Helminths of Domestic Equids

Illustrated Keys to Genera and Species with Emphasis on North American Forms

J. Ralph Lichtenfels (Drawings by Robert B. Ewing)

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Helminths of Domestic Equids

Illustrated Keys to Genera and Species with Emphasis on North American Forms

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Dedication

To Allen McIntosh, teacher, friend,
and inspiration to many helminthologists

ABSTRACT: Dichotomous keys are provided for genera and species of helminths of domestic equids. Keys to genera are illustrated with halftone drawings, usually of the type species, and they include a generic diagnosis. Keys to species are illustrated with photomicrographs of key characters, but species diagnoses are not provided. Only genera and species occurring in North America are illustrated, but all genera are included in the keys and exotic species are compared with similar illustrated species. The helminths include 75 species in 28 genera of Nematoda, four species in three genera of cestodes, and five species in two genera of trematodes. Systematic revision has been kept to a minimum in this well-defined group of helminths. A history and comparison of systematic schemes is provided. The number of genera in the group sometimes referred to as *Cyathostomum, sensu lato*, is reduced from seven to four. Keys to species are given for the nematode genera *Cyathostomum, Cylicocyclus, Cylicodontophorus, Cylicostephanus, Poteriostomum, Triodontophorus, Strongylus, Habronema*, and *Oesophagodontus*, and for the four species of cestodes. Synonyms of all species are listed along with information on geographic distribution, prevalence, and location in the host. Separate lists are provided of: (1) unusual, accidental, or occasional helminths of domestic equids; and (2) helminths from zebras that do not also occur in other equids. Illustrations of larvae and discussion of life histories are given in a separate section, but little is known of most species. A detailed index is provided of all scientific names used.

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I. General Introduction

The horse, *Equus caballus*, the ass, *Equus asinus*, and their hybrids are hosts to a great variety of helminth parasites, most of which have traveled the world with their hosts. Nematodes are represented by 28 genera and 75 species, cestodes by three genera and four species, and trematodes by two genera and five species. Many others are occasionally found in horses.

The recent increase in numbers of horses in the United States has caused in turn a resurgence of interest in the unwelcome worms that share their table, sap their energy, and sometimes kill their hosts, although usually more insidiously than infectious disease organisms. This increased attention to helminths of horses has resulted in the need for diagnostic keys to these parasites using readily recognizable characters and the most recent literature on their systematics.

This treatise is intended to serve as a basic working tool—providing easy identifications to genus and species of adult helminths of equids. Only helminths normally parasitic in the horse, the ass, and their hybrids are covered. Helminths of zebras that are not parasites of other equids are listed in a separate section as are helminths that are occasionally found in horses, mules, and asses but are normally parasitic in other animals. Some illustrations of nematode larvae are given in a section following the keys to species, but little information is available and many larvae cannot be identified (sometimes not even to genus) because of the lack of life cycle studies of most species.

This treatise consists of illustrated keys to genera and to species. The keys to genera are illustrated with halftone drawings of the type species of each genus and include a diagnosis of the genus. For genera with only a single species *in equids*, a diagnosis of the species is given instead of the genus. Illustrations are original unless noted otherwise.

The keys to genera include all known genera of helminths of equids anywhere in the world; however, exotic genera—not known to occur in North America—usually are not illustrated because specimens were not available. Keys to species known to occur in North America are illustrated with photomicrographs of key characters—usually buccal and cephalic characters—that will identify both males and females. Exotic species are usually not included in the keys to species, but are listed at the end of the key with a brief comparison to illustrated species. A short discussion of the systematics of the genus and species is provided. The most available diagnoses of species are cited in the keys to species, and complete species diagnoses are not given in this treatise. A synonymy of each species is provided in the Outline Classification, and authors and dates of species are given only there and in the Index. Geographic distribution, prevalence, and location in host are also given for each species in the Outline Classification.

Some workers will lament that most exotic genera and species have not been illustrated or included in the keys to species. For a host like the horse that has traveled much of the world with man this may appear to be a major shortcoming; however, species absent from North America are not commonly found in other parts of the world either, and any disadvantage attributable to the omission of the exotic and usually rare species from the keys is outweighed by their greater simplicity. It should be possible to differentiate exotic species from similar illustrated species by using the brief comparisons that follow the keys.

Although this treatise will provide no information on pathology, control, or treatment, it is hoped that progress in these areas may be spurred by facilitating identification of the helminths.

II. Materials and Methods

The writer made no collections of helminths directly from hosts for this study. Specimens were obtained from the USDA Parasite Collection, from the USNM Helminthological Collection, and from workers currently engaged in studies of helminths of equids at various laboratories in the United States. Specimens from the USNM Helminthological Collection included many paratypes from Looss' (1900) type series. The A. O. Foster collection (Foster, 1936, 1937; Foster and Ortiz, 1937; Foster and Alicata, 1939), consisting for the most part of large numbers of accurately identified specimens, was invaluable in this study. Numerous specimens, especially larvae, were supplied by K. C. Kates and M. L. Colglazier of this institute. Other individuals and laboratories that provided specimens are listed in the Acknowledgments. Usually large numbers of specimens were available for study. *En face* mounts of a few species were studied.

Nematodes were cleared for study in temporary wet mounts in a solution of 80% melted phenol crystals and 20% absolute alcohol. Photomicrographs were taken with the aid of a 35-mm camera and a microscope equipped with a differential interference contrast attachment.

Drawings were made with the aid of a camera lucida. Final rendering of the drawings involved a pencil tone technique.

III. Outline Classification of Helminths of Domestic Equids, Their Geographic Distribution, Prevalence, Location in Host, and Synonyms

The species are listed by genus and higher categories. Each species is followed by its geographic distribution, location in host, and a list of its synonyms. Geographic distribution is given by continent or as cosmopolitan and may be abbreviated. An asterisk precedes names of species not known to occur in North America.

The classification for nematodes follows B. G. Chitwood (Chitwood and Chitwood, 1950, reprinted 1974) and M. B. Chitwood (1969) above generic level. The classification of genera and species of Nematoda is modified from previous systems and is discussed further in the introduction to the Nematoda given in this treatise. The classification system for cestodes and trematodes follows Yamaguti (1959, 1971).

Phylum Nematoda
Order Rhabditida
Suborder Rhabditina
Family Cephalobidae

Micronema deletrix Anderson and Bemrick, 1965
Rare—N. A.; Afr.—nares; brain

**Rhabditis gingivalis* Stefanski, 1954
Very Rare—Eur.—gums

Family Strongyloididae

Strongyloides westeri Ihle, 1917
Common in foals—cosmopolitan—small intestine

Order Strongylida
Suborder Strongylina
Family Strongylidae
Subfamily Strongylinae

Oesophagodontus robustus (Giles, 1892) Railliet and Henry, 1902
Rare—cosmopolitan—colon
=*Sclerostoma robustum* Giles, 1892
=*Pseudosclerostomum securiferum* Quiel, 1919
=*Strongylus robustus* (Giles, 1892) Popov, 1927

Triodontophorus serratus (Looss, 1900) Looss, 1902
Rare—cosmopolitan—colon
=*Triodontus serratus* Looss, 1900
=*Triodontophorus intermedius* Sweet, 1909

Triodontophorus minor (Looss, 1900) Looss, 1902
?Common—cosmopolitan—colon
=*Triodontus minor* Looss, 1900

Triodontophorus tenuicollis Boulenger, 1916
Rare—cosmopolitan—colon

Triodontophorus brevicauda Boulenger, 1916
Rare—cosmopolitan—colon

Triodontophorus nipponicus Yamaguti, 1943
Common—Eur., N. A., S. A., Asia—colon

**Triodontophorus popovi* Ershov, 1931
Rare—Asia—colon

**Triodontophorus brochotribulatus* Martinez Gomez, 1966
Rare—Eur.—colon

Strongylus equinus Mueller, 1780
Common—cosmopolitan—cecum
=*Strongylus equorum* Zeder, 1800
=*Strongylus armatus* Rudolphi, 1802, in part
=*Strongylus neglectus* Poeppel, 1897
=*Sclerostoma equinum* (Mueller, 1780) Blainville, 1828
=*Sclerostomum quadridentatum* Sticker, 1901, not Dujardin, 1845

Strongylus edentatus (Looss, 1900) Railliet and Henry, 1909
Common—cosmopolitan—colon
=*Sclerostoma edentatum* Looss, 1900
=*Alfortia edentatus* (Looss, 1900) Skrjabin, 1933

Strongylus vulgaris (Looss, 1900) Railliet and Henry, 1909
Very common—cosmopolitan—cecum
=*Sclerostoma vulgare* Looss, 1900
=*Strongylus armatus* Rudolphi, 1802, in part
=*Sclerostomum bidentatum* Sticker, 1901
=*Delafondia vulgaris* (Looss, 1900) Skrjabin, 1933

**Strongylus asini* Boulenger, 1920
Rare—Asia, Afr., S. A.—cecum, liver
=*Delafondia asini* (Boulenger, 1920) Skrjabin, 1933

Craterostomum acuticaudatum (Kotlan, 1919) Ihle, 1920
Rare—Afr., Asia, Eur., N. A.—colon, cecum
=*Cylicostomum acuticaudatum* Kotlan, 1919
=*Cylicostomum mucronatum* Ihle, 1920
=*Craterostomum mucronatum* (Ihle, 1920) Ihle, 1920

**Craterostomum tenuicauda* Boulenger, 1920
Very rare—Eur., Asia—colon, cecum

Subfamily Globocephalinae

**Acheilostoma paranecator* Travassos and Horta, 1915
Very rare—S. A.—intestine

Subfamily Cyathostominae

Cyathostomum tetracanthum (Mehlis, 1831) Molin, 1861, in part, Looss, 1900
Rare—cosmopolitan—cecum, colon
=*Strongylus tetracanthus* Mehlis, 1831, in part
=*Sclerostomum tetracanthum* (Mehlis, 1831) Diesing, 1851, in part
=*Cylichnostomum tetracanthum* (Mehlis, 1831) Looss, 1902
=*Cylicostomum tetracanthum* (Mehlis, 1831) Gedoelst, 1903
=*Cylicostoma tetracanthum* (Mehlis, 1831) Looss, 1911
=*Trichonema tetracanthum* (Mehlis, 1831) Railliet, 1919
=*Trichonema arcuata* Cobbold, 1874, in part
=*Trichonema aegyptiacum* Railliet, 1923
=*Cylicostomum aegyptiacum* (Railliet, 1923) Cram, 1924
=*Cylicostomias aegyptiaca* (Railliet, 1923) Cram, 1925
=*Erschowinema aegyptiacum* (Railliet, 1923) Tshoijo, 1957
=*Sclerostoma quadridentatum* Dujardin, 1845, in part

Cyathostomum coronatum Looss, 1900
Common—cosmopolitan—cecum, colon
=*Cylichnostomum coronatum* (Looss, 1900) Looss, 1902
=*Cylicostomum coronatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema coronatum* (Looss, 1900) LeRoux, 1924
=*Cylicostomias coronata* (Looss, 1900) Cram, 1925
=*Erschowinema coronatum* (Looss, 1900) Tshoijo, 1957
=*Trichonema subcoronatum* Yamaguti, 1943

*Species not known to occur in North America.

Cyathostomum labiatum (Looss, 1902) McIntosh, 1933
Common—cosmopolitan—cecum, colon
=*Cyathostomum labratum* Looss, 1900, in part
=*Cylichnostomum labiatum* Looss, 1902
=*Cylicostomum labiatum* (Looss, 1902) Gedoelst, 1903
=*Cylicostomum labiatum digitatum* Ihle, 1921
=*Trichonema labiatum* (Looss, 1902) LeRoux, 1924
=*Cylicostomias labiatum* (Looss, 1902) Cram, 1925
=*Schulzitrichonema labiatum* (Looss, 1902) Barus, 1961

Cyathostomum labratum Looss, 1900
Common—cosmopolitan—cecum, colon
=*Cylichnostomum labratum* (Looss, 1900) Looss, 1902
=*Cylicostomum labratum* (Looss, 1900) Gedoelst, 1903
=*Trichonema labratum* (Looss, 1900) LeRoux, 1924
=*Cylicostomias labrata* (Looss, 1900) Cram, 1925
=*Schulzitrichonema labratum* (Looss, 1900) Barus, 1962

**Cyathostomum alveatum* Looss, 1900
Rare—Afr., Asia, Eur.—cecum, colon
=*Cylichnostomum alveatum* (Looss, 1900) Looss, 1902
=*Cylicostomum alveatum* (Looss, 1900) Gedoelst, 1903
=*Cylicocercus alveatus* (Looss, 1900) Cram, 1924
=*Trichonema alveatum* (Looss, 1900) Yorke and Maplestone, 1926
=*Erschowinema alveatum* (Looss, 1900) Tshoijo, 1957

Cyathostomum pateratum (Yorke and Macfie, 1919) K'ung, 1964
Common—cosmopolitan—cecum, colon
=*Cylicostomum pateratum* Yorke and Macfie, 1919
=*Trichonema pateratum* (Yorke and Macfie, 1919) LeRoux, 1924
=*Cylicocercus pateratus* (Yorke and Macfie, 1919) Cram, 1924
=*Cylicodontophorus pateratus* (Yorke and Macfie, 1919) Ershov, 1939
=*Cylicostomum cymatostomum* Kotlan, 1919

Cyathostomum catinatum Looss, 1900
Very common—cosmopolitan—cecum, colon
=*Cylichnostomum catinatum* (Looss, 1900) Looss, 1902
=*Cylicostomum catinatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema catinatum* (Looss, 1900) LeRoux, 1924
=*Cylicocercus catinatum* (Looss, 1900) Cram, 1924
=*Erschowinema catinatum* (Looss, 1900) Tshoijo, 1957
=*Cylicostomum pseudocatinatum* Yorke and Macfie, 1919
=*Cylicostomum catinatum litoraureum* Yorke and Macfie, 1920

**Cyathostomum montgomeryi* (Boulenger, 1920) K'ung, 1964
Rare—Afr.—cecum, colon
=*Cylicostomum montgomeryi* Boulenger, 1920
=*Cylicotoichus montgomeryi* (Boulenger, 1920) Cram, 1924
=*Trichonema montgomeryi* (Boulenger, 1920) Yorke and Maplestone, 1926
=*Erschowinema montgomeryi* (Boulenger, 1920) Tshoijo, 1957

**Cyathostomum sagittatum* (Kotlan, 1920) McIntosh, 1951
Rare—Eur., Asia—cecum, colon
=*Cylicostomum sagittatum* Kotlan, 1920
=*Trichonema sagittatum* (Kotlan, 1920) LeRoux, 1924
=*Cylicostomias sagittatum* (Kotlan, 1920) Cram, 1925
=*Cylicodontophorus sagittatum* (Kotlan, 1920) Ershov, 1939

Cylicodontophorus bicoronatus (Looss, 1900) Cram, 1924
Common—cosmopolitan—cecum, colon
=*Cyathostomum bicoronatum* Looss, 1900
=*Cylichnostomum bicoronatum* (Looss, 1900) Looss, 1902
=*Cylicostomum bicornatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema bicoronatum* (Looss, 1900) LeRoux, 1924

*Species not known to occur in North America.

Cylicodontophorus euproctus (Boulenger, 1917) Cram, 1924
Rare—cosmopolitan—colon, cecum
=*Cylichnostomum euproctus* Boulenger, 1917
=*Cylicostomum euproctus* (Boulenger, 1917) Ransom and Hadwen, 1918
=*Trichonema euproctus* (Boulenger, 1917) LeRoux, 1924

Cylicodontophorus mettami (Leiper, 1913) Foster, 1936
Very rare—Afr., Asia, Eur., N. A.—colon, cecum
=*Cylicostoma mettami* Leiper, 1913
=*Cylicostomum mettami* (Leiper, 1913) Ransom and Hadwen, 1918
=*Trichonema mettami* (Leiper, 1913) LeRoux, 1924
=*Cylicocercus mettami* (Leiper, 1913) Cram, 1924
=*Cylicostomum ihlei* Kotlan, 1921

Cylicocyclus radiatus (Looss, 1900) Chaves, 1930
Rare—cosmopolitan—colon
=*Cyathostomum radiatum* Looss, 1900
=*Cylichnostomum radiatum* (Looss, 1900) Looss, 1902
=*Cylicostomum radiatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema radiatum* (Looss, 1900) LeRoux, 1924
=*Cylicostomum prionodes* Kotlan, 1921

Cylicocyclus auriculatus (Looss, 1900) Chaves, 1930
Rare—Afr., Asia, N. A., S. A.—colon
=*Cyathostomum auriculatum* Looss, 1900
=*Cylichnostomum auriculatum* (Looss, 1900) Looss, 1902
=*Cylicostomum auriculatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema auriculatum* (Looss, 1900) LeRoux, 1924

Cylicocylus elongatus (Looss, 1900) Chaves, 1930
Common—cosmopolitan—cecum
=*Cyathostomum elongatum* Looss, 1900
=*Cylichnostomum elongatum* (Looss, 1900) Looss, 1902
=*Cylicostomum elongatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema elongatum* (Looss, 1900) LeRoux, 1924
=*Cylicostomum elongatus kotlani* Ihle, 1920
=*Cylicostomum elongatus macrobursatum* Kotlan, 1920

Cylicocyclus nassatus (Looss, 1900) Chaves, 1930
Very common—cosmopolitan—colon
=*Cyathostomum nassatum* Looss, 1900
=*Cylichnostomum nassatum* (Looss, 1900) Looss, 1902
=*Cylicostomum nassatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema nassatum* (Looss, 1900) LeRoux, 1924
=*Trichonema ashworthi* LeRoux, 1924
=*Cylicocyclus bulbiferus* Chaves, 1930
=*Cylicostomum nassatum parvum* Yorke and Macfie, 1918

Cylicocyclus insigne (Boulenger, 1917) Chaves, 1930
Very common—cosmopolitan—colon
=*Cylichnostomum insigne* Boulenger, 1917
=*Cylicostomum insigne* (Boulenger, 1917) Ransom and Hadwen, 1918
=*Trichonema insigne* (Boulenger, 1917) LeRoux, 1924
=*Trichonema insigne rosenbuschi* Galofre and Rosa, 1944
=*Cylicostomum zebrae* Boulenger, 1920

Cylicocyclus leptostomus (Kotlan, 1920) Chaves, 1930
Common—Afr., Asia, Eur., N. A.—cecum, colon
=*Cylicostomum leptostomum* Kotlan, 1920
=*Trichonema leptostomum* (Kotlan, 1920) LeRoux, 1924
=*Schulzitrichonema leptostomum* (Kotlan, 1920) Ershov, 1943
=*Cylicotetrapedon leptostomum* (Kotlan, 1920) K'ung, 1964
=*Cyathostomum bogoriense* Smit and Notosoediro, 1923

Cylicocyclus ultrajectinus (Ihle, 1920) Ershov, 1939
Common—cosmopolitan—colon
=*Cylicostomum ultrajectinum* Ihle, 1920
=*Trichonema ultrajectinum* (Ihle, 1920) LeRoux, 1924
=*Cylicodontophorus ultrajectinum* (Ihle, 1920) Cram, 1924

Cylicocyclus triramosus (Yorke and Macfie, 1920) Chaves, 1930
Rare—Afr., Asia, N. A.—colon, ?stomach
=*Cylicostomum triramosum* Yorke and Macfie, 1920
=*Trichonema triramosum* (Yorke and Macfie, 1920) LeRoux, 1924

Cylicocyclus brevicapsulatus (Ihle, 1920) Ershov, 1939
Very rare—Afr., Asia, Eur., N. A.—colon
=*Cylicostomum brevicapsulatum* Ihle, 1920
=*Cylicobrachytus brevicapsulatum* (Ihle, 1920) Cram, 1924
=*Trichonema brevicapsulatum* (Ihle, 1920) Mönnig, 1926

**Cylicocyclus adersi* (Boulenger, 1920) Chaves, 1930
Rare—Afr., Asia—colon
=*Cylicostomum adersi* Boulenger, 1920
=*Trichonema adersi* (Boulenger, 1920) LeRoux, 1924

**Cylicocyclus largocapsulatus* (Iren, 1943) n. comb.
Very rare—Asia—colon
=*Trichonema largocapsulatus* Iren, 1943

**Cylicocyclus matumurai* (Yamaguti, 1942) n. comb.
Very rare—Asia—colon
=*Trichonema maturmurai* Yamaguti, 1942

Cylicostephanus calicatus (Looss, 1900) Cram, 1924
Very common—cosmopolitan—colon
=*Cyathostomum calicatum* Looss, 1900
=*Cylichnostomum calicatum* (Looss, 1900) Looss, 1902
=*Cylicostomum calicatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema calicatum* (Looss, 1900) LeRoux, 1924
=*Erschowinema calicatum* (Looss, 1900) Tshoijo, 1957
=*Cylicostomum barbatum* Smit and Notosoediro, 1923
=*Trichonema tsengi* K'ung and Yang, 1963

Cylicostephanus poculatus (Looss, 1900) Cram, 1924
Rare—cosmopolitan—colon, cecum
=*Cyathostomum poculatum* Looss, 1900
=*Cylichnostomum poculatum* (Looss, 1900) Looss, 1902
=*Cylicostomum poculatum* (Looss, 1900) Gedoelst, 1903
=*Trichonema poculatum* (Looss, 1900) LeRoux, 1924
=*Petrovinema poculatum* (Looss, 1900) Ershov, 1943

Cylicostephanus minutus (Yorke and Macfie, 1918) Cram, 1924
Very common—cosmopolitan—colon, cecum
=*Cylicostomum minutum* Yorke and Macfie, 1918
=*Trichonema minutum* (Yorke and Macfie, 1918) LeRoux, 1924
=*Erschowinema minutum* (Yorke and Macfie, 1918) Tshoijo, 1957

Cylicostephanus longibursatus (Yorke and Macfie, 1918) Cram, 1924
Very common—cosmopolitan—colon, cecum
=*Cylicostomum longibursatum* Yorke and Macfie, 1918
=*Trichonema longibursatum* (Yorke and Macfie, 1918) LeRoux, 1924
=*Cylicostomum nanum* Ihle, 1919
=*Cylicostomum calicatiforme* Kotlan, 1919

Cylicostephanus asymetricus (Theiler, 1923) Cram, 1925
Very rare—Afr., Asia, Eur., N. A.—cecum, colon
=*Cylicostomum asymetricum* Theiler, 1923
=*Cylicotetrapedon asymetricum* (Theiler, 1923) Ihle, 1925
=*Schulzitrichonema asymetricum* (Theiler, 1923) Ershov, 1943
=*Erschowinema asymetricum* (Theiler, 1923) Tshoijo, 1957

Cylicostephanus bidentatus (Ihle, 1925) n. comb.
Very rare—Eur., N. A.—colon
=*Cylicostomum bidentatum* Ihle, 1925
=*Cylicotetrapedon bidentatum* (Ihle, 1925) Ihle, 1925
=*Trichonema bidentatum* (Ihle, 1925) Yorke and Maplestone, 1926
=*Schulzitrichonema bidentatum* (Ihle, 1925) Barus, 1963

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*Species not known to occur in North America.

Cylicostephanus hybridus (Kotlan, 1920) Cram, 1924
Rare—Asia, Eur., N. A., S. A.—colon, cecum
=*Cylicostomum hybridum* Kotlan, 1920
=*Trichonema hybridum* (Kotlan, 1920) LeRoux, 1924
=*Erschowinema hybridum* (Kotlan, 1920) Tshoijo, 1957
=*Schulzitrichonema hybridum* (Kotlan, 1920) Barus, 1963
=*Trichonema parvibursatus* Vaz, 1934

Cylicostephanus goldi (Boulenger, 1917) n. comb.
Common—cosmopolitan—colon, cecum
=*Cylichnostomum goldi* Boulenger, 1917
=*Cylicostomum goldi* (Boulenger, 1917) Ransom and Hadwen, 1918
=*Trichonema goldi* (Boulenger, 1917), LeRoux, 1924
=*Cylicocercus goldi* (Boulenger, 1917) Cram, 1924
=*Schulzitrichonema goldi* (Boulenger, 1917) Ershov, 1943
=*Cylicotetrapedon goldi* (Boulenger, 1917) K'ung, 1964
=*Cylicostomum tridentatum* Yorke and Macfie, 1920

**Cylicostephanus ornatus* (Kotlan, 1919) n. comb.
Rare—Eur., ?Asia, ?N. A.—colon, cecum
=*Cylicostomum ornatum* Kotlan, 1919
=*Trichonema ornatum* (Kotlan, 1919) LeRoux, 1924
=*Cylicostomias ornatum* (Kotlan, 1919) Cram, 1925
=*Cyathostomum ornatum* (Kotlan, 1919) McIntosh, 1933
=*Cylicodontophorus ornatum* (Kotlan, 1919) Ershov, 1939

**Cylicostephanus skrjabini* (Ershov, 1930) n. comb.
Rare—Asia—colon, cecum
=*Trichonema skrjabini* Ershov, 1930
=*Petrovinema skrjabini* Ershov, 1943

Poteriostomum imparidentatum Quiel, 1919
Common—cosmopolitan—colon, cecum
=*Cylicostomum imparidentatum* (Quiel, 1919) Ihle, 1920
=*Cylichnostomum imparidentatum* (Quiel, 1919) Vevers, 1920
=*Poteriostomum pluridentatum* Quiel, 1919
=*Cylicostomum zebrae* Turner, 1920
=*Hexodontostomum markusi* Ihle, 1920

Poteriostomum ratzii (Kotlan, 1919) Ihle, 1920
Common—cosmopolitan—colon, cecum
=*Cylicostomum ratzii* Kotlan, 1919
=*Cylichnostomum ratzii* (Kotlan, 1919) Yorke and Macfie, 1920
=*Craterostomum ratzii* (Kotlan, 1919) Ostertag, 1932
=*Poteriostomum ratzii nanum* Theiler, 1923

**Poteriostomum skrjabini* Ershov, 1939
Rare—Asia—colon, cecum

Gyalocephalus capitatus Looss, 1900
Rare—cosmopolitan—cecum, colon
=*Gyalocephalus equi* Yorke and Macfie, 1918

**Caballonema longicapsulatum* Abuladze, 1937
Very rare—Asia—cecum, colon
=*Caballonema longispiculata* Kopyrin and Burikova, 1940
=*Sinostrongylus longibursatus* Hsiung and Chao, 1949

**Cylindropharynx aethiopica* Roetti, 1947
Very rare—Asia—cecum, colon

**Cylindropharynx asini* Roetti, 1947
Very rare—Asia—cecum, colon

Suborder Trichostrongylina
Family Trichostrongylidae
Subfamily Trichostrongylinae

Trichostrongylus axei (Cobbold, 1879) Railliet and Henry, 1909
Common—cosmopolitan—stomach
=*Strongylus axei* Cobbold, 1879
=*Strongylus extenuatus* Railliet, 1898
=*Strongylus tenuissimus* Mazzanti, 1891
=*Strongylus gracilis* McFadyean, 1896 (not Leuckart, 1842)
=*Cobboldostrongylus axei* (Cobbold, 1879) Sarwar, 1956

Family Dictyocaulidae
Subfamily Dictyocaulinae

Dictyocaulus arnfieldi (Cobbold, 1884) Railliet and Henry, 1907
Rare—cosmopolitan—lungs
=*Strongylus arnfieldi* Cobbold, 1884
=*Arnfieldia arnfieldi* (Cobbold, 1884) Sarwar, 1957

*Species not known to occur in North America.

Order Ascarida
Suborder Ascaridina
Family Ascarididae
Subfamily Ascaridinae

Parascaris equorum (Goeze, 1782) Yorke and Maplestone, 1926
Common in foals, rare in adults—cosmopolitan—small intestine
=*Ascaris equorum* Goeze, 1782
=*Ascaris equi* Schrank, 1788
=*Fusaria lumbricoides equorum* Zeder, 1800
=*Ascaris gigas equi* Rudolphi, 1809
=*Ascaris megalocephala* Cloquet, 1824
=*Ascaris laevissima* Baird, 1853

Suborder Oxyurina
Family Oxyuridae
Subfamily Oxyurinae

Oxyuris equi (Schrank, 1788) Rudolphi, 1803
Common—cosmopolitan—colon
=*Trichocephalus equi* Schrank, 1788
=*Oxyuris curvula* Rudolphi, 1803
=*Oxyuris mastigodes* Nitzsch, 1857
=*Lepturis curvula* (Rudolphi, 1803) Schlotthauber, 1860

**Oxyuris poculum* Linstow, 1904
Very rare—Ceylon—colon

Subfamily Probstmayriinae

Probstmayria vivipara (Probstmayr, 1865) Ransom, 1907
Very common—cosmopolitan—colon
=*Oxyuris vivipara* Probstmayr, 1865
=*Rhabdonema vivipara* (Probstmayr, 1865) Railliet, 1887
=*Anguillula vivipara* (Probstmayr, 1865) Railliet, 1893
=*Strongyloides vivipara* (Probstmayr, 1865) Linstow, 1905

Order Spirurida
Suborder Spirurina
Family Spiruridae
Subfamily Habronematinae

Draschia megastoma (Rudolphi, 1819)
Rare—cosmopolitan—stomach
=*Spiroptera megastoma* Rudolphi, 1819
=*Spirura megastoma* (Rudolphi, 1819) Blanchard, 1849
=*Filaria megastoma* (Rudolphi, 1819) Schneider, 1866
=*Habronema megastoma* (Rudolphi, 1819) Railliet, 1923

Habronema muscae (Carter, 1861) Diesing, 1861
Common—cosmopolitan—stomach
=*Filaria muscae* Carter, 1861
=*Filaria stomoxeos* Linstow, 1875
=*Dermofilaria irritans* Rivolta, 1884

Habronema majus (Creplin, 1849) Ransom, 1911
Common—cosmopolitan—stomach
=*Spiroptera megastoma major* Creplin, 1849
=*Filaria microstoma* Schneider, 1866
=*Spiroptera microstoma* (Schneider, 1866) Zurn, 1872

**Habronema tyosenense* Yamaguti, 1943
Very rare—Asia—stomach

Family Thelaziidae
Subfamily Thelaziinae

Thelazia lacrymalis (Gurlt, 1831) Railliet and Henry, 1910
Very rare—Asia, Eur., S. A.—eye
=*Filaria lacrymalis* Gurlt, 1831
=*Filaria palpebralis* Wilson, 1844

Suborder Filariina
Family Onchocercidae
Subfamily Onchocercinae

**Elaeophora boehmi* Supperer, 1953
Rare—Eur.—arteries, veins

Onchocerca reticulata Diesing, 1841
Rare—cosmopolitan—tendons, ligaments
=*Spiroptera reticulata* (Diesing, 1841) Railliet, 1885
=*Spiroptera cincinnata* Ercolani, 1866
=*Filaria reticulata* (Diesing, 1841) Creplin, 1846
=*Trichina reticulata* (Diesing, 1841) Creplin, 1841

Onchocerca cervicalis Railliet and Henry, 1910
Common—cosmopolitan—cervical ligaments

Family Setariidae
Subfamily Setariinae

Setaria equina (Abildgaard, 1789) Railliet and Henry, 1911
Very common—cosmopolitan—body cavity, mesenteries, eye, and many other sites
=*Gordius equinus* Abildgaard, 1789
=*Filaria equi* Blanchard, 1849
=*Filaria papillosa* Rudolphi, 1802
=*Filaria oculi* Siebold, 1839

*Species not known to occur in North America.

Family Filariidae
Subfamily Filariinae

**Parafilaria multipapillosa* (Condamine and Drouilly, 1878) Yorke and Maplestone, 1926
Rare—Asia, Eur., Afr., S. A.—subcutaneous and intermuscular connective tissue
=*Filaria multipapillosa* Condamine and Drouilly, 1878
=*Filaria haemorrhagica* Railliet, 1885

Nematoda of Uncertain Classification Parasitic in Horses

Cylicocyclus pekingensis K'ung and Yang, 1964—See Key to Species for discussion.
Tridentoinfundibulum gobi Tshoijo, 1957
Bidentostomum ivaschkini Tshoijo, 1957, in Popova, 1958—This and the preceding genus and species are based on the presence of large teeth in the buccal cavity. Because of the rather unconventional system of classification devised by Tshoijo and described by Popova (1958), I prefer to await additional information before accepting these two new genera and species.
Cylicodontophorus mongolica Tshoijo, 1957—See Key to Species for discussion.
Schulzitrichonema schulze Ershov, 1943—So little description of this species has been published that it must be considered *species inquirenda.*
Schulzitrichonema caragandicum (Funicova, 1939) Skrjabin, 1953—See page 13 for discussion.

