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Studies on the Helminth Fauna of Japan. Part 51. Mammalian Nematodes, V.

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Studies on the Helminth Fauna of Japan. Part 51. Mammalian Nematodes, V.*

Satyu Yamaguti

Abstract

Strongylidae Baird. 1853 1. *Trichonema goldi* Boulenger. 1916 2. *T. poculatum* (Looss. 1900) 3. *T. longibursatum* (Yorke et Macfie. 1918) 4. *T. bicoronatum* (Looss. 1900) 5. *Bourgelatia diducta* Railliet. Henry et Bauche. 1919 6. *Gyalcephalus capitatus* Looss, 1900 7. *Oesophagostomum columbianum* Curtice. 1890 8. *Chabertia ovina* (Gmelin. 1790) Railliet et Henry. 1909 Trichostrongylidae Leiper. 1912 9. *Trichostrongylus axei* (Cobb., 1879) Railliet et Henry. 1909 10. *T. colubriformis* (Giles. 1892) Ransom. 1911 11. *Haemonchus contortus* (Rud., 1803) 12. *Ostertagia circumcincta* (Stadelmann. 1894) Ransom. 1907 13. *Cooperia curticei* (Giles. 1892) Ransom. 1907 14. *Heligmosomum costellatum* (Duj., 1845) Railliet et Henry. 1909 15. *Longistriata wolgaensis* Schulz. 1926

Studies on the Helminth Fauna of Japan¹⁾

Part 51. Mammalian nematodes, V.

With 2 Plates

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Contents

Strongylidae Baird, 1853	105
1. <i>Trichonema goldi</i> Boulenger, 1916	105
2. <i>T. poculatum</i> (Looss, 1900)	106
3. <i>T. longibursatum</i> (Yorke et Macfie, 1918)	107
4. <i>T. bicoronatum</i> (Looss, 1900)	108
5. <i>Bourgelatia diducta</i> Railliet, Henry et Bauche, 1919	109
6. <i>Gyalocephalus capitatus</i> Looss, 1900	111
7. <i>Oesophagostomum columbianum</i> Curtice, 1890	112
8. <i>Chabertia ovina</i> (Gmelin, 1790) Railliet et Henry, 1909	113
Trichostrongylidae Leiper, 1912	114
9. <i>Trichostrongylus axei</i> (Cobb., 1879) Railliet et Henry, 1909	114
10. <i>T. colubriformis</i> (Giles, 1892) Ransom, 1911	115
11. <i>Haemonchus contortus</i> (Rud., 1803)	115
12. <i>Ostertagia circumcincta</i> (Stadelmann, 1894) Ransom, 1907	116
13. <i>Cooperia curticei</i> (Giles, 1892) Ransom, 1907	117
14. <i>Heligmosomum costellatum</i> (Duj., 1845) Railliet et Henry, 1909	117
15. <i>Longistriata wolgaensis</i> Schulz, 1926	119
Literature	120
Explanation of Plates	121
Abbreviations used in Figures	121

STRONGYLIDAE Baird, 1853

1. *Trichonema goldi* Boulenger, 1917

Two males were found associated with other species in the colon of the Korean pony from Quelpart Island (Saisyu-to).

Body 6.95×0.35 mm and 7.65×0.4 mm respectively. Head $105 - 108 \mu$ in diameter. Mouth collar rather flat, $87 - 100 \mu$ in dia-

1) Four species are from Korea and one is from Saghalien.

meter, external leaves 22, internal leaves 38-40, in number. Submedian papillae jointed, projecting as far forward as outwardly curved external leaves. Buccal capsule $27-33\ \mu$ in length, $60-63\ \mu$ in maximum outside diameter, its wall about $6\ \mu$ thick. Nerve ring, excretory pore and cervical papillae situated $0.2-0.23\ \text{mm}$, $0.35\ \text{mm}$ and $0.36-0.38\ \text{mm}$ respectively from anterior end of external leaf-crown. Esophagus $0.4\times 0.09-0.1\ \text{mm}$, with 3 sharp teeth in esophageal funnel. Bursa with fine longitudinal striations $0.5\ \text{mm}$ from its tip to origin of externodorsal ray; bursal rays as described by me in Part 41 of the series. Genital cone bulging out ventrally in form of a hemisphere, with two pairs of unequal digitiform processes and a pair of small conical teeth at tip of its dorsal wall; the inner process is $25\ \mu$ long, with its tip curved dorsally, the middle process is plump and just half as long, and attached to the outer side of the base of the inner process, the outer tooth-like process is only $6\ \mu$ long and lies immediately externodorsal to the middle process. Spicules filiform, equal, about $0.92\ \text{mm}$ long, provided at their fused tip with a dorsal and two ventral barbs; gubernaculum $0.192-0.21\ \text{mm}$ long.

2. *Trichonema poculatum* (Looss, 1900)

Habitat and locality. Colon of Korean pony; Quelpart Island (Saisyu-to), Korea.

