

# THE UNIQUE LUNGWORMS (NEMATODA: METASTRONGYLOIDEA) OF THE OPOSSUM (*DIDELPHIS MARSUPIALIS* LINNAEUS)

Roy C. ANDERSON<sup>1</sup>, M.D. LITTLE<sup>2</sup> and UTA R. STRELIVE<sup>1</sup>

<sup>1</sup> Department of Zoology, College of Biological Science, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

<sup>2</sup> Department of Parasitology, Tulane University, School of Medicine, New Orleans, Louisiana, 70112, U.S.A.

## Summary

*Prestwoodia delicata* (Travassos, 1946) Anderson, 1978, *Heterostrongylus heterostrongylus* Travassos, 1925 and *Didelphostrongylus hayesi* Prestwood, 1976 are redescribed on the basis of new collections of specimens from *Didelphis marsupialis* from North and South America. The three genera are unique to the opossum. *Prestwoodia* from the nasal sinuses is most similar to *Troglostrongylus* of Felidae. *Heterostrongylus* and *Didelphostrongylus* are similar in size and certain other features such as their six prominent lips and reduced bursae. The dorsal ray in the former, however, consists of a large, rounded lobe whereas in the latter, it is divided into two long branches. *Didelphostrongylus* is found under the pleura whereas *Heterostrongylus* is found in the bronchi.

## Introduction

The opossum is host to three distinct monotypic lungworm genera which, however, have not been adequately described. *Prestwoodia* Anderson, 1978 was proposed for *Troglostrongylus delicatus* Travassos, 1946 from the nasal sinuses. Anderson gave a new illustration of the male caudal extremity to illustrate the main generic character but other features of this species have not hitherto been verified or elucidated. *Heterostrongylus* Travassos, 1925 was proposed for *H. heterostrongylus* from the bronchi of the opossum in South America. Anderson (1978) showed that

the genus belongs in the Angiostrongylidae and he redescribed the caudal end of the male and the cephalic structures to establish the validity of the genus. Travassos's description of *H. heterostrongylus* contains numerous errors and the species has been in need of redescription for many years. *Didelphostrongylus* Prestwood, 1976 from under the lung pleura, requires restudy to clarify its relationship to *Heterostrongylus*. The generitypes of both genera are short, stout worms with well developed lips and other features in common. Prestwood did not compare her new genus with *Heterostrongylus* because the latter had been classified incorrectly with the Metastrongylidae. In transferring *Heterostrongylus* to the Angiostrongylidae, Anderson (1978) noted the affinities between *Didelphostrongylus* and this genus. He illustrated the bursa of the latter and established the distinctness of the two genera. *D. hayesi*, however, requires a redescription because certain characters were not fully described originally and care must now be taken to separate this species from *H. heterostrongylus*.

In the present article, *Prestwoodia delicata*, *Heterostrongylus heterostrongylus* and *Didelphostrongylus hayesi* are redescribed on the basis of new specimens.

## Materials and methods

Four male and four female specimens of *P. delicata* were available for study. Ten male and 13 female specimens of *H. heterostrongylus* were studied. These specimens and those of *P. delicata*

## The unique lungworms of *Didelphis marsupialis*

were collected from the opossum in Cali, Colombia and were in excellent condition after preservation in glycerin alcohol. In addition, the types of *H. heterostongylus* were obtained through the courtesy of Dr. D. C. Gomes of the Institute of Oswaldo Cruz. These consisted of a complete female and a complete male as well as fragments of a second male. Although somewhat darkened they were in satisfactory condition for study.

Six male and six female specimens of *D. hayesi* were collected in Georgia and kindly made available by Dr. A. K. Prestwood, University of Georgia. Specimens studied had been preserved in glycerin alcohol and were in excellent condition. Specimens were studied usually after clearing in glycerin or lactophenol. Rarely beechwood creosote was used to reveal details of the spicules and gubernaculum. Measurements are given in micrometres unless otherwise indicated. The range is followed by the mean.

