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# New Species of Monogenoidea from Fishes of Ceylon

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During the stay of the vessel " Ob " (Soviet Antarctic Expedition) at Colombo, May, 1957, I received from Dr. C. H. Fernando some specimens of different species of fishes from Ceylon, preserved in formalin, as a present for the Zoological Institute ( Academy of Sciences of the U. S. S. R.).

New species of Monogenoidea have been found when examining the gills of the fishes received and the present paper deals with their description.

The material was preserved in strong formalin which highly condensed the tissues of the parasites. Therefore the details of the anatomical structure in most of the specimens could not be recognized even by means of phase-contrasting equipment. So my description is confined almost exclusively to the chitinoid armature of the haptor and copulatory organ.

It would be greatly desirable to reinvestigate (in order to elucidate the morphology) all species described and to extend the investigation on to living specimens. It is all the more desirable, as hitherto no attention has been paid in Ceylon to the studies of Monogenoidea, though this interesting group must be richly represented there as in India.

The terms and the measurements used in this paper are the same as those used previously (Gussev, 1955).

It is a pleasant duty to express my sincere thanks to Dr. C. H. Fernando for presenting me with this most interesting material, to Professor P. Kirtisinghe for his assistance in publishing my work and to Professor B. E. Bychowsky for valuable recommendations and help in working out the collection.

## *DACTYLOGYRIDAE* BYCHOWSKY, 1933
## *DACTYLOGYRINAE* BYCHOWSKY, 1933

*Dactylogyrus curiosus* sp. n. Fig. 1.

Small worms 0.16–0.20 mm. in length, maximum body width 0.027–0.075 mm. Marginal hooks with well demarcated handle and pivot of handle, the tip of the handle is bulb-shaped ; their total length 0.018–0.023 mm. Anchors with well developed processes (roots) and a short straight point, abruptly turning into shaft ; total length 0.032–0.35 mm., length of the shaft about 0.021, of external process 0.007, of internal process 0.017, of point 0.009 mm. The single and only dorsal bar massive, of a V-shaped form unusual for the genus; its thickness about 0.003 mm., the length of lateral branches about 0.020 mm.

Copulatory organ consists of a hardly visible curved tube with a broader initial part ; its length about 0.021 mm., diameter of initial part 0.003 mm. No accessory piece has been discovered. Vaginal chitinoid armature has not been discovered.

Habitat and locality Gill filaments of **Rasbora daniconius** (Hamilton–Buchanan) ; neighbourhood of Colombo.

Two specimens studied and measured.

*Dactylogyrus saranae* sp. n. Fig. 2.

Small worms, length 0.09–0.14, width 0.033–0.052 mm. Haptor well set off from the body proper by an intake line ; its length is about 0.025 mm., width 0.027–0.033 mm. Pharynx rounded, its diameter 0.009–0.012 mm. Marginal hooks have well marked handle and pivot and a well developed " heel " of the point. Shape of the anchors is of the same type as in *D. wunderi* Bych. with well developed processes and a straight point ; their total length 0.025–0.033 mm., length of the shaft 0.017–0.019, external process about 0.002, internal process 0.011–0.013, point 0.011–0.013 mm. The single and only dorsal bar is nearly straight, slightly wider in the middle part and at the ends, its dimensions are 0.002–0.003 × 0.017–0.019 mm..

Copulatory organ consists of a hardly visible tube, 0.020 mm. long, with a diameter of 0.002, is slightly curved and has a short accessory piece in the shape of a curved chitinized bit. No vaginal armature has been found.

Habitat and locality : Gill filaments of *Puntius sarana* (Hamilton-Buchanan) ; Nugegoda and Meegoda. Six specimens have been studied and measured.

*Dactylogyrus daniconii*, sp. n. Fig. 3, 3*a*

Small worms with a swollen body, 0.15–0.20 mm. long and 0.07–0.09 wide. Marginal hooks have either a bulb-shaped handle or a simple one without any marked division-line between it and its pivot, their length is 0.012–0.016 mm.. Some of the specimens showed a strong deformation of marginal hooks which may be taken as a proof of their elasticity. Anchors are of the same type as in *D. wunderi* Bych. with well developed processes and a nearly straight point, which passes by an abrupt bend into the shaft ; total length 0.022–0.026 mm., length of the shaft 0.016–0.020 mm., external process 0.002–0.003 mm., internal process 0.007–0.009 mm., point 0.010–0.011 mm.. The single and only dorsal bar has a backwards curve in its middle part (V-shaped) and sometimes has a small membranous process in the middle part of its posterior border. Its size is 0.002–0.007 × 0.018–0.021 mm..

Copulatory organ consists of a tube and accessory piece supporting it. The tube is whip-shaped and makes a loop, with a hardly visible narrowing towards the end and a bubble-like protuberance in its initial part ; total length about 0.087 mm., diameter 0.001–0.002, at the initial part 0.007–0.008 mm.. Accessory piece has the appearance of a small curved lamella 0.010–0.015 mm. long.

Vaginal armature, a tube with a peculiar bubble-like widening at the end, has a length of up to 0.060 mm. and a diameter about 0.002 mm..

Habitat and locality : Gill filaments of *Rasbora daniconius* (Hamilton-Buchanan) ; Nugegoda.

Ten specimens have been studied and measured.

*Dactylogyrus aequipinnati* sp. n. Fig. 4.

Small worms 0.16–0.27 mm. long, 0.08–0.12 mm. wide. Marginal hooks have a ball-like or pointed end, short handle, very elastic ; on account of this in the majority of parasites studied hooks of the first to fifth pairs are very deformed ; they are 0.012–0.017 mm. long. Shape of the anchors are of *D. wunderi* Bych.-type with well developed processes and almost straight point, which turns into shaft by an abrupt bend ; their total length 0.022–0.0.26 mm., length of shaft 0:015–0.018, external process 0.001–0.002, inner process 0.009–0.010, point 0.010–0.012 mm.. The only dorsal bar is almost straight, without visible enlargement at the ends, its size 0.003–0.004 × 0.017–0.019 mm..

Copulatory organ consists of a tube and accessory piece. Tube is thin, curved loop-like, gradually narrowing towards the end, with a strongly enlarged, round initial part ; its total length 0.070–0.077, diameter 0.001–0.002 mm., diameter of initial part 0.007–0.009 mm.. Accessory piece is represented by a curved short lamella, 0.010–0.013 mm. long.

No vaginal chitinoid armature has been discovered.

Habitat and locality : Gill filaments of *Danio aequipinnatus* (Mc Clelland) ; Meegoda.

Seven specimens have been studied and measured.

*Dactylogyrus dorsalis* sp. n. Fig. 5.

Small worms, 0.18–0.20 mm. long, maximum body width 0.04–0.05 mm. Haptor is broader than the body proper, its size about 0.035 × 0.062 mm.. Pharynx almost spherical, about 0.012–0.014 mm. in diameter. Marginal hooks rough in form, with well marked handle and its pivot, but without a protruding " heel " of point. Hooks of sixth and seventh pairs differ from rest by more powerful point and the presence of finger-like " heel " protruding backwards. Length of marginal hooks 0 023–0.028 mm.. Anchors have very long straight shaft, short point and internal process ; their total length 0.040–0.043, external process no longer than 0.001, internal process 0.029–0.032, point 0.007–0.008 mm.. There are two bars. Unpaired ventral bar has X-like form, anterior branches 0.010, posterior ones 0.013 mm. in length, their thickness about 0.002 mm.. Twin dorsal bar is made of two V-shaped halves joined together, the size of each half 0.004–0.005 × 0.019–0.023 mm.. There is a pair of round, shining glandular formations between the anchors.

Testis round, small, placed behind ovary in posterior third of body. The ovary is elongated, almost tube-like, it is three or four times as long as broad. Copulatory organ consists of a tube and accessory piece. Tube bent in the form of a ring with widened initial part ; its length about 0.040, diameter of middle part less than 0.001, initial part 0.002–0.003 mm.. Accessory piece has the form of a round, disk-shaped plate, its size 0.013–0.020 mm..

Vaginal chitinoid armature in the form of a spiral-twisted tube about 0.045 mm. long and 0.001 mm. in diameter, located near the testis.

Habitat and locality : Gill filaments of *Puntius dorsalis* (Jerdon) ; Meegoda.

Seven specimens have been studied and measured.

Doubling and situation of parts of dorsal joining bar of this species and the following one are characteristic of the representatives of the genus **Dactylogyroides** described below. Nevertheless, in contrast to the latter, the presence of one testis leads me to include these two species in the genus **Dactylogyrus** pending their detailed study. Whether this is correct or not, they are morphologically transitional from **Dactylogyrus** to **Dactylogyroides.**

*Dactylogyrus fernandoi* sp. n. Fig. 6.

Small worms 0.16–0.18 mm. long and 0.05–0.07 mm. wide. Haptor set off from the body proper by a slight intake ; its size is 0 030 × 0.060 mm.. Marginal hooks with clearly marked handle and its pivot and projecting "heel" of point ; their total lengths are 0.016–0.025 mm.. Anchors have well developed internal process and a short point ; the external process is missing or concealed beneath the anchor ; their total length amounts to 0.028 mm., shaft is 0.020, internal process 0.011, point 0.008 mm. long. There are two bars ; the ventral bar is unpaired, it has the appearance of a simple stick lying across the haptor ; its size being 0.001 × 0.021 mm.. Dorsal bar is twin, each of the halves being 0.003 × 0.018 mm..

Copulatory organ consists of a tube and accessory piece. Tube is spirally curved, broader at the beginning and tapering towards the end, with a length about 0.050 mm., diameter 0.003 mm. in the initial part and less than 0.001 mm. in the middle part. Structure of accessory piece not examined. No vaginal chitinoid armature has been discovered. Two of the specimens examined had eggs, 0.048 × 0.035 mm. in size.

Habitat and locality. Gill filaments of *Puntius dorsalis* (Jerdon) ; Meegoda.

Four specimens have been studied and measured.

This species named in honour of the Ceylon scientist Dr. C. H. Fernando.

**Dactylogyroides** gen. n.

*Dactylogyroides macracanthus* (Tripathi, 1959) Fig. 7, 7*a*, 7*b*.

Small worms 0.12—0.17 mm. long and 0.04—0.06 mm. wide. Body with nearly parallel running side edges, slightly narrowing to the front and towards haptor. The latter is wide, short, its size is 0.023—0.030×0.062—0.080 mm.. Pharynx round, about 0.01mm. in diameter. There are three elongated testes lying transversely across the body, one behind the other.

Ovary rounded. Vaginal pore is in the middle of the right hand side of the body.

Marginal hooks with well marked handle, pivot of handle and a projecting "heel" of point, are 0.013—0.019 mm. long. Anchors, with small but well developed processes and a short curved point, have a total length 0.029—0.036 mm., length of shaft 0.021—0.025, external process 0.003, internal process 0.010—0.014, point 0.008—0.010 mm.. There are two bars, which lie one over the other. Ventral bar bracket-shaped, its free ends turning forward and the middle widening; its branches have a thickness of about 0.001mm., the greatest distance between the same being 0.022—0.026 mm.. Dorsal bar is double, both its halves lying at an angle to each other in the shape of V; a membranous short process goes from the joining place of the halves of the bar, curving towards the ventral side; each half of the bar is about 0.004 mm. thick and 0.019—0.025 mm. long.

Copulatory organ consists of a tube and accessory piece. Tube is Γ-shaped, with thick walls, a widened initial part, slightly tapering towards the end, its length 0.029—0.035 mm., diameter of the middle part about 0.002 mm.. Accessory piece consists of two thin membranous plates, entering at an angle into each other. The end plate has a short thorn-like process and an opening for the passing through of a tube. No vaginal chitinoid armature has been discovered.

Habitat and locality: Gill filaments of *Puntius filamentosus* (Valenciennes), *P. malenamphys sinhala* (Duncker), *P. sarana* (Hamilton-Buchanan); Nugegoda. Tripathi (1959) noted the presence of this species on *P. ticto* and *P. stigma* in Indian (locality ?) ponds.

About 50 specimens have been examined (15 were measured).

There are apparently some misprints in table 4 published by Tripathi showing the measurements of new species of *Dactylogyrus*. For *D. macracanthus* for instance, the length of parasites (0.406—0.68 mm.) in the table shown by him is too big, as in the plate given by him it is 0.22 mm. only; length of bar in the table is shown as being 0.10 mm., while on the plate it is 0.040 mm., length of copulatory organ is indicated to be 0.09 in the table and on the plate it is 0.030 mm.. Data taken from Tripathi's plate coincide fully with ours.

*Dactylogyroides vittati* sp. n. Fig. 8.

Very small worms 0.08—0.12 mm. long and 0.048 mm. wide. Body fusiform. Haptor well set off from the body proper, its size 0.023×0.039—0.044 mm.. Pharynx round with a diameter about 0.009 mm.. Marginal hooks have well marked handle, pivot of handle and "heel" of point are 0.012—0.020 mm. long. Anchors have a very long internal process, a short external one and a straight point abruptly bending into shaft. Their total length is 0.012—0.028 mm., length of shaft 0.012—0.015, external process not over 0.001, internal process 0.012—0.014, point 0.007—0.009 mm.. There are two bars, a ventral one is a thin stick lying across haptor, its size being 0.001—0.002 × 0.013—0.018 mm.. Dorsal bar double consists of two inter-connected, V-shape plates thickened at their ends; each half having the size of 0.003—0.004 × 0.013—0.018 mm.. Two round brilliant glandular formations lie between anchors on their ventral side and another single elongated one lies across haptor just in front of the bar. Three testes are in the posterior third part of the body lying one behind the other and preceded by ovary. Vaginal pore opens on right-hand side at the level of ovary. Neither chitinoid armature, of copulatory organ nor of vaginal duct, has been discovered.

