

ASCAROID NEMATODES FROM AUSTRALIAN BIRDS

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[Read 12 June 1941]

Much of the material referred to in this paper was collected by the late Dr. T. L. Bancroft at Eidsvold, Burnett River, Queensland; his daughter, Dr. M. J. Mackerras, from the same locality, and from the Thompson River at Longreach, Western Queensland; Professor J. B. Cleland from some localities in New South Wales, South Australia and Western Australia; J. T. Gray, Orroroo, South Australia; and the late Dr. W. D. Walker at Morgan, Murray River, South Australia. Some of Krefft's original material was forwarded by the Director of the Australian Museum, Sydney, for our examination. The rest was obtained by the senior author from localities in Queensland, New South Wales, and South Australia, the material from Tailem Bend having been found in birds collected for us by Messrs. G. and F. Jaensch and L. Ellis. To all who have assisted us we tender our thanks. The study of the material was made possible by the Commonwealth Research Grant to the University of Adelaide.

Most of the species described below belong to *Contracaecum*. It is regretted that, in the past, many authors omitted to indicate the ratios of lengths of parts of the alimentary canal and of the spicules to the total body length. In the older and even in some of the recent descriptions a wide range of body length but only one length of spicule is given, so that the actual ratio which appears to us to be of systematic value is not available for comparison. In describing the new species, we have stressed what have appeared to us to be the main distinguishing specific characters—the shape and relative lengths of lips and interlabia, width of the head relative to the body, the ratios of the oesophagus and of the diverticula of the alimentary canal to the body length, the ratio of the spicules to the body length, the position of the vulva, and the arrangement of the male caudal papillae. The two last-mentioned features are similar in several different species, so that they alone are insufficient for diagnostic purposes.

Types of the new species have been deposited in the South Australian Museum.

LIST OF PARASITES ARRANGED UNDER THEIR HOSTS

- PHALACROCORAX CARBO Linn. (var. NOVAE-HOLLANDIAE). *Contracaecum spiculigerum* Rud. (Lower Hawkesbury R., N.S.W.; Tailem Bend, S. Aust.).
C. simulabiatum n. sp. (Eidsvold, Qld.).
- PHALACROCORAX FUSCESCENS Vieill. *C. spiculigerum* Rud. (Kangaroo Island).
- PHALACROCORAX VARIUS Gmelin. *Contracaecum spiculigerum* Rud. (Perth, W.A.).
- PHALACROCORAX MELANOLEUCUS Vieill. *Contracaecum spiculigerum* Rud. (Hawkesbury R., N.S.W.; Thompson R., Qld.; Adelaide, Orroroo, and Encounter Bay, S. Aust.). *C. simulabiatum* n. sp. (Tailem Bend, S. Aust.).
- PHALACROCORAX SULCIROSTRIS Brandt. *Contracaecum spiculigerum* Rud. (Thompson R. and Burnett R., Qld.; Adelaide).
- PLOTUS NOVAE-HOLLANDIAE Gould. *Contracaecum simulabiatum* n. sp. (Burnett R. and Thompson R., Qld.). *C. tricuspe* (Ged.) (Australian Museum; Burnett R., Qld.).
- PELECANUS CONSPICILLATUS Temm. *Contracaecum bancrofti* n. sp. (Burnett R. and Thompson R., Qld.; Sydney Zoological Gardens, from N.S.W.; Morgan, S. Aust.). *C. clelandi* n. sp. (Perth). *Contracaecum* sp., larvae and immature worms (Perth; Tailem Bend, S. Aust.).
- NOTOPHOYX PACIFICA Lath. *Porrocaecum reticulatum* Linst. (Thompson R. and Eidsvold, Qld.). *Contracaecum spiculigerum* Rud. and *Contracaecum* sp. (Thompson R., Qld.).