### ***Prestwoodia delicata* (Travassos, 1946) Anderson, 1978** (Figs. 1–9)

Syn. *Troglostongylus delicatus* Travassos, 1946.

#### *General*

Metastrongyloidea, Crenosomatidae, *Prestwoodia* Anderson, 1978. Large worms slightly tapered at extremities. Cuticle slightly inflated but teguminal sheath not prominent. Oral opening large and surrounded by broad but thin cuticular ring, leading into shallow buccal cavity with thin walls. Cephalic extremity without obvious elevations. Cephalic papillae inconspicuous. Lips absent.

#### *Male*

Length 4.2–4.6(4.5) cm. Maximum width 360–570 (440), near middle of body. Oesophagus 450–540 (500) in length. Nerve ring inconspicuous, 171–202 (192) from cephalic extremity. Excretory pore prominent, 200–262 (237) from cephalic extremity, leading into long conspicuous terminal excretory duct connected to long excretory glands extending posteriorly in pseudocoelom. Bursa highly developed, as long as broad (270–285 in diameter), joined anteriorly and not incised posteriorly. Rays well developed. Ventral rays in form of long stalk

split at apices. Externolateral rays independent of other lateral rays. Mediolateral and externolateral rays in form of long stalk split at apices. Externodorsal ray well developed, arising independently of other rays. Dorsal ray in form of two mounds, each with small ventral papilla and two long branches. Spicules long and slender, 1350–1450 (1415) in length. Gubernaculum well defined, in form of distal spoonlike expansion and proximal handle, 210–300 (248) in length.

#### *Female*

Length 11.2–11.5 (11.4) cm. Maximum width 630–760 (720) near middle of body. Oesophagus 530–610 (572) in length. Nerve ring inconspicuous, 190–249 (246) from cephalic extremity. Excretory pore prominent, 190–250 (223) from cephalic extremity. Vulva 5.2–5.4 (5.2) cm from cephalic extremity. Vulva circular, not on elevation, leading into double ovejector. Each arm of ovejector giving rise to uterus with many first-stage larvae. Tail tapering to blunt point, 210–260 (242) in length. Anus prominent, with cuticular flap.

#### *Host*

*Didelphis marsupialis* (Didelphidae)—opossum.

#### *Localization in Host*

Nasal sinuses.

#### *Locality*

Cali, Colombia.

