

Nematode Parasites of Wild Boar from Iriomote Island, Japan

By

Chuzaburo SHOHO

1-6 Nakayama-Soen, Takarazuka

and

Masaaki MACHIDA

Department of Zoology, National Science Museum, Tokyo

Iriomote Island is one of the southwesternmost islands of the Japanese Archipelago, not far from Taiwan, 322 square kilometers in area, mountainous, covered with subtropical jungle, and famous for its still surviving wild cat, *Mayailurus iriomotensis*. The inhabitants have their dwellings at the coastal strip, engaging in agriculture. The wild boar, *Sus riukiuanus*, is trapped beyond the season, only when the crop damage is made by them. One of us (C. S.) collected the specimens of *Setaria* from the wild boar on the island in March, 1977. On that occasion, some other nematodes were obtained from the stomach and upper small intestine of the animal. The nematodes were preserved in 5% formalin and cleared in glycerin or Gater's solution. The specimens are deposited in the collection of the National Science Museum, Tokyo.

Capillariidae

1. *Capillaria riukiensis* n. sp.

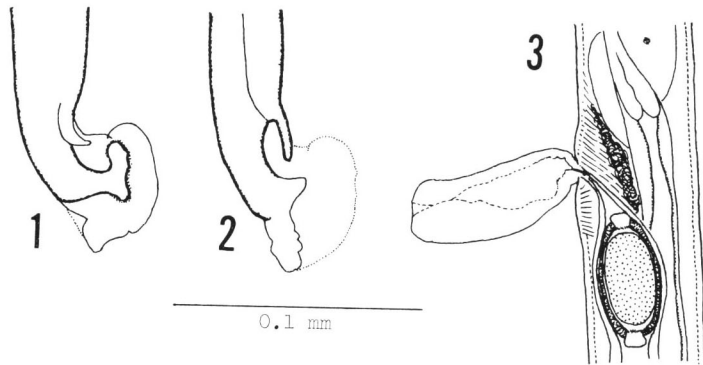
(Figs. 1-3 & 22-23)

Habitat. Stomach of *Sus riukiuanus* KURODA.

Locality. Iriomote Island, Okinawa Prefecture, Japan.

Specimen No. NSMT-As 1526.

Description. Male (4 specimens). Body 10.3-12.9 × 0.028-0.041 mm. Bacillary band extending just posterior to nerve ring till near tail end, up to 20 μ broad at central part. Nerve ring 74-88 μ from head end. Anterior portion of esophagus 0.32-0.43 mm long, posterior portion 3.7-5.4 mm long, entire length 4.0-5.8 mm. Ratio of esophagus to intestinal portion 1: 1.2-1.6. Stichocytes 36-44 in number. Spicule 0.81-0.98 mm long, 9-11 μ broad at anterior end. Spicular sheath 11-15 μ wide, with fine transverse striations. A single median process just anterior to cloaca, directed backward, 15-16 μ long. Tail 52-58 μ long, provided with membranous caudal alae which are supported by an anterior pair of delicate thorn-shaped rays at



Figs. 1-3. *Capillaria riukiensis* n. sp. — 1. Caudal ala. — 2. Cloacal region. — 3. Vulvar region.

level of cloaca and a posterior pair of hook-shaped rays at midlevel of tail.

Female (7 specimens). Body $18.8-24.3 \times 0.048-0.054$ mm. Bacillary band similar in anteroposterior extent to that of male, $25-28 \mu$ broad at central part. Nerve ring $88-101 \mu$ from head end. Anterior portion of esophagus $0.35-0.40$ mm long, posterior portion $3.87-4.54$ mm long, entire length $4.3-4.9$ mm. Ratio of esophagus to intestinal portion 1: $3.3-4.4$. Number of stichocytes within the range given above for the male. Vulva $4.34-5.00$ mm from head end or $43-112 \mu$ posterior to esophageal end, divided body length in ratio of 1: $4.27-5.26$, with cylindrical appendage $46-70 \times 25-30 \mu$. Tail roundly pointed, with subterminal anus. Eggs elliptical, thick-shelled, $50-56 \mu$ long including polar plugs and $24-28 \mu$ wide, with sculptured surface.

Discussion. Five species of *Capillaria* have been reported from Suidae: *C. suis* YAMAGUTI, 1943 from the stomach of *Sus leucomystax* in Japan (Yamaguchi and Wakayama Prefectures); *C. gastrosuis* PIGOLKIN, 1963 from the stomach and small intestine of wild boar and pig in USSR (Primorskii Krai); *C. platyspicula* PIGOLKIN, 1963 from the urinary bladder of wild boar in USSR (Primorskii Krai); *C. papuensis* COPLAND, 1975 from the tongue of *Sus scrofa papuensis* in Papua New Guinea; *C. garfiai* GALLEGO et MAS-COMA, 1975 from the tongue of *Sus scrofa* in Spain. Besides, SUGIMOTO (1935) reported *Capillaria* sp. from the stomach of wild boar in Taiwan, but did not describe the morphology of the worm.

