

# COMPARATIVE MORPHOLOGY OF GENITAL CONES OF GENUS *ANCYLOSTOMA* DUBINI, 1843

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## INTRODUCTION

Looss (1911) stated that there were no external appendages at the anogenital aperture of male *Ancylostoma ceylanicum*, *A. duodenale*, *A. caninum* but that in *A. malayanum* there were a number of papillae-like or finger-shaped processes of various sizes. The genital cone is a useful taxonomic character in certain nematode species (Shul'ts and Andreeva, 1953; Andreeva, 1957; Stringfellow, 1970, 1972). To date there has been no report on the description of anogenital structures of *Ancylostoma*. The present paper compares the genital cones and shows their value in separating species of *Ancylostoma*.

## MATERIALS AND METHODS

Adult *Ancylostoma braziliense* and *A. tubaeforme* were collected from cats in Brisbane, Australia; *A. ceylanicum* and *A. duodenale* from man in Bangkok, Thailand; *A. malayanum* from a Malayan sun bear, *Helarctos malayanus*, Thailand; *A. kusimaense* from a badger sent by Dr. Y. Yoshida from Japan; *Agriostomum vryburgi* from cattle and *Cyclodontostomum purvisi* from rats in Malaysia. All specimens were fixed in 70% alcohol and cleared in glycerine or in creosote. Drawings were done by using a camera lucida. The scanning technique has been described previously (Setasuban, 1974).

## DESCRIPTION OF THE GENITAL CONES

*A. braziliense* (Plate 1, Figs. 1, 2); There are two groups of papillae. The first group

consists of two pairs of papillae on the dorsal surface on either side of the cloacal openings; the upper pair (A) points dorso-laterally; these are stronger and longer than the others which lie underneath (B). The second group also consists of two stout pairs of papillae situated latero-ventral to the cloacal openings; the lateral pair (C) is slightly larger than the median (D).

*A. ceylanicum* (Plate 1, Figs. 3, 4 and Fig. A). The pattern of anogenital papillae are the same as in *A. braziliense* but are much bigger.

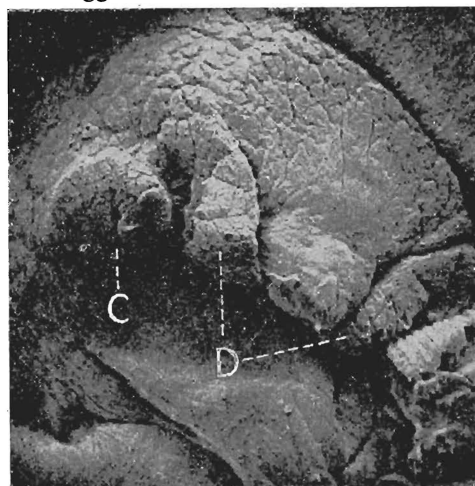


Fig. A—Showing the dorso-lateral (C) and dorso-medial papillae (D) of *A. ceylanicum* x 1700.

*A. kusimaense* (Plate 1, Figs. 5, 6). There is a pair of semilunar membrane-like structures on either side of the end of the gubernaculum (A). Under these membranes are three pairs of papillae; the first pair is lateral, strong, long and blunt (B); the second pair is long and sharp, situated on either side

