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FURTHER OBSERVATIONS ON
PARASITES OF THE JAPANESE SHREW MOLE,
UROTRICHUS TALPOIDES TEMMINCK

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A new lungworm, *Angiostrongylus minutus* n. sp. (Nematoda: Metastrongylidae), was described from 13 out of 14 specimens of the Japanese shrew mole, *Urotrichus talpoides* TEMMINCK, which were collected at Yumoto, Nikkô and areas near Lakes Saiko and Kawaguchi at the foot of Mt. Fuji. The male of this nematode is characterized by its minute body size, the existence of the gubernaculum, two simple branches of the dorsal ray, etc. Larval and immature Rhabditoidea gen. sp. were recognized in the nasal cavities of 2 cases. Larval *Toxocara canis* (WERNER, 1782) was demonstrated in one case, which showed multiple necrotic foci in the lungs. A trematode, *Ectosiphonus* sp., was obtained from the intestine of one case. *Eimeria* spp. were found in epithelial cells of the biliary canals and small intestine in two other cases. As for mycotic origin, adiaspores of *Emmonsia crescens* EMMONS et JELLISON, 1960, were found in the lungs of one case.

INTRODUCTION

In the preceding two papers^{11,12)}, we described various helminth and protozoan parasites of the Japanese shrew mole. Thereafter, the histological section preparations of various organs stained by hematoxylin-eosin were examined about 3 cases, which were newly obtained. In these sections, the existence of lungworms, *Eimeria* spp., Rhabditoidea gen. sp. and larval *Toxocara canis* was proven. Therefore, the lungs and nasal cavities of 5 cases used in the preceding papers were reexamined.

MATERIALS AND METHODS

The 8 specimens above-mentioned were composed of one case collected at Yumoto, Nikkô, on 22 Oct., '70, one and 6 cases at areas near Lakes Kawaguchi and Saiko at the foot of Mt. Fuji, respectively, during a period 9 Sept. to 16

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Nov., '71. Among these cases, one case from Saiko was negative for lungworms. Recently, a further 6 cases were captured at Saiko on 25 to 28 Oct., '72. Among these cases, the lungworm was observed in all cases, and a trematode species was obtained from one case. All the materials, which were fixed by formalin solution, were examined using a microscope, and the nematodes obtained were mounted by lacto-phenol solution. The trematode specimens were stained by Delafield's hematoxylin.

The specimens of parasites are preserved in the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

RESULTS AND DISCUSSIONS

1) *Angiostrongylus minutus* n. sp. (Nematoda: Metastrongylidae)

About 30 specimens including complete ones of 6 males and 3 females were obtained, although the removal of the nematodes was difficult work. In histological sections, the nematodes were observed in dilated alveolar ducts and alveoles. Around the nematode, eggs showing various developmental stages and larvae were scattered.

Host: *Urotrichus talpoides* TEMMINCK

Habitat: Lungs

Locality: Yumoto, Nikkô, and areas near Lakes Saiko and Kawaguchi

Date collected: 22 Oct., '70~16 Nov., '71

Description: Very small nematode. Cuticle with fine transverse striations. Mouth cavity reduced. Minute papillae around mouth. Esophagus showing slender club-shape.

Six males, length 0.998~1.374 mm, maximal width 0.024~0.032 mm, posterior body bending ventrally. Esophagus 0.120~0.152 mm long by 0.016 mm wide. Nerve ring at 0.050~0.052 mm from cephalic end. Bursa pouched and considerably well-developed, with reduced dorsal lobe. Ventral rays arise separately from laterals, fused excepting distal one fourth; ventro-ventral slightly shorter than latero-ventral. Lateral rays unequal, medio-lateral thickest and longest; tip of antero-lateral reaching distal one third of medio-lateral, almost entirely fused with medio-lateral except tip; postero-lateral shorter than antero-lateral, proximal half fused with medio-lateral. Externo-dorsal ray slender, arising separately, equal to postero-lateral in length. Dorsal ray short, bifurcates at base at wide angle with simple arms. Spicules, 0.114~0.135 mm long, with fine transverse striations, slightly thickened near distal end; tip thin, pointed, bends ventral showing hook-like figure. Gubernaculum weakly chitinized and undulated, length 0.012~0.016 mm.