Habitat and locality: Gill filaments of *Puntius vittatus* Day; neighbourhood of Colombo.

Twenty specimens have been examined (10 were measured).

*Dactylogyroides bimaculati* sp. n. Fig. 9.

Small worms about 0.12 mm. long and 0.04 mm. wide. Marginal hooks in first 5 pairs (1—5) and of the 7th pair have a well marked handle, pivot of handle and " heel " of point ; hooks of the 6th pair roughly-shaped, the handle without marked sections, the " heel " of the point finger-shaped and directed backwards, and a big strong point nearly 1.5 times bigger than the points of the rest of marginal hooks. Length of marginal hooks 0.013—0.019 mm.. Anchors with a well developed internal process, a small external one and a small point passing gradually into shaft ; total length of anchors 0.021—0.025 mm., of shaft 0.012—0.014, external process 0.002, internal process 0.010—0.012, point 0.004—0.006 mm.. There are two bars ; ventral bar unpaired, curving backwards in the middle, 0.001 × 0.013 mm. size. Dorsal bar is double consisting of two massive pieces connected with each other ; each of the halves is of 0.003—0.004 × 0.013—0.014 mm. size.

Copulatory organ consists of nearly invisible tube and accessory piece. Tube with thin walls is nearly straight ; its size is 0.010—0.012 × 0.001—0.002mm.. Accessory piece has the appearance of a soft plate. No vaginal armature has been discovered.

Habitat and locality : Gill filaments of *Puntius bimaculatus* (Bleecker) ; Meegoda.

Nine specimens have been studied and measured.

The material collected by me on the above described species of Monogenoidea of the genera **Dactylogyrus** and **Dactylogyroides** though not very large is still of great interest in many respects. Thus, no one representative of the genus **Dactylogyrus** known hitherto has a dorsal bar of such type as in *Dactylogyrus curiosus* and marginal hooks with bulb-like handle as in *D. curiosus* and *D. aequipinnati*. The fact of dismemberment of dorsal bar in *D. dorsalis* and *D. fernandoi* is very interesting as well. A similar process of dismemberment of bars has been going on in different independent groups—in Ancylodiscoidinae, Ancyrocephalinae, Diplectanidae (see below) and others.

The presence of three testes in the three described species of **Dactylogyrus** is unusual not for **Dactylogyrus** only, but for all **Dactylogyridae** also. This characteristic together with the peculiarities of structure of chitinoid armature of haptor were taken as bases for the formation of a new genus.

The diagnosis of the new genus **Dactylogyroides** will be as follows.

**Dactylogyroides** gen. nov.

Dactylogyridae ; Dactylogyrinae. Body flattened, elongated. There are two pairs of the cephalic lobes and four eye-spots. Haptor set off from body proper, with seven pairs of marginal hooks, one pair of anchors and two bars : unpaired ventral and paired dorsal. Haptor is provided with very well developed system of glands, which form sometimes two round transparent bodies ; one situated in the centre from the side of anchors and another elongated across the haptor in front of bars. Intestine bifurcate and the crura confluent posteriorly as in **Dactylogyrus.** Testes three, situated one behind the other in front of posterior intestinal arch. Ovary round or elongated, massive, lying in front of testes. Vaginal pore opens on the right side. Parasites on gills of fresh water fishes of South Asia.

Genotype : **D. macracanthus** (Tripathi, 1959).

## *ANCYLODISCOIDINAE* A. GUSSEV, 1961

*Ancylodiscoides jaini* sp. n. Fig. 10, 10*a*.

Small worms, 0.13–0.18 mm. long and 0.06–0.08 mm. wide. Pharynx rounded, about 0.015 mm. in diameter. Haptor broad, projected forward on dorsal side almost to the level of testes. There are seven pairs of marginal hooks of embryonal type (very thin, with small finger-like " heel " of point) their length 0.012–0.014 mm.. Dorsal anchors are of the same type as in *A. siluri* (Zandt, 1924), with well developed internal process* and sabre-shaped large point, their total length0.033–0.041 mm..

*In one of investigated specimens there is a small outer root 0.001 mm. long.

length of shaft 0.022–0.030, internal process 0.009–0.012, point 0.020–0.023 mm.. Additional supporting bars (near the internal process of dorsal anchors) are feebly curved, their size 0.003- 0.004 × 0.010–0.012 mm.. Dorsal bar curves backwards in its middle part with widening and obliquely cut ends; its size 0.002–0.004 × 0.023–0.027 mm.. Ventral anchors with straight point, disposed at an angle of 90° to the axis of shaft; base of anchors is broad; their total length 0.013–0.016 mm., length of shaft 0.012–0.014, external process 0.002–0.003, internal process 0.004–0.006, point 0.015–0.017 mm.. Ventral bar is double, thin, usually ~-shaped; its division into two portions is incomplete; in the majority of investigated specimens, between inner tapering ends of its right and left pieces a long thin ligament is present, reflecting light as well as showing chitinoid formations. The size of each piece (to the ligament) 0.002–0.003 × 0.029–0.033 mm..

Testis oval, about 0.007 × 0.010 mm.. Copulatory organ consists of tube and accessory piece. Tube with enlarged initial part, feebly narrowing to end; its length 0.023–0.031, diameter of initial part about 0.004, middle part 0.0015 mm.. Accessory piece in the shape of two plates, joined at the beginning, then diverging, with curved ends meeting each other; its length 0.021–0.029 mm.. Ovary stretches along longitudinal axis of body, its size about 0.011 × 0.009 mm.. Vaginal duct opens on the left side of body; it is armed with short chitinoid tube about 0.010 mm. long and 0.002 mm. in diameter.

Habitat and locality: Gill filaments of *Macrones keletius* (Valenciennes); Nugegoda.

Fourteen specimens have been studied and measured.

This species is named in honour of the Indian scientist Prof. S. L. Jain.

## *ANCYROCEPHALINAE*. BYCHOWSKY, 1937

### **Ancyrocephalus** (s. l.) Creolin, 1839

In this, without any doubt, combined genus we include for the present Dactylogyridae, having in general features similar anatomical structure to **Dactylogyrus** and **Ancylodiscoides,** provided with seven pairs of marginal hooks (with well developed handle or small of embryonal type), two pairs of anchors and two similar bars.

In 1934 Mueller suggested the retention of this name only for marine species and described two new genera from fresh-water fishes of North America. Eight new genera were described during the following six years. The main feature was considered to be the situation, presence or absence of the vaginal duct. However, the latter was not always and at once found, and it happens sometimes that in different specimens of one species the vaginal duct opens either from the right or from the left. Because of this, species were frequently transferred from one genus to another. Such formal method of approach has led to confusion in this group of Monogenoidea. During the following years the confusion has increased as a number of investigators described many genera of Monogenoidea belonging to the group of **Ancyrocephalus** (s. l.). Besides, to the " genera " belonging to the group **Ancyrocephalus** s. l., some species were erroneously referred, e.g. *Ancylodiscoides gomtius* (Jain, 1952) described as *Haplocleidus gomtius, A. vachi* (Tripathi, 1959) described as *Haplocleidus vachi* and *A. vachius* (Jain, 1961), described as *Urocleidus vachius* and so on (see Gussev, 1961).

Inaccuracy and direct mistakes in determinations and descriptions of different species and genera of this group were noticed by Bychowsky (1957). I am, therefore, compelled to refer the species described below to **Ancyrocephalus** s. l. till the revision of the morphology and taxonomy of Ancyrocephalinae.

### *Ancyrocephalus* (s. l.) *esomi* sp. n. Fig. 11.

Small worms 0.13—0.18 mm. long and 0.03—0.044 mm. wide.

Body elongated. Cuticula forms a ring of wrinkles going out slowly from haptor to anterior end. Haptor is slightly constricted off from body proper. Marginal hooks with well marked handle and pivot of handle and projected " heel " of point; they are 0.015—0.020 mm. long. Anchors of unequal size and shape. Dorsal anchors are bigger than ventral ones, with well developed internal

process and small external one, with straight point, by steep bend turning into shaft; their total length about 0.027 mm.. length of shaft 0.019, external process 0.002, internal process 0.008, point 0.009 mm.. Ventral anchors with straight point, gradually turning into curved shaft; their total length about 0.017 mm., length of shaft 0.010, external process 0.002, internal process 0.007, point 0.010 mm.. Bars slightly curved, without thickening, with ends bent backwards; size of dorsal bar 0.001—0.002 × 0.020 mm., ventral one 0.001—0.002 × 0.018 mm..

Copulatory organ large, consists of tube and accessory piece. Tube is thick-walled, with enlarged initial part, forms loop-like crook at the beginning, almost straight afterwards; its length up to 0.050, diameter of middle part from less than 0.002 to less than 0.003 mm., size of initial part 0.010 × 0.005 mm.. No vaginal chitinoid armature has been discovered.

Habitat and locality: Gill filaments of *Esomus danrica* (Valenciennes); Nugegoda.

Three specimens have been studied and measured.

*Ancyrocephalus* (s. l.) *heteranchoris* sp. n. Fig. 12, 12*a*, 12*b*.

Small worms 0.15—0.20 mm. long, 0.058—0.084 mm. wide. Marginal hooks with well marked handle, pivot of handle and a well developed "heel" of point, they are 0.015—0.021 mm. long. Dorsal anchors are two to three and a half times bigger than the ventral ones; they are massive, with a big internal process and a small external one with a gently curving point; total length 0.026—0.036 mm., length of shaft 0.026—0.036, external process 0.002—0.004, internal process 0.009—0.013, point 0.009—0.010 mm.. Ventral anchors have well developed internal process, no external one, the point being straight and thin; their total length is 0.011—0.015 mm., length of shaft 0.005—0.010, internal process 0.005—0.006, point up to 0.007 mm.. Dorsal bar is slightly curving backwards in its middle part with widened ends, its size being 0.002—0.004 × 0.022—0.035 mm. Ventral bar is ∪∪- shaped, its size is 0.001—0.003×0.015—0.019 mm..

Copulatory organ consists of a tube and accessory piece. Tube is spirally twisted, wide in its initial part tapering to end, its length being up to 0.080 mm., diameter of initial part 0.003—0.004 and in the middle part about 0.001 mm.. Structure of accessory piece not seen clearly. No vaginal armature has been discovered.

Habitat and locality: Gill filaments of *Rosbora daniconius* (Hamilton-Buchanan); Nugegoda.

Seven specimens were examined and measured.

*Ancyrocephalus* (s. l.) *rasborae* sp. n. Fig. 13, 13*a*.

Small worms 0.15—0.17 mm. long and about 0.006 mm. wide. Haptor well set off from body proper, its size about 0.039 × 0.049—0.054mm.. Marginal hooks with well marked handle and pivot of handle and projecting "heel" of point; hooks of the seventh pair are of embryonal type with small spherical handle, their length 0.012—0.013 mm., length of others 0.014—0.019 mm. Dorsal anchors are somewhat smaller than ventral ones and differ in form from the latter; their thin straight point turns into the shaft by abrupt bend; their total length 0.027—0.029 mm., length of shaft 0.017—0.019, external process 0.002, internal process 0.010—0.013, point 0.006—0.008 mm.. Ventral anchors with sabre-shaped point, gently turning into shaft; their total length 0.033—0.035 mm., length of shaft 0.023—0.027, external process 0.004—0.007, internal process 0.012—0.014, point 0.007—0.008 mm. (boundary of the latter is accepted conditionally as the place most remote from end of internal process). Dorsal bar bends backwards in middle part, without widening, its size 0.002—0.003 × 0.023—0.027 mm.. Ventral bar almost straight, slightly wavy with widening obliquely cut ends; its size 0.004 × 0.021—0.026 mm..

Copulatory complex consists of spirally-shaped tube with a bubble-shaped initial part; length of tube 0.047 mm., diameter of initial part 0.006, middle part 0.001 mm.. No accessory piece has been discovered. Vaginal chitinoid armature has not been discovered.

Habitat and locality : Gill filaments of *Rasbora daniconius* (Hamilton -Buchanan) ; locality is unknown.

Five specimens have been studied and measured.

*Ancyrocephalus* (s.l.) *daniconii* sp. n. Fig. 14.

Small worms 0.14—0.23 mm. long and 0.05—0.08 mm. wide. Haptor set off from the body proper by slight intake, its size 0.029—0.035 × 0.039—0.045 mm. Marginal hooks 0.012—0.016 mm. long with well marked handle and pivot of handle ; hooks of 6 and 7th pairs are of embryonal type with ball-shaped handle. Dorsal anchors are somewhat smaller than ventral ones and differ from the latter in shape. Their total length 0.017—0.019 mm., length of shaft 0.014—0.016, external process 0.002, internal process 0.006—0.008, point 0.006 mm.. Dorsal bar is band-like, curving backwards in its middle part, its size about 0.002—0.019 mm.. Ventral anchors with massive internal process and strong curved point ; their total length 0.023—0.026 mm., length of shaft 0.014, external process 0.004, internal process 0.013—0.015, point 0.008—0.010 mm.. Ventral bar more massive than dorsal one, with slightly enlarged ends ; its size about 0.004 × 0.020 mm..

Copulatory organ consists of tube and accessory piece. Tube spirally-shaped-with retort-shaped enlarged initial part. Its length about 0.032, diameter of initial part 0.006, middle part 0.001 mm.. Accessory piece in form of a membrane-like plate with wavy borders. Vaginal armature has not been discovered.

