

Two New Spirurid Nematodes in Japanese Moles, *Mogera* spp.

YASUSHI YOKOHATA¹⁾ AND HISASHI ABE²⁾

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Abstract

The stomachs and intestines of Japanese moles, 2 *Talpa mizura*, 129 *Mogera wogura*, 221 *M. kobeae* and 28 *M. tokudae* which were collected from almost all over Japan were examined mainly for their helminth infections. Two new spirurid species were discovered. *Ascarops mogera* n. sp. was found from three species of genus *Mogera*, and distinguished from *A. scaptochiri* Yin and Zhang, 1981 by the number of papillae on the tail end of the male. *Protospirura pseudomuris* n. sp., which was found from *M. wogura* and *M. kobeae*, is similar to *P. muris*, but differs from it in the smaller body without pseudolabial denticle and larger ratio of left vs right spicule than in *P. muris*. Intraspecific variations were rarely observed in the spicules of *P. pseudomuris*.

Key words: *Ascarops mogera* n. sp., *Protospirura pseudomuris* n. sp. *Mogera* spp., Japan.

Introduction

There are at least four species of moles, *Talpa mizura*, *Mogera wogura*, *M. kobeae*, and *M. tokudae* (Abe, 1967, 1985, 1988; Imaizumi and Obara, 1966; Tsuchiya, 1988; Yoshiyuki, 1986) in Japan, but reports on their helminth fauna are still scanty (Yamaguti, 1941; Yokohata *et al.*, 1988a, b, 1989). The authors have carried out studies on the helminths of some hundred mole specimens collected at various sites in Japan.

In this paper, two new species of spirurids are reported from three species of moles of the genus *Mogera* in Japan with some attention to the phylogenetic relationships of hosts and intraspecific variations of the worms.

Materials and Methods

Specimens of four species of moles, 2 *Talpa mizura*, 129 *Mogera wogura*, 221 *M. kobeae* and 28 *M. tokudae* were collected from 47 localities in Japan during the period from Jan., 1, 1958

¹⁾ Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University, Sapporo 060, Japan

²⁾ Institute of Applied Zoology, Faculty of Agriculture, Hokkaido University, Sapporo 060, Japan

横畑 泰志 (北海道大学獣医学部家畜寄生虫病学講座)

阿部 永 (北海道大学農学部応用動物学講座)

to Apr., 6, 1988. The specimens were fixed in 10% formalin, and helminths were collected from their stomachs and intestines, cleared in lactophenol solution, and then observed and measured under a light microscope.

The type specimens were deposited in the Department of Parasitology, Faculty of Veterinary Medicine, Hokkaido University, Sapporo, and National Science Museum, Tokyo, Japan.

Result

Two new species of spirurid nematodes were collected. In the following descriptions, all measurements are in mm unless otherwise noted. Average measurements are in parenthesis, with SD when more than 20 specimens were measured.

1) *Ascarops mogera* n. sp.

Host: *Mogera wogura*, *M. kobeae* and *M. tokudae*.

Locality: Morioka, Iwate Pref.; Semine, Miyagi Pref.; Ryoju, Sado Is., Kakizaki and Shibata, Niigata Pref.; Agematu, Chiyo, Okuwa, Shiojiri and Yomikaki, Nagano Pref.; Nijouzan, Nara Pref.; Saigo, Oki Is., Shimane Pref.; Kawashima, Tokushima Pref.

Habitat: Stomach and intestine.

Type specimens: Holotype male No. 2877 (from *M. wogura* in Kakizaki), allotype female

No. 2878 (from *M. kobeae* in Nijouzan), paratypes No. 2879 (from others) in Hokkaido University and paratypes No. 1907—1908 in National Science Museum, Tokyo.

Description: Mouth round, surrounded by six lips, each with single sclerotized tooth on inner median margin (Arrowed in fig. 2). Pharynx with internal, spiral, sclerotized ridges. Oesophagus divided into muscular and glandular portions. Excretory pore slightly behind nerve ring.