Three females, body length 1.624~2.416 mm, maximal width 0.032~0.040 mm.

Esophagus 0.132~0.172 mm long by 0.016~0.020 mm wide. Nerve ring at 0.052~0.060 mm from cephalic end. Vulva in posterior body, at 0.144~0.188 mm from caudal end, covered by pre-vulvar protrusion with cuticular thickening. Anus at 0.022~0.036 mm from tip of conical tail. Uterine eggs around 3 in number per female, non-embryonated, elliptical with rounded ends, 0.048~0.056×0.024~0.030 mm in size. Eggs, showing various developmental figures, and larvae in pulmonary parenchyma; larvae, around 0.200 mm in length, with rounded head and simple pointed tail.

Discussion: *Angiostrongylus minutus* is a very small nematode; some males are less than 1 mm in length. The spicules, however, are long as compared with body length. Three species of *Angiostrongylus* are known from insectivorous mammals: *A. blarini* OGREN, 1954, from *Blarina brevicauda*, in Illinois, U.S.A., *A. soricis* SOLTYS, 1954, from *Sorex minutus* in Poland, and *A. michiganensis* ASH, 1967, from *Sorex cinereus cinereus* in Michigan, U.S.A. DROZDZ (1970) reviewed the genus *Angiostrongylus* KAMENSKY, 1905, and assigned the three species above-mentioned to a new genus *Stephanskostrongylus*. In this genus, the dorsal ray of the bursa is well-developed and bifurcates, each arm terminates again in two short branches, and the gubernaculum is absent. On the other hand, he divided *Angiostrongylus* into two subgenera, *Angiostrongylus* and *Parastrongylus*; the former contains species of carnivorous hosts and the latter those of rodents. *A. minutus* is different from any species of *Stephanskostrongylus* in morphology of the dorsal ray, but similar to those of *Angiostrongylus* (*Angiostrongylus*) from carnivores. In *A. minutus*, the gubernaculum chitinized weakly is recognizable, although the member of *Stephanskostrongylus* are lacking in this structure.

The species of *Angiostrongylus* of carnivorous and rodent mammals are always parasitic in the pulmonary blood vessels. ASH (1967) pointed out that those of insectivores do not live in the vascular system different from those of other hosts in this system. *A. minutus* is different from the species from insectivores morphologically, but its habitat is outside the vascular system similar to them.

2) Rhabditoidea gen. sp. (Nematoda)

In one case collected at Kawaguchi, on 16 Sept., '71, histologically, transverse sections of a nematode were recognized attaching to the mucosa of turbinates. The structure of these sections showed similarity those of larval Rhabditoidea in the lungs of the case (Saiko, 3/XI, '71) in the second report¹²⁾. No materials of the head area of the former case remained, but the latter case was reexamined, and 5 immature female nematodes, which were composed of 2

complete and fragmental ones, and 2 larvae were obtained from the nasal cavities. The larvae were identical to those from the lungs above-mentioned. In other case (Saiko, 28/X, '72), numerous immature female nematodes were also obtained from the nasal cavities.

Host: *Urotrichus talpoides* TEMMINCK

Habitat: Nasal cavities

Locality: Saiko

Date collected: 3 Nov., '71, and 28 Oct., '72

Description: Two immature females, body slightly bends ventrally, 2.228 and 1.914 mm in length, 0.120 and 0.128 mm in maximal width at about middle of body. Cuticle smooth and thin. Minute papillae around mouth, their number unknown; buccal capsule short and cylindrical, 0.008 mm long by 0.003 mm wide in both specimens. Esophagus, 0.296 and 0.268 mm in length, posterior part expanded, maximal width 0.088 and 0.052 mm. Excretory pore and nerve ring at 0.260 and 0.212 mm and at 0.156 and 0.152 mm from cephalic end, respectively. Vulva slightly anterior to middle of body, 1.287 and 1.073 mm from caudal end. Anus at 0.116 and 0.164 mm from caudal end. Tail tapered posteriorly and pointed.