Male. $7.6-8.0\times 0.3-0.38\ \text{mm}$. Head $125-130\ \mu$ in diameter, mouth collar $98-100\ \mu$ in diameter, flattened, indistinctly constricted off from head. Submedian papillae about $18\ \mu$ long, 2-segmented. Nerve ring, excretory pore and cervical papillae situated $0.42-0.44\ \text{mm}$, $0.48-0.53\ \text{mm}$ and $0.48-0.54\ \text{mm}$ respectively from anterior extremity. Buccal capsule subcylindrical or somewhat funnel-shaped, with forwardly attenuated wall, $70-75\ \mu$ in length, $72-80\ \mu$ in outside diameter near the anterior end whose margin is curved inwards, $78-84\ \mu$ in outside diameter at the posterior hoop-like thickening, which is $8-10\ \mu$ thick and lies close to the base of the buccal capsule. The lining of the capsule forms three (a dorsal and two subventral) folded ledges at about the middle. External leaf-crown consisting of 30 elements; internal leaf-crown inside of incurved anterior margin of buccal capsule, consisting of 113-114, very fine, styliform elements. Esophagus club-shaped, $0.81-0.83\times 0.13-0.16\ \text{mm}$. Bursa finely striated longitudinally, with dorsal

lobe projecting 0.2–0.3 mm beyond the marginal notch lying at the junction of the lateral with the dorsal lobe; ventral rays cleft to base; mediolateral ray running parallel to externolateral ray, though arising from a common base with the posterolateral ray; externodorsal ray very close to posterolateral ray for its greater proximal portion but diverging from it distally; dorsal ray 0.4–0.47 mm long from its tip to base of externodorsal ray, with two outer branches. Though not mentioned by previous authors it is to be noted that between the two dorsal rays at a point 0.15–0.21 mm from the tip of the bursa is a slender, backwardly projecting seta 33–84 μ long. Genital cone projecting beyond edge of lateral lobe of bursa as pointed out by Baylis, provided at the tip with an acetabular pad which is 0.1–0.11 mm in diameter and granular on the inner surface. Spicules 0.7–0.8 mm long, barbed at tip as usual; gubernaculum 0.14–0.15 mm long, with a semicircular nodular swelling near its anterior end.

Female. Body 8.7–9.6 $\times$ 0.45–0.46 mm. Head 147–150 μ in diameter. Mouth collar 105–114 μ in diameter, strongly flattened. Nerve ring, excretory pore and cervical papillae situated 0.44–0.45 mm, 0.52–0.55 mm and 0.5–0.55 mm respectively from anterior extremity. Buccal capsule 80–90 μ in length, 84–90 μ in outside diameter at incurved anterior end, 96 μ in diameter at basal hoop, whose thickness is 10–13 μ . External leaf-crown comprising 41 elements, internal 133–134. Esophagus 0.85–0.88 $\times$ 0.15–0.16 mm. Tail tapering to a blunt-pointed process, about 0.35 mm long. Vulva 0.13–0.16 mm in front of anus. Vaginal eggs elliptical, 84–96 $\times$ 36–45 μ as mounted in lactophenol.

3. *Trichonema longibursatum* (Yorke et Macfie, 1918)

Habitat and locality. Colon of Korean pony; Quelpart Island (Saisyu-to), Korea.

Material. 5 males and 6 females, fixed in formol.

Male. Body 6.2–7.2 $\times$ 0.27–0.3 mm. Mouth collar low, 60–66 μ in diameter. Head 75–84 μ in diameter, followed by an inconspicuous neck. Nerve ring and cervical papillae located 0.18–0.19 mm and 0.27–0.33 mm respectively from anterior extremity. External leaf-crown comprising 18 elements, internal also 18. Buccal capsule bulging out posteriorly, 24–27 μ long, with hoop-like thickening dorsally, 36–40 μ in maximum outside diameter. Eso-

phageal funnel with 3 teeth. Esophagus $0.31-0.345 \times 0.06-0.078$ mm. Bursa with very long dorsal lobe; rays as described and figured in Part 41 of the series. Ratio of dorsal ray to body length 1:7.3-8.5. Spicules $0.85-0.94$ mm long. Gubernaculum $0.15-0.18$ mm long.

Female. Body $6.5-7.1 \times 0.23-0.3$ mm. Mouth collar $66-72 \mu$ in diameter. Head $78-97 \mu$ in diameter, with slight neck constriction behind. Nerve ring, excretory pore and cervical papillae situated $0.15-0.21$ mm, $0.16-0.28$ mm and $0.24-0.3$ mm respectively from anterior extremity. Elements of external leaf-crown 18, of internal 16 or 18, in number. Esophagus $0.31-0.37 \times 0.078-0.097$ mm. Tail $0.11-0.14$ mm long. Vulva $60-80 \mu$ in front of anus. Vaginal eggs $100-102 \times 48-50 \mu$.

4. *Trichonema bicoronatum* (Looss, 1900)

Habitat and locality. Colon of Korean pony; Quelpart Island (Saisyu-to), Korea.

Material. Two males and one female, fixed in formol.

