Identification of cyathostomes in equines in Iran

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Summary

Attempts were made to present a practical key for identification of small strongyles, the identification of which seems to be a difficult task to do. 4000 nematodes collected from the large intestine of horses and donkeys were examined. 18 species of small strongyles of horse and 15 of donkey were found. From 6 species of large strongyles found in both animals, we only dealt with 3 of *Triodontophorus* sp. In horses, 3 species of *Coronocyclus* (*C. coronatus*, *C. labiatus* and *C. labratus*), 4 species of *Cyathostomum* (*C. alveatum*, *C. catinatum*, *C. pateratum* and *C. tetracanthum*), 5 species of *Cylicocyclus* (*C. auriculatus*, *C. insigne*, *C. nassatus*, *C. radiatus* and *C. elongatus*), 1 species of *Cylicodontophorus* (*C. bicoronatus*), 4 species of *Cylicostephanus* (*C. calicatus*, *C. goldi*, *C. longibursatus* and *C. minutus*), 1 species of *Gyalocephalus* (*G. capitatus*), and 3 species of *Triodontophorus* (*T. brevicauda*, *T. serratus* and *T. tenuicollis*) were found. From the above-mentioned species, *C. minutus*, *C. calicatus* and *G. capitatus* were absent in specimens examined from donkeys.

Key words: Cyathostomes, Species, Equines, Iran

Introduction

Small strongyles inhabit the large intestine of equines and could cause morbidity, and even mortality in heavily-infected animals (Roumen *et al*., 2004). On the other hand, due to the frequent and sometimes, incorrect dosage of anthelmintics, resistance of these nematodes to a wide range of anthelmintic drugs is reported (Baudena *et al*., 2000).

So far, 57 species in the subfamily Cyathostominae and several species of large strongyles are identified throughout the world (Lichtenfels *et al*., 1998, 2002) of which three species in the genus *Triodontophorus* are described in this study.

In Iran, some species of small strongyles are reported from labor horses (Mirzayans *et al*., 1974), donkeys and mules (Eslami, 1997). The presence of this group of organisms is confirmed by faecal culture in race horses of Isfahan (Eslami *et al*., 1998) and around Tehran (Eslami *et al*., 2005).

The identification of cyathostomes to the level of species, even genus, is a difficult task. It requires long-term practice, focus, patience and access to proper keys. The objective of this paper was to study the species of cyathostomes present in the equine of Iran and also to present a practical key for their identification.

Materials and Methods

Four thousand small strongyles and a few large strongyles were obtained either from the worm collection, Department of Parasitology, Faculty of Veterinary Medicine of Tehran, or from the washed materials of the large intestines of horses and donkeys at necropsy. The specimens were preserved in 70% alcohol and cleared in glycerin for microscopic examinations.

The two good guidelines, i.e. those of Lichtenfels (1975) and Tolliver (2000), were used. According to these authors, the most critical structure for identification of the species of these organisms is the buccal cavity components which in sequence of importance are the walls of buccal capsule, its shape and dimension, presence or absence of extra-chitinous supports of external leaf crowns, and submedian and lateral papilla (Fig. A). The less important structures, though sometimes very helpful,

include the shape of posterior ends of males and females, shape of esophagus, and the position of the excretory pore to esophagus. Beside these two categories, other helpful portions for identification of these organisms will be cited whenever necessary.

The best specimens, representatives of a species, were selected for photomicroscopy.

Results

Using the criteria suggested by Lichtenfels (1975) and Tolliver (2000), especially the latter one, 4000 nematodes collected from the large intestines of horses and donkeys were examined. A practical key is presented for 18 species of small strongyles of horse and 15 of donkey. From six species of large strongyles found, here, we only dealt with three species of *Triodontophorus*.

The morphological characteristics of these species with numeric reference to their original photomicrographs are described in sequence of species in the following pages.

Discussion

Out of 4000 nematodes collected from the large intestines of horses and donkeys, 18 species of small strongyles in horse and 15 in donkey and six of large strongyles in both animals were identified. Albeit, from the six species of large strongyles identified, in this paper we dealt only with three species, *i.e. Triodontophorus* sp.

It seems, despite the presence of many cyathostomes species reported in equine from different parts of the world, that only a few are among the most prevalent ones.

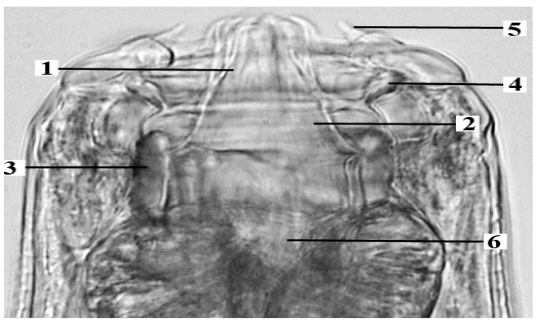
According to Tolliver (2000), 10 out of 33 species reported from horses in Kentucky and essentially the same number in the United Kingdom (Ogbourne, 1976) and elsewhere in the United States (Reinmeyer, 1986) constitute the most prevalent species. In Normandy, France, 10 out of 19 and in Australia 14 out of 35 species found, were reported to be the most prevalent species (Mfitilodze and Hutchinson, 1990; Collobert-Laugier *et al*., 2002).

Our findings suggested that six out of 18 species recovered from horses namely, *C. nassatus*, *C. coronatus*, *C. labiatus*, *C. minutus*, *C. calicatus*, *C. catinatum* and 10 out of 15 species isolated from donkey namely, *C. nassatus*, *C. tetracanthum*, *C. labratus*, *C. labiatus*, *C. auriculatus*, *C. bicoronatus*, *C. coronatus*, *C. alveatum*, *C. elongatus and C. insigne* are among the most prevalent species.

The present study also revealed that three and four species of small strongyles reported from horses were in common with those reported by Tolliver (2000) and Collobert-Laugier *et al*. (2002) from horses of Kentucky and in Normandy, France, respectively. Meanwhile, of those species reported from donkeys, 7 were in common with 13 species reported from donkeys of Zimbabwe (Eysker and Pandey, 1987).

The morphologic characteristics presented in the current key are in line with those of Tolliver (2000) and Lichtenfels (1975), although in the present paper the attempts were made to show the relation between the position of the excretory pore and esophagus; we found that in some species, this relation can be useful (e.g., *C. calicatus* and *C. minutus*).

The key features presented in this article can be a helpful tool for study the pathogenesis of different species as well as their resistance pattern against anthelmintic drugs.