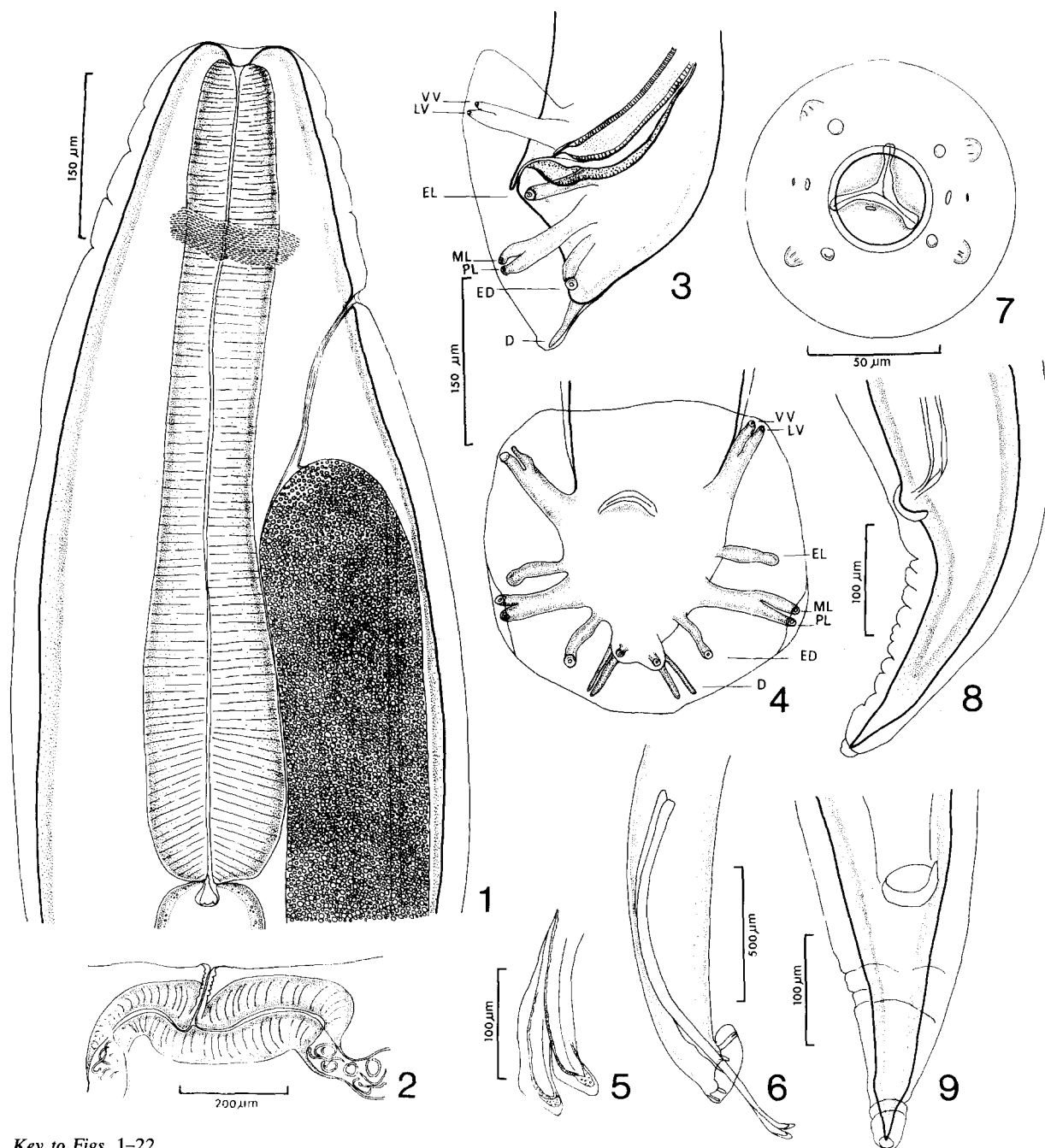
#### *Specimens*

United States National Museum Helminthological Collection Number 74957

### ***Heterostongylus heterostongylus* Travassos, 1925** (Figs. 10–16)

#### *General*

Metastrongyloidea, Angiostrongylidae, *Heterostongylus* Travassos, 1925. Short, stout worms with moderately developed teguminal sheath. Cephalic extremity with six well-developed lips. Oral opening circular and surrounded by delicate ring leading into shallow, inconspicuous buccal



Key to Figs. 1-22

D = dorsal ray, ED = externodorsal ray, EL = externolateral ray, LV = lateroventral ray, ML = mediolateral ray, PL = posterolateral ray, VV = ventroventral ray.

Figs. 1-9

*Prestwoodia delicata* (Travassos, 1946) Anderson, 1978

Fig. 1. Anterior extremity female, lateral view.

Fig. 2. Vulva region, lateral view.

Fig. 3. Caudal extremity male, lateral view.

Fig. 4. Caudal extremity male, ventral view.

Fig. 5. Distal extremity spicules, lateral view.

