HELMINTH PARASITES OF AGAMA STELLIO

(REPTILIA: AGAMIDAE) IN LEBANON

A Thesis

by

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ABSTRACT

Helminth parasites recovered from hundred *Agama stellio* (Linn. 1758) (Reptilia: Agamidae) from different localities in Lebanon are described. One new genus and several new species have been found. *Oochoristica tuberculata* (Cestoda: Anoplocephalidae) (Rudolphi, 1819) Lühe, 1898 and four other species (probably new, but not named) belonging to the same genus are described from the small intestine. These differ from the closest, previously described species in a combination of morphological characters including strobilar and organ measurements and characteristics. Cysticercoids encapsulated in the liver and belonging either to the genus *Joyeuxiella* or *Diplopylidium* are described.

Four species of tissue-inhabiting nematodes (Filarioidea: Onchocercidae) were found: (1) *Foleyella philistinae* Schacher and Khalil, 1967 from the subcutaneous tissues and superficial muscle fasciae, (2) *Brygoofilaria agamae* gen. et sp. n. from peri-esophageal and peri-tracheal connective tissue, from lymph spaces in the intestinal mesentery or in the peri-cardial cavity. It differs from other genera in the sub-family Eufilariinae parasitic in reptiles in various characters including vulvar position, absence of a gubernaculum, spicule morphology and size of microfilariae, (3) *Saurositus baal* sp. n. from hepatic and mesenteric lymph spaces and free in the body cavity. It differs from other species by a combination of characters including the length of the gubernaculum, the number and placement of genital papillae, the sparcity of microfilariae *in utero* and the presence in the female of a plicate or villiform uterine mucosa. The status of *S. macfiei*

Fitzsimmons, 1958 is discussed and it is concluded that it is a distinct species rather than a synonym of S. agamae Macfie, 1924, (4) A "stumpy" microfilaria, adults of which were not recovered, is also described.

Two species of nematodes were recovered from the digestive tract: (1) Abbreviata adonisi sp. n. (Physalopteroidea: Physalopteridae) is described from the stomach. It differs from the closest related species by the length of its esophagus and the number and disposition of genital papillae, (2) Thelandros (Parapharyngodon) tyche sp. n. is described from the cecum. It differs from the closest known species by the length of its spicules and the size of the eggs.

Larval acanthocephalans were recovered from capsules attached to the serosal surface of the small intestine; species identification was not made.

The occurence of these different groups of parasites is discussed in relation to the ecology and food habits of the host.

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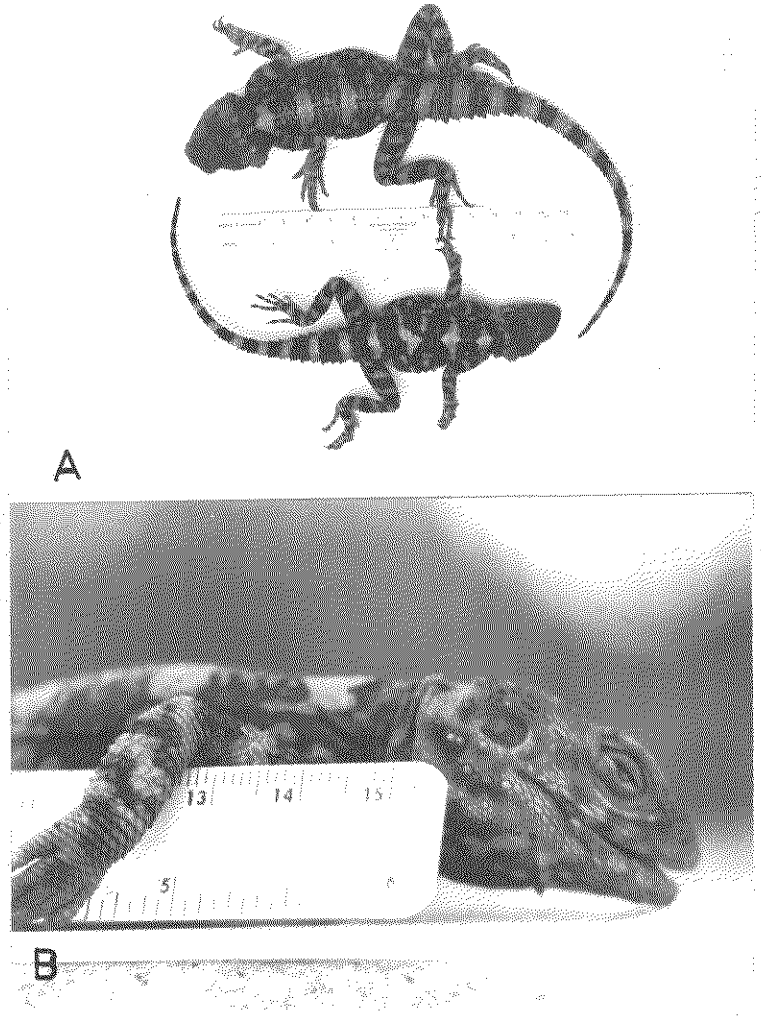
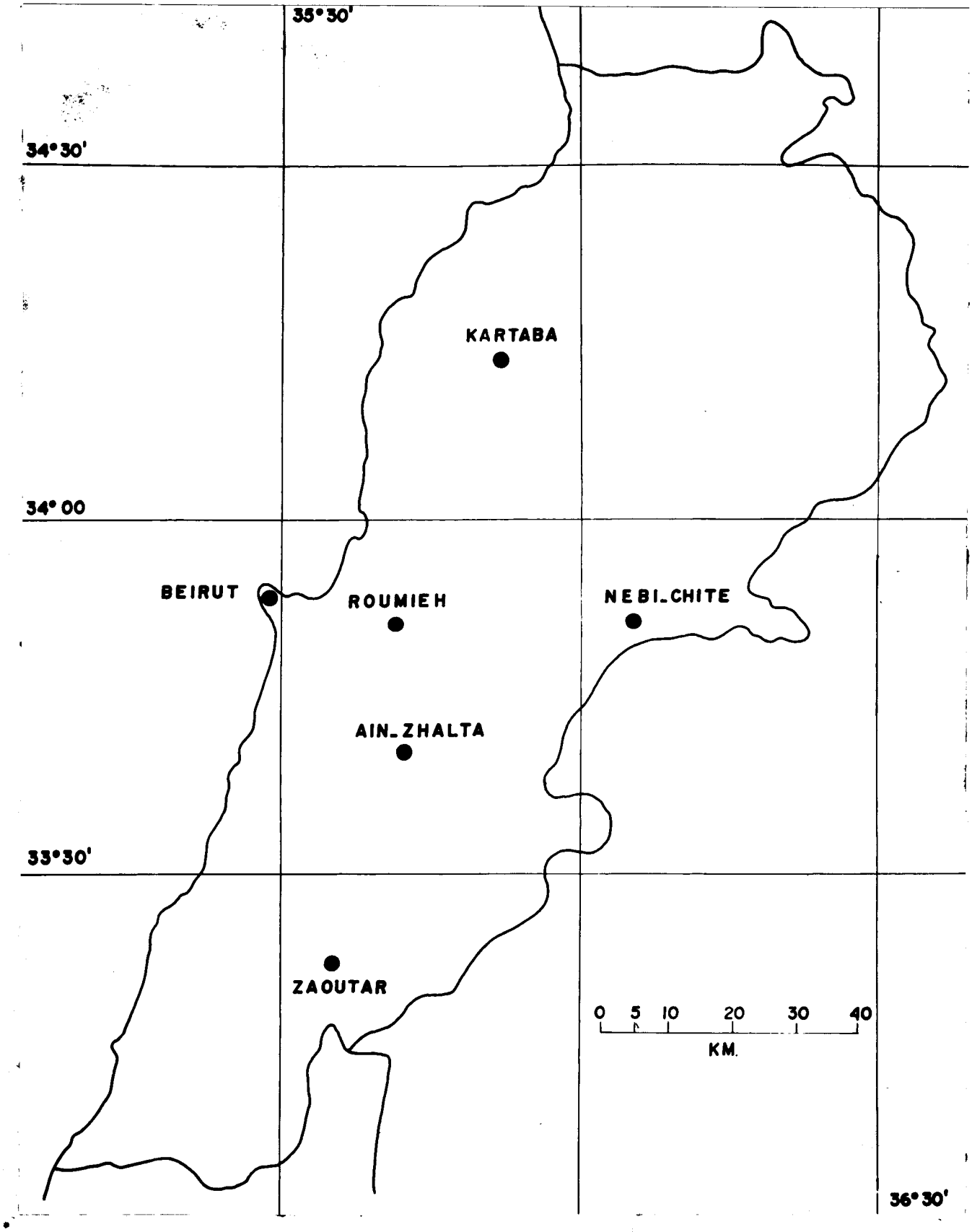
INTRODUCTION

Agama stellio (Linn. 1758), commonly called "hardun" in Arabic, is found in a wide range of habitats and at various altitudes in Lebanon (Text fig. 1). In the present study, specimens were examined from Ain-Zhalta (altitude 1100 m), Beirut (0-100 m), Kartaba (1150 m), Nebi-Chite (1100 m), Roumieh (650 m) and Zaoutar (1100 m) (Text fig. 2).



Text fig. 1 A. Agama stellio, dorsal view to show size and color pattern.

B. Lateral view of head and anterior half of body.



Text fig. 2 Map of Lebanon, showing the localities from which A. stellio was examined.

Bodenheimer (1937) lists the following Agama species as found in the Mediterranean region: Agama stellio, A. ruderata, A. pallida, A. sanguinolenta, A. persica and A. savignyi. The possible presence of A. caucasica should also be investigated (Lewis, 1967). It may be of interest in regard to the specimens examined in the present study to append the description of A. stellio given by Khalaf (1959):

" Agama stellio stellio (Linnaeus)
(rough-tailed agama, "hardun")

Head moderately depressed. Sides of the head and neck with groups of short spine-like scales. Ear exposed, about as large as the eye opening. Distinct dorso-lateral fold. Enlarged scales on sides are conical, spinose, and arranged in tranverse series. Tail divided into distinct segments, each composed of a pair of rings of large, strongly spinose scales; spiny scales, therefore, arranged circularly and not in spiral around the tail. Digits compressed, fifth toe extending beyond the first. Male with 3-5 rows of anal pores and a double series of pores on the middle of belly.

Head with swollen cheeks in the male. Upper head scales smooth or feebly keeled. Throat with irregular, strong, transverse folds beset with spinous horny scales. No gular pouch.

Stout body, much depressed, with vertical folds on the sides in addition to the dorso-lateral fold. Vertebral region with irregular, keeled scales intermixed with scattered enlarged ones. On the dorso-lateral fold and on the flanks, the enlarged scales are conical, spinose, and arranged in transverse series. Ventral scales smooth.

Tail round, depressed at base, about twice as long as the distance from the gular fold to vent. Third and fourth fingers equal or the fourth very slightly longer; fourth toe little longer than third.

Color of the upper parts olive spotted with black, with a series of large yellow or olive spots down the middle of the back. Throat of male reticulated with bluish grey. Male in the breeding season assumes red tints on the head and neck. Growing to nearly 15 inches in length."

This lizard is primarily insectivorous, feeding mostly on beetles, ants and flies, and secondarily on vegetation (Lewis, 1967). The body temperature of these lizards depends upon that of the environment. Bodenheimer (1935) found that in cooler seasons, their maximal activity is at noon, while in summer, they remain in the shade during the hottest period of the day. They are in a state of cold torpor at 3.4°C, high activity at 39.2°C and death occurs at 47.5°C. Their preferred temperature is about 35.3°C. No true hibernation is known; in winter and autumn,

A. stellio remain in a state of semi-torpor in groups of 6-20, in holes under rocks. When the weather is warm, they again become active and may be found on rocks, walls and tree trunks. They run with an erected body, and in warm weather, have nodding movements of the head. In the present study, only females dissected in May and June contained eggs, although Bodenheimer (l.c.) felt that the seasons and numbers of ovipositions are protracted.

The genus Agama is widespread throughout Africa and the Mediterranean littoral, with numerous publications on its helminth-parasite fauna. Parasites described from this genus in areas near to Lebanon include: Thelandros kuntzi Belle, 1957, Aplectana pharyngeodentata, Ophidascaris larvae, Physaloptera sp., P. abbreviata, P. pallaryi, P. paradoxa, P. varani, Strongyluris larvae, S. brevicaudata, Thelandros alatus, T. bulbosus, T. cinctus, T. kasauli and T. kuntzi from Egypt (Myers et al. 1962). Witenberg and Gerichter (1944) described microfilariae of what they thought to be Foleyella candezei from Agama stellio in Palestine; Schacher and Khalil (1967 a) have described adults and microfilariae of Foleyella philistinae from this lizard in Lebanon and expressed doubts as to Witenberg and Gerichter's specimens. No other parasites from A. stellio in this region of the Middle East have hitherto been reported. The purpose of the present study was to determine the incidence and type of helminth parasites in Agama stellio in Lebanon.

MATERIALS AND METHODS

Lizards were examined shortly after being brought to the laboratory. They were bled by removing one toe from the hind foot using a fingernail clipper. Microfilariae were studied in thin and thick air-dried blood films. Thin blood films were fixed in absolute methanol for 3 minutes and stained with Giemsa; thick films were dehemoglobinized in water, fixed in hot (60°C) 70% ethanol for a half hour and stained with Bullard's Hematoxylin (Fülleborn, 1924). The subcutaneous tissues, muscle fasciae, mesenteries and internal organs were examined macroscopically for the presence of tissue dwelling forms; the gastro-intestinal tract was opened, scraped, washed in saline and the worms recovered by sedimentation.

Cestodes and Acanthocephalans were relaxed in mentholated saline overnight at icebox temperature, fixed in AFA (Lavdowsky's fluid) at 60°C, and kept at room temperature overnight before storing in 70% ethanol. Cestodes were stained in Mayer's HCl-carmine and mounted in Permount(R). Nematodes were fixed in AFA at 60°C, kept in fixative overnight at room temperature, transferred in 70% ethanol-5% glycerine and brought into pure glycerine by evaporation.

Liver was fixed in Bouin's fluid at room temperature for 24 hours, dehydrated in ethanol and serially sectioned in Tissumat(R) at 5-7 μ. Sections were stained with hematoxylin and eosin. En face mounts were made by the modified sodium alginate method of Schacher (1957); total length measurements were made by the method of Schacher (1966); all other measurements and drawings were made with the aid of a camara lucida and ocular micrometer.

PRESENTATION OF DATA

I. Parasites; Location and Incidence

Six species of Cestoda, six of Nematoda and one of Acanthocephala were found in hundred lizards examined from various regions of Lebanon (Table 1; Text fig. 2).

A. Cestoda

Cestodes of the genus Oochoristica (Cyclophyllidea: Anoplocephalidae) were found in the small intestine of 8 per cent of the lizards from Ain-Zhalta, Kartaba and Nebi-Chite. Cysticercoids, probably either of the genus Diplopylidium or Joyeuxiella, were found encysted in the liver in histological sections. Since only one lizard was examined for the presence of this larval cestode, the incidence is not known.