Male. Body $7.4-8.5 \times 0.45-0.55$ mm, covered with finely cross-striated cuticle. Mouth collar prominent, $120-126 \mu$ in diameter, well marked off from head by constriction. Head $0.175-0.21$ mm in diameter at level of esophageal funnel. Nerve ring, excretory pore and cervical papillae situated 0.31 mm, $0.33-0.35$ mm and $0.34-0.35$ mm respectively from anterior extremity. Submedian papillae 2-segmented, projecting very little, if at all, beyond oral margin. External leaves tapering to a sharp point, 36 in number, projecting prominently beyond submedian papillae. Buccal capsule thick-walled, shaped like a Japanese tub, $27-30 \mu$ in length, $90-93 \mu$ in maximum diameter at level of origin of internal leaf-crown or immediately behind it, with basal hoop-like thickening, where the wall is about 9μ thick. The rounded anterior margin of the buccal capsule projects inwards, so that the part anterior to the attachment of the internal leaf-crown appears crooked in optical section. Internal leaf-crown arising $6-8 \mu$ back of anterior margin of buccal capsule, beyond which it projects 18μ ; its elements 36 in number, with uniform breadth of about 5μ except at tip which tapers abruptly. Esophageal funnel apparently without teeth. Esophagus club-shaped, $0.63-0.67 \times 0.18-0.21$ mm. Bursal margin with a wide sinus between lateral and dorsal lobe. As seen from

the side the lateral lobe projects in the form of a cone, to the tip of which reaches the posterolateral ray. The dorsal lobe projects 0.32–0.35 mm further back of the tip of the lateral lobe. Ventral ray cleft, with the two tips directed inwards; three lateral rays close together, medio- and posterolateral rays fused proximally, latter reaching 24–33 μ beyond former. Externodorsal ray curving backward and terminating at base of marginal sinus. Dorsal ray 0.57–0.6 mm long, with two outer branches reaching to bursal margin. These branches as well as the stem may have rudimentary or very slender twigs on the outer side. Genital cone prominent, simple. Spicules 1.8–1.9 mm long, barbed at fused tip as usual. Gubernaculum pistol-shaped, 0.25–0.3 mm long, with a slight ventral incision and a large handle.

Female. Body 9.38×0.62 mm. Mouth collar 144 μ in diameter. Nerve ring and excretory pore situated 0.375 mm and 0.46 mm respectively from anterior extremity. Buccal capsule 30×100 μ . External leaf-crown consisting of 36 elements, internal of 35. Esophagus 0.7×0.21 mm. Tail conical, only 95 μ long. Vulva 0.2 mm in front of anus. There is a very prominent, terminally 2-lobed, prevulvar appendage 0.225 mm long. It projects backward to near the tail end and shows a middorsal longitudinal furrow. Vaginal eggs elliptical, 132×66 μ .

5. *Bourgelatia diducta* Railliet, Henry et Bauche, 1919
Pl. I, Figs. 1–2

Habitat. Intestine of *Sus leucomystax* Temminck.

Localities. Yamaguti and Wakayama Prefectures.

Male. Body $8.8-12 \times 0.5-0.65$ mm, finely cross-striated. Mouth collar 0.14–0.15 mm in diameter, constricted off from head. Submedian papillae projecting very little over the surface of the mouth collar. Nerve ring, excretory pore and cervical papillae located 0.32–0.38 mm, 0.31–0.35 mm and 0.47–0.53 mm respectively from anterior extremity. Buccal capsule thick-walled, shallow, nearly cylindrical in outline, 20–22 μ in length, 90–100 μ in outside diameter, with an internal hoop-like thickening at about middle, whence it thins down abruptly toward the anterior margin, and behind which it attains a maximum thickness of 9–12 μ . External leaf-crown arising immediately in front of hoop-like thickening mentioned above, consisting of 21 bifid elements. (fig.

1). Esophagus lined with very thick cuticle, 0.7-0.8 mm long, swollen at both ends, 0.13-0.15 mm broad anteriorly, 0.2-0.24 mm broad posteriorly; its lumen divided into three rounded chambers at its anterior funnel, but triradiate elsewhere with columnar thickening of cuticle along each side of slits. Bursal margin slightly notched in middorsal line as well as at tip of cleft ventral ray, but deeply incised between lateral and dorsal lobe. Externolateral ray a little shorter than the other laterals, with which it has a common base. Externodorsal ray extending into lateral lobe and terminating on submarginal outer surface. Dorsal ray divided for almost half its length, terminal branch slender, with an outer twig near its base. Genital cone prominent, provided dorsally with a pair of papillae, whose cuticular covering may be produced into a short rod-shaped process. Spicules 1.1-1.25 mm long, each with a transversely striated ventral ala except at its obliquely truncated anterior end. Gubernaculum elongated, 0.16 mm long by $27\ \mu$ broad, with a minute digitiform anterior process $26\ \mu$ long and $6\ \mu$ broad at the base, and a ventral longitudinal groove for the spicules. The transparent ring-shaped structure figured by the original authors is present.

