

A New Record of *Mammomonogamus auris* from the Middle Ear of the Domestic Cats in Japan

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Introduction

Species belonging to the genus *Mammomonogamus* (Syngamidae, Nematoda) are known as parasites of wild and domestic mammals, such as cattle, buffalo, sheep, goat, deer, cat, puma, tiger, hippopotamus, elephant and okapi, and inhabit the larynx, trachea, bronchus, nasal cavity, middle ear and frontal sinus. Geographical distribution is world-wide, reported from Asia, Africa, Central and South America. Three species, *M. auris*, *M. ierei* and *M. mcgaughei*, have been reported from the domestic cat.

We obtained nematodes belonging to genus *Mammomonogamus* from the middle ear of domestic cats caught in Saitama Pref., Japan, and identified them as *Mammomonogamus auris* (Faust et Tang, 1934).

There has been only one record on *Mammomonogamus* species from Japan. Sakamoto *et al.* (1971) reported *M. felis*

from the bronchus of a leopard imported from Thailand. However our case is the first report on the genus from animals living in Japan.

Materials and Methods

We obtained 46 pairs of nematodes from the middle ear of domestic cats, *Felis catus* Linnaeus, caught in Saitama Pref., Japan, during the period from Aug. 1981 to Jun. 1982. Seven cats out of 124 examined were infected (5.6%), and one to eight pairs were found from one ear. Of 46 pairs, 45 were gravid and one was immature. The worms were in both chambers of the middle ear and there was no unilaterality. We also examined 111 cats caught in Osaka Pref. and other places but none were infected.

The worms were fixed in hot 70% ethyl-alcohol and cleared with lactophenol. The female and the male were permanently joined in copula, so some specimens were injured during separating manipulation. We measured 11 gravid females and 15 males which were separated and under good condition to observe.

Description

Female and male permanently joined in

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Table 1 Measurements in mm (means)

	Female	Male
1. Body length	13.7-25.9 (19.4)	3.9-6.7 (5.5)
2. Body width	0.72-1.19 (1.08)	0.25-0.45 (0.36)
3. Distance from head end to vulva (female)	5.6-9.6 (7.3)	
3'. Ratio to body length	31.7-45.2% (38.2%)	
4. Width of buccal capsule	0.242-0.455 (0.360)	0.144-0.202 (0.176)
5. Depth of buccal capsule	0.212-0.303 (0.259)	0.152-0.228 (0.189)
6. Diameter of mouth opening	0.172-0.394 (0.266)	0.073-0.114 (0.090)
7. Diameter of head	0.394-0.636 (0.539)	0.192-0.323 (0.257)
8. Distance from head end to nerve ring	0.657-0.828 (0.762)	0.404-0.606 ^a (0.484)
9. Distance from head end to excretory pore	0.838-1.295 ^b (1.041)	0.545-0.778 ^c (0.670)
10. Distance from head end to cervical papillae	0.929-1.417 ^d (1.216)	0.657-0.889 ^e (0.777)
11. Length of esophagus	0.970-1.265 (1.083)	0.444-0.717 (0.627)
11'. Ratio to body length	4.0-7.8% (5.9%)	9.9-13.1% (11.4%)
12. Minimal width of esophagus	0.086-0.111 (0.099)	0.035-0.076 (0.062)
13. Maximal width of esophagus	0.192-0.404 (0.257)	0.086-0.201 (0.134)
14. Tail length (female)	0.263-0.414 ^f (0.324)	
15. Length of spicules (male)		
right		0.035-0.046 ^g (0.041)
left		0.038-0.048 ^g (0.042)
16. Egg	0.078-0.096 × 0.046-0.058 ^h (0.089 × 0.051)	

* Number of specimen in measurement is as follows: a, 12; b, 4; c, 11; d, 5; e, 8; f, 10; g, 13; h, 33; other data of female, 11; male, 15.

copula and showing Y-shaped appearance (Fig. 1; Photo. 1). Bright red in color while alive and becoming white or brown after fixed. Body transparent and internal organs seen while alive. Cuticles very finely striated transversely. Table 1 shows the measurements of the worms.

