

STUDIES ON AVIAN CESTODES FROM CHINA.

PART I.

CESTODES FROM CHARADRIIFORM BIRDS.

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(With 37 Figures in the Text.)

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INTRODUCTION.

THE material upon which the present paper is based is a part of Faust's valuable collection of avian cestodes from China. It was sent by Dr E. C. Faust, formerly Professor of Parasitology in the Peking Union Medical College,

to the Zoological Laboratory, University of Neuchâtel. The collection, consisting of cestodes from charadriiform birds, was contained in 55 tubes.

The worms were collected in Peking with one exception (Mong. 4, from Kuei-Hua) in 1920–22, but for one lot (Pe 848, derived from the liver), all the worms were derived from the intestine of the birds. The following list gives the scientific names of the birds, the record number of each lot or tube of specimens and the month in parentheses when they were collected:

- Aegialitis curonica* (Gm.): 728, 760, 767, 841 *d* (April, May).
A. minor (Mey. et Wolf): 1462, 1476 *a*, 1496 *a* (April).
Charadrius veredus Gould: 117, 118, 752 *a*, 1416, 1452, 1474 *a*, 1482 (April).
Gallinago media (Frisch): 529, 588, 593, 748, 1466, 1487 (Jan., Feb., April).
G. megala Swinh.: 510, 517, 526, 552 *b* (January).
Lobivanellus cinereus (Blyth.): 672 *a-c*, 691 *a*, 703 *a*, 718, 1400 *b*, 1428 *a*, 1437, 1440 *c*, 1450 *b* (March, April).
Numenius arquatus (Lin.): 701 *e*, 716 *c*, 735 *c*, 1431 *d* (April).
Rhynchea capensis (Lin.): 750, 1490, 85, 107 *a*, 126 (April).
Scolopax rusticola (Vieill.): 751 (April).
Totanus calidris (Lin.): 848, 1459 (April, May).
Totanus sp.: 144 *b*, 151, 823 (May).
Tringa americana Baird: 884 *a* (May).
Tringa sp.: Mong. 4, Peking 828 (Oct. and May resp.).
Vanellus cristatus Mey. et Wolf: 1436 *a*, 1457 *b* (April).

METHODS.

All the specimens studied were stained with a dilute solution of Mayer's haematoxylin (1 pt. stock sol. to 9 pts. 2 per cent. alum sol.) and were cleared finally in clove oil. Material which appeared black or deep brown was first soaked in potassium permanganate solution (1 grm. to 1000 c.c. of dist. water), then treated with oxalic acid (1 grm. to 300 c.c. dist. water), and finally stained with alum haematoxylin in the usual manner. This process was found by me to be the most satisfactory "depigmentation" method. Most of the specimens were macerated, probably owing to their having been removed from the hosts one or two days after their death. As some of the material was unsuitable for sectioning, many of the diagnoses were perforce based on *in toto* preparations, which, however, when carefully handled, appeared satisfactory for examination of the internal organs. Sections were stained with haematoxylin and eosin. All scolices were examined only in dilute glycerin.

ACKNOWLEDGMENTS.

I desire to express my great indebtedness to Prof. Otto Fuhrmann for kindly placing the material at my disposal for investigation and I am most grateful to him for the valuable suggestions and encouragement he gave me in the course of my work.

Family DAVAINEIDAE Fuhrm.

Sub-family DAVAINEINAE Braun.

Genus *Davainea* Blanch.***Davainea himantopodis* Johnston 1911 (Figs. 1–4).**

Host: *Lobivanellus cinereus*.

Locality: Peking, China.

Specimens: Pe 672 *b* and 672 *c*.

Tube 672 *c* contained numerous tiny, free segments which, after being stained and mounted in balsam, proved to be all mature and gravid proglottids as figured in Fig. 2. Tube 672 *b* contained some twenty complete but very short and delicate strobilae, among which only seven or eight proglottids were mounted with scolex (Fig. 1). The posterior segments showed practically the same structure as in 762 *c*. The specific characters of both lots combined agree perfectly with the description of *D. himantopodis* Johnston, an Australian species from *Himantopus leucocephalus* Gould.

Length 0.96 mm., first proglottid 0.170×0.068 mm., mature 0.262×0.182 mm., and gravid 0.547×0.511 mm. Scolex suborbicular 0.204 mm. wide, suckers rounded 0.056 mm. in diam., situated in anterior portion of scolex (according to Johnston, around margin of the former there is a row of small hooks, 0.005 mm. long, which are not seen in Chinese specimens). Rostellum 0.060 mm. in diam. on apex of scolex, carrying 48 (50 ?) hooks (Fig. 3) 0.0117 mm. long, hammer-shaped, arranged in two rows (Fig. 4). Rostellar sac conicoid, extending backward to posterior side of suckers. Neck absent or present. Genital anlage (primordium) beginning immediately at 1st segment, uterus well developed in free segment which falls off after 7th segment. Genital pores regularly alternate, at anterior third of proglottis margin, genital atrium deep. Testes 40–56 mm. in diam., only four in number, three of which behind ovary, the fourth anterolateral to it on the aporal side. Vas deferens wide, much coiled behind internal end of cirrus sac. Cirrus sac large, 0.12×0.24 mm. directed anteromedially two-thirds across segment. Everted cirrus armed at the free end with long bristles and delicate spines at its base. Ovary consisting of two lateral rounded lobes, the whole measuring 0.128×0.060 – 0.053 mm. Vitelline gland, 0.064×0.024 mm., placed at hilus of the latter. Vagina wide, comparatively short, constricting before receptaculum seminis, globular sac of 0.032 mm. in diam. situated dorsal to anterolateral corner of ovary. Excretory vessels not seen. No persistent uterus. Onchospheres 0.028 mm. in diam., single in parenchyma.

With the exception of a slight difference in the form and length of hooks, this cestode is identical with Johnston's species from Australian birds. It may be noted that when Prof. Faust's collection of avian cestodes from China is fully worked out, it will undoubtedly throw some new light on the distribution of tapeworms as indicated by the present species.

Family DILEPIDIDAE Fuhrm.

(a) Sub-family DILEPIDINAE Fuhrm.

Dilepis sp. (Figs. 5-6).Host: *Tringa* sp.

Locality: Kuei-Hua, China.

Specimen: Mong. 4.

Length 25 mm., breadth 2 mm. Scolex (Fig. 5) 0.399 mm. in width, bearing suckers of 0.114-0.136 mm. in diam. at its anterior margin; rostellum 0.262 mm. wide; hooks absent. Young segment 0.408 × 0.051 mm., mature (Fig. 6) 0.935 × 0.340 mm., gravid 1.6 × 0.850 mm. Genital pore unilateral, at anterior third of proglottis margin. Cirrus pouch small and short, 0.228 mm. long, approximating only longitudinal excretory vessels. Vas deferens fine, much coiled, occupying anterior space between two ovarian lobes. Ovary tubular, of two wings, aporal much larger than poral, widely expanded 0.456 × 0.125 mm. Vitelline gland, of variable form 0.171 mm. in diam. Seminal receptacle 0.148 mm. large, in front of vitelline gland, overlaid ventrally by ovary. Vagina posteriorly parallel to cirrus pouch. Testes 40-50 in number, 0.036 mm. diam., delimited laterally by longitudinal vessels. Longitudinal excretory vessels dorsal to genital ducts, the ventral of either side connected by transverse commissure. Eggs with three layers of membranes: the external 0.084 × 0.036 mm., the middle 0.048 × 0.024 mm. and the onchospheres 0.028 × 0.020 mm., its hooklets 0.010 mm. long.