Female. Body $9.3-10.1 \times 0.58-0.6$ mm, not yet full-grown. Mouth collar 0.16 mm in diameter. Nerve ring, excretory pore and cervical papillae situated 0.32-0.33 mm, 0.3-0.33 mm and 0.42-0.53 mm respectively from anterior extremity. Buccal capsule $24 \times 105-110\ \mu$, with internal hoop-like thickening as in the male, $12\ \mu$ thick at base. External leaf-crown with 22 elements, internal with same number of bifid elements. Esophagus 0.82-0.9 mm long, 0.16-0.17 mm broad at anterior swelling, 0.21-0.225 mm broad at posterior swelling. Tail pointed, 0.45-0.5 mm long. Vulva prominent, 0.9-1.0 mm from posterior extremity, 0.46-0.5 mm in front of anus. Eggs not observed.

As is evident from fig. 1 the buccal capsule is not composed of two portions; the ring-shaped portion which was interpreted by the original authors as the anterior portion of the buccal capsule corresponds to the basal ring of the leaf-crowns, and does not constitute the buccal capsule. This genus is distinguished from *Trichonema* by the internal hoop-like thickening and structural differences in the bursa, spicules and gubernaculum. That the elongate saccular excretory organs extending along the anterior portion of

the intestine on its ventrolateral sides are very conspicuous is also worth noting.

6. *Gyalocephalus capitatus* Looss, 1900

Pl. I, Figs. 3-4

Habitat and locality. Colon of *Equus caballus orientalis*; Kyoto.

The following note is based on 5 males and 2 females fixed in formol in somewhat contracted state.

Male. Body $5.1-6.8 \times 0.3-0.43$ mm. Cuticle finely cross-striated except on head and bursa. Mouth collar $0.16-0.18$ mm in diameter, well marked off by constriction. Head $0.22-0.26$ mm in diameter. Neck distinct, at level of nerve ring. Submedian papillae projecting about 15μ over the surface of the mouth collar. External leaf-crown comprising 90-96 setiform elements, projecting prominently beyond mouth collar. Buccal capsule shallow, cylindrical, $30-33 \times 150 \mu$; its wall thickened (15μ) at anterior margin. In optical section the external surface of the capsule is slightly convex, but the internal surface is distinctly concave, with maximum diameter of 135μ behind equator. Internal leaf-crown consisting of 30, blunt-pointed rods, arising from concave inner surface of buccal capsule behind its thickest anterior margin. Immediately behind the base of the internal leaf-crown is a crown of 30 plates, which are nearly rectangular as seen from inside, 24μ in length and 15μ in breadth at the free margin projecting into the buccal capsule. In lateral view the chitinous marginal rod supporting the plate appears like a triangular tooth measuring 12μ on the anterior margin, and 7μ at the base. This structure gives rise to the cog-wheel appearance referred to by Looss. Esophagus $0.8-0.9$ mm long, $0.175-0.19$ mm in diameter at its anterior bulbous swelling (so-called funnel), $0.18-0.21$ mm in diameter at posterior swelling. Nerve ring, excretory pore and cervical papillae located 0.33 mm, 0.38 mm and 0.4 mm respectively in a slightly contracted individual. Intestine black. The muscular wall of the esophageal funnel, consisting of radial fibers, is divided into three lobes, each of which has a chitinous keel-like ridge on the median inner surface. In lateral view this chitinous ridge shows a blunt-pointed tooth with two accessories anteriorly and another basally. At the bottom of the buccal capsule project forward three pairs of horn-like processes, each pair lying between the septal ridges mentioned above,

and representing the anterior prolongation of the half-chitinous columnar thickening embracing the triradiate lumen of the ensuing esophagus proper.

Bursa finely striated longitudinally, divided into a dorsal and two lateral lobes; each lateral lobe supported by 7 rays (pre-ventral, two ventral, three lateral, and externodorsal), dorsal lobe supported by paired stems of dorsal ray and two pairs of outer branches just as shown by Yorke and Macfie in their figure 8. Dorsal ray 0.24–0.37 mm long from its tip to origin of externodorsal ray. Genital cone very prominent, may be flanked on one side or both by a remarkable cuticular expansion. Spicules slender, equal, 0.95–1.2 mm long, recurved at tip in form of a hook. Gubernaculum elongate, 0.16–0.17 mm long, with a barb-like thickening on fluted ventral side near its blunt-pointed anterior end, recurved dorsally at posterior end.

Female. Body 7.5–8.1×0.5–0.55 mm. Mouth collar 0.19 mm, head 0.26 mm, in diameter. Buccal capsule 33–39×160–170 μ . External leaf-crown consisting of 90–102 elements, internal of 28–30 elements. Esophagus 1.0 mm long, 0.22–0.23 mm broad at anterior funnel, 0.21 mm broad at posterior swelling. Intestine black. Tail straight, tapering to a point, 0.275 mm long. Vulva 0.62–0.67 mm from tail end. Eggs elliptical, thin-shelled, 138–150×58–63 μ .

7. *Oesophagostomum columbianum* Curtice, 1890

Pl. I, Fig. 5

Habitat and locality. Colon of *Ovis aries* Linné; Sapporo.