Of these, *C. garfiai* differs from the former four species in carrying a spinulous spicular sheath and no spicule. The present new species resembles the former four species in having a spicule enclosed in a finely transverse-striated sheath, but differs from them in the caudal structure of the male, especially the presence of a median process just anterior to the cloaca, and having a vulvar appendage.

Strongylidae

2. *Globocephalus amucronatus* (SMIT et NOTOSOEDIRO, 1926)

(Figs. 4-7)

Habitat. Upper small intestine of *Sus riukiuanus* KURODA.

Locality. Iriomote Island, Okinawa Prefecture, Japan.

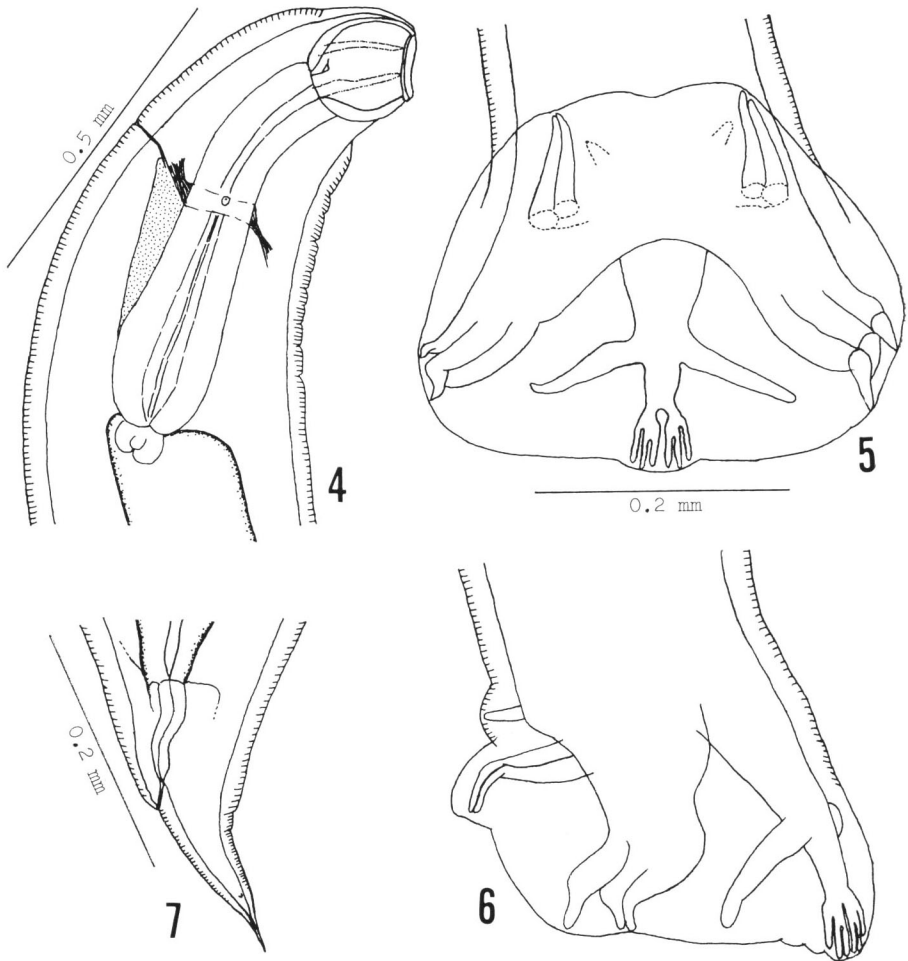
Specimen No. NSMT-As 1527.

Description. Body rather stout. Mouth directed anterodorsally. Buccal capsule subglobular, provided with a pair of triangular subventral lancets near the base. Dorsal esophageal gutter reaching near collar-like area surrounding the mouth. Cervical papillae verruciform, at level of nerve ring.

Male (6 specimens). Body $3.4-4.8 \times 0.31-0.45$ mm. Buccal capsule $0.13-0.14 \times 0.10-0.13$ mm. Esophagus $0.50-0.63 \times 0.13-0.14$ mm. Nerve ring $0.35-0.40$ mm from head end. Excretory pore and cervical papillae $0.35-0.41$ and $0.38-0.44$ mm from head end, respectively. Spicules slender, equal, $0.75-0.82$ mm long, with curved tip; gubernaculum $75-80 \mu$ long. Prebursal papillae conspicuous. Bursal structure as shown in figures. Ventral ray cleft for almost all the length; lateral rays emerging from common trunk, abruptly slender at the distal end; externodorsal ray arising from the trunk of dorsal ray; dorsal ray bifurcated at about middle, each branch terminating in three-pronged processes, of which the central process is somewhat longer.

Female (6 specimens). Body $4.5-5.4 \times 0.34-0.52$ mm. Buccal capsule $0.15-0.18 \times 0.15-0.16$ mm. Esophagus $0.52-0.68 \times 0.12-0.15$ mm. Nerve ring $0.36-0.44$ mm from head end. Excretory pore and cervical papillae $0.36-0.41$ and $0.39-0.44$ mm from head end, respectively. Tail tapering pointed, $0.13-0.16$ mm long, with a pair of phasmids $49-52 \mu$ from tail end. Vulva $3.4-4.0$ mm from head end, and divided body length in ratio of $2.83-3.27 : 1$. Uterine eggs oval, thin-shelled, $52-62 \times 33-38 \mu$.

