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**SOME HELMINTHS OF THE RED FOX, *VULPES VULPES*
SCHLENCKI KISHIDA, IN HOKKAIDO, JAPAN, WITH
A DESCRIPTION OF A NEW TREMATODE,
MASSALIATREMA YAMASHITAI N. SP.**

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From four red foxes, *Vulpes vulpes schlencki* KISHIDA, in Hokkaido, 11 helminth species were collected: *Massaliatrema yamashitai* n. sp., *Pricitrema* sp., *Echinocasmus japonicus* TANABE, 1926, *Alaria alata* (GOEZE, 1782), *Strongyloides* sp., *Ancylostoma kusimaense* NAGAYOSHI, 1955, *Uncinaria stenocephala* (RAILLIET, 1884), *Molineus* sp., *Echinococcus multilocularis* LEUCKART, 1863, *Multiceps serialis* (GERVAIS, 1847) and *Mesocestoides* sp. *Massaliatrema yamashitai* was differentiated from *M. gyrinicola* DOLLFUS et TIMON-DAVID, 1960, the only known species of this genus, by the smaller acetabulum, the larger uterine eggs, the not markedly branched vitellaria etc.

INTRODUCTION

In Hokkaido, no systematic survey of the helminths of the red fox, *Vulpes vulpes schlencki* KISHIDA, except investigations of *Echinococcus multilocularis* LEUCKART, 1863, from the view points of human echinococcosis¹⁶⁾, has been published. YAMAGUTI (1942, 1943), however, reported *Toxocara canis* (WERNER, 1782), *Trichuris vulpis* (FROELICH, 1789), and *Uncinaria stenocephala* (RAILLIET, 1884), and KITAMURA & MACHIDA (1973) reported *Cryptocotyle lingua* (LINTON, 1915) in the fox of Hokkaido. In this paper, the authors deal with 4 trematode species, 4 nematode species, and 3 cestode species.

MATERIALS AND METHODS

Two young animals before leaving their burrow (Cases No. 1 & 2) were captured alive at Horonobe-chô, Teshio district, northern Hokkaido. The animals were sacrificed and all the visceral organs and tissues were carefully examined macro- and microscopically. The materials of Cases No. 3 and 4 were collected at the time a survey of echinococcosis multilocularis was made in eastern Hokkaido. Whole-mounted preparations of the trematodes and cestodes were fixed using 70% alcohol, and were stained by DELAFIELD's hematoxylin. The nematodes were fixed in 5% formalin solution and treated by lacto-phenol

TABLE 1 *Materials examined*

| CASE NO. | PLACE OF ORIGIN | DATE COLLECTED | AGE OF HOST | HELMINTH SPECIES | | | | | | | | | | |
|----------|--------------------------------|----------------|-------------------------|--|-----------------------|--------------------------------|---------------------|--------------------------|-------------------------------|-------------------------------|---------------------|------------------------------------|---------------------------|--------------------------|
| | | | | <i>Massaliatrema yamashitai</i> n. sp. | <i>Pricetrema</i> sp. | <i>Echinochasmus japonicus</i> | <i>Alaria alata</i> | <i>Strongyloides</i> sp. | <i>Ancylostoma kusimaense</i> | <i>Uncinaria stenocephala</i> | <i>Molincus</i> sp. | <i>Echinococcus multilocularis</i> | <i>Multiceps serialis</i> | <i>Mesocetooides</i> sp. |
| 1 | Horonobe, northern Hokkaido | July 24 '72 | Less than 1 year old | + | + | + | + | + | + | + | - | - | - | - |
| 2 | " | " | " | - | - | - | + | + | - | - | - | - | - | - |
| 3 | Bekkai, eastern Hokkaido | July 8 '66 | " | - | - | - | - | - | - | + | + | + | + | - |
| 4 | Nemuro, eastern Hokkaido | June 12 '66 | unknown | - | - | - | - | - | - | - | - | - | - | +* |

*: Immature specimens from the scraping of the small intestine

Helminths of red fox

solution for microscopic examination.

The materials examined are shown in table 1. The specimens used in this paper are preserved in the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

DESCRIPTIONS AND DISCUSSION

A Trematoda

1 *Massaliatrema yamashitai* n. sp.

Three mature worms were obtained from the small intestine of Case No. 1.