Class Cestoda
Family Anoplocephalidae
Subfamily Anoplocephalinae

Anoplocephala perfoliata (Goeze, 1782) Blanchard, 1848
Rare—cosmopolitan—intestine
=*Taenia perfoliata* Goeze, 1782
=*Taenia equina* Pallas, 1781, in part
=*Taenia quadrilobata* Mueller, 1789
=*Alyselminthus lobatus* Zeder, 1800
=*Taenia quadriloba* Gmelin, 1790

Anoplocephala magna (Abildgaard, 1789) Spengel, 1905
Rare—cosmopolitan—intestine
=*Taenia magna* Abildgaard, 1789
=*Taenia plicata* Zeder, 1800
=*Taenia plicata servei* Bounhiol, 1912
=*Taenia plicata strangulata* Railliet, 1893
=*Taenia megalocephala* Cobbold, 1874
=*Taenia zebrae* Rudolphi, 1808
Paranoplocephala mamillana (Mehlis, 1831) Baer, 1927
Rare—cosmopolitan—intestine
=*Anoplocephala mamillana* (Mehlis, 1831) Blanchard, 1891
=*Taenia mamillana* Mehlis, 1831

Subfamily Monieziinae

**Moniezia pallida* Mönnig, 1926
Rare—Afr.—intestine

Class Trematoda
Family Paramphistomidae
Subfamily Gastrodiscinae

**Gastrodiscus aegyptiacus* (Cobbold, 1876) Railliet, 1893
Rare—Afr., Asia—intestine
=*Diplostoma aegyptiacum* Cobbold, 1876
=*Cotylogaster cochleariformis* (Diesing, 1838)
=*Gastrodiscus sonsinoii* Cobbold, 1877
=*Gastrodiscus polymastos* Leuckart, 1880
=*Hemistomum aegyptiacum* (Cobbold, 1876)
**Gastrodiscus equi* LeRoux, 1938
Rare—Afr.—intestine
**Gastrodiscus secundus* Looss, 1907
Rare—Asia—intestine

Subfamily Pseudodiscinae

**Pseudodiscus collinsii* (Cobbold, 1875) Stiles and Goldberger, 1910
Common—India—intestine
=*Amphistoma collinsii* Cobbold, 1875
=*Pseudodiscus stanleyii* (Cobbold, 1875) Stiles and Goldberger, 1910
=*Paramphistomum collinsii* (Cobbold, 1875)
**Pseudodiscus cobboldi* Montgomery, 1906
Rare—India—intestine

*Species not known to occur in North America.

IV. Nematoda Parasitic in Domestic Equids

A. Introduction

The nematodes normally parasitic in the horse fall into seven suborders, 12 families, 28 genera, and 75 species (of which 22 genera and 53 species are known to occur in North America). The great majority (56 of 75 species) belong in a single family, the Strongylidae. The other 19 nematode species, scattered in 10 different families, are for the most part so well known and easily identified that they are discussed herein only in the keys to genera and species. The family Strongylidae, however, with many closely related species, has been a difficult group for many workers and an introductory discussion of this family follows.

The Strongylidae of horses—nematodes with a well-developed buccal capsule, a mouth collar with two leaf-crowns, and a strongyloid copulatory bursa—can be separated into two subfamilies: Strongylinae, usually large or medium-sized with a globular or funnel-shaped buccal capsule; and Cyathostominae, usually small to medium-sized with a cylindrical buccal capsule. In this treatise the Strongylinae of domestic equids are organized in four genera, *Strongylus*, *Oesophagodontus*, *Triodontophorus*, and *Craterostomum*; and 14 species (the four genera and 10 species are known to occur in North America). This four-genera system is accepted by most taxonomists except that Skrjabin and his students subdivide the genus *Strongylus* into three genera following Ershov (1943). The reasons I do not follow Ershov (1943) are given in the Discussion of the Key to the Species of the Genus *Strongylus*. The strongylins are relatively easy to identify (Figs. 34–49; 156–173).

The Cyathostominae of domestic equids consisting of eight genera and 41 species (of which six genera and 29 species are known to occur in North America) are the most difficult to identify for the inexperienced worker. However, with careful attention to the characteristics of the mouth collar, cephalic papillae, internal leaf-crown (ILC) and external leaf-crown (ELC), extra-chitinous supports of the ELC, buccal capsule, and esophageal funnel (Fig. 1), these species of small to medium-sized strongylids are readily recognizable. Characteristics of the posterior ends of males and females are also illustrated in Figure 1 to assist the inexperienced worker; however, cephalic characteristics are used almost exclusively in the keys.

Most of the cephalic characters listed above have been used by almost all previous workers, but one character needs further explanation. Extra-chitinous supports for the ELC consist of a sclerotized ring anterior to the buccal capsule. It sometimes appears to be a continuation of the buccal capsule, but it is usually connected by strands of connective tissue to the buccal capsule, the leaf crowns, and mouth collar giving support to the ELC elements that are characteristic of this genus. Extra-chitinous supports are found only in the genus *Cyathostomum* as defined in this treatise. Looss (1902) referred to this structure as "problematic structure in substance of mouth collar," and described and illustrated it in *C. tetracanthum*, *C. coronatum*, *C. catinatum*, *C. labratum*, and *C. labiatum*. This terminology was followed by Ihle (1922) and Skladnik (1935). Theiler (1923) changed the name of this structure to extra-chitinous supports of the external leaf-crown. She described this structure in *C. sagittatum* in addition to those mentioned by Looss (1902) above. To my knowledge, however, no workers have previously attached any systematic importance to this structure. It became apparent in the course of the present study that this structure is present in all species of the natural group first recognized by Looss (1902) as the "tetracanthum group." All species included in the genus *Cyathostomum* in this treatise have this structure except perhaps for *C. montgomeryi* which occurs only rarely in Africa and was not available for study. Thus, the presence of extra-chitinous supports of the external leaf-crown is proposed as an additional diagnostic character for the genus *Cyathostomum*.

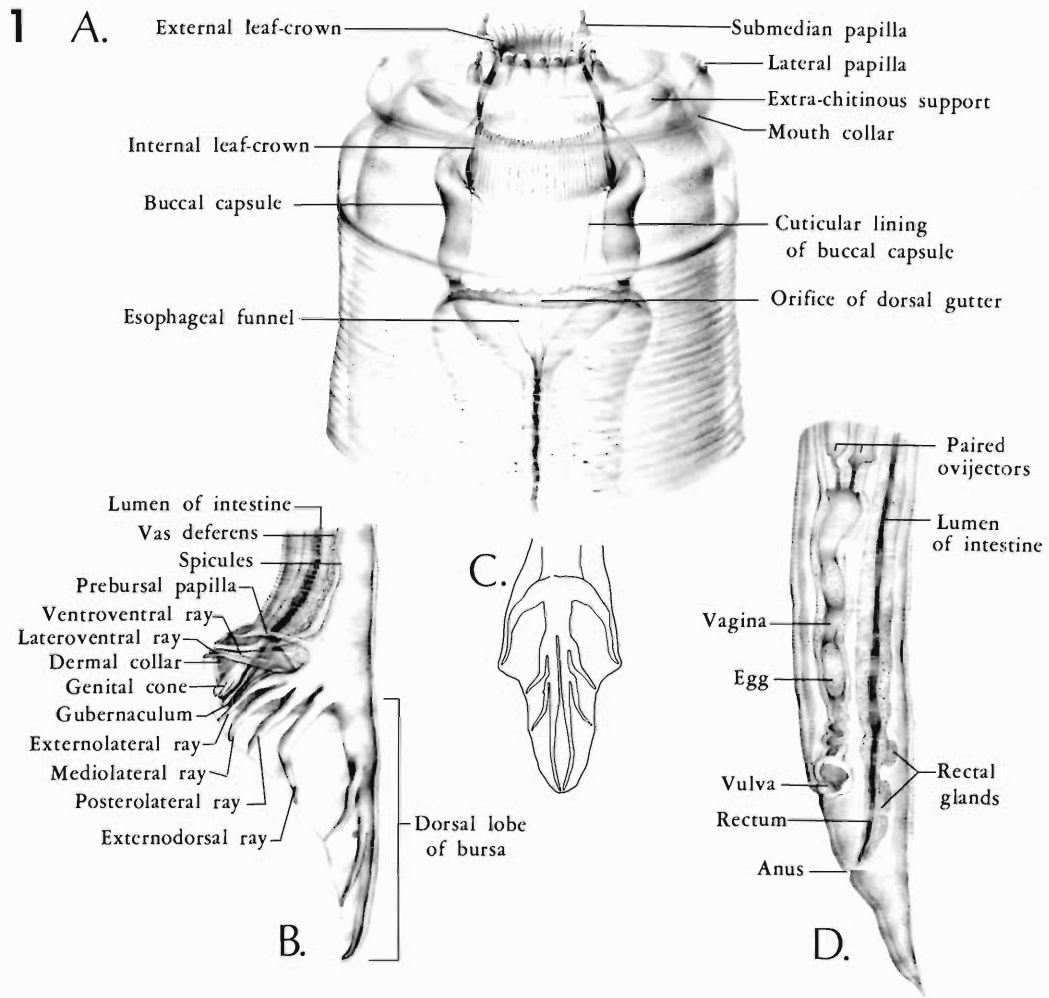

Figure 1, A–D. ***Cyathostomum coronatum,*** **labeled drawings showing characteristics typical of Cyathostominae. A. Head, dorsoventral view, × 700. B. Male tail, lateral view, × 300. C. Dorsal lobe of bursa of male tail, dorsal view, × 300. D. Female, lateral view of posterior end, × 300.**

The eight genera of Cyathostominae of domestic equids are *Cyathostomum* Molin, 1861 *sensu stricto*; *Cylicocyclus* Ihle, 1922; *Cylicodontophorus* Ihle, 1922; *Cylicostephanus* Ihle, 1922; *Poteriostomum* Quiel, 1919; *Gyalocephalus* Looss, 1900; *Caballonema* Abuladze, 1937; and *Cylindropharynx* Leiper, 1911. The last four of these genera are universally accepted and no further discussion of them will be given here. The first four genera listed above, however, are more controversial. They contain all the 53 species (some now listed as synonyms) of the genus *Cyathostomum* Molin, 1861, *sensu lato* that various workers have grouped into at least 15 different genera since 1900 when Looss placed 12 new species in this genus. To aid the reader in relating the present system of four genera for *Cyathostomum, sensu lato* to that used by previous workers, the following brief history is given. More detailed discussion of the bases for placing various species in particular genera can be found in the Discussion following each key to species.

B. History and Comparison of Classification Schemes

The genus *Cyathostomum* was described for the small to medium-sized strongylids of horses by Molin (1861) who lumped them all in one species, *C. tetracanthum* (Mehlis, 1831). Cobbold (1874) later described *Trichonema arcuata* for a larval form of *C. tetracanthum*—in reality a group of species. Looss (1900) described 12 new species in the genus *Cyathostomum*, selecting *C. tetracanthum*, the most common species, as type of the genus. Much controversy has developed over which genus, *Cyathostomum* or *Trichonema*, is valid. Both Cobbold (1875) and Looss (1902) abandoned their genera in favor of others. American workers (Foster, 1936, 1937; McIntosh, 1951) eventually accepted the validity of *Cyathostomum* based on the International Code of Zoological Nomenclature which clearly recognizes genera as valid even when the name differs in only one letter from another genus name. In the case of *Cyathostomum*, the existence of another nematode genus, *Cyathostoma* Blanchard, 1849, had convinced many workers that *Cyathostomum* was a homonym. The arguments for accepting *Cyathostomum* were summarized by McIntosh (1951), long after he had settled the question for himself and his co-workers and had submitted the case to the International Commission of Zoological Nomenclature in 1932. The Commission ruled (Hemming, ed., 1943) that *Cyathostomum* was not a homonym of *Cyathostoma*.

Unfortunately, many workers, especially Skrjabin and his students and co-workers, have followed the arguments of LeRoux (1924) that *Cyathostomum* is a *nomen nudum* and have recognized *Trichonema* as the name for this genus. According to the International Commission's Opinion, Looss' (1900) restriction of *C. tetracanthum* to the species most commonly found in horses and asses in Egypt could only be questioned if there was reasonable doubt as to whether this species was among those studied by Mehlis (1831). We now know that *C. tetracanthum* does occur in Europe so no reasonable doubt should exist that *Cyathostomum* is valid.

As can be seen in the lists of synonyms in the Outline Classification preceding this section, many additional genera have been coined for the species collectively known as *Cyathostomum, sensu lato*. Major contributions and schemes of classification for this group were made by Ihle (1922), Ershov (1943), McIntosh (1951), and K'ung (1964). In the following paragraphs the systems of these workers are briefly described and compared with that resulting from the present study.

The system of Ihle (1922) organized 20 species in seven groups—five of which he designated as subgenera—all in the genus *Cylicostomum* which is a synonym of *Cyathostomum*. Ihle's five subgenera were *Cylicostomum*, *Cylicocercus*, *Cylicocyclus*, *Cylicostephanus*, and *Cylicodontophorus*. His other groups were the Brevicapsulatum-group and the Montgomeryi-group. Cram (1924) raised all the subgenera of Ihle (1922) to generic rank, placed the Brevicapsulatum-group in the genus *Cylicobrachytus* Cram, 1924, and the Montgomeryi-group in *Cylicotoichus* Cram, 1924. The system of McIntosh (1951) is essentially identical to that of Ihle (1922) as modified by Cram (1924) except that *Cylicotoichus* is omitted (probably because *C. montgomeryi* was a parasite of the zebra not known from domestic equines) and *Cylicotetrapedon* Ihle, 1925, is added. The results of the present study differ from the scheme evolved by Ihle, Cram, and McIntosh as follows:

1. The genus *Cylicocercus*, which was distinguished primarily by the bent female tail, is eliminated by placing three species (*C. alveatum*, *C. catinatum*, and *C. pateratum*) in the genus *Cyathostomum* and one species (*C. goldi*) in the genus *Cylicostephanus*.
2. The species of the genus *Cylicotetrapedon*, which were distinguished by the presence of teeth in the esophageal funnel, are included in *Cylicostephanus* as suggested by Foster (1936).
3. The two species of *Cylicobrachytus* (*C. prionodes* and *C. brevicapsulatum*) are placed in *Cylicocyclus* following Ershov (1939) and K'ung (1964).
4. *Cylicodontophorus ultrajectinus* is moved to *Cylicocyclus* following Ershov (1939).
5. *Cyathostomum ornatum* is moved to *Cylicostephanus*.

The system of Ershov (1943) divided *Cyathostomum, sensu lato* into five genera including *Trichonema*, *Cylicocyclus*, *Cylicodontophorus*, *Petrovinema* Ershov, 1943, and *Schulzitrichonema* Ershov, 1943. The results of the present study differ from the scheme of Ershov (1943) as follows:

1. The species of *Trichonema* are assigned either to *Cyathostomum* or to *Cylicostephanus*.
2. Two species, *C. pateratum* and *C. sagittatum*, are moved from *Cylicodontophorus* to *Cyathostomum*.
3. The genus *Schulzitrichonema* Ershov, 1943, distinguished by teeth in the esophageal funnel and identical to *Cylicotetrapedon* Ihlc, 1925, is eliminated and the species are assigned to *Cylicocyclus* (*C. leptostomus*) or to *Cylicostephanus* (*C. asymetricus* and *C. goldi*).
4. *Petrovinema* is eliminated and the two species are included in *Cylicostephanus*.
5. *Cylicodontophorus ornatum* is moved to *Cylicostephanus*.

In 1964 K'ung reorganized *Cyathostomum, sensu lato*. He substituted *Trichonema* for *Cylicostephanus* and accepted *Cyathostomum*, *Cylicocyclus*, *Cylicodontophorus*, *Cylicotetrapedon*, *Petrovinema*, and *Skrjabinodentatus* Tshoijo, 1957. The results of the present study differ from the system of K'ung (1964) as follows:

1. *Trichonema* is not acceptable as a substitute for *Cylicostephanus*.
2. The species of the genus *Petrovinema* are included in *Cylicostephanus*.
3. The species of the genus *Cylicotetrapedon* are included in *Cylicostephanus* except for *C. leptostomum* which is placed in *Cylicocyclus*.
4. *Skrjabinodentatus* Tshoijo, 1957, is not acceptable. This genus was created for *S. caragandicum* (Funicova, 1939) by Tshoijo who used a very peculiar set of differential characters. I regard this species, therefore, as *species inquirenda*.

The nematodes of horses, except for the lack of a uniform taxonomy above the species level, are a stable well-known group. As can be seen from the Outline Classification, very few legitimate new species have been described since 1925.

C. Key to Genera

1A. Males lacking; females long, slender and delicate, with cylindrical esophagus about one-fifth to one-seventh as long as nematode ..... *Strongyloides*

B. Dioecious; females usually with relatively short esophagus 2

Strongyloides westeri—only species in horses. DIAGNOSIS: Strongyloididae. Body long, 8–9 mm, slender, 80–95 μ, attenuated anteriorly. Lips indefinite; buccal capsule very small. Esophagus cylindrical, without bulb, about one-seventh as long as body. Tail short, conical. Vulva posterior to midbody, opens directly into opposed uterine branches. Ovejectors absent. Few eggs (40–50 by 30–40 μ) with those closest to vulva usually embryonated. Ovaries reflexed. Only females in parasitic generation.

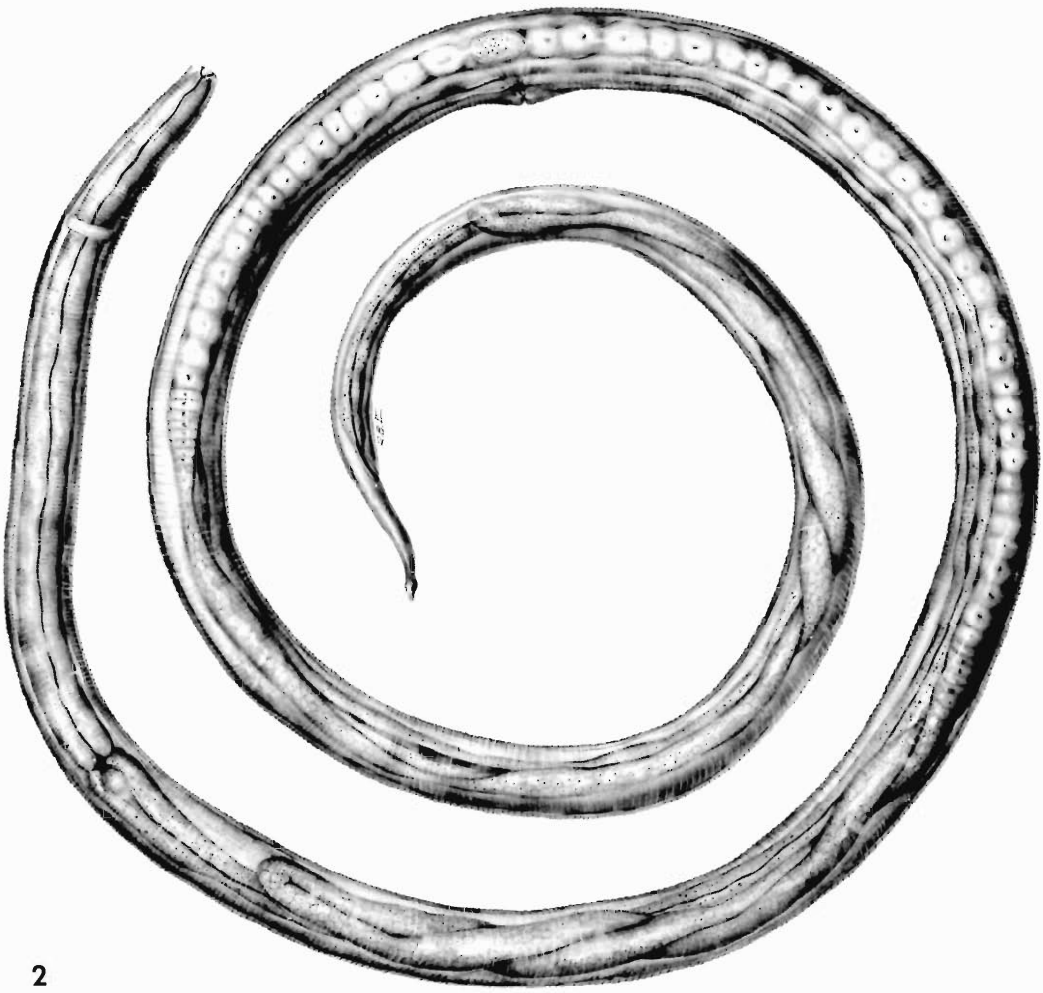

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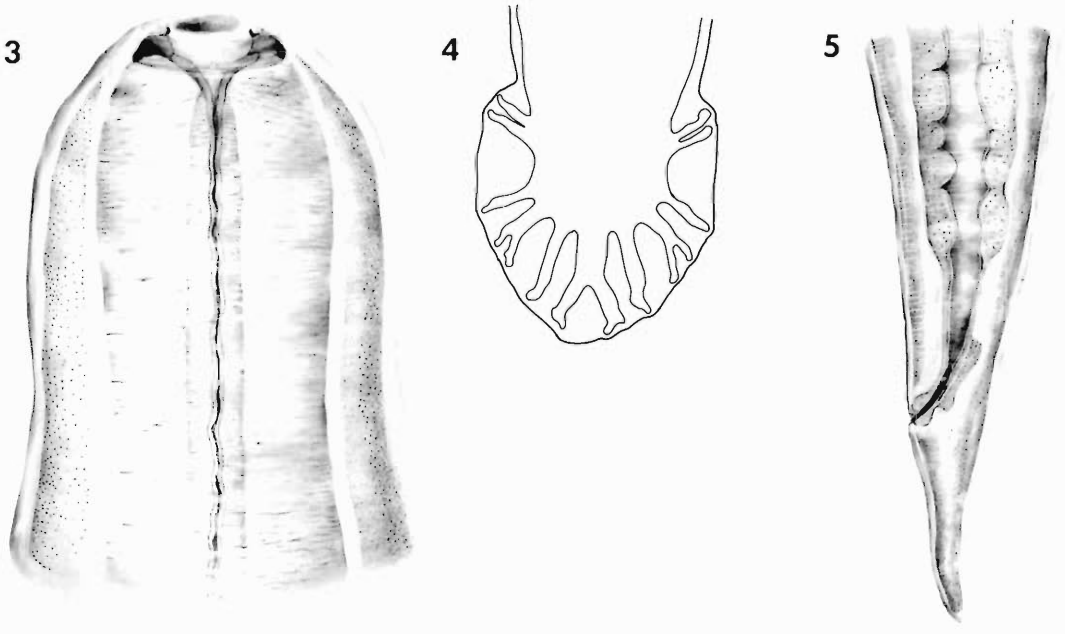
Figure 2. ***Strongyloides westeri*, parasitic female, lateral view, × 64.**

2A. Males with strongylid bursa copulatrix; intestine composed of few large multinucleate cells 3
B. Males without strongylid bursa copulatrix; intestine composed of many usually uninucleate cells 17

3A. Parasites of respiratory system ..... *Dictyocaulus*
B. Parasites of digestive tract 4

Dictyocaulus arnfieldi—only species normally occurring in horses. DIAGNOSIS: Dictyocaulinae. Body white, filiform. Mouth surrounded by six flat papillae. Buccal capsule small but distinct, about twice as broad as deep. Esophagus with slight bulbar swelling at posterior end. MALE 24 to 40 mm long, 250 μ wide. Bursa copulatrix short with short lobelike rays not lobulated; dorsal ray divided and the 2 branches slightly bidigitate. Spicules slightly curved, equal, 200–250 μ long, with brown spongy appearance. Gubernaculum of irregular ovoid shape, 50 μ long. FEMALE 43–70 mm long, 400 μ wide. Vulva slightly anterior to midbody. Anus 400 μ from bluntly pointed tail. Eggs 80–100 by 50–60 μ, embryonated.

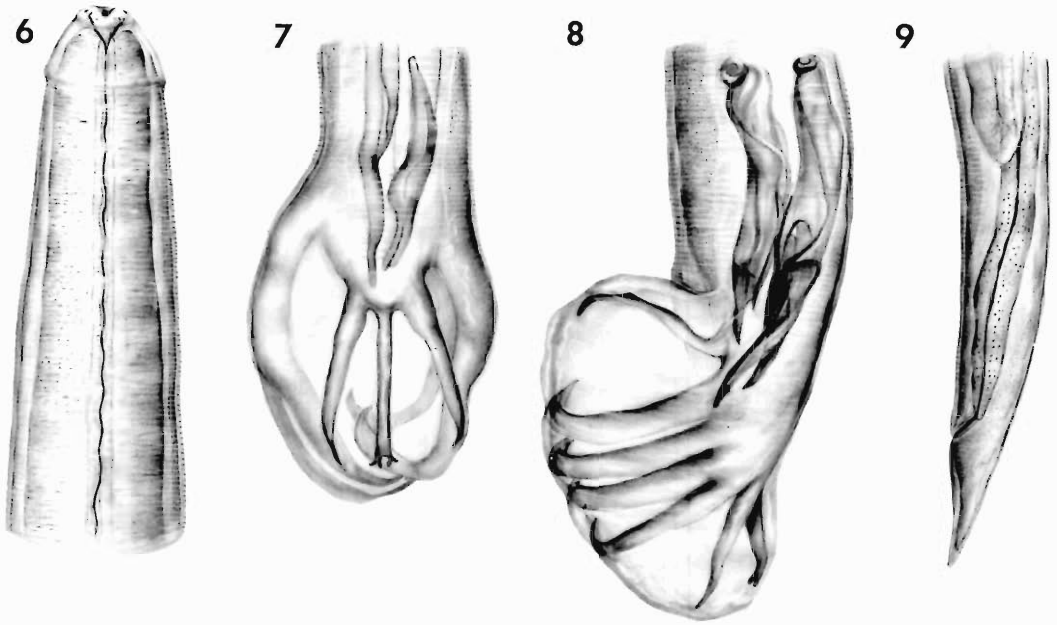


Figures 3–5. ***Dictyocaulus arnfieldi.*** **3. Head, dorsal view, × 290. 4. Male tail, dorsal view, × 140. 5. Female tail, lateral view, × 75.**

4A. Filiform worms without buccal capsule ..... *Trichostrongylus*

B. Stouter worms with well-developed buccal capsule 5

Trichostrongylus axei—only species normally occurring in horses. DIAGNOSIS: Trichostrongylinae. Small slender nematode without buccal capsule. MALE 3.4–4.4 mm long. Bursa copulatrix wider than long, unlobulated; ventroventral ray very slender; dorsal ray slender, divided near tip and each branch further divided. Spicules unequal in size; right 89–95 μ ending in short blunt point; left spicule 110–120 mm ending in long curved slender point; slender process near middle on medial side of each spicule. Gubernaculum spindle-shaped, 50–60 μ long. FEMALE 4.5–5.5 mm long. Vulva in posterior third of body. Muscular ovejectors opposed, vagina and ovejectors lined with thick cuticle. Tail straight, tapers gradually.

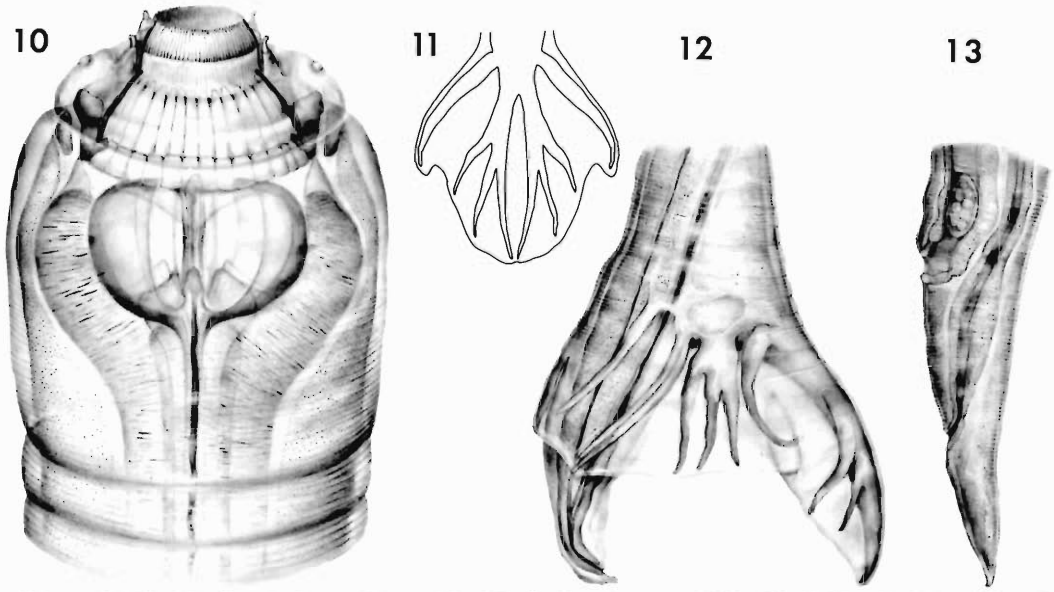


Figures 6–9. ***Trichostrongylus axei.*** **6. Head, ventral view, × 2,080. 7. Male tail, dorsal bursal ray, × 450. 8. Male tail, lateral view, × 450. 9. Female tail, lateral view, × 450.**

5A. Buccal capsule cylindrical or ring-shaped 6
B. Buccal capsule globular or funnel-shaped 13

6A. Anterior end of esophagus greatly dilated, with three large sickle-shaped teeth ..... *Gyalocephalus*
B. Anterior end of esophagus not greatly dilated 7

Gyalocephalus capitatus—only species in genus. DIAGNOSIS: Cyathostominae. Body relatively short and thick, about 8.5–11.0 mm long. Mouth collar high with inconspicuous papillae. External leaf-crown (ELC) of many (90–95) fine-pointed elements that project from mouth collar. Internal leaf-crown (ILC) consists of 30 large elements, broad, and pointed with origin at base of buccal capsule. Buccal capsule short, much wider than deep, and thick-walled, with ring of toothlike structures around posterior internal surface at origin of ILC. Dorsal gutter absent. Esophageal funnel very large, surrounded by greatly dilated anterior end of esophagus; contains 3 large sickle-shaped dentiform projections—1 dorsal, 2 subventral—each with a small tooth at its base; 3 additional small double teeth spaced among sickle-shaped projections. Esophagus flask-shaped. MALE. Bursa lobulated, large with exceptionally long prebursal papillae. Genital cone of variable length, long to very long, usually extends to or beyond edge of bursa. FEMALE. Vulva 300–400 μ anterior to anus. Tail 200–300 μ long, tapers gradually to conical tip. Eggs large, 120 by 50 μ.



Figures 10–13. ***Gyalocephalus capitatus.*** **10. Head, dorsal view, × 190. 11. Male tail, dorsal bursal ray, × 120. 12. Male tail, lateral view, × 120. 13. Female tail, lateral view, × 55.**

7A. Cylindrical buccal capsule greatly elongated, about 2 or 3 times deeper than wide 12

B. Buccal capsule not greatly elongated, not more than 1.5 times deeper than wide 8

8A. Elements of internal leaf-crown (ILC) as long as or longer, broader, and usually less numerous than elements of external leaf-crown (ELC) 11

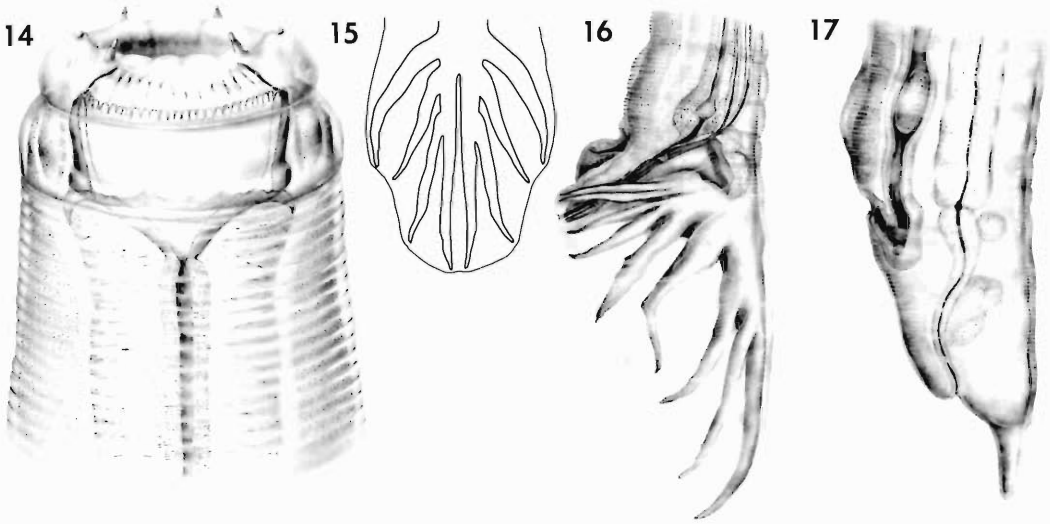
B. Elements of ILC shorter, usually narrower, and more numerous than elements of ELC 9

9A. Posterior margin of buccal capsule with ringlike hoop-shaped thickening; lateral papillae usually large, broad, and hornlike ..... *Cylicocylus*

B. Posterior margin of buccal capsule not as above; lateral papillae usually not prominent 10

Cylicocyclus Ihle, 1922. DIAGNOSIS: Cyathostominae. Small to medium-sized, about 10–25 mm long. Mouth collar usually high with broad lateral papillae that may be prominent. Elements of ELC much larger, broader, and fewer than those of the ILC. Elements of ILC usually short, thin rods at or near anterior edge of buccal capsule. Extra-chitinous supports of ILC absent. Buccal capsule short with thin walls tapering anteriorly; hoop-shaped thickening around posterior margin. Dorsal gutter usually not present in buccal capsule. Buccal cavity much broader than deep. MALE. Dorsal ray of bursa split to region of origin of externodorsal rays. Spicules filiform, equal, with pick-shaped tips. FEMALE. Vulva close to anus. Tail usually straight but may be bent slightly dorsally.