So far as I am aware, the six species of the genus *Dilepis* described from charadriiform birds are: *D. tringae* Cholod. (1913), *D. retrostris* Krabbe (1869), *D. recapta* Clerc (1906), *D. nymphoides* Clerc (1903), *D. limosa* Fuhrm. (1907), *D. odhneri* Fuhrm. (1909); none of these agrees with the specimen here described, but in the absence of rostellar hooks, it is safer to leave it unnamed.

Amoebotaenia fuhrmanni n.sp. (Figs. 7-11).Host: *Gallinago* sp.

Locality: Nanking, China, C. H. Chang Coll.

Length 1.5 to 4.77 mm., breadth 0.23 to 0.51 mm., consisting of 17 to 21 proglottids with a very short or long neck according to the degree of construction. Scolex 0.22 mm. in diam., rostellum with an apical disc of 0.068 mm.

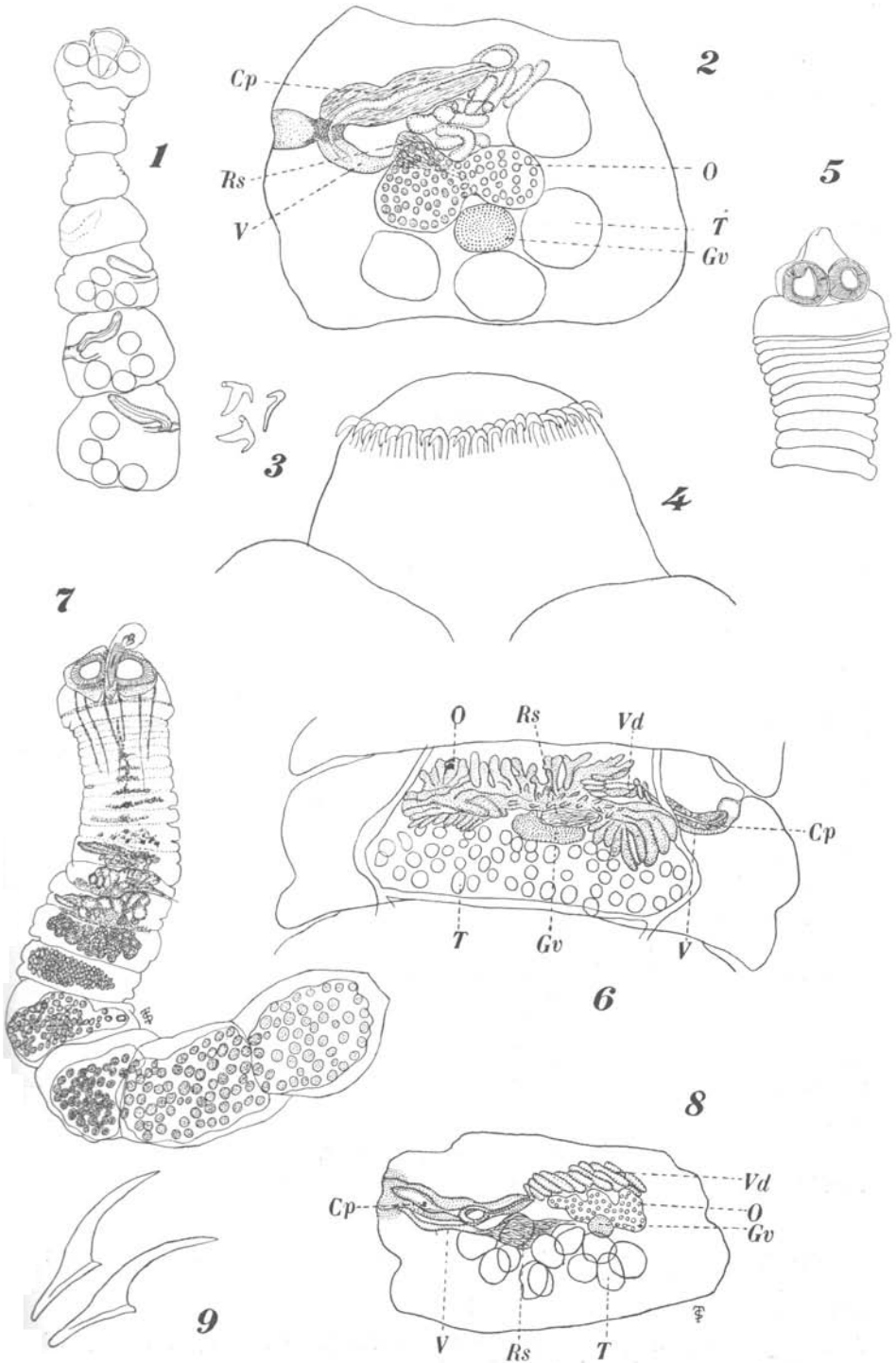
Legends to Figs. 1-9.

Figs. 1-4. *Davainea himantopodis* John. (1) Scolex and strobila showing disposition of testes in mature proglottids. (2) Mature segment. (3) Rostellar hooks. (4) Rostellum, partly extended, showing crown of hooks.

Figs. 5, 6. *Dilepis* sp. (5) Scolex and part of strobila. (6) Mature segment.

Figs. 7-9. *Amoebotaenia fuhrmanni* n.sp. (7) Normal condition (balsam mount). (8) Mature proglottis. (9) Rostellar hooks.

Lettering to figures: *Cp.* Cirrus pouch; *Gv.* Vitelline gland; *O.* Ovary; *Rs.* Receptaculum seminis; *T.* Testes; *V.* Vagina; *Vd.* Vas deferens.



in diam., its double sac often extending over posterior border of suckers; 10 rostellar hooks, 0.070 mm. long; suckers rounded or oval, 0.080 mm. in diam. Genital pore regularly alternate, normally at the centre of proglottis margin. Anlage of genitalia beginning immediately behind neck. Genital organs fully developed at 14th and degenerated at 16th segment. Cirrus sac 0.044–0.052 × 0.014–0.020 mm., extending over longitudinal excretory vessels, crossing about one-third width of segment. Testes 12–16, 0.012–0.020 mm. in diam., crowded together behind female complex. Vagina posterior to cirrus pouch, extending inward from genital atrium to central globular receptaculum seminis. Ovary displaced to aporal side, of irregular shape, slightly lobed, situated between vitelline glands and vas deferens. Vitelline gland round. Uterus sac-shaped, with numerous diverticula, later filling up nearly whole segment. Eggs globular, 0.018 mm. in diam., with 2 shells; scattered loosely in parenchyme of last segments. Onchospheres, 0.014 mm. in diam.

The present species (Fig. 7) normally has a small strobila with a very short neck, which may, however, be stretched to several times its normal length. Among the specimens studied were found certain forms having a long neck, with elongated scolex (Figs. 10, 11). Therefore, the two forms might possibly be regarded as distinct species, but the difference in length of neck is simply due to the difference in the state of fixation.

