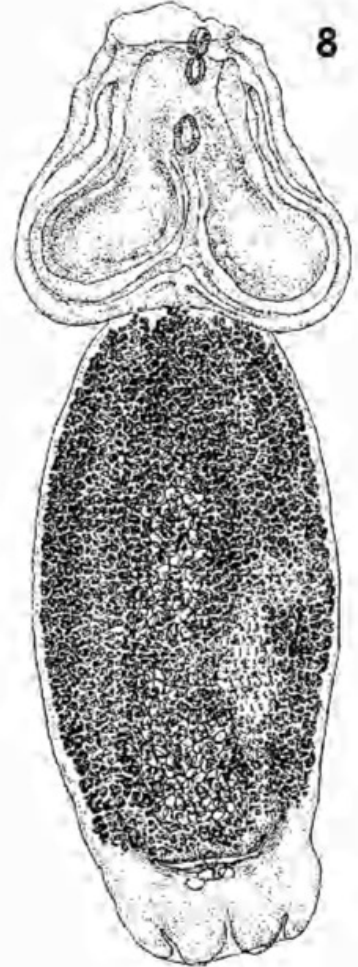




6



7



8



9

10



11

Johnston 1904, p. 114). Ratio of length of posterior segment/genital cone = 3.0–3.7 in *C. musculosus* (average 3.3) and 4.0–5.3 in *C. hilli* (average 4.8). The two species occur in Lariformes, the first in terns, the second in gulls.

***Cardiocephaloides ovicarpus* n.sp.**

FIGS. 8–11

*Hosts and origin:* *Phalacrocorax melanoleucos brevirostris* Gould, from Dunedin, New Zealand, 20.ii.1940 (6 specimens, collected by Miss M. Fyfe, Otago University). *P. varius* (Gmelin), from Port Gawler, S. Aust., 29.vi.1938 (several specimens, from two birds). Unknown host (18 attached and free specimens) (type material).

*Habitat:* intestine.

*Holotype:* length 5.4 mm. SAM, E929.

*Paratypes:* E930. (Sections in Neuchâtel University and Adelaide University collections).

*Description:* Body medium-sized, divided into distinct anterior and posterior segments. Total length 2–7.6 mm. Specimens which have recently begun egg production 2.5–3 mm long. Anterior segment, 0.98–2.40 by 1.40–2.80 mm, comprising from three-tenths to four-tenths of the body length, subcordiform, with two dilated and dorsally incurved lateral expansions in its second half, which appear with their ventral connection like a reniform collar surrounding base of cephalic cupule; latter spherical or a truncated cone. Posterior segment 1.5–5.4 by 1.0–2.6 mm, ovoid to spindle-shaped, sometimes cylindrical (fixed in extended state), often slightly arched, dumpy, massive in contracted state (greatest diam. at level of testes), narrower in atrial zone of bursa (0.74–1.75 mm) which is delineated by a more or less definite constriction at the last fifth, sixth or seventh of the segment. Ratio of hindbody to forebody ranging from 1.4–2.5, averaging 1.96. Oral sucker (marginal), pharynx and ventral sucker all small; ventral sucker a little larger than oral, situated at mid-length of forebody or in front of it (42–45/100). Oral sucker 140–200 by 110–200  $\mu$ m, pharynx 85–180 by 75–127  $\mu$ m and ventral sucker 180–210 by 120–200  $\mu$ m. Caeca enclosed in muscular, ventro-lateral bundles and extending as far as equator of genital cone, i.e. posterior limit of vitellaria. Tribocytic organ well developed, often protruding anterior to margin of forebody, and penetrating into the lateral expansions. A layer of large cells delimits the whole active

surface of this organ. Proteolytic glands distributed in numerous small, relatively scattered bunches, as shown by Baer (1969, fig. 4).

Ovary ovoid, 320 by 230  $\mu$ m, situated dorsally between 27th and 31st hundredths of length of hindbody. Testes multilobed, the mass of which measures 2100 by 1300  $\mu$ m. Vitellaria are confined to hindbody, profusely developed and obscuring its contents; lying in a large field along ventro-lateral surface up to constriction delineating genital atrium. (Last follicles 420–890  $\mu$ m distant from posterior end, having their limit between 77th and 85th hundredths of this part of body.) Field widest anterior to gonads, where follicles extend towards dorsal surface. Vitelline reservoir intertesticular. Mehlis' gland well developed, lateral and posterior to ovary. Bursa copulatrix enclosing a genital cone, 450–980 by 420–920  $\mu$ m (320–1000  $\mu$ m in diam. inside the atrium). Central part of this cone appears less muscular, but more spongy and coloured; its inner wall thrown into a few folds delimiting sinuous spaces. Uterus extending into first third of hindbody, where it develops several convolutions, then descends ventrally; behind seminal vesicle, it makes a conspicuous right angled bend to open into genital cone. Sinuous ductus ejaculatorius, wall of which is 5–16  $\mu$ m thick, opens near entrance of uterus to genital cone. Eggs very numerous, 120–130 by 78–94  $\mu$ m (thickness of shell 4–5  $\mu$ m, up to 8  $\mu$ m at the non-operculate pole).

*Relationships:* The new species resembles *C. physalis* (Lutz, 1926) [syn. *C. szidati* (Hartwich, 1954)], as figured by Dubois (1968, figs. 187–188) and rediscovered by Baer (1969) in the intestine of a cormorant from Peru (Guahape Islands), but *C. physalis* differs from it in having a much bigger bursa copulatrix, eggs with very thick shell and vitellaria extending only as far as the beginning of the bursa, and in the geographic distribution.

***Cotylurus (Cotylurus) magniacetabulus* n.sp.**

FIG. 12

*Host and origin:* *Cygnus atratus* (Latham), from Taillem Bend, S. Aust., 25.x.1945 (16 specimens).

*Habitat:* lower intestine.

*Holotype:* Length 2 mm. SAM, E931 (with 5 paratypes, E932, on same slide; and a second slide, E932).

*Description:* Body very muscular, with meridian muscles in walls of forebody and circular fibres surrounding the oblique open-



lag; at beginning of hindbody are longitudinal muscles dorsally, gathered into several bundles which spread out at level of reproductive organs, dorsal one reaching posterior end of worm.

Body 2.0–2.6 mm long. Forebody cupuliform, hemispherical to spheroidal, obliquely truncated in front, with ventral border nearly rectilinear and shorter than strongly incurved dorsal border, 0.60–0.71 by 0.74–0.86 mm, well marked off from the gradually attenuated cucumiform hindbody, 1.34–1.65 by 0.53–0.67 mm, which is eccentrically fastened to the former. Ratio of hindbody to forebody from 2–2.6. Oral sucker 105–127 by 130–155  $\mu$ m; ventral sucker much larger, cupuliform in profile, 180–240 by 160–190  $\mu$ m (ratio of the average diams. of the latter to the former 1.35–1.74, average 1.47); pharynx feebly muscular, 80–95 by 64–75  $\mu$ m.