Type species: *C. radiatus* illustrated below. Key to species on pages 42–48.

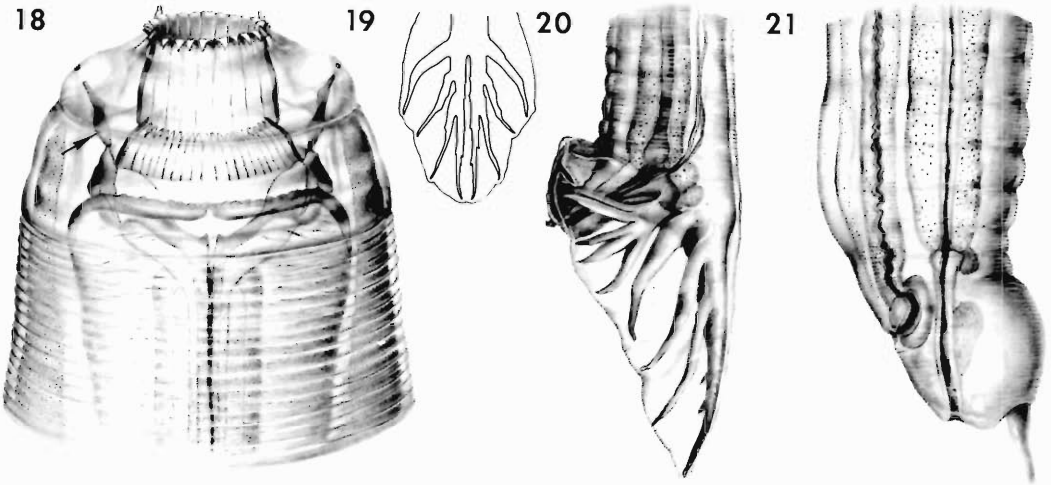


Figures 14–17. ***Cylicocyclus radiatus.*** **14. Head, dorsal view, × 260. 15. Male tail, dorsal bursal ray, × 65. 16. Male tail, lateral view, × 65. 17. Female tail, lateral view, × 100.**

10A. Base of ILC quite posterior to anterior margin of buccal capsule; extra-chitinous supports of ELC present; ILC may be inserted in uneven line; buccal collar usually not depressed; buccal cavity of uniform diameter or wider anteriorly ..... *Cyathostomum*

Cyathostomum Molin, 1861, *sensu stricto*. DIAGNOSIS: Cyathostominae. Small, about 5–12 mm long. Mouth collar moderately high. Cephalic papillae not prominent. Elements of ELC larger, broader, and fewer than elements of ILC but elements of both leaf-crowns of similar shape. Elements of ILC inserted at considerable depth in buccal cavity. Sclerotized extra-chitinous supports of ILC occur at or near anterior edge of buccal capsule. Buccal capsule generally short, thick-walled. Dorsal gutter not present in buccal capsule. Buccal cavity as broad or broader than deep. MALE. Dorsal ray of bursa split to region of proximal branch or to origin of externodorsal rays. Spicules filiform, equal, with pick-shaped tips. FEMALE. Vulva close to anus. Tail may be straight or bent dorsally with a ventral bulging anterior to the vulva.

Type species: *C. tetracanthum* illustrated below. Key to species on pages 38–42.

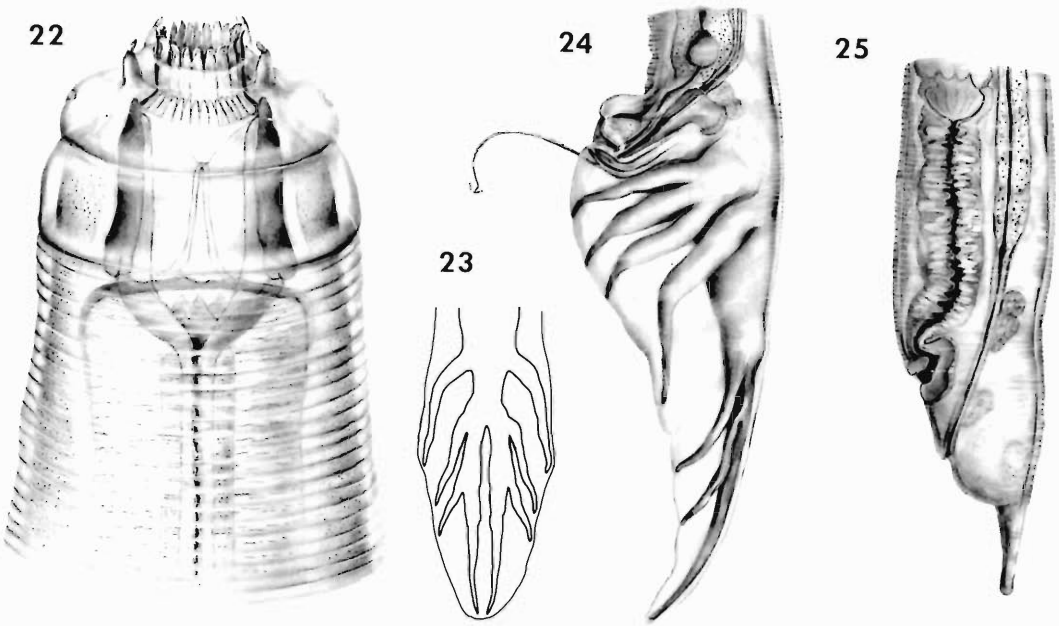


Figures 18–21. ***Cyathostomum tetracanthum.*** **18. Head, dorsal view. Extra-chitinous supports indicated (arrow), × 340. 19. Male tail, dorsal bursal ray, × 50. 20. Male tail lateral view, × 90. 21. Female tail, lateral view, × 110.**

B. Base of ILC at or near anterior margin of buccal capsule; extra-chitinous supports of ELC absent; buccal collar depressed; buccal cavity usually narrower anteriorly ---------- *Cylicostephanus*

Cylicostephanus Ihle, 1922. DIAGNOSIS: Cyathostominae. Small, about 4–10 mm long. Mouth collar depressed. Lateral papillae (amphids) not prominent. Submedian papillae prominent. Elements of ELC longer, usually broader, and fewer than elements of ILC. Elements of ILC are short thin rods or plates inserted at or near the anterior edge of the buccal capsule. Extra-chitinous supports for ILC absent. Buccal capsule of varying thickness, usually with dorsal gutter. Buccal cavity usually slightly narrower anteriorly. MALE. Dorsal ray of bursa split to region of proximal branch or to origin of externodorsal rays. Spicules filiform, equal, with pick-shaped tips. FEMALE. Vulva near anus. Tail usually straight.

Type species: *C. calicatus* illustrated below. Key to species on pages 51–55.

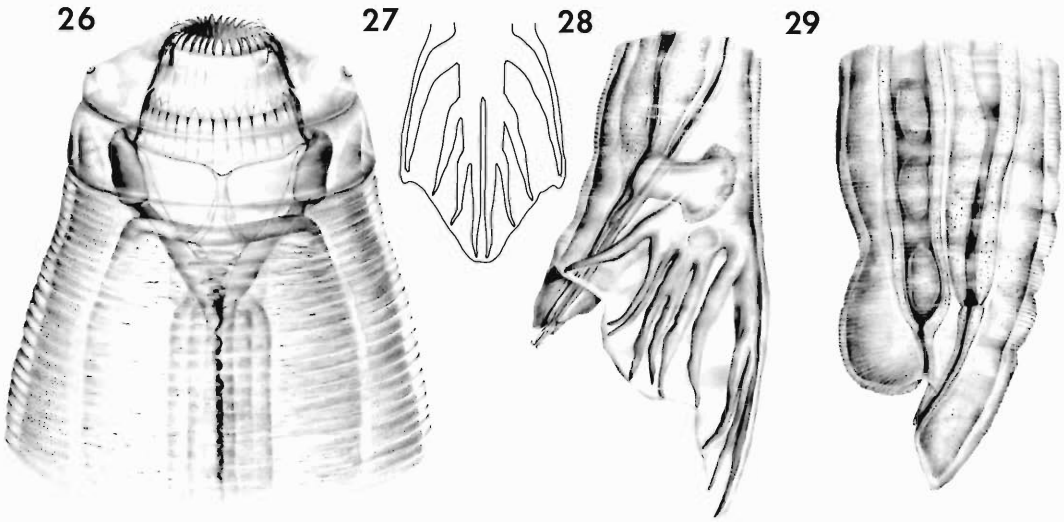


Figures 22–25. ***Cylicostephanus calicatus.*** **22. Head, dorsal view, × 425. 23. Male tail, dorsal bursal ray, × 65. 24. Male tail, lateral view, × 100. 25. Female tail, lateral view, × 140.**

11A. Buccal capsule walls of uniform thickness or thicker anteriorly; ILC inserted slightly posterior to anterior margin of buccal capsule, dorsal bursal ray split to level of proximal branches; female tail short with sharp tip ..... *Cylicodontophorus*

Cylicodontophorus Ihle, 1922. DIAGNOSIS: Cyathostominae. Small, medium-sized, about 7–14 mm long. Mouth collar high with lateral papillae inconspicuous and submedian papillae short and conical. ELC not as salient as ILC. ILC elements usually longer, broader, and less numerous than ELC elements. ILC elements inserted near anterior edge of buccal capsule. Extra-chitinous supports of ELC absent. Buccal capsule short, thick-walled—of nearly uniform thickness or thicker anteriorly. Dorsal gutter present or absent. Buccal cavity broader than deep. MALE. Dorsal ray split only to proximal branch. Spicules filiform, equal, with hook-shaped tips. FEMALE. Vulva near anus. Tail of female short with sharp tip. Prominent ventral bulge may be present anterior to vulva.

Type species: *C. bicoronatus* illustrated below. Key to species on pages 49–50.

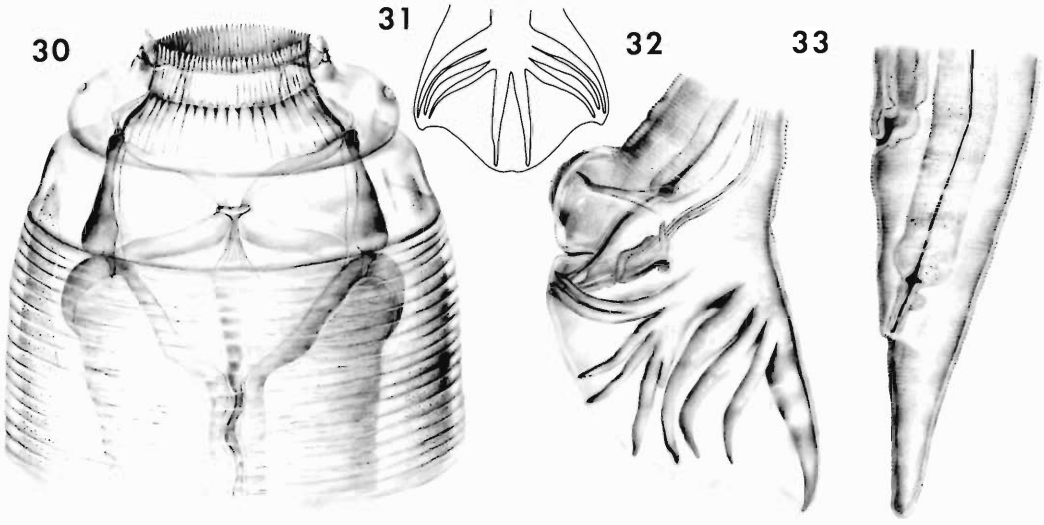


Figures 26–29. ***Cylicodontophorus bicoronatus.*** **26. Head, dorsal view, × 290. 27. Male tail, dorsal bursal ray, × 50. 28. Male tail, lateral view, × 70. 29. Female tail, lateral view, × 95.**

B. Buccal capsule walls thicker posteriorly than anteriorly; ILC inserted on anterior edge of buccal capsule; dorsal bursal ray split only to most distal branches; female tail long, tapered to blunt tip ..... *Poteriostomum*

Poteriostomum Quiel, 1919. DIAGNOSIS: Cyathostominae. Medium-sized, about 12–18 mm long and rather thick. Mouth collar high with short, inconspicuous submedian papillae with broad round bases; lateral papillae short and broad. ELC of numerous short, thin, pointed elements that protrude from mouth collar. ILC arises at anterior edge of buccal capsule; consists of long, broad acutely tipped elements. Buccal capsule broader than deep; walls thicker posteriorly. Dorsal gutter usually present; broad, extends almost ½ depth of buccal cavity. Esophagus short, thick, posterior ⅔ expanded. Esophageal funnel large, cone-shaped. MALE. Dorsal ray of bursa split only to most distal branch; branches arise at right angles. Edge of bursa with fine denticulation. FEMALE. Vulva near anus. Tail long or short.

Type species: *P. imparidentatum* illustrated below. Key to species on pages 55–56.



Figures 30–33. ***Poteriostomum imparidentatum.*** **30. Head, dorsal view, × 230. 31. Male tail, dorsal bursal ray, × 30. 32. Male tail, lateral view, × 50. 33. Female tail, lateral view, × 50.**

12A. Dorsal gutter projects well into buccal cavity; esophageal funnel with 3 small teeth; ELC of 8 broad petals, ILC inconspicuous ..... *Caballonema**

Caballonema longicapsulatum—only species in genus. DIAGNOSIS: Cyathostominae. Small to medium-sized, 6–12 mm long. Mouth collar high; submedian papillae long; lateral papillae short, inconspicuous. ELC of 8 broad petals, ILC inconspicuous. Buccal capsule cylindrical, exceptionally deep, almost 3 times as deep as wide (300 by 120 μ). Dorsal gutter well developed, about 170 μ long. Esophageal funnel with 3 conical denticles that do not project into buccal cavity. Esophagus cylindrical. MALE. Dorsal lobe of bursa markedly elongated; bifurcated to externodorsals. Edge of bursa denticulated. Gubernaculum scoop-shaped. FEMALE. Vulva fairly distant from anus, about twice as distant as length of tail.

B. Dorsal gutter does not project into buccal cavity; esophageal funnel without teeth; ELC of 6 broad petals; ILC of 12 broad petals ..... *Cylindropharynx**

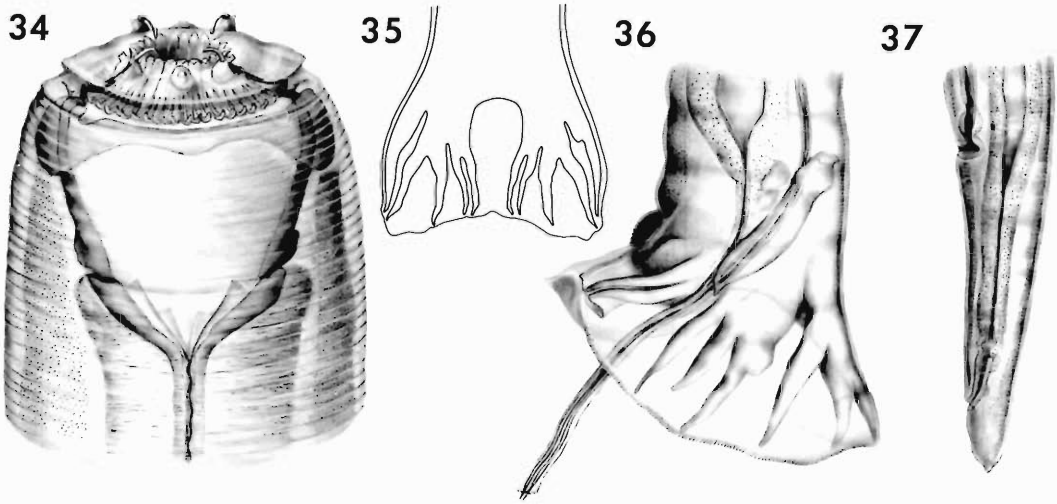
Cylindropharynx Leiper, 1911—2 species in horses (*C. aethiopica* and *C. asini*), but descriptions not available. GENERIC DIAGNOSIS: Cyathostominae. Mouth collar depressed, submedian papillae large, lateral papillae broad but not protruding. ELC of 6 large petals that may be greatly modified. ILC of 12 broad thick petals at anterior edge of buccal capsule. Buccal capsule cylindrical and extremely long. Dorsal gutter absent. Esophageal funnel without denticles. Esophagus cylindrical, thicker posteriorly. MALE. Dorsal ray with one lateral branch on each side that may be split distally; externodorsal ray arises separately from dorsal ray. Edge of bursa may be denticulated. FEMALE. Vulva fairly close to anus.

* Genera not known to occur in North America but reported elsewhere in domestic equids. Specimens were not available for study and no illustrations are given.

13A. Buccal capsule funnel-shaped, with thickened posterior ring; dorsal gutter absent ..... *Oesophagodontus*

B. Buccal capsule globular or subglobular without thickened posterior ring; dorsal gutter prominent 14

Oesophagodontus robustus—only species in genus. DIAGNOSIS: Strongylinae. Buccal capsule shaped like a funnel or a wine glass with a thickened ring encircling its posterior margin. Esophageal funnel with 3 lancetlike teeth that do not project into buccal capsule. ILC of many long slender pointed elements at anterior edge of buccal capsule. ILC elements are bent backwards at base with free ends reflected slightly anteriorly. ELC composed of fewer, broader, thicker elements of about same length. Mouth collar depressed with sharp ridge on peripheral edge. Lateral papillae short, not prominent. Submedian papillae prominent, extend above mouth collar, consist of broad base and a long slender distal part with broad base bearing short bilobed process. Dorsal gutter absent. MALE 15–18 mm long by 1 mm wide. Bursa closed all around with no protruding dorsal lobe. Dorsal ray represented by 2 groups of 4 rays. FEMALE 19–24 mm long; tail 500–700 μ long; vulva 2.2–3.5 mm anterior to anus.



Figures 34–37. ***Oesophagodontus robustus.*** **34. Head, dorsal view, × 70. 35. Male tail, dorsal view, × 85. 36. Male tail, lateral view, × 100. 37. Female tail, lateral view, × 15.**

14A. Leaf-crowns present; mouth directed straightforward 15

B. Leaf-crowns absent; mouth directed slightly dorsally ..... *Acheilostoma**

Acheilostoma paranecator—only species in horses. DIAGNOSIS: Globocephalinae. Medium-sized, 8–12 mm long. Mouth directed slightly dorsally. Mouth collar well developed, somewhat subterminal. Leaf-crowns absent. Buccal capsule spherical with 2 subventral and 2 subdorsal teeth at its bottom. Dorsal gutter extends into buccal cavity as a cone between

* Not known to occur in North America but reported elsewhere in domestic equids. Specimens were not available for study and no illustrations are given.

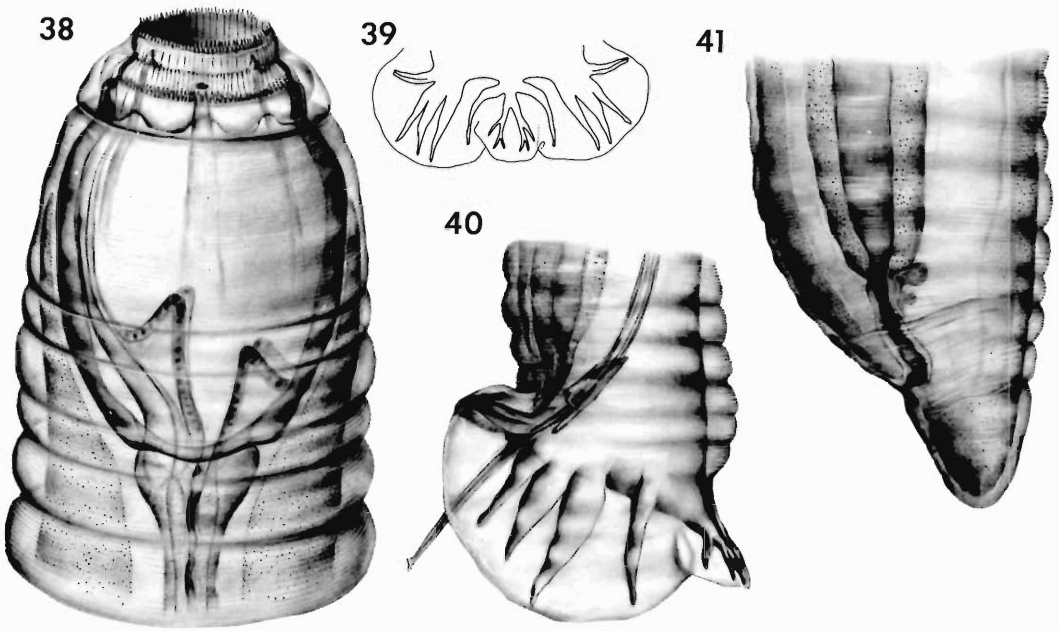
the subdorsal teeth. MALE. Caudal bursa trilobate, dorsal lobe smaller than laterals. Rays of bursa thick. Dorsal ray bifurcated with bifid tips. Externodorsals branch from thick dorsal ray. Spicules about 1.0 mm long, thin, end in small hook. FEMALE. Vulva at midbody. Uterine branches divergent. Tail 170 μ long. Eggs oval, 63 by 43μ.

15A. Buccal capsule globular, deeper than wide ..... *Strongylus*

B. Buccal capsule subglobular, wider than deep 16

Strongylus Mueller, 1780. DIAGNOSIS: Strongylinae. Large stout nematodes. Buccal capsule globular, deeper than wide with greatest diameter near middle. ELC with numerous thin-pointed elements protruding from high mouth collar. ILC similar in size and number of elements to external crown. Elements of ELC originate near tips of ILC elements so 2 crowns appear to be one. Lateral and submedian papillae not prominent. Dorsal gutter long, extends to anterior part of buccal capsule. Buccal capsule with or without teeth. MALE bursa small closed all around with dorsal lobe and slightly developed genital cone. Spicules not hook-shaped at distal ends. FEMALE with vulva near beginning of posterior third of body; uteri divergent.

Type species, *S. equinus*, illustrated below. Key to Species of *Strongylus* on pages 60–61.

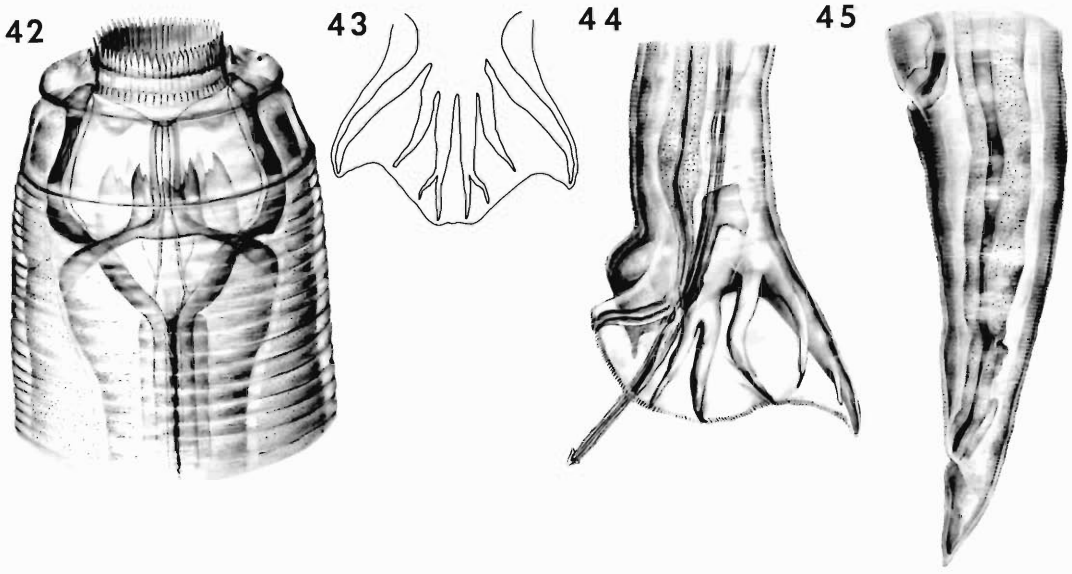


Figures 38–41. ***Strongylus equinus.*** **38. Head, lateral view, × 27. 39. Male tail, dorsal view, × 27. 40. Male tail, lateral view, × 40. 41. Female tail, lateral view, × 34.**

16A. Three large teeth extend into buccal cavity from esophageal funnel; elements of ELC numerous ..... *Triodontophorus*

Triodontophorus Looss, 1902. DIAGNOSIS: Strongylinae. Medium-sized worms. Buccal capsule subglobular with three large esophageal teeth protruding into buccal cavity to about ½ its depth. Anterior rim of buccal capsule surrounded by 6 platelike structures which give appearance of the capsule being thickened anteriorly. Mouth collar well-developed with peripheral edge rounded or depressed as a ridge. Submedian papillae small, conical or slender. Lateral papillae not prominent. ELC of numerous slender elements protrudes from buccal collar. ILC of oval plates of same number as ELC elements. Dorsal gutter extends to anterior edge of buccal capsule. Each of 3 esophageal teeth composed of 2 plates joined at an angle medially. MALE with well-developed dermal collar on genital cone. Bursa with finely denticulated margin and closed ventrally. FEMALE with vulva close or up to 3.0 mm from anus. Uteri parallel.

Type species, *T. serratus*, illustrated below. Key to species of *Triodontophorus* on pages 57–60.

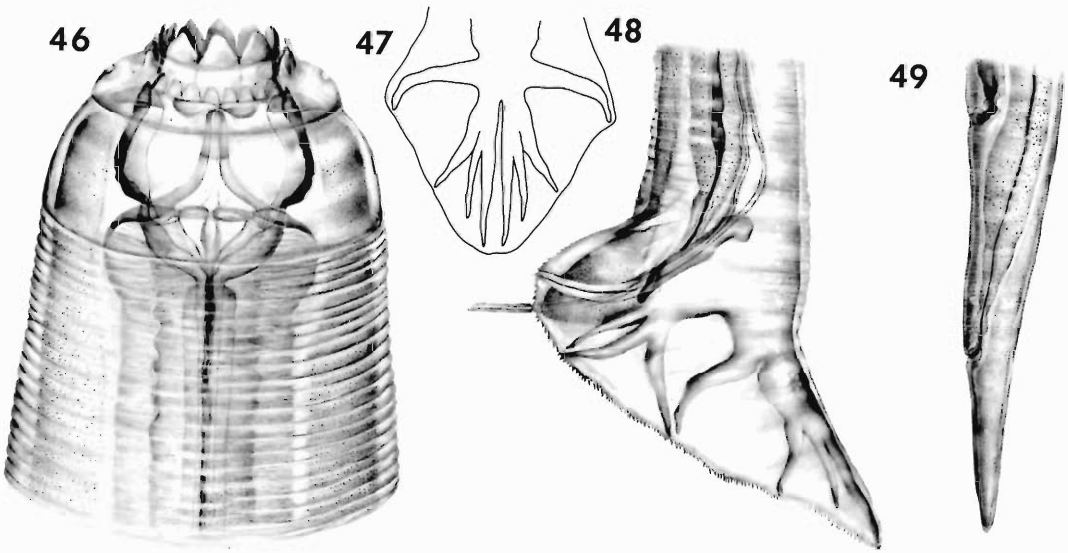


Figures 42–45. ***Triodontophorus serratus.*** **42. Head, dorsal view, × 200. 43. Male tail, dorsal view, × 45. 44. Male tail, lateral view, × 50. 45. Female tail, lateral view, × 40.**

B. Esophageal teeth do not extend into buccal cavity; elements of ELC few ..... *Craterostomum*

Craterostomum Boulenger, 1920. DIAGNOSIS: Strongylinae. Small worms, 6–10 mm long. Buccal capsule of greatest diameter in middle, wall thickened just behind anterior edge. Dorsal gutter strongly developed. Esophageal funnel shallow with 3 small triangular teeth that do not project into buccal cavity. Elements of ELC large, transparent, and less numerous than short, broad elements of ILC that ring anterior edge of buccal capsule. Mouth collar depressed; submedian papillae extend beyond mouth collar. MALE. Bursa with finely denticulated border, closed. FEMALE. Tail long, pointed. Vulva relatively far from anus, but not more than 1.0 mm from it.

The only species of this genus that occurs in North America is the type species, *C. acuticaudatum*. It is illustrated below. A discussion of this genus is given on pages 56–57.



Figures 46–49. ***Craterostomum acuticaudatum.*** **46. Head, dorsal view, × 310. 47. Male tail, dorsal bursal ray, × 60. 48. Male tail, lateral view, × 100. 49. Female tail, lateral view, × 50.**

17A. Esophagus dilated posteriorly into a distinct bulb 18
B. Esophagus without dilated bulb 20

18A. Parasitic in tissues; microscopic in size (less than 500 μ long). ..... *Micronema*
B. Parasitic in digestive tract; at least 2–3 mm long 19

Micronema deletrix—only parasitic species. DIAGNOSIS: Rhabditina. Microscopic, cylindrical body 250–445 μ long tapering anteriorly and rapidly posterior to anus. Cuticle with fine striations about ½ μ apart near midbody. Cephalic region transparent, composed of 6 lips bearing 6 papillae and amphids. Stoma cephaloboid. Cheilorhabdions present, prorhabdions long, mesorhabdions shorter and thinner than prorhabdions, dorsal metarhabdion bears tooth, telorhabdions form ring at base of stoma. Esophagus panagrolaimoid 70–92 μ long, metacorpus a distinct bulb, procorpus and isthmus about equal in length, basal bulb pyriform with refractive valvular apparatus. Nerve ring at middle of isthmus. Excretory pore indistinct. Lateral cephalic papillae prominent near base of isthmus. Tail conical, 49–70 μ long, abruptly tapered to sharp point. Phasmids near middle of tail. Vulva slightly posterior to midbody, vulval lips protrude slightly. Gonad single, extends about 3 or 4 body widths anteriorly before reflexing posteriorly 1½ body widths beyond vulva where it reflexes dorsally and anteriorly. Each large ovum 9–17 by 32–46 μ develops alone sometimes to larval stage. Probably parthenogenic, oviparous. MALE unknown. See Discussion and photographs of *M. deletrix* in tissue on pages 61–62.