Male: Measurements are based on the thirteen specimens collected in 1959 and 1960. Body 4.9—7.2 (5.6) long, 0.12—0.17 (0.14) wide. Nerve ring 0.13—0.24 (0.19), excretory pore 0.15—0.31 (0.23) from anterior end. Pharynx 57—82 (72) μm long, 12—18 (15) μm wide. Muscular oesophagus 0.24—0.39 (0.29) long, 19—29 (23) μm wide. Glandular oesophagus 1.7—2.1 (1.9) long, 41—76 (57) μm wide. Total oesophagus 1.9—2.4 (2.2) long. Left spicule 1.0—1.2 (1.1) long. Right spicule 0.25—0.35 (0.30) long. Ratio of spicule length (right:left) 1:2.7—1:4.2 (1:3.7). Gubernaculum 23—39 (29) μm . Tail tapering with spade-shaped caudal alae. Four pairs of long pedunculated preanal papillae, two pairs of postanal papillae, former pair sessile, latter one pedunculated postanal papillae, followed by three more posterior small pairs of sessile papillae and far posterior another pair of sessile ones. Each sample has been damaged due to the long preservation period. True measurements of fresh specimens would be larger than the present ones.

Female: Measurements were based on the eight fresh specimens collected in 1988. Body 11.1—14.4 (13.2) long, 0.17—0.23 (0.21) wide. Nerve ring 0.15—0.23 (0.20), excretory pore 0.20—0.33 (0.27) from anterior end. Pharynx 72—97 (79) μm long, 27—37 (33) μm wide. Muscular oesophagus 0.27—0.53 (0.36) long, 23—43 (27) μm wide. Glandular oesophagus 2.4—3.2 (2.9) long, 74—93 (82) μm wide. Total oesophagus 2.7—3.7 (3.3) long. Tail tapering rapidly to a blunt point. Anus 0.12—0.17 (0.14) from posterior end. Vulva 5.6—7.1 (6.4) from anterior end. Embryonated eggs with loose-fitting outer membrane and thick shell, 34—41 (38) μm long, 16—19 (18) μm wide.

Remarks: The genus *Ascarops* has been found in many host species, i.e., pigs, wild boars, rodents, birds, reptiles, etc. (Jairajpuri and Siddiqi, 1971; Shoho and Machida, 1979; Webster and Speckmann, 1977; Yamaguti, 1961). There have been some reports of this genus in moles. Mamaev and Okhotina (1968) found the larva of *A. strongylina* (Rudolphi, 1819) Van Beneden, 1873 in the mesentery and the liver of the large mole, *Mogera robusta* in USSR. Dimitrova (1969) reported the common mole, *Talpa europaea* as a new host of *A. strongylina* in Bulgaria. Adult worms of *A. scaptochiri* Yin and Zhang, 1981 and *A. talpa* Huber, Schmidt and Robert, 1983 have been found from the intestines of the musked moles, *Scaptochirus moschatus* in China and from the stomachs of the Formosan moles, *Talpa micrura insularis* in Formosa, respectively. In *A. scaptochiri* the left spicule is longer (1.19—1.27) than the right one (0.30—0.32) as same as the present ones, whilst the left spicule of *A. talpa* (0.17—0.26) is shorter than right one (0.92—1.20). The present specimens are most similar to *A. scaptochiri* in all *Ascarops* species, but there is only one pair of far posterior papillae on the male tail end of the present specimens, while *A. scaptochiri* has 9—15 pairs of sessile papillae in the same position. The authors proposes the present specimens to be a new species, *A. mogera*, because of this feature and host and geographic differences. The similarity between this species and *A. scaptochiri* may indicate the phylogenetic relation between some Chinese and Japanese mole species. *S. moschatus* is regarded as a primitive species (Imaizumi and Obara, 1966) as well as *M. tokudae*, which is expected more primitive than *M. wogura* and *M. kobeae* (Abe, 1967, 1988; Yoshiyuki, 1986; Tsuchiya, 1988). The prevalence of *A. mogera* was much higher in *M. tokudae* than in other two species.