Judging from all characters, such as the much less numerous but rather large rostellar hooks (10 : 0.070 mm.), the smaller testes (0.012–0.020 mm.) and the shorter cirrus sac (0.044–0.052 mm.), this tiny tapeworm is decidedly distinct from any known species of the genus *Amoebotaenia*.

The species is dedicated to Professor Otto Fuhrmann, University of Neuchâtel, in honour of his contributions to our knowledge of tapeworms.

***Amoebotaenia pekinensis* n.sp. (Figs. 12–14).**

Host: *Charadrius veredus*.

Locality: Peking, China.

Specimen: Pe 1474 a.

Minimum length 3 mm., breadth of last proglottids 0.70–1.0 mm. × 0.374 mm. and that of young proglottids 0.42 × 0.045–0.057 mm., consisting of about 20 segments. Scolex 0.467 × 0.285 mm., rostellum 0.079 mm. in diam. with a double sac 0.2964 mm. long, extending backwards as far as the

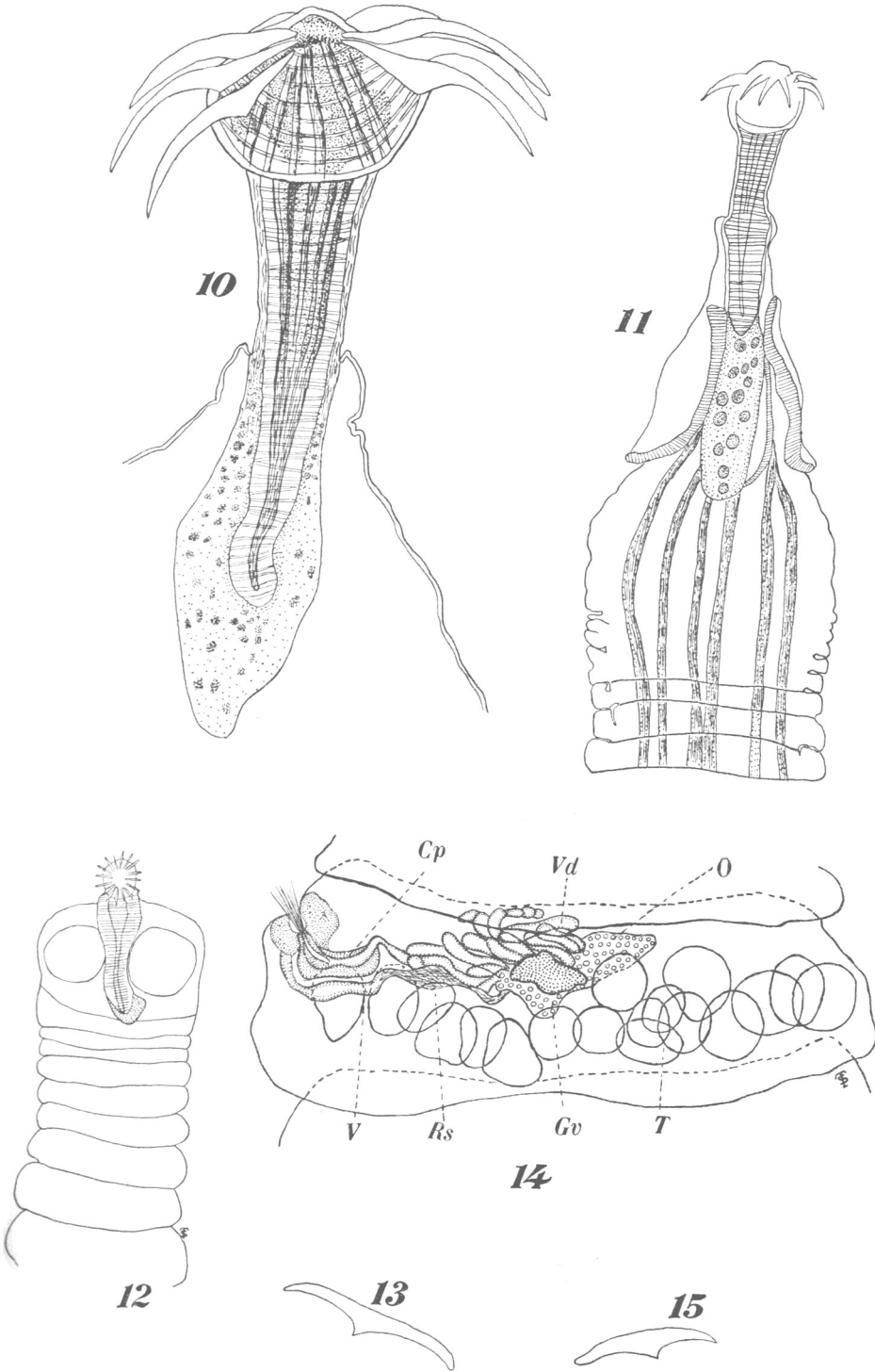
Legends to Figs. 10–15.

Figs. 10, 11. *Amoebotaenia fuhrmanni* n.sp. (10) Showing hooks of normally extended rostellum and structure of rostellar sac. (11) Scolex and part of strobila showing suckers elongated and a distinct neck.

Figs. 12–14. *Amoebotaenia pekinensis* n.sp. (12) Scolex and part of strobila. (13) Rostellar hook. (14) Mature proglottis.

Fig. 15. *Amoebotaenia vanelli* Fuhrm., rostellar hook.

Lettering to figures: *Cp.* Cirrus pouch; *Gv.* Vitelline gland; *O.* Ovary; *Rs.* Receptaculum seminis; *T.* Testes; *V.* Vagina; *Vd.* Vas deferens.



posterior border of scolex. Rostellar hooks 16, 0.054–0.061 mm. long, arranged in one row. Neck present but very short. Proglottids broader than long. Genital pore regularly alternate, at anterior third of proglottis margin. Genital atrium well-marked, surrounded with darkly stained cells. Cirrus sac 0.040 × 0.100–0.180 mm., when extended, past longitudinal excretory vessels, penis armed with bristles. Testes 12–20, 0.060–0.080 mm. in diam., extending transversely to lateral margins in posterior half of proglottids. Vas deferens coarse, much coiled, anterolateral to female genital organs, reaching anterior border of proglottids. Vagina, a wide tube running medially posterior to cirrus sac and swelling into seminal receptacle midway between ovary and cirrus sac. Ovary an irregular mass, central, ventral to vitelline gland. Vitelline gland sub-triangular, 0.080 × 0.040 mm. Eggs rounded, with two shells, 0.048 mm. in diam. (in balsam). Onchospheres 0.032 mm. in diam.

The disposition of testes and the special form of rostellar hooks justify the creation of the new species.

Amoebotaenia vanelli Fuhrm. 1907 (Figs. 15, 16).

Host: *Charadrius veredus*.

Locality: Peking, China.

Specimens: Pe 1482, 752 *a* and 117.