Female: Body uniformly cylindrical and tapering gradually from vulvar region to either extremity. Posterior end narrowing suddenly and sharply pointed. A pair of phasmids at the caudal end (Fig. 5). Distance of vulva from anterior end of body is 31.7-43.5% of total body length. Ovarian tubules and uteri reaching near the level of anus. Mouth widely open at the anterior extremity. Buccal capsule broader than long and cupule-like form (Fig. 3). At its base eight stoutly-built teeth each

extending to a short rib. Many small granulations on the inner surface. Through head-on view dorsal and ventral sector of capsular rims broader than other four lateral ones (Fig. 4). Esophagus relatively short and posterior half is about twice as wide as anterior half. Nerve ring situated at the middle portion of esophagus. A pair of non-protuberant cervical papillae at the lateral sides of body about the level of posterior end of esophagus. Excretory pore at the ventral side of body and slightly anterior to cervical papillae.

Egg resembling that of hookworm, but a little larger than the latter (Fig. 11; Photo. 4). Egg shell thick without opercula and numerous indentation on its surface. Egg usually found to be eight-cell stage in the feces of infected cats.

Male: Body entirely cylindrical. Buccal capsule is as broad as deep (Fig. 2). Other basic characters of the anterior part similar to those of female. Copulatory spicules small and fine (Fig. 10). Right spicule and left one similar and subequal. They could be observed only after separation and clarification with lactophenol, although in some specimens they could not be found. Gubernaculum absent. Copulatory bursa supported by blunt rays (Figs. 6, 7). Ventral rays short and thick, with two branches subequal and close together. Lateral rays having common stem and branching into three, medio-lateral considerably shorter than the other two. Externo-dorsal ray isolated and relatively long. Dorsal ray bifurcating at the middle part of the ray. In some specimens it bifurcating at the base. Its tip often digitating or having some appendices, but many variations about the shape of dorsal ray (Figs. 8, 9).

Discussion

Genus *Mammomonogamus* was established in 1948 by Ryzhikov, separating from genus *Syngamus* Siebold, 1836. Ryzhikov (1949) listed eight species of *Mammomonogamus* in his monograph of Syngamidae, and Skrjabin (1952) added *M. auris* and listed nine species. Lengy (1969) proposed that family Syngamidae comprised one genus *Syngamus* which contained *Mammomonogamus* as subgenus. Baruš and Tenora reviewed taxonomic problems of Syngamidae (1972, a), and listed ten species of this genus (1972, b) (Table 2).

Five species have been recorded from family Felidae, and three have been from the domestic cat, *Felis catus* Linnaeus. Three species from the domestic cat are as follows.

1. *M. auris* (Faust et Tang, 1934)
Habitat: middle ear.
Geographical distribution: China.

Table 2 List of genus *Mammomonogamus*
Ryzhikov, 1948

Genotype

1. *M. laryngeus* (Railliet, 1899)
Host: cattle, buffalo, sheep, goat, deer, man.
Habitat: trachea, larynx, nasal cavity.
Geographical distribution: Asia (India, Malaya), Africa (Cameroon), Central and South America.

Other species

2. *M. auris* (Faust et Tang, 1934)
Host: domestic cat.
Habitat: middle ear.
Geographical distribution: China.
3. *M. dispar* (Diesing, 1851)
Host: puma.
Habitat: trachea.
Geographical distribution: Brazil.
4. *M. felis* (Cameron, 1931)
Host: tiger.
Habitat: bronchi.
Geographical distribution: Malaya.
5. *M. hippopotami* (Gedoelst, 1924)
Host: hippopotamus.
Habitat: nasal sinuses.
Geographical distribution: Zaire.
6. *M. ierei* (Buckley, 1934)
Host: domestic cat.
Habitat: nasal cavity.
Geographical distribution: West Indies.
7. *M. indicus* (Mönnig, 1932)
Host: Indian elephant.
Habitat: pharynx.
Geographical distribution: India.
8. *M. loxodontis* (Vuylsteke, 1935)
Host: African elephant.
Habitat: trachea.
Geographical distribution: Zaire.
9. *M. mcgaughei* (Seneviratne, 1954)
Host: domestic cat.
Habitat: frontal sinus, nasal cavity, pharynx.
Geographical distribution: Sri Lanka.
10. *M. okapiae* (Berghe, 1937)
Host: okapi.
Habitat: trachea, bronchi.
Geographical distribution: Zaire.

* *M. nasicola* (Linstow, 1899) and *M. kingi* (Leiper, 1913) are generally regarded as synonyms of *M. laryngeus*.