- NOTOPHOYX NOVAE-HOLLANDIAE Lath. *Contracaecum spiculigerum* Rud. (N.S.W.). *Contracaecum* sp., fragments and larvae (Tailem Bend, S. Aust.).
- NYCTICORAX CALEDONICUS Gmelin. *Contracaecum spiculigerum* Rud. (Tailem Bend, S. Aust.).
- BOTAURUS POECILOPTILUS Wagl. *Contracaecum spiculigerum* Rud. (Orroroo S. Aust.).
- XENORHYNCHUS ASIATICUS Lath. *Contracaecum* sp. larvae (Zoological Gardens, Adelaide, from Murray R., S. Aust.).
- EGRETTA ALBA Less. *Porrocaecum reticulatum* (Linst.) (Thompson R., Qld.). *Contracaecum* sp., larvae (Tailem Bend, S. Aust.).
- CHENONETTA JUBATA Lath. *Heterakis chenonettae* Johnst. (Sydney Zoological Gardens, from N.S.W.).
- ANAS BOSCHAS Linn. (DOMESTICA Briss.). *Contracaecum microcephalum* (Rud.) and *Heterakis isolonche* Linst. (Lord Howe Island).
- ANAS SUPERCILIOSA Gmelin. *Contracaecum microcephalum* Rud. (N.S.W.).
- EUDYPTULA MINOR Forst. *Contracaecum* sp., larva (Brighton, S. Aust.).
- ANOUS STOLIDUS Linn. *Contracaecum magnicollare* n. sp. (North-West Islet, Great Barrier Reef, Qld.).

CONTRACAECUM SPICULIGERUM (Rud.)

Fig. 1-2

We have identified this species from *Phalacrocorax carbo* (Eidsvold, Qld.; Lower Hawkesbury River, N.S.W.; Tailem Bend, S. Aust.); *P. sulcirostris* (Adelaide, S. Aust.; Thompson R., Qld., coll. Dr. Mackerras); *P. melanoleucus* (Encounter Bay, S. Aust., coll. Dr. Cleland; Orroroo, S. Aust., coll. J. T. Gray; Hawkesbury River, N.S.W., coll. Dr. Cleland; Thompson River, Qld., coll. Dr. Mackerras; Adelaide); *P. fuscescens* (American River, Kangaroo Island); *Notophoyx pacifica* (Thompson River, Qld., coll. Dr. Mackerras); *N. novae-hollandiae* (N.S.W.); *Botaurus poeciloptilus* (Orroroo, S. Aust., coll. J. T. Gray); *Nycticorax caledonicus* (Tailem Bend, S. Aust.). Some broken specimens from *Phalacrocorax varius* from Perth, W. Aust., are also assigned to this species.

This species was described very briefly by Rudolphi (1809). Schneider, in 1886, gave a longer illustrated account, but omitted measurements except the total length of the worm. Since then the parasite has been recorded from many different species of birds from various parts of the world. One of us recorded it from *Phalacrocorax sulcirostris* (Johnston 1912, 74; 1912 b, 108; 1916, 49) from Southern Queensland; and as *Ascaris spiculigera* ? (1912, 75) from *P. carbo* from Sydney. *Ascaris* sp. of Johnston (1912 b, 108) from *P. carbo* from N.S.W. is the same species. The presence in *Pelecanus conspicillatus* from Sydney of parasites, apparently referable to the species, was also mentioned (Johnston, 1912, 74); and these nematodes were also quoted as *Ascaris spiculigera* ? (Johnston, 1912 b, 108), but our re-examination of the material indicates that they belong to a closely related new species, *C. bancrofti*. *Ascaris spiculigera* of Johnston (1912, 74; 1912 b, 108; 1916, 49) from *Plotus novae-hollandiae*, Burnett River, Queensland, has been re-examined and is now identified as a very closely allied new species, *Contracaecum sinulabiatum*, together with *C. tricuspe* (syn. *Ascaris* sp. Krefft, 1873).