B. Nematoda

Two species of intestinal nematodes were found:

Abbreviata adonisi sp. n. (Physalopteroidea: Physalopteridae) was found in the stomach of 2 per cent of the lizards from Kartaba. None were found in animals from other locations. Thelandros (Parapharyngodon) tyche sp. n. (Oxyuroidea: Pharyngodonidae) was found in the cecum of 85 per cent of the lizards. The highest incidence occured in Nebi-Chite, but lizards from other areas contained this nematode also.

Four species of tissue inhabiting nematodes belonging to the superfamily Filarioidea were found, all in family Onchocercidae:

Paleyella philistinae Schacher and Khalil 1967, was found in the connective tissue and muscle fasciae of 7 per cent of the lizards and microfilariae were found in the blood. The locality of highest incidence was Kartaba. Brygoofilaria agamae gen. et sp. n. was recovered from periesophageal and peri-tracheal connective tissues, from lymph spaces in

the intestinal mesentery or in the peri-cardial cavity of 3 per cent of the lizards from Nebi-Chite. Saurositus baal sp. n. was recovered from the hepatic and mesenteric lymph spaces and free in the body cavity of 26 per cent of the lizards, mostly from Nebi-Chite. A "stumpy" microfilaria was found in 8 per cent of the lizards from Nebi-Chite. Adults corresponding to the embryo were not recovered, hence no specific designation can be given at this time.

C. Acanthocephala

Larval acanthocephalans were recovered from capsules attached to the serosal surface of the small intestine from 2 per cent of the lizards.

II. Description of Helminths Recovered

A. Cestoda

1. Oochoristica tuberculata (Rudolphi, 1819) Lühe, 1898; Anoplocephalidae Cholodkovsky, 1902; Anoplocephalinae Blanchard, 1891; Oochoristica Lühe, 1898.

a. Description (based on seven intact strobila): Strobila: length 32-53 mm, maximum width 2.0-2.2 mm. Scolex (Plate I; Fig. A) 0.2-0.9 mm in transverse diameter; sucker diameter 70-90 μ. Neck 0.83-1.01 mm long. External segmentation distinct between mature segments; transverse surficial grooves present irregularly in cuticle; musculature 28-30 μthick. Segments acraspedote; mature segments (Plate I; Fig. C) broader (0.68-1.06 mm) than long (0.43-0.80 mm); gravid segments (Plate I; Fig. B) square (1.04-1.07 mm x 1.38-1.29 mm) or rectangular (1.53 x 0.97 mm). Genital pores irregularly alternating, situated in anterior 1/3 of segment; genitalia medullary; mature system begins in segments 17-20. Testes ovoid (22 x 38 μ), number 40-50, lying in compact group posterior and lateral to vitellarium. Vitellarium 90-130 μ wide, compact, ovoid, situated near aporal wing of ovary. Ovary with two unequal, irregularly

lobulated lobes; transverse diameter 250 μ in last mature segments, width of which is 1.8 mm. Seminal receptacle lacking. Cirrus sac 121-171 μ long; vas deferens and vagina both narrow parallel tubes, passing dorsal to ovary. Genital atrium with prominent radiating musculature in both mature and gravid segments. Genitalia disintegrate at level of 25-27th mature proglottid. Eggs 37-68 μ in diameter; oncosphere oval , 22-40 μ in diameter; hooks 16-19 μ long.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Ain-Zhalta, Lebanon

b. Remarks

Judging from keys and descriptions in the works of Spasskii (1951), Lopez-Neyra and Diaz-Ungria (1957) and Dollfus (1965), the present specimens can be referred to Oochoristica tuberculata (Rudolphi, 1819) Lühe, 1898, on the basis of strobilar and organ measurements and characteristics. According to Dollfus, (l.c.) O. tuberculata has the following characters: body length 20.5 mm; width 1.35 mm; scolex diameter 262 μ; sucker diameter 103 μ; testicular number 38-48, size 32-40 x 17-21 μ; cirrus sac length 121-166 μ; seminal receptacle absent; egg diameter 32 x 40 μ; oncosphere diameter 32-36 μ. This author (l.c.) divided this species on the basis of testicular number into:

O. tuberculata forma multitesticulata: 38-48 testes
O. tuberculata forma pseudagamae: 26-35 testes.

In the present material, the number of testes varies from 40-50 and the other measurements approximate most closely to those of O. tuberculata forma multitesticulata. It differs, however, in the position of the vitellarium, which is not median but situated near the aporal wing of the ovary. This last feature is characteristic of O. tuberculata forma pseudagamae, but as other measurements and characteristics are closer to

O. tuberculata forma multitesticulata, we feel that the present specimens probably belong to the latter form.

2. Oochoristica sp. 1

a. Description (based on one incomplete strobilus): Strobilus: length 26-28 mm, maximum width 1.33 mm. Scolex (Plate II; Fig. A) 0.21 mm in transverse diameter; sucker diameter 74 x 80 μ. Neck 1.39 mm long. Transverse surficial grooves present irregularly in cuticle; musculature 28 μ thick. Segments acraspedote; immature segments three times broader than long (0.80 x 0.27 mm); mature segments (Plate II; Fig. B) rectangular (0.94 x 1.33 mm); no gravid segments found. Genital pores irregularly alternating, situated in anterior 1/3 of segment; genitalia medullary; primordia begin in segment 18; mature system begins at level of 47th segment. Testes spherical, 48 x 51 μ, medullary, follicular, 30-32 in number, posterior and lateral to vitellarium. Vitellarium 108 μ wide, compact, at midline of ovary. Ovary butterfly shaped, irregularly lobulated, 274 μ wide. Seminal receptacle present. Cirrus sac 342 μ long with thick musculature. Vas deferens and vagina both narrow parallel tubes, passing dorsal to ovary.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Kartaba, Lebanon.

b. Remarks

The present material is close to both Oochoristica hainanensis Hsü, 1935 from a lizard in Hainan (China) and Oochoristica fibrata Meggitt, 1927 from Boiga multimaculata (Dipsadomorphidae) in Egypt. It differs from O. hainanensis in size, sucker diameter, cirrus sac length, width

of the ovary and testicular number. (O. hainanensis length: 134 mm; sucker diameter 141-159 μ; cirrus sac 188-205 μ long; ovary 450 μ wide; testes 40-50 in number). It differs from O. fibrata in size, width, scolex diameter and cirrus sac length. Unfortunately, the descriptions of Meggitt are incomplete. (O. fibrata length 55-69 mm; width 0.6-0.8 mm; scolex diameter 460 μ; cirrus sac 156-240 μ long).

Again the present material probably differs from the closest known species sufficiently to justify the creation of a new species to contain it.

3. Oochoristica sp. 2

a. Description (based on two intact strobila): Strobila length 63-73 mm, maximum width 2.0-2.5 mm. Scolex (Plate III; Fig. A) 0.15-0.19 mm in transverse diameter; sucker diameter 80-91 μ. Neck 1.33-1.99 mm long. External segmentation distinct between mature segments; transverse surficial grooves present irregularly in cuticle; musculature 34 μ thick. Segments acraspedote; mature segments (Plate III; Fig. C) broader (1.99-2.29 mm) than long (1.06-1.29 mm); gravid segments (Plate III; Fig. B) square (2.09-2.18 mm x 2.01-2.12 mm) or rectangular (1.76 x 2.04 mm). Genital pores irregularly alternating, in anterior 1/3 of segment; genital primordia begin in segments 28-30; mature system begins in segments 48-50. Testes spherical (37-40 μ) in diameter, follicular, number 40-44, lying posterior and lateral to vitellarium. Vitellarium 160 μ wide, slightly lobulated in early mature segments, compact in others; median to ovary. Ovary bilobed, with transverse diameter of 265 μ. Seminal receptacle absent. Cirrus sac 228 μ long; vas deferens loops slightly. Vagina a narrow tube running across ovary. Genital atrium with prominent radiating musculature in both mature and gravid segments. Genitalia disintegrate at level of 19-21st mature proglottids. Eggs 44 μ in diameter; oncosphere 38 μ in diameter; hooks 16-19 μ long.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

The present material comes nearest to descriptions given by Spasskii (1951) Lopez-Neyra and Diaz-Ungria (1957) and Dollfus (1965) of Oochoristica gallica Dollfus, 1954 from Psammodromus gallica (Lacertidae). The present material differs, however, in strobilar length and width, scolex diameter, ovarian width and in the absence of a seminal receptacle. (O. gallica: strobilar length 15-30 mm; width 0.67 mm; scolex diameter 240-315 μ ; ovarian width 280-300 μ; seminal receptacle present).

Thus, this specimen differs considerably from the closest previously described species, probably justifying the creation of a new species.

4. Oochoristica sp. 3

a. Description (based on one incomplete strobilus): Strobilus: length 82 mm, maximum width 0.70 mm. Scolex (Plate IV; Fig. A) 0.32 mm in transverse diameter, spatulate; sucker diameter 68 x 80 μ. Neck 0.45 mm long. External segmentation distinct between mature segments; cuticle smooth; musculature 22 μ thick. Segments acraspedote; mature segments (Plate IV; Fig. B) rectangular, twice as broad as long (0.70 x 0.37 mm). Gravid segments not recovered. Genital pores alternate irregularly, situated in anterior 1/3 of segments; genital primordia begin in segment 14; mature system begins in segment 30. Testes spherical (23 μ in diameter), follicular, medullary, number 28-40, lying posterior and lateral to vitellarium. Vitellarium 45 μ in diameter, compact, median to ovary. Ovary asymmetrically bilobed, 93 μ in transverse diameter. Seminal receptacle absent. Cirrus sac 171 μ long with thick, muscular wall; vas deferens loosely coiled. Genital atrium with thick radiating musculature, opens

surficially near but not at lateral margin. Some abnormal segments found with genital pore median, with cirrus sac very close to ovary.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

The present material comes closest to Oochoristica truncata (Krabbe, 1879) Zschokke, 1905. (Synonyms: Taenia truncata Krabbe, 1879; Oochoristica agamae Baylis, 1919; Oochoristica africana Malan, 1939 and O. africana var. ookiepensis Malan, 1939 teste Spasskii, 1951). It differs from O. truncata in sucker diameter, body width and diameter of the ovary. The measurements given by Rudin, 1916 (in Spasskii, l.c.) are: body width 1-1.5 mm; sucker diameter 180 µ; ovary diameter 160 µ. These measurements for the present specimens are 0.70 mm, 68 x 80 µ, 93 µ respectively.

The peculiar placement of genital pores in some proglottids of this specimen may indicate that it is an anomalous "monster".

5. Oochoristica sp. 4

a. Description (based on two incomplete and two intact strobila): Strobila: length 30-51 mm, maximum width 1.54 mm. Scolex (Plate V; Figs A, D, G)0.14-0.19 mm in transverse diameter; sucker diameter 74-100 µ. Neck 1.16-2.37 mm long. External segmentation distinct between mature segments; transverse surficial grooves present irregularly in cuticle; musculature 23-34 µ thick. Segments acraspedote; immature segments broader than long or twice as long as wide; mature segments (Plate V; Figs. E, broader (1.4-1.68 mm) than long (0.86-1.33 mm) or longer (1.01 mm) than wide (0.69 mm). Gravid segments (Plate V; Figs. C, F, I) broader (1.57-1.83 mm) than long (0.86 mm - 1.33 mm) with some rectangular (1.66 x 1.88 mm)

Genital pores irregularly alternating, in anterior 1/3 of segments; genital primordia begin in segments 12-27; mature system begins in segments 27-38. Testes ovoid (23-32 x 26-34 μ), follicular, number 40-44, lying posterior and lateral to vitellarium. Vitellarium lobed, median to ovary, 91-125 μ wide. Ovary bilobed, each lobe deeply lobulated, looking like a cluster of grapes, transverse diameter 160-233 μ. Seminal receptacle absent. Cirrus sac 137-190 μ long. Genitalia disintegrate at level of 16-37th segment. Eggs 21-40 μ in diameter; oncosphere 16-29 μ in diameter; hooks 15-19 μ long.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

The present material comes closest to Oochoristica truncata (Krabbe, 1879) Zschokke, 1905 and Oochoristica tuberculata (Rudolphi, 1819) Lühe, 1898. It differs from O. truncata in scolex and sucker diameter, and oncosphere width. (The measurements of O. truncata are: scolex diameter 450-600 μ; sucker diameter 180 μ; oncosphere diameter 28-48 μ.) It differs from O. tuberculata in scolex diameter, ovary width, vitellarium diameter and size of the testes. (The measurements of O. tuberculata given by Dollfus (1965) are: scolex diameter 262 μ; ovary width 344 μ; vitellarium diameter 132-166 μ and size of the testes 32-40 x 17-21 μ.)

The present material probably differs from the closest known species sufficiently to justify the creation of a new species.

6. Oochoristica sp. 4 var.

a. Description (based on eight intact strobila): Strobila: length 21-30 mm, maximum width 1.05-1.23 mm. Scolex (Plate VI; Fig. A) 0.10-0.15 mm in transverse diameter; sucker diameter 65 x 84 μ. Neck 0.83-1.01 mm long. External segmentation distinct between mature segments;

transverse surficial grooves present irregularly in cuticle; musculature 29 μ thick. Segments acraspedote; immature segments broader than long; mature segments (Plate VI; Fig. C) broader (0.68-1.06 mm) than long (0.43-0.6 mm); gravid segments (Plate VI; Fig. B) longer (1.29-1.53 mm) than broad (0.97-1.07 mm). Genital pores irregularly alternating, in anterior 1/3 of segments; genital primordia begin in segments 18-19; mature system begins in segment 36-40. Testes ovoid (15 x 21 μ), medullary, number 34-46, lying posterior and lateral to vitellarium. Vitellarium compact, median to ovary, 91-105 μ wide. Ovary bilobed, transverse diameter 148-205 μ. Cirrus sac 148-182 μ long. Genitalia disintegrate at level of 9-10th mature segments. Eggs 35-38 μ in diameter, oncosphere 26-28 μ in diameter; hooks 17-19 μ long.

HOST: Agama stellio

HABITAT: small intestine

LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

The present material comes closest to that described immediately before it (p. 12), but differs markedly from it in the size of its testes (13-18 x 16-23 μ) vs 23-32 x 26-34 μ. As there seems to be variation in only this one character, we feel this specimen to be a variety of the species described above.

7. Larval cestode

a. Description

Numerous larval tapeworms of the cysticercoid type were found in sections of the liver of one animal examined (Plate VII; Figs. A, B). These metacestodes are enclosed in cystic spaces ranging from 0.66 mm to 1.16 mm in diameter. The cyst wall is composed of fibrous tissue; inflammatory

cells and cellular debris are included in the fluid surrounding the cysticercoids proper, which are 0.63-0.89 mm long and 0.36-0.50 mm broad, with four inverted acetabulate suckers and a rostellum bearing multiple rows of "rose-thorn-shaped hooks" (Plate VII; Fig. C). These morphological features show that these cysticercoids probably belong to the family Dilepididae and to either the genus Diplopylidium or to Joyeuxiella.

b. Remarks

Dilepidid cysticercoids of Joyeuxiella pasqualei, J. echinorhynchoides, Diplopylidium noelleri and D. acanthotetra have been reported in agamids from Palestine by Witenberg (1932). Adults corresponding to both genera have been found in cats (feral and domestic), dogs and foxes (Schacher, 1967) in Lebanon, but specific identification has not been made. In the present study, no attempt was made to examine the liver of all the specimens dissected, hence, no incidence figures can be given.