Ovary reniform, 130–160 by 175–210  $\mu$ m, situated between 17th and 24th hundredths of hindbody. Testes trilobate, with lobes directed posteriorly, the first measuring 210–350 by 275–320  $\mu$ m, the second a little smaller, 210–320 by 265–300  $\mu$ m. Vitellaria very profuse through hindbody, and extending anteriorly into the two lips of tribocytic organ (erratic follicles); vitelline reservoir and Mehlis' gland intertesticular. Seminal vesicle lying dorsally; ejaculatory duct and uterus (which extends to intersegmental constriction) uniting and opening through a short common duct (length 70–80  $\mu$ m) into atrium. Genital bulb, 140–170  $\mu$ m in diam., provided with a conspicuous muscular thickening at its base, on the dorsal side. Eggs from 30 to 60 in the uterus, 84–99 by 58–72  $\mu$ m (average 89 by 63  $\mu$ m).

**Relationships:** This new species closely resembles *C. strigeoides* Dubois, 1958, but differs from it in the larger size of the acetabulum, relative to the oral sucker (ratio of the average diams. 1.10–1.13 in *C. strigeoides*), in the ovary being more distant from the beginning of the hindbody (7–8/100 in *C. strigeoides*), and in the geographic locality.

**Schwartzitrema pandubi** (Pande, 1939). Dubois, 1968: 248, figs. 257–260. Dubois & Pearson, 1965: 90, figs. 8, 9; 1967: 190. Pande, 1939: 26, figs. 3, 4.

FIGS. 13, 14

**Hosts and origin:** *Phalacrocorax carbo* (Linn.), from Tailem Bend, S. Aust., 21.iv.1941 (4 specimens). *P. sulcirostris* (Brandt), from Tailem Bend, 15.i.1941 (16

specimens, of which 10 ovigerous), 15.i.1941 and 26.iii.1943 (numerous cysts, some excysting, from stomach, along with fish remains). *P. melanoleucos* (Vieillot), from Tailem Bend, 25.x.1945 (14 immature specimens), 30.iii.1938 and 24.ii.1943 (24 specimens) and 6.vi.1945 (40 specimens). **Habitat:** intestine.

**Description:** Body length 0.7–1.4 mm (ovigerous specimens).

**Remarks:** This parasite appears to be common in cormorants at Tailem Bend (cf. Dubois & Pearson 1965, 1967).

The tetracotyles found in the stomach of *P. sulcirostris* were both encysted and encapsulated. The cysts are dark, strong, ovoid, helmet-shaped, with a subconical pole and a circular opposite aperture. They measure 400–450 by 320–360  $\mu$ m (230–320  $\mu$ m at the level of the opening). The cyst wall varies from 40–90  $\mu$ m in thickness (70–130  $\mu$ m at the pole). At this stage the structures in the forebody of the tetracotyle are clearly differentiated, and the conical hindbody is separated by a marked constriction. The characteristic processes of the pseudo-suckers are in a conspicuous position (Fig. 13). The cysts are often surrounded by a thin layer of hyaline secretion (5–18  $\mu$ m in thickness, 8–24  $\mu$ m at the pole).

The cysts were also found free in the stomach and proventriculus of grebes, *Fodiceps novaehollandiae* Stephens (24.ii.1943 and 14.iv.1943), *P. poliocephalus* Jardine & Selby (14.iv.1943) and *P. cristatus* (Linn.) (24.xi.1947), all from Tailem Bend; from the stomach of *Pelecanus conspicillatus* (Temminck) along with fish and the crustacean, *Cherax destructor* (27.i.1942, 25.v.1942, 17.iv.1944), from Tailem Bend; in the stomach of *Platalea flavipes* Gould, along with fish (24.ii.1943), from Tailem Bend; and from fish remains, with escaping metacercariae, in *Botaurus poeciloptilus* (Wagler) (20.vi.1949) from Mannum, River Murray, S. Aust.

## Family DIPLOSTOMIDAE Poirier

### Subfamily DIPLOSTOMINAE Monticelli

**Bolbophorus confusus** (Krause). Dubois, 1970: 266, figs. 272–276, 278 (metacercaria). Dubois & Pearson, 1965: 95, fig. 13.

**Host and origin:** *Pelecanus conspicillatus* (Temminck) from Tailem Bend, S. Aust., April 1938, Dec. 1938, 27.i.1942, 25.v.1942, 23.xi.1942, 17.iv.1944, 20.iii.1950 (40

mature specimens, and 20 metacercariae and young specimens).

*Habitat*: stomach and intestines.

*Description*: Body length 1.5–2.2 mm.

*Remarks*: The first Australian record of this cosmopolitan species is that of Dubois & Pearson (1965), who observed an acetabulum measuring 42–65 by 48–92  $\mu\text{m}$ . In the mature specimens of the present collection, this organ is smaller, 32–40 by 42–50  $\mu\text{m}$ .

**?Diplostomum (Diplostomum) amygdalum**

Dubois & Pearson, 1965: 90, figs. 10–11.

Dubois, 1970: 300, figs. 297–298.

*Host and origin*: *Nycticorax caledonicus* (Gmelin), from Tailem Bend, S. Aust., 1.vi.1940 (9 immature specimens).

*Habitat*: unknown.

*Description*: Body length 0.55–0.66 mm. The vitellaria are not yet developed. This species, adapted to the Ardeidae, commonly occurs in Brisbane, Qld. (Botanical Gardens).

**Diplostomum (Diplostomum) parvulum n.sp.**

FIGS. 15, 16

*Hosts and origin*: *Hydroprogne caspia* (Pallas), from Tailem Bend, S. Aust., Dec. 1939 (Type material: 5 specimens). *Pelecanus conspicillatus* (Temminck) from Tailem Bend, date? (4 specimens).

*Habitat*: intestine.

*Holotype*: length 0.56 mm. SAM. E933, with 2 or 3 (?) paratypes (E934) on same slide.

The type-material was obtained from a Caspian tern at Tailem Bend. Another collection has been found in a pelican from the same place: this is probably a case of erratic parasitism, the worms being mixed with metacercariae of *Bothophorus confusus* (Krause).

*Description*: Body 0.42–0.87 mm long, more or less distinctly divided in two segments. Forebody 0.25–0.53 by 0.24–0.34 mm, oval in outline, foliiform, spoon-shaped with posterior margin curved ventrally. Hindbody ovoid, bent dorsally, 0.16–0.34 by 0.21–0.27 mm (dorso-ventral diam. 0.21–0.32 mm). Ratio of length