Discussion: All the specimens were immature or larval. The immature ones had a very short buccal capsule different from the larvae, and the esophagus is not clearly rhabditiform. The life cycle is unknown, but it is supposed that the nematode may reach the nasal cavities after migration through tissues including the pulmonary arteries. In the nasal cavities, no pathological changes were observable in the turbinate-mucosa.

3) *Toxocara canis* (WERNER, 1782) (Nematoda: Ascarididae)

The second stage larvae of *T. canis* were found in the pulmonary foci of a case collected at Saiko, on 9 Sept., '71.

In the lungs, numerous yellowish gray foci of various sizes, up to ca. 2 mm in diameter, were observed. The foci were rounded, but some foci irregular in shape; the latter ones were usually small in size, and showed boring lesion. The focus was established by a central mass of degenerated eosinophiles containing sections of larval nematodes, and an outer layer of immature fibrous tissue accumulated by histiocytes. In some fresh foci, however, the reactions of granulation tissue was scanty. In transverse sections of the larva, single lateral alae and well-developed excretory filaments were confirmed. The nematode removed from the foci was identified as the second stage larva of *Toxocara canis* showing following characteristics.

Body length 0.324~0.395 mm, maximal width 0.014~0.018 mm. Cephalic end

asymmetric. Length of esophagus including well-developed ventriculus 0.135~0.145 mm. Tail conical with pointed tip, length 0.032~0.036 mm.

Morphological studies on larval *T. canis* have been published by several authors^{7,8,17,18}, especially in connection with "visceral larva migrans". The present specimens were identical to those described by them.

4) *Ectosiphonus* sp. (Trematoda: Brachylaimidae)

In one case collected at Saiko, on 28 Oct., '72, two immature trematode specimens were observed. One of them contained some eggs, but other one was lacking. The body was contracted because of formalin-fixation.

Host: *Urotrichus talpoides* TEMMINCK

Habitat: Intestine

Locality: Saiko

Date collected: 28 Oct., '72

Description: One subadult specimen. Body rounded oval in shape, contracted showing transverse striations on surface; 0.592 mm in length, 0.472 mm in width. Cuticle unarmed, subcuticular circular muscle fibers well-developed. Oral sucker terminal, with wide lumen, 0.200×0.212 mm in size. Prepharynx and esophagus unrecognized. Pharynx globular, 0.088×0.096 mm. Ceca running antero-laterad, then posteriad to posterior extremity, showing undulations. Acetabulum prominent, just preequatorial, 0.108×0.188 mm in size. Testes tandem, at posterior third of body, situated close together; anterior testis 0.084×0.108 mm, posterior one 0.080×0.112 mm. Ovary rounded, at dextro-lateral portion close to testes, situated intertesticularly; size 0.072×0.076 mm. Vitelline glands confined to levels between ovary and posterior half of acetabulum. Genital pore ventral to anterior testis; uterine coils at intercecal field from anterior testis to pharyngeal level. Several eggs at area between anterior testis and acetabulum. Eggs elliptical, 0.022~0.028×0.012~0.016 mm.

In the second specimen, body size 0.440×0.360 mm. Oral sucker 0.108×0.208 mm, pharynx 0.080×0.076 mm, acetabulum 0.100×0.136 mm. Anterior testis 0.068×0.060 mm, posterior testis 0.068×0.052 mm, ovary 0.052×0.048 mm. No eggs in uterus.

Discussion: This species belongs to the genus *Ectosiphonus* SINITZIN, 1931, judging from distribution of the vitelline glands and the uterine coils, arrangement of the ovary and the testes, position of the genital pore, etc. The specimens, however, were subadult or immature, and were in insufficient state for preparation. Therefore, detailed observations on the genital system and others for identification were impossible. Further specimens in good condition will be desirable in the future.