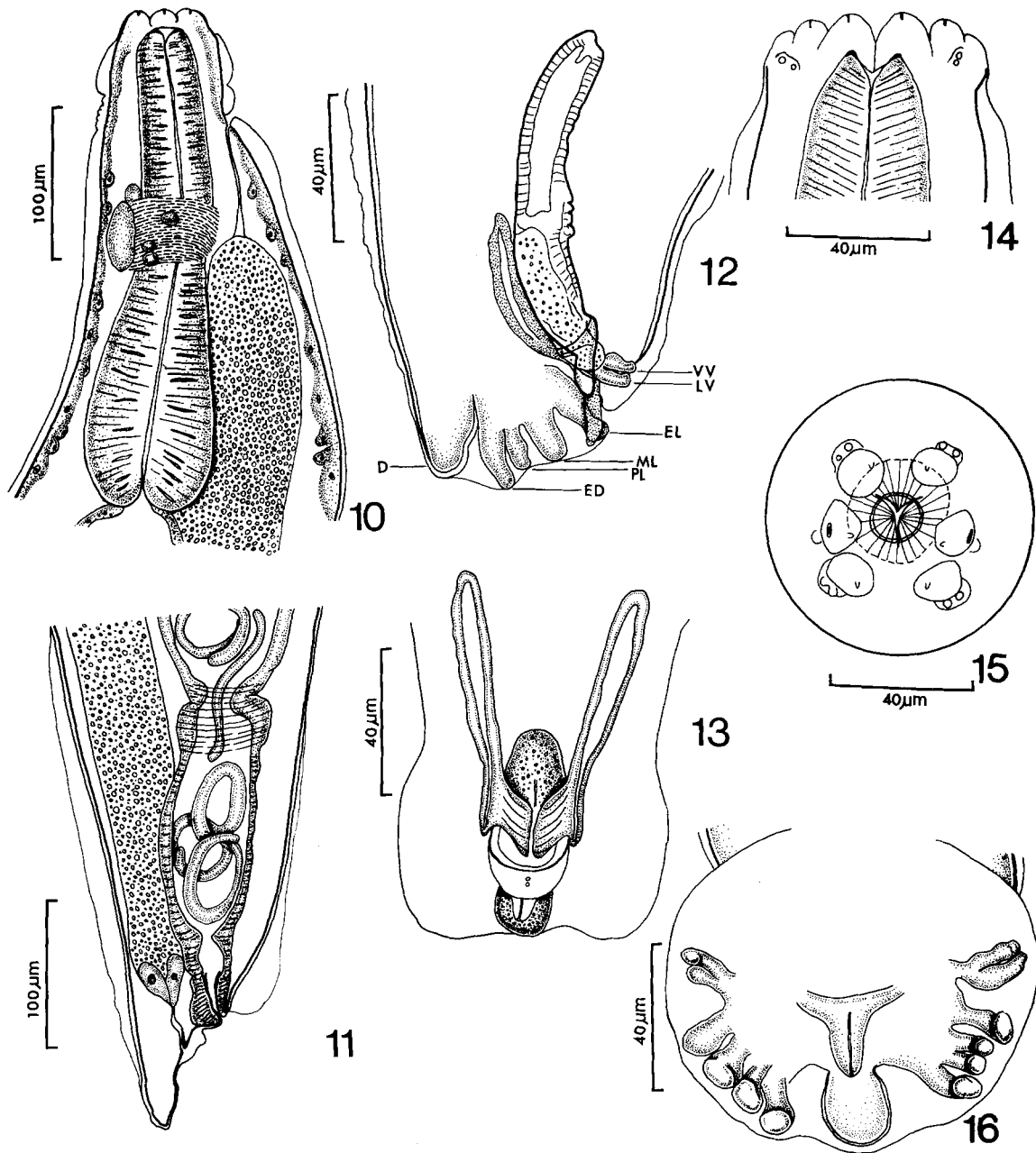
Fig. 6. Caudal extremity male, lateral view.

Fig. 7. Cephalic extremity female, *en face* view.

Fig. 8. Caudal extremity female, lateral view.

Fig. 9. Caudal extremity female, ventral view.

The unique lungworms of *Didelphis marsupialis*



Figs. 10–16

*Heterostrongylus heterostrongylus* Travassos, 1925

Fig. 10. Anterior extremity female, lateral view.

Fig. 11. Caudal extremity female, lateral view.

Fig. 12. Caudal extremity male, lateral view.

Fig. 13. Caudal extremity male, ventral view.

Fig. 14. Cephalic extremity female, lateral view.

Fig. 15. Cephalic extremity female, en face view.

Fig. 16. Caudal extremity male, ventral view.

cavity. Cephalic papillae well developed. Cuticle immediately behind lips often constricted to form neck-like region. Oesophagus short, claviform. Nerve ring inconspicuous. Excretory pore leading into long terminal excretory duct followed by prominent glands.

