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HELMINTHS OF MUSTELIDAE IN HOKKAIDO

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Seven males of *Mustela sibirica itatsi* TEMMINCK, a male of *Mustela nivalis namiyei* KURODA and 3 males of *Martes zibellina brachyura* TEMMINCK captured at Teshio district of northern Hokkaido, Japan, were examined.

Helminths obtained were: 5 species of Nematoda, *Capillaria putorii* RUDOLPHI, 1819, *Capillaria* sp., Spiruridea gen. sp. (larva), *Filaroides martis* (WERNER, 1782) DOUGHERTY, 1943, *Strongyloides* sp.; one of Trematoda, *Echinostoma hortense* ASADA, 1926; and one of Acanthocephala, juvenile form of *Centrorhynchus elongatus* YAMAGUTI, 1935. *C. putorii* is the first record from Japan. It is supposed that *F. martis* is widely distributed in the mustelids of Hokkaido. Juvenile form of *C. elongatus* is the first recorded from the mustelids.

INTRODUCTION

Several helminth species of mustelids in Japan have been studied by ASADA (1926), FUKUI (1929), YAMAGUTI (1939, 1941), KANDA (1958) and others. Of the mustelid hosts in Hokkaido, however, no studies of helminths except *Filaroides martis* have been published (YAMASHITA, 1963). In the present paper, the authors describe 5 species of nematodes, a trematode and a juvenile form of acanthocephalan found in 11 mustelids, which were captured during the period from January to February, 1972, at Teshio district, northern Hokkaido, Japan.

MATERIALS AND METHODS

The animals examined were preserved under the snow for some time at the places where they were captured. Consequently, some intestinal helminths, especially *Strongyloides* sp., were somewhat damaged. All the organs and tissues of the hosts were examined carefully using a microscope. The nematodes were fixed in 5% formalin solution and were treated by lacto-phenol solution. Whole-mounted preparations of trematodes and acanthocephalans were made by fixation using 70% alcohol, and were stained by Delafield's hematoxylin.

RESULTS AND DISCUSSION

Filaroides martis (WERNER, 1782) DOUGHERTY, 1943, showed the highest rate

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of infection. *M. zibellina brachyura* was infected with only *Capillaria putorii* RUDOLPHI, 1819. *Echinostoma hortense* ASADA, 1926, was obtained from *M. sibirica itatsi*, and more than 100 specimens were collected from two cases, Nos. 3 and 6, respectively. The former animal was extremely emaciated. Six species of helminths could be taken from *M. sibirica itatsi*. The helminth parasites recovered are summarized in table 1. The specimens are preserved in Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

TABLE 1 *Incidence of helminth parasites examined*

HOSTS		PARASITES						
		Capillaria putorii	*Capillaria* sp.	*Strongyloides* sp.	*Filaroides martis*	Spiruridea gen. sp. (larva)	*Echinostoma hortense*	*Centrorhynchus elongatus* (juvenile)
Mustela sibirica itatsi	1			+	+			
	2							
	3	###			##	##	###	
	4				+		##	+
	5				+		+	
	6	+			+		###	
	7				##			
M. nivalis namiyei	1		+		+			##
Martes zibellina brachyura	1	+						
	2	+						
	3	###						

Remarks: +, ## and ### indicate number of specimens less than 5, 5~10 and more than 50, respectively (No cases were parasitized by 16~49 specimens). Incidence in *Filaroides martis* indicates number of nodules.

Nematoda

Genus *Capillaria* ZEDER, 1800

Capillaria putorii RUDOLPHI, 1819 (figs. 1~5, 25 & 26)

All the parasites, except one female from the upper small intestine, were

TABLE 2 *Measurements of Capillaria putorii (in mm)*

PARTS MEASURED	AUTHORS AND SEXES OF PARASITE					
	LÓPEZ-NEYRA, 1947		KONTRIMAVICHUS, 1963*		PRESENT AUTHORS	
	Male	Female	Male	Female	Male	Female
Length of body	5.4~8	9.4~15	7.21	11.4	5.427~6.113	7.191~10.588
Maximum width of body	0.058~0.068	0.068~0.088	0.047	0.052	0.044~0.058	0.062~0.073
Width at end of esophagus	—	—	0.045	0.049	0.044~0.050	0.044~0.058
Length of esophagus	2.41~2.55	3.02~3.59	3.47	3.59	2.412~2.897	2.970~3.971
Length of lateral caudal alae	0.149~0.168	—	0.256	—	0.153~0.160	—
Length of spicule	0.149~0.168	—	0.397	—	0.291~0.335	—
Esophagus/body ratio	1 : 2.24~3.13	1 : 3.11~4.12	1 : 2.07	1 : 3.17	1 : 2.03~2.39	1 : 2.65~3.32
Size of eggs	—	0.064~0.072 × 0.028~0.032	—	0.063×0.029	—	0.058~0.066 × 0.026~0.029

* Cited from KONTRIMAVICHUS (1969)

recovered from the stomach in 2 cases of *M. sibirica itatsi* and all cases of *M. zibellina brachyura*. Measurements were taken of 5 males and 10 females. A comparison of the measurements with those by other authors is summarized in table 2.