5) *Eimeria* spp. (Sporozoa: Eimeriidae)

Two species were recognized in histological section preparations, although we could examine neither fresh nor fixed materials. Of these, one species was found in the biliary system, and the other in the intestinal canal.

Species 1 This species was observed in one case collected at Kawaguchi, on 16 Sept., '71. Epithelial cells of the hepatic duct and its branches were parasitized.

Numerous macrogametocytes and a few microgametocytes in cytoplasm of epithelial cells. Macrogametocytes containing red plastic granules, 0.012~0.014×0.010~0.012 mm in size. Microgametocytes about 0.012 mm in diameter. Oocysts, about 0.016 mm in length, found very rarely; exact shape undetermined, because of deformity by artefact.

Species 2 This species was observed in one case collected at Saiko, on 16 Nov., '71.

A small number of macrogametocytes were found in epithelial cells at the basal portion of villi of the small intestine. One or two microgametocytes eccentrically sectioned were also recognized. Mature oocysts were unrecognizable.

Several protozoan species of Eimeriidae are known from mammals of Talpidae. TANABE (1938) obtained *Eimeria scapani* HENRY, 1932, and *Cyclospora caryolytica* SCHAUDINN, 1902, from the intestine of *Mogera wogura coreana* in Korea. Recently, PÉLLERDY and TANYI (1968) described *Cyclospora talpae* from the bile canals of *Talpa europaea*. As to localization, the present species Nos. 1 and 2 are similar to *Cyclospora talpae* and *Eimeria scapani*, respectively, but the identification is impossible at present due to limited materials. Further detailed investigation of various developmental stages including oocysts are needed in the future.

Appendix Two adiaspores of *Emmonsia crescens* EMMONS et JELLISON, 1960, were removed from the lungs of one case from Kawaguchi, 16 Sept., '71. The one was 0.188 mm in diameter and the wall was 0.012 mm in thickness, and the other 0.228 mm in diameter, its wall 0.024 mm thick. OHBAYASHI and ISHIMOTO (1971) found the same fungus from *Apodemus argenteus* in Hokkaido. We consider that the fungus is widely distributed among various small mammals in Japan.

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EXPLANATION OF PLATES

PLATE I

- Figs. 1~8 *Angiostrongylus minutus* n. sp.
Fig. 1 Male, anterior end
Fig. 2 Male, posterior end, lateral view
Fig. 3 Male, bursa, ventral view
Fig. 4 Male, bursa, dorsal view
Fig. 5 Spicule, distal end
Fig. 6 Female, posterior end
Fig. 7 Female, vulvar region
Fig. 8 Eggs and larvae from pulmonary tissue
Figs. 9 & 10 Rhabditoidea gen. sp., immature
Fig. 9 Anterior end
Fig. 10 Posterior end
Fig. 11 *Ectosiphonus* sp., ventral view

