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STUDIES ON HELMINTHS OF VOLES IN HOKKAIDO*

I TAXONOMICAL STUDY

Yasuo ISHIMOTO

Department of Parasitology
Faculty of Veterinary Medicine
Hokkaido University, Sapporo, Japan

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The helminth fauna was studied on 415 specimens of voles, *Clethrionomys rufocanus bedfordiae*, *Apodemus argenteus hokkaidi* and *A. speciosus ainu*. The animals were captured in the forest in the vicinity of Nopporo, Hokkaido, Japan. Through taxonomical examination, 15 helminth species were described: *Paranoplocephala omphalodes*, *Coronacanthus apodemi*, *Cladothyridium* sp., *Strobilocercus fasciolaris*, *Cysticercus* sp., *Plagiorchis muris*, *Heligmosomum yamagutii*, *H. kobayashii* n. sp., *Longistriata hokkaidensis*, *Mammaniduloides hokkaidensis*, *Syphacia emileromani*, *S. montana*, *Heterakis spumosa*, *Trichuris* sp. and *Capillaria hepatica*. Among these helminths, *Heligmosomum kobayashii* is new to science, and *Paranoplocephala omphalodes* and *Cladothyridium* sp. are new host and distribution records.

INTRODUCTION

Some papers on rodent helminths have been published in Japan, but most of them have dealt with the helminths of *Rattus norvegicus* or *R. rattus*, because of considerations of public health. On the other hand, recently, ecological studies of voles have progressed in Japan, owing to the necessity of protecting forests against damage caused by them. However, few faunistic reports concerning the helminths of voles in Japan have been published.

YAMAGUTI (1943, 1954) described *Syphacia montana* YAMAGUTI, 1943, from *Clethrionomys smithi*, *Hymenolepis apodemi* YAMAGUTI, 1954 (= *Coronacanthus apodemi* (YAMAGUTI, 1954) SPASSKY, 1954) from *Apodemus argenteus*, and *Longistriata wolgaensis* SCHULZ, 1926 (= *L. hokkaidensis* by CHABAUD et al., 1963) from *Apodemus speciosus* collected on Mt. Ontake, Kiso, central Japan. OSHIMA (1953) reported heavy infection of *A. speciosus* with *Moniliformis* sp., and discussed the biological control of vole population by this acanthocephalan parasite. KONNO (1958) described *Longistriata speciosa* as a new species from *A. speciosus* captured

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in Fukui Prefecture, central Japan. CHABAUD et al. (1963) investigated the nematode fauna of small mammals of northern Japan and reported five species including four new ones from *C. rufocanus*, *A. speciosus* and *A. argenteus*. Recently, OHBAYASHI et al. (1968) described a new nematode *Mammaniduloides hokkaidensis* from voles in Hokkaido, and they studied its distribution and pathological findings.

In this paper, the author intends to clarify the helminth fauna of voles in Hokkaido, because the reports mentioned above are still insufficient, except in the case of nematodes.

MATERIALS AND METHODS

The voles examined were provided by the members of the Hokkaido Group of Field Mouse Research. The voles were captured in three days of the first week of each month, from June 1967 to May 1968, in the Nopporo National Forest (43°25' N, 141°25' E) in the vicinity of Nopporo, 20 km east of Sapporo, Hokkaido.

The number of cases examined were 165 of *Clethrionomys rufocanus bedfordiae* (THOMAS), 183 of *Apodemus argenteus hokkaidi* (TEMMINCK et SCHLEGEL) and 67 of *A. speciosus ainu* (THOMAS). No parasites of the stomach and head were examined, since the former organ was used for a survey of food habits, and the latter for a taxonomy of the host animals.

All the organs and tissues except the stomach and head were examined parasitologically. After a naked-eye examination, most of the parasites were collected under the dissection microscope. Nematode specimens were preserved in 5% formalin and cleared in lacto-phenol solution. Cestode and trematode specimens were fixed in 70% ethanol, stained by Delafield's hematoxylin, and mounted by Canada balsam. Sections stained by hematoxylin-eosin were prepared from some formalin-fixed cestode specimens.

All the specimens used in this paper are preserved in the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

RESULTS AND DISCUSSION

Fifteen species of helminths were obtained as described below; 5 cestodes including 3 larval forms, 1 trematode and 9 nematodes.

A Cestoda

1 *Paranoplocephala omphalodes* (HERMANN, 1783) LÜHE, 1910

This cestode was found in the small intestine of 8 cases of *Apodemus argenteus* and 2 of *A. speciosus*.