Host: *Mustela sibirica itatsi* TEMMINCK and *Martes zibellina brachyura* TEMMINCK

Habitat: Stomach

Description: Long, filiform nematode, gradually tapering toward the cephalic end, bacillary band obvious, cuticle without transversal striations. Mouth terminal and leads into long esophagus. In male, pedunclate structure on each side of cloaca. Spicule filiform, with swelling near its distal end, tip pointed. Spicular sheath aspinose, with fine transverse striations. Cloacal aperture opens subterminally in both sexes. In female, caudal end conical. Vulva at 4.882~6.618 mm from caudal end. Cuticular expansion of vulvar region in most of females. Eggs oval to somewhat elongate in shape. Egg-shell establised by a thick inner layer, with pattern of irregular net-like meshes, and a thin outer layer. Opercula slightly protruded.

Discussion: *C. putorii* is distributed in western Europe, U.S.A. and USSR (LÓPEZ-NEYRA, 1947; SKRJABIN, 1957; KONTRIMAVICHUS, 1969). This is the first case of *C. putorii* recorded in Japan.

Capillaria sp. (figs. 6~8; tab. 3)

One each of male and female specimens was collected from the stomach of *M. nivalis namiyei*.

Host: *Mustela nivalis namiyei* KURODA

Habitat: Stomach

Description: Body gradually tapers toward cephalic end, bacillary recognizable, cuticular striations not obvious. Male, without lateral caudal alae. Caudal bursa composed of two lobes, each lobe supported by single peduncle; length of peduncle and ala 0.032 mm and 0.018 mm, respectively. Spicular sheath transversely striated and aspinose. Spicule, without swelling near its distal end. In female, vulva at 2.206 mm from caudal end. Cuticular expansion unrecognizable at vulvar region. Egg shell composed of two layers, inner one with irregular network pattern like melon-rind.

Discussion: The characteristics of this nematode are similar to those of *C. putorii*, but the body length of the former is smaller than the latter, and the male possesses no lateral caudal alae. In the female, esophagus/body ratio is markedly different from that of *C. putorii*. The present species is also very different from other Capillaria-species from mustelids as *C. linsi* FREITAS et

TABLE 3 *Measurements of Capillaria sp. from Mustela nivalis namiyei (in mm)*

PARTS MEASURED	SEXES OF PARASITE	
	Male	Female
Length of body	2.427	5.0
Maximum width of body	0.038	0.051
Width at end of esphagus	0.033	0.051
Width at vulvar aperture	—	0.044
Length of esophagus	0.882	2.735
Maximum width of esophagus	0.022	0.029
Length of spicule	0.204	—
Esophagus/body ratio	1 : 2.74	1 : 1.82
Size of eggs	—	0.058～0.066 × 0.029～0.033

LENT, 1935, *C. mucronata* (MOLIN, 1858) TRAVASSOS, 1915 and *C. mustelorum* CAMERON et PARNELL, 1933. This nematode may be a new species, but the number of specimens is quite few (♂1, ♀1) and slightly damaged. Therefore, it is necessary to collect more specimens in a fresh condition.

Spiruridea gen. sp. (larva) (figs. 9, 10 & 23)

Seven larval nematode encapsulated in the stomach wall were collected from a specimen of *M. sibirica itatsi*. Judging from morphological characteristics, especially those of the esophagus, this larval nematode belongs to the order Spiruridea.

Host: *Mustela sibirica itatsi* TEMMINCK

Habitat: Stomach wall

Description: Body length 1.70～1.92 mm, cuticular striations obvious at intervals of 0.003～0.004 mm. Body coiled dorsally. Cephalic end pointed, showing triangular figure laterally, with one each minute protrusion on dorsal and ventral corner. Esophagus 1.20～1.25 mm long, divided into a short muscular portion and a long glandular portion, length 0.08～0.09 mm and 1.1～1.2 mm, respectively. Nerve ring and excretory pore at 0.106～0.116 mm and 0.145～0.153 mm from cephalic end, respectively. Caudal end abruptly pointed, cloaca slightly protruded at 0.069～0.073 mm from caudal end.

Genus *Filaroides* BENEDEN, 1858

Filaroides martis (WERNER, 1782) DOUGHERTY, 1943 (figs. 11～14, 27 & 28; tab. 4)

Subpleural nodules, 3 to 5 mm in diameter, were found in contact with

TABLE 4 *Measurements of Filaroides martis (in mm)*

PARTS MEASURED	AUTHORS (HOSTS) AND SEXES OF PARASITE					
	ANDERSON, 1962 (*Mustela vison vison*)		KONTRIMAVICHUS, 1963* (*Martes zibellina*)		PRESENT AUTHORS (*Mustela sibirica itatsi* / *M. nivalis namiyei*)	
	Male	Female	Male	Female	Male	Female
Maximum width of body	0.150	0.400	—	—	0.218	0.353
Width at esophageal end	—		0.106~0.158		0.084~0.135	
Width at vulva	—	—	—	0.060~0.110	—	0.084~0.135
Length of esophagus	0.224~0.270		0.236~0.307		0.218~0.250	
Length of spicule	0.174~0.183	—	0.151~0.185	—	0.167~0.200	—
Length of gubernaculum	0.030~0.032	—	0.029~0.039	—	0.033~0.040	—
Length of tail	0.018~0.021	0.029	0.031~0.051	0.029~0.041	0.029~0.040	0.026~0.029
Length of larva	0.271~0.318		0.32~0.43		0.260~0.356	
Cephalic end to nerve ring	0.108~0.110		0.087~0.135		0.109	
Cephalic end to excretory pore	0.126~0.178		0.139~0.142		0.138	
Caudal end to vulva	—	—	—	0.079~0.085	—	0.051~0.105