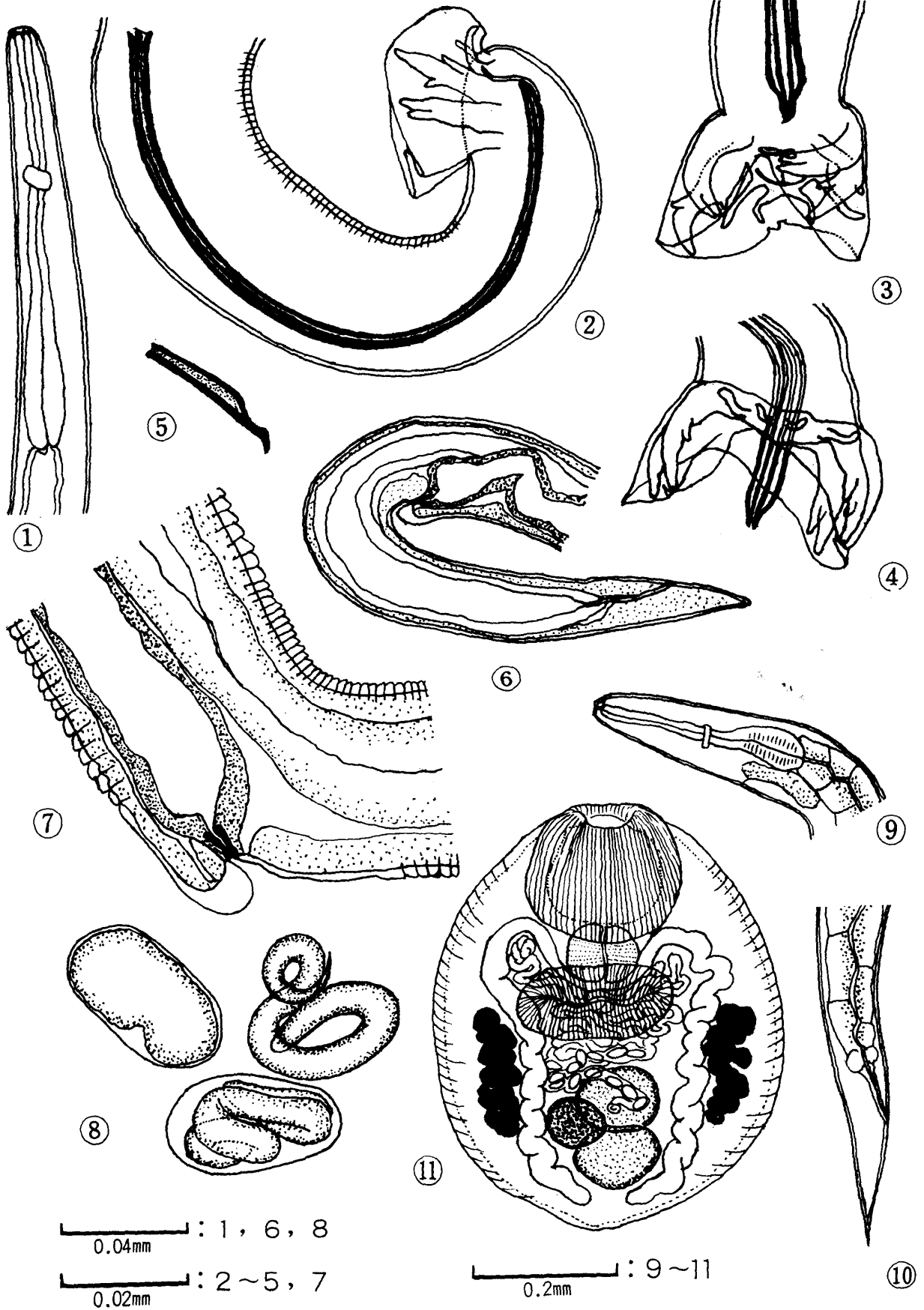


PLATE II

- Fig. 12 Lung section showing adults, eggs and larvae of *Angiostrongylus minutus* n. sp. Hematoxylin-eosin (H.-E.) stain
- Fig. 13 Eggs and larva of *A. minutus* n. sp. obtained from pulmonary tissue Mounted by lacto-phenol solution
- Fig. 14 Lung section showing focus of larva migrans by *Toxocara canis* H.-E. stain
- Fig. 15 Larval *T. canis* removed from pulmonary focus Mounted by lacto-phenol solution
- Fig. 16 Section of nasal portion showing Rhabditoidea gen. sp. on nasal mucosa H.-E. stain
- Fig. 17 Section of hepatic duct showing *Eimeria* sp. 1 in epithelial cells H.-E. stain
- Fig. 18 Section of small intestine showing *Eimeria* sp. 2 in epithelial cells H.-E. stain
- Fig. 19 Adiaspore of *Emmonsia crescens* removed from lung Mounted by lacto-phenol solution