2. *M. ierei* (Buckley, 1934)
Habitat: nasal cavity.
Geographical distribution: West Indies.
3. *M. mcgaughei* (Seneviratne, 1954)
Habitat: frontal sinus, nasal cavity,
pharynx.
Geographical distribution: Sri Lanka.

Our specimen under discussion coincides with *M. auris* on the point that both of them live in the middle ear of the domestic cat. Morphologically our specimen has some differences from Faust and Tang's description (1934). They described that male dorsal ray of *M. auris* was practically vestigial and consisted of a single bulb-like thickening with a pair of minute bifurcations. The dorsal ray of our specimen basically has Y-shaped appearance (Fig. 6), although its shape has many variations (Figs. 8, 9). Their measurement of buccal capsule and copulatory spicules are slightly larger than our measurement, but the discrepancy can be explained by such things that the method of fixation is different and they used only type specimen in measurement of buccal capsule and spicules. They also described that there was a suggestion of a pair of papillae in the female caudal extremity, but there are no papillae but a pair of phasmids in that of our specimen. We think they must mistake phasmids as papillae. Though there are some differences between Faust and Tang's description and our specimen, particularly in the size of spicules and in the shape of dorsal ray, the present specimens are identified as *M. auris* until more detailed observation on the variations could become available.

M. ierei was found from nasal cavity or nasopharynx of the domestic cat (Buckley, 1934; Cuadrado *et al.*, 1980), but our specimen was obtained only from the middle ear. We examined nasal cavity, pharynx, larynx, trachea and alimentary tract of infected cats but the worm was not dis-

covered. Our specimen is morphologically similar to *M. ierei*. The shape of male dorsal ray and the length of spicules accord with those of *M. ierei* described by Buckley (1934). However our specimen differs from *M. ierei* in providing ribs in the buccal capsule.

Seneviratne's description (1954) of *M. mcgaughei* was so insufficient that we could not compare our specimen with *M. mcgaughei*. It is interesting that he reported *M. auris* was also found from the middle ear of cats in his survey.

The taxonomy of genus *Mammomonogamus* is in the state of disorder. For example, *M. nasicola* is generally regarded as a synonym of *M. laryngeus* (Vaz, 1935; Ryzhikov, 1949; Lengy, 1969; etc.), but Buckley (1934), Graber *et al.* (1972) and Mejia-Garcia *et al.* (1979) asserted the identity of *M. nasicola*. Macko *et al.* (1981) made deliberations on this problem but they did not give a clear answer. Lengy (1969) claimed that *M. laryngeus*, *M. felis* and *M. ierei* were so similar that there was no possibility to differentiate among them or establish their identity without additional knowledge. Presently available keys of the genus are quite insufficient. In Ryzhikov's key (1949) mammomonogamids are divided into two groups on the standpoint that family Felidae is the host or not. As the key is premised on the host specificity, it is inappropriate to use. In Lengy's key (1969) he regarded *Mammomonogamus* as subgenus and listed 14 species. He used the shape of the male dorsal ray as a key, for example, dorsal ray not splitting, or splitting at some distance from its base into two branches, or splitting at its base into two separate branches. But the shape of dorsal ray has many individual variations and such forms can be observed all in our specimens. So it may be inappropriate to use the shape of male dorsal ray as a key. He also used the presence of small papillae at the female tail, but such

papillae must be same as phasmids judging from descriptions in original papers, so it cannot be used in the key.

Causes of such perplexity are as follows: 1. As life-cycle has been still unknown, experimental study has not been succeeded. 2. Individual variability is very large and moreover some descriptions of *Mammomonogamus* spp. were made from observation of only small number of specimens. So there is a possibility that the individual variations might lead to diagnose the same species as different one.

To establish appropriate taxonomy of genus *Mammomonogamus*, it is indispensable to disclose the life-cycle and to revise species so far reported. We hope these problems will be solved in the near future.

Summary

Nematodes belonging to genus *Mammomonogamus* were obtained from the middle ear of domestic cats in Saitama Pref., Japan. They were identified as *M. auris* (Faust et Tang, 1934), and their morphological features are described. This is the first record of the genus from animals living in Japan.

Nematodes belonging to the genus have many individual variations. The taxonomy of the genus is in the state of disorder. To establish appropriate taxonomy it is indispensable to disclose the life-cycle and to revise species so far reported.