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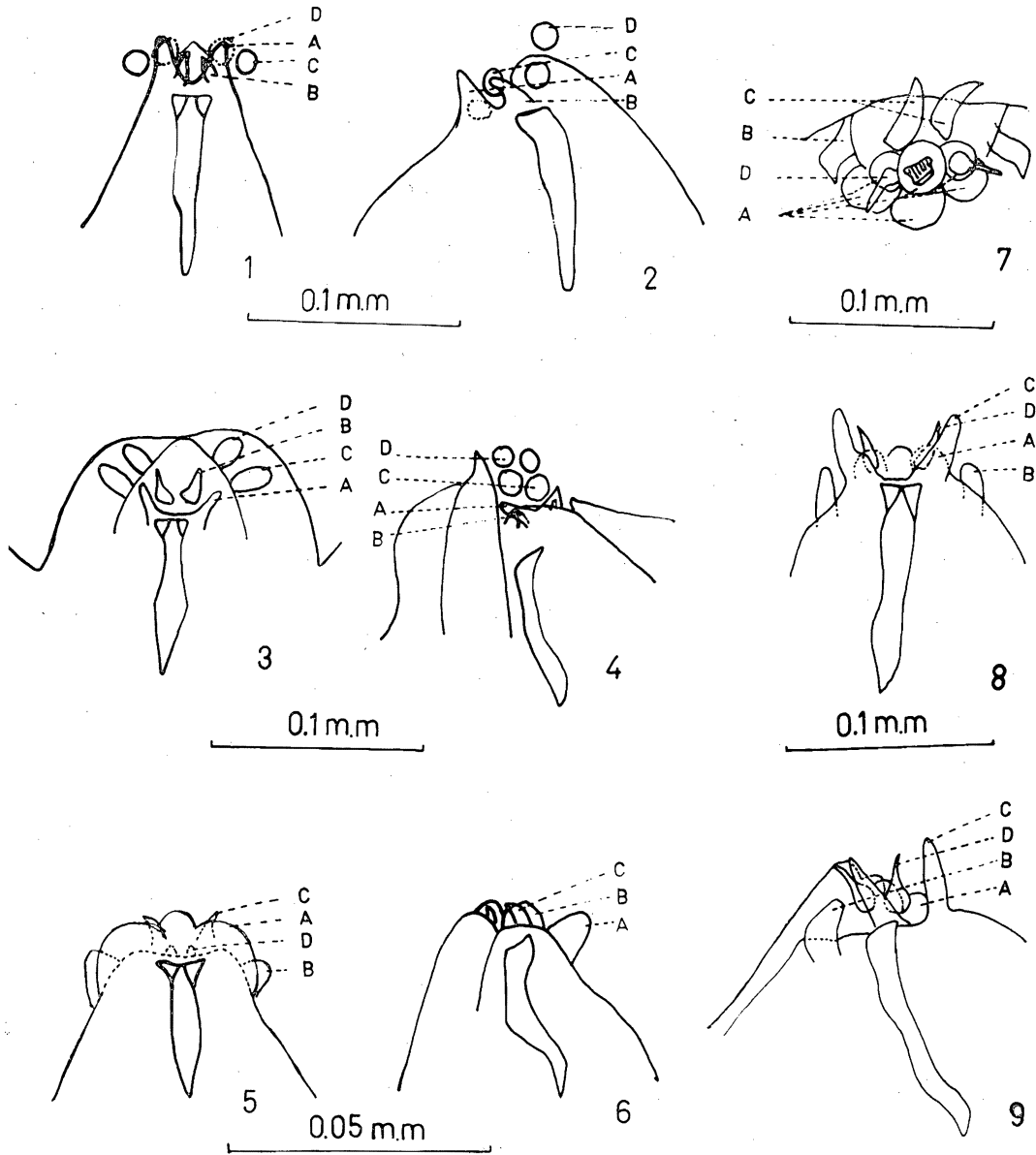


Plate 1

Figs. 1, 2 —Showing the anogenital papillae of *A. braziliense*; Dorsal (1), Lateral (2).  
 Figs. 3, 4 —Showing the anogenital papillae of *A. ceylanicum*; Dorsal (3), Lateral (4).  
 Figs. 5, 6 —Showing the anogenital papillae of *A. kusimaense*; Dorsal (5), Lateral (6).  
 Figs. 7, 8, 9—Showing the anogenital papillae of *A. malayanum*; En face (7), Dorsal (8), Lateral (9).