1- External leaf crown
2- Internal leaf crown
3- Wall of buccal capsule
4- Extra chitinous support of external leaf crown
5- Submedian papilla
6- Esophageal funnel

Fig. A: Different parts of anterior end of a equine cyathostomes

Coronocyclus coronatus

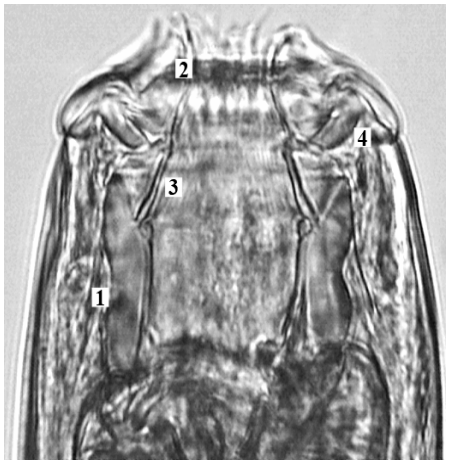


Fig. 1

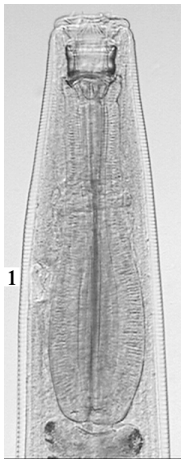


Fig. 2

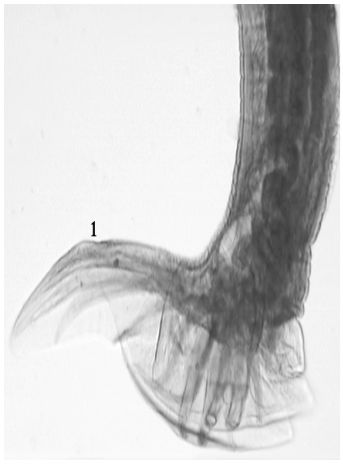


Fig. 3

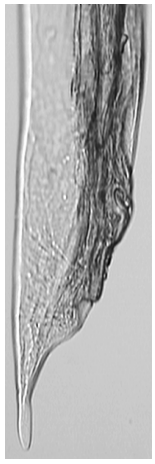


Fig. 4

Walls of buccal capsule: ●Relatively thick and bent inward in the middle. ●Look like two unshelled peanuts or boomerangs (Fig. 1-1)
Other characteristics: ●Buccal cavity is as deep as broad. ●Extra-chitinous supports of ELC are present and are very prominent (Fig. 1-4). ●ILC (Fig. 1-3). ●Elements of ELC shoot out from buccal cavity and bend over at the end to form a cornet (Fig. 1-2). ●Dorsal ray in male bursa is quite long (Fig. 3-1). ●Female tail gradually tapers (Fig. 4). ●The excretory pore is located near the junction of the middle and posterior esophagus (Fig. 2-1)

Coronocyclus labratus

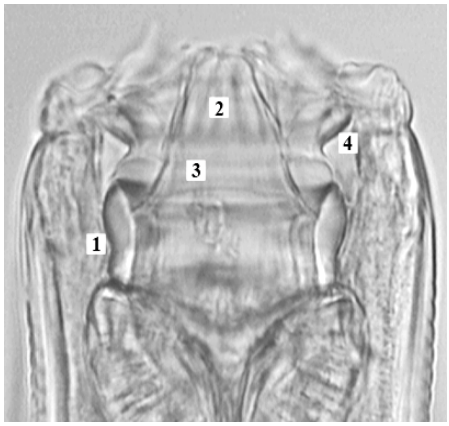


Fig. 5

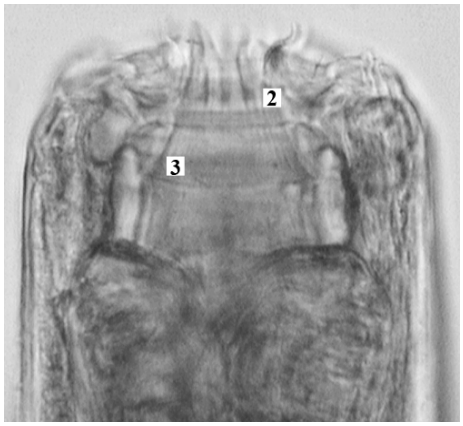


Fig. 6

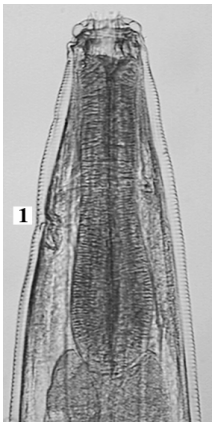


Fig. 7

Walls of buccal capsule: ●Relatively thick. ●In some position look like the bottom of a pair of man's dress shoes pointed away from each other (Fig. 5-1)
Other characteristics: ●ILC elements (Fig. 5-3 and Fig. 6-3) more than one-half as long as ELC (Fig. 5-2 and Fig. 6-2) elements. ●Extra-chitinous supports of ELC pyriform (Fig. 5-4). ●Square head. ●The male bursa is symmetrical with a dorsal ray of average length (Fig. 8-1). ●The female tail is fat with a small spike at the tip (Fig. 9-1). ●The excretory pore is located near the middle of esophagus (Fig. 7-1)