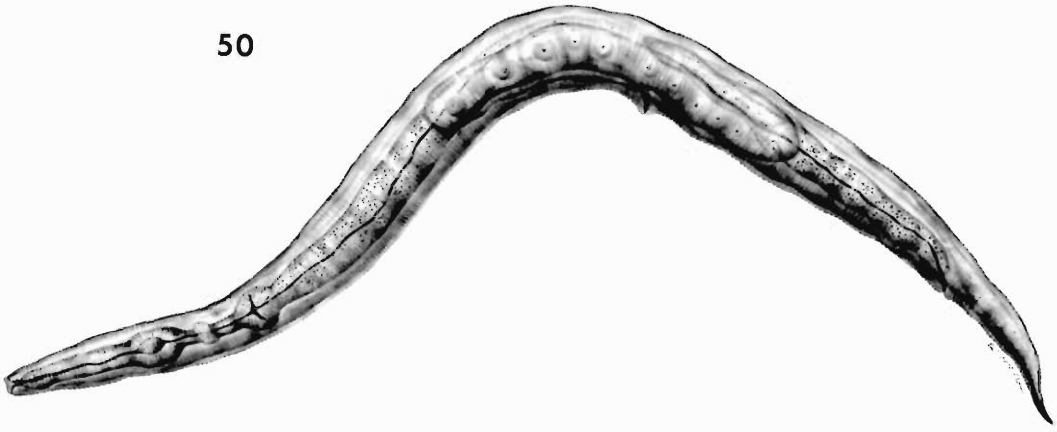
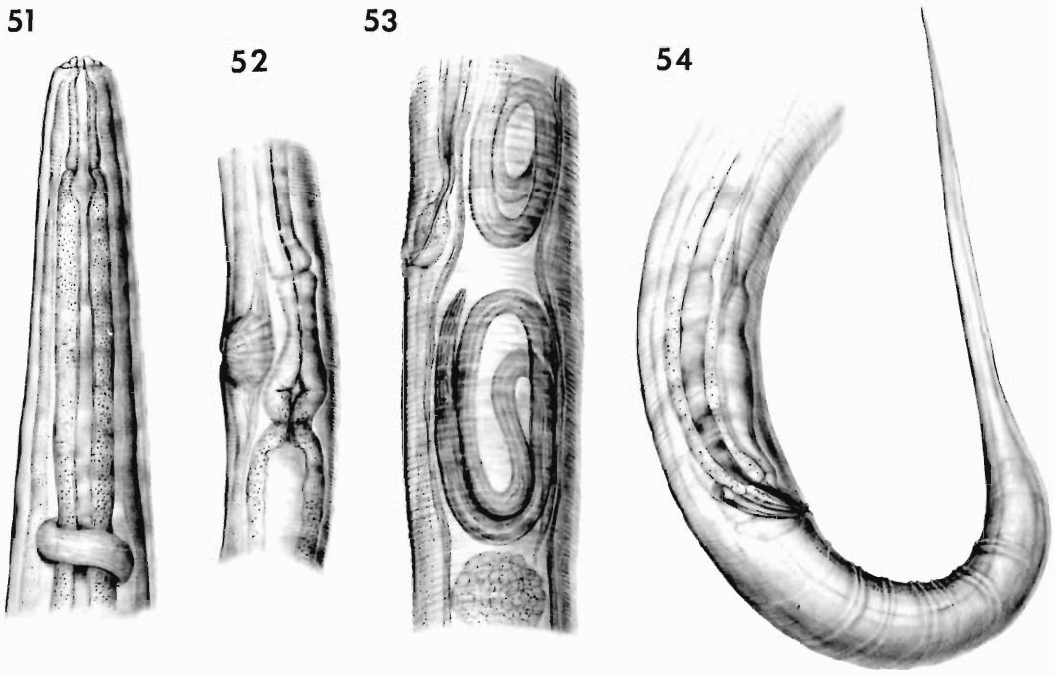


Figure 50. ***Micronema deletrix*, female, lateral view, × 300.**

19A. Transparent, small slender nematodes with relatively long narrow stoma; esophagus expanded in posterior bulb; large prominent suckerlike excretory pore; viviparous ..... *Probstmayria*

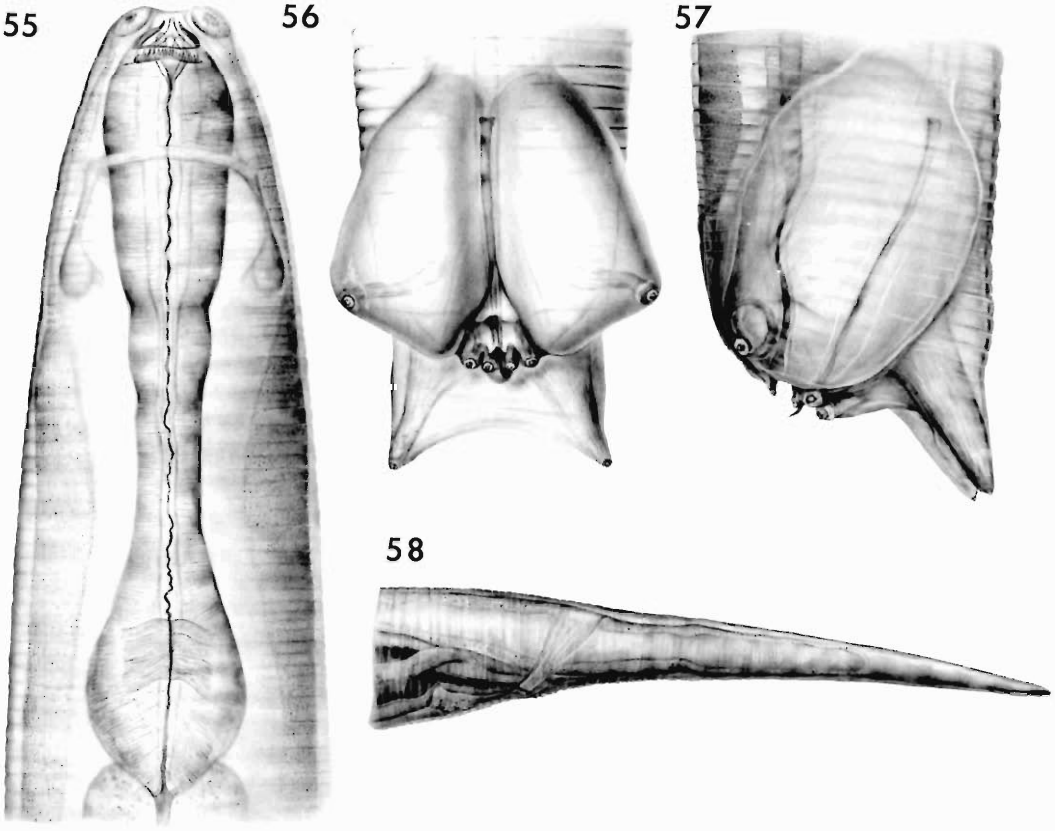
Probstmayria vivipara—only species in horses. DIAGNOSIS: Probstmayriinae. Small, slender, transparent, 2–3 mm long. Mouth with 6 small lips. Buccal capsule cylindrical, long and narrow. Esophagus with long cylindrical part and separated flask-shaped bulb. Large suckerlike excretory pore present. Tail long and pointed in both sexes. MALE. Caudal alae absent. Caudal papillae inconspicuous. Two small, nearly equal spicules 58–67 μ long. Gubernaculum absent. FEMALE. Vulva near midbody. Viviparous; early developmental to large immature stages visible inside females.



Figures 51–54. ***Probstmayria vivipara.*** **51. Anterior region, lateral view, × 160. 52. Esophagointestinal junction and excretory pore, lateral view, × 120. 53. Vulva and developing larvae in female, lateral view, × 160. 54. Male tail, lateral view, × 160.**

B. White, large, stouter nematodes with relatively short broad stoma; esophagus expanded anteriorly and posteriorly; excretory pore not prominent; oviparous ..... *Oxyuris*

Oxyuris equi—only species in horses, except *O. poculum* which occurs in Ceylon and has spicules 440 μ long. DIAGNOSIS: Oxyurinae. Medium to large, white; males 9–12 mm long, females up to 100 mm long. Mouth hexagonal, 2 sucker-like papillae on each lateral lip. Buccal capsule short with bristles at bottom. Esophagus expanded in anterior ½, followed by constricted ⅓, and a posterior bulb with a valvular apparatus. MALE. Caudal alae short supported by one large pair of preanal and one large pair of postanal papillae. Another pair of papillae flank the vent. Spicule single and needlelike about 120–200 μ long. Gubernaculum absent. FEMALE. Vulva in anterior part of body. Excretory pore quite posterior to esophagus, just anterior to vulva. Tail varies greatly in length, may be extremely long and whiplike. Eggs with operculum, 85–95 by 40–45 μ, embryonated.

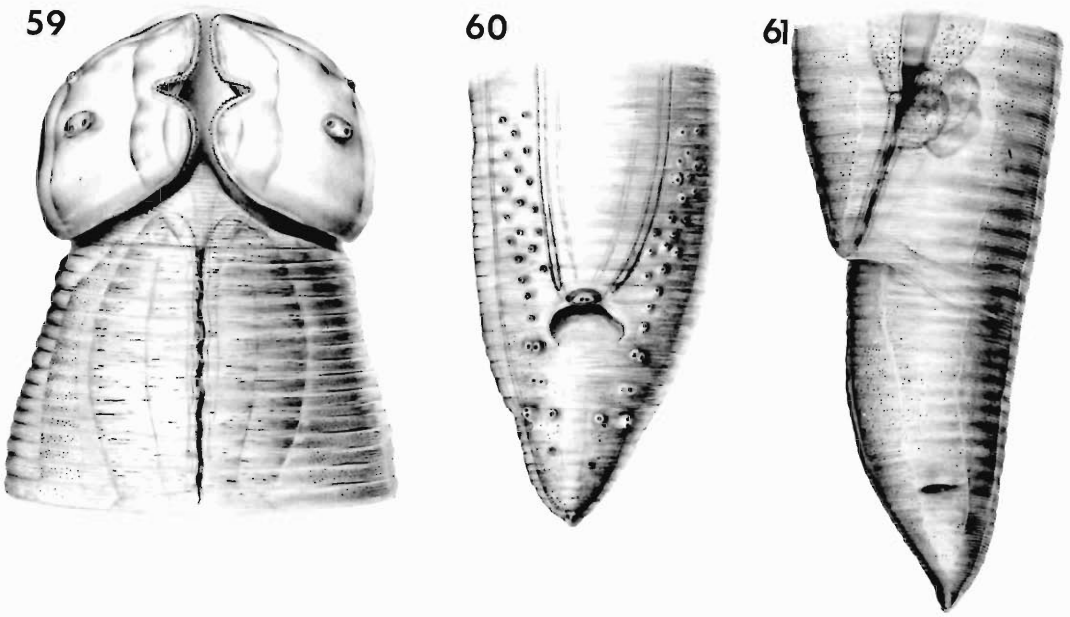


Figures 55–58. ***Oxyuris equi.*** **55. Anterior region, dorsal view, × 35. 56. Male tail, ventral view, × 154. 57. Male tail, lateral view, × 154. 58. Female tail, lateral view, × 15.**

20A. Head with 3 large lips; long, thick, opaque worms; esophagus short stout muscular, difficult to see except in dissected specimens ..... *Parascaris*

B. Head not as above; relatively slender worms; esophagus usually long with 2 distinct parts 21

Parascaris equorum—only species in horses. DIAGNOSIS: Ascaridinae. Large, 15–50 cm; thick; opaque. Mouth surrounded by 3 large quadrangular lips separated by small interlabia. Each lip with a denticulated inner surface. Each lip divided by horizontal groove except on outer surface. Two large double papillae on dorsal lip and one large double papilla on each subventral lip. Each subventral lip with large additional pair of papillae in anterolateral part of lip. Buccal capsule absent. Cervical alae absent. MALE. Tail bluntly conical with small caudal alae. Spicules equal, 2–2.5 mm long. Gubernaculum absent. About 6 pairs of postanal papillae; many preanal papillae. FEMALE. Vulva near beginning of second quarter of body. Tail ends in short conical projection. Oviparous; eggs with pitted thick shell, subglobular, 90–100 μ in diameter.



Figures 59–61. ***Parascaris equorum.*** **59. Head, ventral view, showing large pair of papillae and one of lateral pair of papillae on each subventral lip, × 40. 60. Male tail, ventral view, only distal tips of spicules are shown, × 40. 61. Female tail, lateral view, × 30.**

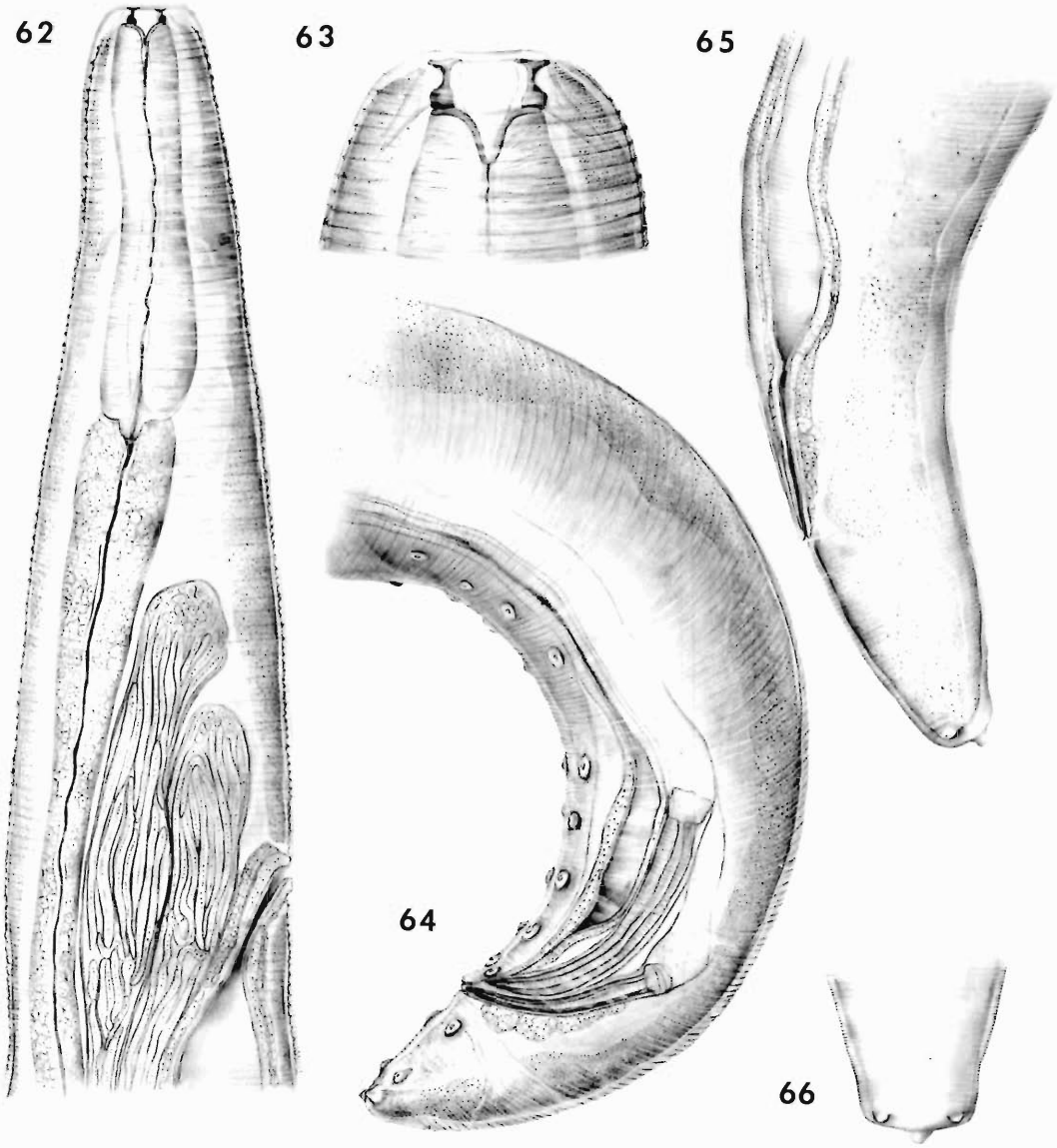
21A. Sclerotized buccal capsule present; vulva near midbody; oviparous 22

B. Buccal capsule absent or rudimentary; vulva in anterior region of body; gravid females usually contain microfilariae 24

22A. Parasites of lacrimal ducts or surface of eye ..... *Thelazia*

B. Parasites of digestive tract 23

Thelazia lacrymalis—only species of genus in horses. DIAGNOSIS: Thelaziinae. Males 8–12 and females 14–18 mm long. Mouth small, without lips, dorsoventrally elongated. Six small papillae surround mouth; 8 larger cephalic papillae and lateral papillae in outer circle

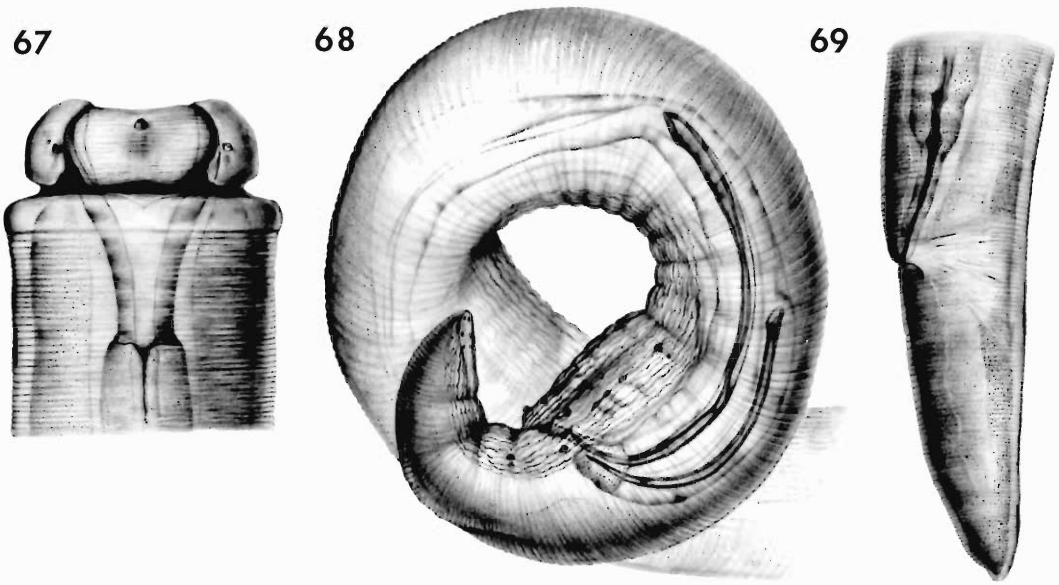


Figures 62–66. ***Thelazia lacrymalis.*** **62. Anterior end of female, lateral view, × 50. 63. Head, lateral view, × 160. 64. Male tail, lateral view, × 100. 65. Female tail, lateral view, × 100. 66. Female tail, ventral view of posterior end, × 100.**

of 10. Buccal capsule short, thick-walled, oval, without teeth. Esophagus short and thick. Cuticle transversally annulated with fine striations. MALE. Tail blunt and recurved without caudal alae. Preanal papillae numerous, paired except for one anterior to vent; 3–4 postanal papillae. Spicules unequal, left 170–190 μ long; right 130–140 μ long. FEMALE. Tail blunt with a pair of papillae near tip. Vulva just posterior to esophagointestinal junction. Uterine branches directed posteriorly. Viviparous.

23A. Anterior part of stoma funnel-shaped; lips separated from body by constriction ..... *Draschia*

Draschia megastoma—only species in genus. DIAGNOSIS: Habronematinae. Medium-sized, 7–13 mm long, white. Mouth with 2 unlobed lateral lips (pseudolabia). Interlabia present, well developed. Lips separated from body by constriction, forming knobs. Four submedian papillae each with a smaller one next to it. Lateral papillae on pseudolabia. Anterior part of buccal capsule thickened and funnel-shaped, without teeth. Esophagus with anterior muscular and posterior glandular parts. Lateral alae present. MALE. Tail with spiral twist. Four pairs pedunculated preanal papillae, 2 pairs postanal, and a cluster of very small ones near the tip. Spicules markedly unequal—left longer. Gubernaculum present. FEMALE. Vulva anterior to midbody. Viviparous.

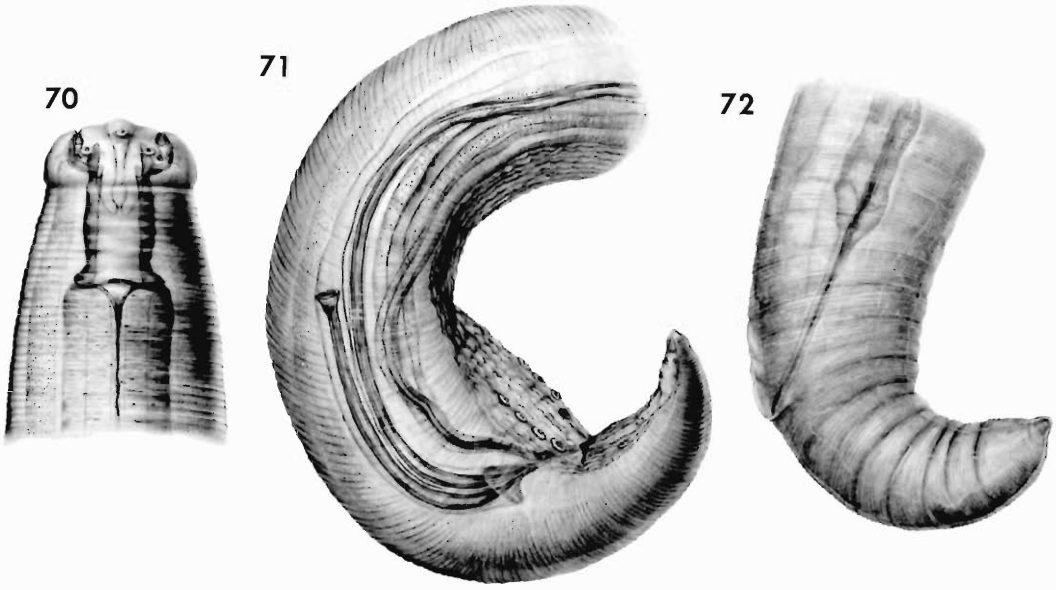


Figures 67–69. ***Draschia megastoma.*** **67. Head, lateral view, × 220. 68. Male tail, lateral view, × 220. 69. Female tail, lateral view, × 380.**

B. Anterior part of stoma cylindrical; lips not separated from body by constriction ..... *Habronema*

Habronema Diesing, 1861. DIAGNOSIS: Habronematinae. Medium- to large-sized, 8–35 mm long. Two lateral trilobed lips (pseudolabia) with or without teeth on inner surface. Interlabia present. Four submedian papillae, each with a smaller one next to it. Lateral papillae on lateral lips. Buccal capsule well developed, cylindrical or fusiform. Esophagus consists of short anterior muscular part and longer posterior part of glandular and muscular tissue. Cuticular alae bilateral or unilateral. Cervical papillae anterior to nerve ring. MALE. Tail with spiral twist. Caudal alae wide, 4 pairs pedunculated papillae preanal and 1–2 pairs postanal. Additional 2–3 pairs of small papillae near tip of tail. Spicules markedly unequal—left longer. Gubernaculum present. FEMALE. Vulva near midbody uteri divergent; tail cone-shaped. Oviparous, eggs embryonated.

Type species, *H. muscae*, illustrated below. Key to species of *Habronema* on pages 63–64.

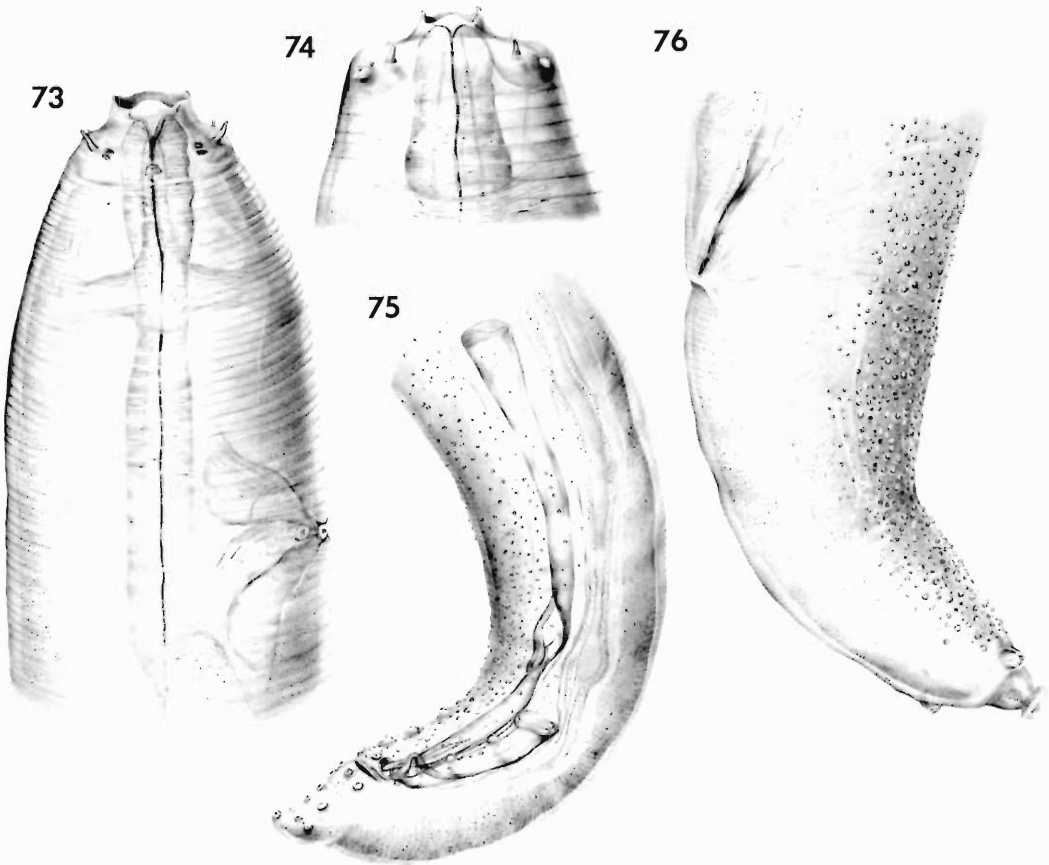


Figures 70–72. ***Habronema muscae.*** **70. Head, lateral view, × 220. 71. Male tail, lateral view, × 75. 72. Female tail, lateral view, × 120.**

24A. Mouth surrounded by peribuccal crown that projects as 4 lips; 4 additional hornlike cephalic spines posterior to peribuccal crown ..... *Setaria*

B. Mouth without peribuccal crown; head without hornlike spines 25

Setaria equina—type of genus and only species in horses. DIAGNOSIS: Setariinae. Long, white; male 51–66 mm long; female 110–130 mm long. Mouth surrounded by peribuccal crown that is modified into 4 projecting lips. Surrounding the 4 raised lips are 4 hornlike cephalic spines. Slightly more posteriorly are 4 pairs of papillae. Esophagus divided into anterior muscular and posterior glandular parts. MALE. Caudal alae very small. Usually 4 pairs of preanal papillae; one preanal and one postanal unpaired papillae located medially; and 3–4 pairs of postanal papillae. Very small caudal appendages near end of tail. Spicules unequal and dissimilar, left 610–640 μ and right 280–290 μ long. Right spicule with processes at tip that serve to support left spicule that usually protrudes from vent. Left spicule with expanded loop near middle. FEMALE. Vulva in cervical region. Tail with 2 small lateral appendages near knobby tip.



Figures 73–76. ***Setaria equina.*** **73. Head, lateral view, × 70. 74. Head, ventral view, × 70. 75. Male tail, lateral view, × 100. 76. Female tail, ventral view, × 100.**

25A. Parasitic in aorta or other arteries or veins; female with slender anterior end and sharply expanded posterior; male filiform; special annulation in cuticle beneath surface layers ..... *Elaeophora**

B. Parasitic in skin, subcutaneous tissues or tendons; marked sexual dimorphism lacking 26

**Elaeophora boehmi*—only species in horses. DIAGNOSIS: Onchocerinae. Long, slender, white; male 45–60 mm; female 40–200 mm long; sexual dimorphism pronounced. Mouth without lips, but small papillae present. Cylindrical esophagus very long. Intestine very narrow. MALE. Tail curved ventrally; caudal alae absent; 2 pairs of preanal and 3 pairs of postanal papillae. Spicules unequal, left 270–300 μ, right 90–100 μ long. FEMALE. Vulva in esophageal region, 460–600 μ from anterior end. Diameter of posterior part of body 5–6 times that of anterior part. Viviparous.

26A. Parasitic in subcutaneous and intramuscular connective tissue; cuticle of anterior end with elliptical or circular bosses ..... *Parafilaria**

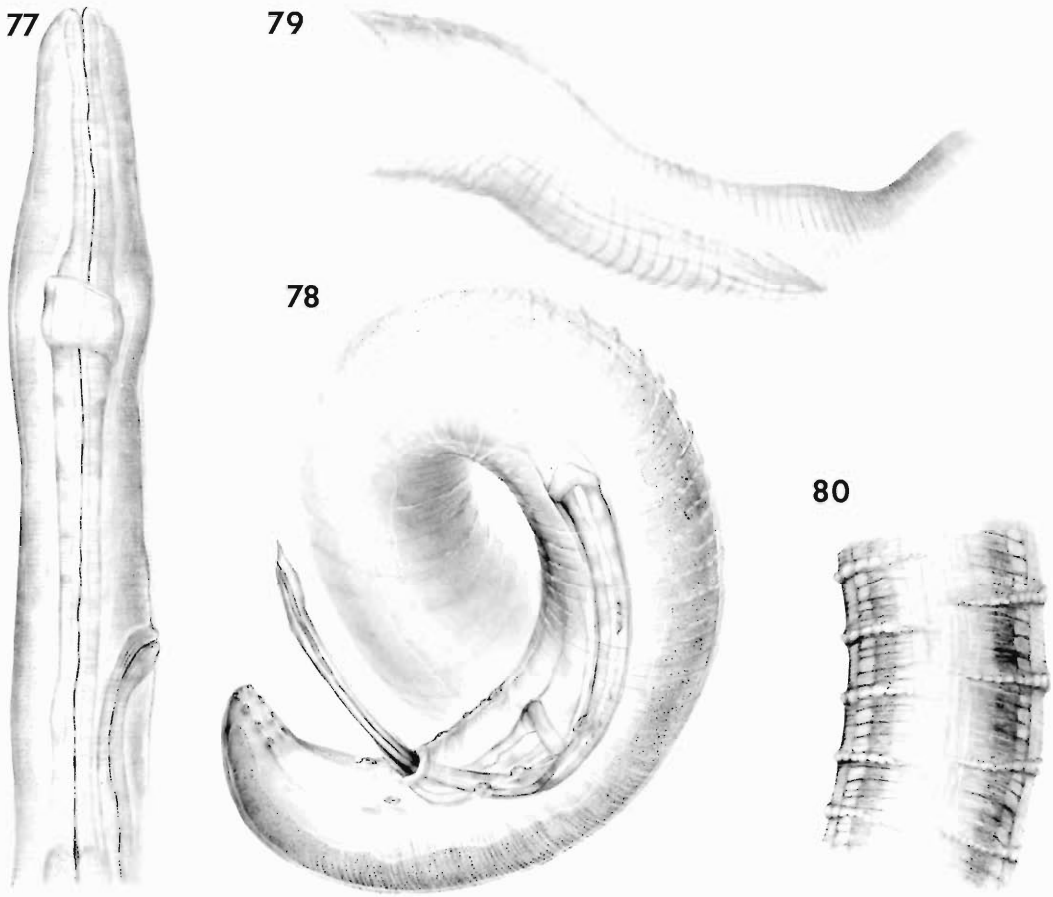
**Parafilaria multipapillosa*—only species in horses. DIAGNOSIS: Filarinae. Long, filiform, white; male about 30 mm and female 40–60 mm long. Mouth simple, with 2 lateral lips. Cuticle of cervical region with elliptical or circular bosses in 13–15 rings. Esophagus very short, undivided. MALE. Tail short, bluntly rounded. Many preanal and postanal papillae. Spicules unequal and dissimilar—left 680–750 μ, right 130–140 μ long. FEMALE. Vulva very near to mouth. Posterior end blunt, anus subterminal. Oviparous, embryonated.

B. Parasitic in ligamentum nuchae, flexor tendons, or suspensory ligament; cuticle with spiral thickenings ..... *Onchocerca*

Onchocerca Diesing, 1841. DIAGNOSIS: Onchocercinae. Both sexes filiform, very long. Mouth without lips or prominent papillae. Cuticle thick, transversally striated; always in female and usually in male with spiral thickenings. Esophagus short, not clearly divided into 2 parts. MALE. Tail spirally coiled, without caudal alae, with 4 circumanal papillae and one or more papillae anterior or posterior to these. Spicules unequal. FEMALE. Vulva about 500 μ from anterior end. Microfilariae unsheathed.

Type species, *O. reticulata*, not illustrated because specimens were unavailable. *O. cervicalis* illustrated below. See page 64 for a key to the 2 species.

* Not known to occur in North America but reported elsewhere in domestic equids. Specimens were not available for study and no illustrations are given.



Figures 77–80. *Onchocerca cervicalis*. 77. Anterior end of female, lateral view, × 120. 78. Male tail, lateral view, × 200. 79. Female tail, lateral view, × 120. 80. Spiral thickenings and internal striae in cuticle, × 150.

D. Keys to Species

The following keys to species of nematodes include only those known to occur in North America unless noted otherwise. Exotic species of each genus are listed following the key and compared with North American species. Usually only key characters are illustrated. References to complete descriptions of each species are included in the keys.