2) *Protospirura pseudomuris* n. sp.

Host: *Mogera wogura* and *M. kobeae*.

Locality: Hanaizumi and Morioka, Iwate Pref.; Semine, Miyagi Pref.; Mishima and Tadami, Fukushima Pref.; Kakizaki and Shibata,

Niigata Pref.; Agematsu, Fukushima, Kiso, Okuwa, Shiojiri and Souga, Nagano Pref.; Saigo, Oki Iss., Shimane Pref.; Kawashima, Tokushima Pref.; Zendoji, Fukuoka Pref.; Izuhara, Tushima Iss., Nagasaki Pref.; Kagoshima and Yaku Is., Kagoshima Pref.

Habitat: Stomach and intestine.

Type specimens: Holotype male No. 2880, allotype female No. 2880 (Both specimens from *M. wogura* in Kakizaki), paratypes No. 2881 (from others) in Hokkaido University and No. 1909 in National Science Museum, Tokyo.

Description: Mouth opening surrounded by two lateral trilobed lips. Each lip subdivided into subventral and subdorsal pseudolabia of equal size and a larger median pseudolabium. Median one trapezoid with no denticle and a small median groove. Each subventral and subdorsal ones with single small denticle. Four cervical papillae found at base of subventral and subdorsal pseudolabia. Body surface striated, ca. 10 μm width.

The specimens are less damaged than *A. mogera*, owing to the thickness of the body. Ordinary measurements were obtained from every fifty adult males and females.

Male: Body 14.1—24.0 (18.9 ± 2.7) long, 0.20—0.45 (0.36 ± 0.05) wide. Nerve ring 0.23—0.37 (0.30 ± 0.03), excretory pore 0.28—0.46 (0.38 ± 0.05) from anterior end. Pharynx 41—72 (56 ± 6) μm long, 39—78 (54 ± 8) μm wide. Muscular oesophagus 0.21—0.41 (0.30 ± 0.05) long, 49—89 (69 ± 11) μm wide.

Glandular oesophagus 4.2—7.4 (5.7 ± 0.9) long, 0.11—0.21 (0.16 ± 0.02) wide. Total oesophagus 4.4—8.2 (6.0 ± 0.9) long. Left spicule shorter and wider with finely and sagittally wrinkled surface, 0.27—0.38 (0.33 ± 0.03) long, and sometimes with spade-shaped clear membrane when its posterior part protrudes out of the cloaca. Right spicule longer and narrower with smooth surface, 0.54—0.79 (0.68 ± 0.06) long. Ratio of spicule length (left:right) 1:1.7—1:2.5 ($1:2.1 \pm 0.4$). Gubernaculum saddle-shaped, 49—78 (65 ± 9) μm long. Tail tapers to a blunt point with an isosceles triangle caudal alae. Four pairs of long pedunculated preanal papillae, two pairs of pedunculated postanal papillae (first pair short, second pair long), followed by four small pairs (first and second short pedunculated, third and fourth sessile) with single median sessile preanal papilla. Total and spicule lengths of male worms in some regions were shown in Table 1.

Apart from specimens for these measurements, morphological deviations were rarely found in the spicules. Only one specimen (Fig. 18) retained long and narrow spicules with smooth surface, left, 0.46 and right, 0.62 long. Its ratio of right to left one was 1.4. In five specimens (Fig. 19), both left and right spicules were short and wide, 0.19—0.36 (0.30) and 0.20—0.58 (0.40) long, respectively. Sometimes fine and sagittal wrinkles were observed on both. The ratio of the spicule length was 1:1.0—1:1.6 (1:1.3). These worms closely resembled the normal ones in other features.