Length 3–5 mm., breadth 0.85 mm., consisting of 20–23 segments, all broader than long. Scolex 0.16 mm. in diam., suckers 0.102–0.136 mm. diam., rostellar disc 0.091 mm. diam., muscular sac 0.171 mm. long, extending posteriorly only to anterior level of suckers, suckers 0.102 mm. diam., hooks 16 in number 0.046–0.500 mm. long. Genital pore regularly alternate, genital atrium opening at junction of anterior and middle third of proglottis margin. Cirrus sac 0.100 × 0.038 mm. bending anteriorly from genital atrium. Vas deferens coarse, much coiled behind cirrus sac. Testes 12–18, 0.048–0.056 mm. diam., packing up behind female genital organs. Ovary central, large, trilobed. Vitelline gland round. Vagina running medially, posterior to cirrus sac, at level of poral lobe of ovary, forming receptaculum seminis, fusiform 0.028 × 0.060 mm.

Legends to Figs. 16–28.

Fig. 16. *Amoebotaenia vanelli* Fuhrm., mature segment.

Fig. 17. *Amoebotaenia brevicollis* Fuhrm., rostellar hook.

Figs. 18, 19. *Anomotaenia citrus* (Krabbe). (18) Scolex and part of strobila. (19) Rostellar hooks.

Figs. 20–22. *Anomotaenia stentorea* (Fröl.). (20) Scolex. (21) Rostellar hooks. (22) Egg with two elongated threads at opposite poles.

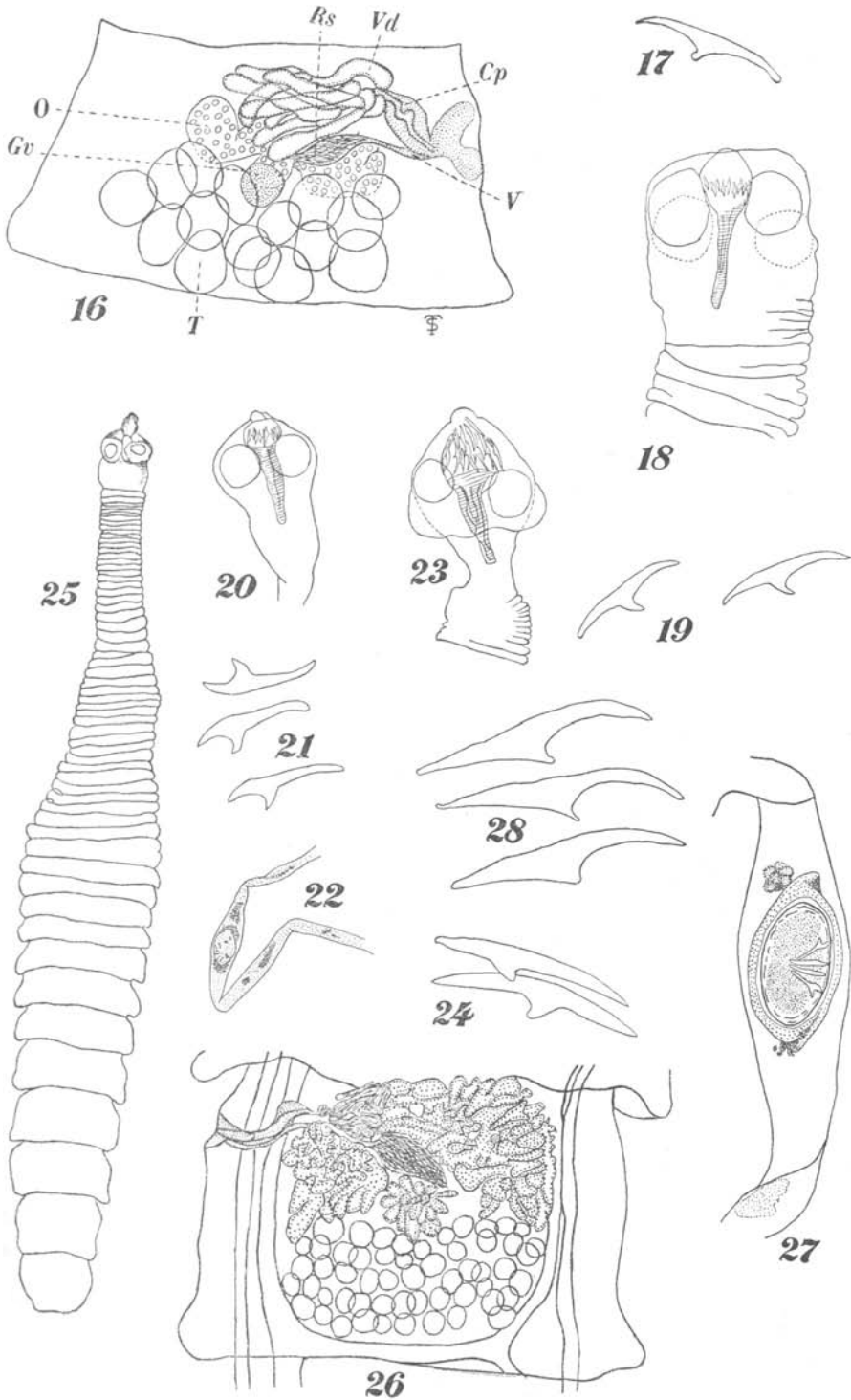
Figs. 23, 24. *Anomotaenia nymphaea* (Schränk.). (23) Scolex and part of strobila. (24) Rostellar hooks.

Fig. 25. *Anomotaenia microrhyncha* (Krabbe), scolex and whole strobila.

Figs. 26, 27. *Anomotaenia* sp. (26) Mature segment. (27) Mature egg.

Fig. 28. *Icterotaenia paradoxa* (Rud.), rostellar hooks.

Lettering to figures: *Cp.* Cirrus pouch; *Gv.* Vitelline gland; *O.* Ovary; *Rs.* Receptaculum seminis; *T.* Testes; *V.* Vagina; *Vd.* Vas deferens.



Excepting slight difference in form and size of ovary, the present specimen from *Charadrius* agrees very well with Fuhrmann's type from *Vanellus*.

***Amoebotaenia brevicollis* Fuhrm. 1907 (Fig. 17).**

Host: *Charadrius veredus*.

Locality: Peking, China.

Specimens: Pe 1416 and 118.

Tubes 1416 and 118 contained some tiny, fragmentary, dark brown tapeworms. The process of depigmentation and staining¹, owing to the poor preservation, did not prove satisfactory for detailed anatomical study. Consequently description is incomplete: scolex subglobular 0.357 mm. wide, rostellum short with apical disc 0.136 mm. in diam. and rostellar sac 0.187 mm. long; neck present 0.323 × 0.102 mm.; young segment 0.340 × 0.034 mm., mature segment 0.374 × 0.153 mm.; testes 12–13, 0.102 mm. diam. (larger than specimen described by Fuhrmann); cirrus pouch 0.120–0.18 mm.; genital pore at centre of proglottis margin.

On certain scolices there are but few hooks, 0.064–0.066 mm. These are exactly like those of *A. brevicollis*, described in detail by Fuhrmann (1907, p. 520) and Baczyńska (1914, p. 224).

According to Fuhrmann's lists of avian cestodes, only five described species occur in the genus *Amoebotaenia*. The chief differential characters of these species, including those of the Chinese forms, are given in Table I. The genital pore is regularly alternate in all seven species.

***Anomotaenia citrus* (Krabbe 1869) (Figs. 18, 19).**

Syn.: *Choanotaenia citrus* Clerc 1903.

Hosts: *Charadrius veredus* and *Gallinago media*.

Locality: Peking, China.








Specimens: Pe 1452, 1474 a and 1487.