Discussion. SMIT and NOTOSOEDIRO (1926) described *Characostomum amucronatus* based on the material collected from the intestine of domestic pig in Java. SMIT and IHLE (1928) redescribed this species based on the same material and transferred it to the genus *Globocephalus*. Later, MAPLESTONE (1930) regarded this species as a synonym of *G. urosubulatus*, but ORTLEPP (1964) re-erected it as a valid species. According to SMIT and IHLE (1928), *G. amucronatus* was characterized by the elongated buccal capsule, the triangular lancets, the structure of the caudal bursa, the spicular length, the tapering tail of the female, and the position of the vulva. As shown in Table 1, the present specimen closely resembles *G. amucronatus* from Java, except for somewhat smaller body length and longer spicules in the present specimen. The spicular lengths of the present specimen are given as $0.750-0.820$ mm; those are considered to be continuous with $0.664-0.747$ mm in Javanese specimen. Regarding a diagnostic character of *G. amucronatus*, KOBULEJ (1954) stated the central process of the dorsal ray being longer than the two lateral ones. The present specimen carries



Figs. 4-7. *Globocephalus amucronatus* (SMIT et NOTOSOEDIRO, 1926). — 4. Anterior end of female. — 5-6. Bursa. — 7. Posterior end of female.

certainly a little longer central process, but it is not so remarkably long as shown in his figure (p. 226, fig. 6).

Consequently, there are three species of *Globocephalus* in Japan: *G. longemucronatus* (MOLIN, 1861) from the wild boar, *Sus leucomystax* (YAMAGUTI, 1935; SHIOTA *et al.*, 1976), *G. samoensis* (LANE, 1922) from the same host (YAMAGUTI, 1935), and *G. amucronatus* (SMIT et NOTOSOEDIRO, 1926) from the wild boar, *Sus riukiuanus* (the present authors). YAMAGUTI (1935) also found the former two species from the deer, *Sika nippon*. When the buccal lancets of the three species from Japan are compared, it is easily distinguishable from one another by that those of *G. longemucronatus* are

Table 1. Dimensions of *Globocephalus amucronatus* (in microns except for body size).

Host	Author	Body (in mm)	Buccal capsule	Esophagus	Tail of female	Spicules	Vulva divides body length in ratio of
Domestic pig from Java	SMIT & IHLE (1928)	♂ 5 ×	127-155 ×	496-530 ×		664-747	
		0.220-0.325	110-119	123-130			
		♀ 6-7 ×	170-180 ×	580-670 ×	132-166		Ca. 3:1
		0.375-0.410	143-152	156-188			
Wild boar from Japan	Present authors	♂ 3.4-4.8 ×	130-140 ×	500-630 ×		750-820	
		0.31-0.45	100-130	130-140			
		♀ 4.5-5.4 ×	150-180 ×	520-680 ×	130-160		2.83-3.27
		0.34-0.52	150-160	120-150			:1

inconspicuous, those of *G. samoensis* are bicuspid and those of *G. amucronatus* are triangular.

Recently, UCHIDA *et al.* (1979) reported *Globocephalus* sp. from the wild rat, *Deplhthrix legata*, on Amami Island, southern Japan.

Ascaridae

3. *Ascaris* sp.

A single female of *Ascaris* (NSMT-As 1528) was found in the stomach content, probably having moved up into the stomach under the trapped condition of the host. The body is 105 mm long, without egg development in the uterus. Since the other seven hosts examined did not harbour any *Ascaris* at all and the pig farming has set up on the coastal strip of the island, the wild boar might have been infected from pig source. At present, there is no clear notion about the natural infestation of the wild boar with *Ascaris* in Japan. NODA (1973) informed male and female, each four, of *Ascaris suum* from the small intestine of a wild boar in Nara Prefecture. According to the experience by one of us (C. S.) in early months of 1978 in Hyogo and Kyoto Prefectures, the wild boar was found infested with *Ascaris* in 3 out of 7 examined cases and the infestation was mild (1-3 worms) and unisexual.

Spirocercidae

4. *Ascarops strongylina* (RUDOLPHI, 1819)

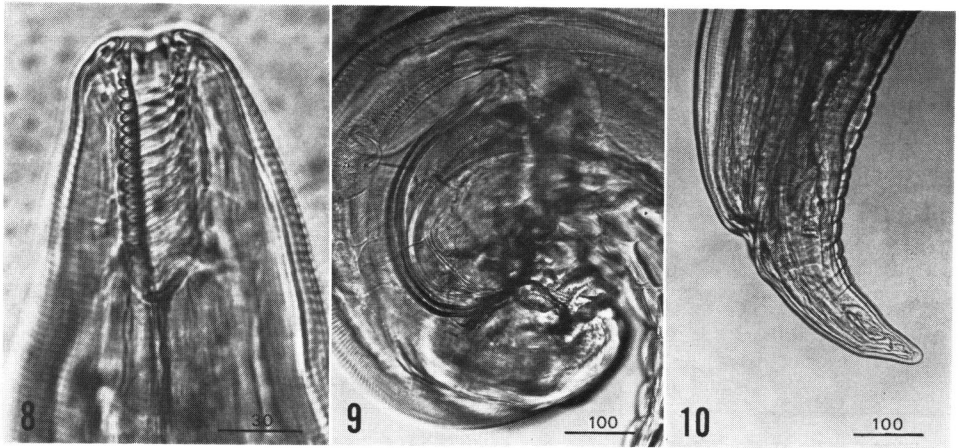
(Figs. 8-10)

Habitat. Stomach of *Sus riukiuanus* KURODA.