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References

- 1) Baruš, V. and Tenora, F. (1972, a): Notes on the systematics and taxonomy of the nematodes belonging to the family Syngamidae Leiper, 1912. Acta Univ. Agric., (Brno), Fac. Agron., 20, 275-286.
- 2) Baruš, V. and Tenora, F. (1972, b): Notes on the evolution of the nematodes belonging to the family Syngamidae Leiper, 1912. Acta Univ. Agric., (Brno), Fac. Agron., 20, 287-295.
- 3) Buckley, J. J. C. (1934): On *Syngamus nasicola* Linstow, 1899, from sheep and cattle in the West Indies. J. Helminth., 12, 47-62.
- 4) Buckley, J. J. C. (1934): On *Syngamus ierei* sp. nov. from domestic cats, with some observations on its life-cycle. J. Helminth., 12, 89-98.
- 5) Cuadrado, R., Maldonado-Moll, J. F. and Segarra, J. (1980): Gapeworm infection of domestic cats in Puerto Rico. JAVMA, 176, 996-997.
- 6) Faust, E. C. and Tang, C. C. (1934): A new species of *Syngamus* (*S. auris*) from the middle ear of the cat in Foochow, China. Parasitology, 26, 455-459.
- 7) Graber, M., Euzéby, J., Gevrey, J. and Troncy, P.-M. (1972): *Mammomonogamus* des ruminants domestiques et sauvages. Annls. Parasit. Hum. Comp., 47, 225-241.
- 8) Lengy, J. (1969): Notes on the classification of Syngamidae (Nematoda) with new data on some of the species. Israel J. Zool., 18, 9-23.
- 9) Macko, J. K., Bírová, V. and Flores, R. (1981): Deliberations on the problems of *Mammomonogamus* species (Nematoda, Syngamidae) in ruminants. Folia Parasit., 28, 43-49.
- 10) Mejia-Garcia, A., Graber, M., Gevrey, J. and Euzéby, J. (1979): La mammomonogamose des bovins au Mexique. Bull. Acad. Vét. Fr., 52, 367-374.
- 11) Ryzhikov, K. M. (1948): Filogeneticheskiye vzaimosvjazi nematod sem. *Syngamidae* i opyt perestrojki ikh sistematiki. Dokl. Akad. Nauk SSSR, 62, 733-736. (in Russian)
- 12) Ryzhikov, K. M. (1949): Osnovy nematologii t. I., Singamidy domashnikh i dikikh zhivotnykh. Izdat. Akad. Nauk SSSR, Moskva Leningrad, 1-164. (in Russian)
- 13) Sakamoto, T., Kaneda, H. and Nakagawa, S. (1971): Ten species of parasites from leopard *Panthera pardus* (Linnaeus). Jap. J. Parasit., 20, 59. (Suppl.), (in Japanese)
- 14) Seneviratne, P. (1954): *Syngamus macgaughei* sp. nov. in domestic cats in Ceylon. Ceylon Vet. J., 2, 55-60.

- 15) Skrjabin, K. I. (1952): Key to parasitic nematodes, vol. III. Strongylata. (English translation, 1961), Israel Program for Scientific Translation, Jerusalem, 177-193.
- 16) Vaz, Z. (1935): Sobre a pretensa validez de "Syngamus nasicola" presencia do "Syngamus laryngeus" nas fossas de carneiros do Brasil. Arch. Inst. Biol., S. Paulo, 6, 35-39.

日本産ネコの中耳腔より得られた線虫 *Mammomonogamus auris* (新記録)