#### Male

Length 5.1–8.3 (7.0) mm. Maximum width 285–320 (285), near middle of body. Oesophagus 265–328 (294) in length. Nerve ring well developed, 111–168 (136) from cephalic extremity. Excretory pore 70–109 (93) from cephalic extremity. Bursa small, round and not joined anteriorly, Rays thick. Ventral rays short, separate. Lateral rays independent of each other, externolateral largest of group. Mediolateral and externolateral rays short and stout. Externolateral ray independent, as prominent as externolateral. Dorsal ray in form of large ovoid unbranched lobe. Spicules 86–170 (132) in length, stout, slightly arcuate with complex medially expanded distal ends. Gubernaculum broad, boat-like, apparently extending as hyaline, tongue-like structure from posterior lip of anus, 118–145 (137) in length.

#### Female

Length 6.5–12.3 (9.2) mm. Maximum width 350–480 (420), near middle of body. Oesophagus 313–362 (330) in length. Nerve ring 105–180 (134) from cephalic extremity. Excretory pore 69–150 (114) from cephalic extremity. Vulva 60–135 (90) from caudal extremity. Ovejector rather long and muscular, 185–342 (251) in length, with well developed sphincter near distal end. Ovejector and uteri filled with fully developed first-stage larvae. Tail digitiform, 45–71 (56) in length.

#### Host

*Didelphis marsupialis* (Didelphidae)—opossum.

#### Location in Host

Bronchi.

#### Locality

Cali, Colombia.

#### Specimens

United States National Museum Helminthological Collection No. 74955

***Didelphostrongylus hayesi* Prestwood, 1976.**  
(Figs. 17–22)

#### General

Metastrongyloidea, Angiostrongylidae, *Didelphostrongylus* Prestwood, 1976. Short, stout worms with moderately well-developed teguminal sheath. Cephalic extremity with six well-developed lips. Oral opening triangular, leading into inconspicuous buccal cavity. Cephalic papillae well developed. Cephalic extremity with lips often broader than body immediately posterior. Oesophagus short, claviform. Nerve ring well defined. Excretory pore leading into long terminal excretory duct followed by prominent glands.

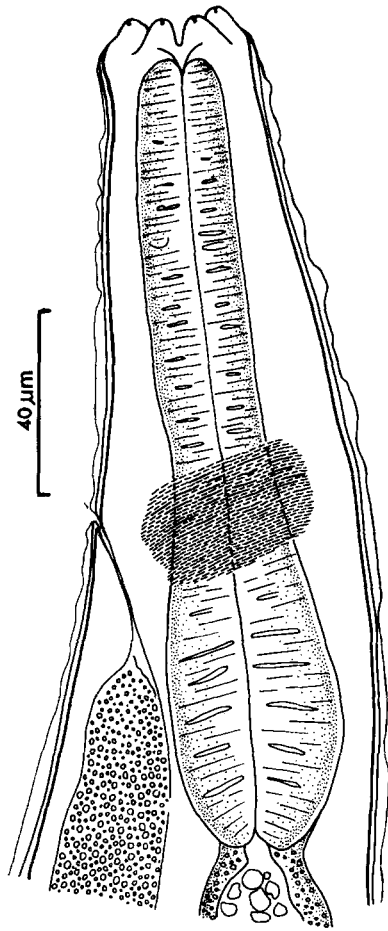
#### Male

Length 5.0–7.5 (5.8) mm. Maximum width 110–162 (131) near middle of body. Oesophagus 140–174 (156) in length. Nerve ring 74–100 (89) from cephalic extremity. Excretory pore 85–100 (93) from cephalic extremity. Bursa weakly developed. Ventral rays short, joined to broad common stalk. Lateral rays stubby and joined to stout triangular common trunk, externolateral ray well separated from other lateral rays which are close to each other. Externodorsal ray well developed and separate from other rays. Dorsal ray consisting of small rounded mound giving rise to pair of long digitiform extensions. Spicules short, complex, slightly arcuate, 60–72 (66) in length. Gubernaculum complex, 60–73 (67) in length, apparently with hyaline extension from posterior border of anus.