HOST: Agama stellio

HABITAT: liver

LOCALITY: Nebi-Chite, Lebanon

B. Nematoda

1. Abbreviata adonisi sp. n.

a. Description (based on one male, four females): Physalopteridae Leiper, 1908; Physalopterinae Railliet, 1893; Abbreviata (Travassos, 1920) Schultz, 1927. (Kartaba, the type locality is on a high plateau above the ancient Adonis river, near to the cave which is its source and where according to legend, Adonis was killed by a boar).

Abbreviata adonisi sp. n.: Female longer than male; body coiled. Body cuticle reflected over anterior end forming collarette (Plate VIII; Fig. A). Stoma with two large lateral pseudolabiata, slightly set off from lateral view, provided with prominent median tooth-like lobes and homogeneous

dentigerous ridges. Four sub-lateral cephalic papillae and two lateral amphids on head (Plate VIII; Fig. B). Lateral alae absent; caudal alae present in male. Short vestibule present, 91-114 μ long; esophagus long, indistinctly divided into shorter (ca. 13 per cent of total length) anterior muscular portion and a darker posterior glandular portion. Nerve ring at level of anterior 1/10 of esophagus.

FEMALE: Mean length 27 mm (25-33 mm; Table 3); body width at esophageal base 497 μ; maximal width at mid-body 565 μ. Nerve ring 334 μ behind head (Plate VIII; Fig. A). Muscular esophagus 0.49 mm long; glandular esophagus 3.55 mm long. Excretory pore 521 μ from anterior end. Intestine straight; anus patent, rectum thick-walled. Genital system tetradelphic, opisthodelphic; vulva non-projecting, located in the esophageal region, 3.32 mm behind anterior end; vagina uterina about 3 mm long; uterus branches dichotomously into four branches; posterior end of uteri modified to form dark, ovoid seminal receptacles clustered together about 5-8 mm from posterior end; ovaries (Plate VIII; Fig. E) extend to posterior end but do not reach level of anus. Oviparous, eggs oval, thick-shelled, 51-62 x 27-32 μ.

MALE: Length 16.2 mm (Table 3); body width at esophageal base 353 μ. Muscular esophagus 0.34 mm, glandular esophagus 3.23 mm long; nerve ring 274 μ behind anterior end. Testis begins behind esophago-intestinal junction, 5.5 mm from head. Pericloacal region rugose, roughened in round patch surrounding aperture (Plate IX; Figs. A, B). Spicules (Plate VIII; Fig. C) unequal, dissimilar, distinctly sclerotized; left spicule 370 μ long, filiform; right spicule 149 μ long, broad; gubernaculum absent. Caudal alae present, broad, diminishing rapidly in size ahead of cloaca. Caudal papillae of both sessile and pedunculate types: three pairs pedunculate preanal, first and second of which at same level; one pair pedunculate adanal;

four pairs sessile postanal; and two pairs of sessile adanal papillae present, one pair of which is pre, others post-apertural (Plate VIII; Fig. D).

TYPE HOST: Agama stellio

HABITAT: small intestine

TYPE LOCALITY: Kartaba, Lebanon.

b. Remarks

Chabaud (1956), has divided the Physaloptera of reptiles into three genera: Skrabinoptera Schultz, 1927; Physaloptera Rudolphi, 1819 and Abbreviata (Travassos, 1920) Schultz, 1927. These genera form seven natural groups differentiated on the basis of cephalic ornamentation. The present material belongs to Chabaud's group III, characterized by a homogeneous denticulation wherein the interno-lateral and submedian teeth do not differ greatly in size from the dentigerous ridges. Seven species of Abbreviata have been described in this group:

A. pallaryi Seurat, 1917 in Agama bibroni from Morocco.
A. amaniensis Sandground, 1928 in Agama mossambica from Tanganyika
A. achari Mirza, 1935 in Calotes versicolor from India
A. baltazardi Chabaud, 1935 in Phrynocephalus heliscopus from Iran
A. polydentata Walton, 1932 in Hemidactylus mabouia from Tanganyika
A. ortleppi Sandground, 1928 in Chamaelo dilepis from Tanganyika
A. physignathi Baylis, 1924 in Physignathus lesueurii from Australia.

Comparison of our material with the above species shows the following: A. pallaryi is excluded on the basis of its measurements (Table 3). A. amaniensis differs by having a post-esophageal vulva, small eggs (45 μ in diameter) and in the disposition of its caudal papillae. A. achari differs in its measurements and in the method of branching of the uterus which divides into four branches at the same point. Additionally, its spicules are not sclerotized. A. baltazardi is excluded on the basis of its measurements (Table 3) and characteristics such as the presence of a

projecting vulva, quadrichotomous branching of the uterus and the presence of twenty one genital papillae in the male. Our material comes closest to A. polydentata (Table 3) which has a shorter esophagus and differs in both the number and disposition of its genital papillae. Although it is described by Chabaud as having very unequal spicules with the left stated to be 1.15 mm long, this is obviously a misplacement of the decimal; Walton (1932) gives the spicule sizes as 0.425 and 0.1625 mm. Our specimens differ strongly from both A. ortleppi and A. physignathi in the character and extent of the peri-cloacal cuticular ornamentation and in the nature of the oral denticulation.

The conclusion derived from comparison of the present material with previously described species is that it constitutes a new species.

2. Thelandros (Parapharyngodon) tyche sp. n.

a. Description (based on five males and ten females): Pharyngodonidae Travassos, 1919; Pharyngodoninae (Travassos, 1920) Lopez-Neyra, 1946; Thelandros Wedl, 1862; subgenus Parapharyngodon Chatterji, 1933. (The species name derives from Tyche, a Phoenician city goddess of fortune, 2nd Century B.C.)

Thelandros (Parapharyngodon) tyche sp. n.: Adult females about as long as males (Table 4); body whitish, attenuated towards the anterior end. Cuticle thick, with conspicuous transverse striations. Mouth surrounded by three simple bilobed lips with four submedian papillae and two lateral amphids (Plate X; Fig. B). Esophagus divided into long (ca. 84 per cent of total length), cylindrical, pre-bulbar region followed by dark posterior bulb. Intestine dilated at junction with esophagus, remainder straight, with dark contents; anus patent. Lateral and caudal alae present in male, alae lacking in female.

FEMALE: Length 6.49-7.92 mm (mean 7.14 mm). Width 700 μ at esophageal

base. Excretory pore prominent, slightly projecting, 1.76 mm from anterior end. Nerve ring 209 μ behind head. Pre-bulbar esophagus 1.11 mm long, bulb sub-globular 0.19 mm long. Anus 0.7 mm from tail end; tail rounded, with terminal spike. Genital system didelphic, prodelphic; vulva post-esophageal, with anterior lip projecting slightly over aperture, 3.76 mm behind anterior end; vagina vera (Plate X; Fig. E) 570 μ long; vagina uterina 3.35 mm long; ovary not coiled around esophagus, totally postbulbar. Oviparous; eggs unembryonated when laid, 90-100 μ in length, 45-60 μ in diameter, with thin subpolar operculum (Plate X; Fig. C).

MALE: Length 2.89-3.59 mm (mean 3.33 mm); body width at esophageal base 289 μ; maximal width at mid-body 350 μ. Nerve ring 166 μ behind head (Plate X; Fig. A). Pre-bulbar esophagus 700 μ long, bulb 116 μ long. Excretory pore not seen. Testis begins behind esophago-intestinal junction. Spicule single, well sclerotized, 100-110 μ long; gubernaculum absent; cloaca terminal. Post cloacal region with short dorsal lip and long, subterminal spinous appendage on dorsal side; cloacal aperture smooth (without pectinate border). Caudal alae present, broad, terminate on level with end of body. Three pairs sessile papillae present: one pair pre-anal, one pair adanal, one pair on caudal appendage (Plate X; Fig. D).

TYPE HOST: Agama stellio

HABITAT: cecum

TYPE LOCALITY: Kartaba, NebiChite, Zaoutar and Beirut, Lebanon.

b. Remarks

The taxonomic status of the genera Thelandros, Pharyngodon and Parapharyngodon have been and remain considerably confused. Comparison of the works of Calvente, 1948, Freitas, 1957 and Yamaguti, 1961 has led the writer to believe that the simplest course at present is to follow the classification scheme of the latter and to consider the genus

Thelandros as having two subgenera: Thelandros and Parapharyngodon based on the presence or absence of lateral alae in the male. Numerous species of Thelandros (Parapharyngodon) have hitherto been described:

T. (P.) maplestoni Chatterji, 1933 from Calotes versicolor and Hemidactylus flavoviridis in India and Ceylan.
T. (P.) echinatus Rudolphi, 1819 from Agama stellio, A. bibroni, Platydactylus fasciularis, Tarentola mauritanica and Chalcides ocellatus in Europe and Africa.
T. (P.) cinctus Linstow, 1897 from Agama stellio in Egypt.
T. (P.) annulatus Linstow, 1899 from Agama stellio and Chalcides ocellatus in Africa.
T. (P.) micipsae Seurat, 1917 from Lacerta ocellatus, Tarentola mauritanica, Scincus officinalis, Seps chalcides and Cerastes cornatus in Africa.
T. (P.) sceleratus Travassos, 1923 from Tropidurus torquatus and Tapinurus scutipunctatus in Brasil.
T. (P.) kasauli Chatterji, 1935 from Uromastix hardwicki in India.
T. (P.) seurati Sandground, 1936 from Acontias percivali in Africa.
T. (P.) rotundus from Agama atra and Pseudocordylus microlepidotus in S. Africa.
T. (P.) almoriensis Karve, 1949 from Agama tuberculata in India.
T. (P.) pseudothaparius Lucker, 1951 from Xanthusia reticulata in USA.
T. (P.) alvarengai Freitas, 1957 from Mabuya maculata in Brasil.
T. (P.) cameroni Belle, 1957 from Chalcides sepoides and Scincus sp. in Egypt.
T. (P.) meridionalis Chabaud and Brygoo, 1962 from Hoplurus sp. and Acrantophis dumerilii in Madagascar.
T. (P.) awokoyai Babero and Okpala, 1962 from Agama colonarum in Nigeria.
T. (P.) verrucosus Freitas and Dobbin, 1959 from Diploglossus lessonae in Brasil.

Comparison of our specimens with the above species shows that all can be removed from consideration on a basis of one or more characters. The closest species to our material is T. (P.) cinctus Linstow 1897 (cit. Baylis, 1923). A comparison of measurements is shown in Table 4. These species differ, however in at least one major and one minor feature: the spicule in the present species is 100- 111 μ long whereas in T. (P.) cinctus, the size given is 67 μ. The respective egg measurements also differ, but to a lesser degree.

Therefore, we consider our specimens as representing a new species.

3. Foleyella philistinae Schacher and Khalil, 1967

a. Description: Onchocercidae (Leiper, 1911) Chabaud and Anderson, 1959; Dirofilariinae (Sandground, 1921) Chabaud and Anderson, 1959; Foleyella Seurat, 1917.

HOST: Agama stellio

HABITAT: subcutaneous tissues, superficial muscle fasciae under buccal mucosa

LOCALITY: Kartaba, Nebi-Chite, Lebanon.

4. Brygoofilaria gen. n.

a. Description: Filarioidea, Onchocercidae, Eufilariinae. Moderate in size, males smaller than females; cuticle smooth; mouth simple, without lips. Esophagus short, clearly divided; terminal intestine, rectum and anus atrophied in female. Male: posterior extremity loosely coiled, caudal alae absent; tail long with few postanal papillae, none pre-anal; spicules subequal, similar; gubernaculum absent. Female: vulva at esophageal level, opisthodelphic; ovoviviparous; microfilariae in blood, sheated. Parasites of reptiles; type species Brygoofilaria agamae sp. n. Generic name after Dr. E.R. Brygoo, Directeur; Inst. Pasteur; Tananarive, Malgache Republic, in honor of his studies on the parasites of reptiles.

4. Brygoofilaria agamae sp. n.

a. Description (based on six males and ten females): Onchocercidae (Leiper, 1911) Chabaud and Anderson, 1959; Eufilariinae Lopez-Neyra, 1956.

Females longer than males (Table 5); body yellowish-white, elongate-fusiform, gradually attenuated towards posterior extremity. Anterior extremity rounded, without cephalic ornamentation; cuticle smooth; lateral alae absent. Buccal capsule absent; mouth simple, without lips, with four

submedian papillae and two lateral amphids (Plate XI; Fig. B). Esophagus divided clearly into a short (ca. twenty per cent of total length) anterior muscular portion and a longer, darker, vacuolated glandular portion. Nerve ring at level of anterior 1/9 of esophagus. Excretory pore not seen.

FEMALE: Length 11-24.5 mm (mean 20.1 mm); body width at level of esophago-intestinal junction 368 μ; maximal width at mid-body 372 μ. Nerve ring 103-148 μ behind head (Plate XI; Fig. A). Muscular esophagus 0.20 mm long; glandular esophagus 0.77 mm long. Terminal intestine and rectum atrophied; tail tip broadly ovoid (Plate XI; Fig. C). Genital system didelphic, opisthodelphic; ovarian loops found near to end of body; vagina vera semi-modified; vagina uterina short, divides into two uterine branches just behind vulva; vulvar aperture covered by a small backward directed papilliform flap. Uterus filled with microfilariae.

MALE: Length 10.2-15.4 mm (mean 12.3 mm); body width at level of esophago-intestinal junction 205 μ; maximal width at mid-body 192 μ (Table 5). Nerve ring 54-124 μ behind head. Muscular esophagus 0.16 mm, glandular esophagus 0.55 mm long. Testicular loop posterior to esophago-intestinal junction, 0.77 mm behind head. Spicules (Plate XI; Fig. E) subequal, similar, both with cup shaped capitulum and stout, boat-like shaft. Left spicule 160-186 μ long (mean 172 μ), right spicule 151-174 μ long (mean 164 μ); spicule ratio 1: 0.9. Gubernaculum absent. Tail (Plate XI; Fig. F) long (length 2^{+} in excess of width at cloaca), tip dorso-ventrally notched, forming small lobes; no caudal alae. Caudal papillae sessile, pre- and adanal papillae absent, five pairs postanal.

MICROFILARIAE: In blood, sheathed (Plate XI; Fig. D), 157 μ (methanol fixed) and 203 μ (hot ethanol fixation) long, 6 μ wide. Width uniform throughout anterior 5/6 of body, tail tapers slightly to end of body. Sheath flexible, fits lateral margins tightly, looser at head and

tail ends. Both anterior and posterior ends bluntly rounded. Cephalic space short (Table 6); nerve ring narrow, 18-22 per cent of body length from anterior end. Excretory pore and cell not seen; Innenkörper absent; genital cells not seen. Anal pore elongate, about 87 per cent of body length from anterior end. Nucleation dense, extends to tip of tail.