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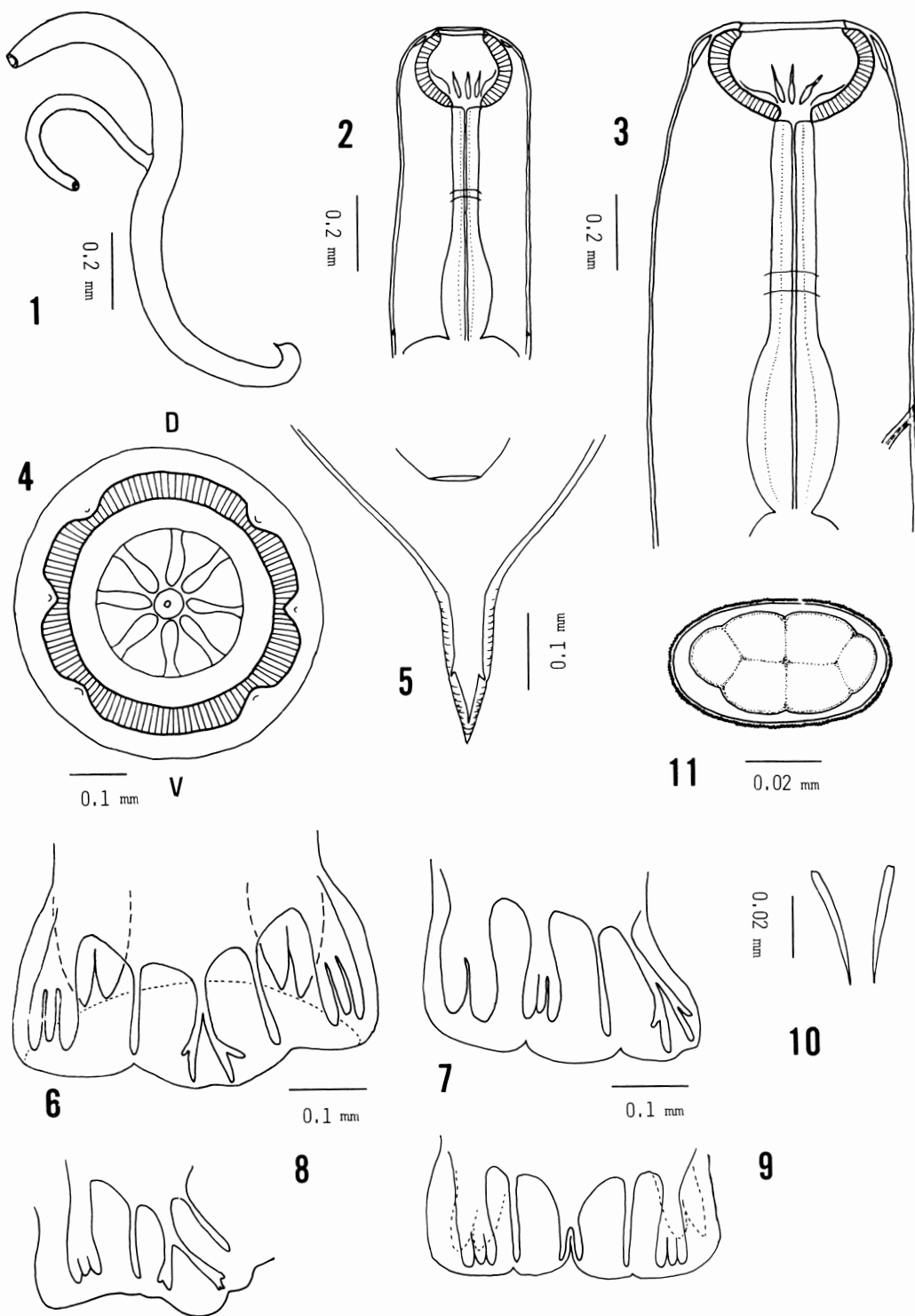
埼玉県で捕獲されたネコ 124 頭を調査し、うち 7 頭 (5.6%) の左右の中耳腔より計 46 対の線虫 *Mammomonogamus auris* (Faust et Tang, 1934) を得た。本属線虫は本邦産動物からは初報告であり、形態を記載した。なお、雄虫交接刺の大きさと背肋の形で若干原記載と異なるが、総合的に判断し上記種と同定した