C. spiculigerum appears to us to be one of several very closely related species formerly confused under that name. Rudolphi's type (1809) of *Ascaris spiculigera* came from a pelican, *Pelecanus onocrotalus*, but in 1819 he recorded it from *Pelecanus carbo*, *P. cristatus*, and *P. pygmaeus* (p. 290), as well as from *P. brasiliensis* and *P. aquila* (p. 662). Most of the identifications made subsequently have been based on specimens from cormorants and other birds. The re-examination of Rudolphi's type material would be necessary to determine the true *C. spiculigerum*. The available descriptions are, however, few and incomplete and the following account based on Australian material is offered.

Length varying greatly, even among adult specimens. Males, 14-26 mm.; females, 16-55 mm. Body tapering in anterior third. Head narrower than succeeding part of body. Lips as described by Schneider (1866), with characteristic antero-lateral projections and without lateral cuticular flange. No dentigerous ridge seen, though figured by Linstow. Interlabia nearly as long as lips, sometimes with bifid tips. Annular striations forming marked "collar" at base of lips. Oesophagus 1:4.6-8.8 of body length, generally 1:7. Oesophageal appendix and intestinal caecum respectively 1:3.5 (usually 1:3.7) and 3:4 of length of oesophagus. Nerve ring about midway between head and anterior end of caecum; cervical papillae just behind that level.