Fig. 8

Fig. 9

Coronocyclus labiatus

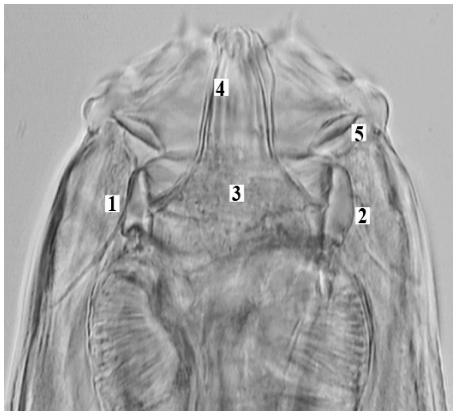


Fig. 10

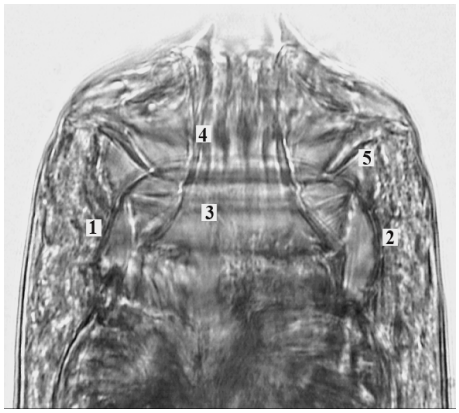


Fig. 11

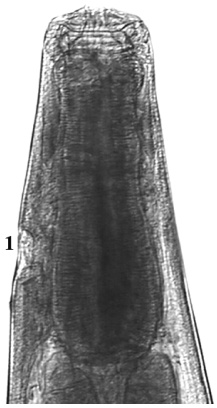


Fig. 12

Walls of buccal capsule: ●Relatively thick seems to be asymmetrical in some position. ●Left side looks like an arrowhead (Figs. 10-1 and 11-1); Right side looks like an orange section (Figs. 10-2 and 11-2)
Other characteristics: ●ILC (Figs. 10-3 and 11-3) elements one-half as long as ELC (Figs. 10-4 and 11-4) elements. ●Extra-chitinous supports of ELC spindle shaped (Figs. 10-5 and 11-5). ●Round head. ●Male bursa has a short dorsal ray (Fig. 13). ●The female tail is short and thick with a spike at the end (Fig. 14). ●The excretory pore is located near the junction of the middle and posterior esophagus (Fig. 12-1)

Fig. 13

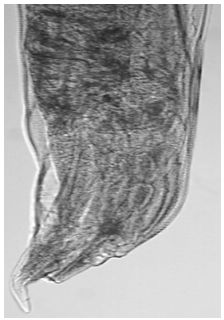


Fig. 14

Cyathostomum tetracanthum

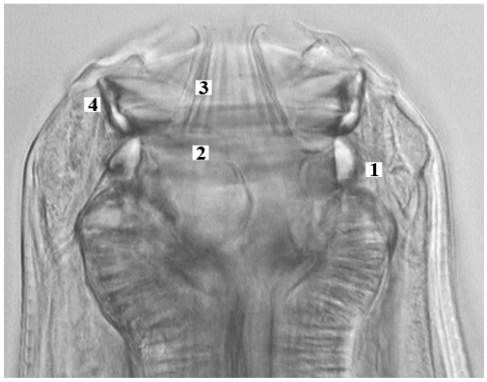


Fig. 15

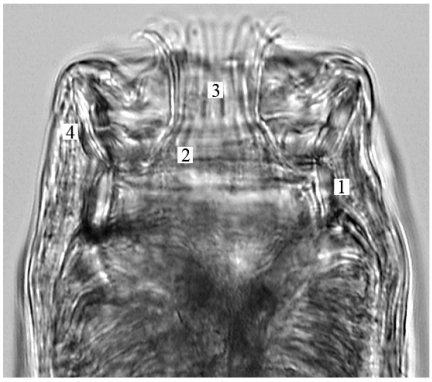


Fig. 16

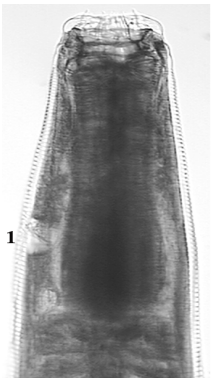


Fig. 17

Walls of buccal capsule: ●Shortand relatively straight in some position looks like kidney bean standing on end (Figs. 15-1 and 16-1). ●Extra-chitinous supports nearly as large as wall of the buccal capsule and appear to be extension of the buccal capsule wall, curve out and up like a pair of "devil's horns" (Figs. 15-4 and 16-4)
Other characteristics: ●Buccal cavity much broader than deep. ●ELC (Figs. 15-3 and 16-3). ●ILC (Figs. 15-2 and 16-2). ●The male bursa is quite broad, but has a short dorsal ray (Fig. 18). ●The female tail tapers at the posterior end and finally ends in a "finger-pointed" tip (Fig. 19). ●The excretory pore is located near the junction of the middle and posterior esophagus (Fig. 17-1)

Fig. 18

Fig. 19

Cyathostomum alveatum

Walls of buccal capsule: ●Thick, larger at the base, taper anteriorly and move away from each other (Fig. 20-1). The walls of the buccal capsule and the esophagus (Figs. 20-3 and 21-1), together resemble a woman's slip with the walls being the slip's strap

Other characteristics: ●ILC inserted as about one-third depth of the buccal capsule (Fig. 20-2)

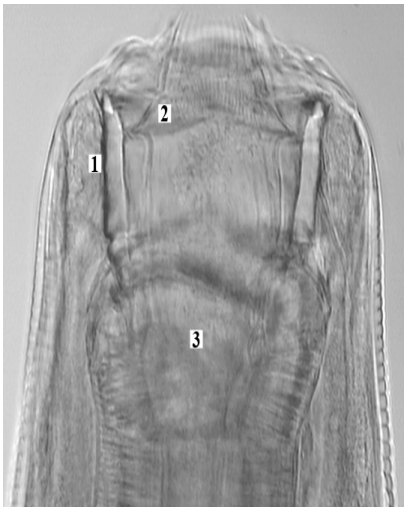


Fig. 20

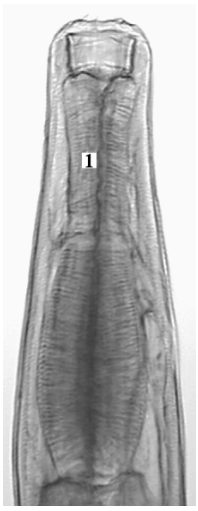


Fig. 21

Fig. 22

●Since the species is small, the esophagus is in view at the same time as the buccal capsule at 10× (Fig. 21)
●The male tail is quite large considering the size of the worm, resembling a raptor's foot (Fig. 22)