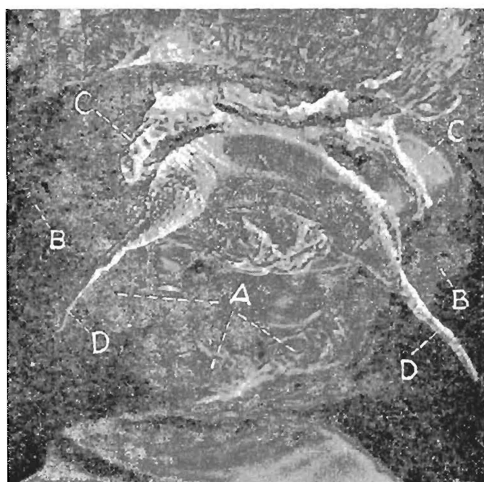


Fig. B—Showing the anogenital papillae of *A. malayanum* x 1450.

of cloacal opening (C); the third pair (D) is small, situated dorso-medial to the second pair.

*A. malayanum* (Plate 1, Figs. 7, 8, 9 and Fig. B). There are two groups of papillae. The first group consists of six small, round papillae which are situated around the anal opening (A). The second group consists of three pairs of long finger-like processes; the first pair is lateral to the cone (B); the other two are postero-dorsal (C) and ventro-dorsal (D).

*A. duodenale* (Plate 2, Figs. 10, 11). There are two pairs of papillae on either side of the cloacal opening. The upper pair (A) is longer than those that lie underneath (B).

*A. caninum* (Plate 2, Figs. 12, 13), *A. tubaeforme* (Plate 2, Figs. 14, 15), *Agriostomum vryburgi* (Plate 2, Figs. 16, 17) and *Cyclodontostomum purvisi* (Plate 2, Figs. 18, 19), all resemble *A. duodenale* in their anogenital papillary pattern.

## DISCUSSION

Looss (1911) remarked on the presence of anogenital structures in *A. malayanum* but

Lane (1916) stated that there were no such structures. Rep (1963) proposed *A. malayanum* as a synonym of *A. duodenale*. In the present work, the anogenital structures of *A. malayanum* were described and found to be entirely different from those of *A. duodenale*.

Nagayoshi (1955) and Yoshida (1965, 1974) did not mention the presence of anogenital structures in *A. kusimaense*. The description of anogenital structures in this species has been added here; it was easily distinguished from the other *Ancylostoma* species. The anogenital structures of *A. braziliense* and *A. ceylanicum*, had the same pattern and situation, but those of *A. braziliense* were much smaller than those in *A. ceylanicum*.

From this study, the character of anogenital cones could be used to distinguish among hookworm species with two pairs of teeth whereas those had three pairs of teeth, it was very difficult to distinguish among them.

## SUMMARY

Male worms of *Ancylostoma braziliense*, *A. ceylanicum*, *A. kusimaense*, *A. malayanum*, *A. duodenale*, *A. caninum*, *A. tubaeforme*, *Agriostomum vryburgi* and *Cyclodontostomum purvisi* have the external appendages beside the anogenital aperture. These anogenital structures are morphologically similar and are assumed to be homologous among the species with three pairs of teeth or more. In hookworms with two pairs of teeth, the anogenital structures are complex. Anogenital features can be used as a taxonomic character in separating the species.