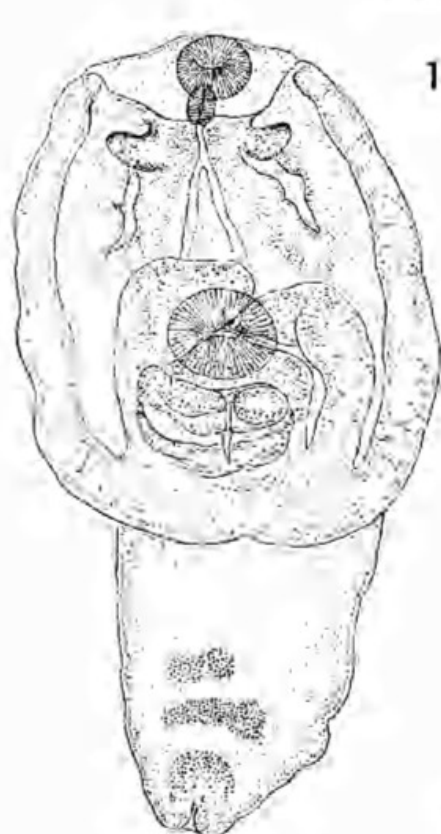
of second segment to first from 0.62–0.75 (average 0.67). Oral sucker rounded, prominent, 50–62 by 52–63  $\mu\text{m}$ ; ventral sucker almost equal in size to the oral or smaller, broader than long, 45–52 by 55–63  $\mu\text{m}$ ; pharynx elongated, 50–52 by 24–30  $\mu\text{m}$  (its antero-posterior diam. is often equal to that of oral sucker); oesophagus short, 15–25  $\mu\text{m}$ ; intestinal caeca narrow (5–10  $\mu\text{m}$ ), conspicuous in forebody and entering hindbody to terminate not far from posterior end. Pseudo-suckers semilunar or kidney-shaped, thicker anteriorly, 73–90 by 37–60  $\mu\text{m}$ . Tribocytic organ approximately circular, with a median cleft, 75–100 by 75–120  $\mu\text{m}$ ; proteolytic gland bilobed, with massive bean-shaped lobes, lying transversely at base of anterior segment.

Ovary submedian, situated at beginning of hindbody, 35 by 60  $\mu\text{m}$ . Anterior testis asymmetrical, 45–55 by 130–170  $\mu\text{m}$ ; posterior testis bilobed, 60–75 by 220–250  $\mu\text{m}$ . Vitellaria extending from posterior margin of ventral sucker or front of tribocytic organ to caudal extremity of body, with the greater density in pretesticular zone, reducing beyond to two medio-ventral sowings of follicles at level of testes, and abutting against the rather compact latero-terminal accumulations behind these; vitelline reservoir intertesticular. Bursa copulatrix small, the pore being dorsal and sub-terminal (at 50–65  $\mu\text{m}$  from posterior extremity); genital cone absent. Eggs few in number (1–3), 89–95 by 55–65  $\mu\text{m}$ .

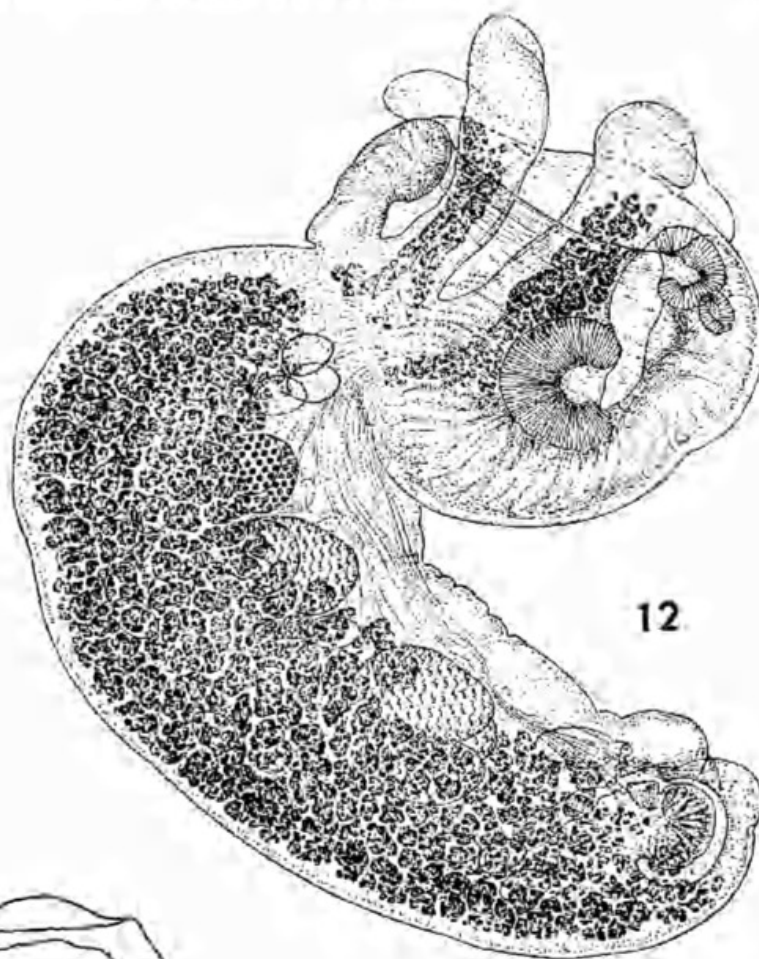
*Relationships*: This diplostome is characterized by its very small size, being the smallest of those described in the subgenus *Diplostomum*. It closely resembles the South American species *D. minutum* Szidat, from *Larus dominicanus* Lichtenstein, but differs from it in the size of the eggs and in the relative diameters of the oral and ventral suckers. (In the latter, the eggs measure 110 by 70  $\mu\text{m}$ , and the ventral sucker is larger than the oral.)

There were yet larger diplostomes in the collection from *Hydroprogne caspia*. They measure 0.7 to 1.0 mm in the contracted state.

- Fig. 12. *Cotylurus (Cotylurus) magniacetabulus* n.sp., from *Cygnus atratus*: Holotype: length 2 mm.
- Figs. 13, 14. *Schwartzitrema pundubi*. Fig. 13.—Excysted tetracotyle, from *Phalacrocorax melanoleucos*. Length 0.67 mm. Fig. 14.—Cyst, from stomach of *P. sulcirostris*, 420 by 320  $\mu\text{m}$ .
- Figs. 15, 16. *Diplostomum (Diplostomum) parvulum* n.sp. Fig. 15.—From *Hydroprogne caspia*: Holotype: length 0.56 mm, ventral view. Fig. 16.—From *Pelecanus conspicillatus*: Length 0.42 mm., dorsal view.
- Fig. 17. *Diplostomum (Diplostomum) spathaceum murrayense*, from *Larus novaehollandiae*. Length 1.7 mm, ventral view.

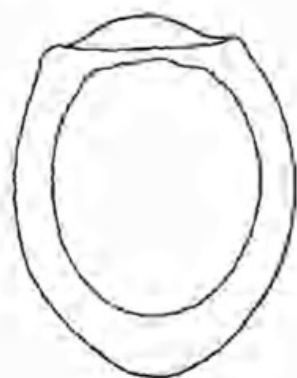


13

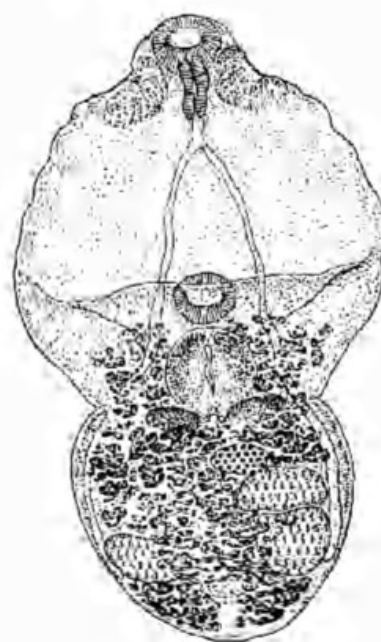


12

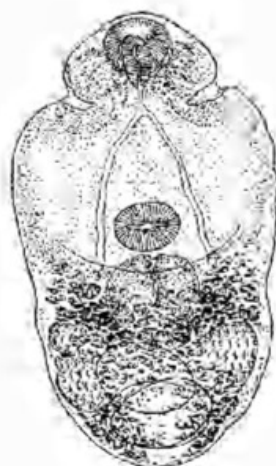
14



15



16



17





Ratio of massive hindbody to forebody from 0.91–1.25 (average 1.02). We would have difficulty in describing them. Perhaps they belong to the former species, but the pharynx is obviously larger (60–70 by 47–52  $\mu\text{m}$ ), and the ventral sucker (89 by 65  $\mu\text{m}$ ) is greater than the oral sucker (68–75 by 57–65  $\mu\text{m}$ ).