Host *Vulpes vulpes schlencki* KISHIDA

Habitat Small intestine

Locality Horonobe-chô, Teshio district, northern Hokkaido, Japan

Description: Body small, pentagonal to polygonal in outline, 0.550~0.585 mm long, 0.480~0.505 mm in maximum width at level of acetabulum. Body surface finely spinose. Body with many dermal cells. Oral sucker ventroterminal, 0.026~0.032 mm long by 0.059~0.078 mm wide. Pharynx globular, well developed, 0.035~0.040 mm long by 0.040~0.045 mm wide. Esophagus variable in length, 0.037~0.062 mm long. Ceca embracing testes and ending blindly at near posterior extremity. Acetabulum small, equatorial or pre-equatorial, 0.062~0.081 mm in diameter. Ratio of width of oral sucker to acetabulum approximately 1:1. Testes symmetrical in position, touched internally with a cecal curve extending almost to the posterior extremity, elongate in shape, slightly lobed, 0.142~0.167 mm long by 0.042~0.062 mm wide. Voluminous seminal vesicle extending transversely between uterine coils and ovary, and overlapping partially with uterine coils. Genital atrium on anterior border of acetabulum, surrounded by radial and circular muscle fibers, contacting with acetabulum. Metraterm uniting with ejaculatory duct just prior to genital atrium. Ovary somewhat irregular in shape, situated between seminal vesicle and right testis, 0.155 mm long by 0.062 mm wide. Globular seminal receptacle almost on the median line between both ends of the ceca, 0.035~0.050 mm in diameter. Uterine coils, with 14~60 eggs, winding from side to side at intercecal field between the acetabulum and seminal vesicle. Egg shell thick, yellow, with granulated surface, 0.032~0.037 mm long by 0.018~0.021 mm wide, with large, indistinct operculum and antipolar shell thickening. Branched vitellaria mostly extracecal, extending from intestinal bifurcation to posterior extremity. Excretory vesicle V-shaped, reaching to anterior end of testes, running along inside margin of both testes. Excretory canals reaching to the pharynx level. Excretory pore terminal and median.

Discussion: Up to this time, there has been only one species in this genus,

M. gyrinicola DOLLFUS et TIMON-DAVID, 1960, which was obtained experimentally from pigeons and cats by feeding metacercarian cysts from tadpoles, *Rana esculenta* LINNAEUS, of Marseilles, France; therefore, the natural host of this trematode species is unknown. The differences between *M. yamashitai* and *M. gyrinicola* are as follows:— 1) The acetabulum is small in the former; the ratio of width of the acetabulum to the oral sucker is approximately 1:1 in the former, on the other hand, 1:1.7 in the latter. 2) The uterine eggs of the former are larger than that of the latter. 3) The seminal receptacle is situated almost at the median line in the former. 4) The uterine coils scarcely overlap with the seminal vesicle in the former. 5) The vitellaria do not branch markedly in the former.

Judging from the characteristics mentioned above, the present species can be concluded as a new species. It is very interesting from distributional points of view to record the genus *Massaliatrema* existing in the Far East for the first time. The specific name is dedicated to Prof. J. YAMASHITA, Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University.

2 *Pricetrema* sp.

A mature worm was obtained from the small intestine of Case No. 1.

Description: Body elongate, oval in shape, 0.500 mm long by 0.180 mm wide at level of acetabulum. Cuticle finely spinose on almost the all of the body, but more conspicuous at anterior part. Large muscular oral sucker globular, slightly subterminal in position, 0.050 mm long by 0.057 mm wide. Prepharynx 0.037 mm long; pharynx small, weakly developed, 0.027 mm long by 0.015 mm wide. Esophagus short, 0.015 mm long. Intestinal bifurcation at 0.130 mm from anterior extremity. Cecae terminate in front of acetabulum. Acetabulum smaller than oral sucker, just post-equatorial, 0.040 mm long by 0.030 mm wide. Position of genital pore not obvious, probably just anterior to acetabulum. Seminal vesicle voluminous, more or less C-shaped, encircling acetabulum. Testes symmetrical and at posterior part in position; elliptical in shape, 0.112 mm long by 0.062 mm wide. Ovary submedian, triangular in shape, anterior to right testis, 0.110 mm long by 0.050 mm wide. Seminal receptacle spherical, 0.029 mm long by 0.023 mm wide, situated dorsal to ovary. Weakly stainable vitellaria, slightly arborescent, not numerous, laterally extending from intestinal bifurcation to level of anterior margin to testes. Uterine coils around acetabulum, containing a small number of eggs. Eggs 0.032 mm long by 0.018 mm wide, thick-shelled, yellow, with distinct operculum and abopercular prominence.