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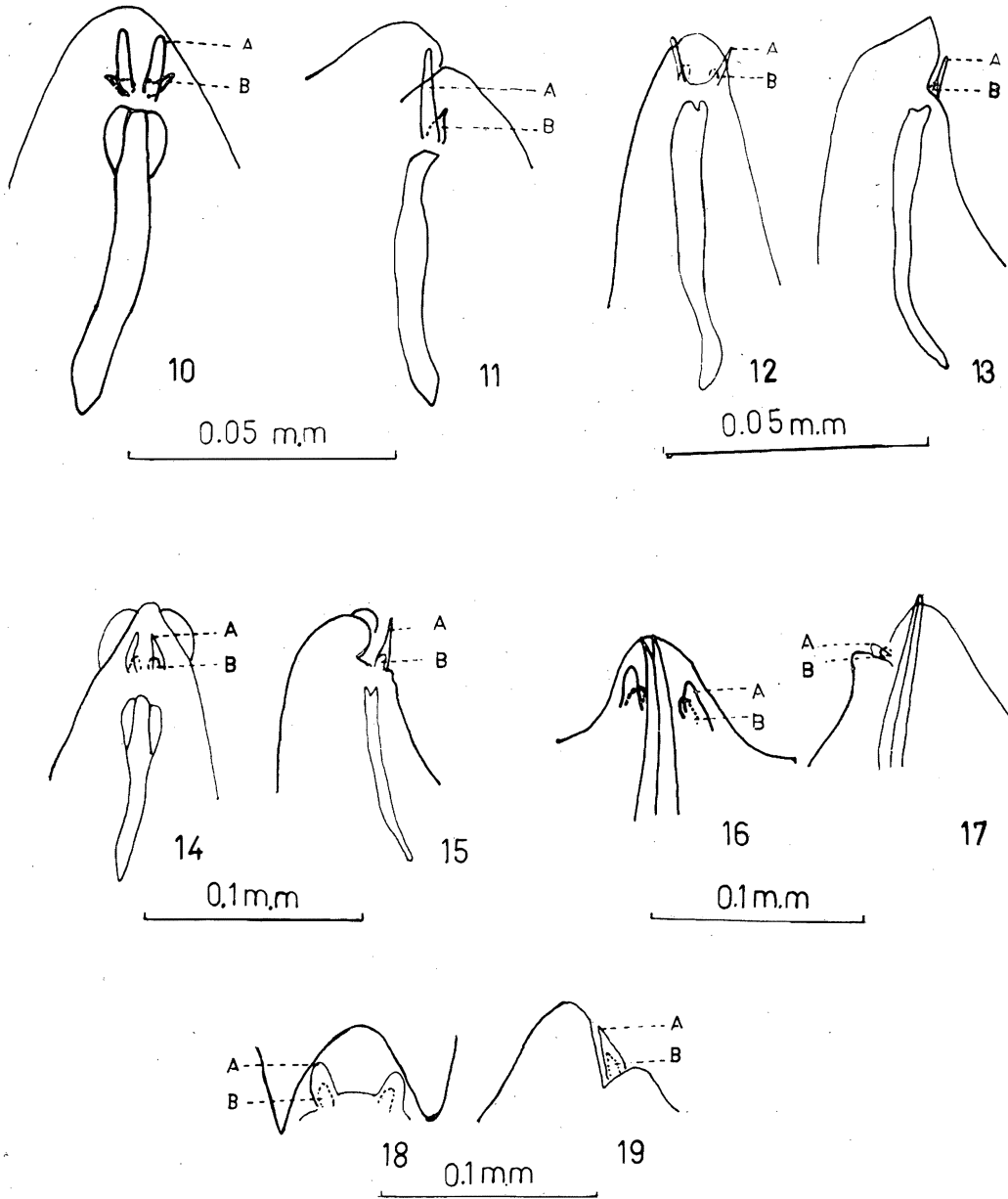


Plate 2

- Figs. 10, 11—Showing the anogenital papillae of *A. duodenale*; Dorsal (10), Lateral (11).  
 Figs. 12, 13—Showing the anogenital papillae of *A. caninum*; Dorsal (12), Lateral (13).  
 Figs. 14, 15—Showing the anogenital papillae of *A. tubaeforme*; Dorsal (14), Lateral (15).  
 Figs. 16, 17—Showing the anogenital papillae of *Agriostomum vryburgi*; Dorsal (16), Lateral (17).  
 Figs. 18, 19—Showing the anogenital papillae of *Cyclodontostomum purvisi*; Dorsal (18), Lateral (19).

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