Male. Body 12–15×0.4–0.47 mm; anterior extremity rolled up dorsally. Lateral flanges extending from immediately behind lateral ends of transverse cervical fold to base of bursa, attaining maximum breadth of 0.1 mm. Cephalic vesicle is absent, though the cuticle is thickened behind the mouth collar (12–16 μ thick ventrally and 8–10 μ thick dorsally). Excretory pore 0.25–0.26 mm from anterior extremity, covered up by cervical fold, which is 20–27 μ in inside length on the midventral line and terminates in the lateral fields. Cervical papillae and nerve ring 0.27–0.3 mm and 0.34–0.38 mm respectively from head end. Mouth collar approximately trapezoidal in profile, with a pair of lateral amphids and two pairs of submedian papillae, whose spiniform tip projects

prominently out of the cuticle, $65-90\ \mu$ in diameter at anterior end, $135-140\ \mu$ in diameter at posterior end; external corona consisting of 23 pointed leaves about $35\ \mu$ long, internal corona of the same number of bifid elements as in *Bourgelatia diducta* Railliet, Henry et Bauche, 1919. Buccal capsule ring-shaped, $84-90\ \mu$ in outside diameter. Esophagus $0.75-0.84 \times 0.15-0.17$ mm, its anterior funnel containing no lancets. Prebursal papillae present. Bursal margin slightly notched at terminations of ventral and lateral rays, between and outside of branches of dorsal ray. Ventral ray cleft; three lateral rays arising from common trunk; mediolateral and posterolateral fused proximally; externodorsal arising at about middle of trunk of dorsal, terminating $42-66\ \mu$ away from bursal margin; dorsal divided into two slender branches reaching to bursal margin, each branch giving off short lateral twig, which bends near its base and then runs parallel to the branch. Spicules nearly equal, alate except at two ends, $0.82-0.9$ mm long; gubernaculum scoop-shaped, $0.09-0.15$ mm long, $40-50\ \mu$ broad, $6-12\ \mu$ thick.

Female. Body $17-22 \times 0.4-0.55$ mm, rolled up dorsally at its anterior extremity as in male. External leaf-crown consisting of 22-26 leaves, internal of as many bifid elements. Tail awl-shaped, $0.36-0.43$ mm long. Lateral flanges up to 0.11 mm broad, arising immediately behind lateral ends of cervical fold and terminating at level of commencement of rectum. Excretory pore, cervical papillae and nerve ring placed $0.25-0.3$ mm, $0.3-0.33$ mm and $0.38-0.41$ mm respectively from head end. Esophagus $0.87-0.94 \times 0.13-0.19$ mm. Ovíectors $0.24-0.27$ mm long; posterior one turned forwards. Vagina lined with folded cuticle, $0.15-0.21$ mm long by $60\ \mu$ wide. Vulva in form of a transverse slit, $0.75-1.2$ mm in front of anus. Eggs elliptical, thin-shelled, $75-90 \times 48-54\ \mu$, containing 2-6 blastomeres.

8. *Chabertia ovina* (Gmelin, 1790) Railliet et Henry, 1909
Pl. I, Fig. 6; Pl. II, Fig. 12

Habitat and locality. Colon of *Ovis aries*; Tokyo.

The material consisting of 5 males and 5 females, was somewhat contracted and gave the following measurements, which are compared with those by earlier workers.

Authors	Gebauer (1932)	Baylis (1936)	Present author
Body length	♂ 13-16 ♀ 15-25	13-16 15-25	11-13.5 14-17
Nerve ring from head end ...	1.2		0.7-0.9
Excretory pore from ventral margin of mouth	0.9		0.5-0.65
Length of buccal capsule ...	0.54	0.54	0.35-0.55
Esophagus	1.3	1.2-1.4	1.15-1.4
Spicules	1.3-1.7	1.3-1.7	1.35-1.5
Gubernaculum	80-100 μ	80-100 μ	80-100 μ
Vulva from tail end	0.5	0.37-0.5	0.35-0.48
Tail of female	0.31	0.2-0.23	0.12-0.2
Eggs		90-100 $\times 50 \mu$	84-110 $\times 45-63 \mu$

Contrary to the previous descriptions by Yorke and Maplestone or by Baylis, there is a single leaf-crown as pointed out by Gebauer; it contains in the male 43-48 sharp-pointed denticular elements; in the female these elements, 42-52 in number, may be bifid at the tip occasionally. According to Gebauer they are about 60.

TRICHOSTRONGYLIDAE Leiper, 1912

9. *Trichostrongylus axei* (Cobbold, 1879) Railliet et Henry, 1909
Pl. I, Fig. 8

Habitat and locality. Stomach of *Equus caballus orientalis*; Kyoto.

The following comparative table shows slight differences in measurements according to different authors.