Tube 1474 a contained two species of cestodes: the one is described as *Amoebotaenia pekinensis* n.sp. on p. 92 whilst the following description relates to the other.

Young tapeworms devoid of gravid segments, measuring 15 × 1 mm., consisting of 100 segments; mature segments 0.456–0.513 × 1 mm. Scolex squarish 0.408 mm. wide, rostellum 0.136 mm. diam., suckers 0.102 mm. diam., rostellar sheath extending far back of suckers. Neck present but short, distinct or not. Rostellar hooks 24 in two rows, 0.05–0.06 mm. long (Krabbe's description: 22–25, 0.054–0.062 mm. but Clerc's description: 30, 0.043–0.048 mm.). Anlage of genital organs beginning at about 15th segment. Genital pore irregularly alternate, genital atrium, when protruded, forming a cone at junction of anterior and middle third of proglottis margin. Cirrus sac extending from atrium to excretory vessels, 0.240 × 0.045 mm. Vas deferens leading from cirrus sac medially and thrown into coils nearly halfway across proglottis.

¹ See p. 92.

SPECIES OF AMOEBOTAENIA FROM BIRDS

Species	Size of body (mm.)	No. of proglottids	Rostellar hooks			Anlagen of genital organs	Cirrus pouch in (mm.)	Testes in (mm.)	Onchospheres (mm.)	Host	Locality
			Size (mm.)	No.	Form						
<i>A. brevicollis</i> Fuhm. 1907	Very small	24	0.059-0.061 long	16		Immediately behind scolex	0.24 long, cirrus armed with long, fine bristles	12-15, 0.06 diam. at posterior side of proglottis between longitudinal vessels	0.034	<i>Charadrius rubicrus</i>	Egypt (Dongola)
<i>A. frigida</i> Meg. 1927	2.2 × 0.5	12-14	0.051 long, in two rows	30		—	0.26 × 0.064	11-15, in two rows	—	<i>Cypselus apus</i>	Egypt
<i>A. vanelli</i> Fuhm. 1907	7 × 1	25	0.046-0.051 long	16		—	0.2 long	18-20, 0.07-0.09 diam. at posterior side of segment	—	<i>Vanellus dongolanus</i> (?)	Egypt (Dongola)
<i>A. brevis</i> v. Linst. 1884	4.2 × 1.6	12	0.023 long	?		Beginning at 7th segment	—	—	—	<i>Charadrius plumalis</i> , <i>Charadrius hiaticula</i> , <i>Squatarola squatarola</i> , <i>Aegialites hiaticola</i>	Europe, Africa
<i>A. sphenoides</i> Cohn. 1899 (Raill. 1892)	2-3.5 × 0.9-1.5	18-23	0.032 long	14		Testes seen in 1st and 2nd segment	—	12-14, against posterior border, in one row, extending to excretory canals	0.035	Fowls	South Africa, South America, Europe
<i>A. fuhmanni</i> <i>mithi</i>	1.5-4.77 × 0.23-0.51	17-21	0.070 long	10		Developing immediately behind scolex	0.044-0.052 × 0.014-0.020	12-16, 0.012-0.02 diam., behind female genital organs	0.014	<i>Gallinago</i> sp.	China (Nanking)
<i>A. pekinensis</i> <i>mithi</i>	3 × 0.7- 1.0	16-20	0.054-0.061 long	16		—	0.100-0.180 × 0.020-0.040	12-20, 0.06-0.08 diam., extending laterally to both margins of segment	0.032	<i>Charadrius veredus</i>	China (Peking)

Testes 18–22 (?), 0.060–0.068 mm. diam. behind female glands. Vagina running posteriorly to cirrus sac and swelling into receptaculum seminis at internal end. Female genital glands in strobila of No. 1474 *a* not discernible, but in No. 1452 from the same host they are distinguishable. Ovary lobed, a transversely elongated sac. Vitelline gland 0.182 mm. in diam. Receptaculum seminis 0.285 mm. long overlaid ventrally by poral lobe of ovary. Shell gland stained slightly, between ovary and vitelline gland and dorsal.

Tube 1487 contained a few tiny tapeworms whose internal organs could not be clearly made out, but owing to the two crowns of hooks being similar to those of the beforementioned specimens, the position of genital pore and numerous testes, it may safely be regarded as of the same species.

The rostellar hooks are of the same size and form as in *A. citrus*, a species very imperfectly described by Krabbe (1869) and Clerc (1911) as regards the internal organs. I venture to refer our specimens tentatively to *A. citrus*, but with uncertainty.

Anomotaenia stentorea (Fröl.) (Figs. 20–22).

Syn.: *T. variabilis* Rud. 1802; *Choanotaenia variabilis* Clerc 1902.

Host: *Vanellus cristatus*.

Locality: Peking, China.

Specimen: Pe 1457 *b*.

Length 65–70 mm., breadth 2 mm. Scolex 0.296 mm. wide, with 23 hooks in two circlelets, of different size: 0.040–0.045 mm., and 0.036–0.037 mm. long respectively. Suckers rounded, 0.116–0.102 mm. in diam. Rostellar sac long, extending a certain distance back of suckers. Neck prominent. Proglottis broader than long. Genital pore irregularly alternate. Cirrus sac 0.410 × 0.045 mm. Testes 35–45, 0.068–0.079 mm. in diam. Ovary tubular, large. Outer embryonal shell with two elongated threads at opposite poles of oval middle part (Fig. 23). Onchospheres 0.030 × 0.021 mm., its hooklets 0.009 mm. long.

Anomotaenia nymphaea (Schränk 1790) (Figs. 23, 24).

Syn.: *Choanotaenia nymphaea* Clerc.

Host: *Numenius arquatus*.

Locality: Peking, China.

Specimen: Pe 701 *e*.

Length 25–30 mm. (*vide* Krabbe: 75 × 1.7 mm.), breadth of young segments 0.306 mm., of mature segments 0.901 mm., and of gravid segments 1.105 mm., shape of segments inconstant, gravid segment always longer than wide. Scolex subangular, 0.342 mm. in transverse diam., sucker subcircular 0.091–0.114 mm., rostellar bulb, when retracted, 0.399 × 0.1400 mm., bearing 24 hooks 0.064–0.088 mm. long, in two circlelets, rostellar sac strongly muscular, extending backward beyond scolex. Neck distinct, narrower than succeeding segments. Genital pore irregularly alternate, marginal, at anterior quarter of

proglottis margin. Cirrus sac small and short, $0.108-0.128 \times 0.028-0.044$ mm., hardly reaching excretory vessels, filled internally with conspicuous cirrus and coiled vas deferens which continues to poral side of ovary. Vagina opening to the exterior behind cirrus-aperture, with comparatively thick wall, leading medially to elongated receptaculum seminis, 0.056 mm. long. Ovary large, bilobed, somewhat arched, aporal lobe larger than the poral, its anterior curvature touching the posterior margin of preceding segment. Vitelline gland, 0.1140 mm. in transverse diam., behind ovary, ventral to the latter. Testes 34-45, 0.032-0.040 mm. in diam., occupying posterior half of proglottis. Ventral vessels larger than the dorsal, lumen measuring 0.034 mm. in diam. Mature eggs not seen.