**Diplostomum (Diplostomum) spathaceum murrayense** (Johnston & Cleland, 1938). Johnston & Cleland, 1938: 127, figs. 1–10 (cercaria). Dubois, 1966a: 40; 1970: 341, fig. 355. Dubois & Pearson, 1965: 93, fig. 12. Johnston & Angel, 1941: 140, figs. 1–10 (life cycle). Johnston & Simpson, 1939: 230, figs. 1–6 (diplostomulum).

#### FIG. 17

*Host and origin:* *Larus novaehollandiae* Stephens, from Swan Reach, River Murray, S. Aust., 14.xii.1937 (12 specimens); Tailem Bend, S. Aust., 8.iii.1940 (8 specimens), 19.iii.1941 (12 specimens), 19.v.1941 (20 specimens), 27.i.1942 (3 specimens) and 28.iii.1942 (13 specimens); Yalkuri, S. Aust., 24.viii.1957 (one specimen).

*Habitat:* intestine.

*Remarks:* Johnston & Simpson (1939) believed that the adult would be found in lariform birds, most probably in the silver gull, *Larus novaehollandiae*. However, Johnston & Angel (1941) reported having found young and adult diplostomes in the marsh tern, *Chlidonias hybrida* (Pallas) [*C. leucopareia*], and successfully infected *Limnaea lessonae* Deshayes with eggs from the adult flukes, later recovering cercariae (*Cercaria murrayensis*) from this snail. From the occurrences recorded above, it seems that the silver gull is an equally, if not more important, definitive host for this parasite.

**Diplostomum (Tylodelphys) podicipinum podicipinum** Kozicka & Niewiadomska, 1960. Dubois, 1970: 388, figs. 420–421.

#### FIG. 18

*Host and origin:* *Podiceps cristatus* (Linn.) from Tailem Bend, S. Aust., 24.xi.1947 (16 specimens).

*Habitat:* unknown.

*Description:* Body length 1.32 mm.

*Remarks:* This is the first Australian record of this parasite originally described from Poland, collected from Slovakia and U.S.S.R., and characterized by the great relative diameter of the acetabulum (90 by 95  $\mu\text{m}$ , equal to a quarter of the body breadth), elongate

gate pseudo-suckers (170  $\mu\text{m}$ ), the ratio of length of body to pseudo-sucker (7.7), and the presence of a conspicuous atrial sphincter.

**Hysteromorpha platalea** Dubinin & Dubinina, 1940. Dubois, 1970: 397, figs. 430–435. *Diplostomum ardeiformium* Odening, 1962.

#### FIG. 19

*Host and origin:* *Threskiornis molucca* (Cuvier), from Qld., 26.vi.1911 (18 specimens; Coll. A. Breinl).

*Habitat:* unknown.

In 1940 this minute trematode was described by Dubinin & Dubinina from the intestine of a spoonbill, *Platalea leucorodia* L., in U.S.S.R. (the Volga delta). Its presence in India was reported by Odening (1962), who considered it as a new species designated by the name of *Diplostomum ardeiformium*, from *Pseudibis papillosa* (Temm.). The present record is the first Australian reference to this parasite.

*Description:* Body length 0.58–0.76 mm. Forebody 0.33–0.40 by 0.36–0.51 mm. Hindbody shortly ovoid, 0.23–0.37 by 0.34–0.44 mm, scarcely demarcated from forebody by a weak constriction. Ratio of hindbody to forebody 0.66–0.94. Oral sucker 52–68 by 57–75  $\mu\text{m}$ ; pharynx 42–52 by 40–45  $\mu\text{m}$ ; ventral sucker small, almost equal in size to pharynx, 42–47 by 47–50  $\mu\text{m}$ , masked by a well-developed tribocytic organ, 210–265 by 170–225  $\mu\text{m}$ . Proteolytic gland oval in outline, crescent-shaped, strongly lobulated, 95–125 by 110–125  $\mu\text{m}$ .

Ovary 45–55 by 95–135  $\mu\text{m}$ , situated at intersegmental level. Anterior testis asymmetrical, 70–105 by 150–210  $\mu\text{m}$ ; posterior testis bilobed, 80–125 by 290–390  $\mu\text{m}$ . Vitellaria well developed throughout most of body; follicles distributed in the foliaceous forebody, especially at its base, and in tribocytic organ, where they are arranged in the form of a semicircle; restricted in hindbody to a medio-ventral field, which widens out to constitute two latero-terminal clusters. Vitelline reservoir intertesticular. Mehlis' gland lateral, opposite anterior testis. Eggs, from 3–10 in the uterus, 95–112 by 58–68  $\mu\text{m}$  (average 103 by 62  $\mu\text{m}$ ).

*Relationships:* *Hysteromorpha platalea* shows a close resemblance to *H. triloba* (Rud.), but the latter appears to be bigger (up to 2.2 mm) whereas its eggs are smaller (75–99 by 48–75  $\mu\text{m}$ ) and more numerous. The acetabulum of *H. triloba* is always larger than the oral sucker, and the hosts are various species of cormorants.

**Hysteromorpha triloba** (Rudolphi, 1819). Dubois, 1970: 400, figs. 436-439, and 440 (cercaria). T. H. Johnston, 1942: 238, *Diplostomulum corti* Hughes, 1929 (metacercaria).

*Diplostomum granulatum* Goss, 1941.

*Parastrigea slovacica* Rysavy, 1958.

**Host and origin:** *Phalacrocorax melanoleucos* (Vieillot), from Tailem Bend, S. Aust., date? (7 specimens).

**Habitat:** unknown.

The first record of this cosmopolitan parasite is that of Miss O. M. Goss (1941) who described it as *Diplostomum granulatum*, from *Phalacrocorax sulcirostris* (Brandt) [= *P. ater*] from Perth, W. Aust. T. H. Johnston (1942) recorded it from various cormorants, especially from Tailem Bend.

**Description:** Body 1.03-1.18 by 0.56-0.67 mm. Ventral sucker 90-92 by 94-98  $\mu$ m; oral sucker 70-73 by 83-84  $\mu$ m; pharynx 50 by 47  $\mu$ m. Eggs 92-95 by 63-68  $\mu$ m. Tribocytic organ rounded, funnel-shaped when protruded. Proteolytic gland bilobed and trapezoidal.

**Neodiplostomum (Conodiplostomum) brachyurum** (Nicol, 1914). Nicol, 1914: 346, pl. 24, fig. 9. Dubois, 1937: 333, figs. 11-12; 1970: 418, figs. 451-452.