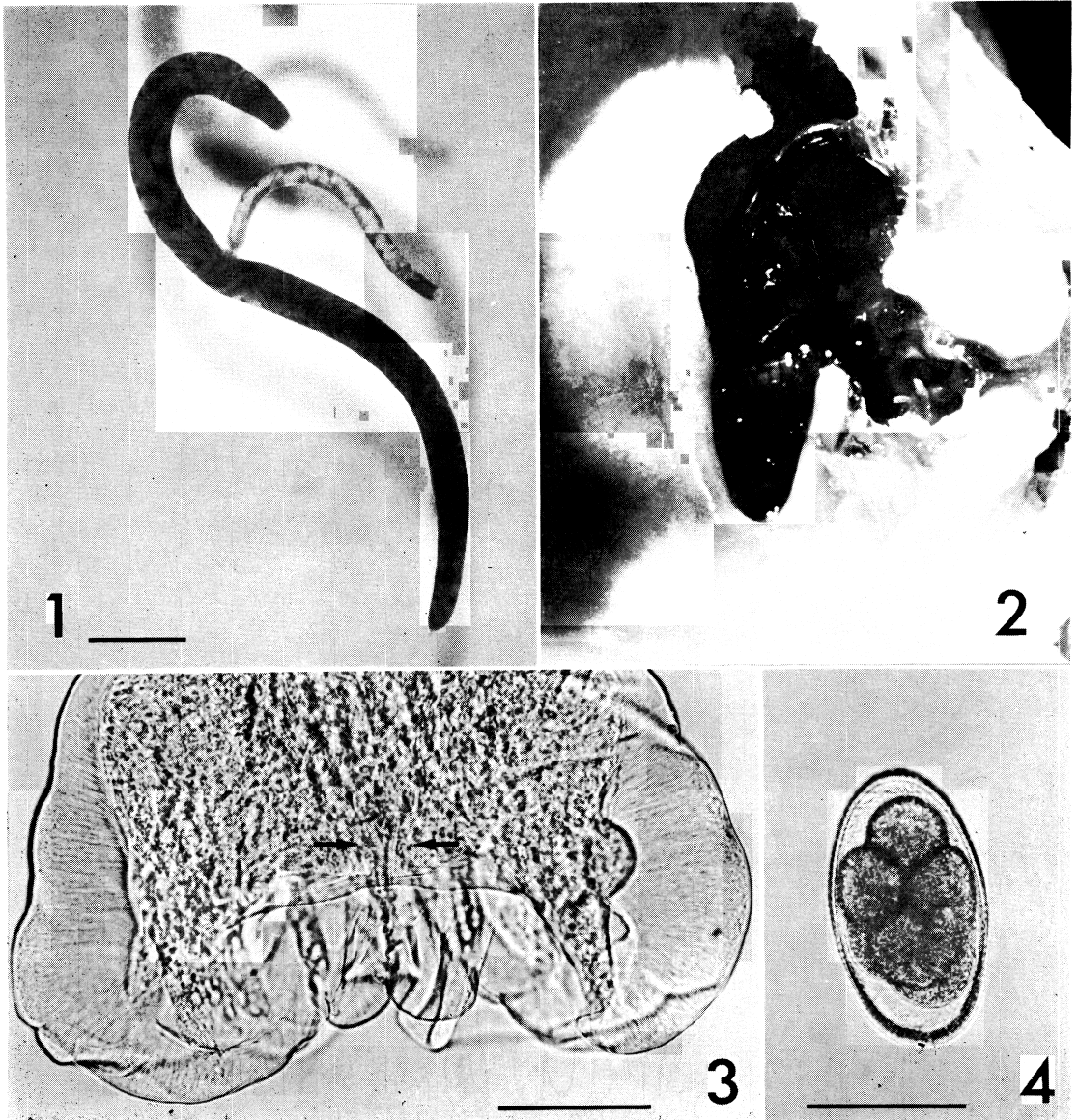
ものである。本種の和名を猫耳開嘴虫 (ネコミミカイシチュウ) (新称) とする。

本属線虫の分類は大変に混乱している。これを正すためには、生活史を解明し、既知種を再検討することが必要である。

Explanation of Figures

- Fig. 1 Coupled female and male.
 Fig. 2 Anterior part of male, ventral view.
 Fig. 3 Anterior part of female, lateral view.
 Fig. 4 Head-on view of female. V: ventral. D: dorsal.
 Fig. 5 Tail of female, ventral view.
 Fig. 6 Male copulatory bursa, dorsal view.
 Fig. 7 Male copulatory bursa, lateral view, one side only.
 Figs. 8, 9 Variation of the shape of dorsal ray.
 Fig. 10 Male copulatory spicules.
 Fig. 11 Egg.





Explanation of Photographs

Photo. 1 The whole body of *Mammomonogamus auris*. Large one is female and small one is male. The bar indicates 0.2 mm.

Photo. 2 *Mammomonogamus auris* in the middle ear of a domestic cat.

Photo. 3 Male copulatory spicules (arrow). The bar indicates 0.1 mm.

Photo. 4 Egg (eight-cell stage). The bar indicates 0.05 mm.