TYPE HOST: Agama stellio

HABITAT: Connective tissue under trachea, pericardial sac, intestinal mesentery

TYPE LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

Brygoofilaria gen. n. is placed in family Onchocercidae (Leiper, 1911) Chabaud and Anderson, 1959 because: (1) it has a smooth and round head; (2) the vulva is anterior; (3) the female produces thin-shelled eggs; (4) the first larval stage is microfilarioid. Its placement in subfamily Eufilariinae Lopez-Neyra, 1956 is indicated by its short esophagus and the absence of caudal alae. Other characters are too variable within the subfamilies to permit placement other than by exclusion. Members of Icosiellinae have dissimilar spicules, cephalic and medio-median papillae having the appearance of spines and are parasites of amphibians. Members of Dirofilariinae have unequal and dissimilar spicules. Onchocercinae have very dissimilar spicules. The Splendidofilariinae have a digitiform tail, the esophagus is often long and thin and the spicules slightly dissimilar. The Ornithofilariinae have a short tail with cloacal papillae gathered into a circle around the cloaca. The Lemdaninae have unequal spicules and are parasites of birds. Brygoofilaria differs principally from the other genera of Eufilariinae in the position of its vulva. Of the other genera, Aproctiana, Skrjabin, 1934; Sarconema, Wehr, 1939; and Eufilaria Seurat, 1921, are parasites of birds and vary from Brygoofilaria in morphological characters such as esophageal character, cuticular

striations and the shape of the caudal tip. Saurositus Macfie, 1924, is the nearest genus to Brygoofilaria but the former has a post-esophageal vulva and a lobed tail in the female. The male of Saurositus has thick, sharply pointed, joined spicules of a different character; gubernaculum and preanal papillae are present; and the microfilariae are half the size of those of Brygoofilaria.

5. Saurositus baal sp. n.

a. Description (based on sixteen males and twenty eight females): Onchocercidae (Leiper, 1911) Chabaud and Anderson, 1959; Eufilariinae Lopez-Neyra, 1956; Saurositus Macfie, 1924.

Adult females long, males about half as long (Table 7); body thread-like, whitish, tapering gradually towards the posterior extremity. Anterior end rounded; cuticle smooth; lateral alae absent; mouth simple, without lips, with four submedian papillae and two lateral amphids (Plate XII; Fig. B). Esophagus divided clearly into a short, (ca. 33 per cent of total length) narrow and clearer muscular region and a longer, wider and darker glandular portion. Nerve ring at junction of muscular and glandular regions. Intestine transparent, atrophied in female; rectum and anus absent. Excretory pore not seen. Parasites of intrahepatic and mesenteric lymph spaces; rarely free in body cavities (Plate XIII; Fig. A).

FEMALE: Length 59-103 mm (mean 81 mm); width 319 μ at mid-body, 276 μ at esophago-intestinal junction. Muscular esophagus 0.18 mm long; glandular esophagus 0.36 mm long. Nerve ring 166 μ from anterior end (Plate XII; Fig. A). Genitalia didelphic, opisthodelphic; vulva behind esophago-intestinal junction in all but one specimen; but with large range in placement (0.57-1.24 mm, mean 0.81 mm). Uterus with plicate or villiform mucosal coat projecting into lumen giving characteristic picture both

grossly and histologically (Plate XIII; Fig. B). Rectum atrophied; posterior end somewhat tapered, with two blunt, non-papillate terminal lobes (Plate XII; Fig. C). Ovoviviparous; embryos in blood.

MALE: Length 26-53 mm (mean 41 mm), maximal width 256 µ at mid-body, 219 µ at esophago-intestinal junction. Nerve ring 147 µ from anterior end; muscular esophagus 0.16 mm, glandular esophagus 0.35 mm long. Testicular head crook-like or bluntly rounded; begins behind esophago-intestinal junction. Spicules (Plate XII; Figs. E, F) subequal, ratio 1: 0.9; right spicule 83 113 µ, left 83-126 µ long; tips broadly joined, with membranous base; gubernaculum present, 26 µ long. Tail coiled in 3-4 turns; no caudal alae. Caudal papillae sessile; one single adanal, four to six preanal, one single postanal, symmetrically distributed or not.

MICROFILARIAE: In blood (Plate XII; Fig. D); sheath seen best with Fülleborn technique; body bluntly rounded at both ends, tapers gradually towards posterior extremity; caudal region nucleated fully. Length 85-87 µ (Table 8). Nerve ring, excretory pore and anal pore well seen, at 30, 38 and 91 per cent respectively of the total length behind the anterior end.

TYPE HOST: Agama stellio

HABITAT: hepatic and mesenteric lymph spaces and free in the body cavity.

TYPE LOCALITY: Nebi-Chite, Lebanon.

b. Remarks

Three species of Saurositus have hitherto been described in the literature:

Saurositus agamae Macfie, 1924 from Agama colonorum in Nigeria and Gold Coast (Ghana);
Saurositus macfiei Fitzsimmons, 1958 from Agama mossambica mossambica in Blantyre and Nyasaland;
Saurositus indicus Deshmukh and Mehdi Ali, 1965 from Calotes versicolor in India.

Although Rasheed (1965), regarded S. macfiei as a synonym of

S. agamae, this synonymy does not seem justified, as the length of the microfilariae of S. macfiei (72-87 μ x 4 μ) differs markedly from that given for S. agamae (106-168 μ x 3-4 μ, Macfie; 148-166 μ x 3 μ, Rasheed). The "stumpy" type (56-78 μ x 5-6 μ) that Macfie referred to S. agamae together with the longer type referred to above probably belongs to another species, the adult of which was not found by him at necropsy.

Saurositus baal sp. n. approximates most closely S. macfiei from which it differs principally in the length of the gubernaculum (10-30 μ in the present material, 72 μ in S. macfiei) and in the number and placement of genital papillae. S. indicus is excluded on the basis of its measurements, and S. agamae on the basis of the length of its microfilariae. In S. baal, in addition to four to six pairs of preanal papillae, both an adanal and a single postanal papillae are present. Both latter papillae are lacking in descriptions of S. macfiei. No ring like anus was seen in the female as described by Fitzsimmons (l.c.) who described the uteri as packed. Considering the large number of female specimens examined, it appears that in this species only a few microfilariae mature at a given time, and that this together with the peculiarities such as a heaped up mucosa may constitute valid species characters. Judging from our material, details of spicule morphology are too variable to be of taxonomic value.

6. "Stumpy" microfilariae

a. Description

Circulating in blood of host (Plate XIV; Figs. A, B); length variable, (Table 9), 39 μ (methanol fixed), 80 μ (after hot ethanol fixation). Sheathed with sheath closely applied to edges of body, extending free anteriorly and posteriorly. Head truncate, tail tip rounded,

nucleated fully. Nuclear column dense, Innenkörper not seen; nerve ring only visible in some specimens fixed in hot ethanol, not seen in methanol fixed, Giemsa stained material. Nerve ring, excretory pore and anal pore 22.5, 41 and 84.5 per cent of body length respectively from anterior end.

b. Remarks

Adults corresponding to these "stumpy" microfilariae were not found at necropsy. Several "stumpy" microfilariae have been described in the literature. Chabaud, Anderson and Brygoo (1959) described as "stumpy" microfilariae (55–60 μ long) of Madathamugadia zonosauri which were found in the water used to wet the carcass during the dissection of Zonosaurus madagascariensis (Gerrhosauridae). In the same paper, they described "stumpy" microfilariae (75 μ long) of Madathamugadia hopluri found in the axillary muscles of Hoplurus sebae (Iguanidae). The body curves of the latter microfilariae are not marked; the sheath was closely applied to the body and difficult to see. Brygoo (1965) described the same microfilariae as 92 μ long; the nerve ring was not seen in all specimens, but the excretory pore was very distinct, while the anal pore was irregularly seen. The posterior extremity was rounded and occupied by nuclei to the tip. The nerve ring, excretory pore and rectal cells were located at 27.1, 41.3 and 60.8 per cent respectively of the body length behind the head. Macfie (1924) described a "stumpy" microfilaria 50–70 μ long which he referred to Saurositus agamae together with a longer slender type 106–168 μ long. It is highly improbable that microfilariae of a single species could vary so widely in measurements, hence Macfie's diagnosis is open to question.

In the absence of adult specimens, the taxonomic affinities of the present material are left open.

C. Acanthocephala

Larval acanthocephala (cystacanths) were found attached to the serosal layer of the small intestine. They measure 4-5 cm in length.

DISCUSSION

Agama stellio is probably the most common and typical of the animals found in Lebanon. As in Palestine (Bodenheimer, 1935), they are common in all regions of the country, where they can be seen running about on rocks, walls, fences and tree-trunks, or sunning themselves throughout the warm season. Their number, availability and ease of laboratory maintenance makes them a good experimental host for parasitological and physiological studies. As they live in close proximity to man and domestic and feral animals, their importance in transmission of zoonotic diseases should be assessed. Insofar as seen in the present study, they probably harbor no helminth pathogens of man; the finding of larval Acanthocephala and cysticercoids show that they may be involved as paratenic hosts in the transmission of helminths to domestic carnivores.

The composition of the fauna of a given region depends both on present environmental conditions and on its past history. According to Bodenheimer (1935), during the early Tertiary Period, *i.e.* the Eocene, Lebanon and Palestine were covered by the sea from which they rose, during the Oligocene and Miocene periods. In the interval between the middle Pliocene and the beginning of the Diluvium, the present features of the land, the last rise of the mountains and the breaking down of the plains took place. Different types of climates have succeeded each other until the present. Among other environmental conditions, the connection with neighbouring countries is of great importance: when the Levant rose from the sea during the Miocene, it was connected with Arabia and Egypt, but was separated from Europe and Asia by the Sea of Tethys. In the Pliocene, this sea became a

continent which extended from the eastern part of the Mediterranean to India. The immigration of European and Asiatic fauna could only take place after establishment of this connection. Influences of the European Ice Age on the formation of the recent fauna are present but are limited in extent. In light of its geological and climatic history and its present day topographic features, the zoo-geographical position of Lebanon, Syria and Palestine is one which allows the occurence of a wide range of faunistic types.

Various species of nematodes and cestodes have been reported in the literature from agamid lizards; but there are very few records of trematodes from this group (Yamaguti, 1958). The only trematodes the writer has been able to trace as reported from the genus Agama are : Infidum nigeriamum from the gall bladder and biliary ducts of Agama colonorum (Babero and Okpala, 1962) and Mesocoelium monodi from the small intestine of the same host in Nigeria (Babero and Okpala, 1962 a). No trematodes were collected in the present study.

Except for the life cycle of Foleyella philistinae, the intermediate host of which is Culex pipiens molestus (Schacher and Khalil, 1967b), no information is available on life cycles of the other species of nematodes found in the present study.

Adult Oochoristica spp. are found in Reptilia, Primata, Carnivora, Insectivora, Marsupialia, Rodentia, Edentata and Chiroptera. Where life cycles are known, the cysticercoids are found in arthropods, especially Coleoptera (Della Santa, 1956). The Oochoristica species recovered and described in this study have not, except for O. tuberculata, been assigned specific status for several reasons. As previous descriptions of species in this genus are often inadequate, it is difficult to assess individual variations and the relative value of many criteria used by

various authors is in doubt. Although it may have been possible to assign specific status to four of the presently studied groups of material, and varietal status additionally to one, the writer agrees with Stunkard and Lynch (1944) when they state: "Since the species of the genus are not clearly delimited and the amount of normal variation which occurs within a given species is not well established, it is questionable to what extent morphological differences should be considered as merely intraspecific variations".

Lizards are the second intermediate hosts of Joyeuxiella or Diplopylidium, the first probably being coprophagous insects (Witenberg, 1932 in Bodenheimer, 1935). The adults are found in the intestine of cats, dogs, foxes, jackals and wolves (Wardle and McLeod, 1952).

According to Bodenheimer (l.c.), lizards act as intermediate hosts for two species of acanthocephalans in Palestine: Prosthenorchis pachyacanthus in jackals and Centrorhynchus clitoridium from owls and hawks. According to Yamaguti (1963), Prosthenorcis pachyacanthus Sonsino, 1899 is of uncertain status; while the latter species is reported by him to be found in cats and dogs in Palestine and cats in Egypt. The lizard is not felt by the writer to be a true intermediate in the life cycle of either species, but rather a paratenic host, with the first host probably an arthropod.

Hyalomma aegyptium, chigger and mesostigmatid mites occur commonly on these lizards (Sweatman, 1967) and might be the intermediate hosts of one or another nematode or cestode parasite of the lizard or other animals. Their importance in this regard waits to be assessed.

TABLE 1

INCIDENCE OF HELMINTHS IN AGAMA STELLIO* FROM DIFFERENT LOCATIONS IN LEBANON

Parasite	Host Origin and Incidence of Helminth Parasites					
	Ain-Zhalta	Beirut	Kartaba	Nebi-Chite	Roumieh	Zaoutar
Oochoristica spp.	2/3	0/2	1/23	5/65	0/1	0/6
Abbreviata adonisi	0/3	0/2	2/23	0/65	0/1	0/6
Thelandros (P.) *tyche*	2/3	2/2	23/23	57/65	0/1	3/6
Folsyella philistinae	0/3	0/2	6/23	1/65	0/1	0/6
Brygoofilaria agamae	0/3	0/2	0/23	3/65	0/1	0/6
Saurositus baal	1/3	0/2	0/23	25/65	0/1	0/6
"Stumpy" Microfilaria	0/3	0/2	0/23	8/65	0/1	0/6
Larval Acanthocephala	0/3	0/2	2/23	0/65	0/1	0/6

* See Text-figure 2 for a map designating the above locations.

TABLE 2

MEASUREMENTS* OF OOCHORISTICA SPP. FROM AGAMA STELLIO

Species & Locality	O. tuberculata Ain-Zhalta	O. sp. 1 Kartaba	O. sp. 2 Nebi-Chite	O. sp. 3 Nebi-Chite	O. sp. 4 Nebi-Chite	O. sp. 4 var. Nebi-Chite
Strobila						
L	39.1(32-53)	26-28	68(63-73)	82	42(30-51)	24.8(21-30)
W	2.08(2.0-2.26)	1.33	2.2(2.0-2.5)	0.70	1.5(0.7-2.3)	1.1
Neck L	0.91(0.83-1.01)	1.39	1.66	0.45	1.6(1.1-2.3)	0.91
Diameter						
Scolex	251(220-290)	216	166(150-190)	320	174(148-193)	145(100-151)
Sucker	(70-90 x 90-100)	74 x 80	80 x 91	68 x 80	74-93 x 100	57-69 x 109
Testes						
Number	44(40-50)	30-32	42(40-44)	28-40	40-44	34-46
Size	22 x 38	48 x 51	37 x 40	23 x 23	23-32 x 34	13-18 x 16-23
Cirrus sac						
Length	160(121-171)	342	228	171	137-190	148-182
Ovary width	260(217-300)	274	265(256-274)	93	160-233	148-205
Vitellarium						
Diameter	114(90-130)	108	160	45	91-125	99-105
Seminal Rec.	Absent	Present	Absent	Absent	Absent	Absent
Egg Dia.	42-50	- -	44	- -	21-40	35-38
Onchosphere	29 x 36	- -	38	- -	16-29	24-27

* Strobila L & W and neck L in mm; all other measurements in microns.