Table 1. Total and spicule lengths of male *Protospirura pseudomuris* in various regions

| Host | Region | Nos. | Length (average \pm S. D.; mm) | | |
|------------------|-----------------|------|----------------------------------|-----------------|-----------------|
| | | | total length | right spicule | left spicule |
| <i>M. wogura</i> | Iwate Pref. | 13 | 19.5 \pm 1.6 | 0.68 \pm 0.06 | 0.33 \pm 0.02 |
| | Miyagi Pref. | 18 | 19.2 \pm 2.9 | 0.66 \pm 0.06 | 0.31 \pm 0.03 |
| | Fukushima Pref. | 7 | 17.0 \pm 2.8 | 0.63 \pm 0.07 | 0.31 \pm 0.02 |
| | Nagano Pref. | 22 | 17.4 \pm 3.7 | 0.68 \pm 0.07 | 0.33 \pm 0.03 |
| <i>M. kobeae</i> | Oki Iss. | 1 | 23.2 | 0.58 | 0.36 |
| | Fukuoka Pref. | 7 | 19.0 \pm 3.4 | 0.63 \pm 0.08 | 0.33 \pm 0.04 |
| | Kagoshima Pref. | 4 | 18.3 \pm 3.3 | 0.71 \pm 0.01 | 0.34 \pm 0.02 |
| | Tushima Iss. | 19 | 16.0 \pm 2.9 | 0.65 \pm 0.10 | 0.30 \pm 0.03 |

Female: 20.5–41.2 (29.7 ± 5.2) long, 0.39–0.77 (0.56 ± 0.09) wide. Nerve ring 0.19–0.43 (0.32 ± 0.05), excretory pore 0.25–0.52 (0.40 ± 0.06) from anterior end. Pharynx 35–89 (68 ± 11) μm long, 49–97 (76 ± 10) μm wide. Muscular oesophagus 0.22–0.45 (0.35 ± 0.06) long, 64–132 (95 ± 13) μm wide. Glandular oesophagus 4.3–9.1 (7.2 ± 1.1) long, 0.14–0.29 (0.23 ± 0.03) wide. Total oesophagus 4.7–9.5 (7.5 ± 1.2) long. Tail tapering rapidly to a blunt point. Anus 0.29–0.80 (0.47 ± 0.11) from anterior end. Vulva 5.5–13.7 (9.8 ± 2.1) from anterior end. Eggs spherical, 49–66 (59 ± 3) μm long, 23–39 (34 ± 3) μm wide with smooth surface and thick shell.

Remarks: The genus *Protospirura* is common in the digestive tracts of Muridae and Microtidae (Yamaguti, 1961; Wertheim, 1962; Crook and Grundmann, 1964; Babero and Matthias, 1967; Quentin *et al.*, 1968; Quentin, 1969; Skrjabin, 1969; Grundmann *et al.*, 1974; Barus *et al.* 1977). Yamaguti (1941), Hamajima (1962), Shogaki *et al.* (1972), Hori *et al.* (1974) and Taniguchi *et al.* (1977) have reported *P. muris* (Gmelin, 1970) Seurat, 1915 from some rats and mice in Japan. There appear to be no reports of this genus from insectivores. The present species is similar to *P. muris*, especially in the position and the number of papillae on the end of the male tail. Wertheim (1962) has studied some characteristics of *Mastophorus* (= *Protospirura*) *muris* based on many specimens, and concluded that the existence of pseudolabial denticles was reliable for differentiation of *P. muris* although the actual

number of denticles was not. The present worms had no denticles. Total and spicule lengths of *P. muris* from some host species were shown in Table 2. The body of the present worm is smaller than that of most of *P. muris*, and differences in length and shape between right and left spicules were larger in the present ones than those of *P. muris*. The spicule lengths were stable character (see Table 1), except for the rare variations. The worms with shorter left and right spicules was similar to *P. muris*. This variation, as well as the male tail papillae, may indicate a close relationship between the present worms and *P. muris*. Some studies on the variations in the length and shape of the spicules of *Ostertagia* spp. (Ohbayashi, 1967; Lancaster and Hong, 1981) have suggested the existence of a polymorphic species using the characters of the spicules, though there are no studies in spirurid nematodes on this problem.

These differences, together with host differences, indicate that the present specimens represent a new species in spite of the intraspecific variation on the spicules. This is the first report of the genus *Protospirura* in insectivores.