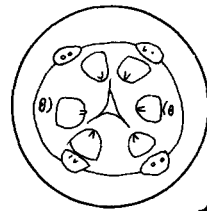
#### Female

Length 11.3–14.2 (12.6) mm. Maximum width 250–300 (259) near middle of body. Oesophagus 159–210 (189) in length. Nerve ring 82–121 (101) and excretory pore 85–102 (97) from cephalic extremity. Vulva 44–89 (61) from caudal extremity, leading into short ovejector 55–86 (70) in length. Uterus with fully developed first-stage larvae. Tail short and rounded, 18–32 (23) in length.

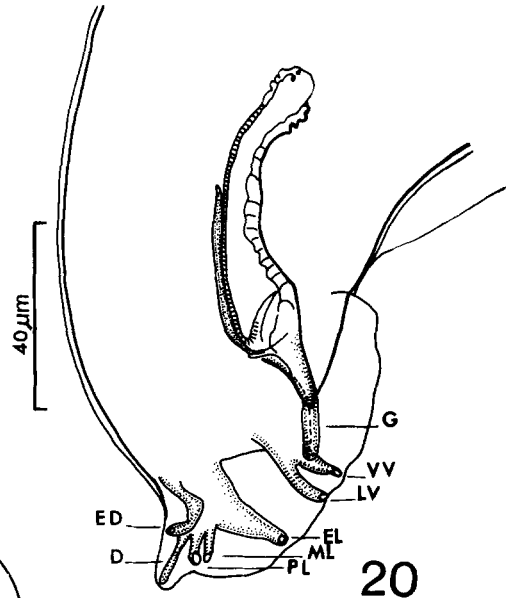
The unique lungworms of *Didelphis marsupialis*



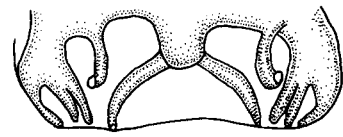
17



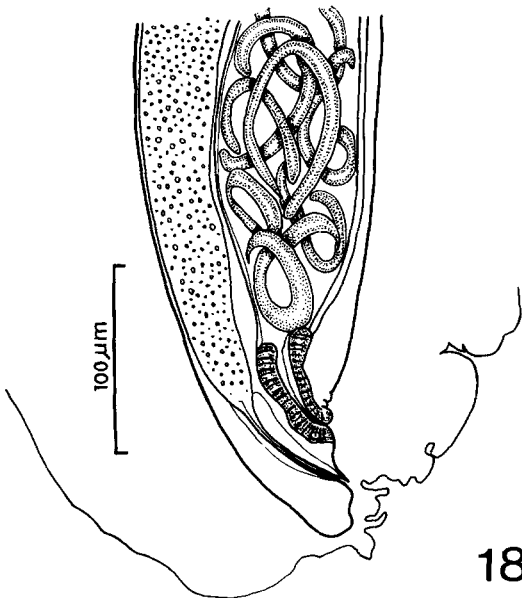
19



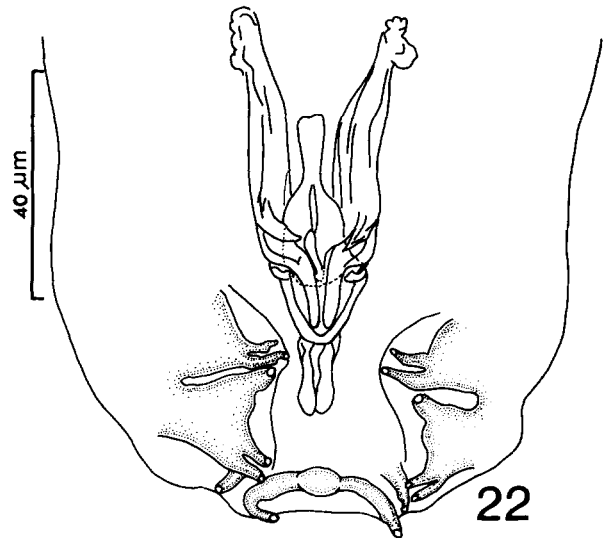
20



21



18



22

*Host*

*Didelphis marsupialis* (Didelphidae)—opossum.