Habitat and locality : Gill flaments of *Rasbora daniconius* (Hamilton-Buchanan) ; locality is unknown.

Six specimens have been studied and measured.

*Ancyrocepahlus* (s.l.) *aequalis* sp. n. Fig. 15.

Small worms up to 0.20 mm. long and 0.06 mm. wide. Haptor well set off from the body, its size 0.039—0.048 × 0.049 - 0.058 mm.. Marginal hooks with well marked handle and pivot of handle and projecting " heel " of point ; their total length 0.013—0.019 mm.. Dorsal anchors somewhat smaller than ventral ones, are of the same form, with well developed processes and short thin point ; their total length 0.027—0.030 mm., length of shaft 0.015—0.018, external process 0.002—0.004, internal process 0.012—0.017, point 0.005—0.006 mm.. Total length of ventral anchors 0.031—0.035 mm., length of shaft 0.019—0.021, external process 0.005—0.006, internal process 0.015—0.017, point 0.005 mm.. Dorsal bar ⊔-shaped, without enlargement, its size 0.003—0.004 × 0.022—0.026 mm.. Ventral bar ∪∪-shaped, has slightly widening ends ; its size 0.003—0.004 × 0.021—0.023 mm..

Copulatory organ consists of tube and accessory piece. Tube loop-like, bent, with enlarged initial part, its length up to 0.050 mm., diameter of middle part 0.001 mm., size of initial part 0.010 × 0.005—0.007 mm.. Structure of initial part is not clear. Vaginal armature has not been discovered.

Habitat and locality : Gill filaments of *Rasbora daniconius* (Hamilton-Buchanan) ; locality is unknown.

Ten specimens have been studied and measured.

*Ancyrocephalus* (s.l.) *kirtisinghei* sp. n. Fig. 16, 16*a*.

Small worms 0.13—0.19 mm. long and 0.03—0.06 mm. wide. Haptor well set off from the body proper, its size 0.023—0.030 × 0.033—0.043 mm.. Marginal hooks with well demarcated handle and pivot of handle and projected " heel " of point ; they are 0.012—0.018 mm., long. Dorsal anchors considerably larger than ventral ones and of different form ; they have well developed internal

process, little external process and thin point, which is separated from shaft by steep bend ; their total length 0.025—0.028 mm., length of shaft 0.018—0.020, external process 0.001—0.002, internal process 0.010, point 0.010 mm.. Ventral anchors with well developed processes and straight thin point, which is situated at an angle of 90° or more to shaft of anchors ; their total length 0.012—0.015 mm., length of shaft 0.006—0.008, external process about 0.002, internal process 0.006—0.008, point 0.006—0.007 mm.. Dorsal bar slightly curved backwards by middle part, without enlargements ; its size 0.002—0.003 × 0.020—0.024 mm.. Ventral bar is almost of the same thickness but smaller ; its size about 0.003—0.017 mm..

Copulatory organ consists of spiral twisted tube and accessory piece, structure of which is not clear. Length of tube 0.055—0.066, diameter of enlarged initial part less than 0.003, middle part about 0.001 mm.. Vaginal armature has not been discovered.

Habitat and locality : Gill filaments of *Rasbora daniconius* (Hamilton-Buchanan) ; locality is unknown.

Four specimens have been studied and measured.

This species named in honour of the Ceylon scientist Prof. P. Kirtisinghe.

*Ancyrocephalus* (s.l.) *tripathii* sp. n. Fig. 17.

Small worms 0.16—0.18 mm. long and 0.05—0.07 mm. wide. Haptor well set off from. the body by an intake, its size 0.035 × 0.054 mm.. Marginal hooks with well marked handle and its pivot has a protruding " heel " of point ; their total length 0.012—0.017 mm.. Dorsal anchors are bigger than ventral ones and are of another shape ; they have a well developed internal process, a small external one and a short thin point merging into shaft with an abrupt twist ; total length 0.025—0.028 mm., length of the shaft 0.016—0.018, external process 0.001, internal process 0.010—0.012, point 0.005—0.006 mm.. Ventral anchors with well developed branches and a sabre-shaped point gently passing into shaft ; total length about 0.019 mm., length of shaft 0.010, external process 0.005, internal process 0.010, point 0.007 mm.. Dorsal bar curving backwards in its middle part widening slightly at the ends ; its size 0.003—0.028 mm.. Ventral bar is almost straight, thin ; its size 0.002 × 0.024 mm..

Tube of copulatory organ is spirally bent, widening in its initial part. Its length about 0.060 mm., diameter of initial part 0.004, middle part less than 0.001 mm.. An accessory piece was not observed. No vaginal armature has been found.

Habitat and locality : Gill filaments of *Rasbora daniconius* (Hamilton-Buchanan) ; locality is unknown.

Two specimens have been studied and measured.

This species named in honour of the Indian scientist Prof. Y. R. Tripathi.

*Ancyrocephalus* (s.l.) *danionis* sp. n. Fig. 18.

Small worms with fusiform body ; haptor well set off from the body. Their total length 0.013—0.019, breadth 0.05—0.88 mm.. Size of haptor 0.029—0.033 × 0.045—0.068 mm.. Marginal hooks with well marked handle and pivot of handle and with projecting "heel" of point ; their length 0.017—0.029 mm.. Dorsal anchors larger than ventral ones and are of another shape ; they have small processes and a short curved point ; their total length 0.027—0.033 mm., length of shaft 0.019—0.023, external process 0.003—0.004, internal process 0.008—0.010, point 0.005—0.006 mm.. Ventral anchors with processes set at a distance from each other and with sabre-shaped point ; their total length 0.018—0.022 mm., length of shaft about 0.013, external process 0.004, internal process 0.008, point 0.008—0.010 mm.. Both bars faintly curved backwards at the middle part and at the ends ; dorsal bar with a widening middle part ; its size 0.003—0.004 × 0.023—0.025 mm., size of ventral bar 0.003 × 0.021—0.023 mm..

Copulatory organ consists of tube and accessory piece. Tube sickle-shaped with a widening initial part and cylindrical for the rest of its length ; its length about 0.045, diameter of initial part 0.005, cylindrical part 0.001 mm.. Accessory piece has the shape of two bands, outstretching from the base of tube. Vaginal chitinoid armature has not been discovered.

Habitat and locality : Gill filaments of *Danio aequipinnatus* (McClelland) ; Meegoda.

Forty specimens have been studied (ten were measured).

*Ancyrocephalus* (s.l.) *etropli* sp. n. Fig. 19.

Very small worms 0.10—0.13 mm. long and 0.06 mm. wide. After fixation and strong shrinking caused by it, the body is egg-shaped. Haptor is marked from body by an intake ; its size is about 0.030—0.050 mm.. Marginal hooks are of dactylogyrusoid type, 0.011—0.017 mm. long. The first 5 pairs of hooks (from 1 to 5) have a handle clearly discernible and marked from its pivot ; the 6th and 7th pairs of hooks are of embryonal type. Anchors are similar in size and shape with small processes and points. Total length of dorsal anchors 0.026—0.031 mm., length of shaft 0.023—0.025, external process 0.001—0.002, internal process 0.005—0.007, point 0.004 mm.. Total length of ventral anchors 0.026—0.030 mm., length of shaft 0.023—0.026, external process 0.002, internal process 0.005—0.006, point 0.004 mm.. Bars are similar in length and shape ; the ventral bar having ends more curved backwards than the dorsal one and its middle slightly bent in the same direction. Their size is 0.003 × 0.023—0.025 mm..

Copulatory organ consists of a tube and accessory piece. The tube long and thin, with a widening in the initial part, twisted in a spiral. In prepared specimens it is difficult to see it, for which reason I was unable to observe its total length. Its diameter in the initial part is about 0.004, elsewhere in total length it is less than 0.001 mm. Accessory piece is a very peculiar shape—a three-branched plate about 0.021 mm. long. There is a thin vaginal tube which I failed to observe in all its length.

Habitat and locality : Gill filaments of *Etroplus suratensis* (Bloch) and *E. maculatus* (Bloch) ; Colombo vicinity.

Ten specimens have been studied and measured.

*Ceylonotrema colombensis* gen. et. sp. n. Fig. 20, 20*a*.

Small worms 0.11—0.17 mm. long by 0.07—0.10 mm. in maximum body width. Their bodies appear to have shrunk considerably after fixation. Body has parallel running lateral edges and a cone-shaped anterior end.

Haptor is wider than body proper, its size 0.05 × 0.014—0.017 mm.. Body is entirely covered with small oval " scales " visible on dorsal side of the posterior end of the body. Haptor armature consists of fourteen marginal hooks, two pairs of anchors, single dorsal bar (unpaired) and a pair of ventral bars. Marginal hooks are of the same type as in most **Dactylogyrus** spp. with well developed handle and a marked off pivot of handle. The first five pairs of hooks (from the 1st to the 5th) are thin and have a protruding " heel " ; hooks of the 6th pair are embryonal type ; hooks of the 7th pair are short, thick, with a large handle tapering towards the end. Hooks of the first five pairs are 0.030—0.050 mm. long, those of the sixth about 0.012 and seventh pair 0.030—0.035 mm.. Anchors are of **Dactylogyrus** type having well developed roots and gently curving sabre-shaped point. Dorsal anchors have a shape similar to that of ventral anchors; their total length is 0.030—0.035 mm. (this may be inaccurate as their unfavourable position on the slides precluded great accuracy in taking their dimensions) ; length of shaft 0.020—0.025, external process 0.005, internal process 0.017,

point about 0.020 mm.. Dorsal bar wavy, thickening in the middle, tapering towards the ends which run to the dorsal side of haptor, its size being 0.006—0.008 × 0.070 mm.. Total length of ventral anchors 0.031 mm., length of shaft 0.027, external process 0.005, internal process 0.010, point 0.011 mm.. Ventral bars approach each other and are enlarged in their middle part; their size being 0.055—0.070 × 0.006—0.009mm..

The conical anterior extremity of body has bunches of three pairs of head-gland-ducts. Two pairs of eye spots, represented by accumulations of pigment granules, of which the anterior ones are small and those behind them are large with brilliant lenses in each eye; they are placed anterior to the pharynx. The latter is rounded, its diameter is 0·016—0·020 mm., caeca ordinary, with no lateral branching, both branches joining behind testis. Testis round or triangular, is almost entirly covered by the posterior part of ovary. Copulatory organ consists of a tube and accessory piece. Tube is sickle-shaped, wide at the beginning, but nearly cylindrical for the rest of its length; its total length is about 0·022 mm., diameter in the initial part 0·007 and in middle part a little over 0·002 mm.. Accessory piece appears to be curved in the shape of "S", but is hard to distinguish, a receptacle of prostate glands lies to the left of copulatory organ. Ovary is egg-shaped, widened in front and narrowed behind. Vaginal canal is hardly distinguishable, appearing only as a clearing in the vitellaria field; it begins at the level of the anterior part of ovary, opens as a pore on the right side end of the body, while its other end enters into the round receptaculum seminis which lies beneath the ovary.

Habitat and locality: Gill filaments of *Etroplus suratensis* (Bloch); Colombo vicinity.

Three specimens have been studied and measured.

This species is of considerable interest owing to its many morphological peculiarities one of which renders it akin to one of the groups of the suborder of Dactylogyrinea, while others relate it to other groups. The structure of the cuticle, shaped like oval "scales" covering the whole body and clearly visible on dorsal side of the posterior part of body, disappearing gradually towards its anterior end, reminds us of the structure of the cuticle of Diplectanidae, whose body has a covering of real scales, cuticular papillae or spines (as for instance in Rhamnocercinae, Monaco, Wood and Mizelle, 1954). The general plan of armament disposition on the haptor is rather analogous to that of some Ancyrocephalinae (**Parancyrocephaloides** Yamaguti, 1938; **Pseudomurraytrema** Bychowsky, 1957; **Protogyrodactylus** Johnston et Tiegs, 1922) and Diplectanidae (**Murraytrematoides** Yamaguti, 1958), differing still in principle from them by its reversed positions of the paired and unpaired bars. In the above mentioned genera of Ancyrocephalinae and Diplectanidae the ventral bar is unpaired and the dorsal one is paired.

The disposition of these bars in **Ceylonotrema** is similar to that of **Ancylodiscoides** Yamaguti, 1937. Of course **Ceylonotrema** has no immediate genetic connection with the latter, as it presents another type of hooks, both the middle ones and partly the marginal; further the structure of its cuticle has a quite different pattern and it inhabits a different host group. Genus **Ceylonotrema** differs from Diplectanidae not only by the disposition of bars, but also by two more important factors: the dactylogyrusoid shape of anchors and marginal hooks, never found in Diplectanidae, and the shape of ovary, which in all kinds of Diplectanidae turns round the right caecum. The presence of these two features makes **Ceylonotrema** akin to the representatives of the group **Ancyrocephalus** s.l., several species of the latter having the same type of marginal hooks. Of course the dactylogyrusoid type of marginal hooks could appear in these for the second time as it happened apparently with some of the marginal hooks in **Bychowskyella** Achmerow, 1952, whose haptor armament is a further complication of chitinoid armature of **Ancylodiscoides** Yamaguti, 1937. The latter has embryonal type marginal hooks as is the case for the majority of Ancyrocephalinae and for all Diplectanidae. Still, the similarity of **Ceylonotrema** and **Ancyrocephalus** s.l. is not to be dismissed lightly. Probably the best and truest supposition will be that **Ceylonotrema** is connected immediately and genetically to **Ancyrocephalus** s.l., which has both bars unpaired and whose place is at the base of morphological rows of groups undergoing the process of gradual parcelling of bars leading to complete disappearance of the

same. An analogous process was observed in Diplectanidae (fig. 21) as also in Dactylogyrineae (see above p. 57). It is due apparently to the fact that manifold knee-joints ensure better moving-capacity of haptor than two knee-joints.