* Cited from KONTRIMAVICHUS (1969)

bronchi in 6 specimens of *Mustela sibirica itatsi* and one of *M. nivalis namiyei*. The nodule was rounded, slightly convexed on the pleura and contained several male and female nematodes tangled with each other. Among nematode bodies were interspaced by fibrous tissue and the nodule itself was encapsulated by fibrous layer. The number of nodules was varied 1 to 7 by host. Several cephalic and caudal ends were protruded at a concave portion of the nodule contacting to the bronchus, and some ends penetrated into the bronchial cavity through its wall. We could not succeed in getting complete specimens of the nematode because of the above-mentioned condition of the nodule.

Host: *Mustela sibirica itatsi* TEMMINCK and *M. nivalis namiyei* KURODA

Habitat: Lungs

Measurements taken of fragmented specimens of 5 male and 3 female *F. martis* are summarized in table 4. The measurements of the present specimens correspond to those by ANDERSON (1962) and KONTRIMAVICHUS (1969). The arrangement of caudal papillae of the male is also identical to the result by ANDERSON (1962). The tegumental sheath is observed. The spicules are equal, curved ventrally and the tip of spicule is not so pointed. Caudal end of the both sexes bluntly conical. The male possesses no bursa. The uteri are filled with larvae.

The first record of this nematode in Japan was made by YAMASHITA (1963) from *M. sibirica itatsi* captured at Nakashibetsu district, eastern Hokkaido. Therefore, *F. martis* seems to be distributed all over Hokkaido in mustelids.

Genus *Strongyloides* GRASSI, 1876

Strongyloides sp.

Two female worms were collected from one specimen of *M. sibirica itatsi*.

Host: *Mustela sibirica itatsi* TEMMINCK

Habitat: Upper small intestine

Description: Body length 6～7 mm. Caudal end tapers and pointed. Eggs 0.056～0.062×0.032～0.040 mm in size.

It was difficult to identify detailed morphological characteristics of this nematode, because the specimens were somewhat damaged. KONTRIMAVICHUS (1969) recorded 6 species of the genus *Strongyloides* from Mustelidae, but there have been no reports published concerning *Strongyloides* of Japanese mustelids.

Trematoda

Genus *Echinostoma* RUDOLPHI, 1809

Echinostoma hortense ASADA, 1926 (figs. 15～18 & 22; tab. 5)

These trematodes were collected from 4 specimens of *M. sibirica itatsi*.

TABLE 5 *Measurements of Echinostoma hortense (in mm)*

PARTS MEASURED	AUTHORS		
	ASADA, 1926	YAMAGUTI, 1939	PRESENT AUTHORS
Size of body	8.2~14.0×0.93~1.6	6.25~6.75×1.2~1.25	8.5~11.7×0.765~1.294
Size of oral sucker	0.160~0.180	0.188~0.255×0.2~0.22	0.171~0.251×0.146~0.240
Size of acetabulum	0.45~0.50	0.61~0.675	0.632~0.765×0.618~0.779
Diameter of head collar	—	0.4	0.367~0.412
No. of collar spines	28	26~27	26~27
Size of pharynx	—	0.17~0.188×0.15~0.175	0.193~0.243×0.149~0.189
Size of ovary	0.28~0.3	0.275~0.31×0.225~0.25	0.207~0.309×0.190~0.250
Size of testes	0.85~0.93×0.5~0.6	0.72~0.8×0.5~0.68	0.456~0.661×0.677~0.779
Size of cirrus sac	0.53~0.62×0.22~0.24	0.56~0.625×0.25	0.485~0.632×0.225~0.279
Size of lateral marginal spines	—	0.048~0.060×0.013~0.017	0.040~0.062×0.015~0.018
Size of dorsal marginal spines	—	0.048~0.068×0.011~0.015	0.040~0.058×0.011~0.015
Size of eggs	—	0.110~0.126×0.061~0.070	0.106~0.142×0.058~0.076

Habitat was mostly the upper small intestine. The specimens were slightly damaged. The measurements of 10 specimens of the parasite are shown in table. 5.

Host: *Mustela sibirica itatsi* TEMMINCK

Habitat: Upper small intestine

Description: Prepharynx 0.036～0.073 mm long, pharynx 0.193～0.243×0.149～0.186 mm. Esophagus 0.397～0.574 mm long. Testes irregular ovoid or elliptical. Center of testicular area at equatorial or in front of middle of body. Vitellaria follicular. Anterior limit of vitellaria usually at same level of ovary. Distance between anterior extremity and anterior margin of acetabulum 0.765～1.519 mm.