Authors	Nagaty (1932)	Gebauer (1932)	Present author
Body	♂ 2.584-3.75 0.044-0.066 ♀ 3.268-4.218 0.044-0.061	3.4-4.4 $\times 0.05-0.06$ 4.5-5.5 $\times 0.055-0.07$	2.5-2.8 $\times 0.06-0.07$ 3.3-4.4 $\times 0.04-0.07$
Diameter of head	8-13 μ	—	8-10 μ
Excretory pore from head end	0.11-0.176	—	0.105-0.165

Length of esophagus ...	514 - 668 μ	600 - 710 μ	♂ 0.53 - 0.71 ♀ 0.66 - 0.75
Spicules { left	96 - 123 μ	110 - 120 μ	105 - 114 μ
{ right	74 - 96 μ	85 - 95 μ	84 - 87 μ
Gubernaculum	52 - 61 μ	50 - 60 μ	45 - 60 μ
Vulva from tail end	646 - 792 μ	1.0	0.72 - 1.0 (dividing body length in ratio of 3.0 - 3.8 : 1)
Tail of female	61 - 79 μ	60 - 90 μ	65 - 85 μ
Eggs	79 - 96 $\times$ 35 - 48 μ	70 - 80 $\times$ 35 - 45 μ	69 - 84 $\times$ 30 - 45 μ

10. *Trichostrongylus colubriformis* (Giles, 1892) Ransom, 1911
Syn. *Trichostrongylus instabilis* (Railliet, 1893) Looss, 1905
Pl. II, Fig. 9

Measurements made on 15 males and 18 females from the small intestine of the Japanese sheep are given below in comparison with those by Nagaty, to whom we are indebted for detailed informations on the known members of the genus.

Authors	Nagaty	Present author
Body length	♂ 4.389 - 7.714 ♀ 5.092 - 8.625	5.0 - 6.6 6.2 - 8.0
Excretory pore from head end ...	114 - 171 μ	120 - 160 μ
Length of esophagus	0.644 - 0.915 (1.021)	♂ 0.67 - 0.88 ♀ 0.75 - 0.91
Spicules { left	136 - 171 μ	144 - 165 μ
{ right	123 - 154 μ	132 - 160 μ
Gubernaculum	66 - 88 μ	70 - 81 μ
Tail of female	66 - 92 μ	70 - 100 μ
Vulva from tail end	1.007 - 1.786	1.2 - 1.7
Combined length of ovijectors ...	396 - 624 μ	0.4 - 0.5
Eggs	79 - 96 $\times$ 35 - 48 μ	84 - 114 $\times$ 40 - 54 μ

11. *Haemonchus contortus* (Rud., 1803)
Pl. II, Fig. 10

Habitat and locality. Fourth stomach of *Ovis aries*; Tokyo.

The following measurements (in mm) taken from 8 males and six females are to supplement the descriptions by earlier writers. Gebauer's measurements are drawn into comparison.

Authors	Gebauer	Present author
Body	♂ 17-20 × 0.23-0.4 ♀ 23-30 × 0.45-0.5	♂ 12.6-17.7 × 0.22-0.26 ♀ 18-28.5 × 0.35-0.55
Length of esophagus	1.2-1.4	1.15-1.45
Cervical papillae from head end	0.3	0.32-0.47
Spicules	0.3-0.5	0.4-0.45
Gubernaculum	0.2-0.25	0.2-0.24
Vulva from tail end	3.0-4.5	2.9-4.8
Tail of female	0.4-0.6	0.33-0.55
Eggs	—	0.066-0.078 × 0.04-0.05

Nerve ring 0.24-0.32 mm, excretory pore 0.28-0.36 mm, from head end in both sexes. As described by Bhalerao the vulvar flap may be entirely absent, or divided into two dissimilar lobes, or developed into a tongue-shaped lobe up to 0.7 mm long. The vulva divides the body length in the ratio of 5:1.

12. *Ostertagia circumcincta* (Stadelmann, 1894) Ransom, 1907
Pl. II, Fig. 11

Measurements of 12 males and 6 females from the fourth stomach of the Japanese sheep are compared below with those of previous authors.

Authors	Travassos (1921)	Gebauer (1932)	Present author
Length	♂ 7-8.5 ♀ 9-12	7.5-8.5 (9-11) 9-12	6.9-7.9 9.3-10.73
Nerve ring from head end ...	0.21	0.21	0.22-0.27
Cervical papillae from head end	0.21-0.35	0.21-0.35	0.29-0.36
Length of esophagus	0.5-0.64	0.5-0.64 (0.695)	♂ 0.5-0.58 ♀ 0.55-0.63
Length of dorsal ray	50-68 μ	50-70 μ	40-42 μ
Spicules	0.28-0.32	0.28-0.32	0.24-0.29
Gubernaculum	84-90 × 30-32 μ	80-90 μ	84 × 30 μ

Tail of female	0.13 - 0.16	0.1 ² - 0.19	0.12 - 0.14
Vulva from tail end	1.5 - 2.5	5 - 2.5	1.68 - 1.98
Combined length of ovijectors	0.35 - 0.55	—	0.32 - 0.48
Eggs	78 - 100 × 35 - 50 μ	—	93 - 102 × 39 - 47 μ

There are 21 longitudinal cuticular ridges in the male and 20 in the female. They are about 20 according to Gebauer.

13. *Cooperia curticei* (Giles, 1892) Ransom 1907

Pl. I, Fig. 7

Habitat and locality. Small intestine of *Ovis aries*; Tokyo.

The following measurements are from five males and four females.