Body length 30~70 mm, the maximum width at posterior end of mature segments, 3.0~5.0 mm. Strobila thick, gradually widening toward the posterior end, containing 88~134 segments. Length/width ratio in immature segments 1: 8.7, in fully mature ones 1: 13.6. Scolex well-developed, 0.6~1.1 mm in diameter. Neck 0.8 mm long. Genital pores unilateral, situated near the middle of the margin. Genital ducts pass ventral to longitudinal excretory canals. In the developed hermaphrodite segments, the entire region of medullary field is filled with genital organs. Testes spherical, 0.084~0.102 mm in diameter, lying close to one another, ranged in number 58~69 per segment (av. 64). Testes extending from the aporal margin of ovary to nearly longitudinal excretory canals. Seminal duct lying antero-ventral to seminal receptacle forming S-shape external seminal vesicle. Elongated cirrus pouch 0.25~0.31 mm long, 0.09~0.10 mm wide. Cirrus slender, aspinose, 0.30 mm long. Genital atrium small, funnel-shaped. Internal seminal vesicle 0.06~0.08 mm by 0.12~0.14 mm in size. Vagina ventro-posterior to cirrus pouch. Seminal receptacle strongly developed, pyriform, 0.34~0.38 mm wide, 0.55~0.80 mm long. Vitelline gland lobed and variable in shape; 0.12~0.14 mm wide, 0.06~0.08 mm long, distinctly discerned in immature segments, situated at the proximal end of seminal receptacle. Developed ovary attaining 0.8 mm in width, its digitated lobules extending in all directions. Immature uterus lying across the anterior field of segment. Uterine growth resulting regular anterior and posterior sacculations. Gravid uterus nearly filling terminal segments. Eggs spherical, 0.033~0.042 mm in diameter, with pyriform apparatus.

Fourteen species of *Paranoplocephala* are known from rodent hosts. Among these, *P. brevis* (KIRSCHENBLAT, 1938) is a common parasite of *Apodemus sylvaticus* in Europe. According to KIRSCHENBLAT (1938) (after SPASSKY, 1951), this species has a smaller number of testes (28~48) and small spines on the cirrus. Furthermore, the length/width ratio is 1: 4~5 and the excretory canals are ventral to the genital organs. *P. omphalodes* (HERMANN, 1783), the type species of this genus, is a well-known vole cestode in Europe. According to the redescription by SPASSKY (1951), the length/width ratio is 1: 6~10 in the hermaphrodite segments and the number of testes is 50 in all. RAUSCH (1952) obtained the same species from *Microtus paneaki* in Alaska. He described irregularly alternating genital pores and spinose cirrus.

The species in this paper is identical to *P. omphalodes* by SPASSKY. The slight difference in the number of testes is considered to originate in the geographical host difference. Up to this time, no report of rodent *Paranoplocephala* has been published in Japan. Consequently, these are new host and distribution records of this species in this country.

2 *Coronacanthus apodemi* (YAMAGUTI, 1954) SPASSKY, 1954

This cestode was found in the small intestine of 30 cases of *Apodemus argenteus*.

Body length 100~120 mm, maximum width at posterior end of mature segments, 1.5~1.7 mm. Scolex small, rounded, 0.30~0.35 mm in diameter. Rostellum mostly invaginated, 0.042 mm wide, 0.033 mm long, with a single row of 17~20 hooks, 0.010~0.014 mm in length. Blade and guard of hook long, handle reduced. Rostellar sac ellipsoidal, 0.14×0.06 mm. Four suckers unarmed, 0.063~0.084 mm in diameter. Neck slender, 0.20~0.25 mm in width. Genital pores unilateral, emerge 4~5 mm behind scolex, however, the internal segmentation is indicated more anteriorly. Proglottids crowded, the length/width ratio of anterior immature segments 1: 9. Three testes, subglobular, 0.05~0.06×0.06~0.07 mm, the one in poral, postero-ventral to the external seminal vesicle and seminal receptacle and the two in aporal, obliquely tandem. External seminal vesicle well-developed, clubform, 0.06×0.15 mm, situated dorsal to seminal receptacle. From the margin of external seminal vesicle, twisting seminal duct, 0.003 mm wide, extends 0.08~0.10 mm to reach cirrus pouch. Cirrus pouch clubform, 0.045 mm wide and 0.12 mm long in mature segments. Internal seminal vesicle occupies almost whole area of cirrus pouch. Irregularly lobed ovary overlaps with anterior aporal testes and poral seminal receptacle. Genital duct, arising from medio-ventral to ovary, joints with vitelline duct on the half way to seminal receptacle. Shell gland dorsal to vitelline gland. Vitelline gland ventral to ovary, ovoid in shape, 0.05×0.07 mm, situated in central portion of segment. Seminal receptacle claviform, 0.06~0.07×0.12~0.16 mm, ventral to poral half of ovary. Vagina ventral to cirrus pouch. Eggs elliptical with the outer egg shell, 0.050~0.054×0.038~0.042 mm, and the embryonic shell 0.039~0.042×0.029~0.033 mm.