Genus *Cyathostomum*

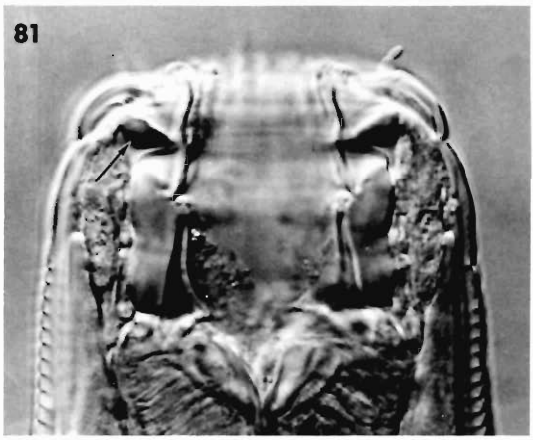
For species descriptions see Popova (1958, English translation, 1965)

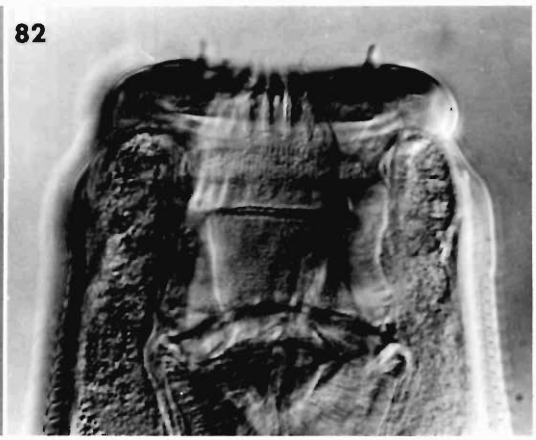
1A. Extra-chitinous supports of ELC prominent and ILC inserted in even line around buccal cavity 2

B. Extra-chitinous supports of ELC not prominent and/or ILC inserted in uneven line around buccal cavity 5

2A. Buccal cavity about as deep as broad, walls thick and bent inwards near middle ..... *C. coronatum*

B. Buccal cavity much broader than deep, walls relatively straight 3

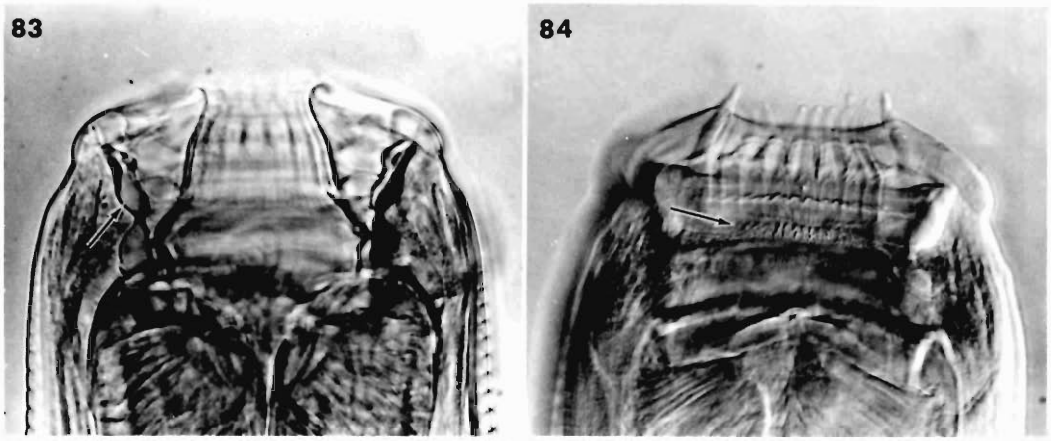




Figures 81, 82. ***Cyathostomum coronatum*** **heads, × 450. 81. Medial, dorsoventral view showing extra-chitinous supports (arrow). 82. Dorsal view showing ILC, ELC, and two submedian papillae.**

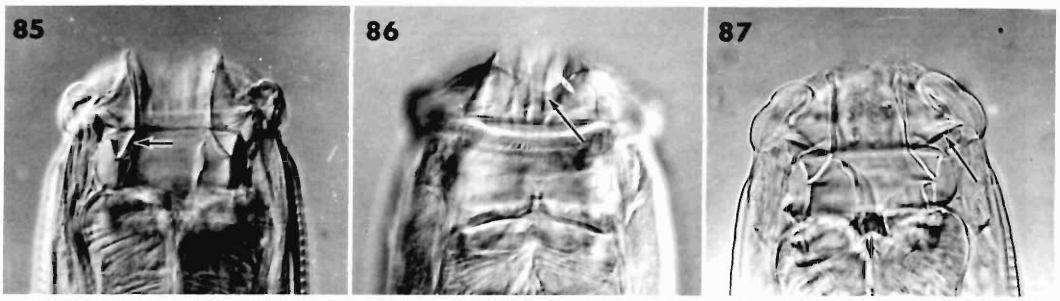
3A. Extra-chitinous supports nearly as large as wall of buccal capsule, appear to be extension of buccal capsule wall ..... *C. tetracanthum*

B. Extra-chitinous supports much smaller than wall of buccal capsule, usually not in line with buccal capsule wall .. 4



Figures 83, 84. ***Cyathostomum tetracanthum*** **heads, × 430. 83. Medial, dorsoventral view showing large extra-chitinous supports (arrow), ELC, ILC, and lateral papillae. 84. Dorsal view showing submedian papillae, ELC, and ILC (arrow).**

4A. Mouth collar notched to form 4 distinct lips; ILC elements one-half as long as ELC elements; extra-chitinous supports of ELC spindle-shaped; excretory pore near junction of middle and posterior thirds of esophagus ..... *C. labiatum*



Figures 85–87. ***Cyathostomum labiatum*** **heads, × 320. 85. Medial, dorsoventral view showing ELC, ILC (arrow), extra-chitinous supports, and lateral papillae. 86. Dorsal view showing notched mouth collar (arrow), submedian papilla, ELC, ILC, and dorsal gutter. 87. Submedian view showing extra-chitinous supports (arrow).**

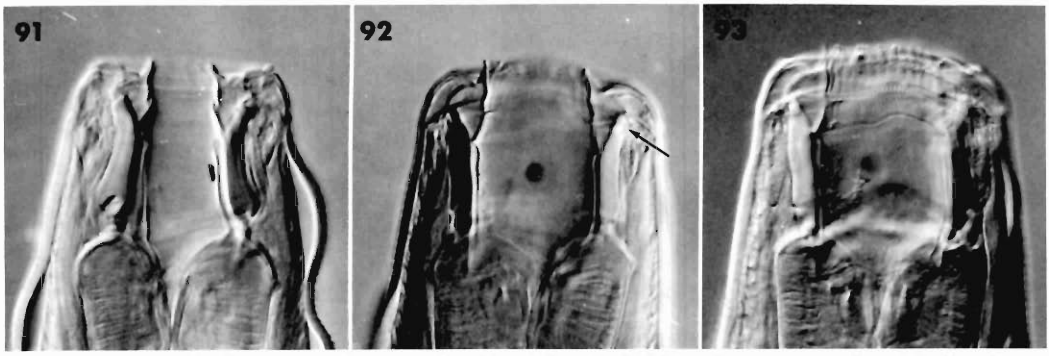
B. Mouth collar not notched; ILC elements more than one-half as long as ELC elements; extra-chitinous supports of ELC pyriform in shape; excretory pore near middle of esophagus ..... *C. labratum*

Figures 88–90. ***Cyathostomum labratum*** **heads, × 350. 88. Medial, dorsoventral view showing buccal capsule wall, ILC, extra-chitinous supports, and lateral papillae (arrow). 89. Dorsal view showing submedian papillae and ILC (arrow). 90. Medial lateral view showing buccal capsule wall, extra-chitinous supports (arrow), and a dorsal tooth in the esophageal funnel.**

5A. Walls of buccal capsule of nearly uniform thickness posterior to insertion of ILC; ILC inserted at about one-third depth of buccal capsule ..... *C. alveatum**

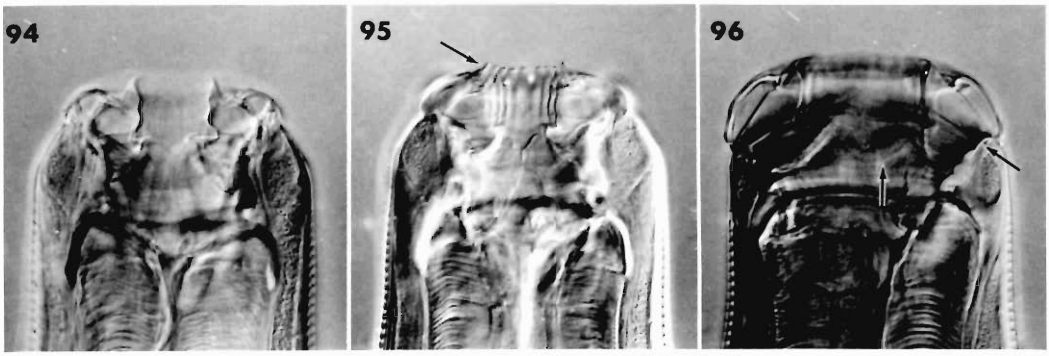
B. Walls of buccal capsule thickened posteriorly; ILC inserted at about one-half depth of buccal capsule 6

* Probably does not occur in North America; included because paratypes were available for study.



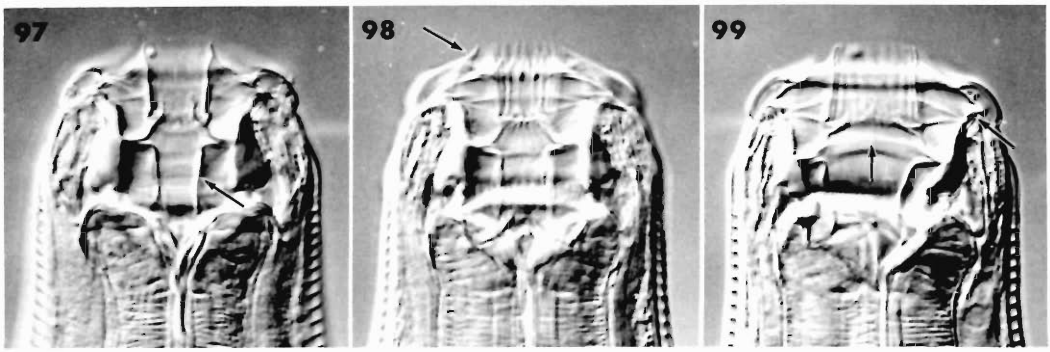
Figures 91–93. ***Cyathostomum alveatum*** **heads, × 230. 91. Medial, dorsoventral view showing buccal capsule wall, ELC, ILC, and lateral papilla. 92. Medial, lateral view showing extra-chitinous supports (arrow). 93. Lateral view showing ILC and ELC.**

6A. ILC inserted in sinuous line deep in buccal cavity (best observed in lateral view) ..... *C. pateratum*



Figures 94–96. ***Cyathostomum pateratum*** **heads, × 220. 94. Medial, dorsoventral view showing ELC, ILC, and lateral papillae. 95. Dorsal view of submedian papillae (arrow) and ELC. 96. Lateral view showing sinuous insertion (arrow) of ILC and extra-chitinous supports (arrow, right).**

B. ILC inserted more anteriorly on lateral sides of buccal capsule than on dorsal and ventral sides, but not in sinuous line ..... *C. catinatum*



Figures 97–99. ***Cyathostomum catinatum*** **heads, × 370. 97. Medial, dorsoventral view showing lateral papillae, ELC, ILC, and cuticular lining (arrow) of buccal capsule. 98. Dorsal view of submedian papillae and elements of ELC. 99. Medial, lateral view showing line of insertion of ILC (arrow) and extra-chitinous supports (arrow, right).**

Exotic species of *Cyathostomum*:

C. alveatum—reported in Africa, USSR, and Italy. Included in above key because paratypes were available for study.

C. montgomeryi—occurs in East Africa in zebra and in South Africa in horses and mules (Mönnig, 1928). Although specimens were not seen, this species appears to be similar to *C. labiatum* and *C. labratum* but without well-defined lips. Walls of buccal capsule longer in dorsoventral view than in lateral view. The presence of extra-chitinous supports in this species has not been demonstrated.

C. sagittatum—occurs in equines in Europe, Indonesia, Siberia. This species is very similar to *C. coronatum* except for a more shallow buccal cavity.

Discussion

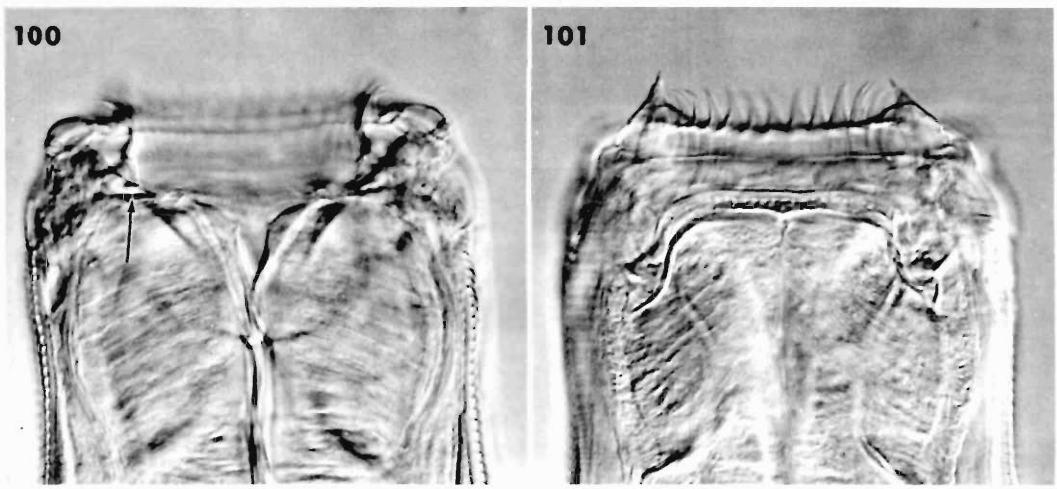
McIntosh (1951) established the validity of the genus *Cyathostomum* and listed a synonymy of the type species. The present writer agrees with the conclusions of McIntosh regarding the validity of *Cyathostomum*, but combines in this genus three species included by McIntosh (1951) and others in *Cylicocercus* Ihle, 1922. Like K'ung (1964), I believe that reliance on the shape of the female tail to separate *Cylicocercus* from *Cyathostomum* is inadequate and impractical. Species of both genera share the distinguishing generic characteristics of the deep origin of the internal leaf-crown and presence of extra-chitinous supports for the ILC. A species described by Yamaguti (1943), *C. subcoronatum*, was considered by Baruš (1962) to be a synonym of *C. coronatum*. The species were separated by Yamaguti on the basis of a greater number of ILC elements than indicated by Looss (1900) in his description of *C. coronatum*. After studying Looss' paratypes of *C. coronatum*, I agree with Baruš that *C. coronatum* has about 80 elements in the ILC and that *C. subcoronatum*, therefore, is its synonym.

Genus *Cylicocyclus*

For species descriptions see Popova (1958, English translation, 1965)

1A. Buccal capsule extremely shallow with very delicate inconspicuous walls ---- *C. brevicapsulatus*

B. Buccal capsule not extremely shallow or delicate ---- 2

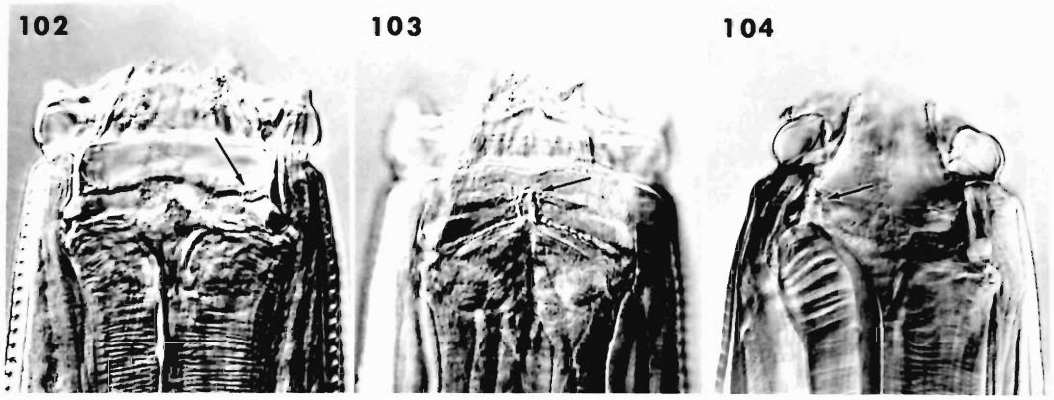


Figures 100, 101. *Cylicocyclus brevicapsulatus* heads, × 300. 100. Medial, dorsoventral view showing delicate walls of buccal capsule with small hoop-shaped thickening (arrow). 101. Dorsal view showing submedian papillae and ELC.

2A. Both lateral papillae and ELC prominent, extending beyond mouth collar; dorsal gutter present 3

B. Either lateral papillae or ELC may be prominent, but not both; dorsal gutter absent 4

3A. Dorsal gutter extends for one-half of depth of buccal cavity; submedian papillae long, extend beyond mouth collar; ELC consists of 20 elements; buccal capsule usually with internal shelflike cuticular projection ..... *C. nassatus*

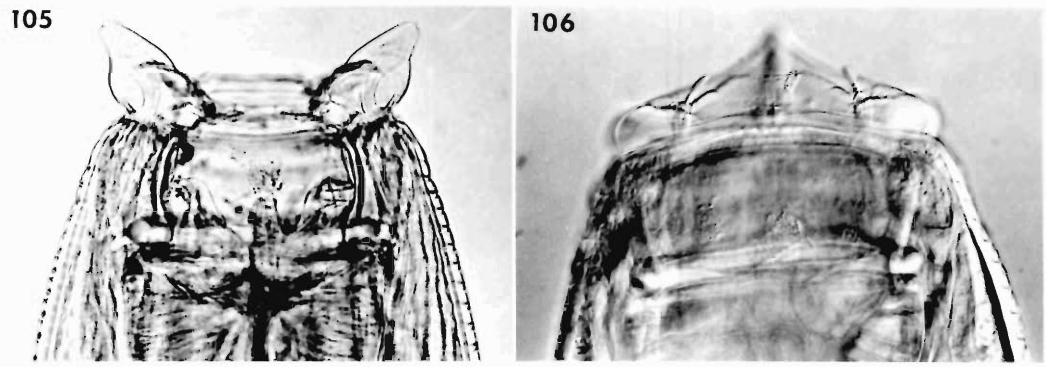


Figures 102–104. ***Cylicocyclus nassatus*** **heads, × 255. 102. Medial, dorsoventral view of prominent lateral papillae and shelflike cuticular projection (arrow) on inside wall of buccal capsule. 103. Dorsal view showing dorsal gutter (arrow). 104. Lateral view of dorsal gutter (arrow) and hooplike thickening at base of buccal capsule.**

B. Dorsal gutter short, little more than a button; submedian papillae relatively short, do not extend beyond mouth collar; ELC consists of 30 elements; buccal capsule without internal projection ..... *C. triramosus**

* Although this rare species has been reported in Puerto Rico, specimens were not available.

4A. Lateral papillae extremely long, earlike or hornlike; extend much higher than mouth collar and submedian papillae; excretory pore and cervical papillae behind esophagointestinal junction .. *C. auriculatus*



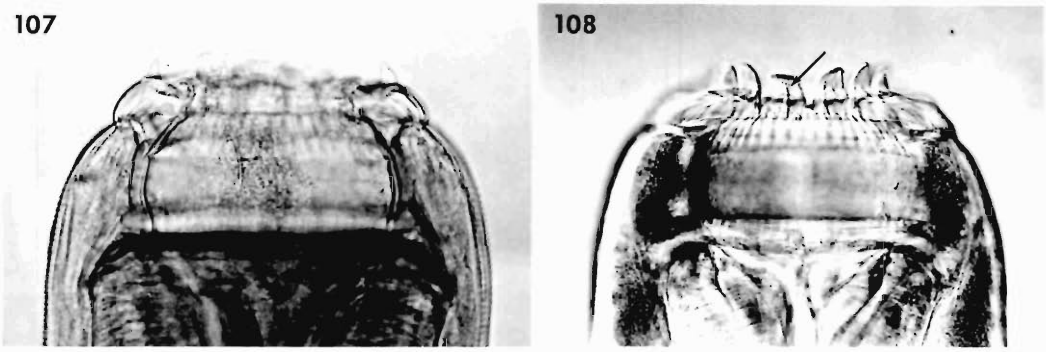
Figures 105, 106. ***Cylicocyclus auriculatus*** **heads, × 220. 105. Medial, dorsoventral view showing large hornlike lateral papillae and hooplike thickening at base of buccal capsule. 106. Lateral view of two submedian papillae, mouth collar, and lateral papilla.**

B. Lateral papillae not extremely long; excretory pore and cervical papillae at or anterior to esophagointestinal junction 5

5A. Excretory pore and cervical papillae near esophagointestinal junction 6

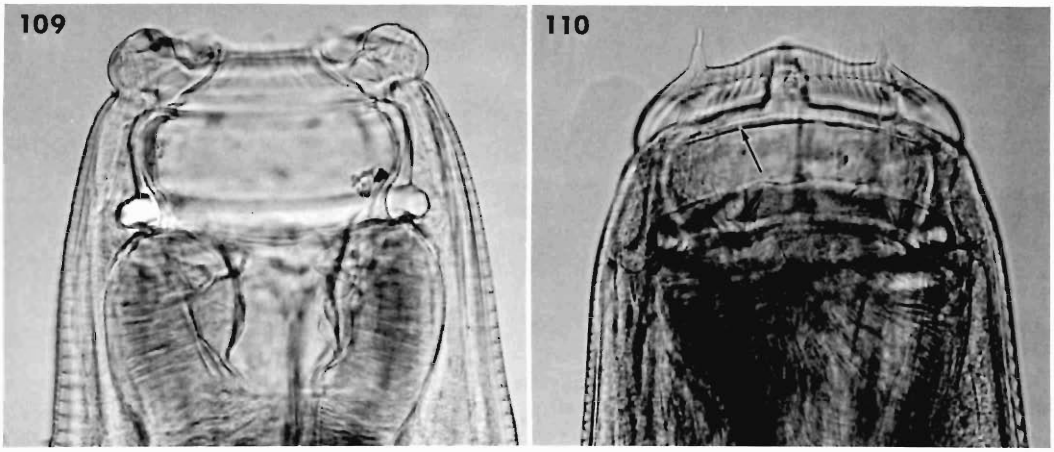
B. Excretory pore and cervical papillae well anterior to esophagointestinal junction 7

6A. ELC elements broad, number 10 to 12; ILC elements as long or longer than ELC elements, 12 of 46 ILC elements longer than others ..... *C. ultrajectinus*



Figures 107, 108. ***Cylicocyclus ultrajectinus*** **heads, × 190. 107. Subventral view showing 2 submedian papillae, buccal capsule with hoop-shaped thickening, and ILC elements (note length). 108. Ventral view of ELC and ILC elements. Note width of ELC and ILC elements and extra length of some ILC elements (arrow).**

B. ELC elements narrow, number about 38 in males and 44 in females; ILC elements much shorter than ELC elements and of uniform length ..... *C. insigne*

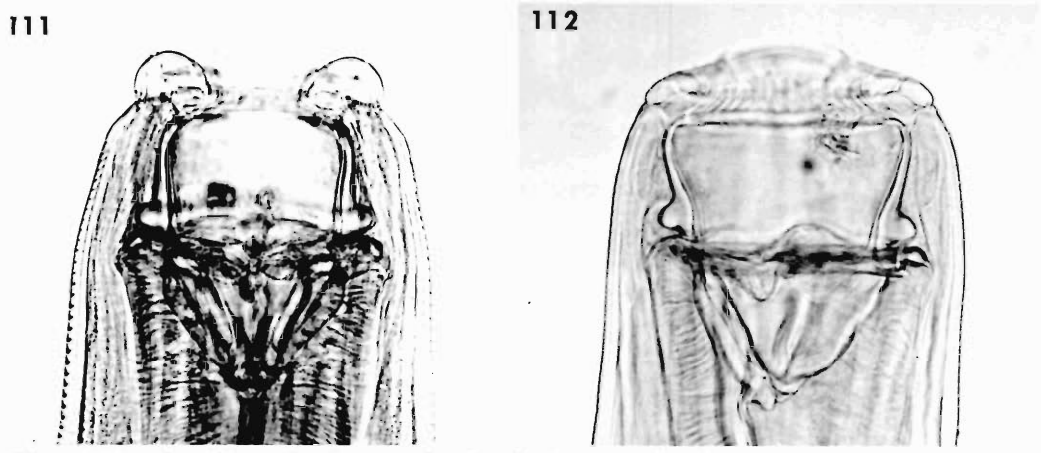


Figures 109, 110. ***Cylicocyclus insigne*** **heads, × 215. 109. Medial, dorsoventral view showing prominent lateral papillae, elements of ELC and ILC, buccal capsule, and large, lightly sclerotized esophageal funnel surrounded by thick muscle. 110. Lateral view of submedian papillae, long ELC elements, and short ILC elements (arrow).**

7A. Esophageal funnel nearly as large as buccal capsule; esophagus greatly elongated with posterior half enlarged but cylindrical ..... *C. elongatus**

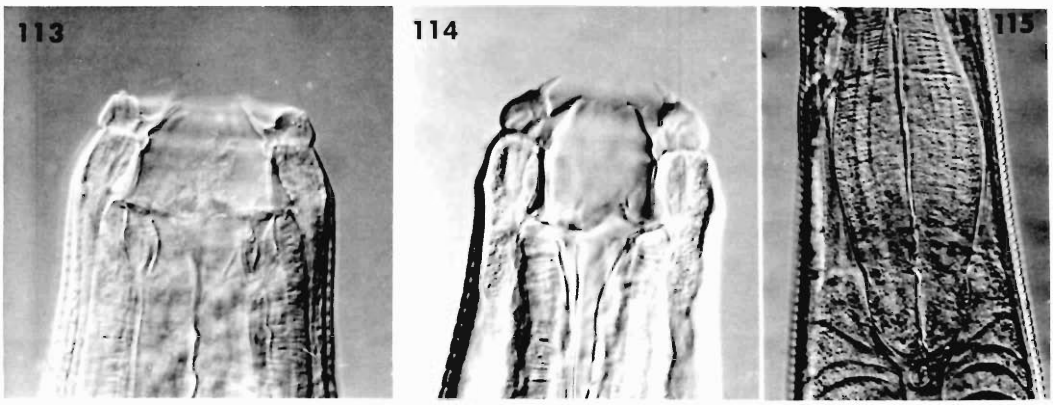
B. Esophageal funnel small; esophagus long with posterior half enlarged and pyriform 8

* This species can be separated into two distinct subspecies. See Discussion.



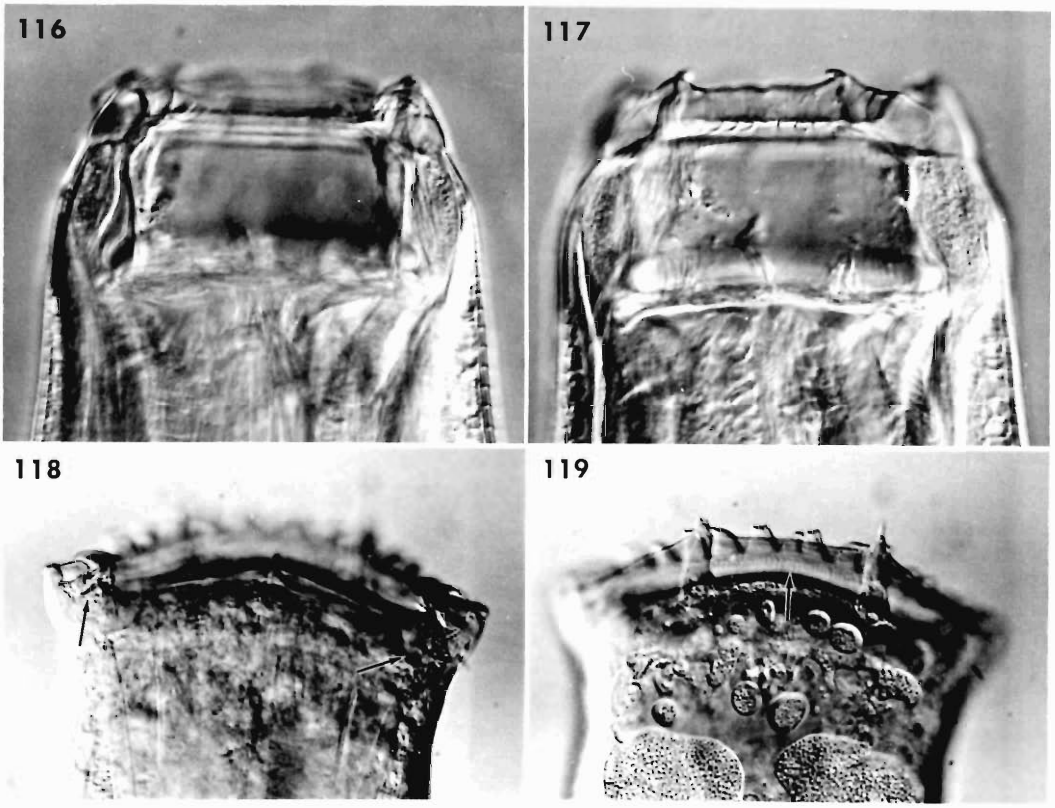
Figures 111, 112. ***Cylicocyclus elongatus*** **heads, × 240. 111. Medial, dorsoventral view of lateral papillae, buccal capsule, and large, heavily sclerotized esophageal funnel. 112. Lateral view of buccal capsule and esophageal funnel.**

8A. Esophagointestinal valve elongated; buccal cavity small, about 30 μ deep by 60 μ wide; elements of ELC almost as long as buccal capsule is deep ..... *C. leptostomus*



Figures 113–115. ***Cylicocyclus leptostomus.*** **113. Medial, dorsoventral view showing lateral papillae, buccal capsule, and elements of ELC and ILC, × 400. 114. Subdorsal view showing submedian papillae, buccal capsule, and elements of ELC and ILC, × 400. 115. Dorsal view of posterior half of esophagus showing pyriform-shaped swelling and elongated esophagointestinal valve, × 180.**

B. Esophagointestinal valve not elongated; buccal cavity large, about 55 μ deep by 120 μ wide; elements of ELC about one-third as long as buccal capsule is deep ..... *C. radiatus*



Figures 116–119. ***Cylicocyclus radiatus*** **heads, × 375. 116. Medial, dorsoventral view of lateral papilla and buccal capsule. 117. Dorsal view of submedian papillae. 118. Medial dorsoventral view of deteriorating specimen in which esophagus is pushed into mouth cavity spreading cephalic structures. Note buccal capsule wall including hooped-shaped ring (arrow on right) and bent anterior edge (arrow on left) of buccal capsule. 119. Same specimen as preceding figure showing submedian papillae (one broken), ELC elements, and ILC elements (arrow).**

Other species of *Cylicocyclus*:

C. adersi—in horse, donkey, mule, and zebra in Russia and Africa. Similar to *C. insigne* but with walls of buccal capsule of more uniform thickness, dorsal gutter short but well developed, and fewer, wider elements in the ILC.

C. largocapsulatus—described from horse in Turkey. No subsequent reports. Similar to *C. radiatus* but has more, longer ILC elements, a small dorsal gutter, and a shorter bursa.

C. matumurai—described from horse in Japan. No subsequent reports. Similar to *C. adersi* but differs in having much smaller buccal capsule and body size and more elements in internal leaf-crown.

Discussion

The name *Cylicocyclus*, calling attention to the hooplike thickening at the base of the buccal capsule, was proposed by Ihle (1922) as a subgenus. Cram (1925) elevated the group to generic level. There has been general agreement concerning the relationship of most of the species presently included in this genus, exceptions being *C. ultrajectinus*, *C. leptostomus*, *C. brevicapsulatus*, and *C. prionodes*.

Ihle (1922), Cram (1924), and McIntosh (1951) included *C. ultrajectinus* in the genus *Cylicodontophorus* because of its rather long ILC elements. However, *C. ultrajectinus* has a distinct hooplike thickening of the buccal capsule; and, unlike the genus *Cylicodontophorus*, the ILC elements are much thinner than the broad ELC elements. I agree with Ershov (1939) and K'ung (1964) who placed *C. ultrajectinus* in the genus *Cylicocyclus*.

Two species with extremely shallow buccal capsules (*C. brevicapsulatus* and *C. prionodes*) were placed in the genus *Cylicobrachytus* by Cram (1924), McIntosh (1951), and others. However, Ershov (1939) included one of these (*C. brevicapsulatus*) in *Cylicocyclus* and K'ung (1964) included both in this genus. Figure 100 shows *C. brevicapsulatus* to have a very delicate buccal capsule wall, but with the characteristics of this genus. The second species with a short buccal capsule, *C. prionodes*, was shown by Skrjabin and Ershov (1933) to be a synonym of *C. radiatus*. As illustrated in Figures 118 and 119, *C. prionodes* is a form of *C. radiatus* in which the esophagus is pushed forward spreading and compressing the cephalic structures. The typical buccal capsule wall of *C. radiatus* with the anterior edge flared can be seen in Figure 116. Initially, I was inclined to retain *C. prionodes* because of a much shorter vagina than in *C. radiatus*, but I now believe this apparent difference to be due to extreme contraction of the vagina in the single specimen that was available.

The available specimens of *C. elongatus* from North America consist only of lots from the Virgin Islands and Panama. Another lot from Canada was redetermined as *C. insigne*. Both of the above lots are *C. elongatus kotlani* (Ihle, 1920) that was described as a variety with a greatly elongated bursa (1.5 mm compared with 700 μ for *C. elongatus elongatus*). Georgi and Whitlock (1971) also reported *C. elongatus kotlani* from New York. Baruš (1962) and Braide and Georgi (1974) reported *C. elongatus kotlani* to have 52–57 elements in the ELC rather than 36 as found in *C. elongatus elongatus* by Looss (1902). This difference in number of ELC elements was also reported by Popova (1958). I was able to confirm these differences between *C. e. elongatus* and *C. e. kotlani* by studying paratypes of the former which Looss deposited in the USNM Helminthological Collection. In addition I observed the vagina of *C. e. elongatus* females to be significantly shorter than that of *C. e. kotlani*. These differences between the two subspecies are as great as those between many species and further study may provide convincing evidence that they are separate species. For the present I prefer to retain the subspecies designation.

C. leptostomus was assigned by Ershov (1943) to the genus *Schulzitrichonema* and by K'ung (1964) to *Cylicotetrapedon*, but I agree with Ihle (1922) in placing this species in *Cylicocyclus*. Although the hooplike thickening of the buccal capsule is not as distinct as in some species of the genus, it is similar to the type species, *C. radiatus*, and characteristics of the lateral papillae and leaf-crowns fit this genus.