Cyathostomum catinatum

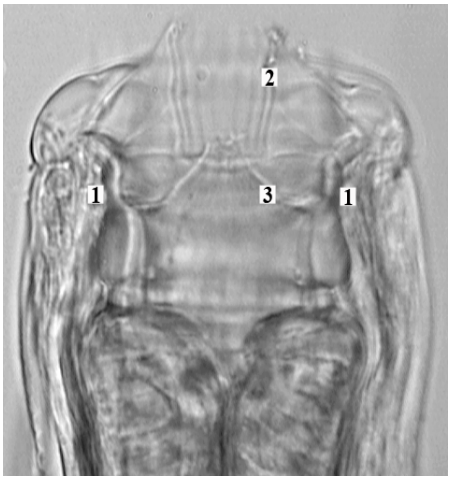


Fig. 23

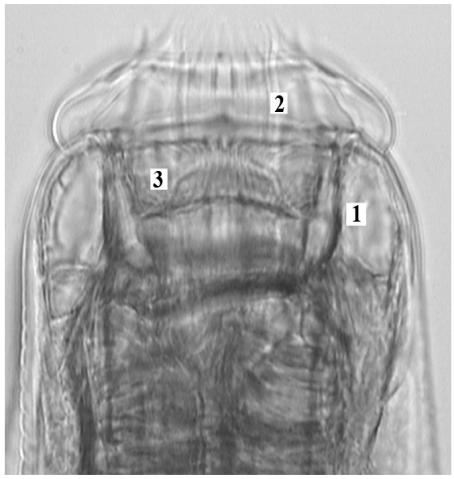


Fig. 24

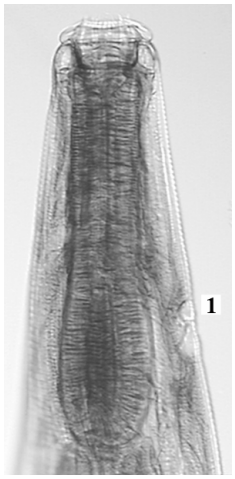


Fig. 25

Walls of buccal capsule: ●Wide at the base, taper nearly to a point anteriorly (Figs. 23-1 and 24-1), resembling a pair of cat's eyes.

Other characteristics: ●ILC inserted as about one-half depth of the buccal capsule (Figs. 23-3 and 24-3). ●ELC (Figs. 23-2 and 24-2). ●The male tail is of average size, and the tip of the dorsal ray slightly curves back ventrally (Fig. 26). ●The female tail is very blunt and resembles a little fat foot (Fig. 27). ●The excretory pore is located near the posterior third of esophagus (Fig. 25-1).

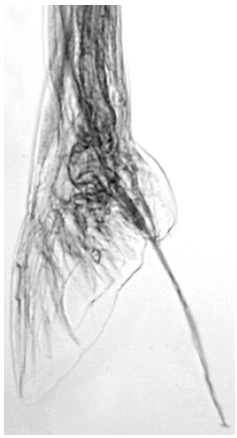


Fig. 26

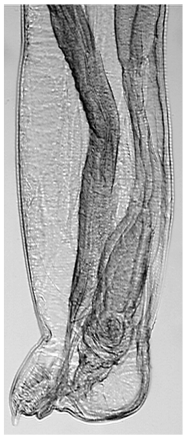


Fig. 27

Cyathostomum pateratum

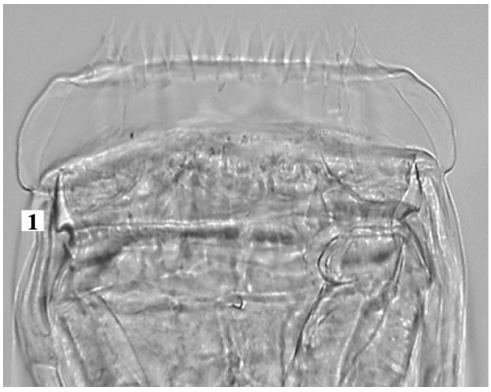


Fig. 28

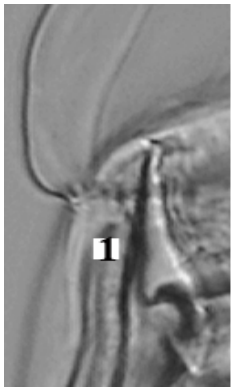


Fig. 29

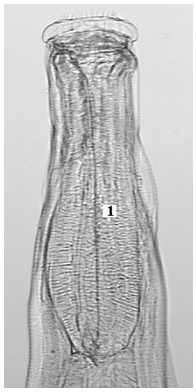


Fig. 30

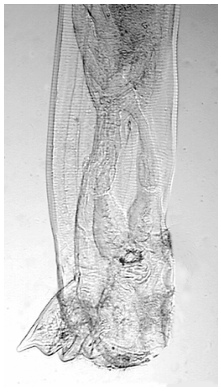


Fig. 31

Walls of buccal capsule: ●Looks like triangles that are slanted and upside down (Figs. 28-1 and 29-1).
Other characteristics: ●Buccal cavity relatively shallow. ●There are two little "hills" running through the middle of the buccal capsule (Fig. 32-1). ●Head is square. ●Esophagus (Fig. 30-1). ●The dorsal ray of the male bursa is short (not shown). ●The female tail looks like a big fat foot (Fig. 31).

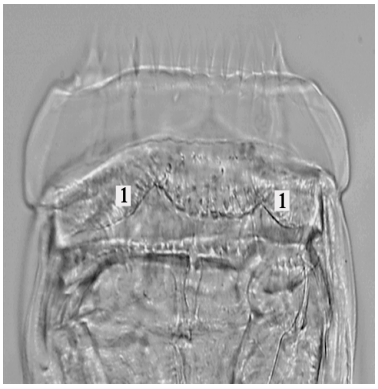


Fig. 32

Cylicocyclus auriculatus

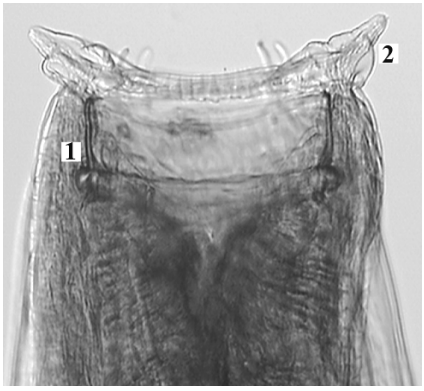


Fig. 33

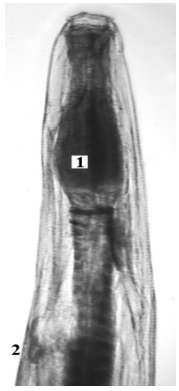


Fig. 34

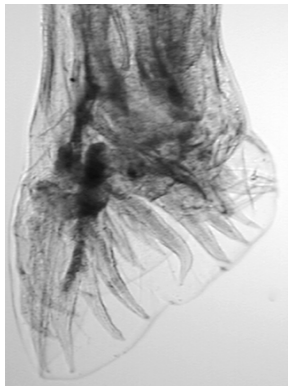


Fig. 35

Fig. 36

Walls of buccal capsule: ●Look like chicken leg bones after the meat has been eaten (Fig. 33-1)
Other characteristics: ●Has hornlike papillae that look like a pair of giant ears (Fig. 33-2). ●It is a very large species. ●Rectangular buccal capsule. ●In lateral view, the worm appears to have a mountain rising out of the top of its head (Fig. 37-1). ●Esophagus (Fig. 34-1). ●The excretory pore is located posterior to the esophagus (Fig. 34-2). ●The male bursa is quite large as befits the size of the worm; however, the dorsal ray is not exceedingly long (Fig. 35). ●The female tail is not tapered and is blunt at the end (Fig. 36).