One morphological row includes the chain of **Parancyrocephaloides—Ancyrocephaloides—Protancyrocephalus,** another —**Ceylonotrema** (the remaining links of the chain being as yet unknown to us), while in the third row we find the chain of **Murraytrematoides**—Diplectanidae (partly)—**Murraytrema—Lobotrema—Pseudomurraytrema** and others.

It is interesting to note, that the process of change in structure of the chitinoid systems of haptor in Ancyrocephalinae and Diplectanidae is proceeding by different channels, in the first by means of parcelling of bars, while in the second it takes, in addition, the direction of a change of function of the single ventral bar. This last serves no more as a stay for ventral anchors in Diplectanidae (and in **Pseudomurryatrema** from Ancyrocephalinae), but gets to be a stay for dorsal bars as well, thus increasing pliability of haptor as a whole, and providing for its growth in width so that it envelops the gill filament, which would be impossible with the single bar without prejudice to its durability.

Parallel to this process there is another one going on at the same time in Ancyrocephalinae and Diplectanidae—the process of reduction of bars. In **Ancyrocephaloides** Yamaguti, 1938, these are very small, apparently losing their importance, while in **Protancyrocephalus** Bychowsky, 1957, they are completely missing.

As regards the question of the place of **Ceylonotrema** in the system, according to results of analysis made, it is only right and proper to put it as a new genus of the subfamily Ancyrocephalinae. Diagnosis of the genus is as follows.

**Ceylonotrema** n. gen. Ancyrocephaline, having a haptor with 14 marginal hooks, 4 anchors (of a dactylogyrusoid type), double ventral bar and single dorsal one, which are joined to the corresponding anchors. The intestine is bifurcate and the crura are confluent posteriorly. Testis single. Ovary simple, egg-shaped. Vagina opens on the right-hand side of the body.

Parasites of fishes fam. Cichlidae.

Genotype : *C. colombensis* sp. n.

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## EXPLANATION OF THE FIGURES

a—anchor, ah—armature of haptor, ap—accessory piece, c—copulatory tube, cc—copulatory complex, b—bar, da—dorsal anchor, db—dorsal bar, dv—dorsal view, $h^6$, $h^7$—marginal hooks 6 and 7, va—ventral anchor, vb—ventral bar, vt—vaginal armature (tube), vv—ventral view. The scale on the drawings (in those cases when its value is not given) is equal to 0.01 mm.

Fig. 1. *Dactylogyrus curiosus* sp. n.

Fig. 2. *Dactylogyrus saranae* sp. n.

Fig. 3. 3*a* *Dactylogyrus daniconii* sp. n.

Fig. 4. *Dactylogyrus aequipinnati* sp. n.

Fig. 5. *Dactylogyrus dorsalis* sp. n.

Fig. 6. *Dactylogyrus fernandoi* sp. n.

Fig. 7. 7*a*, 7*b*, *Dactylogyroides macracanthus* (Tripathi)

Fig. 8. 8*a* *Dactylogyroides vittati* sp. n.

Fig. 9. *Dactylogyroides bimaculati* sp. n.

Fig. 10. 10*a* *Ancylodiscoides jaini* sp. n.

Fig. 11. *Ancyrocephalus* (s. l.) *esomi* sp. n.

Fig. 12. 12*a*, 12*b* *Ancyrocephalus* (s. l.) *heteranchoris* sp. n.

Fig. 13. 13*a* *Ancyrocephalus* (s. l.) *rasborae* sp. n.

Fig. 14. *Ancyrocephalus* (s. l.) *daniconii* sp. n.

Fig. 15. *Ancyrocephalus* (s. l.) *aequalis* sp. n.

Fig. 16. 16*a* *Ancyrocephalus* (s. l.) *kirtisinghei* sp. n.

Fig. 17. *Ancyrocephalus* (s. l.) *tripathii* sp. n.

Fig. 18. *Ancyrocephalus* (s. l.) *danionis* sp. n.

Fig. 19. *Ancyrocephalus* (s. l.) *etropli* sp. n.

Fig. 20. 20*a* *Ceylonotrema colombensis* gen. et sp. n.

Fig. 21. Morphological series of the main armature of haptor of some genera of the sub-family Ancyrocephalinae and of the family Diplectanidae (schematic drawing). 1—*Ancyrocephalus* (s. l.), *Ancylodiscus*, *Tetrancistrum*, *Haliotrema*, 2—*Parancyrocephaloides*, *Pseudomurraytrema* Bychowsky, 1957 (nec Yamaguti, 1958), 3—*Ancyrocephaloides*, 4—*Protancyrocephalus*, 5—*Ceylonotrema*, 6—*Protogyrodactylus*, 7—*Murraytrematoides*, 8—*Murraytrema*, Diplectanidae (part), 9—*Lepidotrema*, 10—*Lobotrema*.