Locality. Iriomote Island, Okinawa Prefecture, Japan.

Specimen No. NSMT-As 1529.

Description. Body slender. Mouth with two lateral trilobed lips. Cervical



Figs. 8–10. *Ascarops strongylina* (RUDOLPHI, 1819). — 8. Anterior end of female. — 9. Posterior end of male. — 10. Posterior end of female. Scales in micron.

papillae asymmetrical. Pharynx cylindrical with spiral cuticular thickenings. Esophagus long, consisting of two parts; the anterior much shorter.

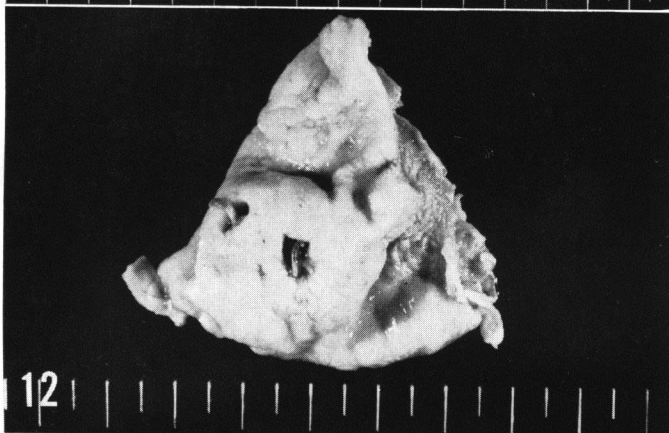
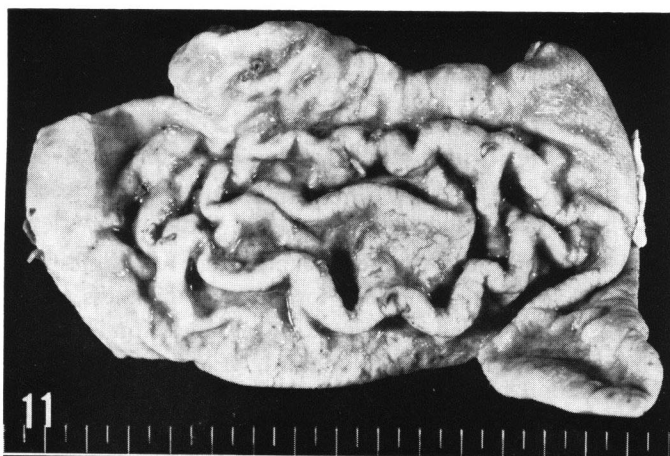
Male (1 specimen). Body 8.6×0.28 mm. Pharynx $67 \times 34 \mu$. Anterior and posterior esophagus 0.26 and 2.1 mm long, respectively. Nerve ring and cervical papillae 0.21 mm, 0.13 and 0.33 mm from head end, respectively. Tail coiled, with asymmetrical alae. Four pairs of preanal and one pair of postanal, pedunculate papillae present. Spicules unequal, dissimilar; the left 2.42 mm long and the right 0.52 mm long. Gubernaculum ring-shaped, 82μ long.

Female (4 specimens). Body $13.0\text{--}18.3 \times 0.34\text{--}0.36$ mm. Pharynx $77 \times 26\text{--}36 \mu$. Anterior and posterior esophagus 0.33 and 2.9–3.1 mm long, respectively. Nerve ring and cervical papillae 0.28–0.29 mm, 0.16–0.19 and 0.32–0.40 mm from head end, respectively. Tail bluntly pointed, 0.21–0.28 mm long. Vulva 5.6–8.6 mm from head end and divided body length in ratio of 1: 1.09–1.31. Eggs elliptical, thick-shelled, with fine granulated surface, $41\text{--}44 \times 22\text{--}24 \mu$, containing larva.

Discussion. The caudal structure of the male was not fully examined owing to the only one specimen, but the foregoing description accords in general with *A. strongylina* described by SUGIMOTO (1935) and MOZGOVOI (1967).

This species is common in pigs in most parts of the world, although it is rare in the main islands of Japan. According to SUGIMOTO (1935), it is very common in pigs and wild boars in Taiwan.

Figs. 11–13. *Gnathostoma doloresi* parasitic in the stomach of *Sus riukiuanus*. — 11. Worms sticking into the gastric wall isolatedly. — 12. Several worms together forming the thickness of gastric wall. — 13. Many worms embedded in the crater-like depression. Scales in cm.