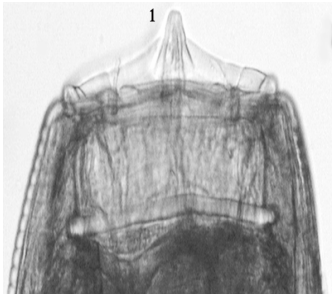


Fig. 37

Cylicocyclus elongates

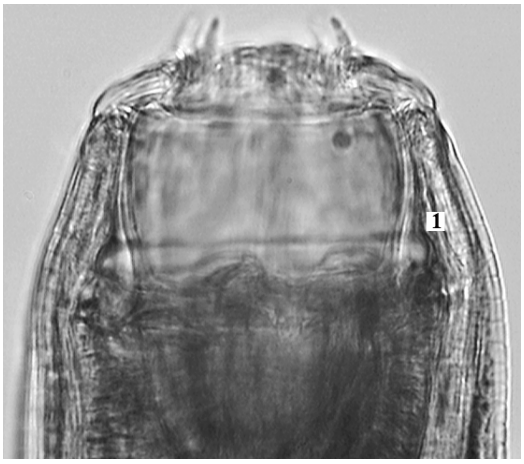


Fig. 38

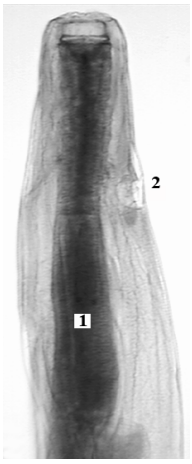


Fig. 39

Fig. 40

Fig. 41

Walls of buccal capsule: ●Look like chicken leg bone after its meat has been eaten and are slightly bowed (Figs. 38-1 and 42-1).
Other characteristics: ●Has a fairly large buccal capsule. ●Esophagus is long and straight (Fig. 39-1). ●The male tail has a very long dorsal ray (Fig. 40-1). ●The female tail ends bluntly and has a spike at the end (Fig. 41). ●The excretory pore is located near the middle of esophagus (Fig. 39-2)

Fig. 42

Cylicocyclus insigne

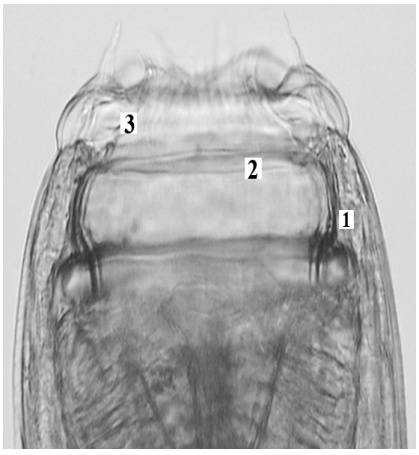


Fig. 43

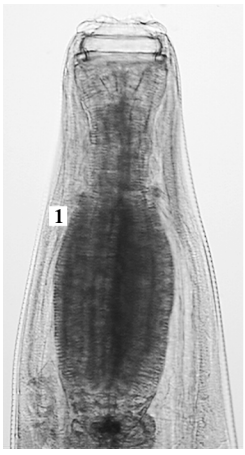


Fig. 44

Fig. 45

Fig. 46

Walls of buccal capsule: ●Resemble chicken leg bone after its meat has been eaten which are really bow outward in the middle (Fig. 43-1)
Other characteristics: ●Buccal cavity much broader than deep (Fig. 43). ●ILC elements (Fig. 43-2) much shorter than ELC elements (Fig. 43-3). ●Has a short, pear-shaped esophagus that begins to bulge almost immediately (Fig. 44-1). ●The male bursa is quite broad with a medium-length dorsal ray (Fig. 45). ●The angle of the female foot is turned down like a ballet dancer's (Fig. 46).

Cylicocyclus radiatus

Fig. 47

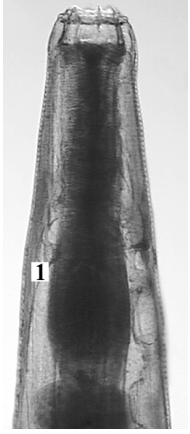


Fig. 48

Fig. 49

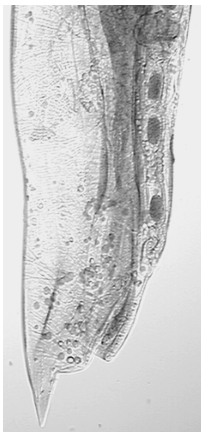


Fig. 50

Walls of buccal capsule: ●Resemble chicken leg bones after its meat has been eaten which are very thin and do not bow out at all instead, they stand straight up (Fig. 47-1)
Other characteristics: ●Buccal capsule is smaller than that of *C. elongatus* and *C. insigne* (Fig. 47). ●Elements of ELC about one-third as long as buccal capsule is deep. ●Esophagus is pear-shaped but does not begin to bulge until about halfway down (Fig. 48-1). ●Male tail has no distinguishing characteristics, but it seems to be broader and longer than it needs to be, considering the size of the worm (Fig. 49). ●The female tail tapers to a definite point (Fig. 50).