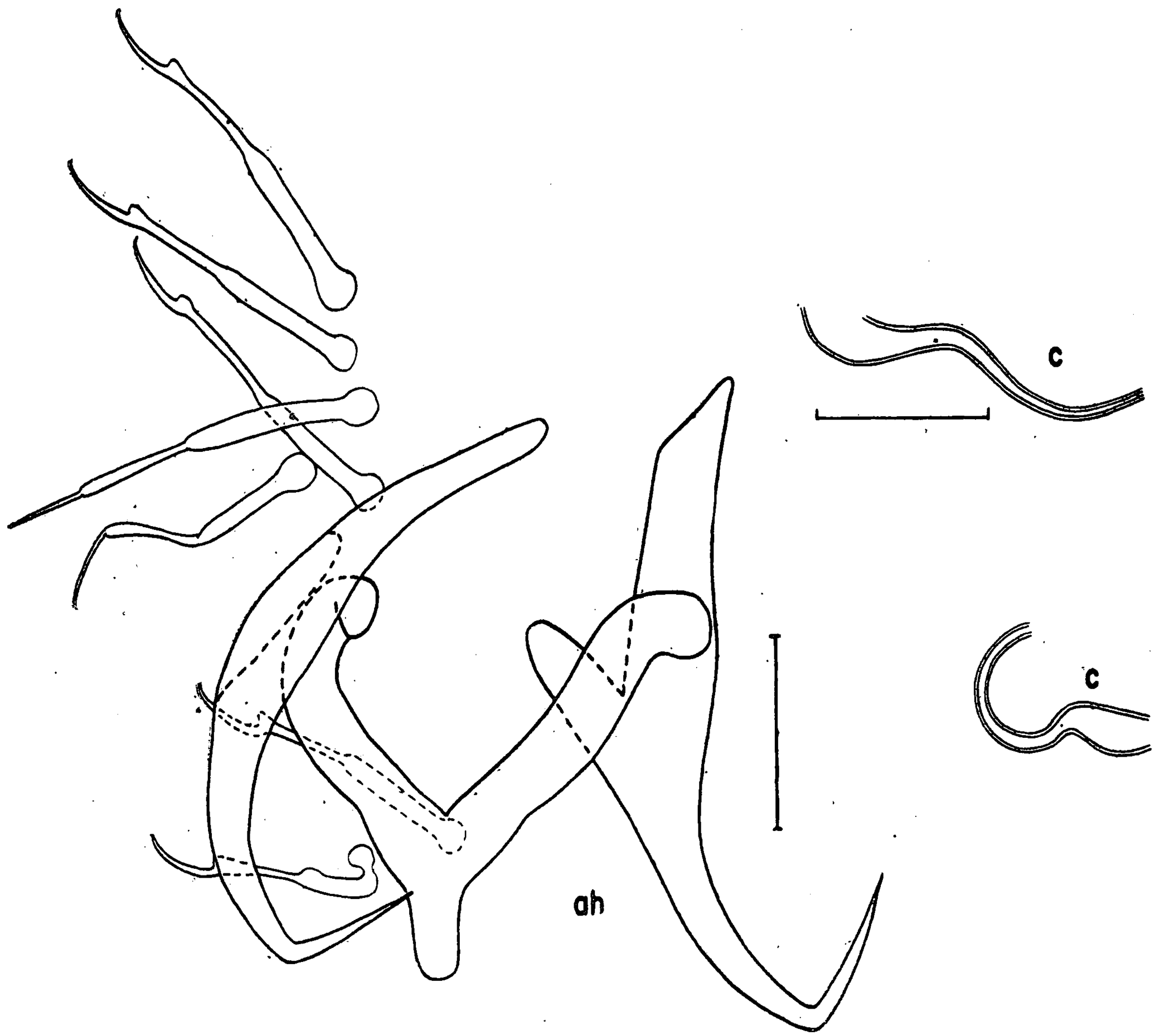



FIG. 1

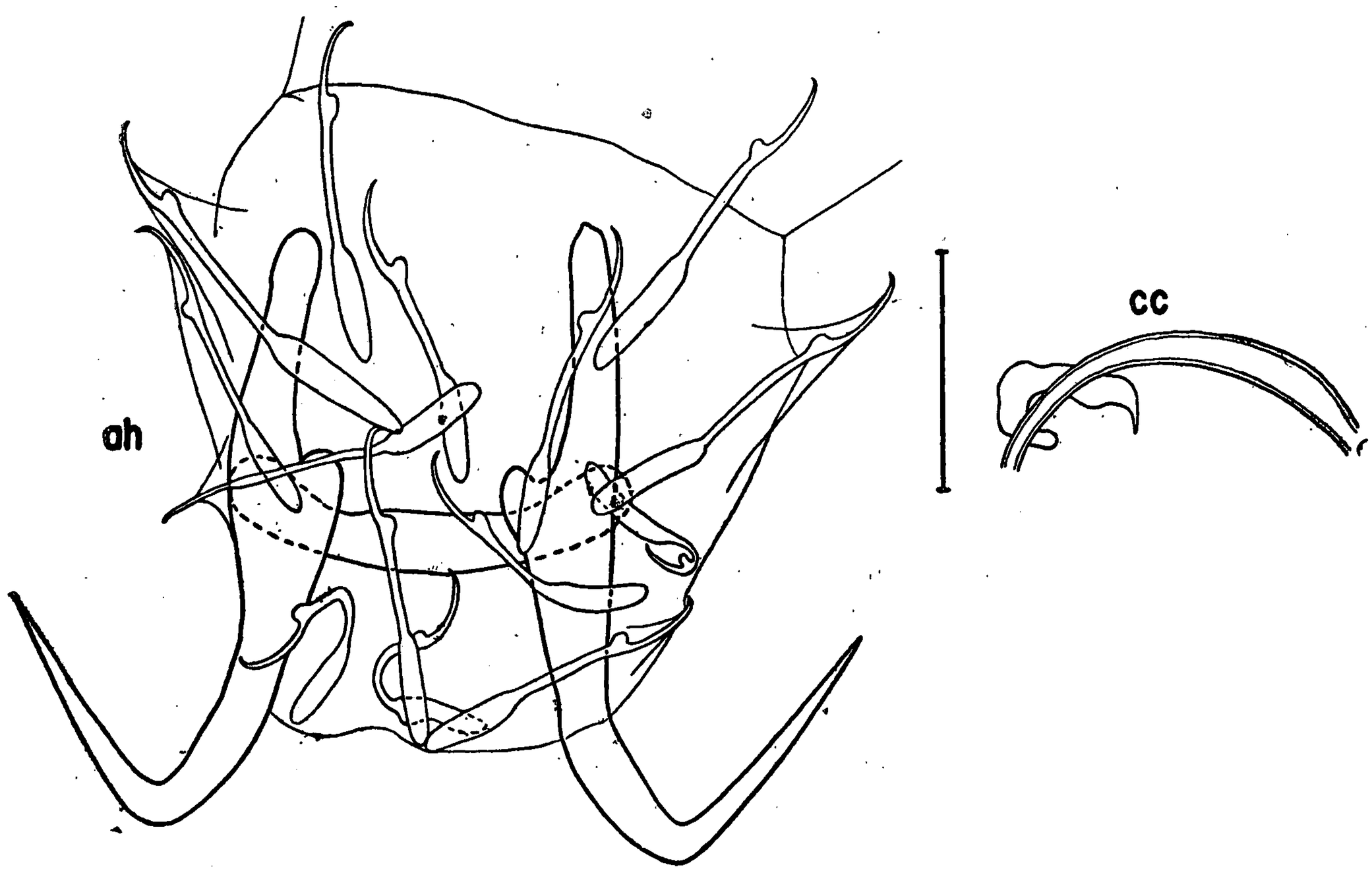



FIG. 2

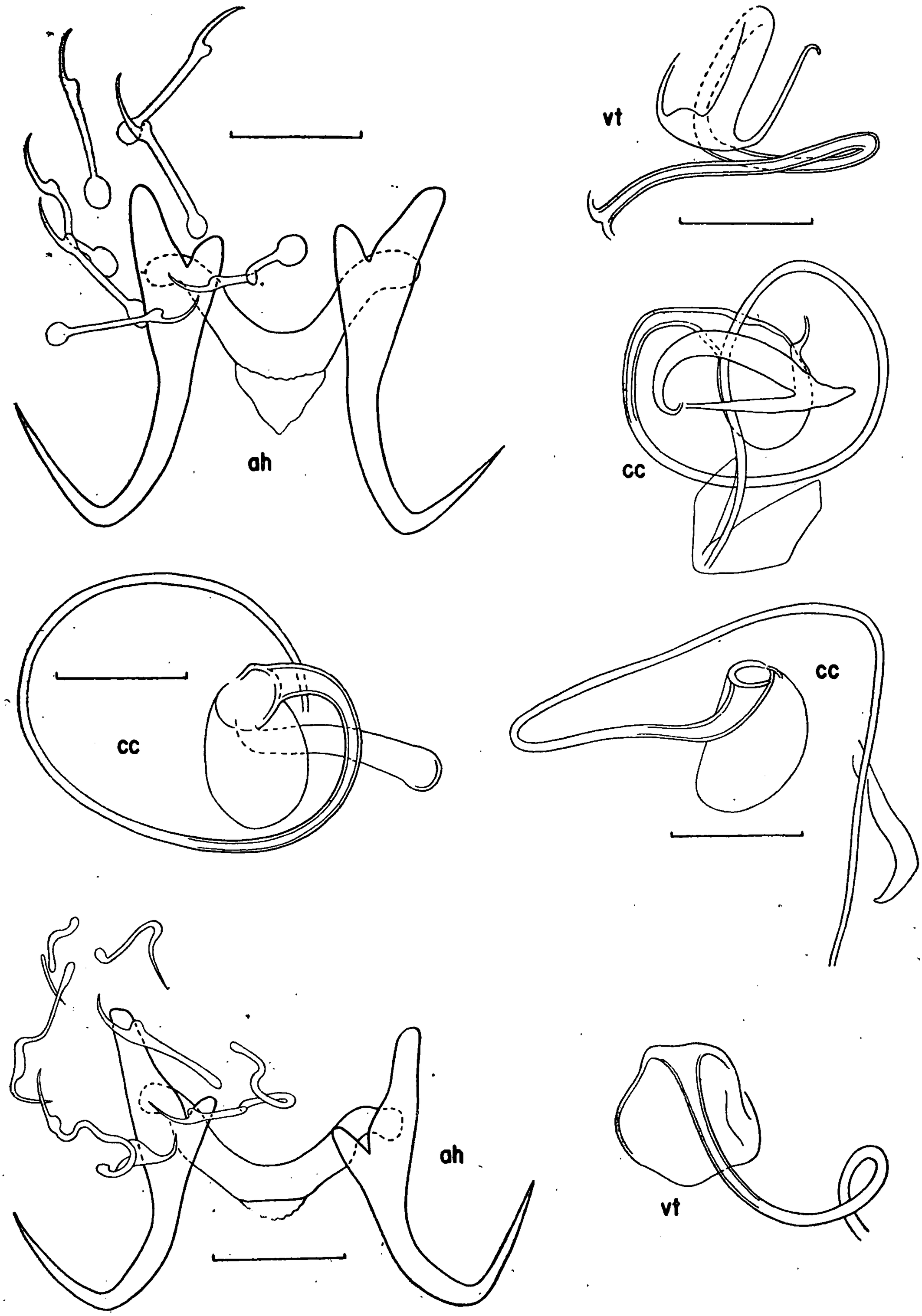
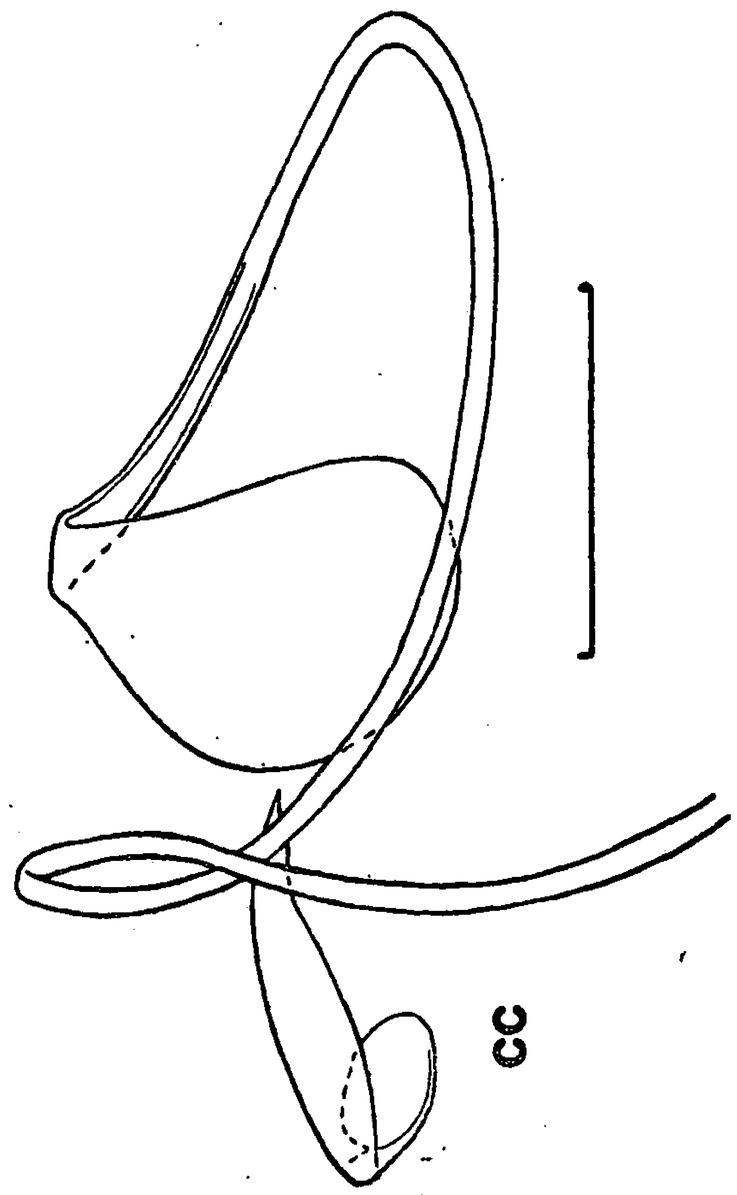



FIG. 3



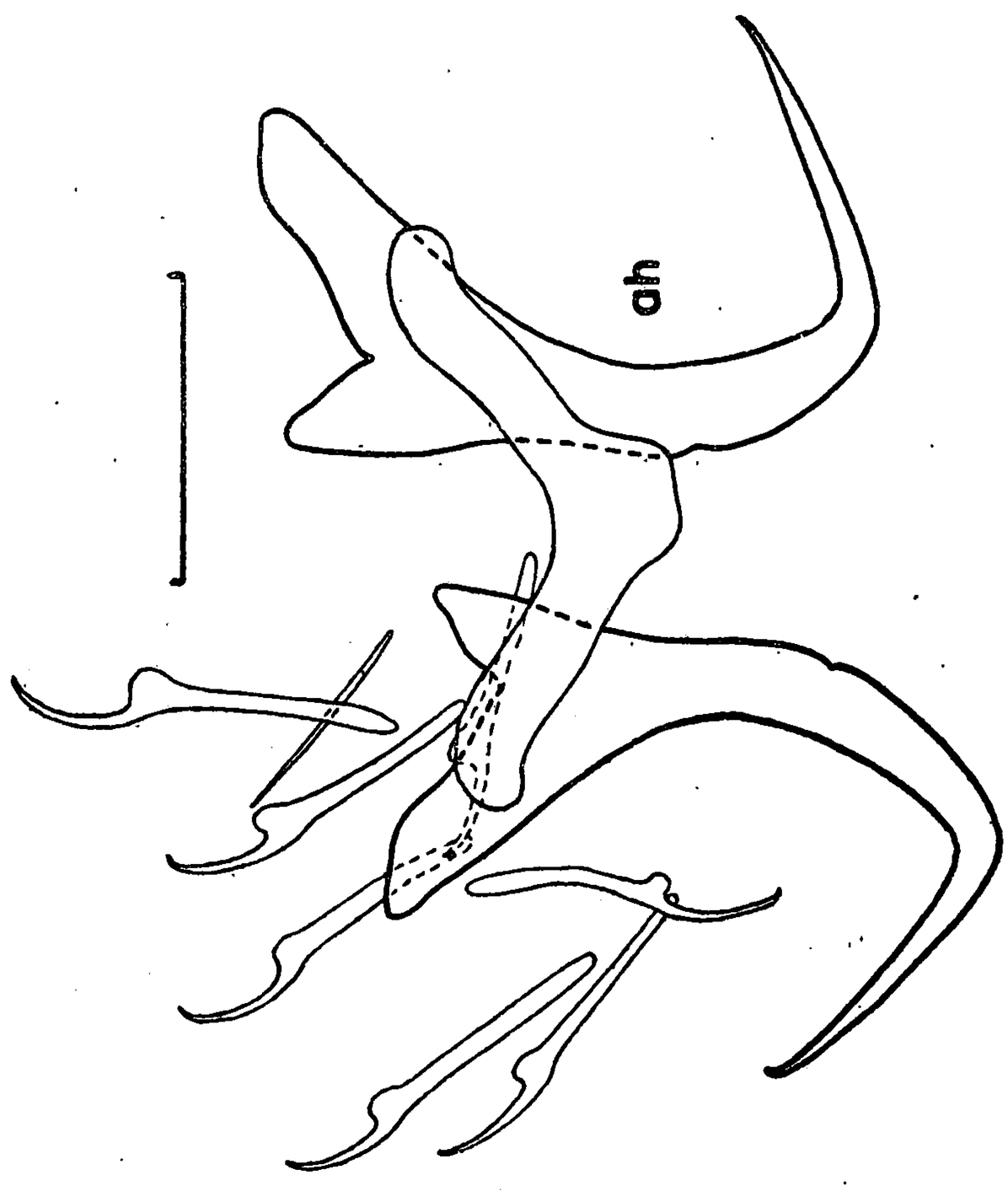




FIG. 3a

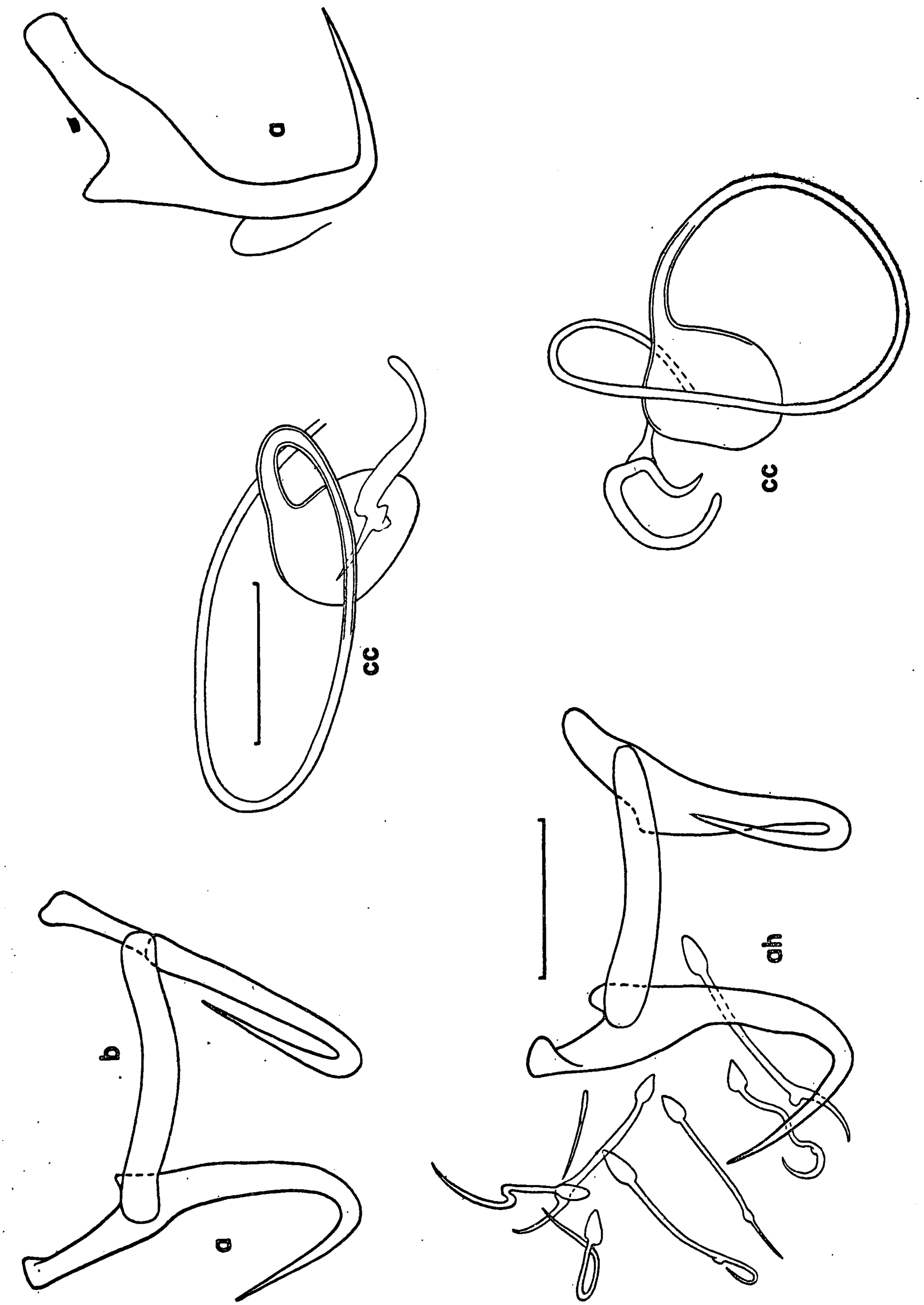
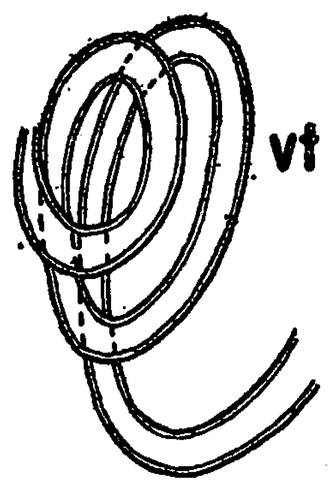
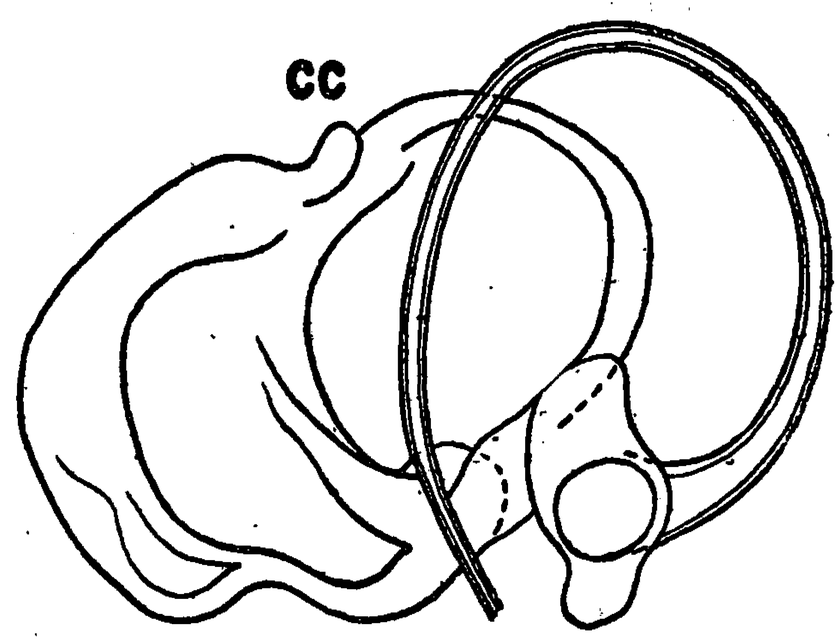