The size of hooks of this present species has been recorded by Schrank and Krabbe, but their anatomy is still obscure. By the courtesy of Prof. Otto Fuhrmann, I have been able to examine preparations of the type-specimen, and conclude that the anatomy of the Chinese species agrees on all points with that of the type.

Anomotaenia microrhyncha (Krabbe 1869) (Fig. 25).

Host: *Aegialitis curonica*.

Locality: Peking, China.

Specimen: Pe 767.

A few young small tapeworms measured 10×1 mm. The form of the strobila varies considerably. The normal one is shown in Fig. 25. Scolex 0.216 mm in transverse diam., rostellum 0.054 mm. in diam., sucker 0.084-0.092 mm. diam. Rostellar hooks incomplete, 0.017-0.018 mm. long, arranged in two rows. Genital pore irregularly alternate. Testes 20-25, 0.034-0.057 mm. Cirrus pouch small, 0.100×0.016 mm. Ovary bilobed, compact, 0.228 mm. in total width. Vitelline gland 0.148 mm. in diam. Eggs not seen.

According to the above description the present specimen has some characters similar to *A. microrhyncha*, recorded from the intestine of the ringed plover (*Aegialitis hiaticola* L.) from different localities.

Anomotaenia sp. (Figs. 26, 27).

Host: *Vanellus cristatus*.

Locality: Peking, China.

Specimen: Pe 1436 a.

Length 87 mm., greatest breadth 1.7 mm. Young segments immediately behind scolex measuring 0.119×0.017 mm. broader than long; mature segments 1.285×0.935 mm., posterior gravid segments 1.530×1.700 mm. longer than broad. Neck present, 0.510 mm. long. Scolex 0.240 mm. diam.: rostellum (in balsam) 0.0510 mm. diam., muscular sac 0.170 mm. long, reaching backward to posterior margin of scolex; hooks absent; suckers 0.170 mm. in diam. Anlage of genitalia commencing at about 82nd segment from neck. Testes numerous, about 40-50, 0.171-0.262 mm. in diam., backed up at the posterior

part of segment, delimited laterally by longitudinal excretory vessels. Ovary of complicated tubular glands, developed enormously, occupying nearly anterior two-thirds of proglottis. Vitelline gland deeply lobed, central, 0.193×0.182 mm. Vagina running inward from genital atrium to an oval receptaculum seminis, 0.228×0.114 mm., lying just in front of vitelline gland. Cirrus sac, narrow, $0.547\text{--}0.575 \times 0.068\text{--}0.114$ mm. hardly passing over ventral longitudinal excretory vessels. Genital atrium irregularly alternate, opening at anterior third of proglottis margin, presenting the following sequence: LLLRLLRLLLRLLR. Fine vas deferens strongly coiled, extending immediately from internal end of cirrus sac to left-hand of receptaculum seminis. Dorsal longitudinal vessels measuring 0.684 mm. in diam., ventral vessels subequal ($0.684\text{--}0.114$ mm.), a transverse canal connecting the latter of either side along the posterior border of proglottis. Gravid segment filled with fusiform eggs, the first shell measuring 0.216×0.036 mm., the second 0.050×0.0252 mm.

According to the form of eggs, the present form differs from the genus *Monopylidium* or *Choanotaenia*, but in the absence of rostellar hooks it is tentatively placed under *Anomotaenia* and remains unnamed.

***Icterotaenia paradoxa* (Rud. 1802) (Fig. 28).**

Syn.: *Choanotaenia paradoxa* Clerc 1903, *Parachoatania paradoxa* Lühe 1910.

Host: *Aegialitis curonica*.

Locality: Peking, China.

Specimen: Pe 728.

Tube 728 contains a few fragments of small brown tapeworms. Preparations *in toto* seem insufficient for determination, although the scolex and gravid segment point to the genus *Icterotaenia*. A careful study of sections permits of the following description:

Length ?, gravid segments 0.894×0.935 mm., that of sexually mature segments 0.595×0.357 mm. Scolex 0.612 mm. wide, followed by a long neck about as wide (0.578 mm.), no distinct demarcation between scolex and neck, thus the anterior being cylindrical. Rostellum retracted, measuring at level of circle of hooks 0.171 mm. in diam., armed with 15 ? hooks $0.086\text{--}0.088$ mm. long in one row. Rostellar sac 0.442×0.341 mm. Suckers 0.200 mm. diam., situated on a level with anterior end of muscular sac. Genital pore opening at anterior third of proglottis margin, its atrium not distinct. Cirrus sac rather long, narrow, 0.100×0.012 mm., cirrus fine and straight. Vas deferens loosely coiled behind internal end of cirrus sac, forming neither internal nor external seminal vesicles. Testes in smaller number, 12–14 (on frontal section), $0.032\text{--}0.044$ mm. diam. Semicircular ovary, 0.044×0.12 mm., situated at the middle of proglottis. Vitelline gland, 0.076 mm. wide, some distance behind ovary. Vagina posterior to cirrus sac, directed posteromedially, and at region of ovary swelling into receptaculum seminis, 0.032×0.048 mm. At the median end of the latter, vagina constricted at first and then again expanded. On section, the first portion of vagina lined with cilia. In gravid segment, one onchosphere

in each parenchymatous capsule, which measures 0.068 mm. diam. (in balsam).

A brief comment on this species may be made as follows: In 1850–51, Diesing, when describing *Taenia paradoxa* Rud., pointed out the special form of proglottids “articuli difformes.” In 1869, Krabbe mentioned that *Taenia paradoxa* bears 14–19 hooks 0.074–0.098 mm. long (misquoted by Clerc as 0.074–0.078 mm.) and their basal part is straight with a ventral rudimentary root, as shown in his fig. 70, pl. III. The size given by Clerc for this species is much smaller, being 0.050–0.075 mm., and the form appears different from that figured by Krabbe, i.e. the basal part of hooks drawn by Clerc in fig. 62, pl. 10 looks rather recurved. However, he was of opinion that the deformity of proglottids in his form agrees with Diesing’s description. Of the present specimen, the form and size of hooks (Fig. 28) are identical with those figured by Krabbe, but the anatomy mentioned above does not agree with Clerc’s description. On account of insufficient and fragmentary material at hand, it is impossible to verify the degree of deformity of the proglottids, therefore, a further study of additional material is necessary.

***Icterotaenia arquata* (Clerc 1906).**

Syn.: *Choanotaenia arquata* Clerc 1906.

Host: *Numenius arquatus*.

Locality: Peking, China.

Specimen: Pe 716 c.

Tube 716 contained a few small fragments moderately preserved, which, after careful treatment rendered a study of the internal anatomy of proglottids possible. The following account is incomplete:

Young segments slightly broader than long, 0.342×0.288 mm.; mature sexual segments 0.570×0.649 mm. Genital pore irregularly alternate. Testes 15–20, $0.028\text{--}0.057$ mm., vitelline gland 0.048 mm.; ovary in two deeply lobed wings, connected by a narrow isthmus; cirrus sac short, hardly one-third the width of proglottids.

Definite determination is impossible on the incomplete material in hand, but comparing the internal structures with those of *Icterotaenia* (*Choanotaenia arquata* Clerc, recorded from the same host, the present specimen bears some similarity thereto.

(b) Sub-family DIPYLIDIINAE Stiles.