TABLE 3

COMPARATIVE MEASUREMENTS (IN MILLIMETERS) OF SOME SPECIES IN THE GENUS ABBREVIATA

SPECIES	A. baltazardi	A. pallaryi	A. polydentata	A. adonisi
AUTHORITY	Chabaud, 1935	Seurat, 1917	Walton, 1932	Present study
Female				
Length	12.5	19.5	30	27.1 (25.0-32.7)
Width (E-I jctn)	—	—	—	0.49 (0.39-0.57)
Width (mid-body)	0.47	0.49	0.45	0.56 (0.53-0.62)
Esop. length	2.01	3.22	4.42	4.25 (3.82-4.90)
Muscular	0.21	0.24	0.42	0.49 (0.45-0.54)
Glandular	1.8	2.98	4.0	3.55 (3.27-3.84)
Head to:				
Nerve ring	—	0.19	0.39	0.33 (0.31-0.34)
Excr. pore	—	0.30	0.52	0.52 (0.47-0.57)
Vulva	2.3	2.37	3.5	3.32 (2.30-4.27)
Egg	.06 x .03	.06 x .03	.05 x .02	.05-.06 x .02-.03
Male				
Length	8.5	8.5	12.65	16.2
Width (E-I jctn)	—	—	—	0.35
Width (mid-body)	0.36	0.30	0.4	—
Esop. length	1.64	1.73	2.27	3.58
Muscular	0.24	0.26	0.37	0.34
Glandular	1.4	1.47	1.9	3.23
Head to:				
Nerve ring	0.21	0.21	0.25	0.27
Excr. pore	0.3	—	0.4	—
Testis	—	—	—	5.5
R Spicule	0.22	0.15	0.16	0.14
L Spicule	0.32	0.26	0.42	0.37

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TABLE 4

COMPARATIVE MEASUREMENTS* OF T. (P.) TYCHE SP. N. AND T. (P.) CINCTUS

SPECIES	T. (P.) cinctus	T. (P.) tyche
AUTHORITY	Linstow, 1897	Present study
Female		
Length	5.9–7.0	7.14 (6.49–7.92)
Width (E-I jctn)	—	0.70 (0.16–0.88)
Esop. length	1.07–1.43	1.32 (1.16–1.63)
Muscular	0.89–1.23	1.11 (0.98–1.28)
Bulb	0.18–0.20	0.19 (0.17–0.21)
Head to :		
Nerve ring	0.2	0.20 (0.17–0.23)
Excretory pore	1.55–1.80	1.76 (0.74–2.16)
Vulva	3.10–3.65	3.76 (3.26–4.50)
Anus–Tail	—	0.33 (0.20–0.52)
Male		
Length	3.1	3.33 (2.89–3.59)
Width (mid-body)	—	0.35 (0.28–0.39)
Width (E-I jctn)	—	0.28 (0.22–0.32)
Esop. length	0.78	0.81 (0.59–0.91)
Muscular	0.64	0.70 (0.46–0.79)
Bulb	0.14	0.11 (0.10–0.12)
Head to :		
Nerve ring	0.19	0.16 (0.15–0.17)
Caudal alae	0.62	0.58 (0.39–0.71)
Spicule	0.067	0.10 (0.10–0.11)
Caudal papillae	3 pairs	3 pairs

* All measurements in millimeters.

TABLE 5

MEASUREMENTS IN MILLIMETERS OF BRYGOOFILARIA AGAMAE GEN. ET SP. N. FROM AGAMA STELLIO

Character	Measurements
Female	
Length	20.1 (11-24.5)
Width (mid-body)	0.37 (0.27-0.43)
Width (E-I jctn)	0.36 (0.28-0.47)
Esop. length	0.97 (0.75-1.24)
Muscular	0.20 (0.12-0.25)
Glandular	0.77 (0.60-1.02)
NR- Head	0.11 (0.10-0.14)
Vulva-Head	0.69 (0.43-0.96)
Male	
Length	12.3 (10.2-15.4)
Width (mid-body)	0.19 (0.17-0.21)
Width (E-I jctn)	0.20 (0.18-0.23)
Esop. length	0.71 (0.62-0.80)
Muscular	0.16 (0.16-0.19)
Glandular	0.55 (0.45-0.66)
NR- Head	0.09 (0.05-0.12)
Testis-Head	0.77 (0.70-0.88)
Cloaca-Tail	0.27 (0.24-0.31)
L Spicule	0.17 (0.16-0.18)
R Spicule	0.16 (0.15-0.17)
Caudal papillae	5 pairs postanal
Microfilaria	
Length	0.15-0.20

TABLE 6

AVERAGE MEASUREMENTS IN MICRONS OF MICROFILARIAE* OF BRYGOOFILARIA AGAMAE GEN. ET SP. N. FROM AGAMA STELLIO

Preparation	Dried Smear	Dried Smear
Fixative	Abs. Methanol	Hot Methanol
Stain	Giemsa	Hematoxylin
Length	157	203
Cephalic space		
Width	3	4
Length	5 (3.1%)**	6 (2.9%)
Head to :		
Nerve ring	34 (21.6%)	37 (18.2%)
Anal pore	136 (86.6%)	177 (87.1%)

* Ten microfilariae measured for each type of treatment.
** Percentage of body length from head.

TABLE 7

MEASUREMENTS IN MILLIMETERS OF SPECIES IN THE GENUS SAUROSITUS

SPECIES	S. agamae	S. macfiei	S. indicus	S. baal
AUTHORITY	Macfie, 1924	Fitzsimmons, 1958	Deshmukh & Mehdi Ali, 1965	Present study
Female				
Length	80–140	72	18.3	81 (59–103)
Width*	0.3	0.37	0.35	0.31 (0.26–0.36)
Width	—	—	—	0.27 (0.19–0.36)
Esop. length	—	0.58	0. 44	0.54 (0.37–0.72)
Muscular	—	0.13	0.16	0.18 (0.11–0.28)
Glandular	—	0.45	0.28	0.37 (0.28–0.50)
NR- Head	—	0.21	0.07	0.16 (0.11–0.19)
Vulva–Head	—	1.24	0.27	0.81 (0.57–1.24)
Male				
Length	42–45	30	11.5	41 (26–53)
Width*	0.2	0.26	0.23	0.25 (0.20–0.30)
Width	—	0.18	—	0.22 (0.11–0.26)
Esop. length	—	0.49	0.41	0.51 (0.43–0.58)
Muscular	—	0.11	0.12	0.16 (0.13–0.18)
Glandular	—	0.38	0.29	0.35 (0.28–0.42)
NR–Head	—	—	0.03	0.14 (0.08–0.17)
Testis–Head	—	0.58	—	0.65 (0.22–1.15)
L Spicule	0.13	0.12	0.04	0.10 (0.08–0.12)
R Spicule	0.10	0.11	0.04	0.09 (0.08–0.11)
Gubernaculum	Small	0.07	0.03	0.02 (0.01–0.03)
Microfilaria L	.10–.16; .05–.07	.07–.08		.08

* Width at esophago–intestinal junction.

TABLE 8

AVERAGE MEASUREMENTS IN MICRONS OF THE MICROFILARIAE* OF SAUROSITUS BAAL SP. N. FROM AGAMA STELLIO

Preparation	Dried Smear	Dried Smear
Fixative	Abs. Methanol	Hot Ethanol
Stain	Giemsa	Hematoxylin
Length	85	87
Cephalic space		
Width	3.4	4.1
Length	3.6 (4.25%)**	3.6 (4.16%)
Head to:		
Nerve ring	25.6 (30.0%)	23.2 (26.6%)
Excretory pore	32.5 (38.0%)	35.3 (40.5%)
Anal pore	77.6 (91.0%)	76.9 (88.0%)

* Ten microfilariae measured for each type of treatment.
** Percentage of body length from head.

TABLE 9

AVERAGE MEASUREMENTS IN MICRONS OF THE STUMPY MICROFILARIAE* FROM AGAMA STELLIO

Preparation	Dried Smear	Dried Smear
Fixative	Abs. Methanol	Hot Ethanol
Stain	Giemsa	Hematoxylin
Length	39	80
Cephalic space		
Width	4	4
Length	2 (5.1%)**	3 (3.7%)
Head to:		
Nerve ring	—	18 (3.7%)
Excretory pore	16 (41.0%)	—
Anal pore	33 (84.5%)	—

*. Ten microfilariae measured for each type of treatment.
**. Percentage of body length from head.

ABBREVIATIONS USED IN ILLUSTRATIONS

a	anal spot
al	ala
am	amphid
ca	caudal appendage
cs	cephalic space
ep	excretory pore
i	intestine
lsp	left spicule
o	ovary
op	operculum
r	rostellum
rsp	right spicule
s	sucker
vu	vulva
vut	*vagina uterina*
vv	*vagina vera*

PLATE LEGENDS

Plate I *Oochoristica tuberculata*

Figures A–C camara lucida drawings.

A. Scolex

B. Gravid segments

C. Mature segments

PLATE I

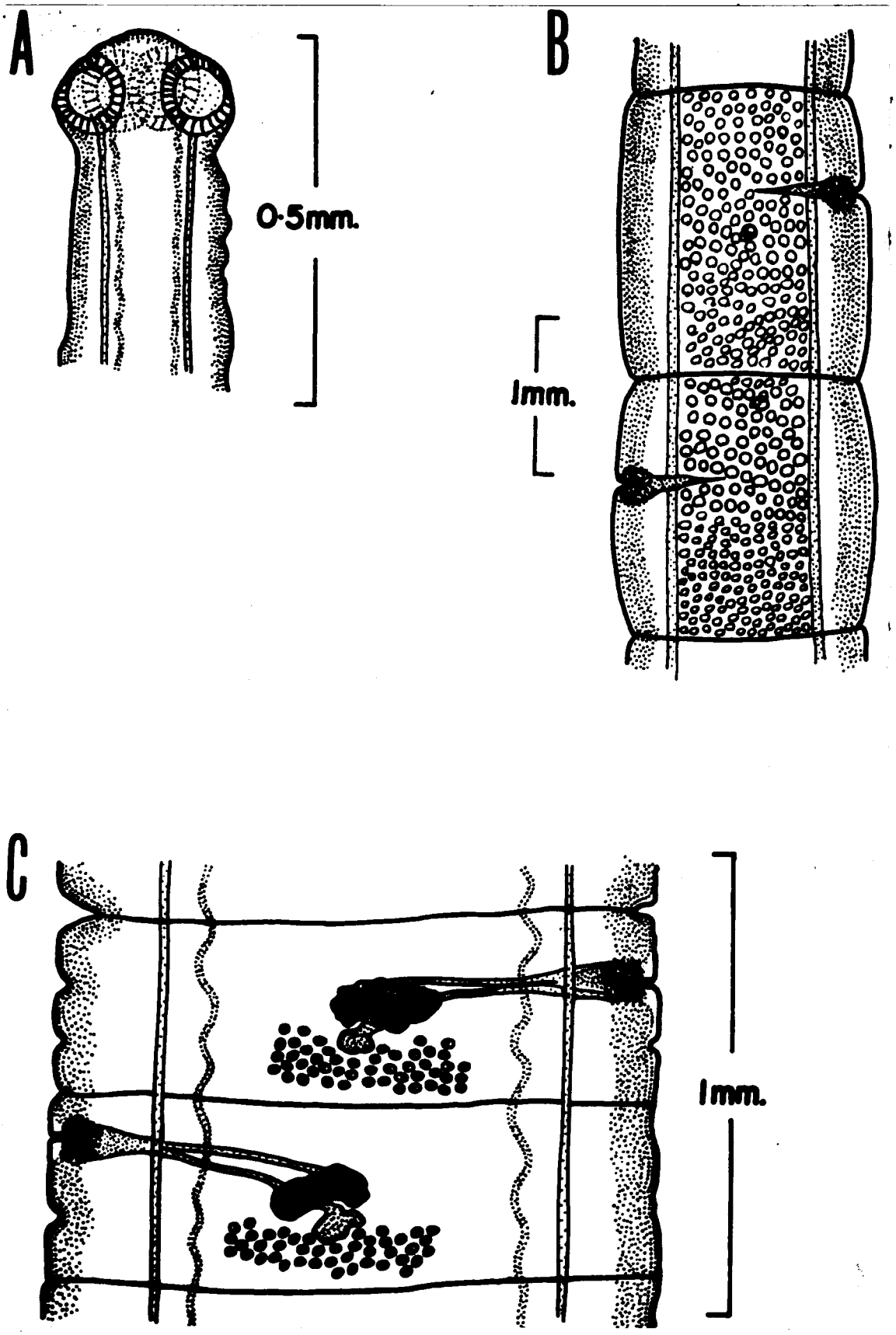


PLATE LEGENDS

Plate II *Oochoristica* sp. 1.