Cylicocyclus nassatus

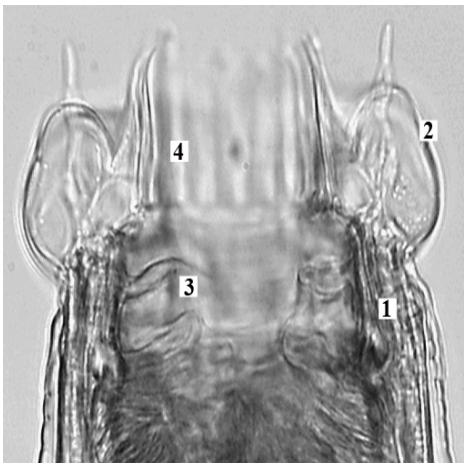


Fig. 51

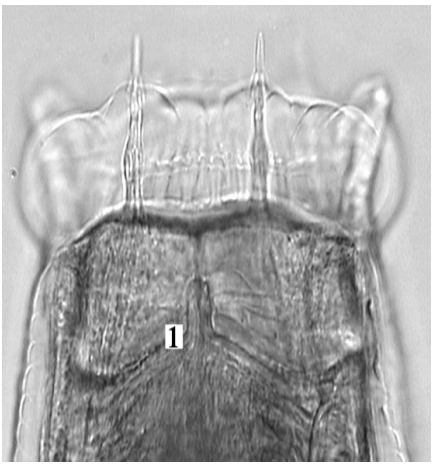


Fig. 52

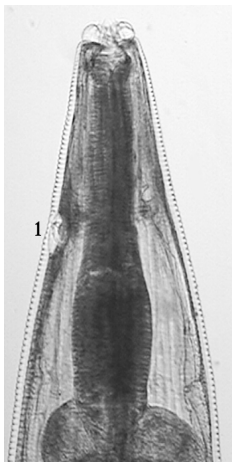


Fig. 53

Walls of buccal capsule: ●Relatively thin and resemble chicken leg bones after its meat has been eaten (Fig. 51-1)
Other characteristics: ●Buccal capsule usually with internal shelf like cuticular projection (Fig. 51-3). ●Lateral papillae give the appearance of ears (Fig. 51-2). ●Submedian papillae long extend beyond mouth collar. ●Dorsal gutter extends for on-half the depth of buccal cavity (Fig. 52-1). ●The male has a symmetrical tail with an average-length dorsal ray (Fig. 54). ●The female tail tapers at the end (Fig. 55). ●The excretory pore is located near the middle of esophagus (Fig. 53-1).

Fig. 54

Fig. 55

Cylicostephanus calicatus

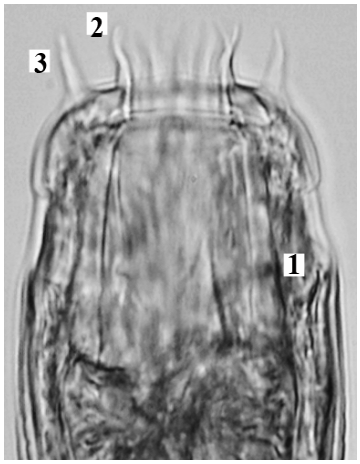


Fig. 56

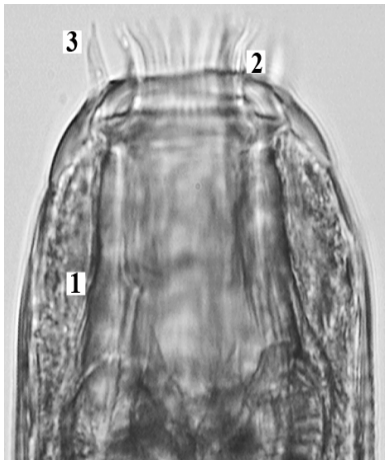


Fig. 57

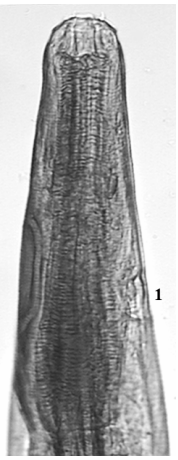


Fig. 58

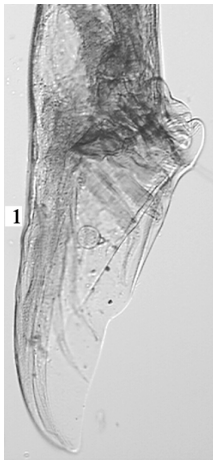


Fig. 59

Walls of buccal capsule: ●Rise up straight toward the mouth opening (Fig. 56-1 and 57-1)
Other characteristics: ●Very small worm. ●Elements of ELC digitiform (Figs. 56-2 and 57-2). ●Submedian papillae notched near the tip (Figs. 56-3 and 57-3). ●*C. calicatus* is slightly bigger than *C. minutus*. ●The dorsal ray of the *C. calicatus* male tail is very long compared to *C. minutus* (Fig. 59-1). ●The *C. calicatus* female tail is quite tapered compared to that of *C. minutus*. (Fig. 60). ●The excretory pore is located near the junction of the middle and posterior esophagus (Fig. 58-1)

Fig. 60

Cylicostephanus minutus

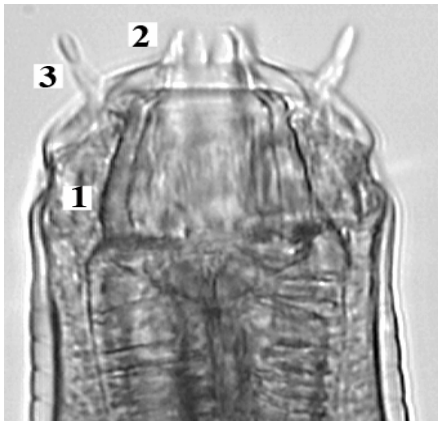


Fig. 61

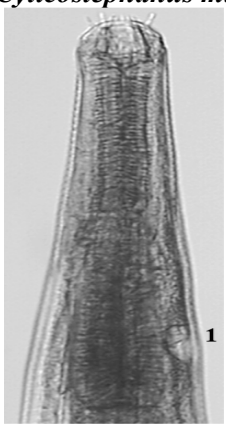


Fig. 62

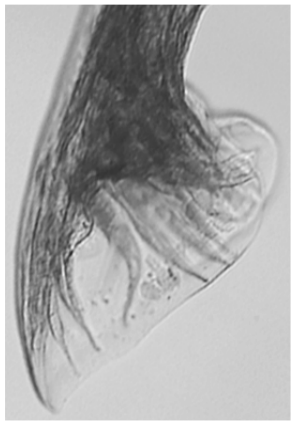


Fig. 63

Fig. 64

Walls of buccal capsule: ●Seem completely symmetrical and rise up straight toward the mouth opening (Fig. 61-1)
Other characteristics: ●Very small worm. ●Elements of ELC triangular (Fig. 61-2). ●Submedian papillae notched at point one -half distance between tip and the mouth collar (Fig. 61-2). ●The male of this species has a little bursa that is about as wide as it is long (Fig. 63). ●Female tail gets fatter on the end and has a small spike that goes off at an angle (Fig. 64). ●The excretory pore is located near the posterior third of esophagus (Fig. 62-1).