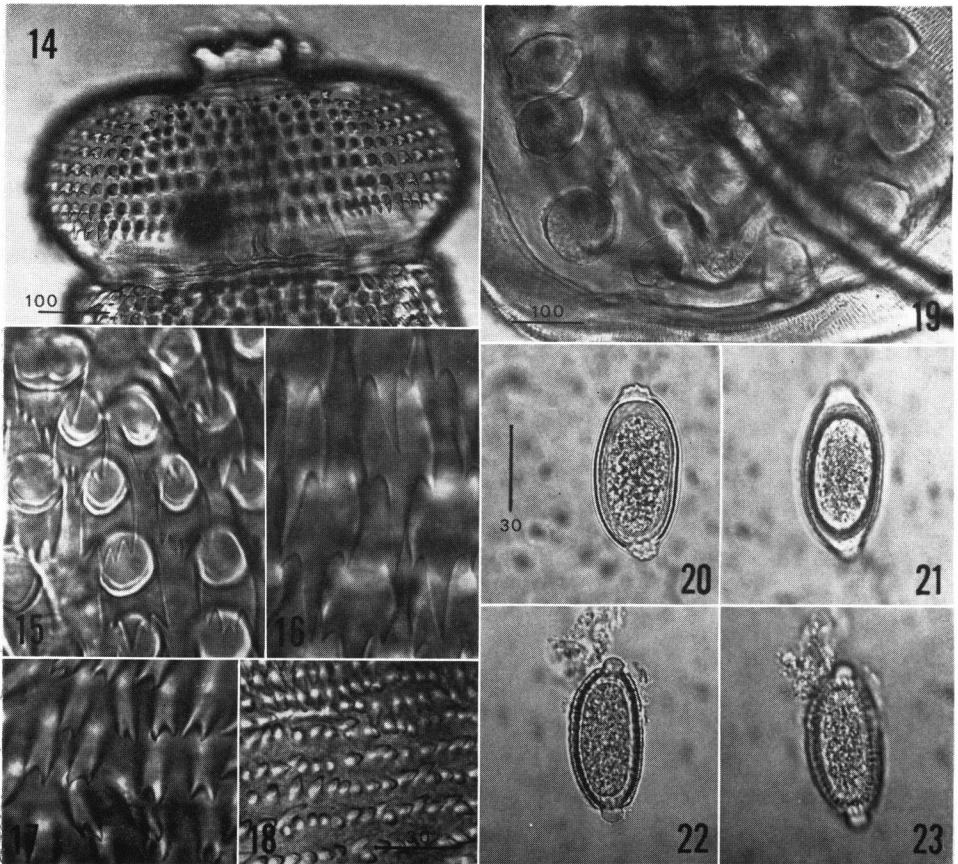
Gnathostomatidae

5. *Gnathostoma doloresi* TUBANGUI, 1925

(Figs. 11-21)

Habitat. Stomach of *Sus riukiuanus* KURODA.*Locality.* Iriomote Island, Okinawa Prefecture, Japan.*Specimen No.* NSMT-As 1530.*Description.* The worms were found sticking their forebodies into the gastric wall isolatedly (Fig. 11) or gather in groups forming the thickness of the gastric wall around them (Fig. 12) or embedded in the crater-like depression (Fig. 13).

Body stout, more slender in the anterior third. Entire surface of body provided



Figs. 14-23. — 14-21. *Gnathostoma doloresi* TUBANGUI, 1925. — 14. Head bulb of female. — 15-18. Variety of body spines. — 19. Posterior end of male. — 20. Egg. — 21. Granulated surface of egg. — 22-23. *Capillaria riukiensis*. — 22. Egg. — 23. Sculptured surface of egg. Scales in micron.

with spines which vary in size and shape in different parts. Anteriormost spines broad and short, with several unequal teeth. Posteriorly, spines slender, bearing three sharp teeth, of which middle tooth is conspicuously longer than the lateral two. Succeedingly, spines become gradually smaller, with two teeth. Posterior two-thirds of body densely covered with single-pointed spines which become smaller posteriorly.

Male (3 specimens). Body $10.0\text{--}13.1 \times 0.87\text{--}1.27$ mm. Head bulb $0.15\text{--}0.23 \times 0.43\text{--}0.55$ mm, provided with 8–9 transverse rows of single-pointed hooklets. Esophagus 2.0–2.3 mm long. Anal papillae consisting of four, large, pedunculate, subventral pairs and three, small, sessile, ventral pairs. Left spicule 1.57–1.91 mm long, right spicule 0.43–0.58 mm long.

Female (4 specimens). Body $10.7\text{--}22.0 \times 0.94\text{--}1.25$ mm. Head bulb $0.23\text{--}0.30 \times 0.50\text{--}0.64$ mm, with 9 transverse rows of single-pointed hooklets. Esophagus 2.40–3.45 mm long. Vulva 6.4–13.3 mm from head end, divided body length in ratio of 1: 0.45–0.67. Eggs 58–62 μ long including polar plugs and 30–33 μ wide, with fine granulated surface.