Figures A-B camara lucida drawings

A. Scolex

B. Mature segments

PLATE II

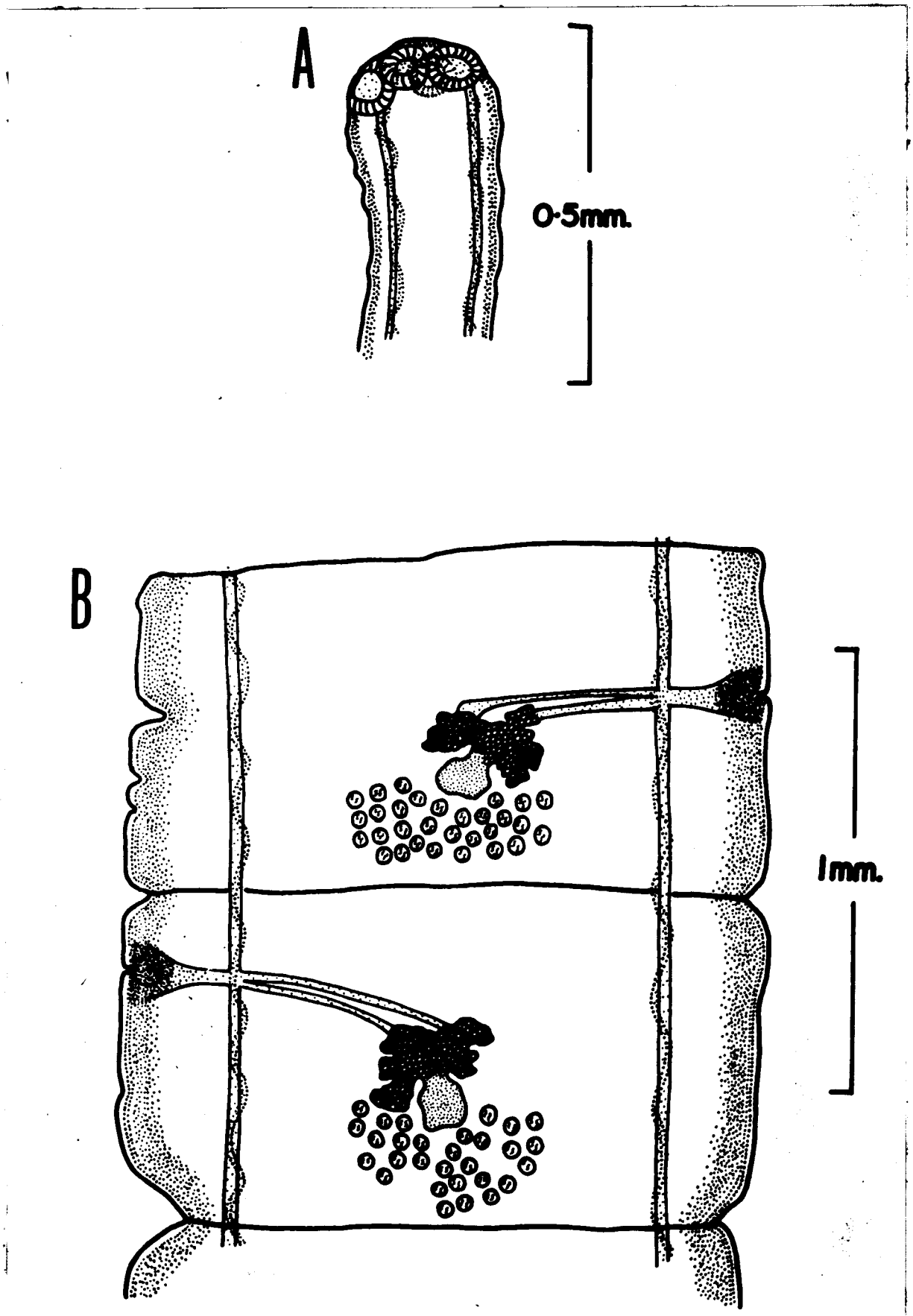


PLATE LEGENDS

Plate III *Oochoristica* sp. 2

Figures A–C *camara lucida* drawings

A. Scolex

B. Gravid segments

C. Mature segments

PLATE III

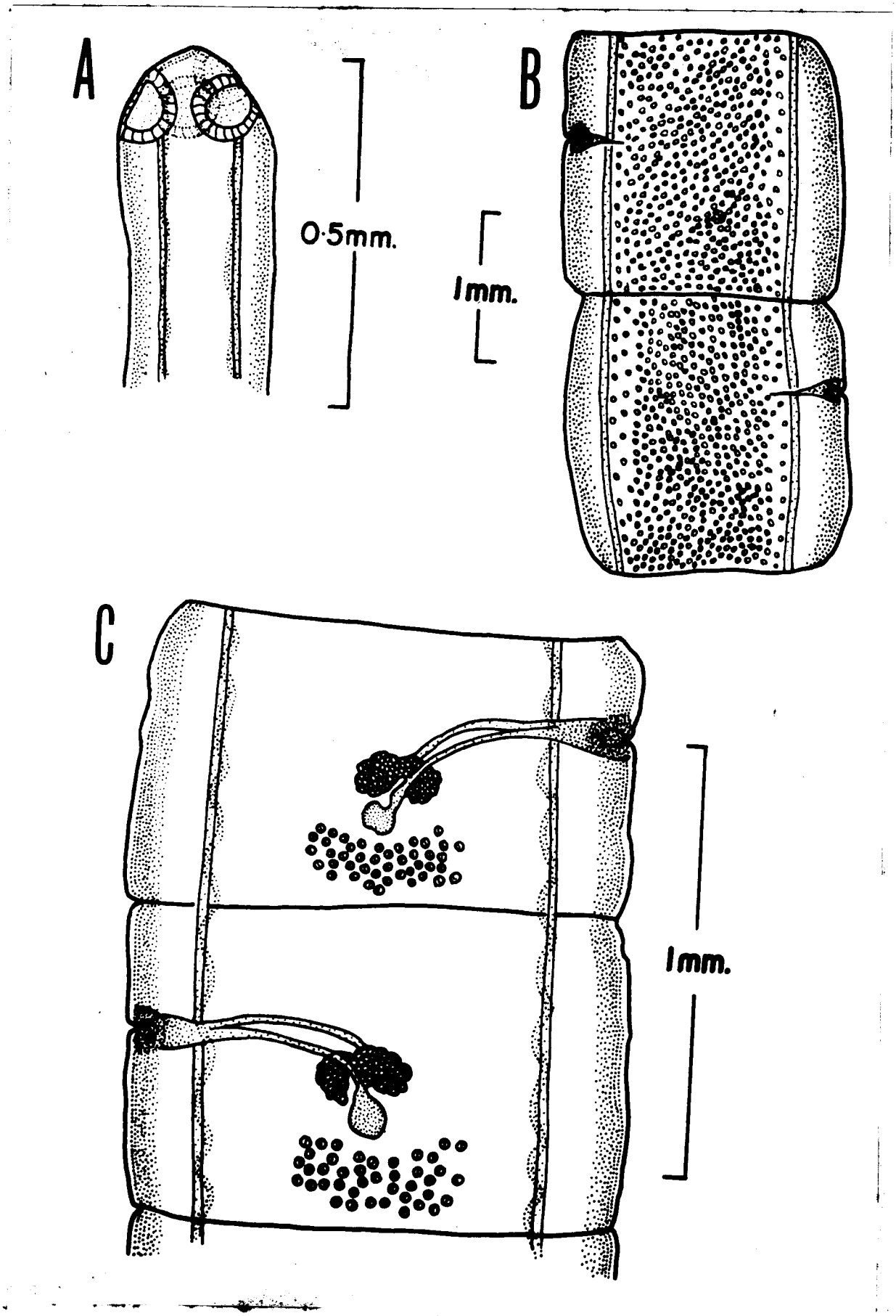


PLATE LEGENDS

Plate IV *Oochoristica* sp. 3

Figures A-B *camara lucida* drawings

A. Scolex

B. Mature segments

PLATE IV

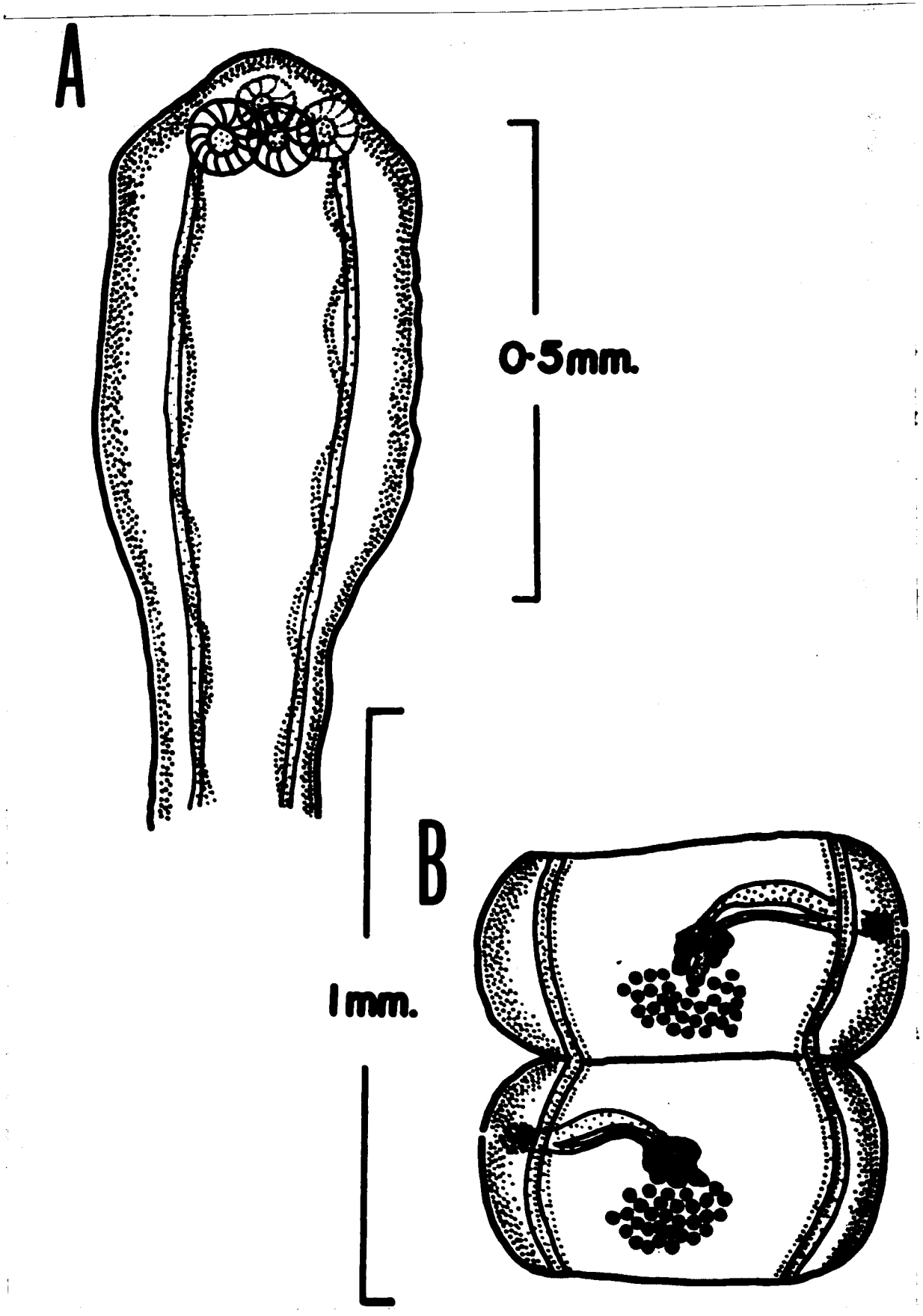


PLATE LEGENDS

Plate V *Oochoristica* sp. 4

Figures A-I *camara lucida* drawings

A, D, G. Scolices of different forms

C, F, I. Gravid segments corresponding to A, B, C above

B, E, H. Mature segments corresponding to A, B, C above.

PLATE V

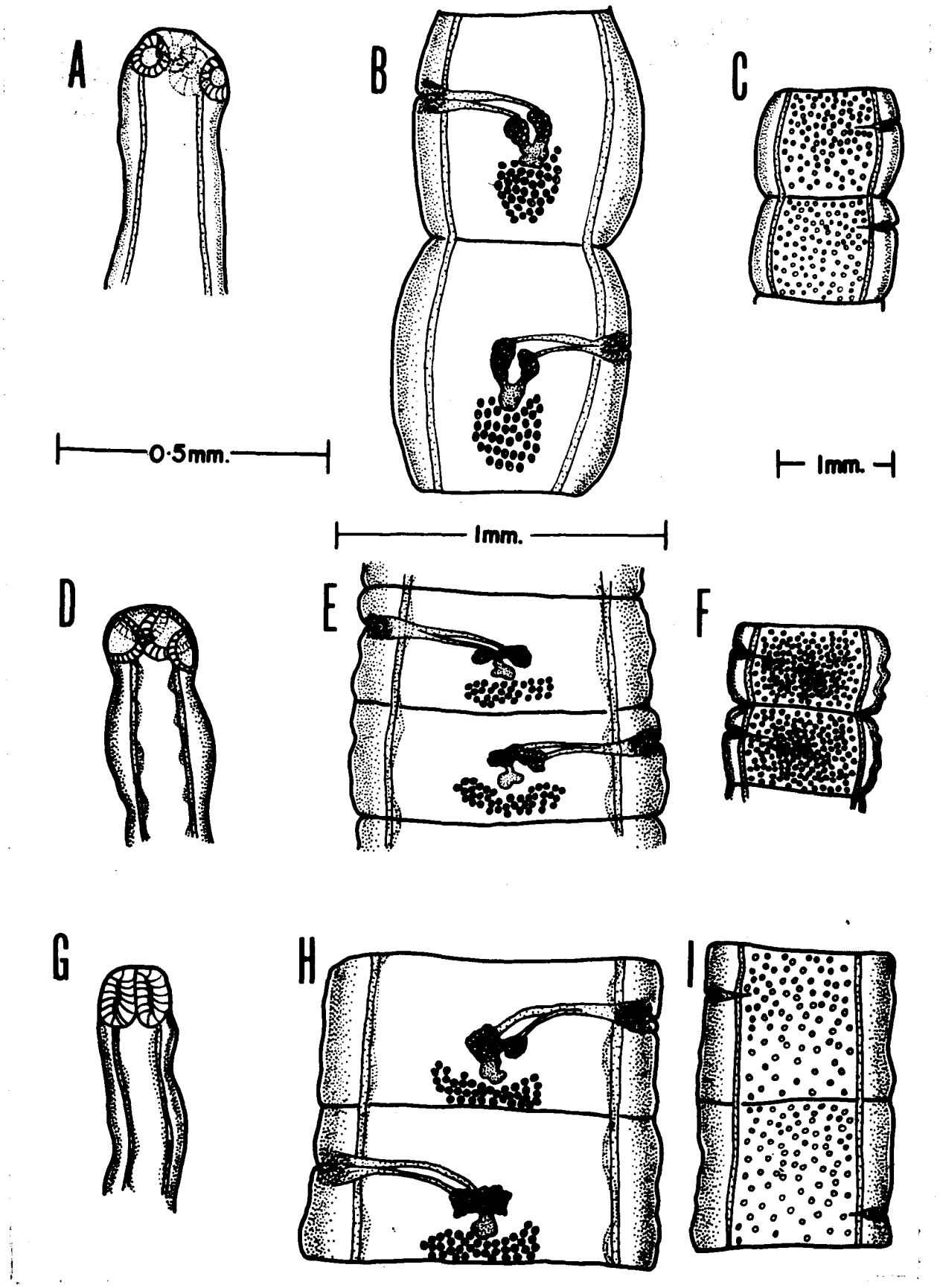


PLATE LEGENDS

Plate VI *Oochoristica* sp. 4 var.

Figures A-C camara lucida drawings

A. Scolex

B. Gravid segments

C. Mature segments

PLATE VI

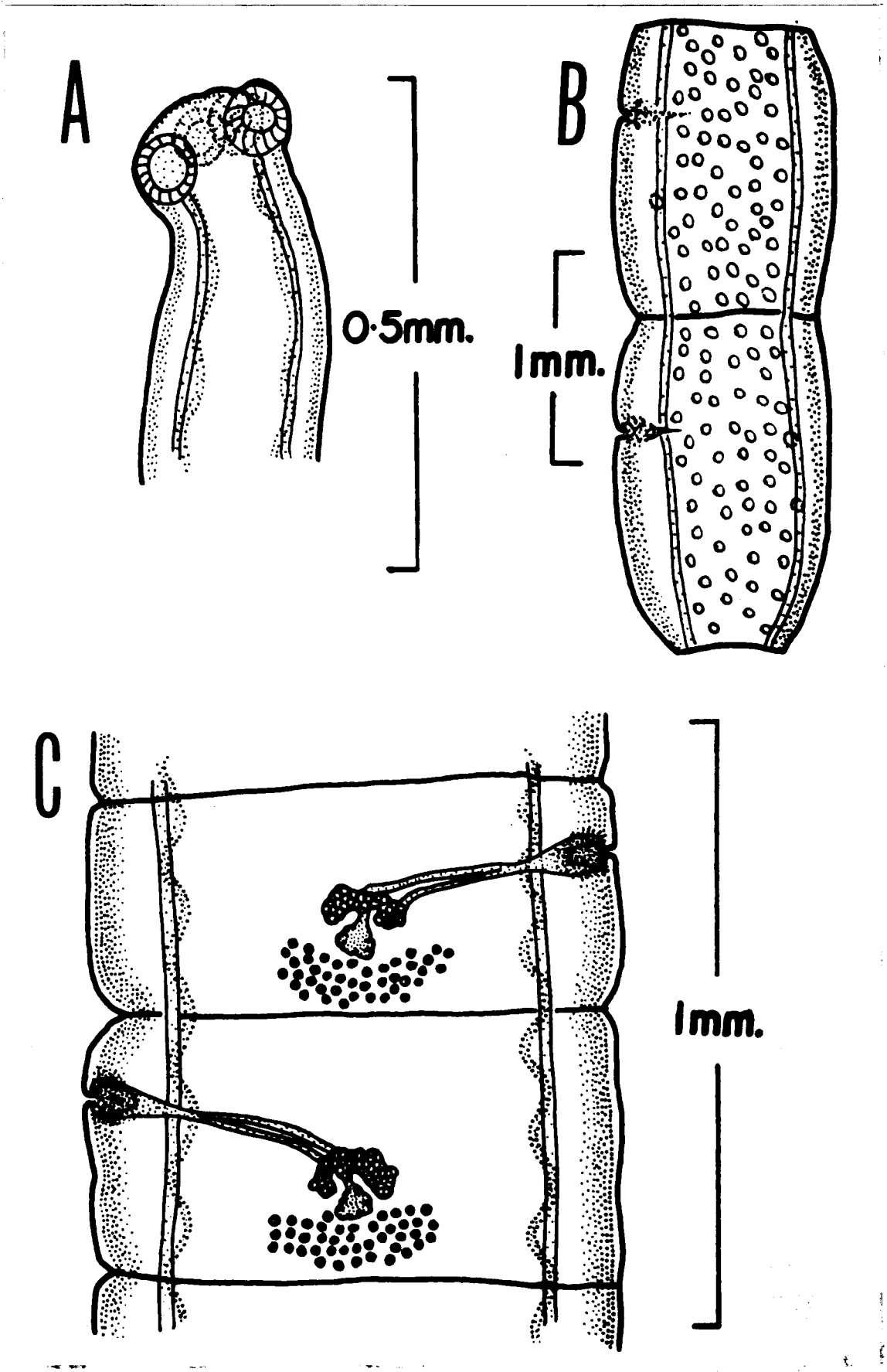


PLATE LEGENDS

Plate VII *Joyeuxiella* or *Diplopylidium* sp. cysticercoid.