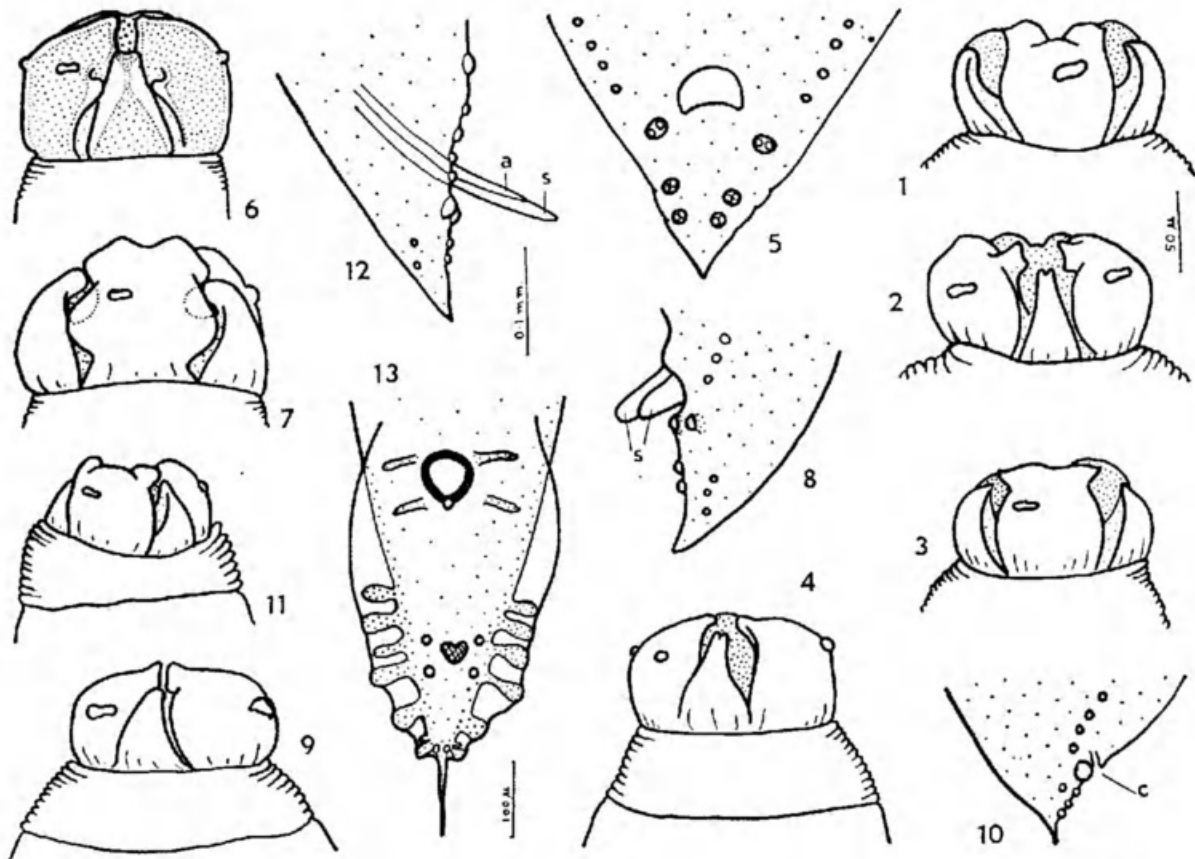


Fig 1-2—*Contracaecum spiculigerum*: two views of head. Fig. 3-5—*Contracaecum bancrofti*: 3 and 4, two views of head; 5, male tail. Fig. 6-8—*Contracaecum sinulabiatum*: 6 and 7, two views of head; 8, male tail. Fig. 9-10—*Contracaecum clelandi*: 9, head; 10, male tail. Fig. 11-12—*Contracaecum magnicollare*: 11, head; 12, male tail. Fig. 13—*Heterakis chenonettae*, ventral view of male tail. Fig. 1 and 2 to same scale; fig. 3 to 12 to same scale. a, alae; c cloaca; s. spicule.

Male—Arrangement of caudal papillae exactly as described and figured by Schneider; in a few specimens the arrangement of the three pairs of lateral post-anal papillae varied slightly. Spicules usually 1:3.6 to 1:4.2 of body length. In one collection from *Phalacrocorax carbo* (Tailem Bend), and in the material from *Notophox novae-hollandiae* the spicules were as short as 1:7 body length, but in the appearance of the head and in the other ratios these specimens agreed with *C. spiculigerum*.

Female—Vulva between a third and a quarter body length from head end.

***Contracaecum bancrofti* n. sp.**

Fig. 3-5

From *Pelecanus conspicillatus* from Burnett River, Queensland, type locality (coll. Dr. Bancroft); Thompson River, Queensland (coll. Dr. Mackerras);

Morgan, South Australia (coll. Dr. Walker); and from Sydney Zoological Gardens, from New South Wales. Males up to 24 mm. long; females to 30 mm. Lips with short antero-lateral projections. Interlabia nearly as long as lips; with bifid ends. Head narrower than body succeeding it; striated cuticular "collar" well developed.

Male—Breadth .64 mm.; oesophagus 3.2 mm. long, 1:6 body length; oesophageal appendix 1:5, and intestinal caecum 3:4.8 of oesophageal length, nerve ring .48 mm. from head in 20 mm. long worm; cervical papillae at same level. Spicules 2.2-2.8 mm. long, 1:7.9 body length, alate, with blunt tips. Tail .18-.2 mm. long, conical. Three pairs double postanal papillae and about twenty-three pairs preanal papillae, latter arranged in a straight row on either side of ventral surface, the first two pairs adanal, and the first ten papillae on each side larger and closer together than the remainder.

Female—Oesophagus 1:7-10 body length; intestinal caecum 3:3.7-4.5, and oesophageal appendix 1:4 of oesophageal length. Tail conical, .34 mm. long. Vulva at 4:9 body length from head. Eggs subglobular, about 54 μ by 58 μ .

The male tail of this species most closely resembles that of *C. micropapillatum* (Stoss.), but the species differs in the length of spicules, size of eggs, and position of the vulva. *C. bancrofti* differs from *C. spiculigerum* in the shape of the lips (antero-lateral projection not so marked in the former), in the length of the spicules and in the arrangement of male papillae.

***Contracaecum clelandi* n. sp.**

Fig. 9-10

From *Pelecanus conspicillatus* from Perth, West Australia, coll. Dr. Cleland. Males, 27-30 mm. long; females, 32 mm. Head much wider than long, interlabia about three-quarters length of lips; papillae on lips just below level of anterior ends of interlabia. Body following head much wider than head. Oesophagus 1:6.1-1:7.5 body length, oesophageal appendix 1:3.5-5, and intestinal caecum 1:1.2-1.3, of oesophageal length. Nerve ring .44 mm. from head, just in front of cervical papillae.