**Hosts and origin:** *Ninox novaeseelandiae* (Gmelin), from Yalkuri, S. Aust., 24.viii.1957 (18 specimens, collected by W. H. Ewers). *Tyto alba* (Scopoli), from Point Turton, Yorke Peninsula, S. Aust., 12.ix.1970 (3 specimens).

**Habitat:** intestine.

**Description:** Body length 1.5-3 mm.

**Remarks:** This species is characterized by the large size of the ventral sucker, 72-105 by 73-110  $\mu$ m (average 87 by 90  $\mu$ m), and by the fact that it occurs in the Strigiformes. The testes are large and symmetrically developed. The vitelline follicles have their maximum density in the forebody, where they quite often reach to the level of the intestinal bifurcation.

**Neodiplostomum (Conodiplostomum) spathula australiense** Dubois, 1937: 337, figs. 13-14; 1970: 428, figs. 465-468. Dubois & Pearson, 1967: 196, fig. 7.

**Hosts and origin:** *Circus approximans* Peale, from Tailem Bend, S. Aust., Dec. 1938 (3 specimens). *Haliaeetus leucogaster* (Gmelin), from Wauraltee, Yorke Pen., S. Aust., 21.viii.1960 (3 specimens). *Falco peregrinus* Tunstall, from Naracoorte, S.

Aust., 12.vi.1956 (24 specimens). *F. subniger* Gray, from Meningie, S. Aust., 6.v.1945 (19 specimens). *Accipiter cirrocephalus* (Vieillot), from Townsville, Qld., 1911 (one specimen, collected by T. H. Johnston).

**Habitat:** duodenum and intestine.

**Description:** Body length 1.0-1.75 mm. Vitellaria densest in forebody, sometimes reaching the intestinal bifurcation.

**Relationships:** The size of the ventral sucker (45-68 by 57-75  $\mu$ m, average 57 by 67  $\mu$ m) constitutes a useful specific character. In this respect *Neodiplostomum spathula* is distinguishable from *N. brachyurum* (Nicol).

**Neodiplostomum (Neodiplostomum) lanceolatum** n.sp.

FIGS. 20, 21

**Host and origin:** *Ninox novaeseelandiae* (Gmelin) from Adelaide, S. Aust., April, 1959 (14 specimens).

**Habitat:** intestine.

**Holotype:** length 1.25 mm. SAM, E935 with 4 paratypes, E936, and another slide, E936.

**Description:** Body distinctly bisegmented, 1.25-1.52 mm long. Forebody flattened, lanceolate, 0.79-1.01 by 0.29-0.38 mm, with posterior border, where it is wider, curved ventrally. Hindbody subcylindrical to claviform, always shorter than forebody, 0.40-0.61 by 0.18-0.21 mm. Ratio of hindbody to forebody from 0.50-0.68, averaging 0.56. Oral sucker 38-47 by 42-50  $\mu$ m; ventral sucker slightly larger, 36-52 by 47-57  $\mu$ m, situated between the 50th and 55th hundredths of length of forebody. Short prepharynx (10-15  $\mu$ m); pharynx ellipsoidal and muscular, 37-45 by 26-32  $\mu$ m; oesophagus reaching length of 40-52  $\mu$ m; caeca narrow (about 5-10  $\mu$ m) in their visible section. Tribocytic organ narrowly ellipsoidal or almond-shaped, 150-210 by 80-125  $\mu$ m.

Ovary oval or rounded, submedian, located at beginning of hindbody between 16th and 21st hundredths, 55-63 by 63-75  $\mu$ m. First testis appears asymmetrically developed, 80-110 by 120-140  $\mu$ m; second testis clearly bilobed (with a posterior median indentation), 80-110 by 150-185  $\mu$ m. Vitelline follicles very conspicuous, with a maximum density at base of forebody; from thence invading tribocytic organ and, separated in longitudinal bands, extending beyond ventral sucker, with their limit on median line between the 24th and 48th hundredths of this part of body; densely

distributed on each side at beginning of hindbody, then receding from dorsal area to become a wide ventral ribbon which ends in two latero-terminal or sub-terminal accumulations. Vitelline reservoir situated at mid-length of hindbody. Mehlis' gland lateral, on level with second half of first testis. Hermaphrodite canal, which prolongs the incurved uterus, does not traverse a genital cone. Genital pore dorsal and sub-terminal, at 65–100  $\mu\text{m}$  from posterior extremity of body. Eggs, few in number (up to 13), 94–115 by 63–72  $\mu\text{m}$  (average 104 by 66  $\mu\text{m}$ ).

**Relationships:** Five species of the subgenus *Neodiplostomum* are parasites of night-birds and have vitellaria passing beyond the ventral sucker. *N. americanum* Chandler & Rausch, *N. canaliculatum* (Nicoll), *N. japonicum* Dubois, *N. rousselati* Dubois and *N. travassosi* Dubois. Among them, only the first has an ellipsoidal tribocytic organ, but the ovary is situated at the junction of the two segments of the body, and the ventral sucker is located between one third and two fifths of the forebody. This American species reaches 2.9 mm.

**Neodiplostomum (Neodiplostomum) subaequipartitum** Dubois & Pearson, 1967: 199, fig. 8. Dubois, 1970: 484, fig. 555.

#### FIG. 22

**Host and origin:** *Haliastur sphenurus* Vieillot), from Tailem Bend, S. Aust., Dec. 1938 (22 specimens), 18.vi.1941 (young specimens).

**Habitat:** intestine.

**Description:** Body 1.16–1.30 mm long, divided into two nearly equal segments. Forebody 0.61–0.68 by 0.36–0.49 mm; hindbody 0.55–0.63 by 0.38–0.43 mm. Ratio of the hindbody to forebody from 0.89–1.02 (average 0.93). Oral sucker 47–55 by 45–52  $\mu\text{m}$ ; pharynx 45–52 by 36–52  $\mu\text{m}$ ; ventral sucker a little larger

than oral, 52–65 by 54–68  $\mu\text{m}$ , situated between 45th and 50th hundredths of length of forebody; tribocytic organ 170–240 by 160–210  $\mu\text{m}$ .

Ovary ovoid or ellipsoidal, lying at beginning of hindbody, 95–110 by 130–170  $\mu\text{m}$ . Anterior testis lateral, asymmetrical, coniform or ovoid, 125–150 by 140–210  $\mu\text{m}$ ; posterior testis bilobed, dumb-bell-shaped, 120–150 by 260–320  $\mu\text{m}$ , with greater lobe obliquely opposite first testis. Eggs few in number (one to four), 84–92 by 58–65  $\mu\text{m}$ .