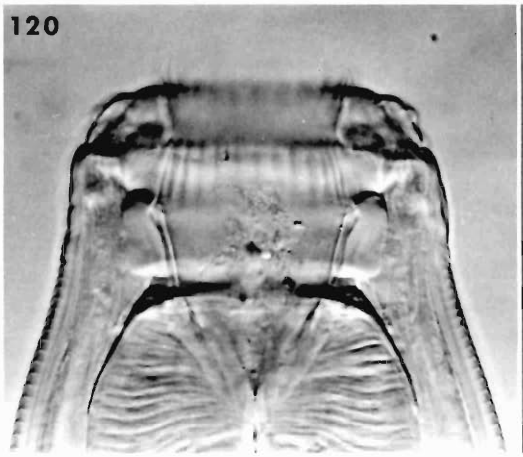
K'ung and Yang (1964) proposed to divide the genus *Cylicocyclus* into three subgenera and included a new species, *C. pekingensis*. This species appears, however, to be closer to *Poteriostomum* than to *Cylicocyclus* except for the male bursa and must be considered a *species inquirenda*. I believe the combination of *C. ultrajectinus* and *C. pekingensis* in a single subgenus by K'ung and Yang (1964) to be untenable. There are generic differences between the two species.

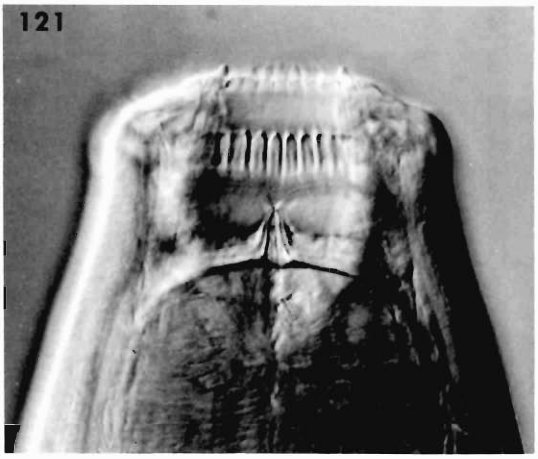
Genus *Cylicodontophorus*

For species descriptions see Popova (1958, English translation, 1965)

1A. Dorsal gutter well developed; elements of ELC and ILC of nearly equal size ..... *C. bicoronatus*

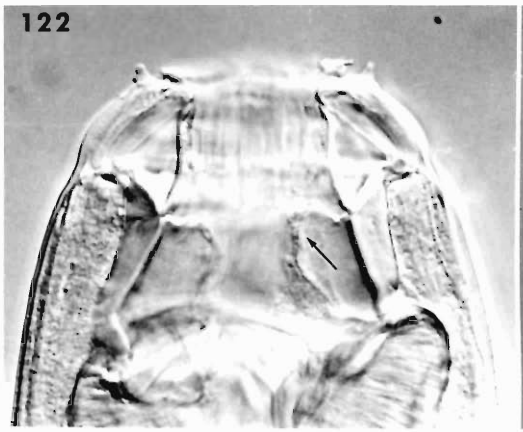
B. Dorsal gutter absent; elements of ILC longer and broader than elements of ELC 2

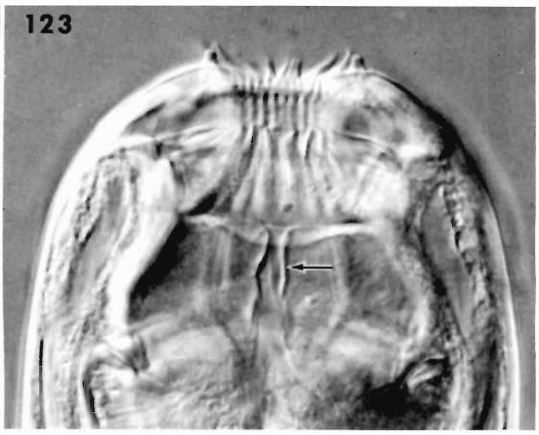




Figures 120, 121. ***Cylicodontophorus bicoronatus*** **heads, × 430. 120. Medial, dorsoventral view of lateral papillae, elements of ELC and ILC, and buccal capsule. 121. Dorsal view of dorsal gutter, prominent elements of ILC, tips of elements of ELC, and two submedian papillae.**

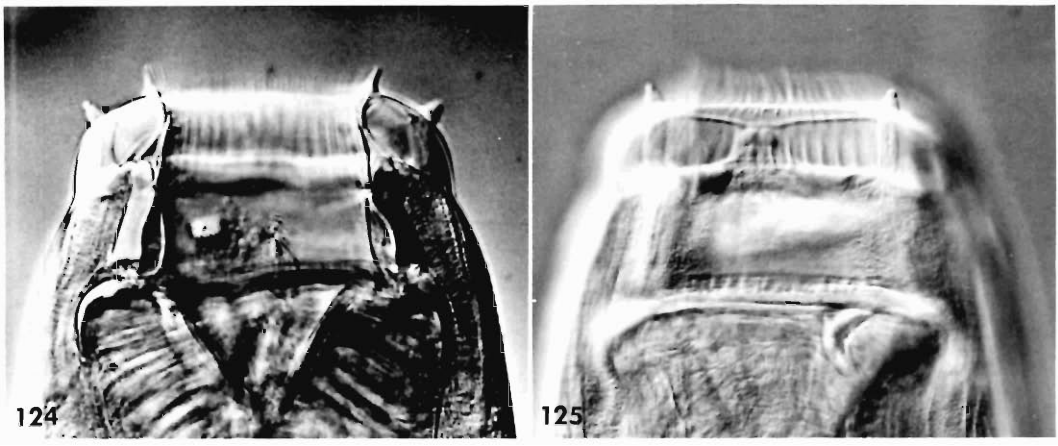
2A. Elements of ILC more than twice as long as elements of ELC, esophageal funnel not well developed ..... *C. euproctus*





Figures 122, 123. ***Cylicodontophorus euproctus*** **heads, × 430. 122. Subventral view showing two submedian papillae, short elements of ELC, long elements of ILC, buccal capsule, and cuticular lining of buccal capsule (arrow). 123. Dorsal view of two submedian papillae, short narrow elements of ELC, longer broader elements of ILC, and cuticular lining (arrow) of buccal capsule.**

B. Elements of ILC less than twice as long as elements of ELC; esophageal funnel well developed ..... *C. mettami*



Figures 124, 125. ***Cylicodontophorus mettami*** **heads, × 350. 124. Subventral view showing two submedian papillae, elements of ELC and ILC, buccal capsule, and esophageal funnel. 125. Lateral view of two submedian papillae, part of a lateral papilla, and elements of ELC and ILC.**

Exotic species of *Cylicodontophorus*:

None.

Discussion

This natural group of species was recognized by Ihle (1922) and Theiler (1923) as a subgenus. Both workers included *C. bicoronatus*, *C. euproctus*, *C. ihlei*, and *Cylicocyclus ultrajectinus*. Cram (1924) raised Ihle's subgenus to the rank of genus and included the same four species. Ershov (1943) and Popova (1958) expanded the genus *Cylicodontophorus*, including three of the above-mentioned four species (excluding *C. ultrajectinus*) and adding *Cyathostomum sagittatum*, *Cyathostomum ornatum*, *Cyathostomum pateratum*, and *C. mettami*. These Russian workers considered *C. ihlei* to be a junior synonym of *C. mettami*. K'ung (1964) considered the genus to have been improperly expanded and included only *C. bicoronatus*, *C. euproctus*, and *C. mettami*. I agree with K'ung in this opinion. The genus *Cylicodontophorus* is restricted to species with the characteristics given in the generic diagnosis in the key to genera.

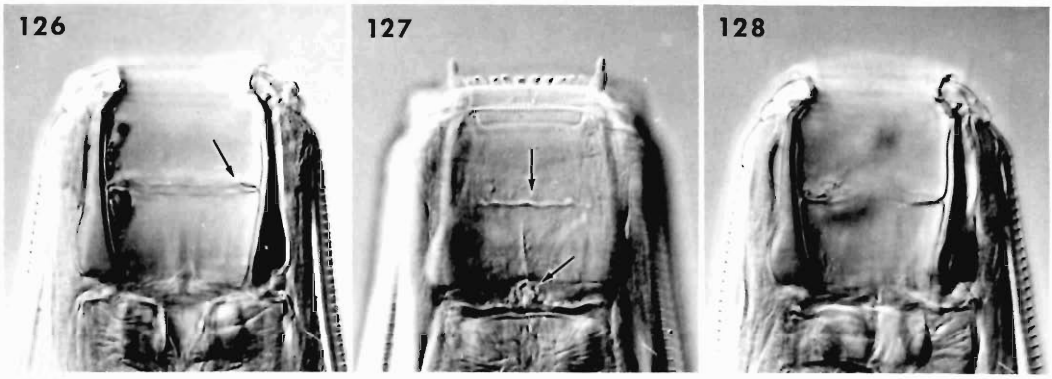
The status of *C. mongolica* Tshoijo, 1957, is uncertain because the illustrations (Tshoijo, 1959) are confusing and specimens of this exotic species were not available. Another species belonging to this genus, *C. schuermanni* (Ortlepp, 1962), is known only in zebras.

Genus *Cylicostephanus*

For species descriptions see Popova (1958, English translation, 1965)

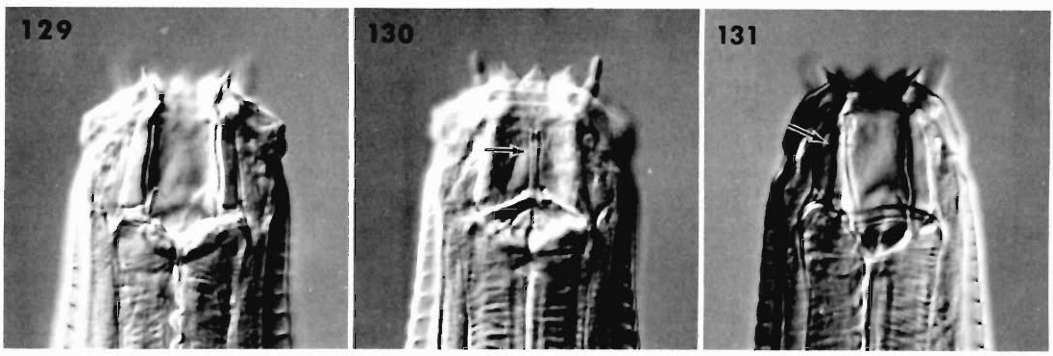
1A. Buccal capsule much deeper than broad in lateral view 2
B. Buccal capsule nearly as broad or broader than deep in lateral view 4

2A. Walls of buccal capsule much thicker posteriorly than anteriorly; ELC composed of about 36 elements ..... *C. poculatus*
B. Walls of buccal capsule of nearly uniform thickness anteriorly and posteriorly; ELC composed of 8–18 elements 3



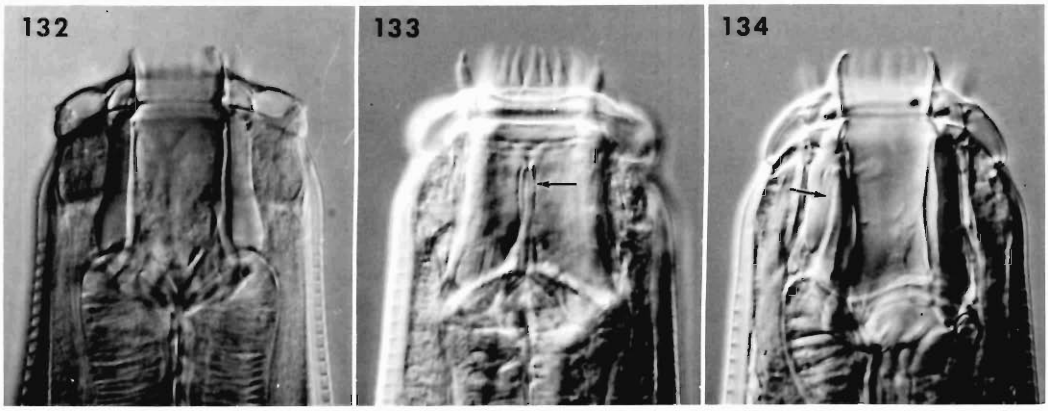
Figures 126–128. ***Cylicostephanus poculatus*** **heads, × 290. 126. Medial, dorsoventral view showing lateral papillae, elements of ELC and ILC, buccal capsule with cuticular lining that forms a shelflike projection (arrow), and esophageal funnel. 127. Dorsal view of submedian papillae, elements of ELC and ILC, part of the shelf (upper arrow) formed by the cuticular lining of the buccal capsule, and buttonlike dorsal gutter (lower arrow) in the floor of the buccal capsule. 128. Lateral view showing depressed mouth collar.**

3A. Elements of ELC triangular, number 8; submedian papillae notched at point one-half distance between tips and buccal collar ..... *C. minutus*



Figures 129–131. ***Cylicostephanus minutus*** **heads, × 500. 129. Medial, dorsoventral view showing lateral papillae, lengths of elements of ELC and ILC, and buccal capsule. 130. Dorsal view of submedian papillae, elements of ELC, and dorsal gutter (arrow). 131. Lateral view showing depressed mouth collar and dorsal gutter (arrow) in wall of buccal capsule.**

B. Elements of ELC digitiform number 12–18; submedian papillae notched near tips ..... *C. calicatus*

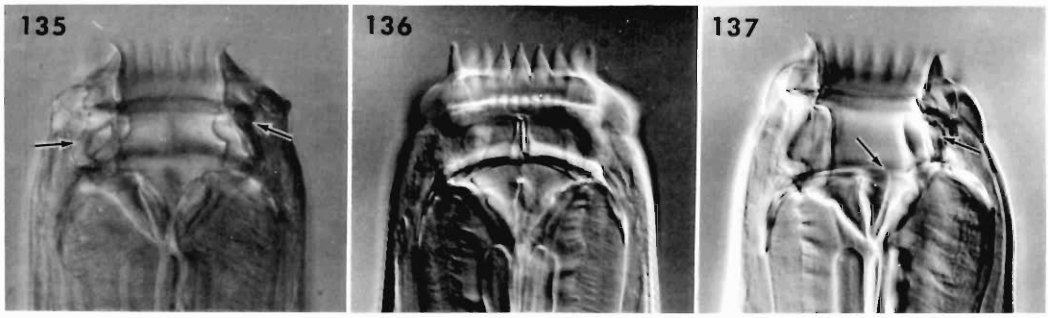


Figures 132–134. ***Cylicostephanus calicatus*** **heads, × 440. 132. Medial, dorsoventral view showing lateral papillae, lengths of elements of ELC and ILC, buccal capsule. 133. Dorsal view of submedian papillae, elements of ELC, and dorsal gutter (arrow). 134. Lateral view of depressed mouth collar and dorsal gutter (arrow) in wall of buccal capsule.**

4A. Walls of buccal capsule markedly thicker anteriorly than posteriorly; elements of ELC about as broad as long; dorsal gutter extends almost to base of ILC 5

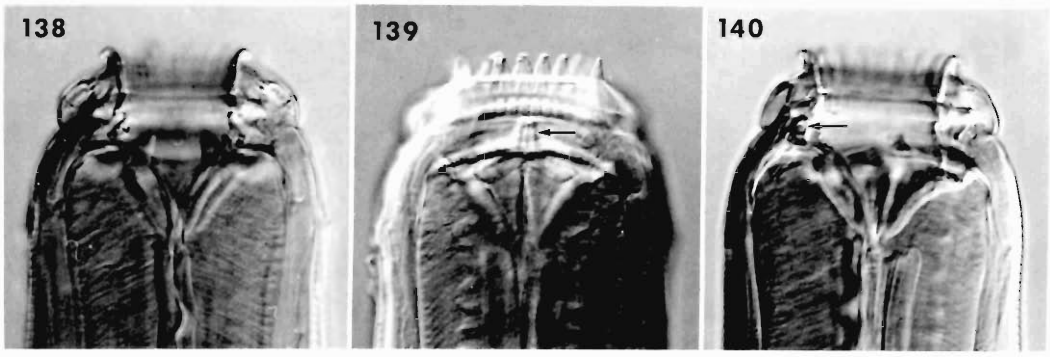
B. Walls of buccal capsule of nearly uniform thickness; elements of ELC more than twice as long as broad; dorsal gutter extends halfway or less toward base of ILC 6

5A. Buccal capsule asymmetrical in lateral view; walls of capsule concave; teeth in esophageal funnel not prominent ..... *C. asymetricus*



Figures 135–137. ***Cylicostephanus asymetricus*** **heads, × 290. 135. Medial, dorsoventral view showing lateral papillae, elements of ELC, buccal capsule (arrows) with cuticular lining, and esophageal funnel. 136. Dorsal view of submedian papillae, elements, of ELC and ILC, and dorsal gutter. 137. Lateral view of elements of ELC and ILC, depressed mouth collar, buccal capsule, dorsal gutter (upper arrow), and tooth (lower arrow) in esophageal funnel.**

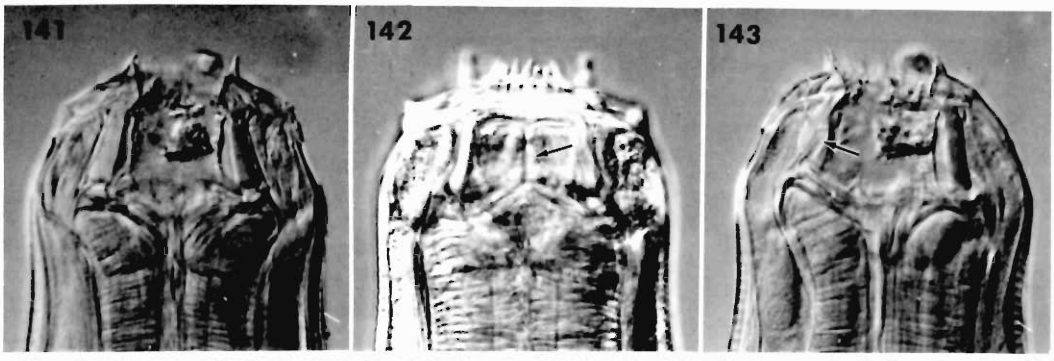
B. Buccal capsule symmetrical; walls of capsule straight; prominent teeth in esophageal funnel ..... *C. bidentatus*



Figures 138–140. ***Cylicostephanus bidentatus*** **heads, × 290. 138. Medial, dorsoventral view showing lateral papillae, elements of ELC and ILC, and two large teeth projecting into buccal cavity. 139. Dorsal view of submedian papilla, elements of ELC and ILC, and dorsal gutter (arrow). 140. Lateral view showing elements of ELC and ILC, depressed mouth collar, and dorsal gutter (arrow).**

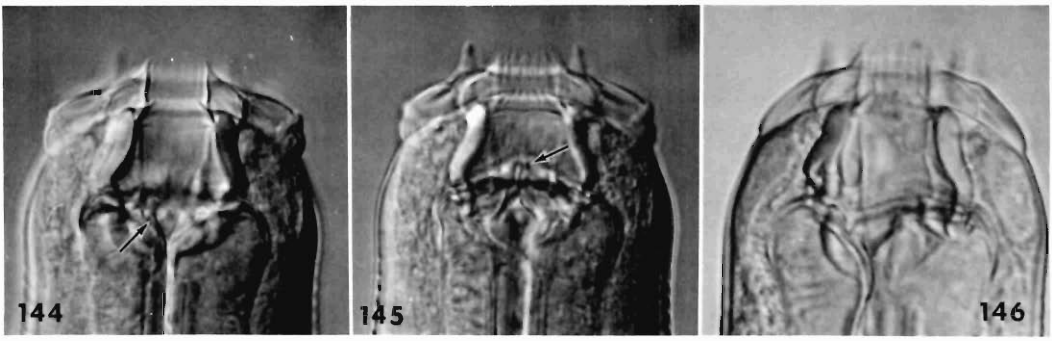
6A. In dorsal view, walls of buccal capsule straight, slightly thicker posteriorly; dorsal gutter ½ as long as depth of buccal capsule ..... *C. hybridus*

B. In dorsal view, walls of buccal capsule with slight compound curve slightly thicker anteriorly; dorsal gutter buttonlike 7



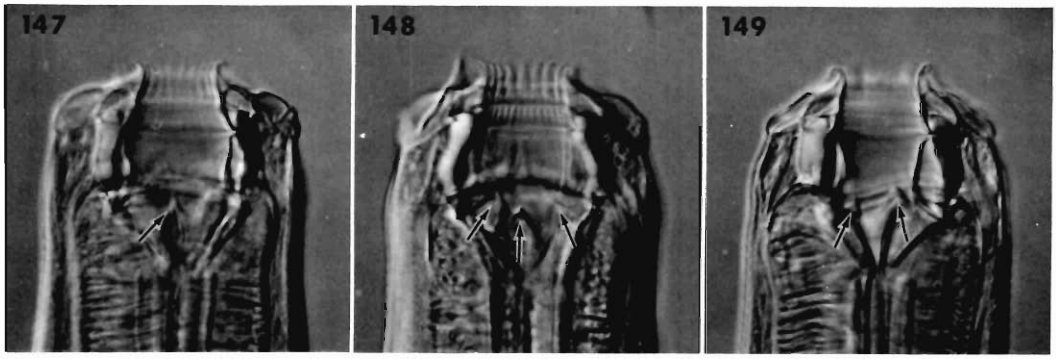
Figures 141–143. ***Cylicostephanus hybridus*** **heads, × 440. 141. Medial, dorsoventral view showing lateral papilla, elements of ELC and ILC, and buccal capsule. 142. Dorsal view of elements of ELC and ILC, with submedian papillae and dorsal gutter (arrow) slightly out of focus. 143. Lateral view of depressed mouth collar, and buccal capsule with dorsal gutter (arrow).**

7A. Elements of ELC and ILC in 1:1 ratio; dorsal ray of male bursa extremely long; female tail straight; teeth in esophageal funnel not prominent ..... *C. longibursatus*



Figures 144–146. ***Cylicostephanus longibursatus*** **heads, × 610. 144. Medial, dorsoventral view showing lateral papillae, lengths of elements of ELC and ILC, curved walls of buccal capsule, and small teeth (arrow) in esophageal funnel. 145. Dorsal view of elements of ELC and ILC, with submedian papillae, buccal capsule, and buttonlike dorsal gutter (arrow) slightly out of focus. 146. Lateral view of depressed mouth collar and buccal capsule.**

B. Elements of ILC almost twice as numerous as elements of ELC; dorsal ray of male bursa not unusually long; female tail bent dorsally with a ventral prominence; prominent teeth in esophageal funnel ..... *C. goldi*



Figures 147–149. ***Cylicostephanus goldi*** **heads, × 380. 147. Medial, dorsoventral view of lateral papilla, elements of ELC and ILC, buccal capsule, and esophageal funnel with teeth (arrow). 148. Dorsal view of elements of ELC and ILC and teeth (arrows) in esophageal funnel, with submedian papilla and buccal capsule slightly out of focus. 149. Lateral view of elements of ELC and ILC, depressed mouth collar, buccal capsule, and esophageal funnel with teeth (arrows).**

Exotic species of *Cylicostephanus*:

C. ornatum—occurs in Holland, Hungary, Africa, India, and Russia; similar to *C. asymetricus*, but has shorter dorsal gutter and shorter, stouter bursa. Although reported in North America, all specimens available for study were redetermined as other species when examined.

C. skrjabini—occurs in Russia and Mongolia; similar to *C. poculatus*, but according to Ershov (1943) differs by lacking the lateral projection on the inner walls of the buccal capsule and by possessing a rim of dentiform processes at the bottom of the buccal capsule.

Discussion

The name *Cylicostephanus* was coined by Ihle (1922) as a subgenus to draw attention to the depressed mouth collar of a group of species including *C. calicatus*, *C. longibursatus*, *C. minutus*, *C. hybridus*, and *C. poculatus*. These species also share the characteristics of an ILC composed of short rods implanted close to the anterior edge of the buccal capsule; an ELC composed of longer and broader elements; and a buccal cavity that is slightly narrower anteriorly than posteriorly. Most subsequent workers have grouped these five species together. To this group Cram (1925) added the species *C. asymetricus*. *Cylicostephanus bidentatus*, a species considered by some workers to be a synonym of *C. asymetricus*, is recognized as a separate species because of its large esophageal teeth and relative lack of asymmetry of the buccal capsule.

The common species *C. goldi* fits well the characteristics of this genus, being very similar in cephalic characteristics to *C. longibursatus*, and is included in *Cylicostephanus* for the first time.

The position of *C. ornatum* in this genus is provisional and is based only on published descriptions. Although there are several reports of *C. ornatum* in North America, all specimens that could be located were redetermined as other species. The characteristics of *C. ornatum* fit this genus; in fact, Skladnik (1935) pointed out that the illustrations of cephalic characters of *C. ornatum* given by Skrjabin and Ershov (1933) and repeated by others (e.g., Popova, 1958) are very similar to those of *C. asymetricus*.

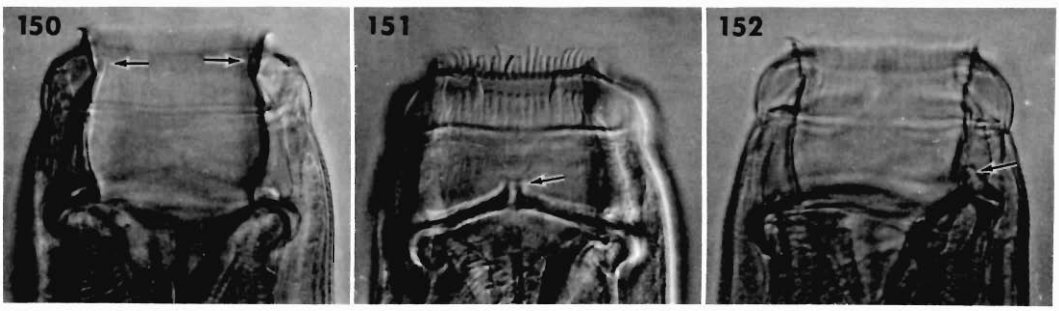
Ershov (1943) included *C. poculatus* and *C. skrjabini* in a new genus, *Petrovinema*. Although this pair of species are easily recognized as distinctive, they do share the characteristics of the genus *Cylicostephanus* and are retained in it.

Trichonema tsengi, recently described in China, is considered to by a synonym of *C. calicatus*. It was separated from *C. calicatus* by a greater number and different shapes of ELC elements. As Baruš (1962) and Braide and Georgi (1974) have shown, however, *C. calicatus* has a greater range in number of ELC elements (12–18) than given in earlier reports and was confused with *C. minutus* by Looss (1902).

Genus *Poteriostomum*

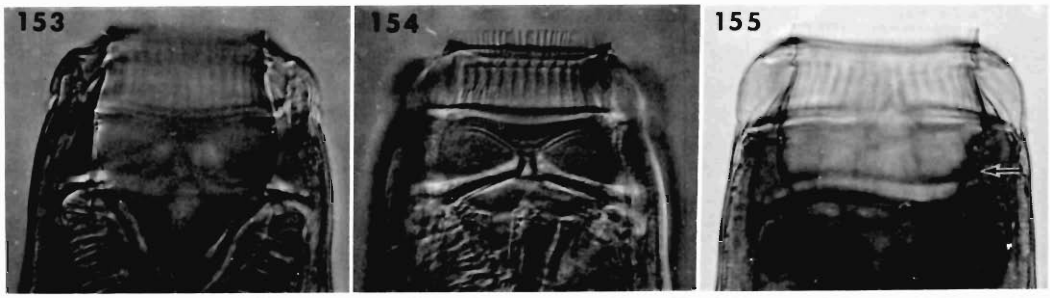
For species descriptions see Popova (1958, English translation, 1965)

1A. Six elements of internal leaf-crown markedly longer than others ---------- ---------- *P. imparidentatum*



Figures 150–152. *Poteriostomum imparidentatum* heads, × 180. 150. Medial, dorsoventral view of lateral papillae, elements of ELC, two of six extra long elements of ILC (arrows), and buccal capsule. 151. Dorsal view of two submedian papillae, elements of ELC (some of which are broken), elements of ILC (including two of the six extra long elements), and dorsal gutter (arrow). 152. Lateral view of lengths of elements of ELC and ILC, high mouth collar, and buccal capsule with dorsal gutter (arrow).

B. All elements of internal leaf-crown of equal lengths ..... *P. ratzii*



Figures 153–155. ***Poteriostomum ratzii*** **heads, × 140. 153. Medial, dorsoventral view of lateral papillae and buccal capsule. 154. Dorsal view of submedian papillae, elements of ELC and ILC, and dorsal gutter. 155. Lateral view of lengths of elements of ELC and ILC, high mouth collar, and buccal capsule with dorsal gutter (arrow).**

Exotic species of *Poteriostomum*:

P. skrjabini—in horse and ass in Russia; distinguished by poorly defined dorsal gutter and short tail with vulva very close to the anus.

Discussion

This genus is closely related to the genus *Cylicodontophorus*, especially in characteristics of the leaf-crown, size, and degree of splitting of the dorsal ray. The two genera can be separated easily, however, by characters of the buccal capsule, especially the point of insertion of the internal leaf-crown and the character of the dorsal ray. The species *P. imparidentatum* and *P. ratzii* are very similar except for the difference in the internal leaf-crown. Kotlán (1921) considered *P. imparidentatum* to be a variety of *P. ratzii*. However, they are recognized almost universally as distinct species.

Craterostomum Boulenger, 1920; Ihle, 1920b Only one species of this genus occurs in North America—
C. acuticaudatum
(Illustrated on page 27)

Exotic species of *Craterostomum*:

C. tenuicauda Boulenger, 1920—reported from zebra in Africa and equines in India. See Discussion below for comparison with other species.

Discussion

As pointed out by Boulenger (1920) and Ihle (1920b, 1922) this genus is similar to *Triodontophorus* except for the absence of teeth in the buccal cavity. Ihle also indicated a relationship to the Cyathostominae by the presence of submedian papillae divided into two parts. Specimens of this genus are very rare and only a few *Craterostomum acuticaudatum* were available for study. Becklund (1963) listed two species occurring in equines in North America—*C. acuticaudatum* and *C. mucronatum*. I could find reports of only *C. mucronatum*; however, the point is moot because of the synonymy discussed below.

Kotlán (1919) described *Cylicostomum acuticaudatum* with 12–16 elements in the ILC. Ihle (1920a) described *Cylicostomum mucronatum* with 24 or 25 ILC elements. Ihle (1920b) moved both species to the genus *Craterostomum* described by Boulenger (1920) for *C. tenuicauda*. Ihle (1920b, 1922) recognized all three species and accepted the number of ILC elements in *C. acuticaudatum* as published by Kotlán (1919). However, Kotlán (1921), in a description of another species, mentioned that he considered *C. mucronatum* to be a synonym of *C. acuticaudatum*. Furthermore, in the B. H. Ransom Reprint Collection maintained at our Institute is a reprint of Kotlán's (1919) description of *C. acuticaudatum* bearing the notation, "Hommage de

l'auteur," in which a pen-and-ink change has been made (apparently by Kotlán) changing the number of ILC elements from 12–16 to 22–26. The reprint was sent to Ransom on 17 June 1920. There is no doubt in my mind that Kotlán, in 1920, considered *C. mucronatum* to be a synonym of *C. acuticaudatum* and that he found *C. acuticaudatum* had more ILC elements than originally reported. I agree with Skrjabin and Ershov (1933) and subsequent eastern European workers who consider *C. mucronatum* to be a synonym of *C. acuticaudatum*.

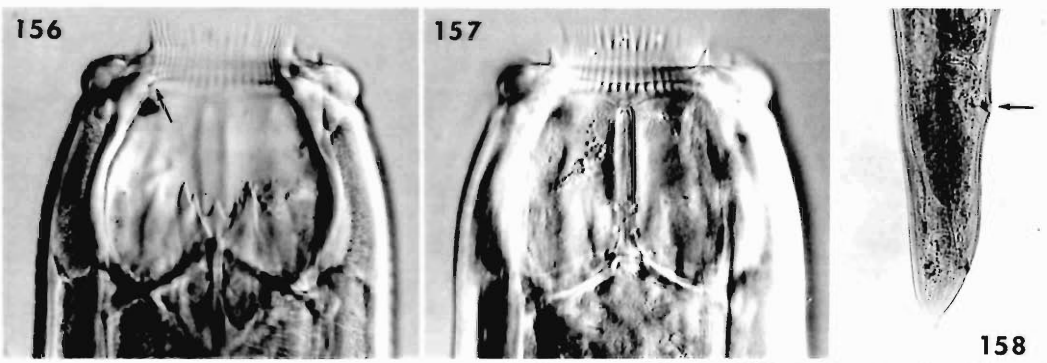
The original description of *C. tenuicauda* was of immature females. Most workers subsequently regarded this species as a synonym of *C. acuticaudatum*. However, Rai (1960) redescribed *C. tenuicauda* from mature females and males, separating it on the basis of a different number of ILC and ELC elements (18 and 9, compared with 22–26 and 6–8 in *C. acuticaudatum*), a proportionately shorter tail although the body length is greater, and the presence of submedian cephalic papillae that are not notched. The tail of Rai's females and the character of the submedian papillae thus differ from the generic diagnosis and from the original description of this species. The status of this exotic species is uncertain and needs further study.