FIG. 4



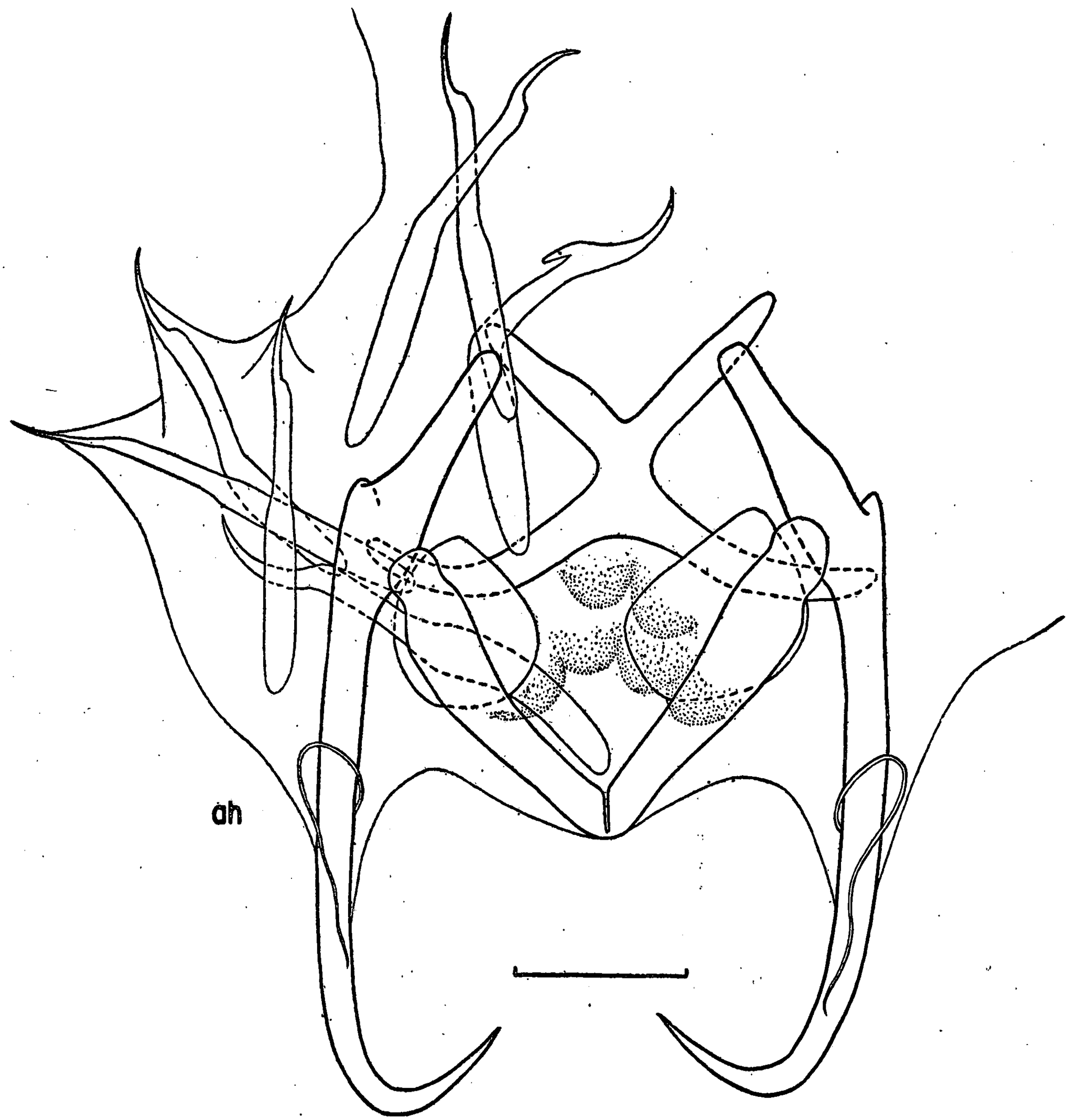




FIG. 5

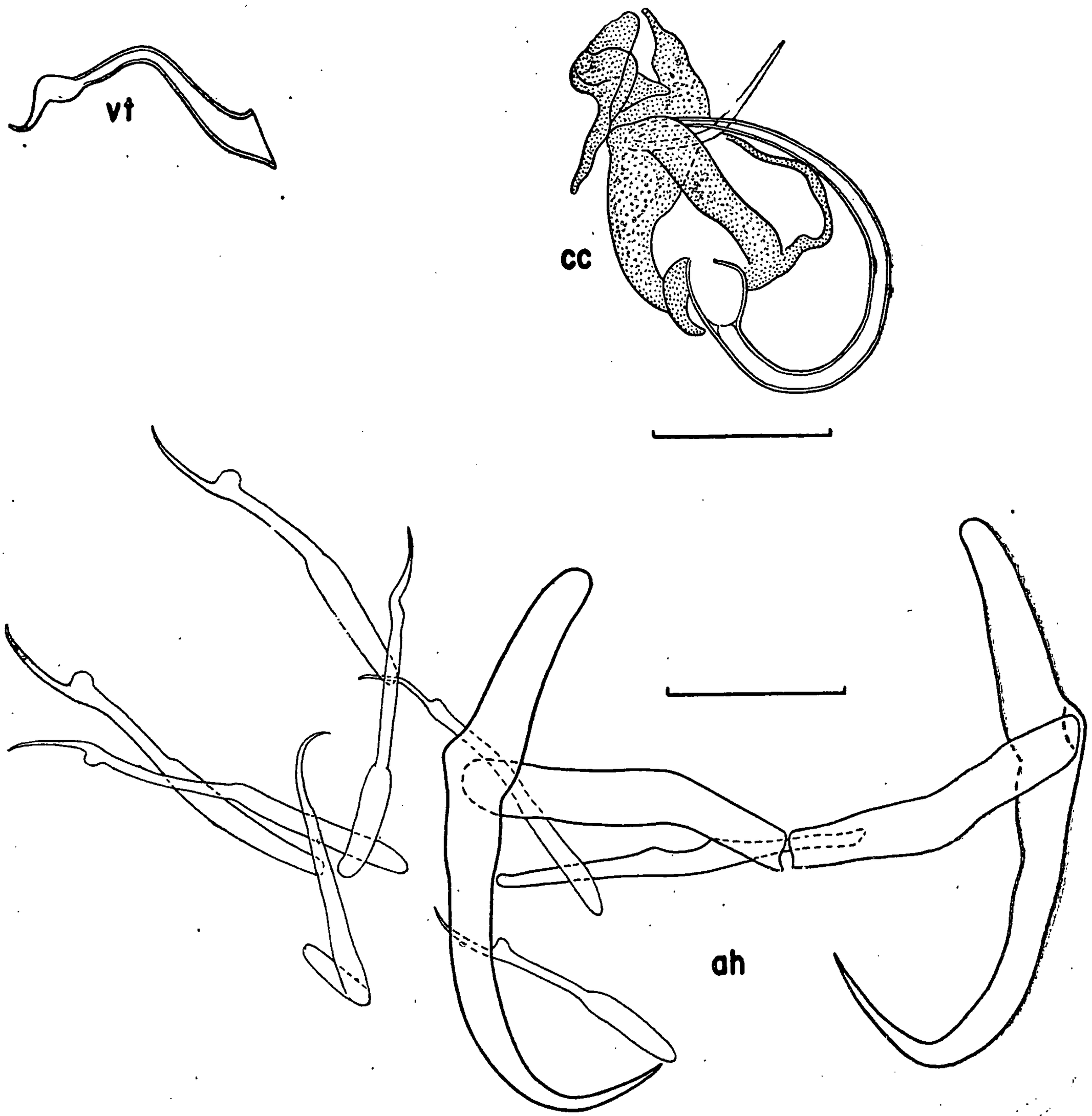



FIG. 6

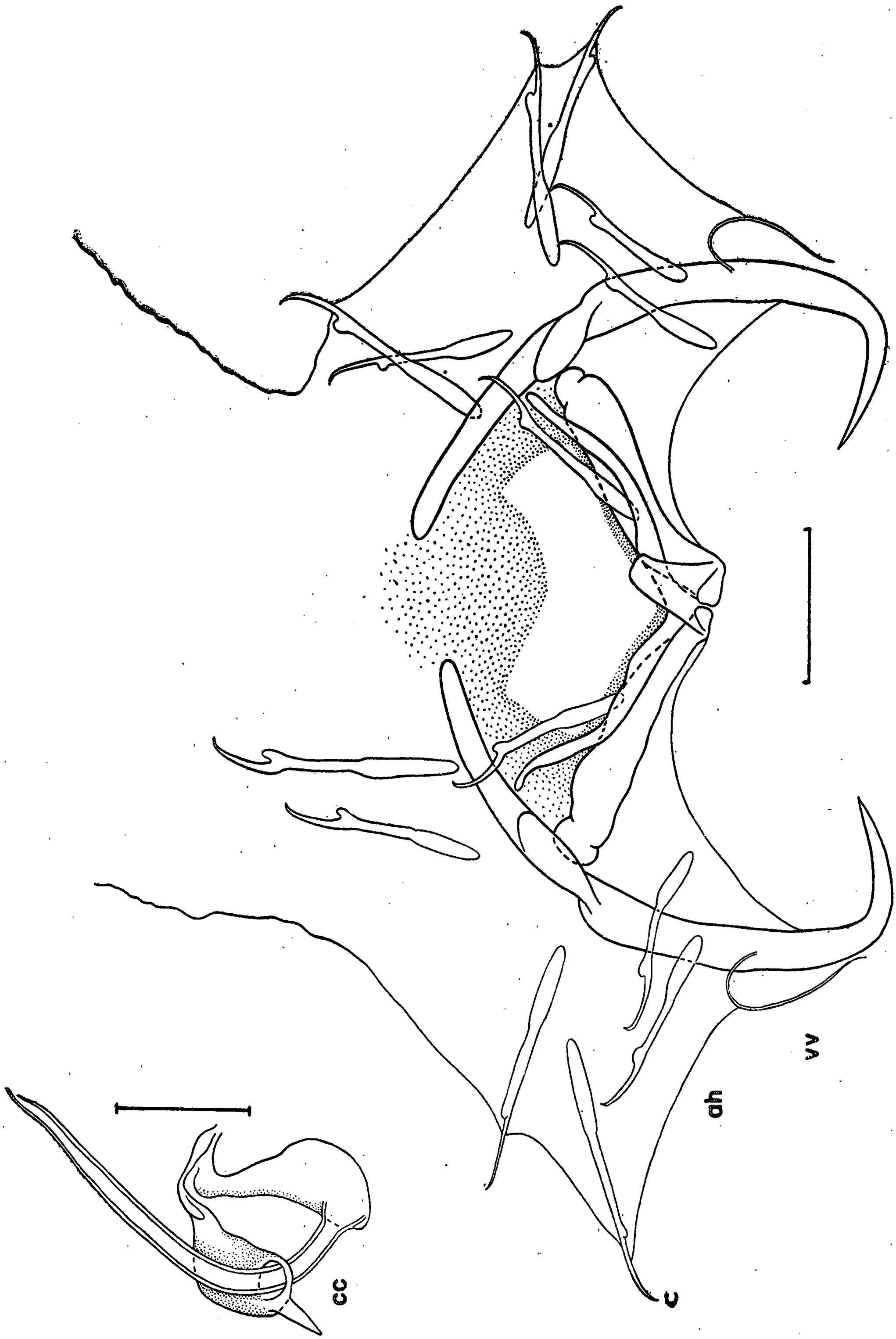



FIG. 7