***Monopylidium macracanthum* Fuhrm. 1907 (Fig. 29).**

Host: *Lobivanellus cinereus* and *Rhynchea capensis*.

Locality: Peking, China.

Specimens: Pe 1400 b, 107 a and 703.

Tube 1400 b contained two species of tapeworms of a *Gyrocœlia* sp. to be described later, and the smaller ones showing the characters of *Monopylidium* with strobila $20\text{--}60 \times 2$ mm.

Length ?, 1–2 mm. broad. Scolex 0.592 mm. in transverse diam., rostellum 0.239 mm. in diam., rostellar sac 0.364 mm. long, suckers 0.182–0.193 mm. in diam. Neck very short, 0.57×0.020 mm. Rostellar hooks 26 in number, of two sizes: larger 0.144–0.148 mm., smaller 0.120–0.124 mm. long, in two rows. Genital pore irregularly alternate, at anterior third of proglottis margin. Cirrus pouch 0.342×0.034 mm., in mature segments, or 0.228×0.045 mm. in gravid segments, slightly overlapping excretory vessels. Vas deferens closely coiled, partly overlaying ovary. Ovary small, 0.160 mm. wide, in front of vitelline gland, 0.079 mm. in diam. Testes 22 ? or more, 0.057 mm. in diam., in posterior half of segment. Calcareous corpuscles abundant. Eggs 0.079 mm. in diam., single in each parenchymatous capsule.

The material from *Rynchea capensis* was all fragmentary and macerated. Careful examination of the scolex and some mature segments appeared to reveal the following characters: Scolex 0.765 mm. wide, rostellum retracted, 0.306 mm. in diam., rostellar sac 0.452 mm. long, extending far from suckers 0.187–0.204 mm. in diam., neck indistinct, rostellar hooks in two rows, 0.124–0.148 mm. long, genital pore irregularly alternating, cirrus pouch $0.193 \times 0.228 \times 0.045$ mm., testes ?, 0.114–0.136 mm. diam., ovary ?, vitelline gland 0.079 mm. diam.

The poor material rendered detailed study of other structures impossible. Tube 703 contained a few specimens in company with *Gyrocœlia* sp.

Monopylidium macracanthum, as fully described by Fuhrmann (1907), Mapleston and Southwell (1923) bears a double crown of long hooks which are identical with the specimens here considered; the internal anatomy shows some similarity to the description of Fuhrmann's species, but cirrus sac is a little longer (only 0.16 mm. long: *vide* Fuhrmann).

***Monopylidium guiarti* n.sp. (Figs. 30–32).**

Host: *Aegialitis minor* and *Aegialitis curonica*.

Locality: Peking, China.

Specimens: Pe 1462, 1476 *a* and 1496 *a*.

Tubes 1462, 1476 *a* and 1496 *a* each contained one characteristic specimen of *Monopylidium guiarti*.

Legends to Figs. 29–37.

Fig. 29. *Monopylidium macracanthum* Fuhrm., rostellar hooks.

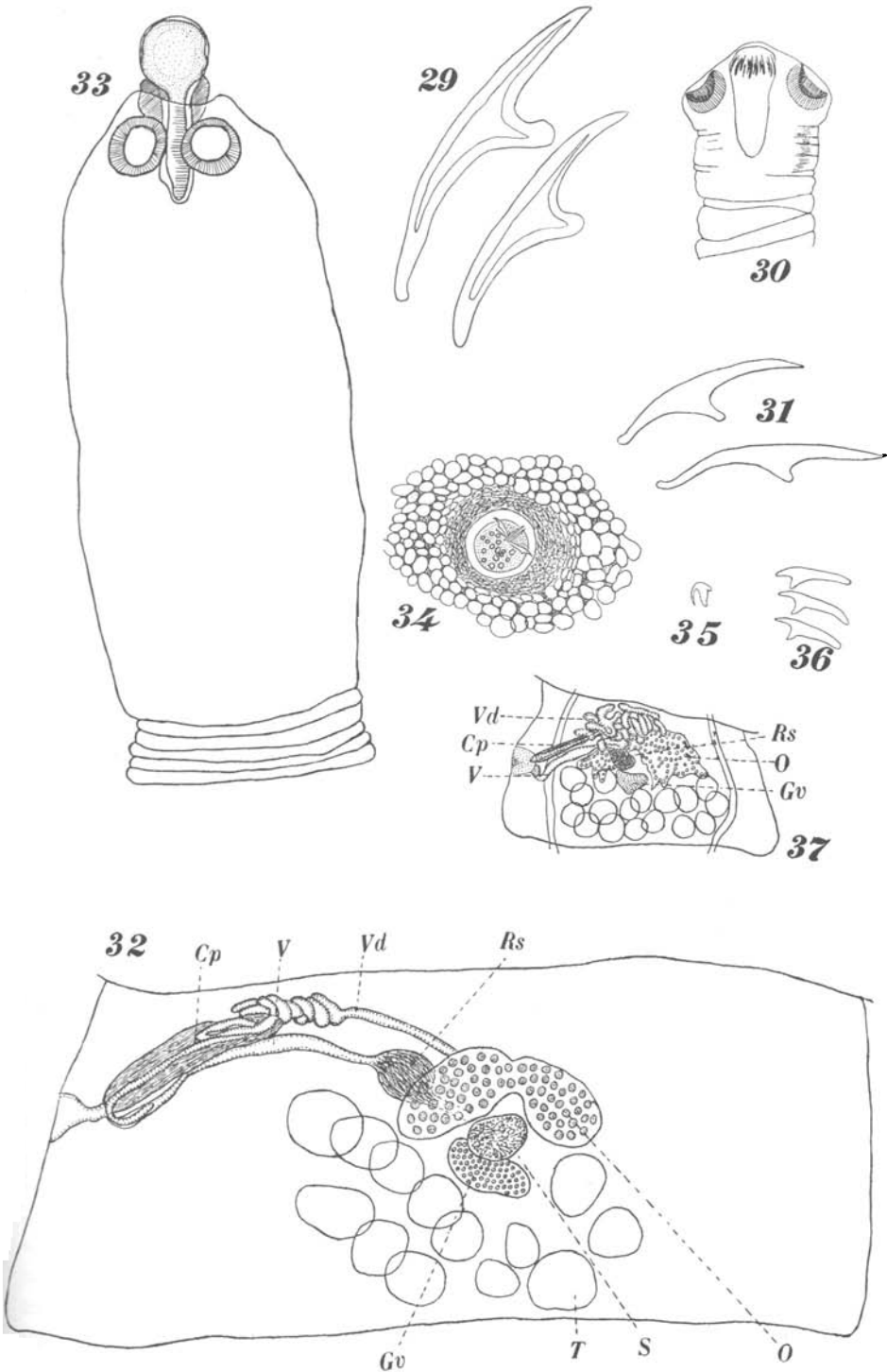
Figs. 30–32. *Monopylidium guiarti* n.sp. (30) Scolex and anterior segments of strobila. (31) Rostellar hooks. (32) Mature segment.

Figs. 33, 34. *Monopylidium* sp. (33) Scolex and neck. (34) Onchosphere surrounded with parenchyma.

Fig. 35. *Choanotaenia cingulifera* (Krabbe), isolated rostellar hook.