Discussion: ASADA (1926) described this trematode as a new species and also clarified that the first intermediate hosts were snails of the genus *Limnaea* and the second intermediate hosts were several species of tadpole. YAMAGUTI (1933) recovered this species from *Rattus norvegicus*. Moreover, this species was collected by YAMAGUTI (1939) from the small intestine of *Lutreola itatsi itatsi* (TEMMINCK) (=*Mustela sibirica itatsi*) from Uji, near Kyoto. He suggested that *L. itatsi itatsi* may be one of the most important natural hosts as same as *R. norvegicus* for this species. In Hokkaido, ORIHARA (unpublished data) collected this species from *M. sibirica itatsi* at Shinoro, near Sapporo.

Acanthocephala

Genus *Centrorhynchus* LÜHE, 1911

Centrorhynchus elongatus YAMAGUTI, 1935 (juvenile form) (figs. 19～21 &24)

Five specimens were collected from the bile duct of *M. nivalis namiyei* and 2 specimens from the stomach of a case of *M. sibirica itatsi*. It is not known whether the bile duct is the normal habitat and migration route.

Host: *Mustela nivalis namiyei* KURODA and *M. sibirica itatsi* TEMMINCK

Habitat: Bile duct and stomach

Description: The proboscis and posterior part of the parasite were invaginated into the trunk. Body plump, 3.5～4.2 mm long by 0.67～0.72 mm broad, slender at posterior part of trunk. Proboscis subglobular, 0.324～0.427×0.377～0.427 mm. Neck 0.294～0.397×0.182～0.412 mm. Hooks on proboscis and neck in 27～29 longitudinal rows of 15～16 each, 0.033～0.055 mm long. Proboscis sheath elongated, double-walled, inserted at about middle of proboscis. Lemniscis elongate in club-shape, 0.618×0.147 mm, reaching backward beyond proboscis sheath. In almost all the specimens, genital primordia and internal organs obscure. Testicular primordia tandem, at about the middle of trunk, 0.091～0.109×0.037～0.040 mm, a little separated from each other.

Discussion: Four species of the genus *Centrorhynchus* are known from Mustelidae. Comparing *C. wardae* HOLLOWAY, 1958, *C. itatsinis* FUKUI, 1929 and *C. ninnii* (STOSSICH, 1891) with the present species, it is obvious that the arrangement of proboscis-hooks on the last one is different from others. *C. conspectus* VAN CLEAVE et PRATT, 1940, differs in the size of the proboscis and the shape of the caudal end. *C. elongatus* was reported by YAMAGUTI (1935) from *Otus bakkamoena semitorques* TEMM. et SCHL., *Asio otus otus* (LINNÉ) and by YAMAGUTI (1939) from *Strix uralensis hondoensis* (CLARK) in Honshu, mainland of Japan. On the other hand, MACHIDA & FUJIMAKI (1965) reported from *Strix uralensis japonica* (CLARK), *Buteo buteo burmanicus* HUME in Hokkaido. The life cycle is unknown, but a juvenile form was recovered from *Sorex unguiculatus* DOBSON captured at Sapporo by MACHIDA & FUJIMAKI (1965). They supposed that the genus *Sorex* possibly be a transport host. KANDA (1958) states that *M. itatsi itatsi* (TEMM.) acts as both intermediate and final hosts of *C. itatsinis,* besides, rats and mice play a role as reservor experimentally. We suppose that *M. sibirica itatsi* and *M. nivalis namiyei* are the transport hosts as same as shrews, rats and mice.

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Explanation of plates

Plate I

Figs. 1~5 *Capillaria putorii*

Fig. 1 Posterior portion of male, ventral view

Fig. 2 Posterior portion of male, lateral view

Fig. 3 Vulvar region

Fig. 4 Posterior portion of female

Fig. 5 Eggs

Figs. 6~8 *Capillaria* sp.