Male—Tail tapering suddenly, .8 mm. long; a pair large postanal caudal papillae, followed by four pairs, as in fig. 10; over twenty pairs preanal. Spicules 1.3-1.4 mm. long, broadly alate.

Female—Vulva 12 mm. from head, at 1:2.7 body length.

The species is distinguished from *C. bancrofti* and *C. spiculigerum* by the relative breadth of the head, the shortness of the spicules, as well as the number and arrangement of male caudal papillae.

***Contracaecum sinulabiatum* n. sp.**

Fig. 6-8

From a darter, *Plotus novae-hollandiae* (type host) from Burnett River (coll. Dr. Bancroft), and Thompson River, Queensland (coll. Dr. Mackerras); from *Phalacrocorax carbo* from Eidsvold, Queensland (coll. Dr. Bancroft); and *P. melanoleucus*, Tailem Bend, South Australia.

Males, 14-16 mm. long; females, 18-20 mm. Head about same width as succeeding body. Each lip with antero-lateral ear-like projections; in addition, below these, prominent lateral cuticular flanges. Interlabia broad; tip widened and frequently bifid, reaching between antero-lateral projections and lateral flanges of adjacent lips. Head about three-quarters as long as wide. Papillae on lips at level of anterior ends of interlabia. Oesophagus 2.08-2.24 mm. long in male, and 2.36 mm. in female, 1:7.8-8.6 body length; intestinal caecum 3:4 and oesophageal appendix 1:2.9-3.7 of oesophageal length. Nerve ring .44-.48 mm. from head, just anterior to cervical papillae.

Male—Tail conical, .15 mm. long; spicules 1:8.3-9.5 of body length, with blunt tips. Between twenty and thirty pairs preanal papillae and seven pairs postanal, arranged as in *C. spiculigerum*.

Female—Tail conical. Vulva at 1:4.4-4.5 body length.

The species differs from *C. spiculigerum* chiefly in the possession of lateral flanges on the lips, in the shortness of the spicules, and in the more anterior position of the vulva.

***Contracaecum magnicollare* n. sp.**

Fig. 11-12

From a noddy, *Anous stolidus*, from North-West Islet, Capricorn Group, Great Barrier Reef, Queensland. Four worms present, two young males 8-11.6 mm. long, and two young females 9.7-10.2 mm. long. Head about twice as wide as long, and rather narrower than succeeding body. Lips with antero-lateral projections but no lateral flanges. Papillae on lips just below level of tips of interlabia; latter four-fifths length of lips. Annulated "collar" following lips well developed, even in young specimens. Oesophagus 1:4.8-6.1 body length; intestinal caecum 3:4.2, and oesophageal appendix 1:3.5 oesophageal length. Nerve ring .35 mm. from head, just anterior to cervical papillae.

About twenty to twenty-two pairs of preanal papillae in male, the four most posterior papillae of each side closest together. Six pairs postanal papillae, their arrangement resembling that in *C. microcephalum*. Vulva 1:2.2-1:2.5 body length from head. Both females young, ripe eggs not present.

The species resembles *C. microcephalum* and *C. punctatum* in the male tail, but differs from both in length of the spicules.

CONTRACAECUM MICROCEPHALUM (Rud. 1809)

This species was taken from the caecum of a domestic duck, *Anas boschas*, from Lord Howe Island; and from a black duck, *Anas superciliosa*, from New South Wales.

Male 18 mm., females 18-25 mm. Head half as long as wide, slightly narrower than succeeding body. Lips with wide earlike antero-lateral projections. Interlabia bifid in all specimens, three-quarters length of lips; papillae on lips at level of tips of interlabia. Oesophagus 1:7-7.5 body length; intestinal caecum 1:1.4 and oesophageal appendix 1:6 oesophageal length. Spicules 1:7 body length. Vulva a third body length from head.