Figs. 36, 37. *Choanotaenia joyeuxi* n.sp. (36) Rostellar hooks. (37) Mature segment.

Lettering to figures: *Cp.* Cirrus pouch; *Gv.* Vitelline gland; *O.* Ovary; *Rs.* Receptaculum seminis; *S.* Shell gland; *T.* Testes; *V.* Vagina; *Vd.* Vas deferens.



Length 17 mm., consisting of about 100 segments, young proglottis measuring 0.408×0.017 mm., mature 1.105×0.34 mm., all broader than long, gravid 0.850×0.680 mm. longer than broad. Neck not very sharply demarcated. Scolex 0.627 mm. in transverse diam., rostellum 0.193 mm. diam., muscular sac 0.469 mm. long, extending backward far behind suckers, suckers 0.193 mm. diam., hooks 30, in two rows, 0.084–0.096 mm. long. Genital pore irregularly alternate, LLLRLRLLLLRLLL, at the anterior third of proglottis margin, no well-marked atrium. Cirrus sac $0.200\text{--}0.360 \times 0.024\text{--}0.045$ mm., extending medially a little past excretory vessels. Testes 12–20, 0.034–0.057 mm. behind female genital glands, sometimes extending more forward on either side of ovary. Vagina, fine and straight, posterior to cirrus sac. Receptaculum seminis 0.120 mm. long, dorsal to ovary. Ovary crescentic, central, compact, embracing rounded vitelline gland, 0.072–0.080 mm., in its posterior hilus. In gravid segment, ova scattered singly in parenchyma. Eggs about 0.048 mm. in diam.

Apart from the internal anatomy which seems different from other known species occurring in closely allied hosts, the form of the hooks is similar to that of *M. chandleri* Moghe 1925, *M. cayennense* Fuhrm. 1909, and *M. macracanthum* Fuhrm. 1907, but the number of hooks in all these species is less than 30. *M. arcticum* (*Choanotaenia arcticum*) Baylis 1919, and *M. secundum* Fuhrm. 1907 are similar to the present specimens in the number of hooks, but different in shape and length. Therefore we regard the form here considered as a new species which is named in honour of Dr J. Guiart, Professor of Parasitology of the University of Lyon, France.

Monopylidium sp. (Figs. 33, 34).

Host: *Lobivanellus cinereus*.

Locality: Peking, China.

Specimen: Pe 672 a.

Tube 672 a contains one large tapeworm devoid of rostellar hooks, but judging from the shape of eggs, the number and disposition of testes and its irregularly alternate genital pore, it belongs to the genus *Monopylidium*.

Length 110 mm., greatest breadth 4 mm. Scolex not differentiated from the neck (see Fig. 33). Rostellum 0.289 mm. diam., suckers comparatively small, 0.221 mm. diam., rostellar sac 0.510 mm. long, extending backward over suckers. Young segment immediately behind neck measuring 0.952×0.119 mm.; mature segments 2.3×0.68 mm., all broader than long, last gravid segment squarish, 2.0×2.0 mm. Genital pore irregularly alternate. Cirrus pouch 0.456×0.045 mm. Vagina 0.002 mm. wide. Genital ducts passing dorsally to longitudinal ducts. Vas deferens thrown into complex loops internal to cirrus pouch and anterior to seminal receptacle which measures 0.1254 mm. in transverse diam. Testes about 60 in number, 0.068–0.078 mm. in diam., posterior and lateral to female organs. Ovary and vitelline gland not

imperfectly seen even in sections. Onchospheres 0.05 mm. diam., one in each capsule (0.072 mm. diam.) densely surrounded by parenchyma (Fig. 35).

The specimen differs from other known species of the genus, but in the absence of rostellar hooks and the shape of female glands not being clearly established, the species is undeterminable.

Choanotaenia cingulifera (Krabbe 1869) (Fig. 35).

Syn.: *Monopylidium cingulifera* Clerc 1903.

Host: *Totanus* sp.

Locality: Peking, China.

Specimen: Pe 823 a.

A very fragmentary specimen, length?, breadth? (*vide* Krabbe, 100×1.0 mm.; Clerc, $80-120 \times 1.0$ mm.). Mature segment 0.459×0.314 mm., gravid segment 0.680×0.391 mm., young segment 0.084×0.08 mm. Scolex 0.124 mm. diam., rostellum short, 0.060 mm. diam., suckers 0.036 mm. Rostellar hooks 40, 0.005 mm. long, in one row, somewhat similar to those of *Davainea* in shape (length appears very variable, *vide* Krabbe, 0.004–0.005 mm.; Clerc, 0.007 mm.; Skrjabin, 0.007 mm.). Genital pore irregularly alternate, in front of centre of proglottis margin. Cirrus pouch short, pyriform, $0.20-0.68 \times 0.128$ mm. Testes 40, 0.016–0.032 mm. diam., occupying posterior, anterior and aporal side of female organs. Ovary not discernible, appearing to approach poral side. Seminal receptacle $0.040-0.060 \times 0.032-0.036$ mm. Vitelline gland 0.040 mm. diam., shell gland not seen. No ripe eggs, but in gravid segment a single egg in capsules, which fill up all the space between longitudinal excretory vessels as figured by Skrjabin (1914).

The specimen agrees in most specific characters with Clerc's (1903) and Skrjabin's (1914) descriptions of *M. cingulifera*. Unfortunately, no further figures of rostellar hooks are to be found. The hooks as figured by Krabbe (1869, fig. 59, pl. III) seem to show a little difference (see Fig. 36).

Choanotaenia joyeuxi n.sp. (Figs. 36, 37).

Host: *Scolopax rusticola*.

Locality: Peking, China.

Specimen: Pe 751.

Tube 751 contains 2 species, one a *Haploparaxis* sp., the other is here described as new.

Length 45 mm., mature segments 0.65 mm. wide, broader than long, young segments behind neck 0.228×0.0228 mm. Scolex 0.353×0.307 mm., rostellum 0.080 mm. in diam., rostellar hooks only ten, in a single row, $0.0234-0.025$ mm. long, rostellar sheath extending backward before posterior margin of suckers, suckers $0.148-0.150 \times 0.182-0.205$ mm. Neck present, about 0.228 mm. long. Genital pore irregularly alternate, at centre of proglottis margin. Cirrus sac $0.028 \times 0.102-0.188$ mm., straight, running obliquely

from atrium to anterior border of proglottis. No internal or external seminal vesicle. Vas deferens much coiled anteromedially to cirrus sac. Testes 14–18, 0.034–0.045 mm. diam., delimited laterally by excretory vessels at posterior half of segment. Vagina 0.020–0.032 \times 0.200 mm., larger and longer than cirrus sac. At internal extremity of vagina, forming oval receptaculum seminis, 0.068 \times 0.08 mm. at level of ovary. Ovary of two lobes, antiporal larger than poral, both slightly lobulate. Vitelline gland 0.684 \times 0.057 mm., central, in posterior concavity of ovary. Mature eggs not seen. No persistent uterus.

The rostellar hooks are shaped much like those of *Icterotaenia decacantha* Fuhrm. (*Choanotaenia decacantha* Fuhrm. 1913), but a little longer, and the internal anatomy is very different. The specimen is described as a new species of *Choanotaenia*. It is named after Dr Ch. Joyeux, Professor of Parasitology, University of Marseilles, France.

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