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Table 2. Total and spicule lengths of *Protospirura muris* from each host

| Host species | Total length | | Spicule length | |
|---|--------------|-----------|----------------|-----------|
| | male | female | right | left |
| <i>Rattus rattus alexandrinus</i> ¹⁾ | 22-27 | 35-71 | 1.06-1.3 | 0.83-1.06 |
| <i>Rattus</i> spp. ²⁾ | 17.0-56.0 | 23.0-87.0 | 1.15-1.52 | 0.95-1.30 |
| <i>Rattus norvegicus</i> ³⁾ | 29.0-44.0 | 56.0-85.0 | 1.21-1.45 | 1.01-1.27 |
| <i>Lemmus lemmus</i> ⁴⁾ | unknown | unknown | 1.12 | 0.82 |

(mm; ¹⁾Yamaguti (1941), ²⁾Wertheim (1962), ³⁾Shogaki *et al.* (1972), ⁴⁾Barus *et al.*, (1941))

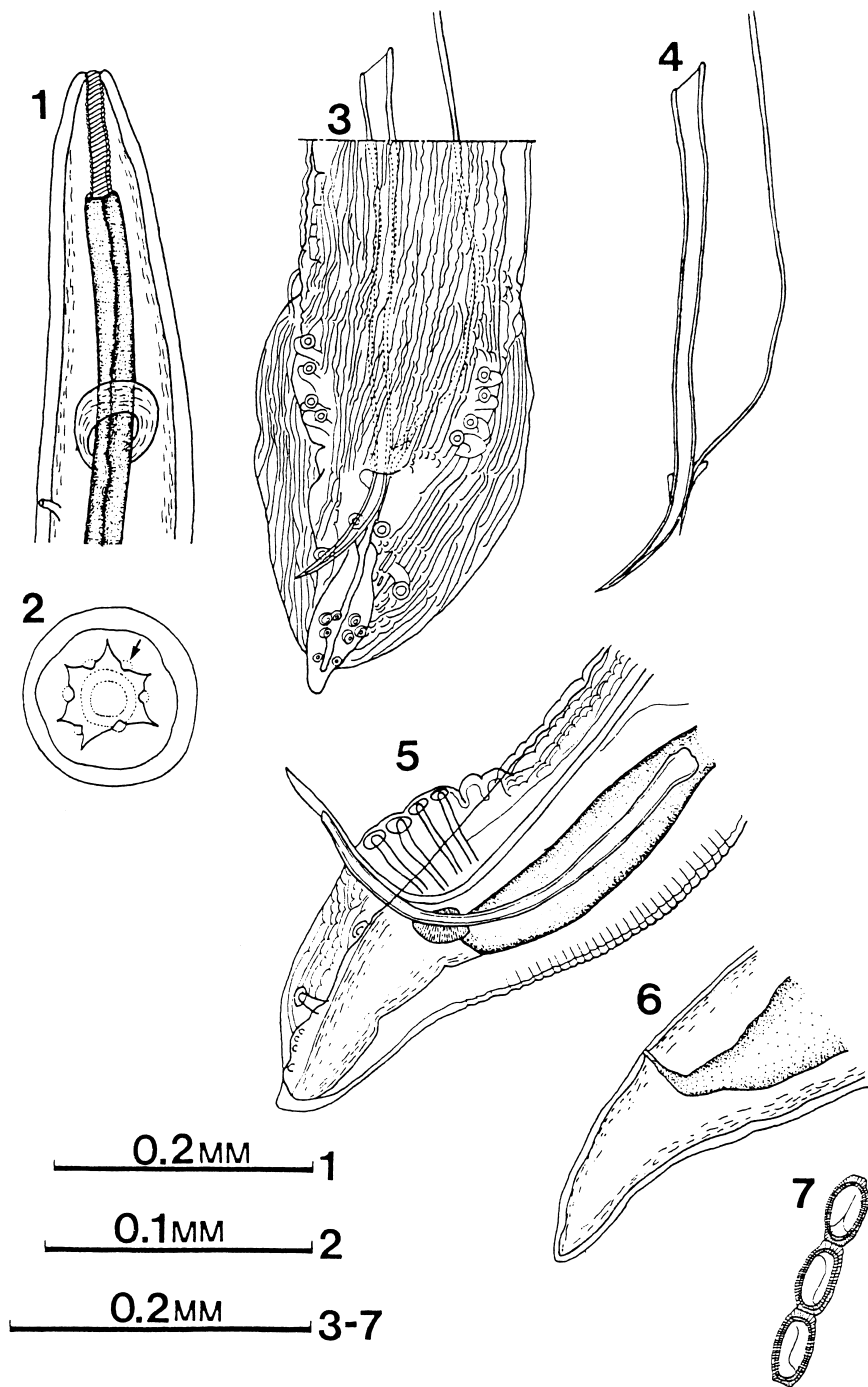


Plate 1. *Ascarops mogera*

1. Anterior end of male
2. Anterior end of female, apical view
(Arrow: sclerotized tooth)
3. Posterior end of male, ventral view