Fig. 6 Posterior portion of male

Fig. 7 Vulvar region

Fig. 8 Eggs

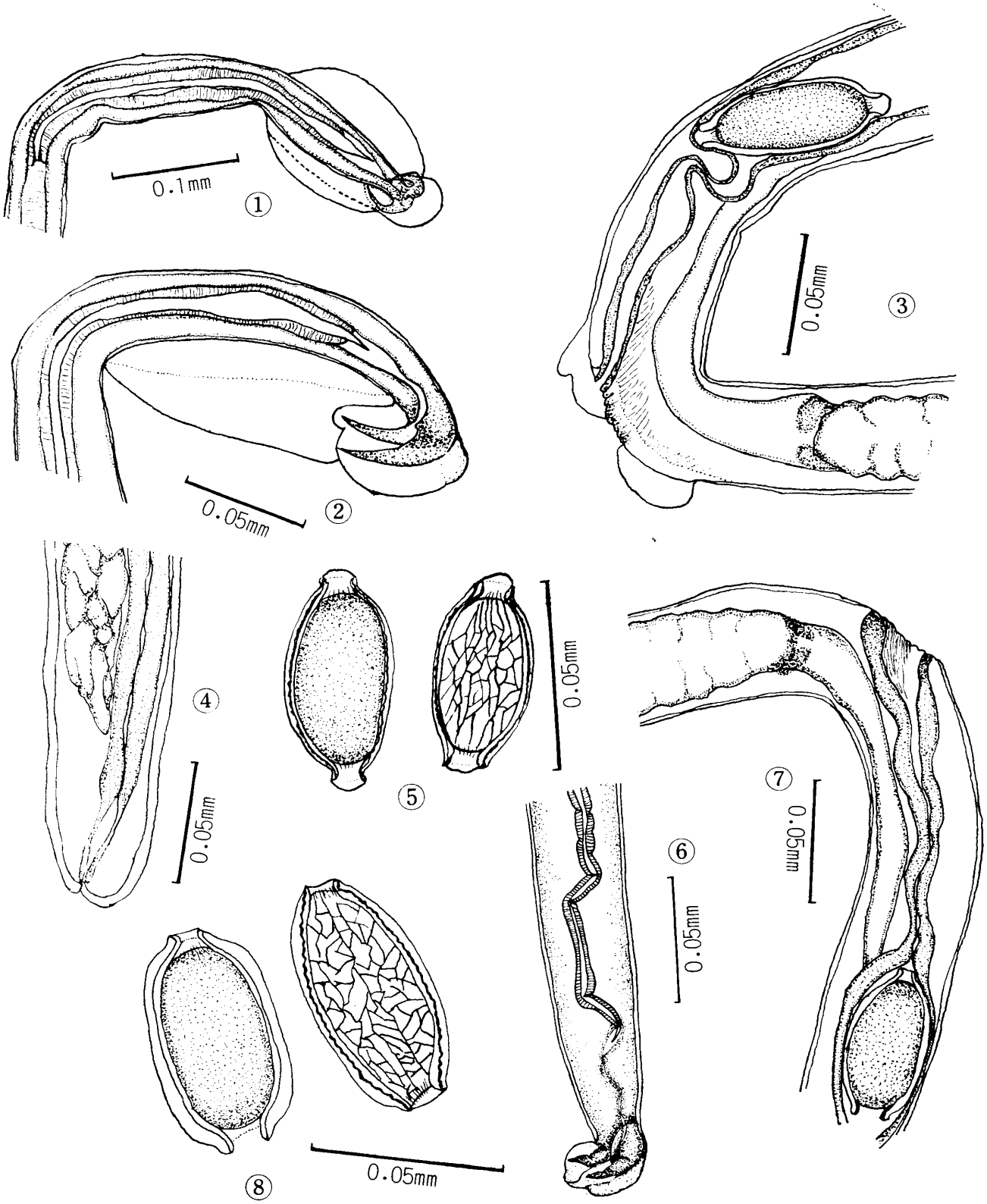
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PLATE II

Fig. 9 General view of Spiruridea gen. sp. (larva)

Fig. 10 Anterior portion of Spiruridea gen. sp. (larva)