Discussion: Up to this time, 2 species of the genus *Pricetrema* have been described; *P. zalophi* (PRICE, 1932), from the California sea lion, *Zalophus californianus* (LESSON) from North America, and *P. erignathi* JURACHNO, 1969,

from the bearded seal, *Erignathus barbatus nauticus* (PALLAS) from the Bering Sea. This is the first distribution record of this genus in Japan. The present specimen resembles *P. erignathi*, but is easily distinguishable from the above-mentioned two species by the intestinal ceca, which terminate in front of the acetabulum. Having just one specimen, it can not be concluded that this character of the ceca is constant. Therefore, more specimens are needed for the final taxonomical decision.

3 *Echinochasmus japonicus* TANABE, 1926

Seven mature specimens were obtained from the small intestine of Case No. 1.

Description: Body elongate, spinose, 0.793~0.988 mm long by 0.258~0.346 mm wide at testicular region. Head collar, 0.125~0.150 mm in diameter; collar spines 24 in number, arranged in a dorsally interrupted row; end group spines in each side, 0.017~0.027 mm long by 0.004~0.005 mm wide; marginal spines 0.023~0.035 mm long by 0.005~0.007 mm wide. Oral sucker slightly prominent, round, 0.036~0.059 mm in diameter. Prepharynx 0.030~0.067 mm long. Pharynx 0.040~0.065 mm long by 0.049~0.062 mm wide. Esophagus 0.153~0.175 mm long, bifurcating at anterior part of middle third of body. Ceca terminating at near posterior extremity. Acetabulum equatorial 0.095~0.127 mm long by 0.088~0.100 mm wide. Testes round or more or less irregular in outline; anterior testis 0.078~0.091 mm long by 0.114~0.166 mm wide; posterior testis 0.065~0.114 mm long by 0.114~0.150 mm wide. Cirrus pouch elliptical, 0.108~0.153 mm long by 0.068~0.088 mm wide. Seminal vesicle constrictive in two portions; the posterior much larger. Genital pore immediately behind intestinal bifurcation. Ovary globular, 0.048~0.065 mm in diameter. Vitellaria extending in lateral fields from posterior end of acetabulum to posterior extremity. Uterus short, containing few eggs, up to 2 in number. Eggs oval, 0.075 mm long by 0.055 mm wide, with operculum and abopercular prominence.

Discussion: This trematode species was described by TANABE (1926) for the first time, and UJIE (1936) demonstrated experimentally the possibility of human infection. This is the first recorded in Hokkaido, and the red fox, *Vulpes vulpes schlencki* KISHIDA, is the new host.

4 *Alaria alata* (GOEZE, 1782)

This trematode species was obtained from the small intestine of Cases No. 1 and 2, 16 and 20 specimens, respectively. This is the first recorded in Japan.

The detailed description will be published elsewhere together with other specimens from Hokkaido by Dr. M. MACHIDA of the National Science Museum, Tokyo.

B Nematoda

5 *Strongyloides* sp.

A number of parasitic female worms were found in the small intestine of Cases No. 1 and 2.

The dimensions are shown in table 2. The exact size of the eggs could not be measured, because the number of matured uterine eggs was very few.

Discussion: As shown in table 2, there still remains a possibility that the present specimens can be segregated into two species; the small and large ones, which are also distinguishable by the marked difference of the esophagus-body ratio.

Up to this time, two species, *S. stercoralis* (BAVAY, 1876) and *S. vulpis* PETROV, 1940, have been known from the fox, *Vulpes* spp. Recently, LITTLE (1966) studied the differentiations among the six species of genus *Strongyloides*, including *S. stercoralis*. He compared the parasitic and free-living stages. It is necessary to examine the morphology of free-living male and female worms for detailed classification of the present specimens.

TABLE 2 *Dimensions of Strongyloides* sp.

| PART MEASURED | SMALL SPECIMEN | LARGE SPECIMEN |
|---------------------------------|-------------------------|------------------------|
| | mm | mm |
| Length of body | 1.573~2.115 (1.844)* | 2.145~3.850 (2.906) |
| Width of body | 0.036~0.046 (0.041) | 0.036~0.049 (0.042) |
| Length of esophagus | 0.546~0.782 (0.648) | 0.572~0.884 (0.732) |
| Distance from mouth to vulva | 1.105~1.385 (1.271) | 1.414~2.301 (1.867) |
| Distance from anus to tail | 0.033~0.055 (0.041) | 0.033~0.049 (0.036) |
| Length of esophagus/body | 35.1% | 25.2% |
| No. of worms measured | 11 | 9 |

*: Parentheses show the mean value.