**Neodiplostomum (Triloborchidiplostomum) diaboli** n. subgen., n.sp.

#### FIGS. 23, 24

**Host and origin:** *Sarcophilus harrisii* (Boitard), from Tasmania, Oct. 1969 (2 specimens).

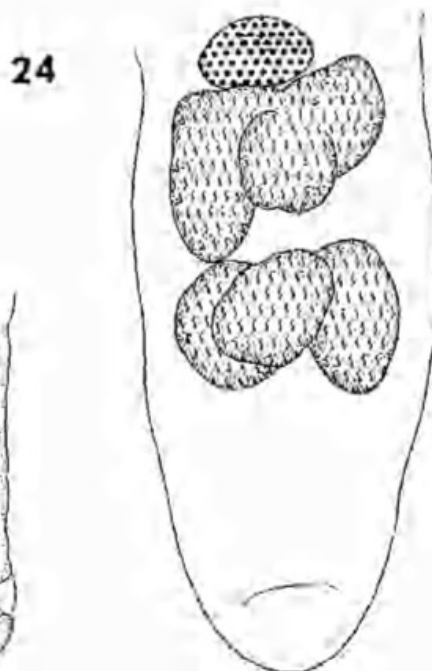
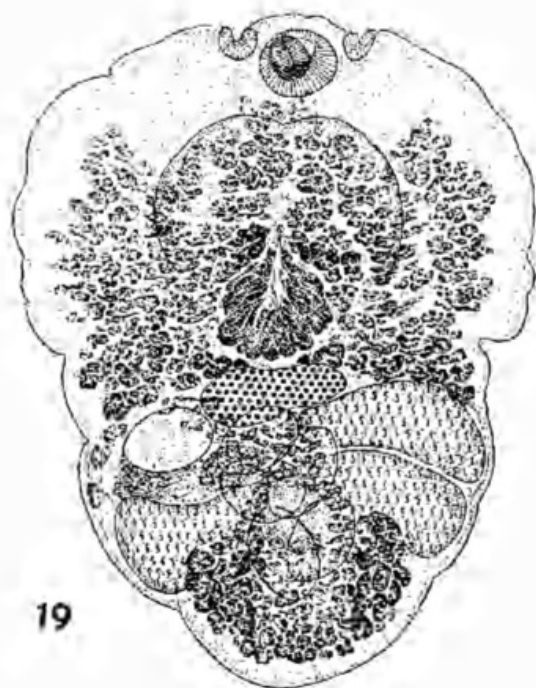
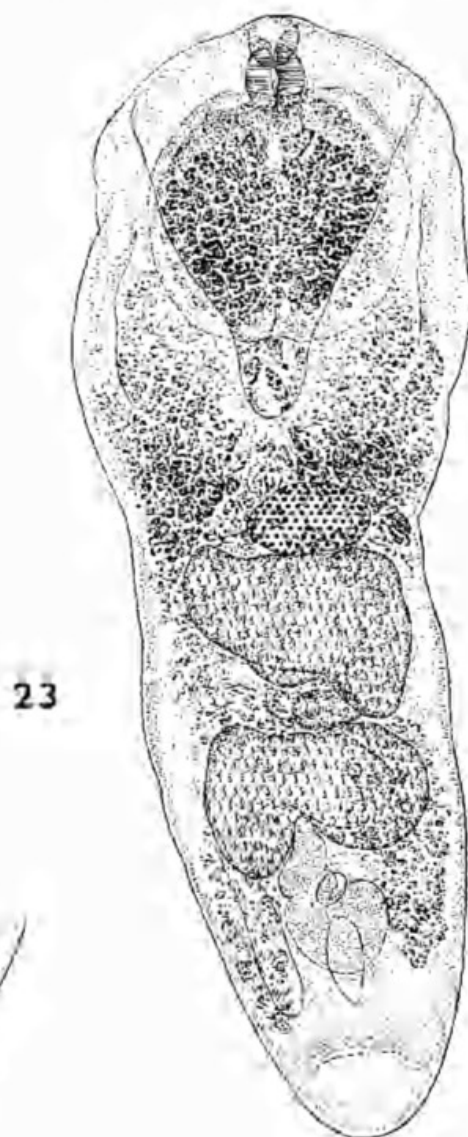
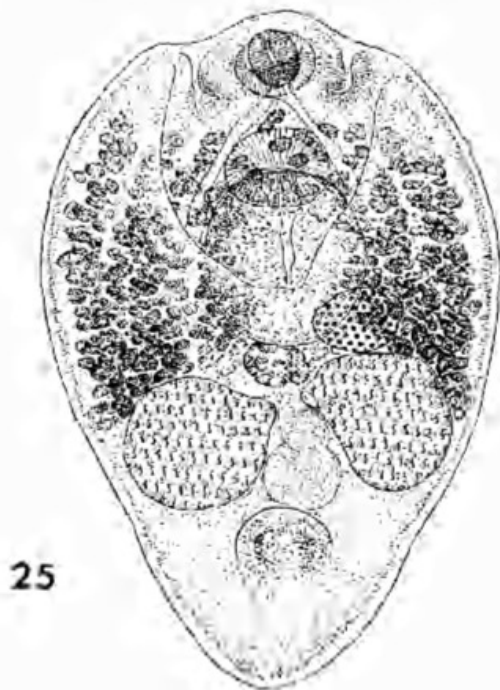
**Habitat:** unknown.

**Holotype:** length 2.05 mm. SAM, E937. Paratype in Neuchâtel University.

**Description:** Body 1.95–2.05 mm long, divided by a constriction into anterior and posterior segments. Forebody broadly elliptical, spathe-shaped, 0.90–0.93 by 0.70–0.73 mm, deeply concave posteriorly, with lateral edges obliquely curled ventrad and continuous with each other behind tribocytic organ. Hindbody long ovoid, or conical, 1.05–1.12 by 0.45–0.56 mm, widest at testicular level. Ratio of hindbody to forebody, 1.2. Oral sucker spheroidal, 90–92 by 93–95  $\mu\text{m}$ ; pharynx elliptical in outline, much larger than oral sucker and very muscular, 122–130 by 118  $\mu\text{m}$ . Ratio of lengths: oral sucker + pharynx/forebody, 0.20. Caeca terminating in front of genital atrium, i.e. to posterior limit of vitellaria. Ventral sucker (ca. 75  $\mu\text{m}$ ) masked by large tribocytic organ, 460–480 by 500–525  $\mu\text{m}$ , irregularly rounded, with a very narrow slit; its frontal border situated between one sixth and one tenth of the length of the forebody, more or less overlapping the pharynx.

- Fig. 18. *Diplostomum (Tylodelphys) podicipinum podicipinum*, from *Podiceps cristatus*. Posterior end with atrial sphincter.
- Fig. 19. *Hysteromorpha platula*, from *Threskiornis molucca*. Length 0.64 mm, dorsal view.
- Figs. 20, 21. *Neodiplostomum (Neodiplostomum) lanceolatum* n.sp., from *Ninox novaeseelandiae*. Fig. 20.—Holotype: length 1.25 mm, dorsal view. Fig. 21.—Lateral view of hindbody.
- Fig. 22. *Neodiplostomum (Neodiplostomum) subaequipartitum*. Outline of posterior extremity of body.
- Figs. 23, 24. *Neodiplostomum (Triloborchidiplostomum) diaboli* n.sp., from *Sarcophilus harrisii*. Fig. 23. Holotype: length 2.05 mm, ventral view. Fig. 24.—Morphology and topography of genital glands of holotype, dorsal view.
- Fig. 25. *Pharyngostomoides dasyuri* n.sp., from *Dasyurus viverrinus* (Shaw). Holotype: length 0.62 mm, dorsal view.