YAMAGUTI (1954) reported this species from *Apodemus argenteus* on Mt. Ontake, Kiso, central Japan. The present species is quite similar to his species except for the size of testes and the distance between the external seminal vesicle and the cirrus pouch. According to his description, the testes are 0.10~0.17×0.07~0.12 mm and the external seminal vesicle attenuates the distal end, and twists just median to the base of the overlapping cirrus pouch. These differences are not considered as bases for speciation, and possibly appear as artifacts. Therefore, the author defined the present species as *Coronacanthus apodemi* (YAMAGUTI, 1954).

3 *Cladothyridium* sp.

Two of *Clethrionomys rufocanus* and one of *Apodemus speciosus* were infected

with this larval cestode. In a heavily infected case of *Clethrionomys*, 15 larvocysts were found in the liver and abdominal cavity. In the other two cases, infection was light and was limited to the liver.

Body thick, irregularly shaped but mostly ovoid, 2.0~2.5 mm in length, 1.3~1.5 mm in width, white in color. Three to 4 transverse folds on body surface. Scolex small, invaginated up to three fifths of body from the anterior margin, provided with 4 weakly developed suckers 0.14~0.18 mm in diameter. Many calcareous corpuscles in parenchyme. Rostellum small, 0.09~0.10 mm in diameter, with two rows of tiny hooks of *Taenia* type, 48~50 in number. Large hooks 0.025~0.029 mm, small hooks 0.019~0.022 mm. The larvocyst was surrounded by a fibrous tissue, 0.10~0.12 mm in thickness, but cell accumulation was scanty.

There are 12 species of the genus *Cladotaenia* in various diurnal birds of prey. However, the larval stage and life cycle are clarified concerning only two of them, *Cladotaenia globifera* (BATSCH, 1786) COHN, 1901, and *C. circi* YAMAGUTI, 1935. ABULADZE (1964) suggested the larvocyst of this genus should be called *Cladothyridium* from the structure of these *Tetrathyridium*-type larvocyst armed with *Taenia*-type hooks. FREEMAN (1959) obtained two species of *Cladothyridium*, *C. globifera* and *C. circi*, from small mammals in North America and studied their life cycles. The present species differs from FREEMAN's, the latter having smaller bodies, larger rostellum and larger hooks. IWATA (1939) reported the presence of adult stage *Cladotaenia circi* in Japan, but there is no report of *Cladothyridium* having been found in Japan.

4 *Strobilocercus fasciolaris* (BATSCH, 1786) LAMARCK, 1816

This larval cestode was obtained from the liver of 3 *Apodemus argenteus*. Pseudosegmentation well-developed. Body length 32~77 mm, width 3.5~6.0 mm. Scolex well-developed, with 4 muscular suckers, 0.29~0.36 mm in diameter, armed with two rows of hooks, 34~40 in number. Large hooks 0.36~0.43 mm and small hooks 0.22~0.29 mm in length.

5 *Cysticercus* sp.

This larval cestode (one specimen) was found only in the liver of *Apodemus argenteus*. As it was in very immature stage, no taxonomical identification was possible. Rounded whitish vesicle of the *Cysticercus* type, 3.5 mm in diameter. Body length 5.3 mm. Scolex with 4 suckers, armed with 2 rows of hooks. Hooks 28 in number, large hooks 0.23~0.25 mm, blade slender and curved, handle straight. Small hooks 0.15~0.17 mm in length.

B Trematoda

6 *Plagiorchis muris* TANABE, 1922

This trematode was obtained from the small and large intestines of 7 cases of *Clethrionomys rufocanus*, one of *Apodemus argenteus* and 7 of *A. speciosus*.

Body elongated, small spines on body; length 1.40~1.89 mm, width 0.38~0.51 mm. Oral sucker, 0.147~0.207 mm in diameter. Prepharynx 0.008~0.016 mm long. Pharynx 0.079~0.105×0.058~0.084 mm. Esophagus 0.010~0.021 mm long. Caeca terminate near posterior extremity. Acetabulum at anterior one third of body, 0.126~0.172 mm in diameter. Testes lobed, suboval and equal in size, 0.14~0.24 mm in diameter, situated obliquely. Cirrus pouch elongated, clubform, 0.51~0.60×0.089~0.092 mm, usually dorso-dextral to acetabulum. Internal seminal vesicle prominent, divided into two parts; anterior part ovoid, 0.025~0.054×0.025~0.084 mm, and posterior one elongated, 0.17~0.25×0.063~0.084 mm. Genital pore antero-sinistral to acetabulum. Ovary suboval, 0.10~0.18 mm in diameter, situated immediately postero-dextral to cirrus pouch. Vitelline follicles well-developed, extending to lateral field of the ventral and whole of the dorsal. Vitelline ducts at level of posterior end of ovary. Uterus begins from hindbody, winding up the field between two testes and reaches to the posterior field of acetabulum. Metraterm dorsal to acetabulum, 0.21 mm in length, along the side of cirrus pouch. Eggs oval, 0.033×0.021 mm in average.