6 *Ancylostoma kusimaense* NAGAYOSHI, 1955

A male was obtained from the small intestine of Case No. 1. This is the first recorded in Hokkaido, and the red fox is the new host record.

The detailed description will be considered elsewhere by Prof. Y. YOSHIDA of the Kyoto Prefectural University of Medicine.

7 *Uncinaria stenocephala* (RAILLIET, 1884)

A male and two female worms were obtained from the small intestine of Cases No. 1 and 3, respectively.

YAMAGUTI (1943) found this species from *Vulpes vulpes japonica* GRAY of Sapporo. This subspecies of the fox is non-indigenous to Hokkaido; therefore, the authors consider the host as a reared one. This species is recognized frequently in the red fox, *Vulpes vulpes schlencki* KISHIDA, of Hokkaido.

8 *Molineus* sp.

A mature female worm was obtained from the small intestine of Case No. 3.

Description: Slender body, 9.88 mm long by 0.100 mm wide at level of vulva. Head with cuticular inflation, 0.023 mm long by 0.036 mm wide. Cuticular annulation at 0.069 mm from anterior extremity. Distinct annular sulcus at 0.297 mm from anterior end. Esophagus 0.473 mm long. Salient vulva and anus 1.55 mm and 0.108 mm from posterior end, respectively. Eggs elliptical, 0.055 mm long by 0.036 mm wide. Tail blunt, with cuticular inflation, bearing a very slender spine, 0.016 mm long.

Discussion: KOZLOV (1963) discovered *Molineus patens* (DUJARDIN, 1845) in Canidae (*Canis familiaris*, *Vulpes vulpes* and *Nyctereutes procyonoides*) from the Far East. Recently, HASS & CHITWOOD (1974) reported *Molineus* sp. in the dog of central Ohio, North America. The authors, however, could not find any report concerning the genus *Molineus* in Japan. It is necessary to collect the male worm in the near future.

C Cestoda

9 *Echinococcus multilocularis* LEUCKART, 1863

A large number of adult worms were obtained from the small intestine of Case No. 3.

This species is frequently recognized in this animal. In the investigations during the period from 1966 to 1973, these cestodes have been found in 328 of 1724 red foxes (19.0%) captured in Nemuro and Kushiro districts, eastern Hokkaido²⁾. The spread of *E. multilocularis* in the red fox is of great importance in the epidemiology of human echinococcosis.

10 *Multiceps serialis* (GERVAIS, 1847)

A scolex with a few immature segments was obtained from the small intestine of Case No. 3. This specimens was identified as *M. serialis* on the basis of the morphology and the number of hooks on the rostellum. The authors suppose that this cestode is one of the common helminths of the red fox in Hokkaido, because *Coenurus serialis* GERVAIS, 1847, is frequently recognized in the hare, *Lepus timidus ainu* BARRETT-HAMILTON, in Hokkaido.

11 *Mesocestoides* sp.

About 20 immature worms were collected from the mucosal scraping of the small intestine of Case No. 4.

Body 2.5~3.0 mm long by 0.42~0.53 mm wide at level of suckers. Suckers 0.25 mm long by 0.20 mm wide. Any primordium of internal organs obscure.

It is necessary to collect the mature worms for clear classification of this species. The authors could not find any prior report concerning the *Mesocestoides* species from the red fox in Hokkaido.