Female. Body 5.9-7.1×0.07-0.09 mm, with 14 longitudinal cuticular ridges. Cuticle finely cross-striated. Cephalic vesicle 30-36 μ in diameter. Nerve ring 0.21-0.235 mm from head end. Excretory pore only slightly behind esophagus, 0.32-0.35 mm from head end. Esophagus 0.2-0.33 mm long. Tail sharp-pointed, 0.12-0.14 mm long. Combined length of ovijectors 0.27-0.37 mm long. Vulva 1.4-1.8 mm from tail end, dividing body length in ratio of 2.4-3.1:1. Eggs elliptical, thin-shelled, with segmented ovum, 75-96×30-36 μ as fixed in formol in the uterus and measured in water. According to Travassos it is 63-70 μ long by 30-32 μ broad.

Male. Body 4.5-5.7 mm in length, 0.1-0.11 mm in maximum breadth immediately in front of bursa, with about 14 longitudinal cuticular ridges. Cephalic vesicle 35-38 μ in diameter. Nerve ring and excretory pore situated 0.24 mm and 0.336 mm respectively from head end. Esophagus 0.3 mm long. Spicules equal, 135-141 μ long. Dorsal ray of bursa bifurcated into nearly parallel branches, each of which has two terminal digitations. From the outer side of the base of each branch is given off another branch, which forms an S-shaped turn at its proximal end. Genital cone showing complex chitinous structure with a marked subterminal constriction.

14. *Heligmosomum costellatum* (Dujardin, 1845)

Railliet et Henry, 1909

Pl. II, Figs. 13-14

Habitat. Intestine of *Clethrionomys rutilus rutilus* (Pallas) and *C. rufocanus bedfordiae* (Thomas).

Locality and date. Noboro, Saghalien ; August 3, 1941.

Female. Body slender, filiform, 12.1–16.1 mm in length, with nearly uniform breadth of 0.22–0.35 mm except at two extremities. The prevulvar region at the level of the anterior part of the vagina usually distended with eggs is markedly swollen and 0.18–0.3 mm in diameter, with a more or less distinct constriction between itself and the vulva. Behind the vulva the body tapers to a pointed process usually tipped with a spike about 10 μ long. This spike may be lacking occasionally. The cephalic vesicular expansion of the cuticle with numerous, circular striations measures 80–120 μ in length and 65–80 μ in breadth. The general transverse striations of the cuticle are very fine, especially behind the cephalic vesicle. The dorsal cuticular folds of the body arise from the left lateral line and run obliquely backward across the middorsal line toward the right lateral line, with a maximum interval of about 30 μ . They are confined to the region between the cephalic vesicle and the anus. In this region at the ventrodextral quadrant there are, in addition, coarser folds running obliquely in the greater anterior part and longitudinally in the posterior part with a maximum interval of 42 μ , and at the ventrosinistral quadrant there are five exactly longitudinal folds, so that at any level of this region there are seen all round the body the cross sections of the folds, whose points are directed toward the left on the dorsal half as well as at the ventrodextral quadrant, but radially at the ventrosinistral quadrant.

Mouth aperture circular, mouth cavity very shallow. One pair of lateral amphids and two pairs of submedian papillae present. Nerve ring and excretory pore located 0.18–0.27 mm and 0.34–0.49 mm respectively from head end. Esophagus slightly enlarged posteriorly, 0.62–0.71 mm long, 45–57 μ broad at anterior end, 60–80 μ broad at posterior end. Intestinal epithelia containing unusually large oval nuclei. Rectum attenuated, especially in postvulvar region ; anus 0.1–0.185 mm from tip of tail spike.

Ovary single, winding, originating at anterior part of intestine, attaining a maximum breadth of 0.11 mm. Ovijector up to 0.24 mm long, with a slight constriction near its proximal end. Vagina 0.43–0.48 mm long. Vulva 0.2–0.3 mm in front of anus, 0.33–0.44 mm from posterior extremity. Eggs oval, 75–90 $\times$ 39–54 μ as fixed

in alcohol and measured in water; contained ovum segmented, but not yet embryonated.

Male. Body $11-12.6 \times 0.22-0.3$ mm, attenuated toward anterior extremity and in front of bursa. Cephalic vesicle $100 \times 80 \mu$. Cuticular folds as in female. Nerve ring and excretory pore situated 0.27 mm and $0.42-0.53$ mm respectively from head end. Esophagus $0.6-0.67$ mm long, $38-45 \mu$ broad at anterior end and $45-60 \mu$ broad at posterior end. Bursa $0.32-0.35$ mm long, with shallow marginal sinus between two dorsal rays. Ventroventral ray with uniform breadth, curved forward; lateroventral unusually thick, plump, divergent from ventroventral; externolateral thicker than the other laterals, parallel to mediolateral; posterolateral slender, divergent from mediolateral; dorsal consisting of a pair of slender, entirely separate branches which are parallel proximally but slightly divergent distally. Prebursal papillae present. Spicules very thin, equal or subequal, $0.75-0.9$ mm long, with narrow flange throughout. Gubernaculum not chitinized, 90μ long, fluted ventrally.

15. *Longistriata wolgaensis* Schulz, 1926

Habitat. Small intestine of *Clethrionomys smithii*, *Apodemus speciosus speciosus* (Temm. et Schleg.) and *Microtus montebelli*.