Figs. 11~14 *Filaroides martis*

Fig. 11 Posterior portion of male, ventral view

Fig. 12 Posterior portion of male, lateral view

Fig. 13 Posterior portion of female

Fig. 14 Anterior portion of unknown sexes

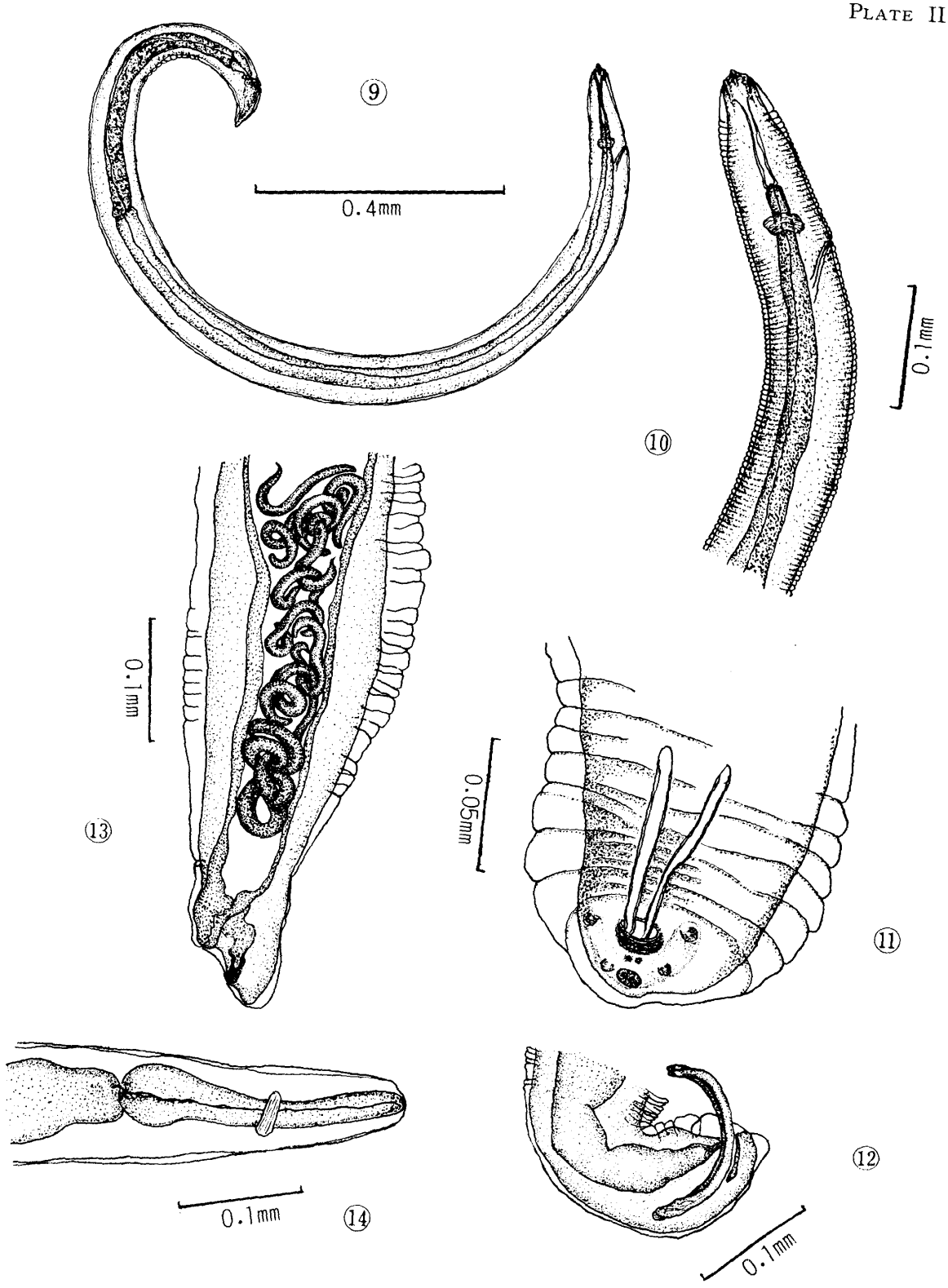
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PLATE III