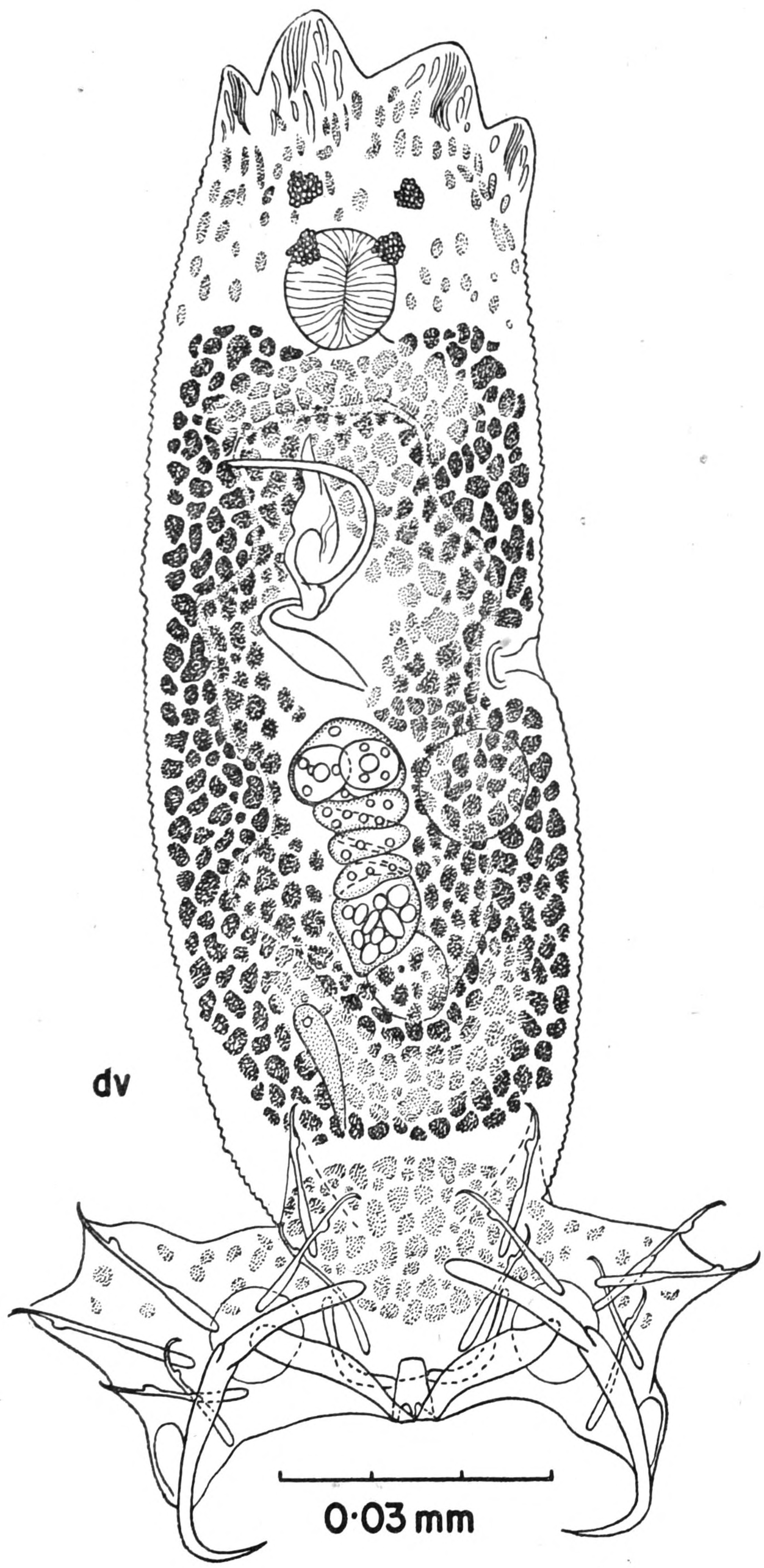



FIG. 7a

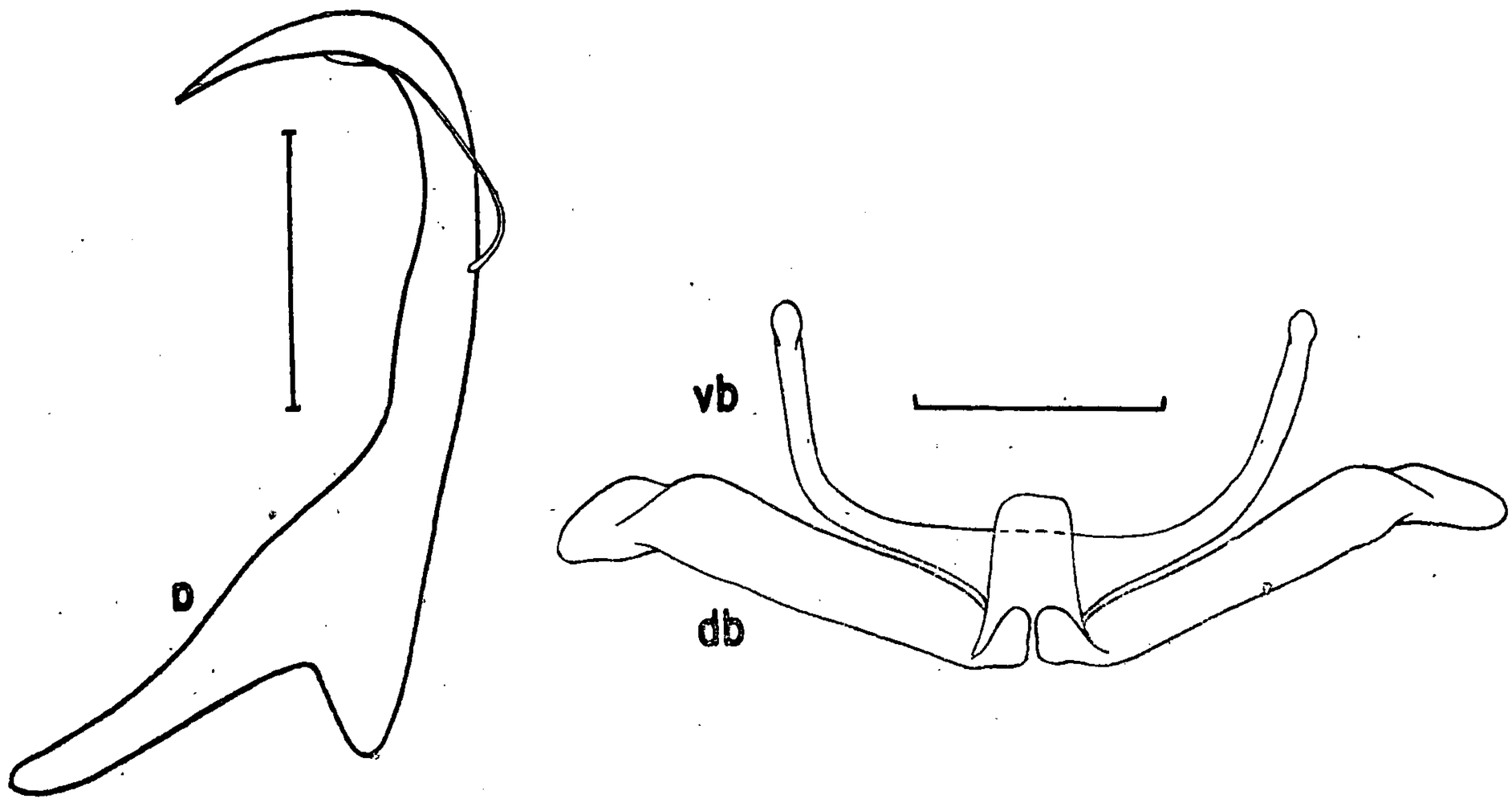



FIG. 7b

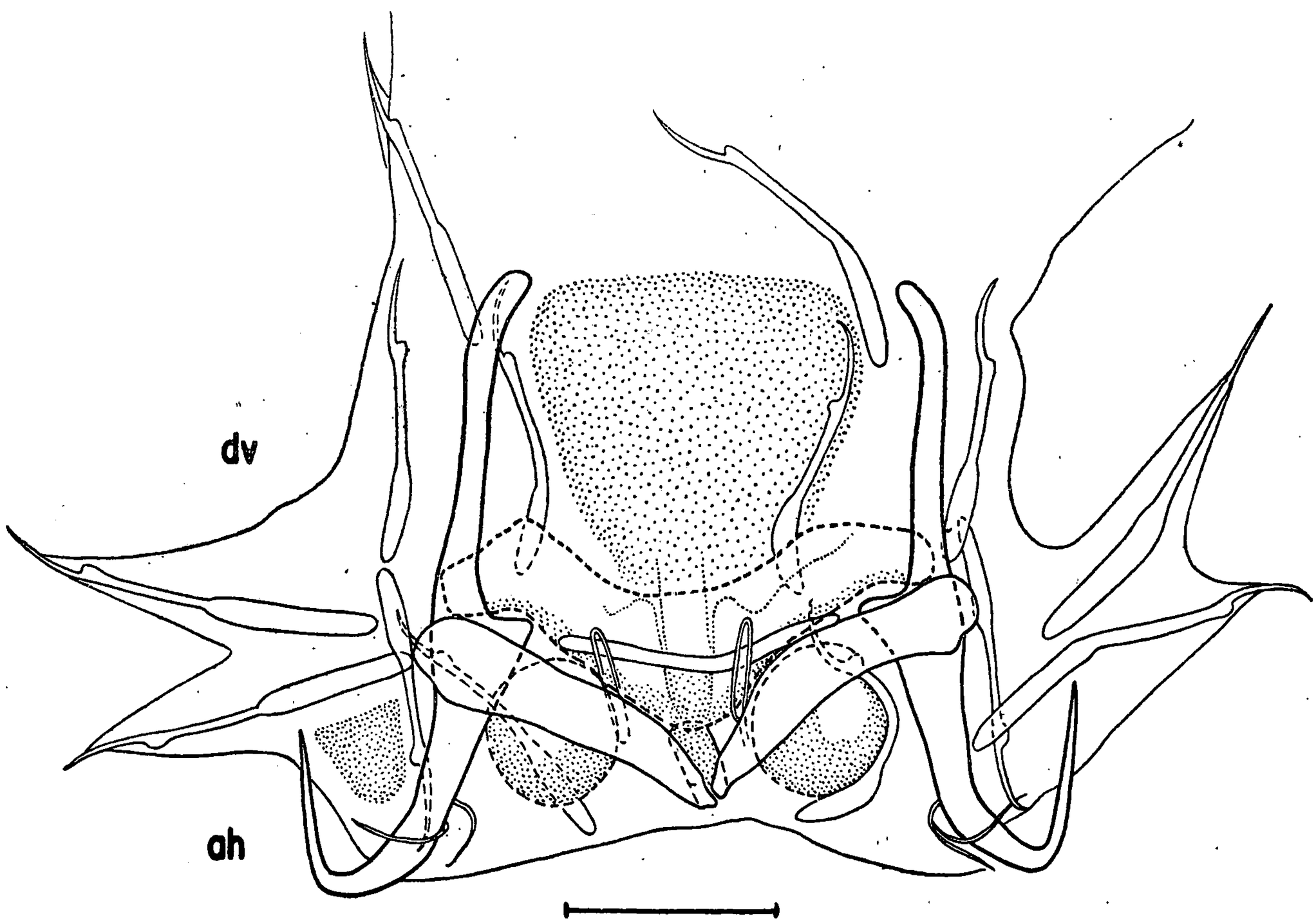



FIG. 8

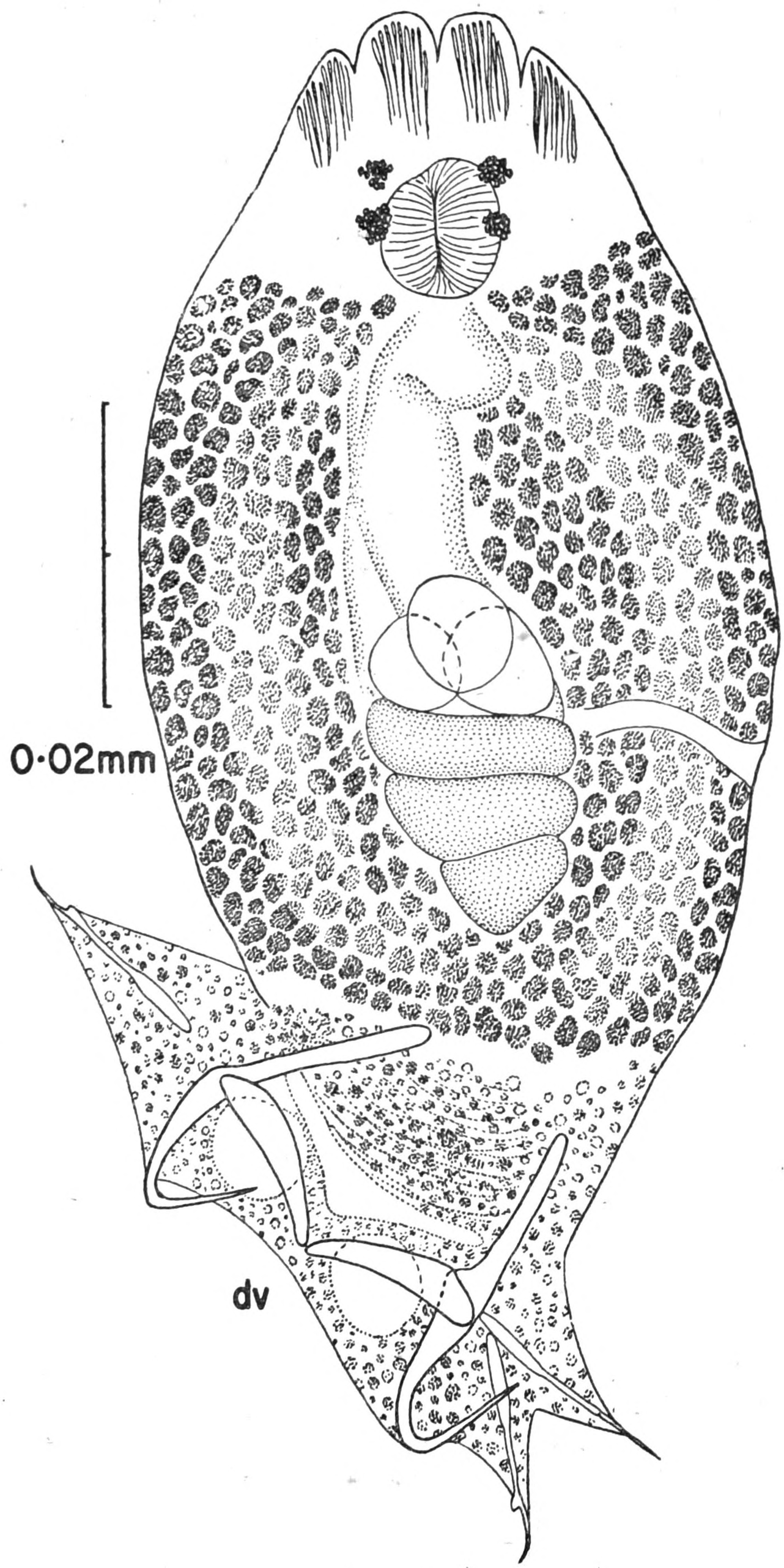