Genus *Triodontophorus*

For species descriptions see Popova (1955, English translation, 1964) except for species for which other references are given below in the key

1A. Mouth collar appears in optical section as inflated round tube in ring around mouth; female tail long, vulva separated from anus by 1.5–3 mm; spicules more than 3 mm long ... *T. serratus*

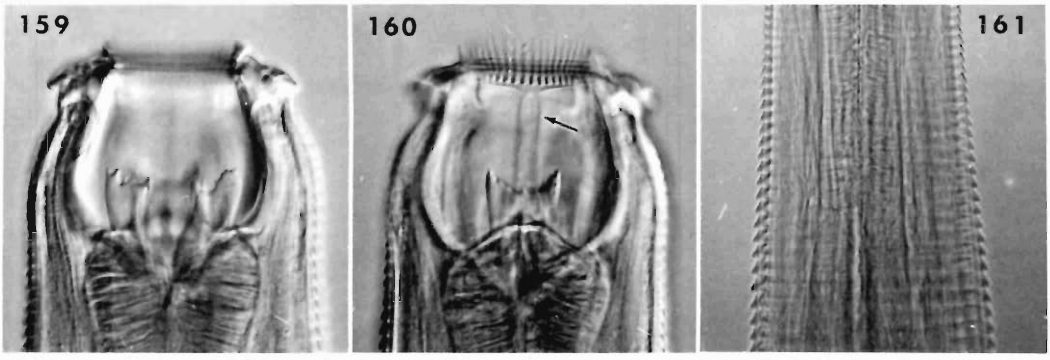
B. Mouth collar somewhat flattened with rather acute edge around outside perimeter; female tail short, vulva separated from anus by less than 1 mm; spicules less than 2 mm long 2



Figures 156–158. ***Triodontophorus serratus.*** **156. Dorsoventral view of head showing dorsal buccal tooth, buccal capsule, one lateral papilla on left, and elements of ELC and ILC (arrow), × 240. 157. Dorsal view of head showing subventral papillae, elements of ELC and ILC, and dorsal gutter, × 240. 158. Lateral view of female tail showing anus and vulva (arrow), × 45.**

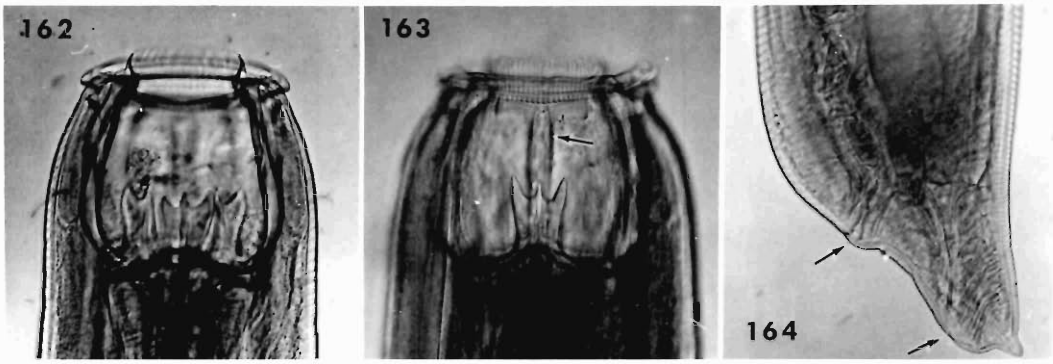
2A. Cuticle strongly serrated in cervical region; dorsal lobe of bursa short; teeth finely denticulated ..... *T. tenuicollis*

B. Cuticle striated but relatively smooth; dorsal lobe of bursa long; teeth smooth or strongly denticulated 3



Figures 159–161. ***Triodontophorus tenuicollis.*** **159. Dorsoventral view of head showing two subventral buccal teeth and mouth collar with acute edge, × 240. 160. Dorsal view of head showing submedian papilla, elements of ELC and ILC, dorsal buccal tooth, and dorsal gutter (arrow) slightly out of focus, × 240. 161. Lateral view of cervical region showing serrated cuticle, × 80.**

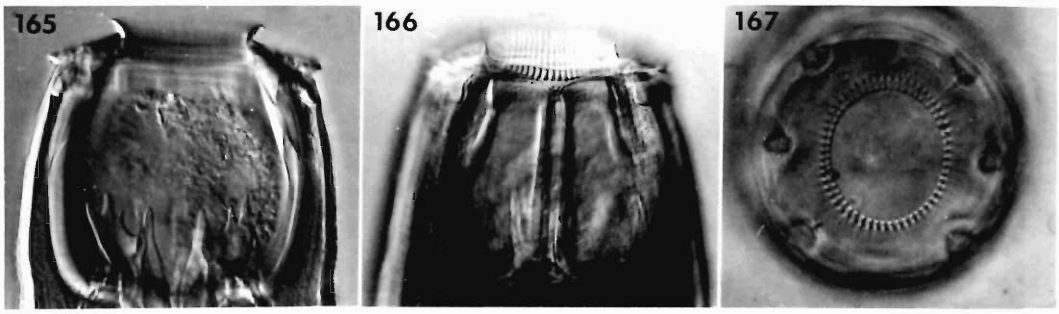
3A. Submedian papillae short, broad, and conical; teeth usually smooth except for 3 elevations on each; female tail very short, vulva very close to anus; dorsal lobe of bursa very long, 625–800 μ ..... *T. brevicauda*



Figures 162–164. ***Triodontophorus brevicauda.*** **162. Medial, dorsoventral view of head showing 3 buccal teeth and buccal capsule, × 135. 163. Dorsal view showing dorsal buccal tooth, dorsal gutter (arrow), and elements of ELC and ILC, × 135. 164. Lateral view of female tail showing anus (lower arrow) and vulva (upper arrow), × 110.**

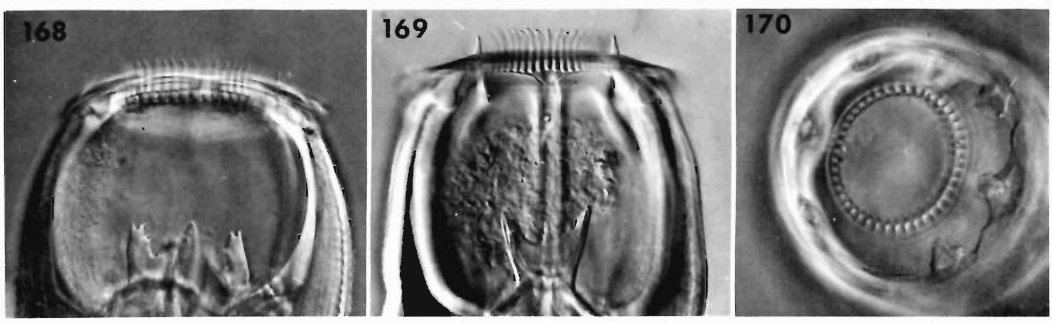
B. Submedian papillae long, narrow, and pointed; teeth usually strongly denticulated; female tail short, vulva separated from anus by more than twice tail length; dorsal lobe of bursa long, 500–525 μ 4

4A. Leaf-crowns consist of 56–69 elements; usually 3 large denticulations on each lateral part of each tooth; spicules 0.800–1.00 mm long ..... *T. nipponicus* For species description see Diaz-Ungria (1965).



Figures 165–167. ***Triodontophorus nipponicus*** **heads, × 200. 165. Dorsoventral view of mouth collar and subventral buccal teeth. 166. Dorsal view of submedian papillae, elements of ELC and ILC, and dorsal gutter. 167.** ***En face*** **view showing elements of ELC and cephalic papillae.**

B. Leaf-crowns consist of 44–50 elements; usually many small to medium denticulations on each tooth; spicules 1.2–1.8 mm long ..... *T. minor*



Figures 168–170. ***Triodontophorus minor*** **heads, × 200. 168. Ventral view of subventral buccal teeth. 169. Dorsal view of 2 submedian papillae, elements of ELC and ILC, dorsal buccal tooth, and dorsal gutter. 170.** ***En face*** **view of elements of ELC and cephalic papillae.**

Exotic species of *Triodontophorus*:

T. popovi—in *Equus* in Russia; distinguished by smaller size but similar to *T. tenuicollis*.

T. brochotribulatus—in horse in Spain; distinguished by small gubernaculum. Very similar to *T. nipponicus*.

Discussion

For many years it has been accepted that four species of this genus occurred in equines in North America—*T. serratus*, *T. tenuicollis*, *T. brevicauda*, and *T. minor*. The present study, however, could confirm no reports of *T. minor* in North America but did reveal *T. nipponicus* including some that had been previously identified as *T. minor*. Only three reports of *T. minor* in North America are known to me. Ward (1946, 1947) reported it in Mississippi. I have not located any of his specimens. Ransom and Hadwen (1918) are sometimes listed as reporting *T. minor* in Canadian horses, but although they figured it, they specifically stated that this species was not found in their survey. Baker and Fincher (1937) reported *T. minor* in a horse in New York State, but their specimens have not been located. In current studies at this Institute *T. nipponicus* has been found in a single horse.

Prior to the description of *T. nipponicus*, *T. minor* was reported all over the world. Subsequently, however, *T. nipponicus* rather than *T. minor* has usually been identified. Yamaguti (1943) described *T. nipponicus* from *Equus caballus orientalis* and *Equus parvis* in Japan and Korea. This species has been reported subsequently in Brazil (Jorge da Silva, 1955), in Czechoslovakia (Baruš, 1962), and in Venezuela (Diaz-Ungria, 1963, 1965). Furthermore, Diaz-Ungria (1963) extended the known range of *T. nipponicus* to China by making *T. hsiungi* K'ung, 1958, a synonym of *T. nipponicus*. K'ung, et al. (1959) listed *T. hsiungi* as one of the most common strongyles in donkeys in Peking. In addition, *T. minor* has been reported in Panama by Foster (1936) and in Antigua by Goodwin (1936). However, both Foster's and Goodwin's specimens have been found to be *T. nipponicus*. Other specimens available for study included several lots from Los Banos, Philippine Islands, previously reported as *T. minor*. These have also been redetermined as *T. nipponicus*. In these studies I have been fortunate to have for comparison numerous paratypes of *T. minor*. Presumably, the geographic distribution of *T. minor* is more restricted than previously believed.

Genus *Strongylus*

For species descriptions see Popova (1955, English translation, 1964)

1A. Prominent teeth present in buccal cavity 2

B. Teeth absent from buccal cavity ..... *S. edentatus*

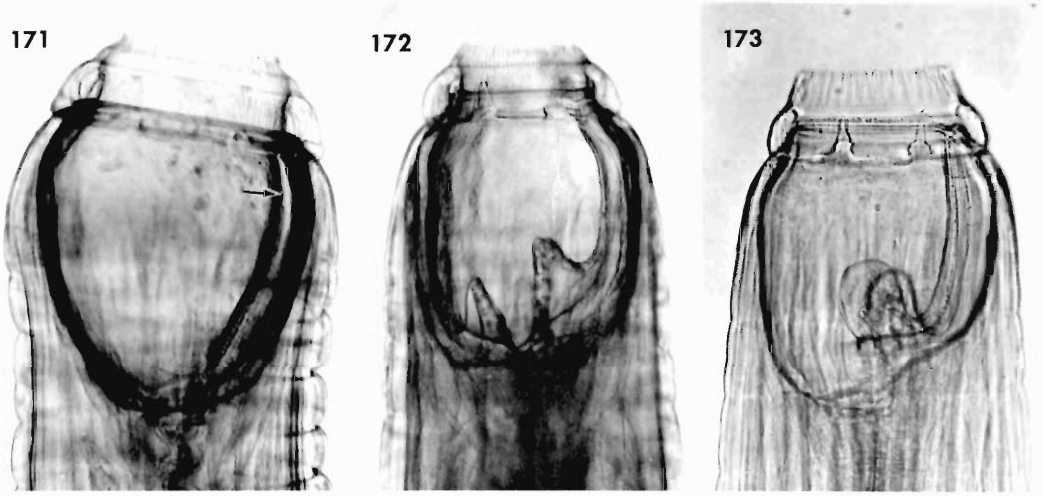
2A. Both dorsal and ventral teeth present in buccal cavity; dorsal tooth with 2 points; 2 ventral teeth pointed and about one-half the height of the dorsal tooth ..... *S. equinus*

B. Only dorsal tooth with 2 rounded lobes present in buccal cavity 3

3A. Lobes of tooth high and smooth, extend almost one-half depth of buccal cavity; internal leaf-crown (ILC) about one-fourth as long as external leaf-crown (ELC) ..... *S. vulgaris*

B. Lobes of tooth low and grooved, extend only one-third depth of buccal cavity; ILC and ELC about same length ..... *S. asini**

* Not known in North America except in zebra. Not illustrated.



Figures 171–173. ***Strongylus*** **spp. heads, lateral view. 171.** ***Strongylus edentatus,*** **showing globular buccal capsule without buccal teeth, dorsal gutter (arrow), high mouth collar, small cephalic papillae, and elements of ELC, × 27. 172** ***Strongylus equinus,*** **showing large globular buccal capsule with dorsal and ventral buccal teeth and dorsal gutter, × 27. 173.** ***Strongylus vulgaris,*** **showing dorsal buccal tooth and dorsal gutter, × 47.**

Exotic species of *Strongylus*:

Only *S. asini*—see above key.

Discussion

In 1900, Looss described three species in the genus *Strongylus*—*S. equinus*, *S. edentatus*, and *S. vulgaris*. In 1920, Boulenger described *S. asini*. Railliet (1923) subdivided the genus into four subgenera—*Strongylus*, *Alfortia*, *Delafondia*, and *Decrusia*. According to Ershov (1943) and others, Skrjabin divided *Strongylus* into three genera in 1933 (reference could not be determined) using three of the above subgenera, excluding the last, based on the number of buccal teeth present. I prefer to retain the four exceptionally similar species from equids in the genus *Strongylus*, without the subgeneric names.

Genus *Micronema*

Micronema Korner, 1954—only one species of this genus is known to occur in equids—*Micronema deletrix* (illustrated on pages 28 and 62).

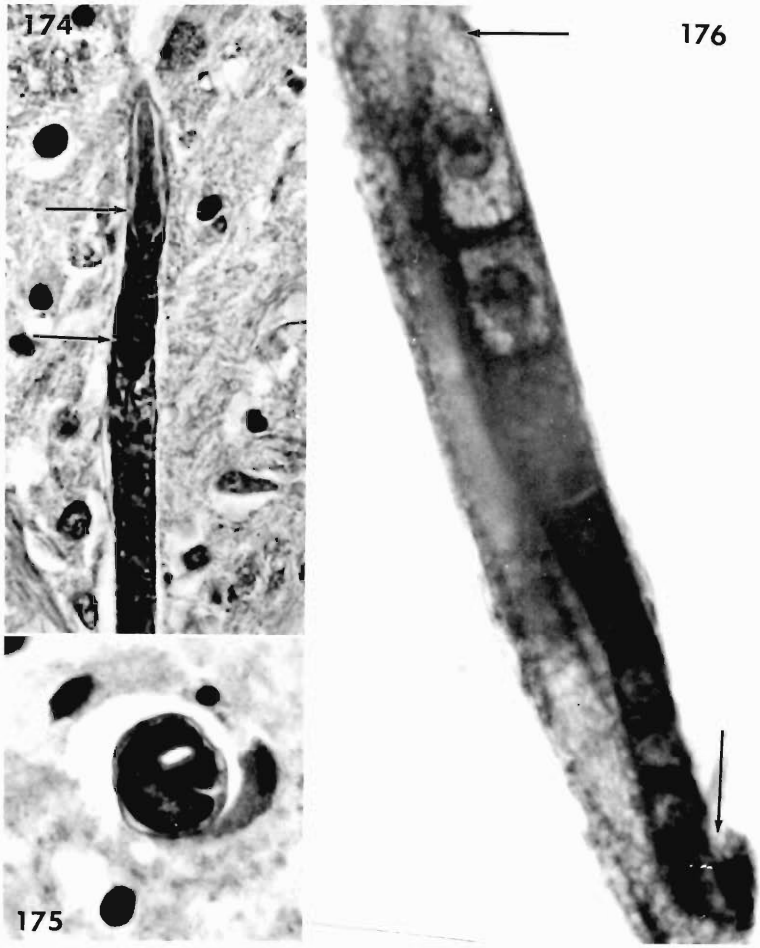
Other species

Several other species of the genus have been described as saprophagous in decaying humus.

Discussion

This species has been found in granulomatous tissue in the nares (Anderson and Bemrick, 1965) and maxilla (Johnson and Johnson, 1966) of a horse in Minnesota; in

the brain of a pony in Georgia (Stone et al., 1970); in the brains of two horses in Egypt (Ferris et al., 1972); and in the brain of a child in Canada (unpublished, Armed Forces Institute of Pathology case record). Typical of nematodes of the order Rhabditida, at least one species of the genus *Micronema*, which are normally saprophagous, can successfully lead a parasitic life. Extremely large numbers of these nematodes were found in diseased tissues by Stone et al. (1970) and by Ferris et al. (1972). *Rhabditis gingivalis* Stefanski, 1954, was described from the gum of a horse in Poland. Because the description is incomplete, it is uncertain whether this species belongs in the genus *Micronema*. If it can be shown because of stomatal characters to belong to the genus *Micronema*, the specific characters will necessitate reducing *M. deletrix* to a junior synonym of Stefanski's species.

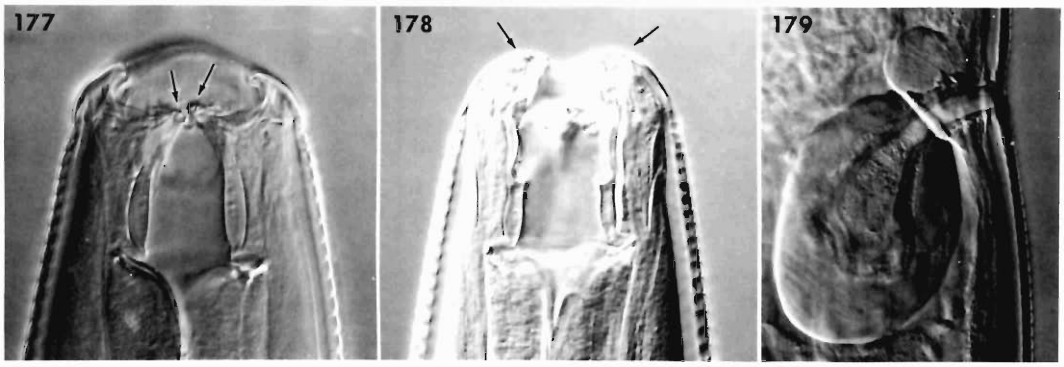


Figures 174–176. ***Micronema deletrix,*** **(figures from Chitwood and Lichtenfels, 1972). 174. Longitudinal section in human brain showing rhabditiform esophagus with corpus (upper arrow), narrow isthmus surrounded by nerve ring, and valved bulb (lower arrow), × 550. 175. Cross section in human brain showing intestine above and ovary below, × 1,350. 176. Part of longitudinal section in brain of horse showing gonad with germinal end of ovary reflexing dorsad (lower arrow) and ova increasing in size toward ventral flexure (upper arrow), × 1,350.**

Genus *Habronema*

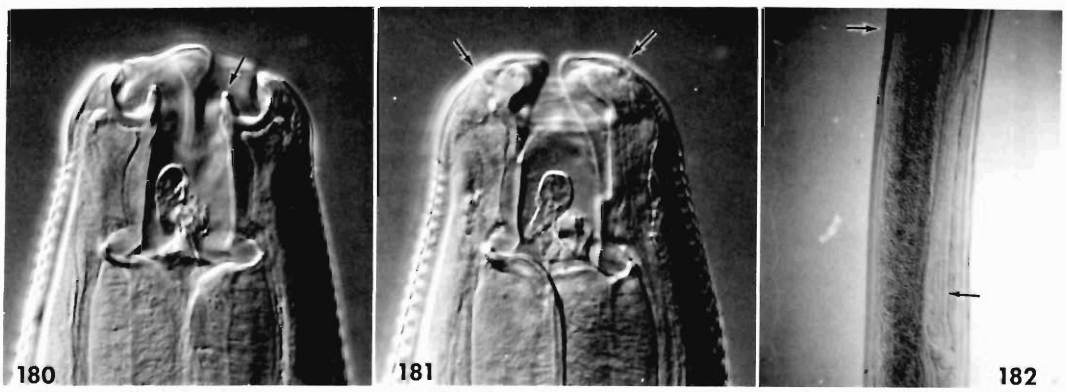
For brief species descriptions see Soulsby (1965) or Levine (1968)

1A. Teeth present on ventral and dorsal wall of buccal capsule; left spicule twice length of right; vagina very short before reaching rounded part of muscular ovejector ..... *H. majus*



Figures 177–179. ***Habronema majus.*** **177. Head, medial, lateral view showing dorsal and ventral buccal teeth (arrows), × 360. 178. Head, medial, dorsoventral view of buccal capsule, and lateral lips with lateral papillae (arrows), × 360. 179. Lateral view of female showing vulva, short vagina, and large rounded muscular ovejector, × 200.**

B. Teeth absent from buccal capsule; left spicule 5 times length of right; vagina very long and narrow, crosses body transversally before reaching long muscular ovejector ..... *H. muscae*



Figures 180–182. ***Habronema muscae.*** **180. Head, lateral view (slightly lateral to medial), buccal capsule with prominent projections (arrow) but no teeth (*H. majus* has similar structures at different focal plane than teeth shown above), × 400. 181. Head, medial, dorsoventral view showing lips, lateral papillae (arrows), and debris in buccal cavity, × 400. 182. Lateral view of female showing vulva (upper arrow) and long muscular part of ovejector (lower arrow), × 140.**

Exotic species of *Habronema*:

H. tyosenense—found only once in pony in Korea; similar to *H. majus* except for a different arrangement of genital papillae and a longer vagina and ovejector.

Discussion

The two well-known species can be separated easily on the bases of vaginal and spicular length and the ovejector morphology. The teeth, high in the buccal capsule of *H. majus*, are seen best in a lateral view and can be used effectively to separate the species.

Genus *Onchocerca*

For species descriptions see Levine (1968)

1A. Parasitic in connective tissue of flexor tendons and suspensory ligament of fetlocks; left spicule 248–294 μ long; cuticle of female with one internal stria between each pair of ridges; microfilariae 330–370 μ long ..... *O. reticulata*

B. Parasitic in ligamentum nuchae; left spicule 320–360 μ long; cuticle of female with 4 internal striae between each pair of ridges; microfilariae 207–240 μ long ..... *O. cervicalis*

For illustrations of *O. cervicalis*, see the Key to Genera, Figures 77–80.

Exotic species of *Onchocerca*:

None.

Discussion

After considerable study by many experienced workers, the question of whether *Onchocerca reticulata* and *O. cervicalis* are two separate species is still unsettled. Furthermore, the distribution of the (?) two species is also confusing because the lumpers have reported the form in the ligamentum nuchae (*O. cervicalis*) as *O. reticulata*, the older name. Although both names have been reported in North America, I have been unable to confirm reports of the form that occurs in suspensory ligaments of fetlocks. Supperer (1953) and others have separated the two species on differences between lengths of the left spicule and the microfilariae. Recently, Beaver (1974) pointed out cuticular differences, previously described by others, as further evidence for recognizing females of both species. However, Mellor (1974) considered the cuticular differences he observed in *O. cervicalis* to be too variable in different regions of the nematode body to be useful in separating the two species. He also reported considerable variation in morphology and size of microfilariae of *O. cervicalis*. In my observations of the cuticle of *O. cervicalis*, the internal striae are difficult to detect in the posterior and especially the anterior portions of the female where the external ridges are also reduced in size and are closer together. Where the internal striae could be observed they were found to be narrower in regions where the external ridges were closer together, but still present in the ratio of four internal striae between each pair of ridges. I did not have specimens of *O. reticulata* for study. Until sufficient specimens of *O. reticulata* become available for study, I prefer to retain both names in order to obtain separate data for what may be two different species. It will be much easier to combine data than to attempt to separate it later.

E. Larvae and Life History of Nematoda Parasitic in Equids

This section describes immature or larval stages of nematodes that are commonly encountered in horses and are so different from the adult stage that they are not easily identifiable with them. Only the part of the life cycle that occurs in horses is described.

Fourth-stage larvae of *Strongylus vulgaris* may be found in the intestinal wall or in widely scattered sites in the arterial system, especially the cranial and other mesenteric arteries, where they may cause aneurysms. The incidence of infection is very high, approaching 100 %. In the intestinal wall the most common sites are the submucosa of the cecum and colon.

Much controversy has existed over the route larvae take to reach the sites of arterial lesions (Soulsby, 1965), but the only investigators who have studied experimental infections (Enigk, 1950, 1951; Drudge et al., 1966; Duncan and Pirie, 1972) agree that the fourth-stage larvae migrate upstream in the mesenteric arteries. The chronology according to

Enigk (1950, 1951) is as follows: Infective larvae enter the wall of the ventral colon and cecum and molt to the fourth stage 6 to 7 days after infection. At this stage they are about 2.5 to 2.9 mm long. From about 11 to 111 days after infection they are found in the arterial lesions. Most fourth-stage larvae remain in arterial aneurysms until 44 to 111 days after infection, attaining lengths of 14 to 18 mm. The larvae then migrate downstream by way of the arterial system to the submucosa of the cecum and colon where they become immature adults after about 90 or more days. After reaching the intestinal lumen they mature, about 200 days after infection. In some cases, however, adult nematodes may be found in arterial lesions or in other sites along the migration route to the cecum and colon. Figures 183 and 184 show fourth-stage larvae of *S. vulgaris* from aneurysms and Figures 185 and 186 show early fifth or adult stages of the same species from the intestinal wall or lumen.

According to Wetzel (1940), larvae of *Strongylus equinus* are found in the walls of the cecum and colon where they molt to the fourth stage. The larvae then migrate to the subserosa where they grow in nodules for about 11 days, reaching lengths of 10 to 15 mm. They develop a provisional buccal capsule before migrating by way of the body cavity to the liver where they molt to the immature adult stage. After 2 to 4 months the adults migrate to the colon and cecum by way of the pancreas.

Strongylus edentatus larvae reach the liver by way of the portal vein, according to Wetzel and Keersten (1956), where they molt to the fourth stage. After 9 weeks of burrowing and growing in the liver, the larvae migrate under the peritoneal membranes to the right flank where the fourth and early fifth stages are found in hemorrhagic nodules. After molting to fifth stage in about 90 days, *S. edentatus* migrates to the wall of the colon and cecum and forms nodules that eventually open to the lumen of the intestine where the nematode matures. The larvae migrate erratically and may be found in unusual sites such as testicles, thoracic cavity, and kidneys.

Little is known of life history and larval development of strongyles other than *Strongylus*. The infective larvae of *Triodontophorus* and those of Cyathostominae enter the walls of the intestine where they cause the formation of small nodules in the mucosa, molt to the fourth stage, and usually develop to early fifth stage before returning to the lumen. There is no evidence of a migration from the intestine. Frequently fourth-stage larvae of *Triodontophorus* and occasionally those of Cyathostominae are found in the lumen of the intestine rather than in mucosal nodules. Fourth-stage *Triodontophorus* (Figs. 187–190) can be recognized by the presence of three lancet-shaped teeth that project well into the buccal cavity.

According to Popova (1958), Tiunov observed in 1949 that infective cyathostomin larvae in the intestine are about 328 to 685 μ long. The larvae penetrate the walls of the large intestine and localize in the tunica propria and submucosa. After 9 to 10 days, the larvae are 1.2 to 4.6 mm long, apparently varying with the species. Most cyathostomin larvae molt once in the wall of the intestine before returning to the intestinal lumen, but some molt twice to the adult stage. The molt to the fourth stage occurs 6 to 12 days after infection when the larvae are 2.3 to 4.9 mm long. Most of the species enter the lumen of the intestine in fourth stage after 1 to 2 months when they are 3.6 to 7.2 mm long.

Popova (1958) reported that Tiunov observed only longer larvae (6.0 to 13.0 mm) in the submucosa. These larvae have two buccal capsules, the adult capsule surrounding the larval capsule (Fig. 192). The adult buccal capsule can be identified as that of *Cylicocyclus*. These larvae, unlike some other cyathostomin larvae, remain in the submucosa until they have molted to the adult stage.

Larvae of the stomach worms, *Habronema muscae*, *H. majus*, and *Draschia megastoma*, undergo development in various muscid flies before they are infective for horses. Third-stage infective larvae leave the fly by way of its mouthparts to be deposited on the lips, nostrils, or wounds of horses. It is also likely that horses become infected by swallowing flies. When larvae are swallowed they enter the mucosa of the glandular stomach. According to Ransom (1913), Bull (1919), and Roubard and Descazeaux (1921, 1922) third-stage larvae of *D. megastoma* leaving the fly are 2.5 to 3.0 mm long with a cylindrical buccal cap-

sule resembling that of the adult, a spiny knobby-tipped tail, and a truncated anterior end. Third-stage larvae of *H. muscae* are similar to *D. megastoma* in size but have a rounded anterior end. Third-stage larvae of *H. majus* are much shorter (~ 1.6 mm long) and, according to Bull (1919), lack the longitudinal ridges found on the cuticle of the other two species. According to Nishiyama (1958), *Draschia megastoma* larvae have a funnel-shaped buccal capsule and constricted head somewhat like the adult, and *H. majus* larvae have a plumper tail than do *H. muscae* larvae. After entering the stomach mucosa, larvae of *D. megastoma* reach the adult stage in about 2 months.

When infective larvae of *Habronema* and *Draschia* are deposited in wounds, they may cause a condition known as "summer sores," in which larvae may persist but do not complete development. According to Nishiyama (1958), infective larvae can initiate such cutaneous sores in addition to contaminating existing wounds. Third-stage larvae of *Habronema* spp. and *D. megastoma* can also cause a conjunctivitis when deposited near the eyes. If larvae are found in the lesions, they can be recognized by the spiny knobs on their tails.

Habronema muscae and *Draschia megastoma* larvae also occur in nodules in lungs of horses in localities where the nematodes are common. Typical larvae with the characteristic spiny tail can be found in early lesions. According to Soulsby (1965) they probably derive from skin lesions.

The life cycle of *Oxyuris equi* (Figs. 200–204) is direct, with infection resulting from ingestion of eggs on contaminated litter or fodder. The eggs hatch in the small intestine and third-stage larvae burrow into crypts of the mucosa of the cecum and ventral colon. The molt to fourth stage occurs 3 to 10 days after infection. Two sizes of fourth-stage larvae are found: males (5 to 6 mm long) with a shorter tail that tapers abruptly behind the anus and ends in a thin tapering point (Fig. 202) and females (5 to 10.5 mm long) with a long gradually tapering tail (Fig. 203). Both male and female are widest at the anterior ends and may appear to the unaided eye to be broken posterior parts of nematodes. The short broad muscular esophagus consists of a posterior oval bulb and a larger greatly expanded corpus (Figs. 200, 201) that can open very wide to serve as a buccal capsule for attaching to the intestinal mucosa (Fig. 204).