A. Photomicrograph of Dilepidid cysticercoid in liver of *Agama stellio*; slightly tangential cross section showing one acetabulate sucker (s) and the rostellum (r). 120X

B. Cysticercoid, longitudinal section showing inverted and introverted scolex. 120X

C. Cross section of rostellum in A (above) to show hook character. 500X

PLATE VII

PLATE LEGENDS

Plate VIII *Abbreviata adonisi* sp. n.

Figures A-E *camara lucida* drawings

A. Anterior end of female, to show nerve ring and associated ganglionic cells and excretory pore (ep).

B. *En face* view showing teeth, dentigerous ridges, cephalic papillae and amphids (am).

C. Left and right spicules (lsp, rsp).

E. Male tail, latero-ventral view showing caudal alae (al), pericloacal rugosity and the placement of genital papillae.

F. Female tail end, lateral view showing an ovarian loop near the rectum.

PLATE VIII

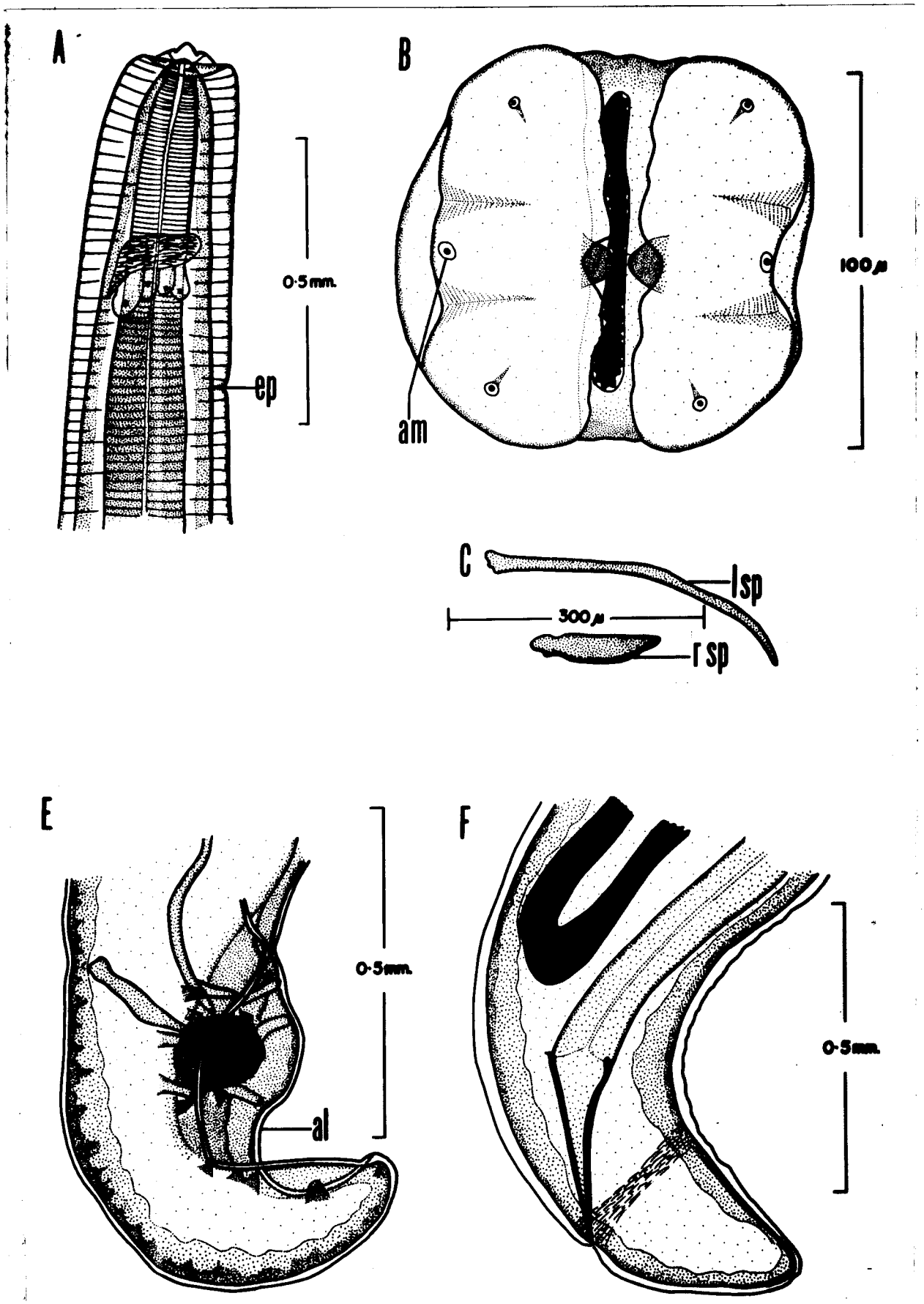


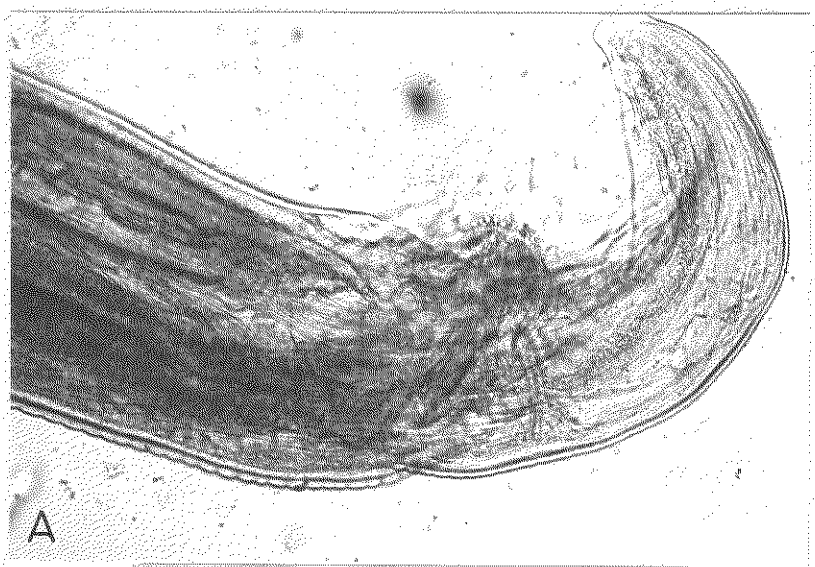
PLATE LEGENDS

Plate IX *Abbreviata adonisi* sp. n.

A. Photomicrograph of male tail, to show caudal alae, genital papillae and rugose peri-cloacal margin. 120X

B. Higher magnification of A (above) to show peri-cloacal rugosities. 500X

PLATE IX



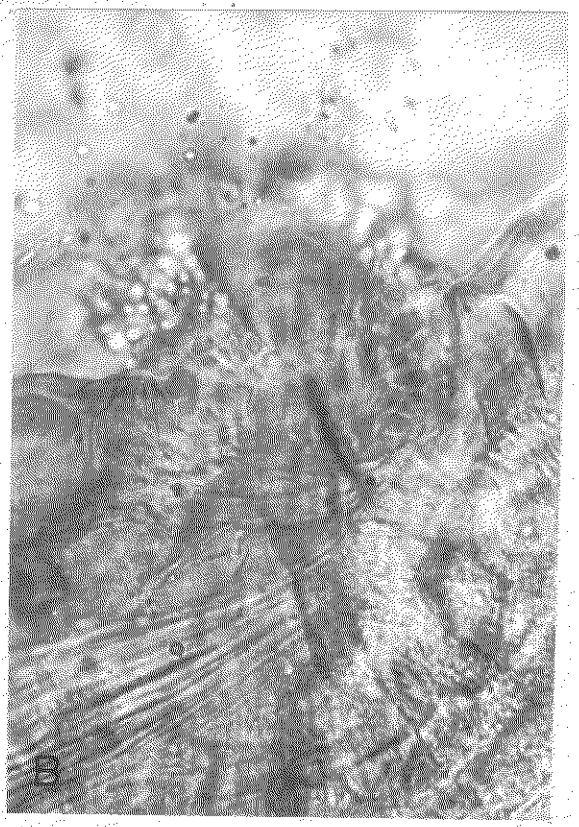


PLATE LEGENDS

Plate X *Thelandros* (*Parapharyngodon*) *tyche* sp. n.

Figures A-E *camara lucida* drawings

A. Anterior end of male showing low lateral alae (al), esophagus anterior intestine and anteriormost extension of the testis.

B. *En face* view showing lips and disposition of amphids (am) and circumoral papillae.

C. Uterine egg with subpolar operculum (op).

D. Male tail, lateral view to show caudal ala (al), caudal appendage (ca) and disposition of papillae.

E. Terminal genitalia of female (dissected specimen) showing vulva (vu), muscular *vagina vera* and *vagina uterina* (vut)

PLATE X

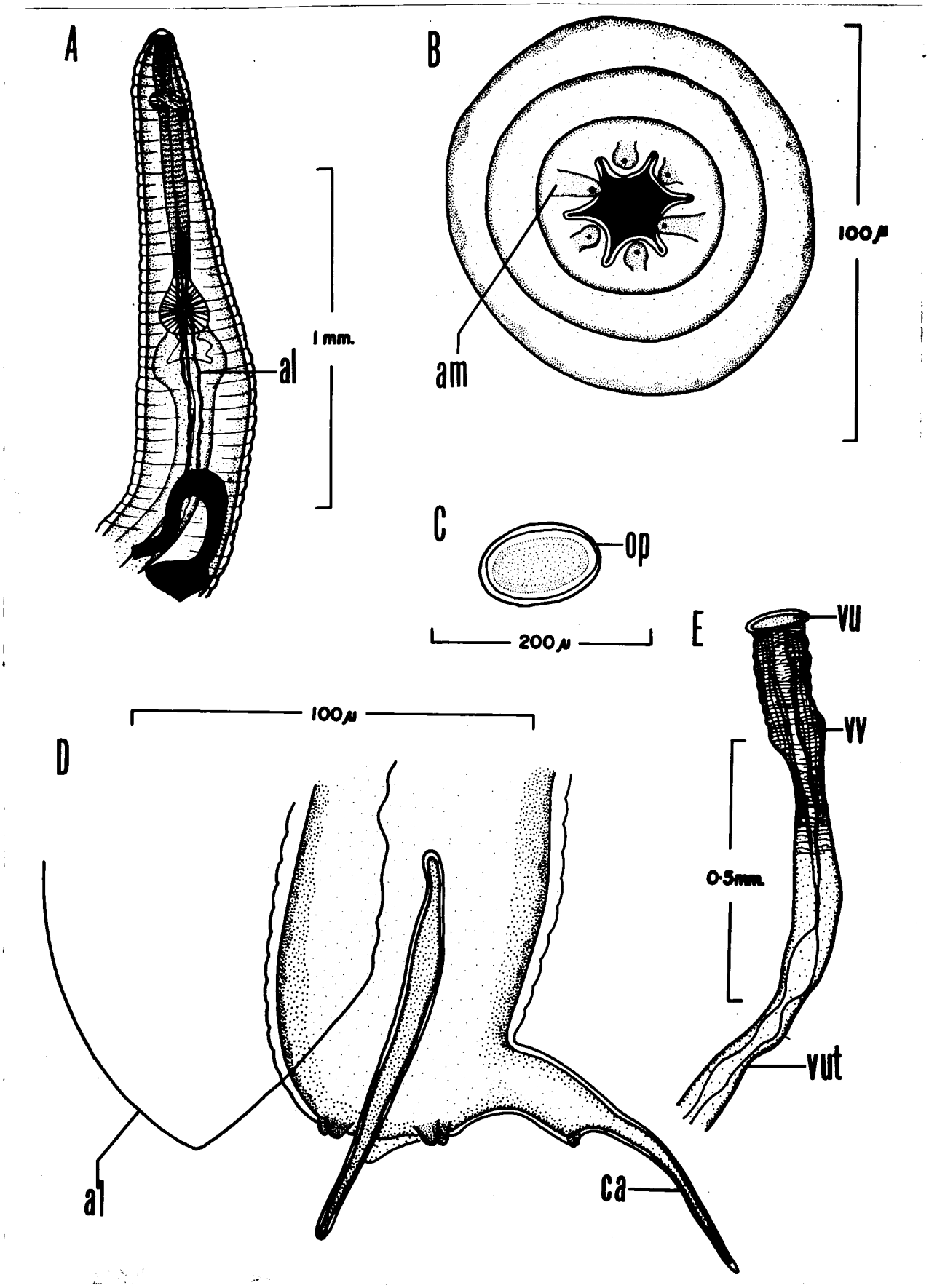


PLATE LEGENDS

Plate XI *Brygoofilaria agamae* gen. et sp. n.

Figures A–F camara lucida drawings

A. Anterior end of female showing projecting anterior lip of vulva; vagina and uterine loop.

B. *En face* view showing amphids (am), mouth and circumoral papillae.

C. Female tail end showing atrophied intestine (i) and ovaries (o)

D. Microfilaria fixed in 70% ethanol at 60°C, stained in hematoxylin. The cephalic space (cs), nerve ring (nr) and anal spot (a) are indicated.

E,F. Male tail ends showing slight variations in the disposition of the papillae and the simple spicule pattern.