Cylicostephanus longibursatus

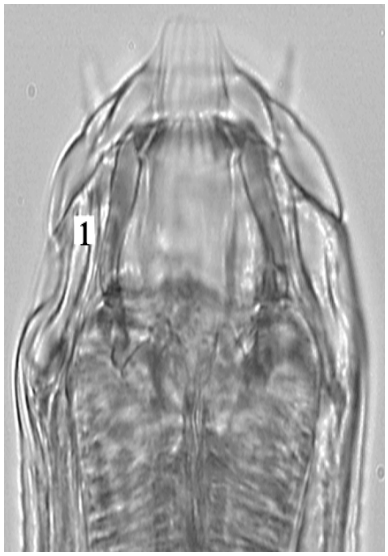


Fig. 65

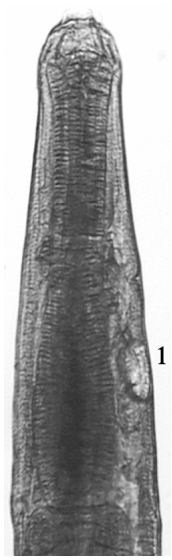


Fig. 66

Fig. 67

Fig. 68

Walls of buccal capsule: ● Look like a set of parentheses which are a little thicker at anterior end (Fig. 65-1)
Other characteristics: ●Small worm. ●Teeth in esophageal funnel not prominent. ●The male bursa is extremely long (Fig. 67-1). ●The female tail tapers and suddenly ends in a point (Fig. 68). ●The excretory pore is located near the junction of the middle and posterior esophagus (Fig. 66-1).

Cylicostephanus goldi

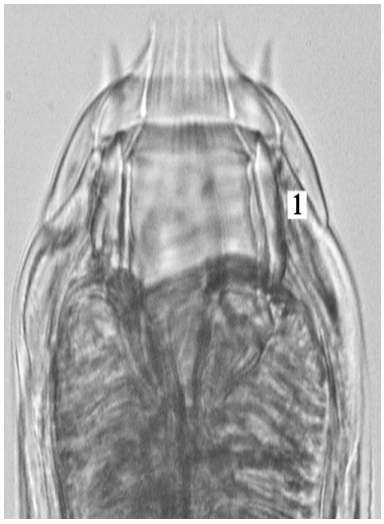


Fig. 69

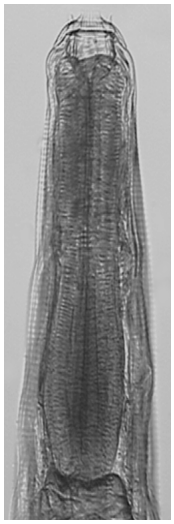


Fig. 70

Fig. 71

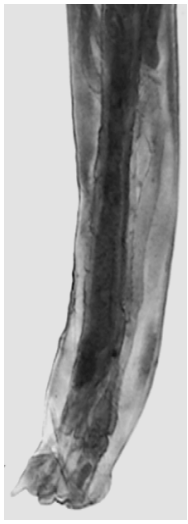


Fig. 72

Walls of buccal capsule: ●When merge with the leaves of the external crown look like two baby birds with sharp, curved beaks facing each other (Fig. 69-1)
Other characteristics: ●Elements of ILC almost twice as numerous as elements of ELC. ●Dorsal ray of the male bursa is relatively long (Fig. 71). ●Female tail bend dorsally with a ventral prominence and looks like a foot (Fig. 72). ●Esophagus (Fig. 70)

Cylicodontophorus bicoronatus

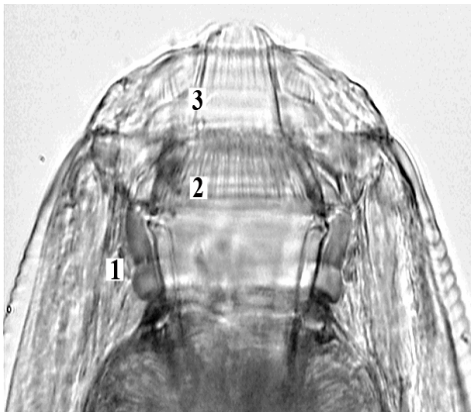


Fig. 73

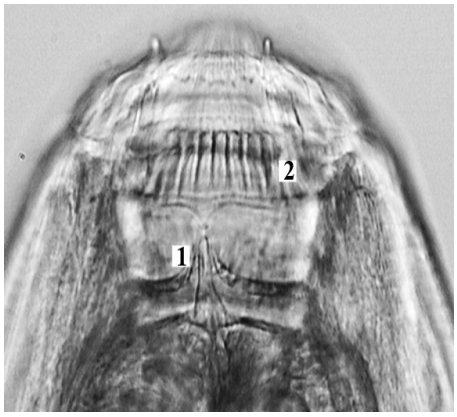


Fig. 74

Fig. 75

Walls of buccal capsule: ●Short, thick, and bullet-shaped which fan out away from each other (Fig. 73-1)
Other characteristics: ●Very heavy internal leaf elements that resemble the teeth of a comb (Fig. 73-2 and 74-2). ●Dorsal gutter well developed (Fig. 74-1). ●ELC (Fig. 73-3). ●The male bursa is symmetrical, has a moderately long dorsal ray, and curves slightly back (Fig. 76). ●The Female tail is thick and blunt, has a fairly wide spike at the end (Fig. 75)