→

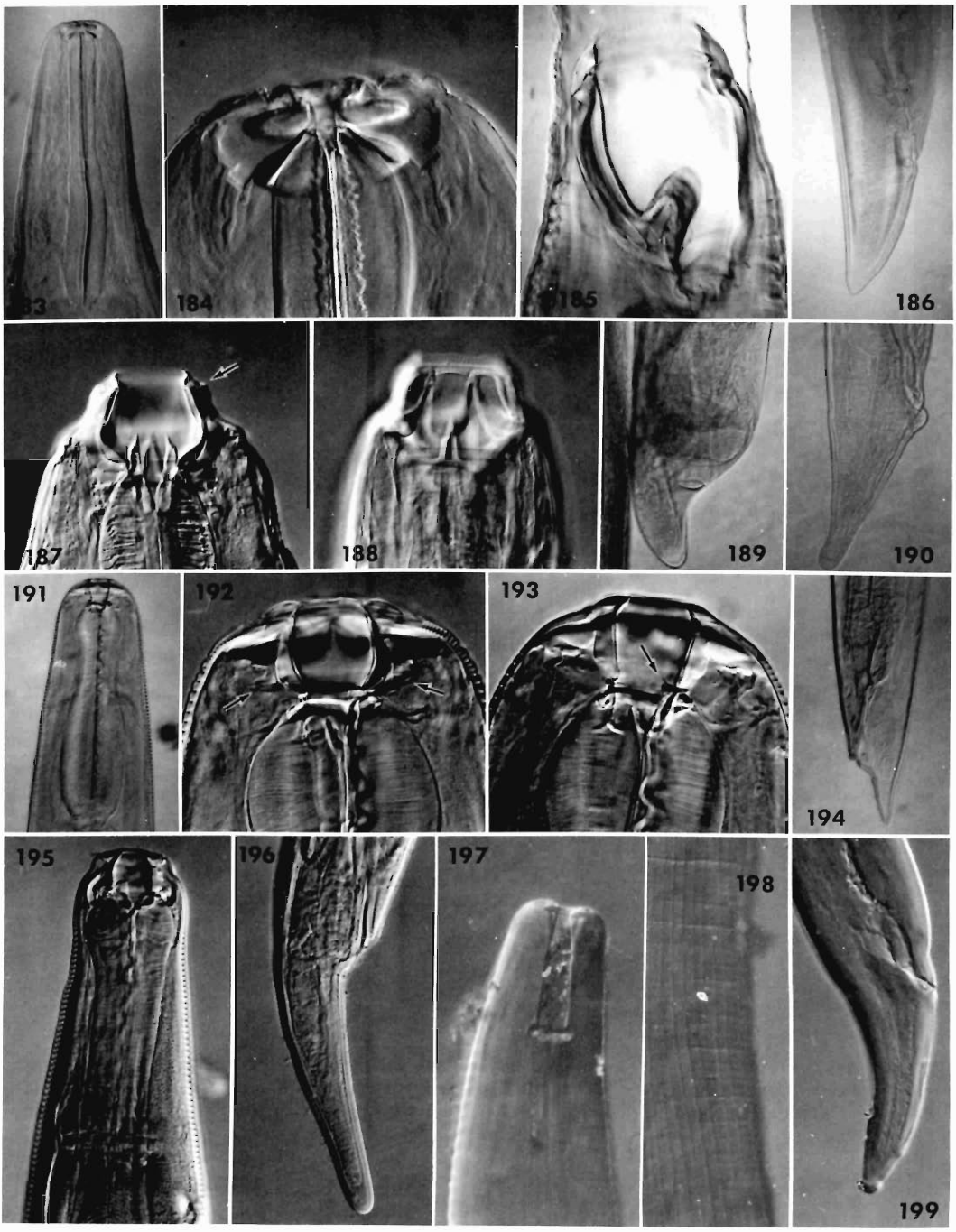
Figures 183–186. ***Strongylus vulgaris.*** **183. Fourth-stage larva, anterior end, × 50. 184. Fourth-stage larva, head showing buccal apparatus of fourth stage and surrounding cavity in which buccal capsule of adult forms, × 210. 185. Head of immature adult within cuticle of fourth stage, from wall of intestine, × 50. 186. Tail of female immature adult, from wall of intestine, × 50.**

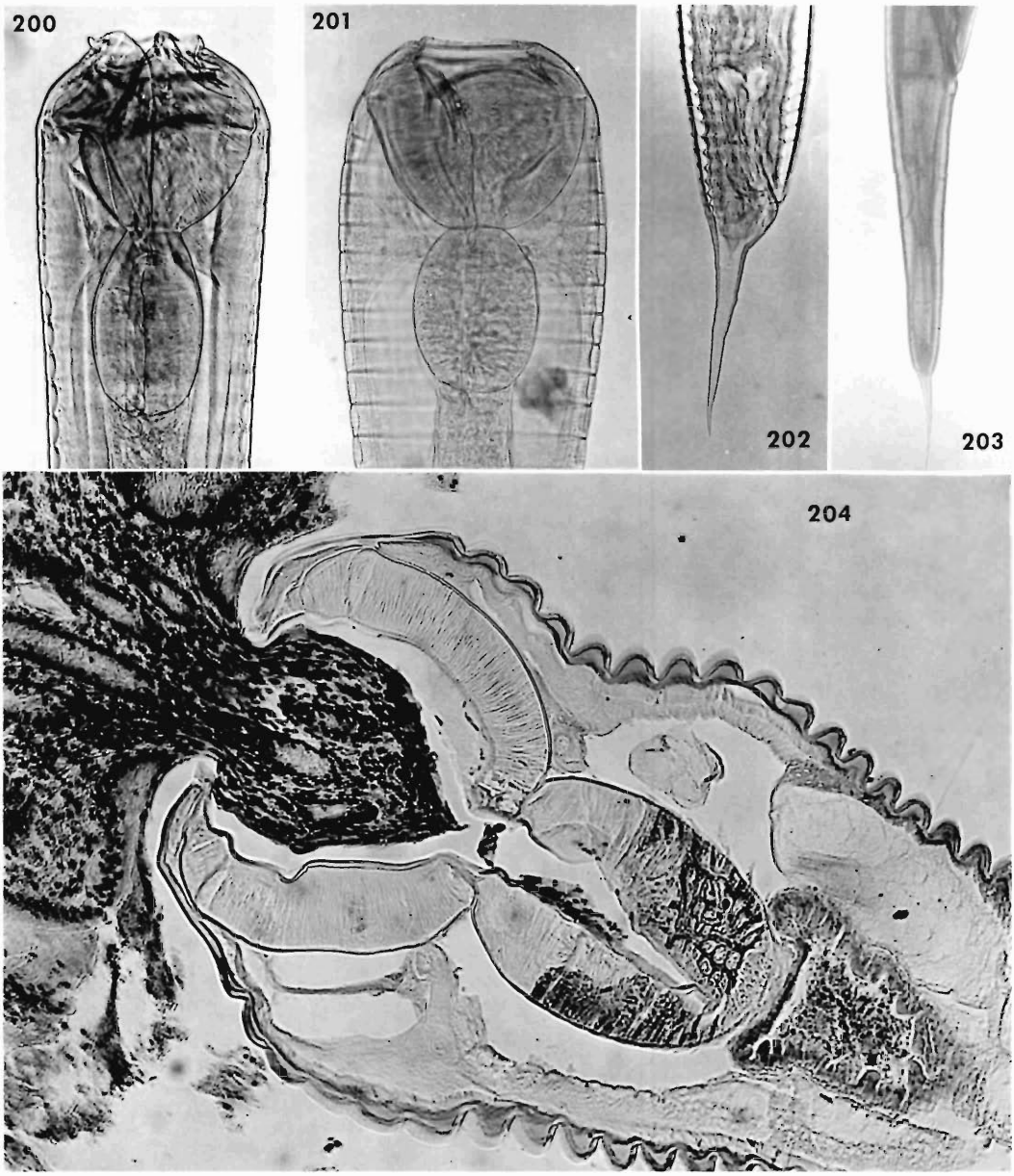
Figures 187–190. ***Triodontophorus*** **sp. fourth-stage larvae. 187. Medial, dorsoventral view of head showing three buccal teeth and lateral papillae (arrow), × 140. 188. Dorsal view of head showing one dorsal tooth, two submedian papillae, and elements of external leaf-crown, × 140. 189, 190. Lateral views of tails of larvae that may reflect different species, × 110.**

Figures 191–194. Fourth-stage larvae of (?) ***Cylicocyclus*** **sp. 191. Lateral view, anterior end, × 55. 192. Lateral view of head showing buccal capsule of fourth stage surrounded by early stages of formation of adult buccal capsule (arrows), × 220. 193. Lateral view of head showing buccal capsule with dorsal tooth (arrow), × 220. 194. Lateral view of tail, × 55.**

Figures 195, 196. Cyathostomin fourth-stage larva. 195. Lateral view of head showing buccal capsule with dorsal tooth, × 220. 196. Lateral view of tail, × 220.

Figures 197–199. ***Habronema muscae*** **larvae from horse stomach, × 350. 197. Head, showing buccal capsule similar to that of adult. 198. Cuticle, showing cross-striations and longitudinal ridges. 199. Tail, showing anus and spiny knobby tip.**





Figures 200–204. *Oxyuris equi* fourth-stage larvae. 200, 201. Anterior ends showing slightly different appearance depending on how wide the mouth is opened, × 110. 202. Male tail, lateral view, × 60. 203. Female tail, lateral view, × 60. 204. Longitudinal section through esophagus showing corpus engorged with intestinal tissue of the host, × 300.

F. Microfilariae

Microfilariae, the motile embryos that are released into host tissues by some female filariin nematodes, are sometimes found in the blood or the skin of horses. The following key for the identification of microfilariae of horses was first published by Supperer (1953), modified slightly by Soulsby (1965) and further modified slightly here.

Key to Microfilariae of Equids

1A. With sheath and marked internal body; in blood of horse ..... *Setaria equina*

B. Without sheath or internal body 2

2A. Less than 200 μ long; with rounded posterior end; on surface of skin or in hemorrhagic nodules of horse ..... *Parafilaria multipapillosa**

B. Usually more than 200 μ long; with pointed posterior end 3

3A. Tail very short; in skin of horse ..... *Onchocerca cervicalis*

B. Tail long, whiplike 4

4A. Distance from genital cell to tip of tail more than 140 μ; in skin of horse ..... *Onchocerca reticulata*

B. Distance from genital cell to tip of tail, less than 120 μ; in blood of horse ..... *Elaeophora boehmi**

* Not known to occur in North America.

V. Cestoda Parasitic in Domestic Equids

Three cestode species, in two genera of the family Anoplocephalidae, occur as adults in domestic equids. *Anoplocephala perfoliata*, *Anoplocephala magna*, and *Paranoplocephala mamillana* are cosmopolitan in distribution. Until recently it was believed (Soulsby, 1965) that *A. magna* was the most common species in North America and *A. perfoliata* was the most common species in other parts of the world. After corresponding with workers who have autopsied horses over many years in North America, I believe that *A. perfoliata* is about as common as *A. magna*. Massive infections with these cestodes can be quite pathogenic, resulting in perforation of the intestine and death of the equid. Oribatid mites are the intermediate hosts.

A fourth species, *Moniezia pallida*, has been found only once in South Africa causing authorities to doubt its validity (Spasskii, 1951). Because only a few cestode species are found as adults in horses, a single key to all species is given below. *Moniezia pallida* is included but not illustrated. Species diagnoses are included in the key. Characters used in the key are those that can be determined with the unaided eye without any processing of specimens.

All other cestodes reported from domestic equids are larval forms of the family Taeniidae. Only *Echinococcus granulosus* larvae occur in a significant number of equids. The larvae are listed in the section "Unusual, Accidental, or Occasional Helminths of Domestic Equids."

A. Key to Species

1A. Well-defined neck follows rounded scolex; genital apparatus double with pore on each lateral edge of each segment ..... *Moniezia pallida**

B. Neck very short, well-defined wide proglottids begin closely behind scolex that is flattened anteriorly; genital apparatus not double 2

**Moniezia pallida*—only species of genus found in horses. DIAGNOSIS: Monieziinae. Up to 138 cm long, 21 mm wide. Craspedote. Scolex rounded, 0.75 mm wide, with 4 rounded suckers directed obliquely anteriorly. A well-defined neck follows scolex. Developing segments 0.75 mm long, 11.0 mm wide; mature segments 15–21 mm wide. Interproglottidal glands arranged linearly. Excretory system of 4 longitudinal trunks and transverse canals with dorsal canals internal to ventrals. Genital apparatus double, pores somewhat anterior to middle of lateral edges of segment. Vagina opens ventrally to cirrus pouch on the right and dorsally on the left. Numerous testes in central field of segment. Cirrus pouch 0.23 mm long and 0.08 mm thick. Cirrus unarmed. Female reproductive organs lie laterally in central field; a fan-shaped, lobed ovary 1.06 mm wide, 0.48 mm long; vitellarium dorsal to ovary; developing uterus, a net of thin tubes, occupies entire central field of segment.

2A. Scolex with lappet behind each sucker ..... *Anoplocephala perfoliata*

B. Scolex without lappets 3

Anoplocephala perfoliata. DIAGNOSIS: Anoplocephalinae. Up to 80 mm long, but usually 25–40 mm long; 8–14 mm wide. Markedly craspedote. Scolex rounded, but with flattened anterior surface 2–3 mm wide. Four earlike lappets 0.5–1.0 mm at posterior edge of scolex. Four powerful, spherical suckers on anterior surface of scolex. Neck very short, strobila widens rapidly. Developing segments 100 times wider than long, 0.02–0.04 mm long, 2–2.5 mm wide. Hermaphrodite segments 0.16–0.20 mm long, 8–9 mm wide. Excretory system complicated reticulum of anastomosing canals. Genital apparatus single, unilateral, situated in anterior half of

* Not known to occur in North America, but reported elsewhere in domestic equids, not illustrated.

lateral marginal edge of segment. Numerous testes throughout central area. Cirrus long, may be armed, in pouch 0.8–1.2 mm long. Female organs in middle of central field, 2.4 mm wide with many lobules. Uterus in central field consists of tubes with bulges.

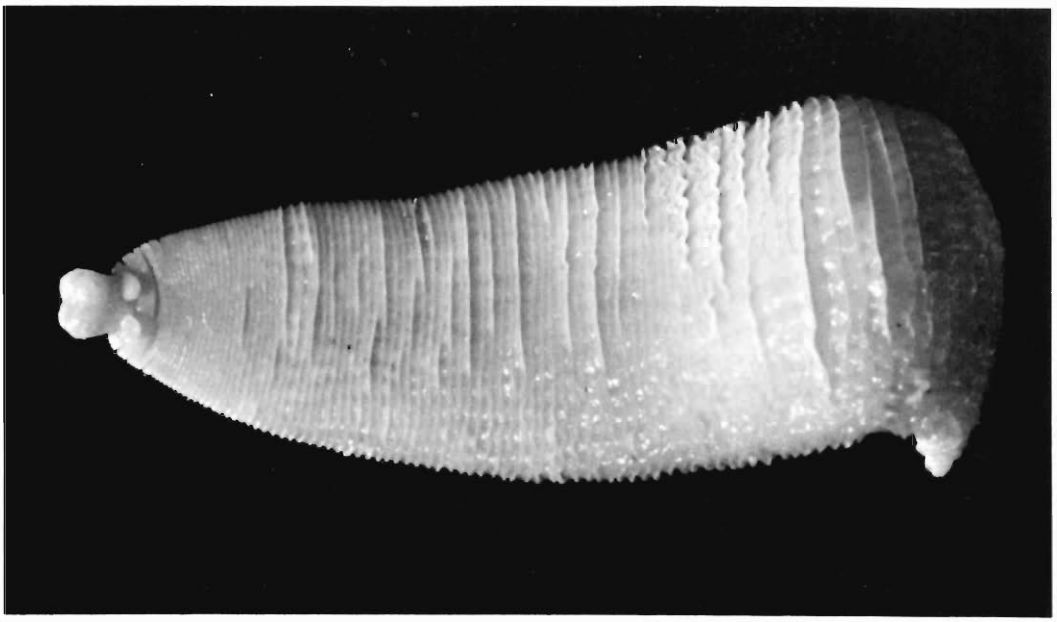


Figure 205. ***Anoplocephala perfoliata.*** **Entire specimen, dorsoventral view, showing two of four lappets at base of scolex, × 4.**

3A. Scolex 4 to 6 mm wide; strobila large, 25 mm wide, up to 800 mm long ..... *Anoplocephala magna*

Anoplocephala magna. DIAGNOSIS: Anoplocephalinae. Largest cestode of horses, up to 520 mm long and 25 mm wide. Markedly craspedote. Large anteriorly flattened scolex 2.8–3.0 mm wide with 4 powerful round suckers 1.0–1.2 mm in diameter. Neck absent. Immature segments 0.05 mm long, 3.0–4.0 mm wide; hermaphrodite segments 0.25 mm long, 7.0 mm wide; mature segments 2.5 mm long, 8.0 mm wide. Excretory system of complicated network of anastomosing canals. Genital apparatus single, unilateral, with pores on posterior half of lateral edge of segment. Numerous testes in dorsal half of central field. Cirrus covered with small spines. Developed ovarium occupies entire width of central field. Uterus is thin transversal chord across central field, later becomes tube with pouches.

Figure 206. ***Anoplocephala magna.*** **Entire specimen, dorsoventral view, showing large flattened scolex, × 2.**

B. Scolex 0.7 to 0.8 mm wide; strobila small, 4 to 6 mm wide, 10 to 40 mm long ..... *Paranoplocephala mamillana*

Paranoplocephala mamillana. DIAGNOSIS: Anoplocephalinae. About 30 mm long and 5 mm wide. Craspedote. Scolex flattened anteriorly, 1.1 mm wide, with 4 round muscular suckers. Neck very short, 0.2 mm long. Strobila short and wide with several dozens of segments. Immature segments 0.08 mm long, 1.1 mm wide; hermaphrodite segments 1.4 mm long, 5.0 mm wide. Excretory system consists of 2 pairs of longitudinal vessels within 0.5 mm of edge of strobila. Ventral vessels with transverse canals in posterior part of segments. Genital apparatus single, unilateral, with ducts dorsal to excretory vessels. About 100 rounded testes in central field aporally to female reproductive glands that lie in poral half of central field. Cirrus pouch 1.0–1.3 mm long, cigar-shaped, 0.2 mm thick. Cirrus armed. Ovary fan-shaped with numerous lobules. Uterus develops into stemlike sac with numerous outpocketings.

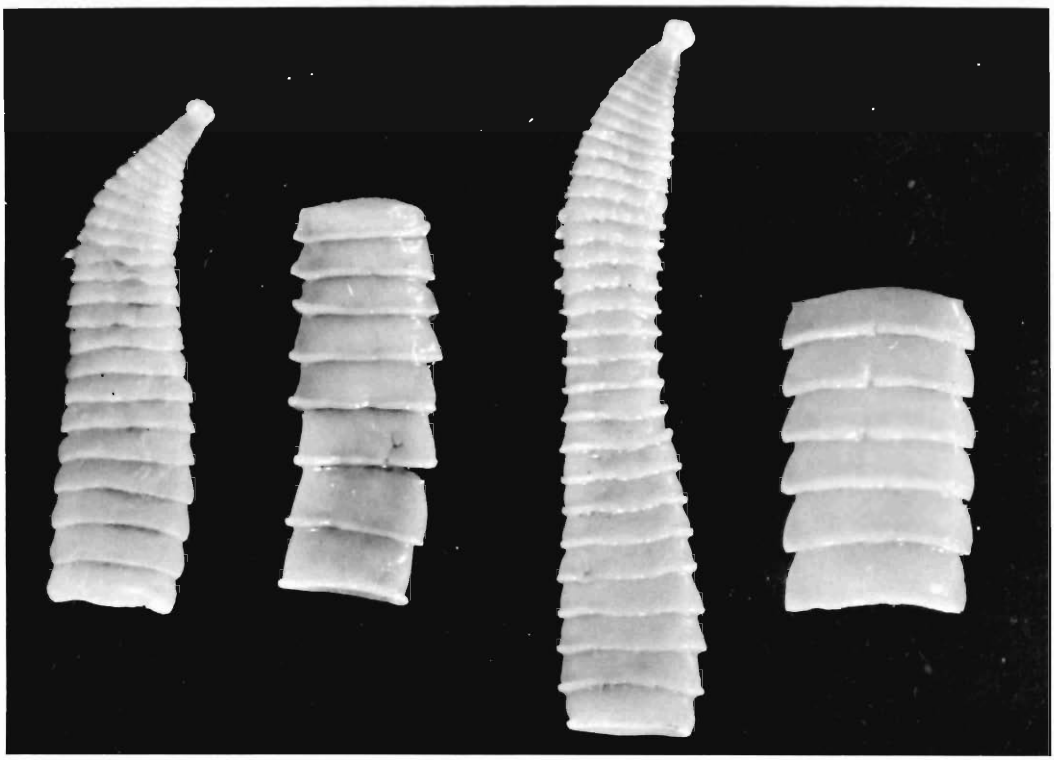


Figure 207. ***Paranoplocephala mamillana.*** **Portions of two specimens, dorsoventral view, showing small scolex, × 5.**

VI. Trematoda Parasitic in Domestic Equids

Of the trematodes reported from horses, only three species in two genera (*Gastrodiscus* and *Pseudodiscus*) are primarily parasites of horses; none are known to occur in North America. A key and generic diagnoses are given below for these two exotic genera. Other trematodes that have been reported from horses, but are primarily parasites of other hosts, are listed in a special section "Unusual, Accidental, or Occasional Helminths of Horses."

A. Key to Genera

1A. Body with cylindrical anterior portion and disc-shaped posterior portion that has numerous papillae on concave ventral surface ..... *Gastrodiscus**

**Gastrodiscus* Leuckart, 1877. DIAGNOSIS: Gastrodiscinae. Body divided into small subcylindrical anterior portion and large posterior disc with numerous papillae on its concave ventral surface. Ventral sucker small, subterminal. Oral sucker with prominent paired diverticula. Esophagus with muscular thickening. Ceca long, simple, extend to region anterior to ventral sucker. Testes lobed or branched, diagonal, in middle third of body; seminal vesicle convoluted; pars musculosa inconspicuous; cirrus pouch absent. Genital pore without sucker, near anterior margin of disc. Ovary lobate, submedian, posterior to testes. Laurer's canal present. Parasitic in intestine.

Type species: *G. aegyptiacus*. Other species: *G. secundus* and *G. equi*. For species descriptions see Maplestone (1923) and LeRoux (1938).

B. Body with conical anterior end widening gradually to oval leaflike shape ..... *Pseudodiscus**

**Pseudodiscus* Sonsino, 1895. DIAGNOSIS: Pseudodiscinae. Body conical, conspicuously serrated along anterior lateral margins. Ventral sucker ventral. Oral sucker with paired pouchlike diverticula. Esophagus without muscular thickening. Ceca long, simple, extending to level of ventral sucker. Testes multilobed, symmetrical, preovarian, in equatorial region; pars musculosa well developed; cirrus pouch absent. Genital pore without sucker. Ovary anterior to ventral sucker. Laurer's canal opens far anterior to excretory pore. Parasitic in colon.

Type species: *P. collinsii*. Other species: None. For species descriptions see Rai (1959) or Stiles and Goldberger (1910).

* Not known to occur in North America, but reported elsewhere in domestic equids, not illustrated.

VII. Unusual, Accidental, or Occasional Helminths of Domestic Equids

Records of the Index-Catalogue of Medical and Veterinary Zoology (U.S. Department of Agriculture, 1966–74, and unpublished) were searched for reports of helminths that occur in horses but normally occur in nonequid hosts. An asterisk precedes the current name of species not known to occur in North America. Only synonyms that have also been reported from horses are included.

NEMATODA

Order Strongylida
Suborder Strongylina
Family Oesophagostomidae

Oesophagostomum venulosum (Rudolphi, 1809)

Family Syngamidae

Syngamus sp. DeDoes, 1907
Stephanurus dentatus Diesing, 1839

Family Uncinariidae

Uncinaria stenocephala (Railliet, 1884)
Bunostomum trigonocephalum (Rudolphi, 1808)
=*Sclerostoma hypostomum* (Rudolphi, 1819)

Suborder Trichostrongylina
Family Trichostrongylidae

Cooperia oncophora (Railliet, 1898) Ransom, 1907
Nematodirus spathiger (Railliet, 1896) Railliet and Henry, 1909
Ostertagia ostertagi (Stiles, 1892) Ransom, 1907
Trichostrongylus colubriformis (Giles, 1892)
Trichostrongylus instabilis Railliet, 1893

Family Dictyocaulidae

Dictyocaulus viviparus (Bloch, 1782)
=*Strongylus micrurus* Mehlis, 1831

Order Ascarida
Suborder Ascaridina
Family Ascarididae

Ascaris lumbricoides Linnaeus, 1758
Toxocara cati (Schrank, 1788)

Suborder Oxyurina
Family Oxyuridae

Passalurus ambiguus (Rudolphi, 1819)

Order Spirurida
Suborder Spirurina
Family Thelaziidae

Thelazia rhodesii (Desmarest, 1827) Blainville, 1828
**Thelazia floresiana* Smit and Notosoediro, 1930

Family Ascaropsidae

**Simondsia paradoxa* Cobbold, 1864
Physocephalus sexalatus (Molin, 1860)
=*Spiroptera sexalata* Molin, 1860
Physocephalus cristatus (Seurat, 1912)

Family Spirocercidae

Spirocerca lupi (Rudolphi, 1809)
=*Spirocerca sanguinolenta* (Rudolphi, 1819)

Family Gongylonematidae

Gongylonema pulchrum Molin, 1857
=*Gongylonema scutatus* (Leuckart, 1873)
=*Spiroptera scutata* Mueller, 1869
=*Gongylonema confusum* Sonsino, 1896

Suborder Camallanina
Family Dracunculidae

Dracunculus medinensis (Linnaeus, 1758)
=*Filaria medinensis* (Linnaeus, 1758)
=*Dragonneau chanterelle* of Degland, 1821

Suborder Filariina
Family Dirofilariidae

Dirofilaria immitis (Leidy, 1856)
=*Filaria sanguinis equi* Sonsino, 1876
=*Filaria cordicola* Linstow, 1905
Dirofilaria repens Railliet and Henry, 1911
=*Filaria conjunctivae* Addario, 1885
=*Dirofilaria conjunctivae* (Addario, 1885)
=*Filaria oculi asini* Condorelli-Francaviglia, 1892
=*Filaria inermis* Grassi, 1887
=*Filaria apapillocephala* Condorelli-Francaviglia, 1892

Family Onchocercidae

Onchocerca gutturosa Neumann, 1910
=*Onchocerca bovis* Piettre, 1912

Family Dipetalonematidae

**Dipetalonema spirovolutum* (Smit and Ihle, 1925) Sprehn, 1932

Family Setariidae

Setaria labiatopapillosa (Alessandrini, 1838)
=*Filaria labiatopapillosa* Alessandrini, 1838
Setaria digitata Linstow, 1906
=*Aritionema digitata* (Linstow, 1906) Yeh, 1959

Order Trichinellida
Family Trichinellidae

Trichinella spiralis (Owen, 1835)

Order Dioctophymatida
Family Dioctophymatidae

Dioctophyma renale (Goeze, 1782)
=*Eustrongylus gigas* (Rudolphi, 1782)
=*Strongylus gigas* Rudolphi, 1802
=*Eustrongylus visceralis* (Gmelin, 1790)

Nematoda of Uncertain Classification

Ancylostoma incertum Sonsino, 1896
Sclerostoma rubrum Theobald, 1898
Dispharagus reticulatus Tokishige, 1898
Filaria pellucida Brown, 1823
Piguris reticulata Schlotthauber, 1860

ACANTHOCEPHALA

Macracanthorhynchus hirudinaceus (Pallas, 1781)

CESTODA (larvae)

Family Taeniidae

Multiceps multiceps (Leske, 1780) Hall, 1910
=*Polycephalus multiceps* (Leske, 1780)
=*Polycephalus coenurus* (Küchenmeister, 1853)
=*Taenia coenurus* Küchenmeister, 1853
=*Coenurus cerebralis* (Batsch, 1786)
=*Coenurus taeniaemulticipitis* Leske, 1780
Multiceps serialis (Gervais, 1847) Stiles and Stevenson, 1905
Taenia solium Linnaeus, 1758
Taenia tenuicollis Rudolphi, 1819
Taenia hydatigena Pallas, 1766
=*Cysticercus taeniaehydatigenae* Pallas, 1776
=*Taenia fistularis* (Rudolphi, 1805)
=*Cysticercus fistularis* Rudolphi, 1805
Echinococcus granulosus (Batsch, 1786) Rudolphi, 1801
=*Echinococcus polymorphus* Diesing, 1850
=*Taenia granulosa* (Batsch, 1786)
=*Taenia echinococcus* Siebold, 1853
Echinococcus multilocularis Leuckart, 1863

TREMATODA

Family Paramphistomidae
Subfamily Paramphistominae

Paramphistomum cervi (Schrank, 1790) Fischoeder, 1901
=*Monostomum conicum* Zeder, 1803

Subfamily Pseudodiscinae

**Hawkesius hawkesi* (Cobbold, 1875) Stiles and Goldberger, 1910
=*Pseudodiscus ornatus* (Cobbold, 1882) Sonsino, 1895

Family Dicrocoeliidae
Subfamily Dicrocoeliinae

Dicrocoelium dendriticum (Rudolphi, 1819) Dujardin, 1845
=*Dicrocoelium lanceatum* Stiles and Hassall, 1896
=*Dicrocoelium lanceolatum* (Rudolphi, 1803) Weinland, 1858a

Family Fasciolidae
Subfamily Fasciolinae

Fasciola hepatica Linnaeus, 1758
=*Fasciola hepatica equi* Gmelin, 1790
Fasciola gigantica Cobbold, 1855
=*Cladocoelium giganteum* (Diesing, 1858) Stossich, 1892
=*Fasciola humana* Gmelin, 1790
Fascioloides magnus (Bassi, 1875) Ward, 1917
=*Distomum crassum* Cobbold of Leidy, 1891
=*Fasciola americana* Hassall, 1891
=*Fasciola carnosa* Hassall, 1891
=*Distomum texanicum* Francis, 1891

Family Schistosomatidae
Subfamily Schistosomatinae

**Schistosoma japonicum* Katsurado, 1904
**Schistosoma bovis* (Sonsino, 1876) Blanchard, 1895
=*Bilharzia crassa* Sonsino, 1888
**Schistosoma indicum* Montgomery, 1906
Schistosoma haematobium (Bilharz, 1852) Weinland, 1858
=*Bilharzia magna* Cobbold, 1859
**Schistosoma spindale* Montgomery, 1906
**Orientobilharzia turkestanica* (Skrjabin, 1913) Srivastava, 1957

Family Brachylaimidae
Subfamily Brachylaiminae

**Brachylaima suis* (Balozet, 1936) Yamaguti, 1971

Family Gastrothylacidae
Subfamily Gastrothylacinae

**Gastrohylax* sp. Henry and Joyeux, 1920

VIII. Helminths from Zebras that Do Not Also Occur in Other Equids

NEMATODA

Order Strongylida
Suborder Strongylina
Family Strongylidae
Subfamily Cyathostominae

Crossocephalus viviparus (Linstow, 1899) Railliet, 1909
=*Pterocephalus viviparus* Linstow, 1899
=*Crossocephalus zebrae* Yorke and Southwell, 1920
Cylicocyclus gyalocephaloides (Ortlepp, 1938) Popova, 1952
=*Trichonema* (*Cylicocyclus*) *gyalocephaloides* Ortlepp, 1938
Cylicodontophorus schuermanni (Ortlepp, 1962) Round, 1968
=*Trichonema* (*Cylicodontophorus*) *schuermanni* Ortlepp, 1962
Cylindropharynx brevicauda Leiper, 1911
Cylindropharynx dollfusi Le Van Hoa, 1962
Cylindropharynx intermedia Theiler, 1923
Cylindropharynx longicauda Leiper, 1911
Cylindropharynx ornata Cram, 1924
Cylindropharynx rhodesiensis Yorke and Macfie, 1920

Cyathostominae Not Referable to Genus

Trichonema (*Javellia*) *aequatorialis* Ricci, 1939
Trichonema (*Cylicocyclus*) *aethiopicus* Ricci, 1939
Trichonema (*Borania*) *maestrii* Ricci, 1939
Trichonema (*Skladnikia*) *symmetrum* Ricci, 1939
Trichonema (*Zebrincola*) *zavattarii* Ricci, 1939

Order Spirurida
Suborder Spirurina
Family Spiruridae
Subfamily Habronematinae

Habronema longistoma Berghe, 1943
Habronema zebrae Theiler, 1923

Suborder Filariina
Family Setariidae
Subfamily Setariinae

Setaria hornbyi Boulenger, 1921

Order Ascarida
Suborder Ascaridina
Family Ascarididae
Subfamily Ascaridinae

Parascaris zebrae (Skrjabin, 1916) Yorke and Maplestone, 1926
=*Ascaris zebrae* Skrjabin, 1916

Suborder Oxyurina
Family Oxyuridae
Subfamily Oxyurinae

Oxyuris tenuicauda Linstow, 1901

CESTODA

Order Cyclophyllida
Family Anoplocephalidae
Subfamily Anoplocephalinae

Anoplocephala rhodesiensis Yorke and Southwell, 1921
=*Taenia zebrae* Collin, 1891, not Rudolphi, 1808
=*Anoplocephala zebrae* of Fuhrmann (1909, 1910)
=*Anoplocephala perfoliata zebrae* Baer, 1923. (This cestode has occasionally been reported in donkeys in Africa.)

TREMATODA

Order Echinostomatida
Family Paramphistomatidae
Subfamily Paramphistomatinae

Cotylophoron cotylophorum (Fischoeder, 1901) Stiles and Goldberger, 1910
=*Paramphistomum cotylophorum* Fischoeder, 1901

Order Strigeatida
Family Schistosomatidae
Subfamily Schistosomatinae

Schistosoma margrebowiei (LeRoux, 1933) Price, 1933
=*Bilharzia margrebowiei* LeRoux, 1933
Schistosoma leiperi LeRoux, 1955
=*Schistosoma spindalis* Montgomery, 1906, of LeRoux (1932, 1933, 1939)

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XI. Alphabetic Index of Genera, Subgenera, Species, and Subspecies Including Synonyms

This index is intended to make it possible to find all places in the manuscript where any subspecies, species, subgenus, or genus is mentioned or illustrated. For species and subspecies, the author and date of the taxon are included and are followed by the genus in which it is placed in this treatise. Subgeneric names are also followed by the genus in which they are placed. Names of genera are followed by the subfamily, family, or other higher taxa in which they belong. Locations in the text are indicated by page numbers. Figure numbers of illustrations are listed with the page number on which the illustrations appear.

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