CONTRACAECUM TRICUSPE (Gedoelst 1916)

From *Plotus novae-hollandiae* from the Burnett River (coll. Dr. Bancroft) and from the Australian Museum (coll. Krefft, also from Burnett River). Krefft (1873) had recorded it as *Ascaris* sp. Spicules in our specimens about 1:4.7 body length, instead of 1:3 as given by Gedoelst, and the two pairs of small papillae figured by that author just posterior to the cloaca are in our single male specimen merged into one pair of very large papillae. In other respects our specimens agree closely with those described by Gedoelst.

CONTRACAECUM spp., larvae

- (1) From the jabiru, *Xenorhynchus asiaticus*; length 24 mm., width .8 mm.; no lips present, larval tooth prominent. Oesophagus 3.2 mm. long, intestinal caecum 2.56 mm., oesophageal appendix .56 mm. Tail .24 mm. long.
- (2) From the egret, *Egretta alba* (Tailem Bend, S. Aust.). Length 8-10 mm.; larval tooth and three low lips present; oesophagus .88-1.6 mm.; oesophageal appendix .4-.52 mm., and intestinal caecum .56-1.12 mm. in length.
- (3) From *Pelecanus conspicillatus* (Tailem Bend, S. Aust.). Length 8.2 mm., width .4 mm.; three low lips present. Oesophagus 1.04 mm.; intestinal caecum .72 mm., and oesophageal appendix .64 mm. in length. Tail .12 mm. long.

- (4) Larval *Contracaecum* spp. were also obtained from *Notophox novae-hollandiae* (Tailem Bend, S. Aust.; and from *Eudypula minor* (Brighton, S. Aust.), latter worms 2 mm. in length.

CONTRACAECUM spp.

Worms and parts of worms unidentifiable specifically were taken from *Pelecanus conspicillatus* (Perth, W. Aust., coll. Dr. Cleland); *Notophox pacifica* (Thompson River, Queensland, coll. Dr. Mackerras); *Notophox novae-hollandiae* (Tailem Bend, S. Aust.) and *Plotus novae-hollandiae* (Australian Museum, from Queensland).

PORROCAECUM RETICULATUM (Linst. 1899)

Material consists of two females; one 80 mm. long, from *Notophox pacifica* from Eidsvold, Queensland (coll. Dr. Bancroft), and the other 65 mm. long, from the same host species from the Thompson River, Queensland (coll. Dr. Mackerras); also a male 35 mm. long from *Egretta alba*, Thompson River, Queensland. We find on the male tail six pairs of preanal papillae and three pairs postanal, the most anterior of the latter group having (as described by Hsü, 1933) double nerve endings. Spicules in our male .41 mm. long, gubernaculum .1 mm.

HETERAKIS CHENONETTAE Johnston 1912

Fig. 13

Several worms belonging to this species were obtained from the caecum of a wood duck, *Chenonetta jubata*, from New South Wales (Sydney Zoological Gardens). A re-examination of the type material shows that a revised description of the male tail is necessary.

Spicules equal, .4-.42 mm. long; sucker .8 mm. diameter, posterior border .2 mm. in front of cloaca; cloaca .25 mm. from tip of tail. Alae commencing just anterior to sucker, extending to within .11 mm. of posterior end of body, leaving narrow spine-like tail. Two pairs pedunculated papillae at level of sucker; two pairs sessile adanal papillae; eight pairs pedunculate papillae in alae, arranged as in fig. 13.

In other features our specimens agree with the original description (Johnston 1912). The species differs from *H. altaica* Spaul 1929 in being smaller, in having a rather longer oesophagus and relatively shorter spicules, and in the arrangement of papillae on the male tail. It most closely resembles *H. papillosa* Bloch, differing chiefly in the shape of the alae and sucker, and in the number of papillae on the male tail.

HETERAKISISOLONCHE Linstow 1906

Several specimens agreeing closely with *H. isolonche* Linst., as described and figured by Li (1933), were taken from the caecum of a domestic duck, *Anas boschas*, from Lord Howe Island. Baylis (1939) has recorded this species from Brisbane, where it was taken from a crested pheasant, *Chrysolophus amherstiae*, an introduced bird.

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