C Nematoda

7 *Heligmosomum yamagutii* CHABAUD, RAUSCH et DESSET, 1963

Numerous specimens were obtained from the small intestine of 120 cases of *Clethrionomys rufocanus*.

Body slender, red in color when alive. Oral aperture circular, mouth cavity shallow. Cuticular folds are distributed from the part posterior to cephalic vesicle to the posterior end of body; oblique transversal ones dorsally and ventro-dextrally, and longitudinal ones ventro-sinistrally. Male:—Body length 8.6~12.9 mm, width 0.207~0.330 mm. Cephalic vesicle 0.088~0.120 mm. Nerve ring and excretory pore 0.19~0.21 mm and 0.40~0.55 mm from head end, respectively. Esophagus 0.51~0.65 mm in length. Prebursal papillae present. Bursa asymmetrical, right lobe considerably larger than the left. Ventral, lateral and externo-dorsal rays arising separately; ventro-ventral curved forwards, latero-ventral largest; antero-lateral thicker than other laterals, parallel to medio-lateral; postero-lateral curves internally. Externo-dorsal slender, arises from the base. Dorsal ray behind genital cone, reduced. Spicules filiform, 0.76~0.94 mm in length, equal or subequal, no fusing at the distal end. Gubernaculum absent. Female:—Body length 15.5~21.0 mm, width 0.21~0.34 mm. Cephalic vesicle

0.104~0.120 mm long. Esophagus 0.62~0.69 mm long. Nerve ring and excretory pore 0.25~0.29 mm and 0.59~0.66 mm from head end, respectively. Vulva and anus 0.34~0.49 mm and 0.13~0.15 mm from posterior end, respectively. Eggs oval, 0.068~0.084×0.044~0.056 mm.

This nematode is identical with *Heligmosomum yamagutii* CHABAUD, RAUSCH et DESSET, 1963, which was obtained from the same host in the same place as the present.

8 *Heligmosomum kobayashii* n. sp.

Thirteen cases of *Apodemus argenteus* and 2 cases of *A. speciosus* were infected with this nematode. In the upper part of small intestine, more than two nematodes were found.

Body shows 3 or 4 coils at anterior part, posterior part relatively thick and straight. Cuticle thin, fragile and easily desquamates. Red in color when alive. Twenty-two conspicuous longitudinal striae begin from the portion posterior to cephalic vesicle to the posterior part of body; intervals of striae 0.016~0.025 mm, ventral ones thicker than the dorsal. Mouth triangular with 4 submedian papillae. Esophagus tubular. Male:—Body length 10.18~17.44 mm, maximum width 0.15~0.19 mm. Cephalic vesicle 0.048~0.054×0.070~0.085 mm. Esophagus 0.53~0.65 mm in length. Nerve ring and excretory pore 0.21~0.24 mm and 0.35~0.38 mm from head end, respectively. Prebursal papillae present. Spicules equal or subequal, very long and filiform, 2.82~3.08 mm in length; distal end enclosed with thin membrane, tips fused and acute. Gubernaculum absent. Bursa asymmetrical, right lobe slightly larger than the left. Ventral rays stout, arise separately from laterals, ventro-ventral thicker than latero-ventral. Laterals arise from the same trunk, antero-lateral and medio-lateral run straight and parallel; postero-lateral bends internally. Externo-dorsal slender, arises independently nearly from base. Dorsal ray 0.052~0.065 mm in length, reduced, hidden or obscured by genital cone, bifurcated at the middle and each branch bifurcates again at once; inner branch longer than the outer. Female:—Body length 15.15~23.00 mm, maximum width 0.26~0.28 mm. Esophagus 0.69~0.71 mm in length. Cephalic vesicle 0.037~0.046×0.050~0.063 mm. Nerve ring and excretory pore 0.22~0.26 mm and 0.35~0.40 mm from head end, respectively. Vulva and anus 0.36~0.42 mm and 0.10~0.16 mm from tip of tail, respectively; tail pointed.