Discussion. The present specimen is characteristic of *G. doloresi* in the shape of body spines and eggs. According to MIYAZAKI (1960, 1968), *G. doloresi* is distributed in the Far East, Southeast Asia and Oceania; that is, it has been reported from pigs in the Philippines, India, Singapore, Malaysia, Vietnam, Thailand, New Guinea and Japan, as well as from wild boars in Taiwan and Japan. In Japan, it is very common in wild boars. In Okinawa Prefecture, the fertilized eggs of *G. doloresi* were found by MIYAZAKI (1960) in the feces of *Sus riukiuanus* which had just been brought from Iriomote Island, and the encysted larvae of *G. doloresi* were detected by MIYAZAKI and KAWASHIMA (1962) in the muscle of the poisonous snake *Trimeresurus elegans* (GRAY) from Ishigaki Island, near Iriomote Island. Later, adults of *G. doloresi* were collected by TADA (1968) from the wild boar in Iriomote Island. The present specimen closely resembles his description, but he seems to have taken right spicule for left one.

As shown in Figs. 20–23, the eggs of the present species resemble those of *Capillaria riukiensis* in having polar plugs, but differences are seen in the former eggs which are somewhat roundish with fine granulated surface instead of sculptured surface, have thinner egg shell, and the rough surface of the plugs.

Setariidae

6. *Setaria bernardi* RAILLIET et HENRY, 1911

(Figs. 24–36)

Habitat. Peritoneal cavity of *Sus riukiuanus* KURODA.

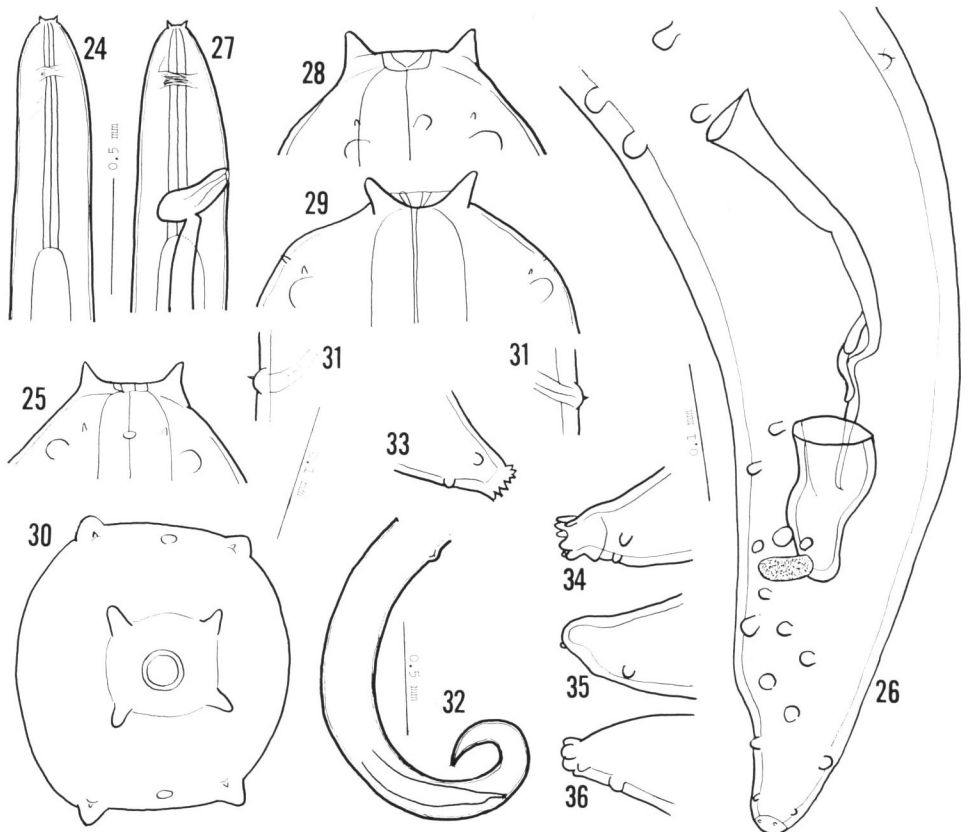
Locality. Iriomote Island, Okinawa Prefecture, Japan.

Frequency. Twenty-seven worms (9 males and 18 females) from six hosts (Number of worm in each host: male and female 3 & 7, 0 & 1, 0 & 2, 3 & 4, 0 & 1, 3 & 3). Two young hosts of age less than one year were free from setarial infestation.

Specimen No. NSMT-As 1531 (3 males and 7 females) and USNM Helm. Coll. No. 74960 (3 males and 4 females).

Description. Peribuccal chitinous crown oblong, lightly dorsoventrally elongated. Four corners of crown pointed and directed outwardly at dorsal and ventral views. Four pairs of submedian papillae just below the head end, arranged in two levels and a pair of lateral amphids at nearly the same level. Esophagus divided. Unilateral postdeirid left subdorsal at posterior part of body. Tail provided with a pair of indistinct lateral appendages near its end.