4. Spicules
5. Posterior end of male, lateral view
6. Posterior end of female, lateral view
7. Eggs

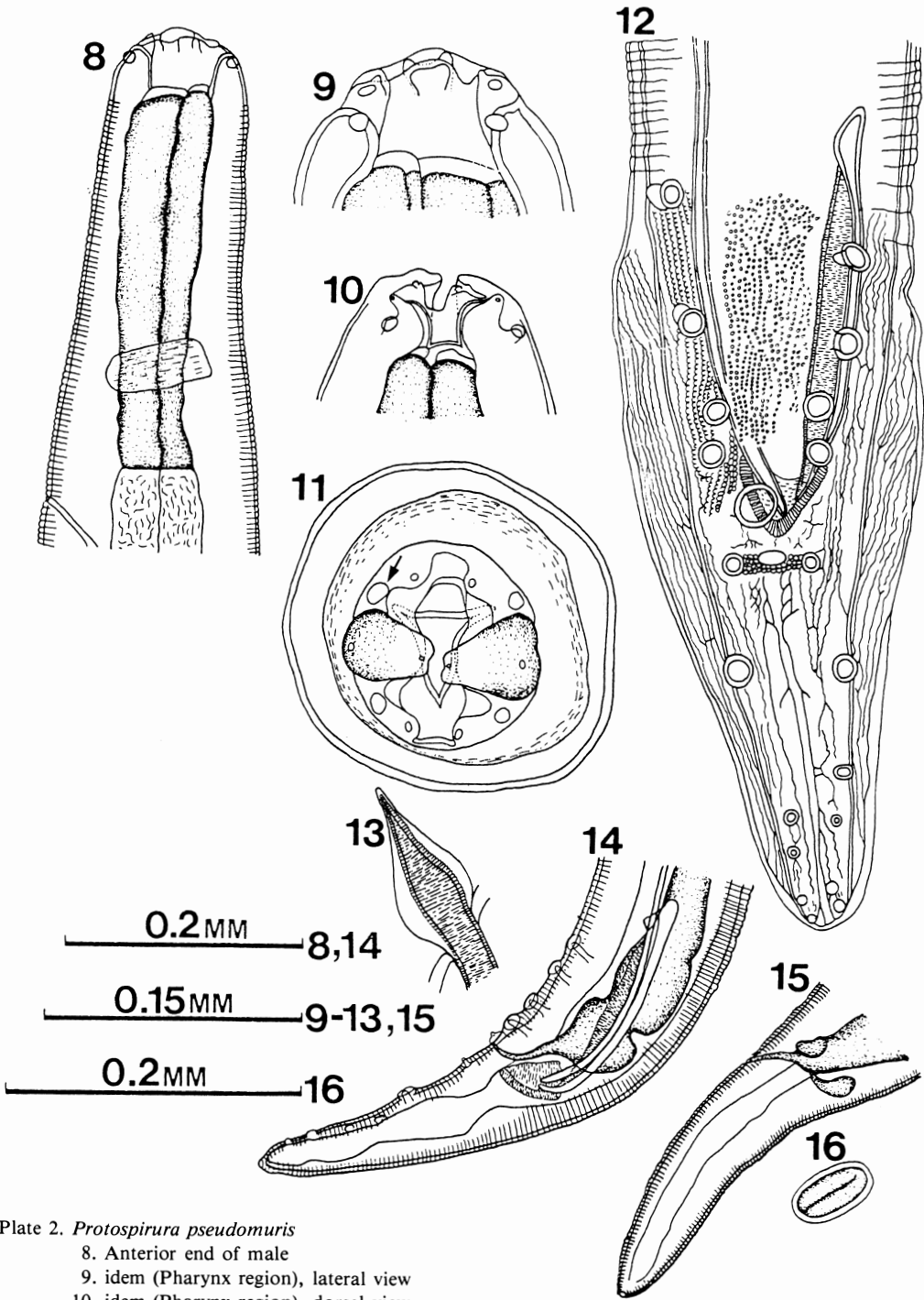


Plate 2. *Protospirura pseudomuris*

- 8. Anterior end of male
- 9. idem (Pharynx region), lateral view
- 10. idem (Pharynx region), dorsal view
- 11. Anterior end of female, apical view