Ovary ovoid, transversely elongate, median or submedian, 130–140 by 180–220  $\mu\text{m}$ , lying at junction of forebody and hindbody. Testes trilobate (with one dorsal lobe and two latero-ventral lobes), occupying with ovary, first three fifths of segment: anterior testis contiguous with ovary, asymmetrical, 140–200  $\mu\text{m}$  on left, 240–320  $\mu\text{m}$  on right, and 350–430  $\mu\text{m}$  in transverse dimension. Second testis 200–230  $\mu\text{m}$  and 275–280  $\mu\text{m}$  on two of its lobes, and 330–410  $\mu\text{m}$  transversely; posterior border of this testis situated between 56th and 63rd hundredths of length of hindbody. Seminal vesicle well developed, posttesticular. Vitelline follicles having their maximum density at junction of two segments and in second half of forebody, penetrating tribocytic organ and extending forward to level of posterior border of pharynx; from beginning of hindbody less abundant, covering ventral face in form of two submedian fields which widen slightly at level of seminal vesicle (distance from last follicles to posterior end of the body is 200–270  $\mu\text{m}$ ). The anterior border of the bursa copulatrix is found between the 87th and the 90th hundredths of length of hindbody. The collapsed eggs of the paratype measure approx. 125 by 70  $\mu\text{m}$ .

**Relationships:** This parasite from the Tasmanian devil is readily distinguished from all other species of the genus *Neodiplostomum* by the trilobate shape of the testis<sup>2</sup>, with the exception of *Neodiplostomum tamarini* Dubois, 1966, of which the posterior testis also develops three lobes (two latero-ventral and one medio-dorsal). This morphological character justifies the establishment of a new subgenus for which we propose the name *Triloborchidiplostomum*, with the type species *N. (T.) diaboli* n.sp.<sup>3</sup> A second character common to the two species is the ratio of the lengths of oral sucker + pharynx/forebody, which varies between 0.20 and 0.25.

#### TRILOBORCHIDIPOSTOMUM n. subgen.

**Diagnosis:** *Neodiplostomum* with the two testes or only the second testis trilobate. Complex of oral sucker and pharynx usually between one-fifth and one-quarter of length of forebody. Tribocytic organ tending to hypertrophy. Intestinal parasites of mammals.

**Type species:** *N. (T.) diaboli* n.sp., in *Sarcophilus harrisii* (Boitard), from Tasmania. **Consubgeneric species:** *N. (T.) tamarini* Dubois, 1966 in *Leontocebus nigricollis* (Spix), from South America.

#### *Neodiplostomum* sp.

**Hosts and origin:** *Notechis scutatus* (Peters) [Ophidia], from Taillem Bend, S. Aust., 1.v.1940 (8 specimens and 2 cysts), *Pseudochis porphyriacus* (Shaw) [Ophidia], from Adelaide Zoo, 5.xi.1957 (5 specimens).

**Habitat:** digestive tract, and subperitoneum.

**Description:** Body oval, 255–475 by 210–285  $\mu\text{m}$ . Caeca gradually and irregularly distended, filled with a yellowish substance. Cysts oval, 350–380 by 300–320  $\mu\text{m}$ . Cyst wall fibrous, 15–40  $\mu\text{m}$  thick.

**Remarks:** One specimen only of this metacercaria (335 by 245  $\mu\text{m}$ ) was found in the intestine of *Grallina cyanoleuca* (Latham) [Passeriformes] from Taillem Bend, 22.iii.1943.

***Posthodiplostomum australe*** Dubois, 1937: 1970: 510, figs. 585–588. Dubois & Pearson, 1967: 201, fig. 9.

**Hosts and origin:** *Phalacrocorax sulcirostris* (Brandt), from Taillem Bend, S. Aust., 26.iii.1943 (2 specimens), *P. melanoleucos* (Vieillot), from Taillem Bend, 6.vi.1945, 31.iii.1948, Oct. 1960 (27 specimens) and 25.x.1945 (4 young specimens). *Pelecanus conspicillatus* (Temminck), from Taillem Bend, date? (7 specimens). *Hydroprogne caspia* (Pallas) from Taillem Bend, Dec. 1939 (2 specimens). *Egretta alba* (Linn.), from Taillem Bend, June 1937 (one specimen). *Ardea novaehollandiae* Latham, from Taillem Bend, 1.v.1940, 24.ii.1943, 6.vi.1945 and 31.v.1949 (19 specimens); Swan Reach, S. Aust., 15.xii.1937 (14 specimens); Taillem Bend, May 1938, 1.v.1940, 24.ii.1943 (27 young specimens escaping and escaped from cysts). *Nycticorax caledonicus* (Gmelin) from Mary River, Northern Territory, May 1962 (17 specimens).

**Habitat:** Stomach and intestine.

<sup>2</sup> As in several species of the subgenus *Paralaria* Krause, in particular *Alaria* (*Paralaria*) *pseudoclathrata* Krause, *A. (P.) mustelae mustelae* Busna, and especially *A. (P.) mustelae canadensis* Webster and Wolfgang (cf. Dubois 1970, figs. 699–700).

<sup>3</sup> In *Fibricola sarcophila* Sanders, 1957, the posterior testis is "characteristically bilobed". The forebody is "typically" longer than the hindbody, and the tribocytic organ "is usually between one-quarter and one-third of the length of the anterior segment".

**Description:** This common species is characterized by its small size: the ovigerous specimens measure 0.42–0.98 mm (five to nine eggs in uterus). In life, there is "orange colour around midsucker". Oral sucker 28–31 by 30–37  $\mu$ m; pharynx 26–30 by 19–25  $\mu$ m; ventral sucker 42–68 by 45–68  $\mu$ m.

Ovary situated at beginning of posterior segment. First testis asymmetrically developed; second testis bilobed, sub-cordiform, with an anterior concavity. Vitellaria very dense at base of forebody, extending anteriorly beyond ventral sucker, in some specimens to a level about equidistant from ventral and oral suckers; in hindbody, extending on ventral side to posterior border of second testis, or only to intertesticular region. Uterus ventral, bending dorsad until it arrives anterior to the bursa copulatrix, and then enters genital cone. Eggs 73–94 by 48–63  $\mu$ m (average 82 by 54  $\mu$ m).

Cyst transparent, ellipsoidal, 340 by 220  $\mu$ m, having a thin wall (6 to 8  $\mu$ m in thickness).

#### Subfamily AFARIINAE Hall & Wigdor

**Fibricola intermedius** (Pearson, 1959). Pearson, 1959: 111, figs. 1–8. Dubois, 1970: 637, fig. 729.

**Host and origin:** *Hydromys chrysogaster* Geoffroy, from River Torrens, Adelaide, S. Aust., July 1923 (21 specimens, some of which have one egg in the uterus).

**Habitat:** intestine.

**Description:** Body length 0.75–0.98 mm.

**Relationships:** This species, the type-host of which is *Rattus assimilis*, was found in the water rat, *Hydromys chrysogaster*, by Pearson (1961). It differs from *F. minor* Dubois (also from *H. chrysogaster*) in having erratic vitelline follicles in the hindbody: they form two distinct lateral bands which extend as far as the zone of the second testis, and even beyond.