Male (3 specimens). Body $66-78 \times 0.55-0.60$ mm. Tips of peribuccal crown $74-84 \mu$ apart laterally and $55-58 \mu$ apart dorsally or ventrally. Nerve ring and a pair of deirids $0.21-0.24$ mm and $0.34-0.40$ mm from head end, respectively. Esoph-



Figs. 24-36. *Setaria bernardi* RAILLIET et HENRY, 1911. — 24-26. Male. — 24-25. Lateral view of anterior end. — 26. Posterior end with spicules, cloacal papillae and unilateral postdeirid. — 27-36. Female. — 27-28. Lateral view of anterior end. — 29. Ventral view of anterior end. — 30. Apical view of head end. — 31. Deirid. — 32. Posterior end with postdeirid. — 33-36. Variety of posterior end.

agus 9.74–11.69 mm long; the anterior portion 0.73–1.02 mm long and the posterior 8.74–10.81 mm long. Tail 0.16–0.18 mm long. There are four pairs each of pre- and postcloacal papillae, plus a central papilla in front of cloaca and a pair of lateral appendages, accompanied with a pair of small papillae posteriorly near tail end. Regarding precloacal papillae, the first and second pairs symmetrically arranged, but the third one asymmetrically as if unpaired, and the fourth well paired, very near to cloaca, embracing a median central papilla between them; postcloacal pairs quite asymmetrically arranged except the last pair which is tiny and symmetrically close to tail end. Lateral appendages lying 58–68 μ from tail end, and a pair of accompanying smaller papillae lying just before mild terminal constriction. Postdeirid 0.70–0.88 mm from tail end. Left spicule 0.32–0.34 mm long and right spicule 0.16–0.18 mm long.

Female (7 specimens). Body 88–165 \times 0.55–0.90 mm. Tips of peribuccal crown 63–87 μ apart laterally and 60–74 μ apart dorsally or ventrally. Nerve ring and a pair of deirids 0.23–0.27 mm and 0.34–0.45 mm from head end, respectively. Esophagus 9.24–10.14 mm long; the anterior portion 0.92–1.11 mm long and the posterior 8.23–9.08 mm long. Vulva 0.45–0.66 mm from head end; vagina fusiform, 0.34–0.40 mm long. Tail 0.52–0.76 mm long, with a pair of indistinct lateral appendages 31–47 μ from tail end. Tail end mostly covered with many short spines, but some terminating in a cap or grossly divided knob. Postdeirid 2.11–2.57 mm from tail end.

Discussion. From the oblong peribuccal crown and the general feature of the posterior part including the form of the lateral appendages, the present specimen can be diagnosed as *Setaria bernardi* RAILLIET et HENRY, 1911. Two other species of *Setaria* from Suidae, *S. congolensis* RAILLIET et HENRY, 1911 and *S. thomasi* SANDOSHAM, 1954, possess the oval peribuccal crown which enables us to differentiate these species from the present species alone by this difference. Another species from Suidae, *S. castroi* ORTLEPP, 1964, can also be easily differentiated from this species by the form of the peribuccal crown which is less prominent and even oblong, much narrower at the dorsal or ventral view. Previous to the report by DESSET (1966) who redescribed the type-specimen of *S. bernardi* from the domestic pig of Annam on the modern standard, CHATTERJI (1939) described this species from the domestic pig of Burma. In Japan, KONO and MORIZONO (1956) reported it from the wild boar, *Sus leucomystax*, of southernmost part of Kyushu. Recently, OHISHI *et al.* (1977) informed a single female of this species from a domestic pig of Kyushu. Compared with the data by these workers, the present specimen is a bit smaller in body length than theirs. As regards the number and arrangement of male caudal papillae, they were treated first substantially in the report by CHATTERJI (1939), but, even though the presence of the fourth pair of precloacal papillae was perceived by him close to the cloaca, it was not seen through by him that the third and fourth papillae in his drawing from the side constituted together one asymmetrically arranged pair, and that a central papilla lay between the papillae of the last precloacal pair. DESSET did not mention in detail the precloacal papillae, thus leaving them as in earlier reports.

At scrutinizing the literature on *S. bernardi*, it has been found that MOZGOVOI (1967) treated them with nearly perfect drawing made on the material from the wild boar of Khabarovsk Province of USSR. Unfortunately, this nearly perfect finding seems to have escaped the attention of SONIN in his new book (1977). With this detailed illustration of the caudal papillae of the male, *S. bernardi* is introduced here as a parasite in the peritoneal cavity of the wild boar, *Sus riukiuanus*, of Iriomote Island of Okinawa Prefecture. This species seems to occur rarely in the domestic pig in Japan, while it does commoner in Taiwan according to the record by SUGIMOTO (1939).