PLATE XI

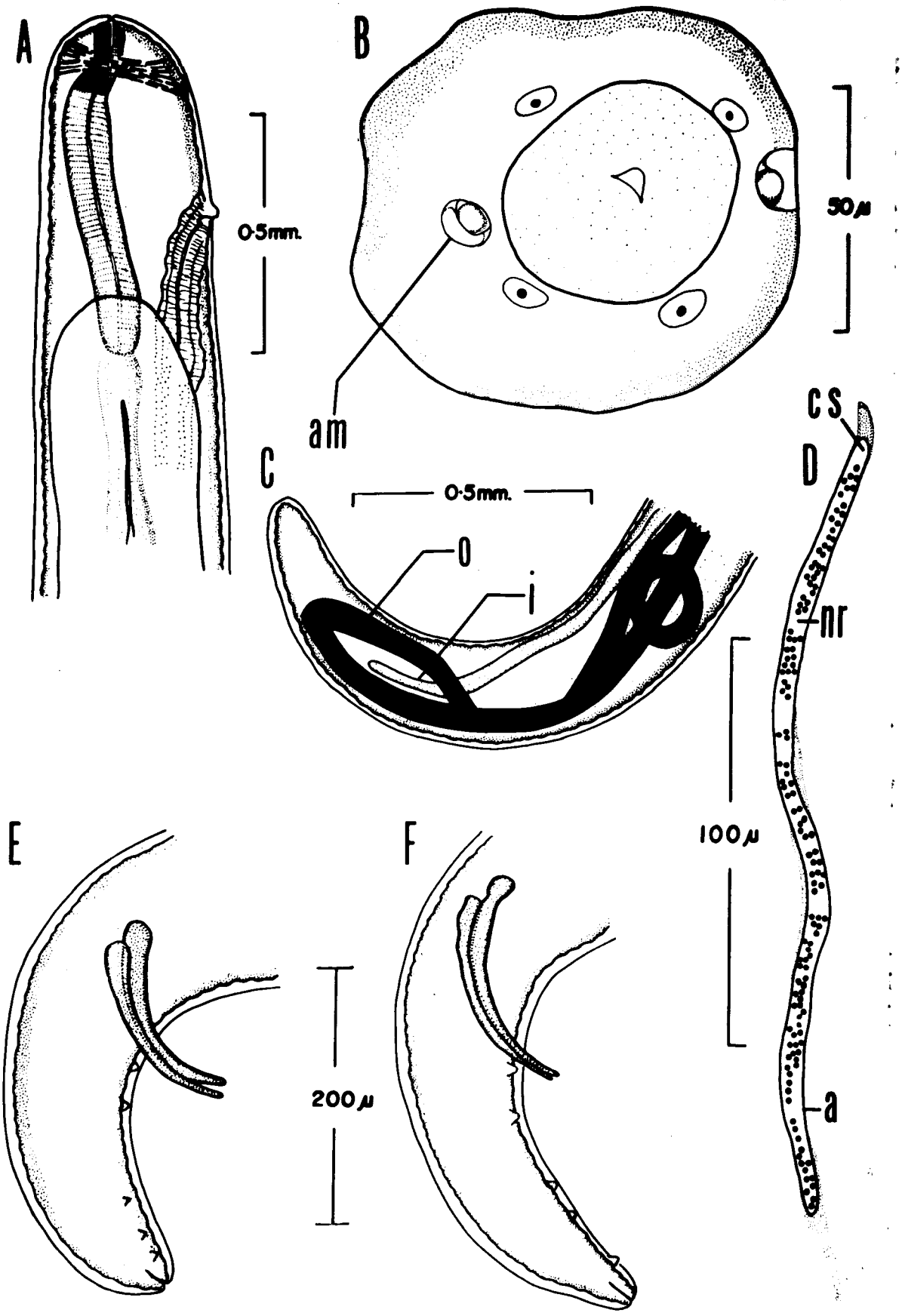


PLATE LEGENDS

Plate XII *Saurositus baal* sp. n.

Figures A-F, *camara lucida* drawings.

A. Anterior end of female, lateral view.

B. *En face* view showing two amphids (am) and oral papillae.

C. Female tail end showing ovaries and remains of atrophied intestine.

D. Microfilaria fixed in 70% ethanol at 60°C, stained in hematoxylin. Note the narrow nerve ring (nr), excretory pore (ep) and anal spot (a).

E. Lateral view of male tail showing spicule pattern, gubernaculum and one of the paired pre-anal papillae.

F. Latero-ventral view of slightly flattened male tail showing papillae and the point of union (arrow of the spicules) which have been separated by flattening.

PLATE XII

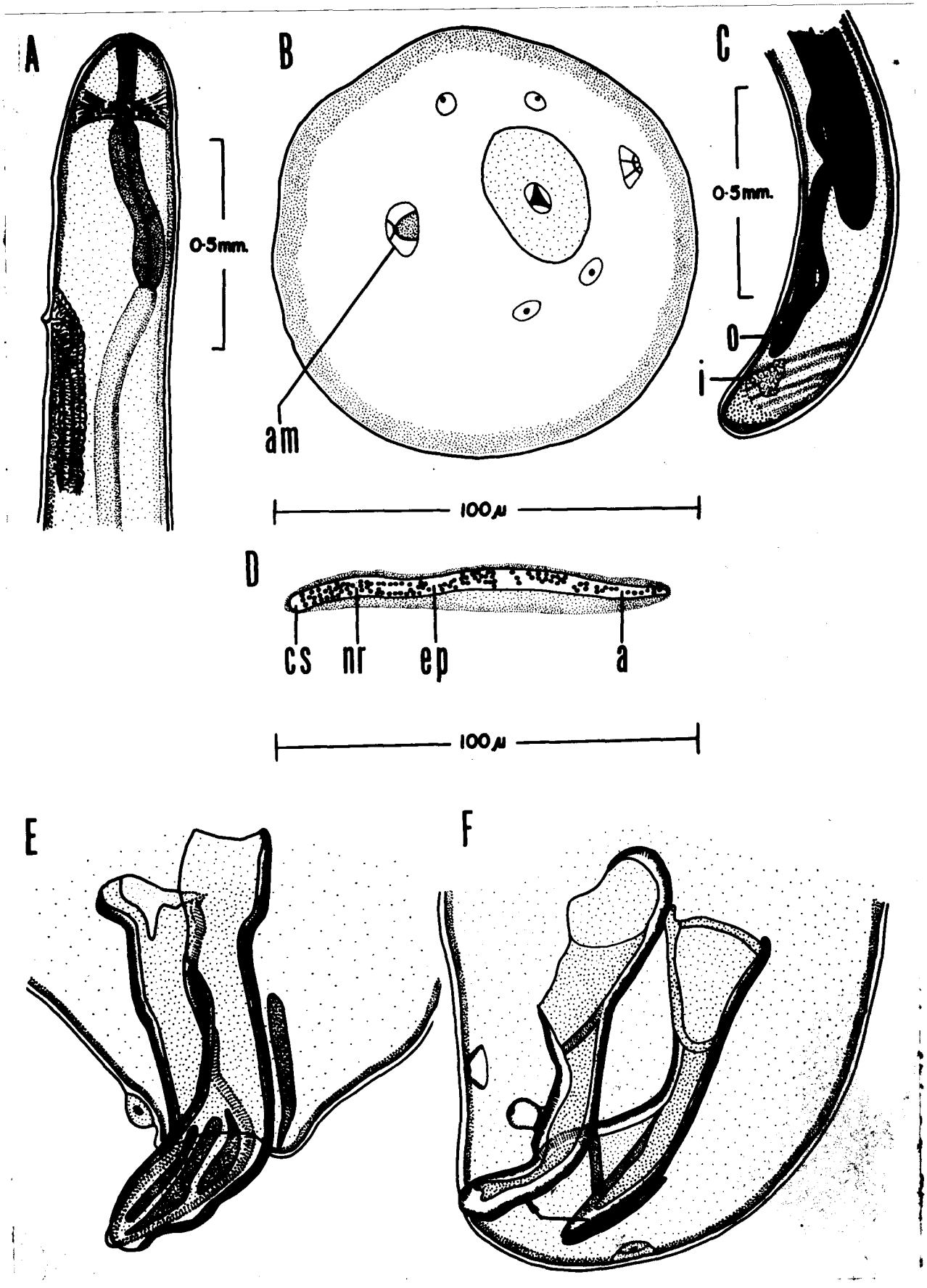


PLATE LEGENDS

Plate XIII *Saurositus baal* sp. n.

A. Photomicrograph of sections of female in intrahepatic lymphatic space. Note the paucity of microfilariae *in utero*. There appears to be little reaction on the part of the host. 120X

B. Cross section through uterine level of adult female to show the heaped up, plicate or villiform mucosal lining of the uterus and the musculature of the body wall. 500X

PLATE XIII

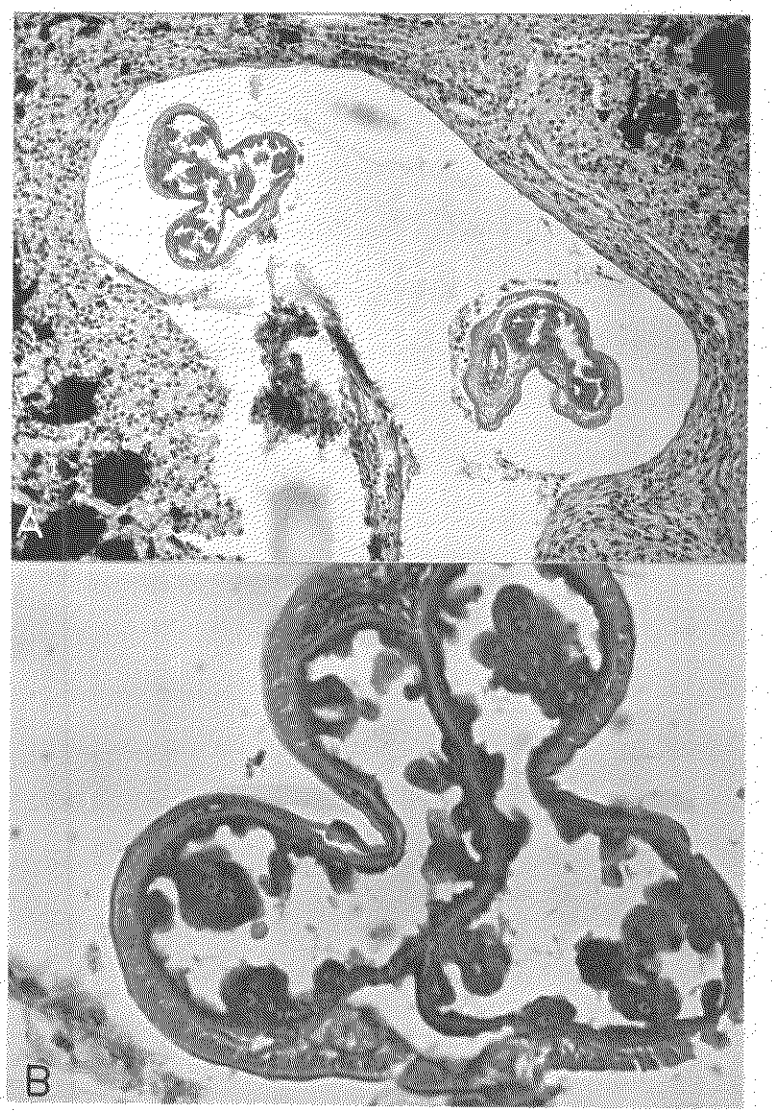


PLATE LEGENDS

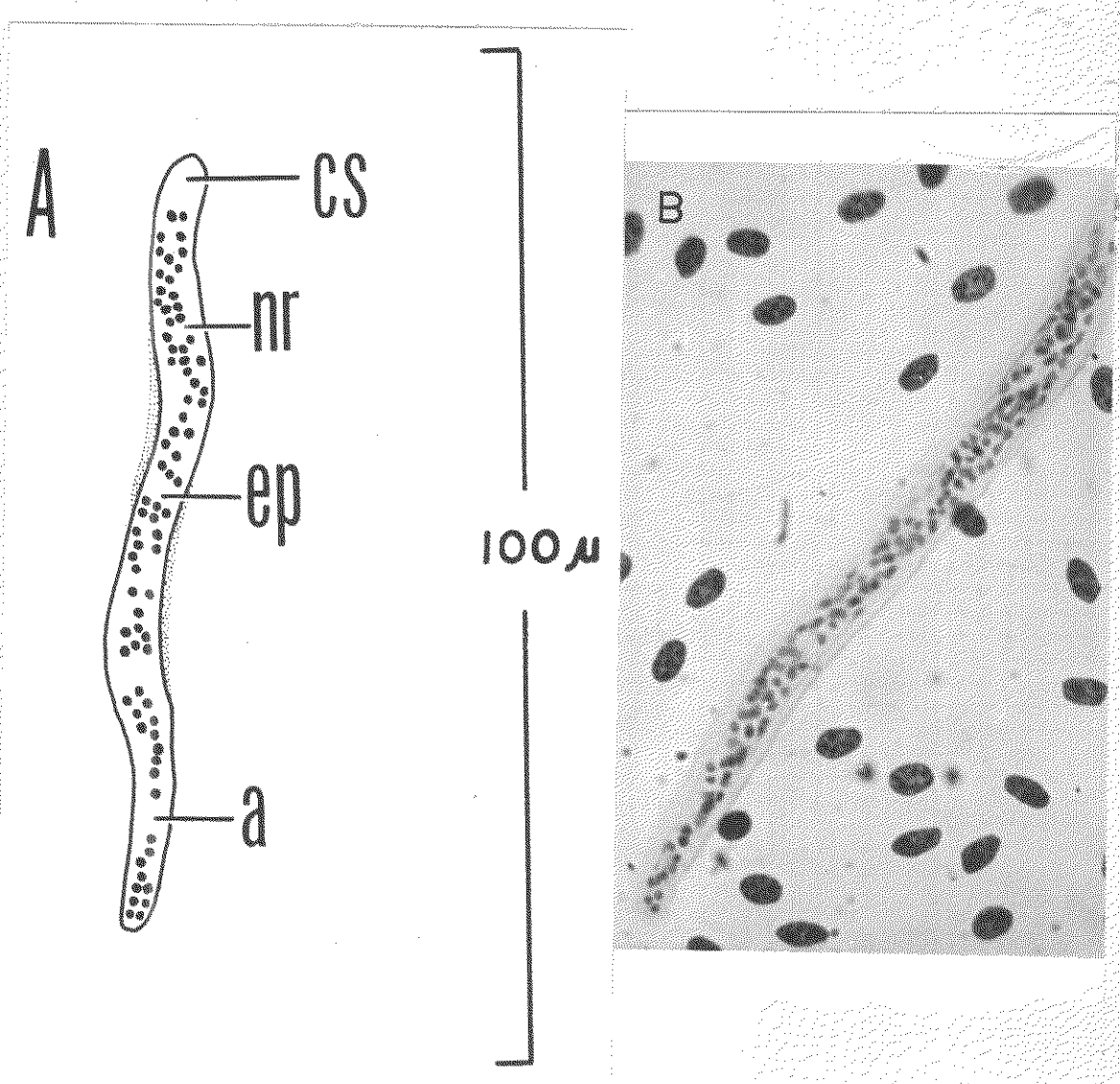
Plate XIV "Stumpy" microfilaria

Figure A *camara lucida* drawing

A. Microfilaria fixed in 70% ethanol at 60°C, stained in hematoxylin. The cephalic space and nerve ring are indicated.

B. Photomicrograph of the same microfilaria. 1230X

PLATE XIV



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