*Location in Host*

Under pleura of lungs.

*Locality*

Georgia, U.S.A.

*Specimens*

United States National Museum Helminthological Collection No. 74956

**Discussion**

The genus *Prestwoodia* is readily distinguished within the family Crenosomatidae by its smooth cuticle, long spicules and dorsal ray with four prominent branches (Anderson, 1978). The last character readily distinguishes *Prestwoodia* from *Troglostrongylus* from the frontal sinuses of Felidae.

The observations reported herein agree generally with those of Travassos who assigned the species to *Troglostrongylus*. He noted the characteristic dorsal ray and ovejector. However, the form of the ventral rays, the structure of the gubernaculum, the cephalic structures and other features were not described in detail by Travassos.

Travassos' (1925) description of *H. heterostrongylus* is most imperfect but after examining the types there is no doubt that the specimens described herein belong to *H. heterostrongylus*. Travassos noted the well-developed lips but stated there were only three although more than three are clearly illustrated. He also noted the constriction in the cuticle behind the lips. He illustrated the dorsal ray as lobe-like although he

states that "rayons dorsaux externes jointes et paralleles avec les rayons dorsaux, qui sont double" implying that the dorsal ray was branched. His illustration suggests two extra rays but they do not arise from the central lobe we take to be the dorsal ray in his figure. Examination of the types indicates that Travassos made an error in observation. He described the spicules as 120–130  $\mu\text{m}$  in length which agrees closely with the observations reported here in both of the type specimens and the new specimens from Colombia.

*Didelphostrongylus* is most similar to *Heterostrongylus* from the opossum but it is readily distinguished by its bifid dorsal ray. Also the rays are more delicate and finger-like in *Didelphostrongylus* and the ventral ray as well as the lateral rays arise from common stalks, the ovejector is not as highly developed in *Didelphostrongylus* and the female tail is short and rounded rather than digitiform as in *Heterostrongylus*. Similarities in head structures and in the spicules and gubernaculum are noteworthy, however.

**Acknowledgements**

We are most grateful to Dr. Delir Correa Gomes, Fundação Oswaldo Cruz for lending the types of *H. heterostrongylus* and to Dr. A. K. Prestwood, University of Georgia for specimens of *D. hayesi*. The collection of the worms was made while the second author (MDL) was assigned to the Tulane University ICMR Program in Colombia, S. A., which is supported by a grant, AI10500, from NIH, NAID.

**References**

Anderson, R.C. (1978). *Keys to genera of the superfamily Metastrongyloidea* CIH Keys to the Nematode Parasites of Vertebrates, No. 5 Anderson, R. C., Chabaud, A. G. & Willmott, S. (Editors). Farnham Royal, UK: Commonwealth Agricultural Bureaux, 40 pp.

Prestwood, A.K. (1976). *Didelphostrongylus hayesi* gen. sp. n. (Metastrongyloidea: Filaroididae) from the opossum, *Didelphis marsupialis*. *Journal of Parasitology* **62**, 272–275.

Travassos, L. (1925). Un nouveau type Metastrongylidae. *Compte Rendu des Séances de la Société de Biologie, Paris*, **93**, 1259–1262.

Travassos, L. (1946). Sobre um Metastrongylidae das cavidades nasais de *Didelphis marsupialis aurita* Wied. *Revista Brasileira de Biologia* **6**, 499–502.

Accepted for publication 2nd January, 1979.

Figs. 17–22

*Didelphostrongylus hayesi* Prestwood, 1976

Fig. 17. Anterior extremity female, lateral view.

Fig. 18. Caudal extremity female, lateral view.

Fig. 19. Cephalic extremity female, *en face* view.

Fig. 20. Caudal extremity male, lateral view.

Fig. 21. Caudal extremity male, ventral view.

Fig. 22. Caudal extremity male, ventral view.