Figs. 15~18 *Echinostoma hortense*

Fig. 15 General view

Fig. 16 Anterior portion

Fig. 17 Dorsal marginal spines

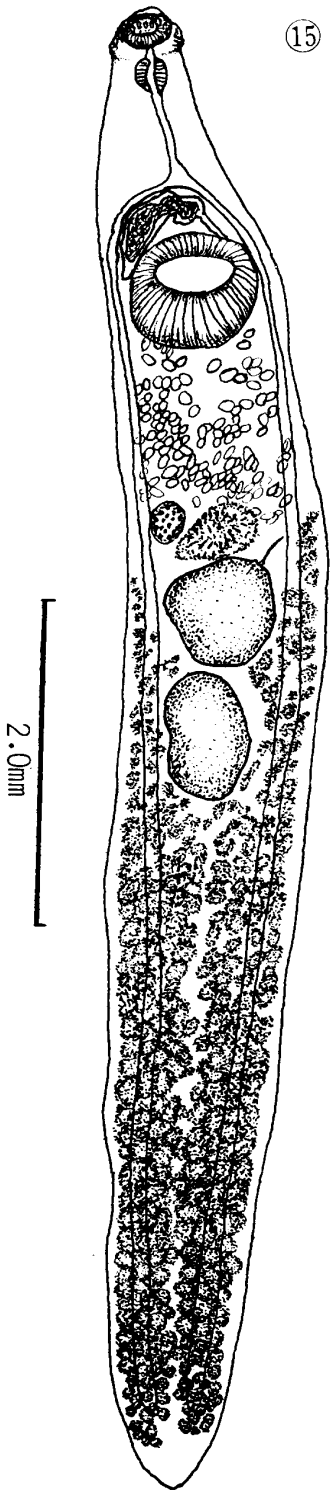
Fig. 18 Lateral marginal spines

Figs. 19~21 Juvenile form of *Centrorhynchus elongatus*

Fig. 19 Male, general view

Fig. 20 Anterior portion of male

Fig. 21 Hooks on anterior, middle and posterior proboscis from left to right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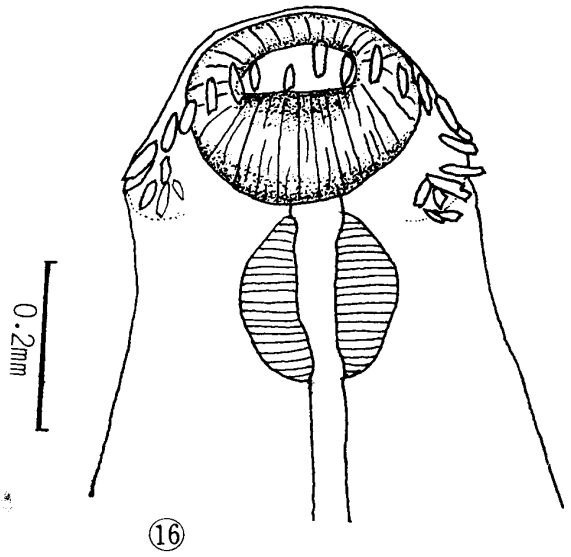
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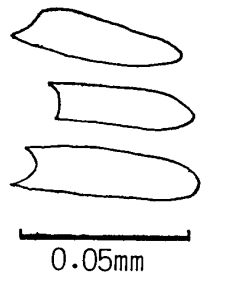
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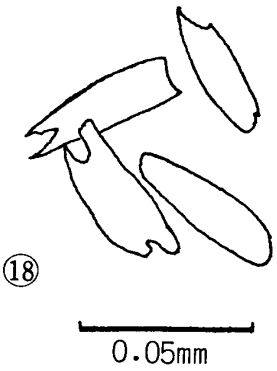
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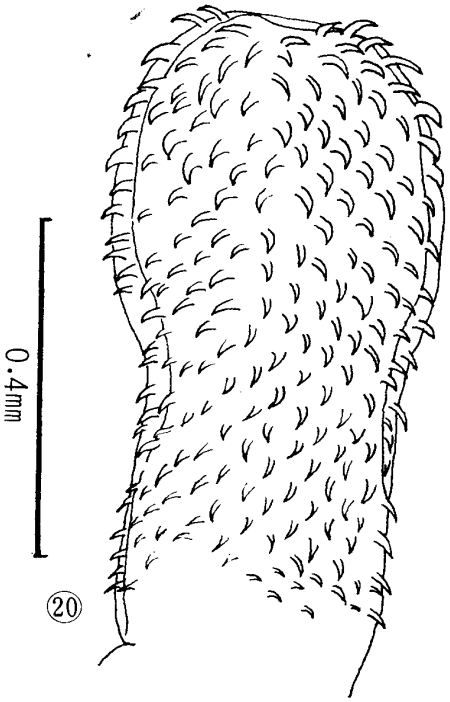
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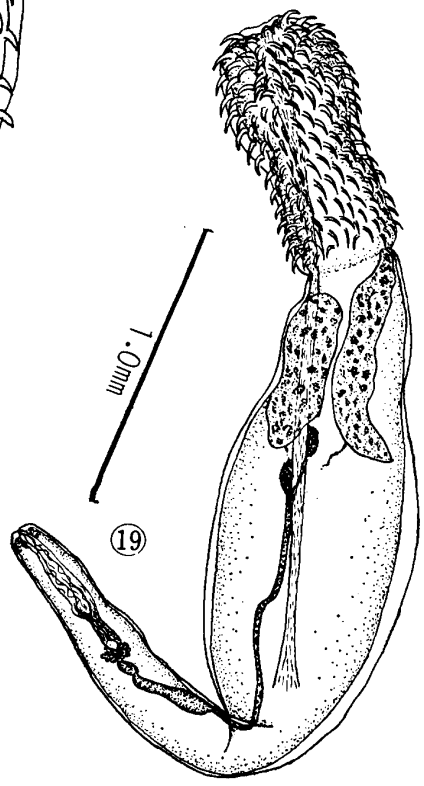
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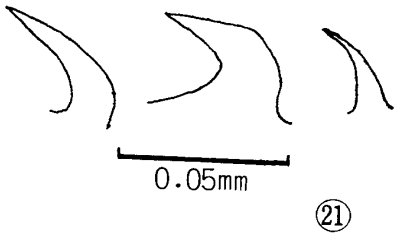

0.05mm
㉑

PLATE IV

Fig. 22 Anterior portion of *Echinostoma hortense*

Fig. 23 Anterior portion of Spiruridea gen. sp. (larva)

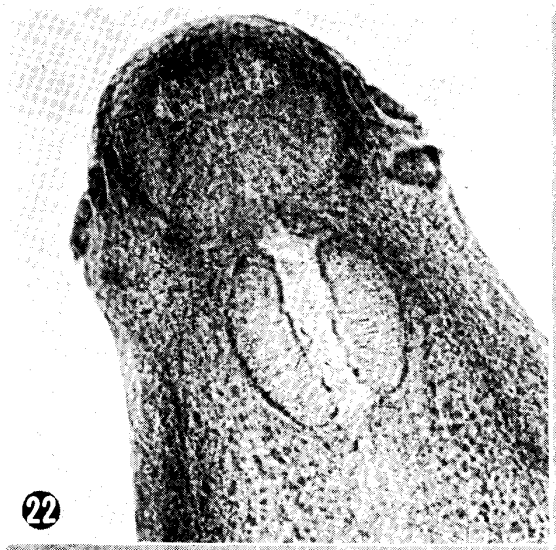
Fig. 24 Proboscis of juvenile form of *Centrorhynchus elongatus*