(Arrow: cervical papilla)

- 14. Posterior end of male, lateral view
- 15. Posterior end of female, lateral view
- 16. Egg

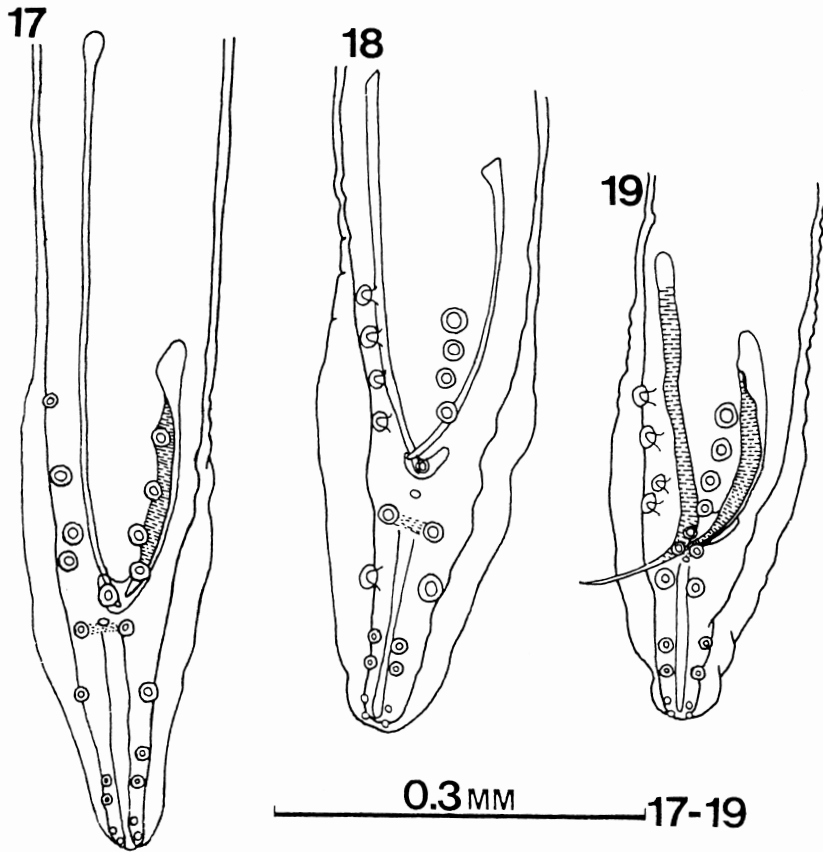


Plate 3. *Protospirura pseudomuris*, variations of spicules

17. Normal
 18. Both right and left long
 19. Both right and left short

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