Two species of the genus *Heligmosomum* are known to have spicules more than 2 mm long. DIKMANS (1940) reported *H. longispiculatus* from *Microtus pennsylvanicus* and *Ondatra zibethica* in the U.S.A. This species has longer spicules—3.9 to 4 mm; however, the body length is 5.5 to 6.5 mm in the male, and the dorsal ray is lacking. SCHULZ (1954)¹⁸⁾ described *H. longicirratum* from

Microtus sp. in the U. S. S. R. This species is similar to the present species in the length of spicules, in the former 2.89 mm long, but the body length is only 6 mm. CHABAUD et al. (1963) described *H. desportesi* obtained from the same host in the same place as the present. In general, this species shows similarities to the present species, but the spicule length of the former is only 0.6 mm. Judging from the characteristics mentioned above, the present species can be considered as a new species. The specific name is dedicated to Dr. T. KOBAYASHI, Institute of Applied Zoology, Faculty of Agriculture, Hokkaido University.

9 *Longistriata hokkaidensis* CHABAUD, RAUSCH et DESSET, 1963

Numerous specimens were obtained from the small intestine of 174 cases of *Apodemus argenteus* and 63 of *A. speciosus*. The measurements were done in the specimens from *A. speciosus*.

Body coiled into 4~5 spirals, red in color when alive. Three labia on head end. Cephalic vesicle $0.029\sim 0.030\times 0.042\sim 0.055$ mm. Nerve ring and excretory pore $0.159\sim 0.189$ mm and $0.176\sim 0.252$ mm from head end, respectively. Esophagus tubular. Cuticle thin and fragile, with 22~24 longitudinal ridges. Male:—Body length 1.50~2.50 mm, width 0.068~0.080 mm. Esophagus 0.25~0.34 mm. Prebursal papillae absent. Spicules equal, 0.21~0.40 mm, filiform, fused at the distal end, enclosed with thin membrane. Gubernaculum boat-shape, $0.042\sim 0.054\times 0.016\sim 0.026$ mm. Genital cone well-developed, with a pair of papillae. Bursa symmetric, $0.063\sim 0.110\times 0.096\sim 0.160$ mm. Ventral rays fused proximally. Laterals stout, arising from the same trunk; antero- and medio-lateral bend anteriorly, postero-lateral bends posteriorly. Externo-dorsal and dorsal arise from the same trunk, the former nearly from base. Tip of dorsal ray bifurcated. Female:—Body length 2.10~3.42 mm, width 0.075~0.084 mm. Esophagus 0.31~0.41 mm. Vulva and anus $0.105\sim 0.147$ mm and $0.037\sim 0.042$ mm from tail end, respectively. Uterus single. Eggs oval, thin-shelled, $0.054\sim 0.066\times 0.033\sim 0.037$ mm.

A considerable difference in body size between the specimens from *Apodemus argenteus* and from *A. speciosus* was mentioned by CHABAUD et al. (1963). In the present specimens, no prominent morphological differences were found except the body size. Therefore, the measurement was done only in the specimens from *A. speciosus*. KONNO (1958) reported *Longistriata speciosa* as a new species from *A. speciosus* in Fukui Prefecture, central Japan. He stated that the nematode had the prebursal papillae and a chitinous thickened structure at the sheath of spicules; he considered the latter as the gubernaculum. On the other hand, CHABAUD et al. (1963) described *L. hokkaidensis* obtained from the same species of host in the same place as the present study. According to CHABAUD, the two species mentioned above are the same species (personal communication,

1970). KONNO's species, however, was described only in Japanese. Recently, DURETTE-DESSET (1970) has transferred this species to the new genus *Tenora-strongylus*.

10 *Mammaniduloides hokkaidensis* OHBAYASHI, ORIHARA et FUJIMAKI, 1968

Numerous specimens were obtained from the three subjected species of voles. This nematode is characterized by its specific habitat, the mammary gland in female host and the prostate and bulbo-urethral glands in male.

Small nematode, body coiled 2 or 3 spirals. Female red, male yellow to pink when alive. Cuticle with 26 longitudinal ridges from anterior to posterior end of body. Mouth simple, cervical papillae absent. Male:—Body length 5.5~6.4 mm, width 0.20~0.29 mm. Esophagus 0.27~0.34 mm long. Nerve ring 0.12~0.18 mm from head end. Prebursal papillae present. Bursa asymmetrical and triangular, right lobe larger than the left. Ventral rays arise from the same trunk. Laterals asymmetrical, right laterals longer than the left. Externo-dorsal and dorsal arise from common base. Spicules equal and slender, 0.74~0.81 mm. Gubernaculum present. Female:—Body length 9.4~12.9 mm, width 0.39~0.53 mm. Esophagus length 0.29~0.40 mm. Nerve ring 0.15~0.18 mm from head end. Vulva at a bending portion of tail, 0.24~0.29 mm from tip of tail. Anus 0.079~0.092 mm from tail end. Eggs elliptical, 0.067~0.082×0.042~0.052 mm.