References

- BERNARD, P. N., & J. BAUCHE, 1911. Sur une filaire péritoneale du porc. *Bull. Soc. Path. exot.*, **4**: 482-485.
- CHATTERJI, R. C., 1939. Report on two unrecorded nematode parasites from domesticated animals of India or Burma. *Ind. J. Vet. Sci.*, **9**: 329-332.
- COPLAND, J. W., 1975. *Capillaria* infections of pigs: Description of *C. papuensis* sp. n. and the pathology of natural infections. *J. Helminth.*, **49**: 187-190.
- DESET, M. C., 1966. Contribution à la systématique des Filaires du genre *Setaria*, valeur des diérides. *Mem. Mus. natn. Hist. nat., Paris*, (A), **39**: 257-286.
- GALLEGO, J., & S. MAS-COMA, 1975. *Capillaria garfiai* n. sp. (Nematoda: Trichuridae), parasito de la mucosa lingual del jabali, *Sus scrofa* LINNAEUS, 1758 (Mammalia: Artiodactyla). *Vie et Milieu*, (C), **25**: 237-248.
- KOBULEJ, D. T., 1954. O vidovom sostave roda *Globocephalus* MOLIN, 1961. *Acta Vet. Acad. Sci. Hung.*, **4**: 263-273. (In Russian, with German summary.)
- KONO, I., & M. MORIZONO, 1956. On *Setaria bernardi* found first in Japan. *Bull. Fac. Agr. Kagoshima Univ.*, **5**: 54-59.
- MAPLESTONE, H. P. A., 1930. Nematode parasites of pigs in Bengal. *Rec. Ind. Mus.*, **32**: 77-105.
- MIYAZAKI, I., 1960. On the genus *Gnathostoma* and human gnathostomiasis, with special reference to Japan. *Exptl. Parasit.*, **9**: 338-370.
- 1968. *Gnathostoma doloresi* TUBANGUI, 1925 from pigs in New Guinea. *J. Parasit.*, **54**: 186-187.
- & K. KAWASHIMA, 1962. On the larval *Gnathostoma doloresi* TUBANGUI found in a snake from Ishigaki-Jima, the Ryukyu Islands (Nematoda: Gnathostomatidae). *Kyushu J. med. Sci.*, **13**: 165-169.
- MOZGOVOI, A. A., 1967. Gel'minty Domashnikh i Dikikh Svinei i Vyzyvaemye imi Zabolevaniya. 540 pp. Moscow, Nauka. (In Russian.)
- NODA, R., 1973. A new species of *Metastrongylus* (Nematoda) from a wild boar with remarks on other species. *Bull. Univ. Osaka Pref.*, (B), **25**: 21-29.
- OHISHI, I., S. KUME & T. TAKEI, 1977. On the *Setaria* from the pulmonary artery of a pig in Japan. 84th Meeting of Jap. Soc. Vet. Sci., 158.
- ORTLEPP, R. J., 1964. Observation on helminths parasitic in warthogs and bushpigs. *Onderstepoort J. Vet. Res.*, **31**: 11-38.
- RAILLIET, A., & A. HENRY, 1911. Remarques au sujet des deux notes de MM. BAUCHE et BERNARD. *Bull. Soc. Path. exot.*, **4**: 485-488.
- SANDGROUND, J. H., 1933. Report on the nematode parasites collected by the Kelley-Roosevelts Expedition to Indo-China with descriptions of several new species. *Z. Parasitenk.*, **5**: 542-583.
- SANDOSHAM, A. A., 1954. Malaysian parasites XV. Seven new worms from miscellaneous hosts. *Stud. Inst. Med. Res. Malaya*, (26): 210-226.

- SHIOTA, K., N. ARIZONO, K. UEMOTO, H. KURIMOTO, K. OKAMOTO & Y. YOSHIDA, 1976. Studies on mammalian helminths in Kyoto. *Jap. J. Parasit.*, **25**: (Suppl.) 49. (In Japanese.)
- SMIT, H. J., & J. E. W. IHLE, 1928. *Globocephalus amucronatus* (SMIT et NOTOSOEDIRO). *Centralb. Bakt. Parasitenk. Infektionsk.*, Abt. 2, **75**: 1–4.
- SONIN, M. D., 1977. Osnovy Nematodologii. Tom 28. Filiariaty Zhivotnykh i Cheloveka i Vyzvaemye imi Zabolevaniia. 220 pp. Moscow, Nauka. (In Russian.)
- SUGIMOTO, M., 1935. Parasites of Formosan wild boar. *Taiwan no Chikusan*, **3**: 1–14. (In Japanese.)
- 1939. A Catalogue of Parasites of Domestic Animals from Formosa. 244 pp. Tokyo, Yōkendo. (In Japanese.)
- TADA, I., 1968. On the adult *Gnathostoma doloresi* TUBANGUI, 1925 found in a wild boar from Iriomote-jima Is., Yaeyama-Gunto, Ryukyu Islands. *Acta Med. Univ. Kagoshima*, **10**: 163–168.
- UCHIDA, A., K. UCHIDA, H. ITAGAKI & T. ITAGAKI, 1979. Helminth fauna of the Amami Islands, Japan. 6. A nematode of the genus *Globocephalus* from a wild rat, *Deplothrix legata*. *Jap. J. Parasit.*, **28** (Suppl.): 16. (In Japanese.)
- YAMAGUTI, S., 1935. Studies on the helminth fauna of Japan. Part 13. Mammalian nematodes. *Jap. J. Zool.*, **6**: 433–457.
- 1943. Ditto. Part 43. Mammalian nematodes, IV. *Ibid.*, **10**: 427–454, pls. 47–49.