#### **Pharyngostomoides dasyuri** n.sp.

FIG. 25

**Host and origin:** *Dasyurus viverrinus* (Shaw) from Icena Estate, Tas., 9.xi.1966 (5 specimens).

**Habitat:** small intestine.

**Holotype:** length 0.62 mm. SAM, E938, paratypes (3 slides) E939.

**Description:** Body oval, indistinctly bisegmented, 0.58–0.67 mm long. Forebody marsupiform, 0.33–0.40 by 0.45–0.48 mm (when contracted), with lateral and posterior margins

folded ventrally. Hindbody more or less conical, 0.23–0.27 by 0.35–0.41 mm (when contracted). Oral sucker subterminal, 63–78 by 75–94  $\mu$ m; pharynx ellipsoidal, more muscular but smaller than oral sucker, 57–63 by 40–48  $\mu$ m; ventral sucker bigger, elliptical in outline, 58–78 by 95–110  $\mu$ m, usually partially covered by tribocytic organ; oesophagus short. Pseudo-suckers cupuliform, 68–75 by 60–63  $\mu$ m. Tribocytic organ well developed, elliptical in outline, 155–195 by 125–150  $\mu$ m, with longitudinal slit-like opening.

Ovary ovoid, 50–75 by 85–110  $\mu$ m, submedian, located dorsally at base of forebody. Testes rounded or ovoid, approximately equal in size, 100–140 by 130–180  $\mu$ m, situated side by side in anterior part of hindbody, close together. Seminal vesicle well developed, post-testicular. Vitelline follicles confined to forebody, with a dense distribution from level of anterior margins of testes, gradually decreasing forwards, penetrating tribocytic organ and extending medially almost to bifurcation of oesophagus, laterally to level of ventral sucker. Vitelline reservoir pretesticular, median or submedian, at junction of anterior and posterior segments. Eggs 115–118 by 60–63  $\mu$ m. Fresh material is needed for a description of the bursa copulatrix.

**Addendum.** On 23rd June, 1972, Dr. G. Gregory collected 64 uncontracted specimens from the intestine of *Dasyurus maculatus* (Kerr), at Ben Nevis, Tasmania. These are described below.

Body length 1.22–1.53 mm. Forebody cochleariform 0.68–0.90 by 0.73–0.95 mm. Hindbody conical, rounded at extremity, 0.52–0.71 by 0.50–0.71 mm at level of testes. Ventral sucker 75–104 by 95–117  $\mu$ m (average 90 by 130  $\mu$ m), subequal to or larger than oral sucker, 65–95 by 85–115  $\mu$ m (average 80 by 95  $\mu$ m), but more muscular. Pseudo-suckers cupuliform, with prosodic glands well developed. Tribocytic organ 300–340 by 210–300  $\mu$ m (230–350 by 265–430  $\mu$ m when completely protruded). Pharynx small, 55–73 by 52–65  $\mu$ m.

Ovary submedian, 110–135 by 120–160  $\mu$ m. Testes spherical or ovoid, situated side by side, 180–255 by 200–300  $\mu$ m. Seminal vesicle inter- and post-testicular, discharging through muscular ejaculatory duct (ejaculatory pouch absent), which unites with descending limb of uterus. (Ascending limb of latter reaching mid-portion of tribocytic organ.) Vitelline follicles confined to forebody, distributed in two



lateral masses confluent anteriorly at acetabular level, divergent backwards where they terminate in contact with the testes, extending medially to level of intestinal bifurcation (just posterior to pharynx). In the triangular space between these two masses are the longitudinal aperture of tribocytic organ, the ovary and the vitelline reservoir (median and pretesticular). Bursa copulatrix muscular, rounded, 220–300  $\mu\text{m}$  in diam., occupying second half of posterior segment, with dorsal, subterminal aperture and deep genital atrium. Eggs 1 to 15, 110–130 by 65–78  $\mu\text{m}$  (largest 130 by 78  $\mu\text{m}$ ), average 118 by 71  $\mu\text{m}$ .

**Relationships:** *Pharyngostomoides dasyuri* n.sp. seems to be closely related to *P. procyonis* Harkema, 1942, but differs in the smaller body, the inequality of the suckers, the position of the ovary, the absence of ejaculatory pouch, the extension of the vitellaria up to level of intestinal bifurcation, the greater dimensions of the eggs, and the geographic distribution. It is probably identical with *Pharyngostomoides* sp. of Sanders (1957, p. 263), recovered from the intestine of a Tasmanian tiger cat, *Dasyurus maculatus* (Kerr).

**Family PROHEMISTOMIDAE** (Dubois, 1938)  
Sudarikov, 1941

**Subfamily PROHEMISTOMINAE** Lutz

**Mesostephanus haliasturist** Tubangui & Masilungan, 1941: 138, pl. 3, fig. 3. Dubois & Pearson, 1965: 96, fig. 14 (from *Haliastur*); 1967: 202 (from *Pelecanus*).

*Mesostephanus minor* Dubois & Pearson, 1965.

**Host and origin:** *Pelecanus conspicillatus* (Temminck), from Tailm Bend, S. Aust., date? (24 macerated specimens).

**Habitat:** unknown.

Tubangui & Masilungan recorded this species

from the small intestine of *Haliastur intermedius* Blyth from the Pampanga Province (Luzon; Philippines). Dubois & Pearson (1965) re-described it by the name of *Mesostephanus minor* from *Haliastur sphenurus* (Vieillot) from Brisbane, Qld., and subsequently (1967) from *Pelecanus conspicillatus* (Temminck) and *Anhinga novaehollandiae* (Gould), from Mackay and Kola, Qld. The fishing-kite is probably an occasional host.

**Description:** Body oval, with small caudal appendix 0.9–1.5 mm long by 0.3–0.5 mm in maximum width; anterior part well expanded, slightly concave ventrally, with lateral borders more or less rolled up into a gutter and meeting posteriorly. Oral sucker 38–52  $\mu\text{m}$ ; ventral sucker slightly larger, 37–55 by 40–60  $\mu\text{m}$ , situated between the 40th and 45th hundredths of the length of the body; pharynx ellipsoidal, 32–50 by 24–40  $\mu\text{m}$ ; oesophagus 47–52  $\mu\text{m}$  long. Tribocytic organ oval in shape, 200–210 by 150–160  $\mu\text{m}$ , with a longitudinal slit.

Ovary globular, 60–80  $\mu\text{m}$ , level with second half of anterior testis, slightly to one side of median line, opposite cirrus sac. Testes subglobular to ovoid, close behind one another, 110–190 by 90–150  $\mu\text{m}$ . Vitellaria composed of fairly large follicles disposed in an eccentric wreath (diameter 300–520  $\mu\text{m}$ ) around tribocytic organ. The two characteristics of the species are that vitellaria (1) do not reach acetabular level (limit 44th to 50th hundredths of length of body, i.e. distant 28–35  $\mu\text{m}$  from posterior border of ventral sucker), and (2) overlap only first half of posterior testis. Ratio of the length of the body to the diam. of the vitelline wreath ranging from 2.7–3.2 (average 3). Cirrus sac well developed, elongated, club-shaped, 310–530 by 50–100  $\mu\text{m}$ , extending forwards to zone of first testis or even beyond. Uterus short, with vaginal sphincter conspicuous, 20–40 by 29–55  $\mu\text{m}$ . Eggs one to six in number, 90–99 by 65–73  $\mu\text{m}$ .

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\* Incorrect original spelling *haliasturus*.

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