Morphologically, this nematode is identical to *M. hokkaidensis*; furthermore, it was easier to specify by its specific habitat in hosts and endemic distribution. DURETTE-DESSET (1969) considers the genus *Mammaniduloides* OHBAYASHI, ORIHARA et FUJIMAKI, 1968, as a synonym of the genus *Mammanidula* SADOVSKAJA, 1952.

11 *Syphacia emileromani* CHABAUD, RAUSCH et DESSET, 1963

Numerous specimens were obtained from the large intestine of *Apodemus argenteus* and *A. speciosus*.

Male:—Body length 1.33~1.45 mm, width 0.11~0.14 mm. Esophagus including bulb 0.28~0.33 mm long. Nerve ring and excretory pore 0.11~0.15 mm and 0.37~0.42 mm from head end, respectively. Three striated mamelons at 0.69, 0.77 and 0.95 mm from head end, respectively. Tail 0.16~0.18 mm. Spicule, single, 0.071~0.084 mm. Gubernaculum 0.025~0.033 mm. Female:—Body length 3.93~5.20 mm, width 0.20~0.38 mm. Esophagus including bulb 0.37~0.51 mm. Nerve ring and excretory pore 0.138~0.168 mm and 0.450~0.600 mm from head end, respectively. Vulva 0.41~0.43 mm posterior to excretory pore. Tail 0.58~0.60 mm. Eggs 0.084×0.033 mm in average.

Male specimen described by CHABAUD et al. (1963) was larger in size, 2.14 mm. The present author could not find such a large male, although 180 cases infected

with this nematode were examined. Excepting this fact, however, the present species is identical to *Syphacia emileromani* morphologically.

12 *Syphacia montana* YAMAGUTI, 1943

Four male and 370 female specimens were obtained from the large intestine of *Clethrionomys rufocanus*.

Male:—Body length 1.45~1.66 mm, width 0.135~0.145 mm, posterior body rolled up ventrally. Cuticle striated transversely. Esophagus including bulb 0.22~0.35 mm, armed with teeth. Nerve ring and excretory pore 0.105 mm and 0.345 mm from head end in average, respectively. Tail 0.117 mm in average. Spicule and gubernaculum 0.067~0.075 mm and 0.033~0.037 mm in length, respectively. Female:—Body length 3.60~5.16 mm, width 0.29~0.34 mm. Esophagus including bulb 0.29~0.39 mm. Nerve ring and excretory pore 0.13~0.15 mm and 0.31~0.51 mm from head end, respectively. Vulva with prominent cuticular swelling, 0.37~0.74 mm from head end. Anus 0.75~0.86 mm from tip of tail. Eggs oval, 0.100~0.110×0.029~0.037 mm.

The morphology of the present specimens corresponds to the original description of *Syphacia montana* from *Clethrionomys smithi* (THOMAS) in Miure, Kiso, central Japan. This species is easily differentiable from the preceding one by its shorter esophagus, prominent cuticular swelling of the vulva and host specificity.

13 *Heterakis spumosa* SCHNEIDER, 1866

Forty-six specimens were obtained from the large intestine of 20 cases of *Clethrionomys rufocanus*, 3 of *Apodemus argenteus* and one of *A. speciosus*.

Body slightly curved ventrally and lateral alae well-developed. Male:—Body length 8.10~9.46 mm, width 0.207~0.258 mm. Pharynx 0.058~0.071 mm long. Esophagus including bulb 0.58~0.86 mm. Nerve ring and excretory pore 0.21~0.24 mm and 0.34~0.42 mm from head end, respectively. Tail 0.21~0.25 mm long. Preanal sucker 0.071~0.084×0.096~0.105 mm, at 0.60 mm from tip of tail. Ten pairs of caudal papillae; 2 pairs beside preanal sucker, 5 pairs near cloaca and 3 pairs on slender portion of tail. Spicules equal or subequal, 0.23~0.34 mm in length. Female:—Body length 11.6~15.0 mm, width 0.27~0.37 mm. Pharynx 0.084~0.086 mm. Esophagus including bulb 0.72~0.92 mm. Nerve ring and excretory pore 0.21~0.25 mm and 0.46~0.51 mm from head end, respectively. Vulva with prominent cuticular swelling, 7.2~7.4 mm from tip of tail. Eggs 0.067~0.075×0.042~0.050 mm.