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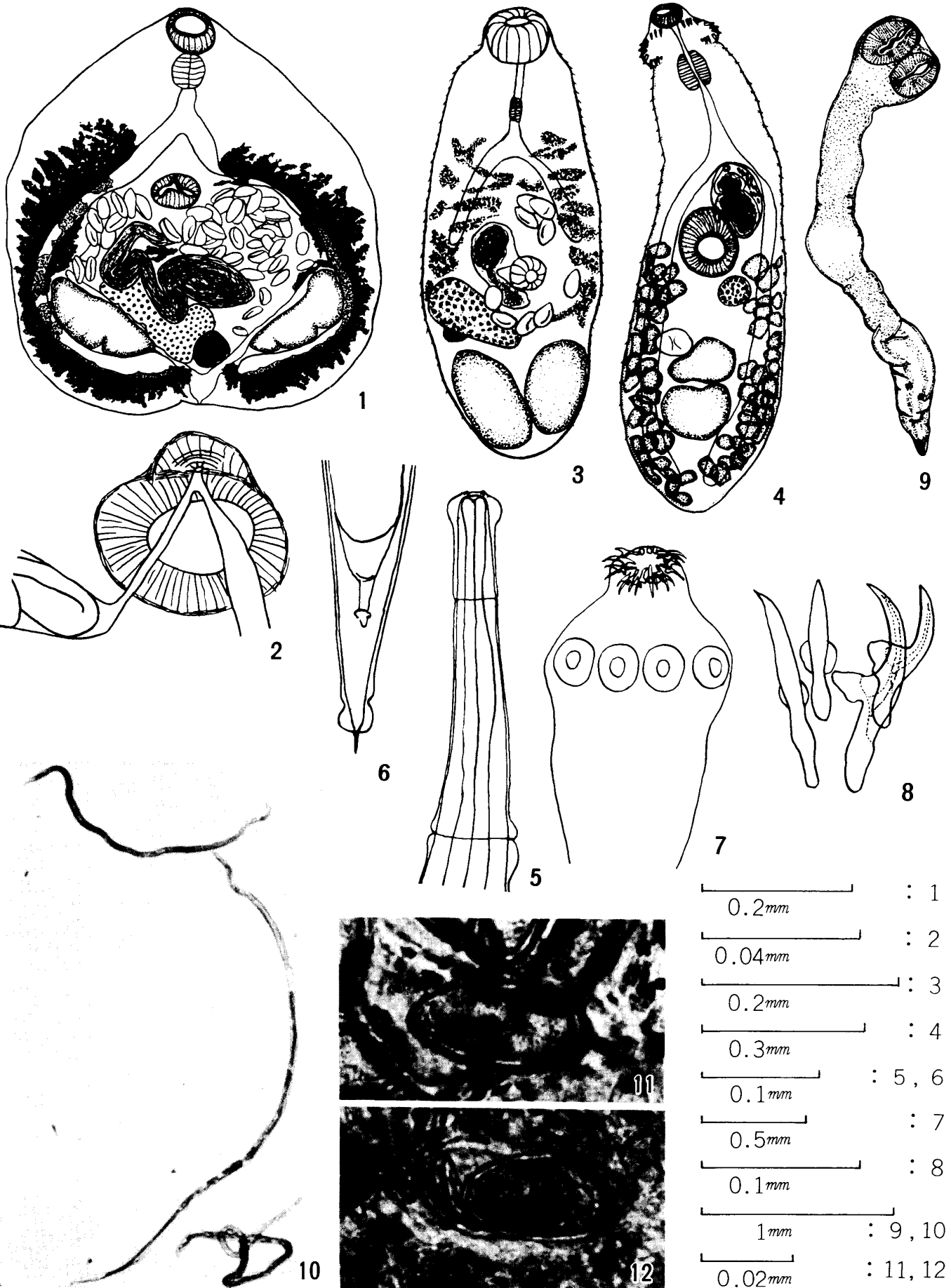
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EXPLANATION OF PLATE

- Figs. 1 & 2 *Massaliatrema yamashitai* n. sp.
Fig. 1 General view
Fig. 2 Acetabulogenital complex, dorsal view
Fig. 3 *Pricetrema* sp.
Fig. 4 *Echinochasmus japonicus* TANABE, 1926
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Fig. 5 Anterior extremity of female
Fig. 6 Posterior extremity of female
Figs. 7 & 8 *Multiceps serialis* (GERVAIS, 1847)
Fig. 7 Scolex
Fig. 8 Hooks
Fig. 9 *Mesocestoides* sp.
Fig. 10 *Strongyloides* sp., showing large and small specimens
Fig. 11 Eggs of *Massaliatrema yamashitai* n. sp., showing granulated surface of egg shell
Fig. 12 Eggs of *Pricetrema* sp.



- 0.2mm : 1
- 0.04mm : 2
- 0.2mm : 3
- 0.3mm : 4
- 0.1mm : 5, 6
- 0.5mm : 7
- 0.1mm : 8
- 1mm : 9, 10
- 0.02mm : 11, 12