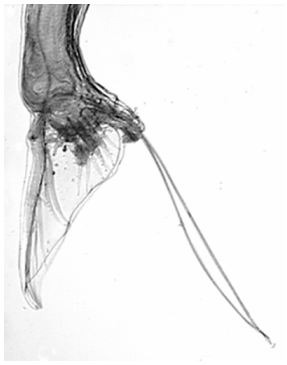


Fig. 76

Gyalocephalus capitatus

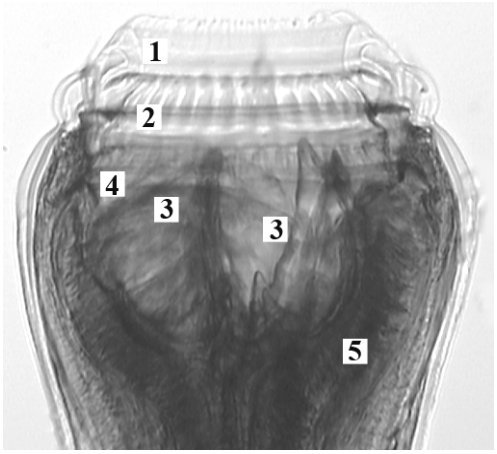


Fig. 77

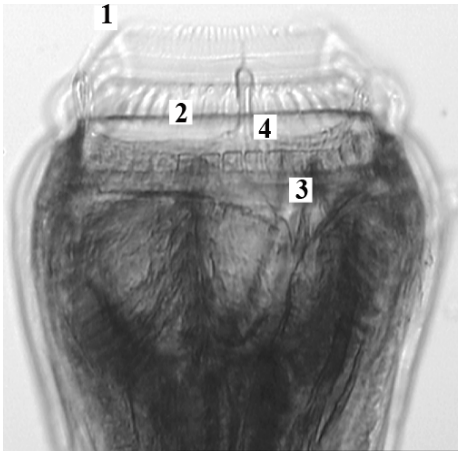


Fig. 78

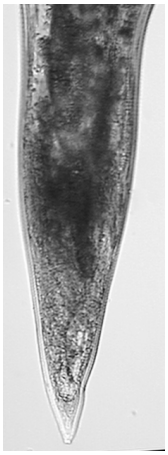


Fig. 79

Buccal capsule: ●Short, much wider than deep, thick walled (Fig. 77)
Other characteristics: ●Esophageal funnel (Fig. 77-5) very large surrounded by greatly dilated anterior end of esophagus, contain 3 large sickle-shaped dentiform projections (Fig. 77-3) and 3 additional small double teeth spaced among sickle-shaped projections. ●ELC (Figs. 77-1 and 78-1). ●The leaves of the internal crown are very broad and quite conspicuous (Figs. 77-2 and 78-2). ●Ring of tooth-like structure around posterior internal surface of buccal capsule at origin of ILC (Figs. 72-4 and 78-3). ●Male bursa large with an exceptionally long prebursal papillae that is as long or longer than the dorsal ray (not shown). ●Female tail is very long and thin and finally ends in a sharp point (Fig. 79)

Triodontophorus brevicauda

Buccal cavity: ●Round. ●Having four teeth, the teeth are not denticulated but each has a U-shaped groove in the middle (Fig. 80-1)
●Top of the head looks like a right-side-up saucer (Fig. 80-2). ●The dorsal ray of the male is quite long. ●The female tail is very thick (*brevicauda*), which does not taper, but comes abruptly to an end (Fig. 81). ●Vulva is very close to anus

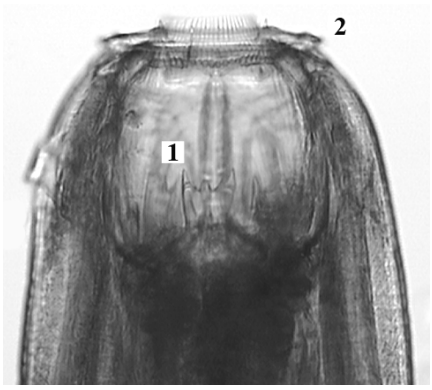


Fig. 80

Fig. 81

Triodontophorus serratus

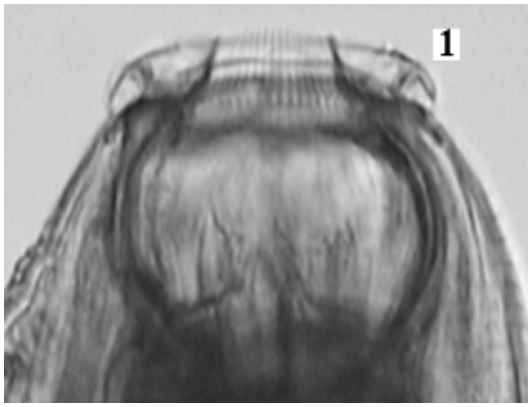


Fig. 82

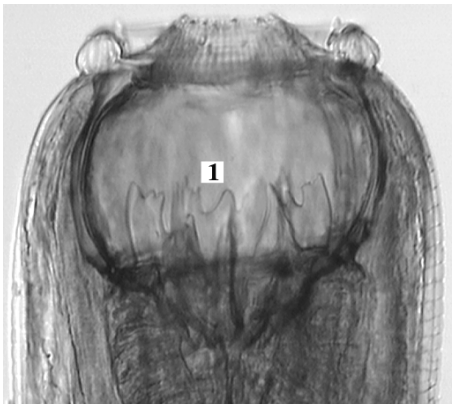


Fig. 83

Fig. 84

Buccal cavity: ●Rround. ●Having four teeth, the teeth are denticulated (Fig. 83-1). ●Top of the head looks like an inverted saucer. (Fig. 82-1). ●The dorsal ray of the male bursa is very short. ●Spicules more than 3 mm long
●Female has a very long tail which taper to a point (Fig. 84). ●Vulva separated from anus by 1.5–3 mm

Triodontophorus tenuicollis

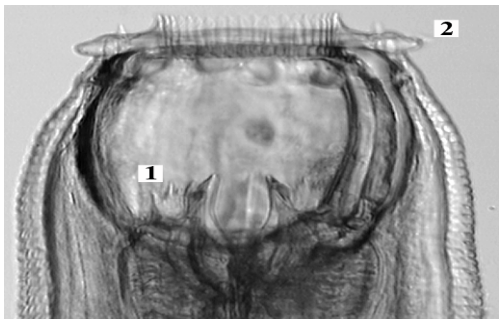


Fig. 85

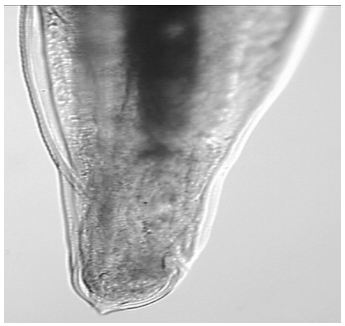


Fig. 86

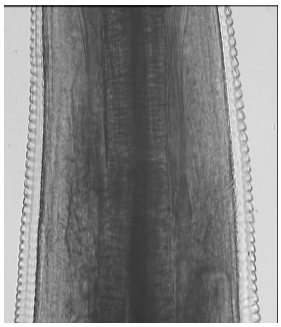


Fig. 87

Buccal cavity: ●Round. ●Teeth are very irregularly shaped and denticulated (Fig. 85-1). ●Top of the head looks like a flat dish that is neither upside down nor right side up (Fig. 85-2). ●Cuticle is strongly serrated at cervical region (Fig. 87). ●Male bursa has a moderately long dorsal ray that is at a right angle to its body and spicules less than 3-mm long. ●The female has a fat, blunt tail with a nipple on the end (Fig. 86). ●Vulva separated from anus by less than 1 mm

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