14 *Trichuris* sp.

Twelve female specimens were obtained from the large intestine of *Clethrionomys rufocanus*.

Female:—Anterior body filiform and the posterior thick, caudal end bends ventrally. Body length 19.3~28.8 mm, width 0.25~0.51 mm. Esophagus 12.9~18.9 mm long, width at the end 0.086~0.120 mm. Vulva 15.0~19.7 mm from head end. Tip of tail with a single papilla. Eggs barrel-shaped, average size 0.058×0.032 mm.

The present female specimens are quite similar to *Trichuris muris* (SCHRANK, 1788) described by SHIKHOBALOVA (1957)¹⁹. However, the author would like to make identification in the near future, when male specimens will be obtained.

15 *Capillaria hepatica* (BANCROFT, 1893)

This nematode was found from the liver of 19 cases of *Clethrionomys rufocanus* and 2 of *Apodemus argenteus*. This nematode is well-known as a cosmopolitan species of rodent and easily distinguishable.

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EXPLANATION OF PLATES

PLATE I

- Figs. 1 & 2 *Paranoplocephala omphalodes* (HERMANN, 1783)
- Fig. 1 Scolex
- Fig. 2 Mature segment
- Figs. 3~5 *Coronacanthus apodemi* (YAMAGUTI, 1954)
- Fig. 3 Scolex
- Fig. 4 Rostellar hooks
- Fig. 5 Mature segment
- Figs. 6 & 7 *Cladothyridium* sp.
- Fig. 6 General view
- Fig. 7 Rostellar hooks
- Fig. 8 *Plagiorchis muris* TANABE, 1922
- Figs. 9~13 *Heligmosomum kobayashii* n. sp.
- Fig. 9 Anterior extremity of female
- Fig. 10 Posterior extremity of male
- Fig. 11 Dorsal ray
- Fig. 12 Lateral and ventral views of distal end of spicules
- Fig. 13 Posterior extremity of female