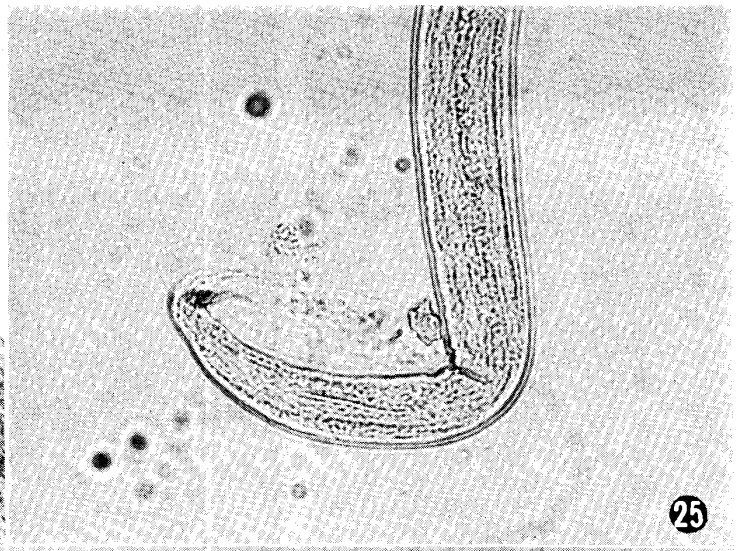
Fig. 25 Posterior portion of male *Capillaria putorii*, lateral view

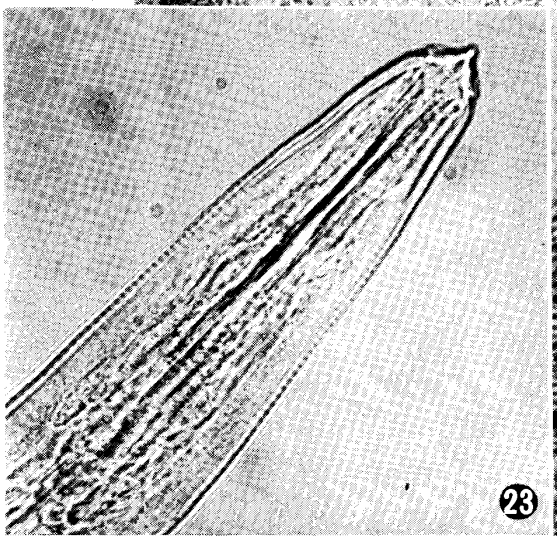
Fig. 26 Eggs of *C. putorii*

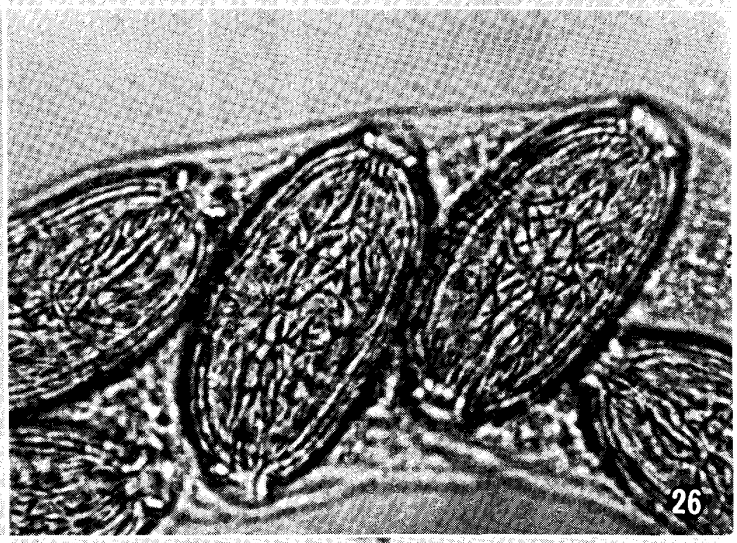
Fig. 27 Posterior portion of male *Filaroides martis*, lateral view

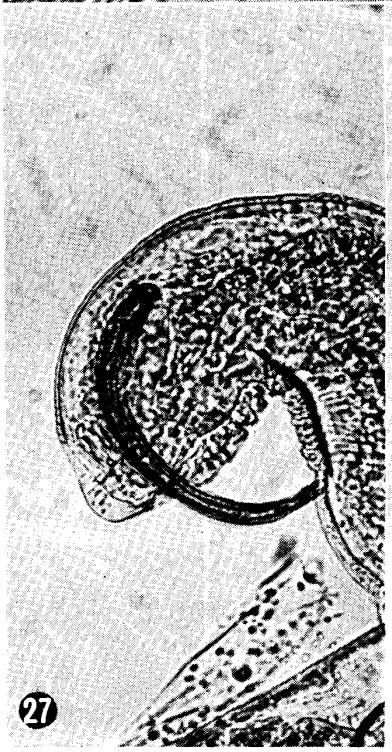
Fig. 28 Larva of *F. martis*

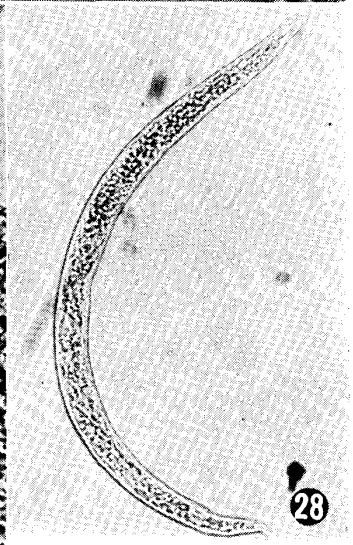












22 , 24 — 0. 2mm
28 — 0. 1mm
25 , 27 — 0. 1mm
23 — 0.05mm
26 — 0.04mm