Locality and date. Miure, Kiso; May 2, 1942.

Male. Body filiform, coiled spirally, tapering anteriorly at esophageal region, $2.38-2.97 \times 0.05-0.09$ mm, with 16 longitudinal ridges originating at posterior end of cephalic cuticular vesicle. The lateral ridges extend to the lateral lobes of the bursa, to which some of the dorsal ridges also are continued. Cephalic vesicle $42-48 \times 23-27 \mu$, head (exclusive of cuticle) $16-18 \mu$ in diameter. Nerve ring and excretory pore located $90-105 \mu$ and $0.18-0.23$ mm respectively from head end. Esophagus $0.3-0.33$ mm long, $21-27 \mu$ broad at enlarged posterior end. No prebursal papillae. Genital cone prominent, supported by two half-chitinized wedge-like structures, of which the ventral is simple and 24μ long, while the dorsal has a sharp somewhat curved point and a bifid base and is 15μ long. Bursa copulatrix consisting of two symmetrical lateral lobes; dorsal lobe fused with lateral lobes, with a distinct median incision. Ventral rays with common trunk, divergent, reaching to margin of bursa; externolateral close together with mediolateral

for its greater thick proximal portion but divergent from it at its abruptly tapering distal portion ; posterolateral branching off from mediolateral, only $40\ \mu$ long, gently curved posterodorsally ; exterodorsal arising from trunk of dorsal a little distal to its middle, reaching to margin of bursa ; dorsal divided into two, distally bifid branches separated one from the other by the median marginal notch mentioned above. Spicules equal, very slender, curved ventrally at distal end, $0.36-0.42$ mm long, $6-10\ \mu$ broad at anterior end, with a ventral ala at distal curvature and a cuticular swelling on dorsal side of its point. Gubernaculum $30-50\ \mu$ long, fluted ventrally, with its wall up to $5\ \mu$ thick at its thickest dorsal portion and attenuated toward both ends ; the two lateral processes at its distal end as observed by Schulz have not been made out.

Female. Body filiform and coiled as in male but strongly curved ventrad at posterior extremity in form of a hook, $2.25-2.94 \times 0.057-0.07$ mm. Nerve ring and excretory pore situated $96-141\ \mu$ and $0.17-0.21$ mm respectively from head end. Cephalic vesicle $39-48 \times 16-30\ \mu$. Head end (excluding cuticle) $16-18\ \mu$ in diameter. Esophagus $0.27-0.32$ mm long by $21-30\ \mu$ broad. Tail pointed conical, $30-40\ \mu$ long. Ovary usually reaching to posterior end of esophagus. Ovijector strongly muscular, about $40\ \mu$ in diameter. Vulva $54-75\ \mu$ in front of anus. Eggs elliptical, thin-shelled, containing up to 2-4 blastomeres, $66-78 \times 33-45\ \mu$.

It is to be noted that the present material differs from the Russian in the length and structure of the gubernaculum.

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Expianation of Plates

Plate I

Fig. 1. Anterior extremity of male of *Bourgelatia diducta* Railliet, Henry et Bauche, 1919, lateral view.

Fig. 2. Posterior extremity of male of *Bourgelatia diducta* Railliet, Henry et Bauche, 1919, ventral view.

Fig. 3. Anterior extremity of male of *Gyalocephalus capitatus* Looss, 1900, end-on view.

Fig. 4. Posterior extremity of male of *Gyalocephalus capitatus* Looss, 1900, lateral view.

Fig. 5. Posterior extremity of male of *Oesophagostomum columbianum* Curtice, 1890, lateral view.

Fig. 6. Anterior extremity of female of *Chabertia ovina* (Gmelin, 1790), lateral view.

Fig. 7. Anterior extremity of female of *Cooperia curticei* (Giles, 1892), lateral view.

Fig. 8. Posterior extremity of male of *Trichostrongylus axei* (Cobbold, 1879), ventral view.

Plate II

Fig. 9. Posterior extremity of male of *Trichostrongylus colubriformis* (Giles, 1892), ventral view.

Fig. 10. Posterior extremity of male of *Haemonchus contortus* (Rud., 1803), ventral view.

Fig. 11. Posterior extremity of male of *Ostertagia circumcincta* (Stadelmann, 1894), dorsal view.

Fig. 12. Posterior extremity of male of *Chabertia ovina* (Gmelin, 1790), lateral view.

Fig. 13. Anterior extremity of male of *Heligmosomum costellatum* (Duj., 1845), lateral view.

Fig. 14. Posterior extremity of male of *Heligmosomum costellatum* (Duj., 1845), lateral view.

Abbreviations used in Figures

BC = buccal capsule, BD = branch of dorsal ray, C = cloaca, D = dorsal ray, E = esophagus, ED = externodorsal ray, EL = externolateral ray, ELC = external leaf-crown, EP = excretory pore, G = gubernaculum, I = intestine, ILC = internal leaf-crown, LA = lateral amphid, LV = latero-ventral ray, ML = mediolateral ray, NR = nerve ring, P = papilla, SM = submedian papilla, SP = spicule, VV = ventroventral ray.