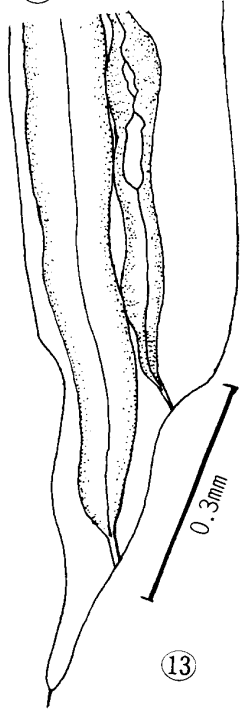
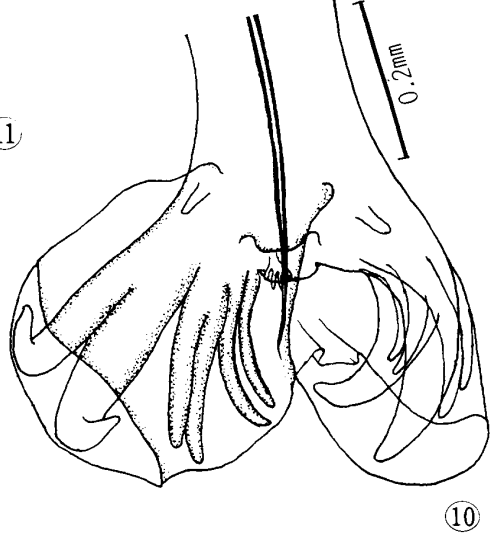
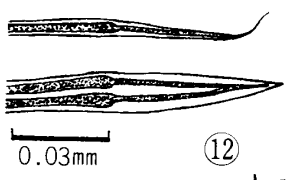
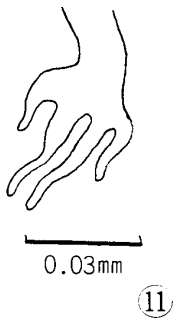
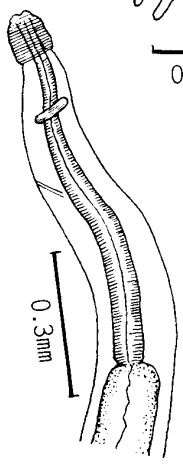
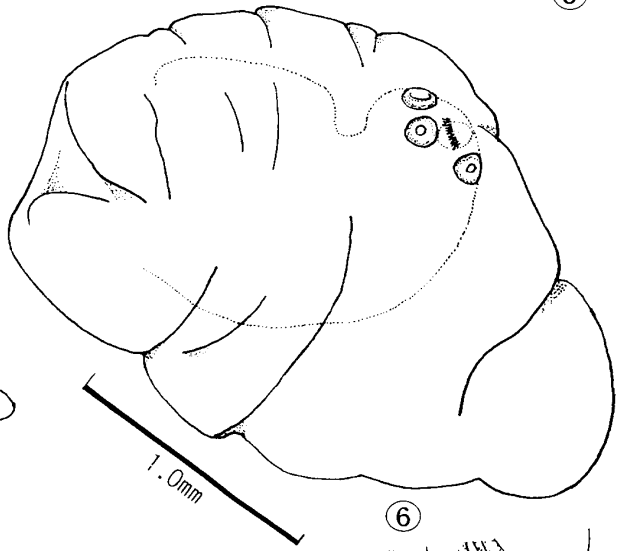
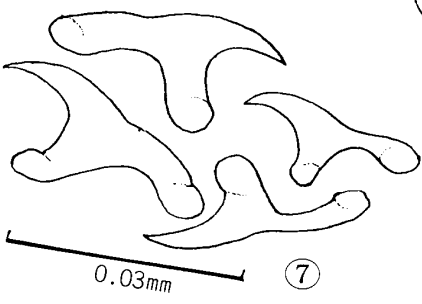
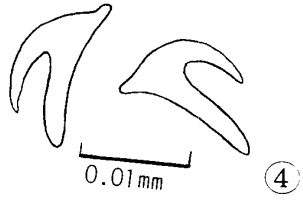
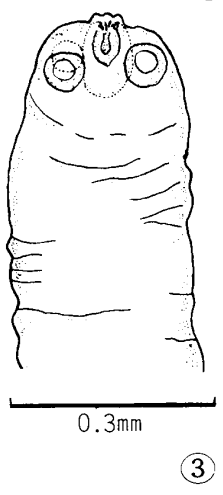
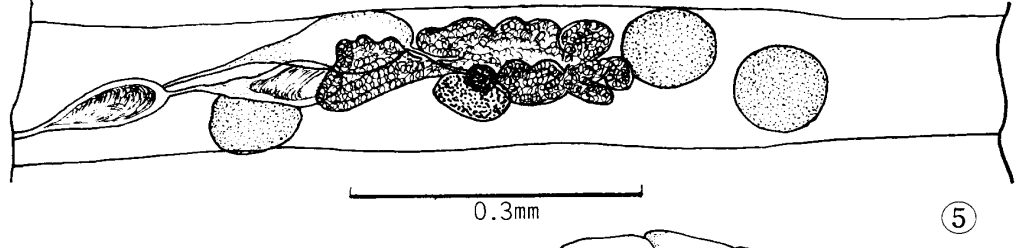
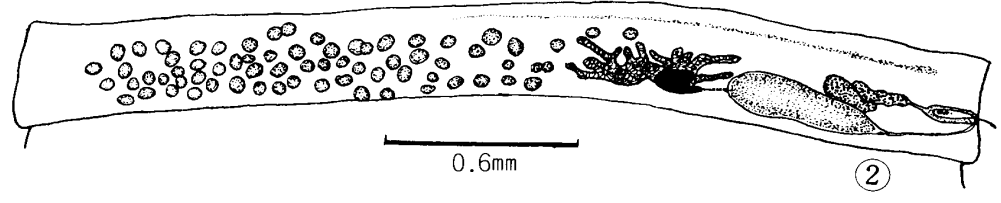
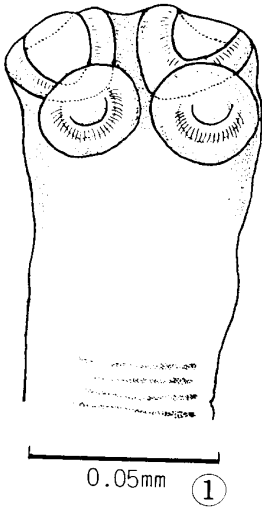


PLATE II

Figs. 14~16 *Heligmosomum yamagutii* CHABAUD, RAUSCH et DESSET, 1963

Fig. 14 Anterior extremity of female

Fig. 15 Posterior extremity of male

Fig. 16 Posterior extremity of female

Figs. 17~19 *Longistriata hokkaidensis* CHABAUD, RAUSCH et DESSET, 1963

Fig. 17 Anterior extremity of female

Fig. 18 Posterior extremity of female

Fig. 19 Posterior extremity of male

Figs. 20~22 *Syphacia emileromani* CHABAUD, RAUSCH et DESSET, 1963

Fig. 20 General view of male

Fig. 21 General view of female

Fig. 22 Anterior end of male

Figs. 23 & 24 *Syphacia montana* YAMAGUTI, 1943

Fig. 23 Posterior extremity of male

Fig. 24 Anterior extremity of female