FIG. 8a

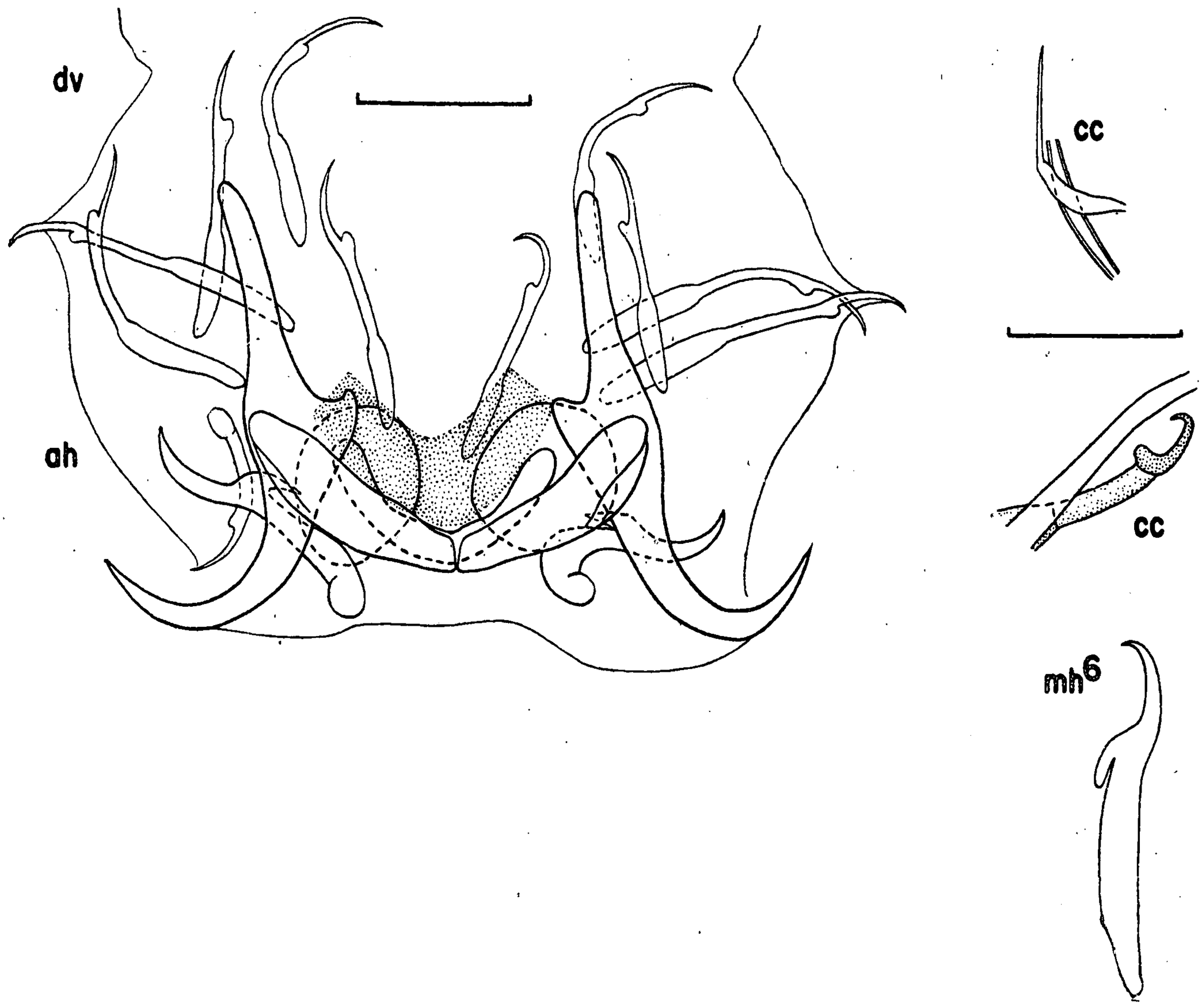



FIG. 9

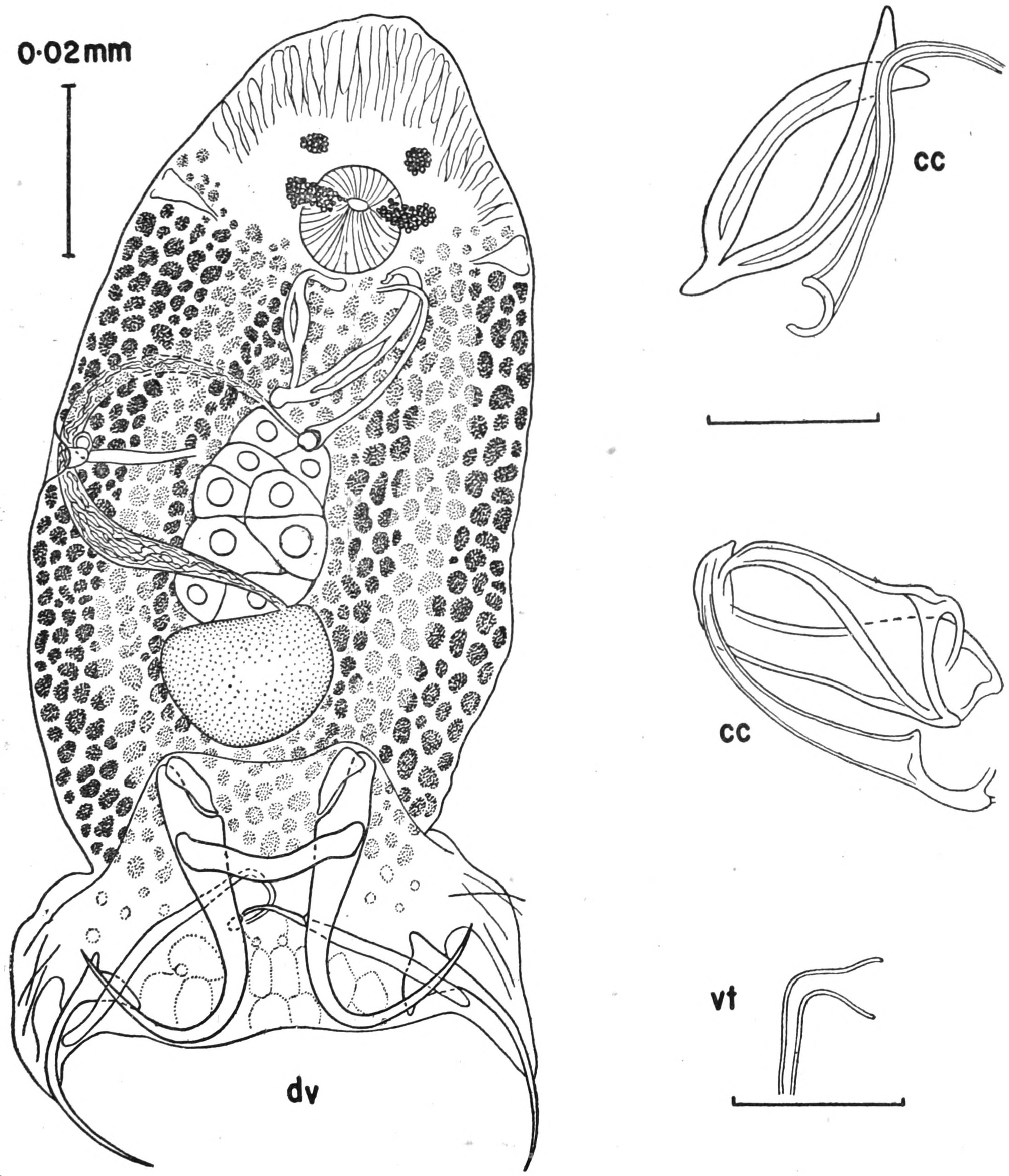



FIG. 10

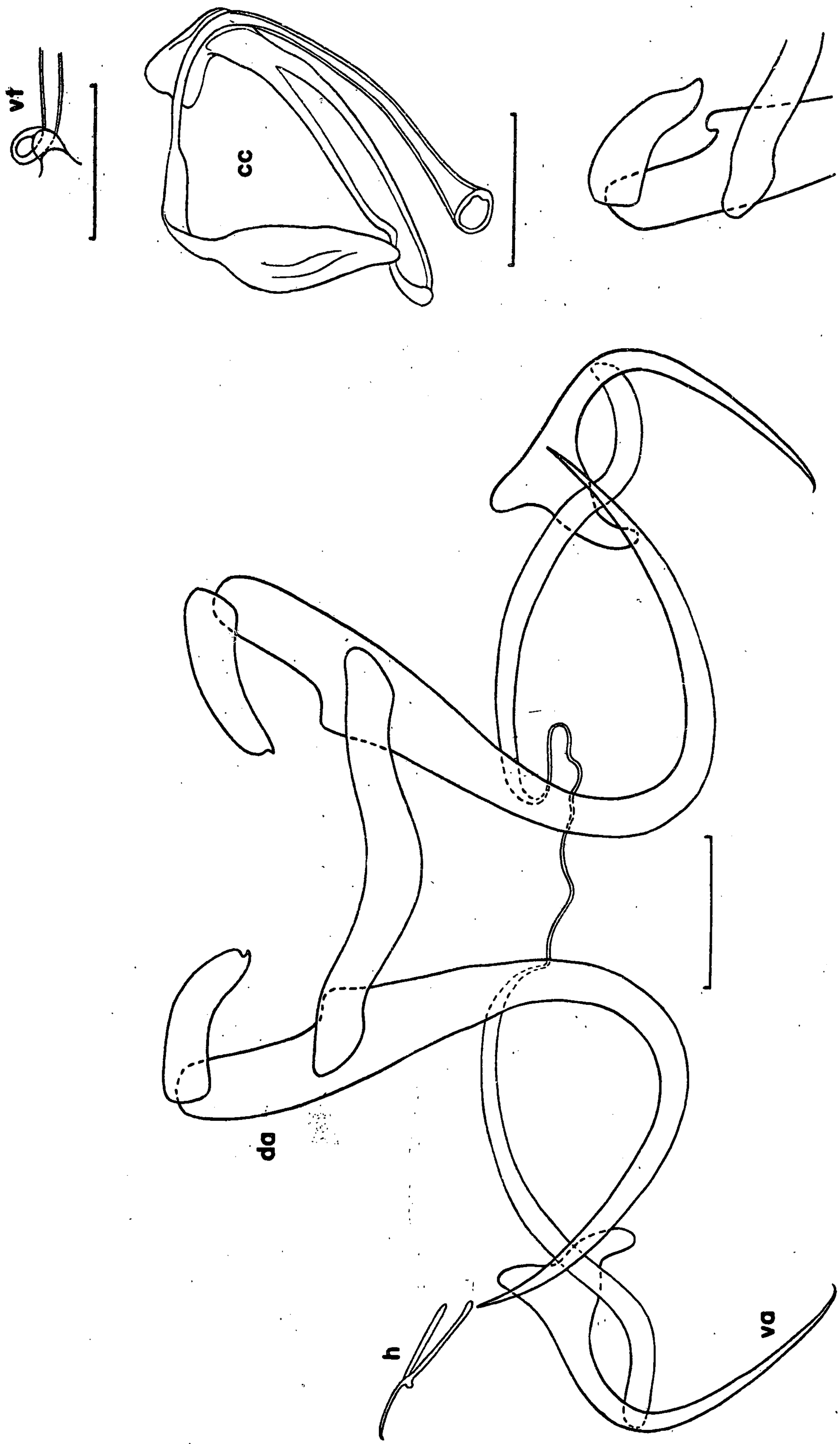
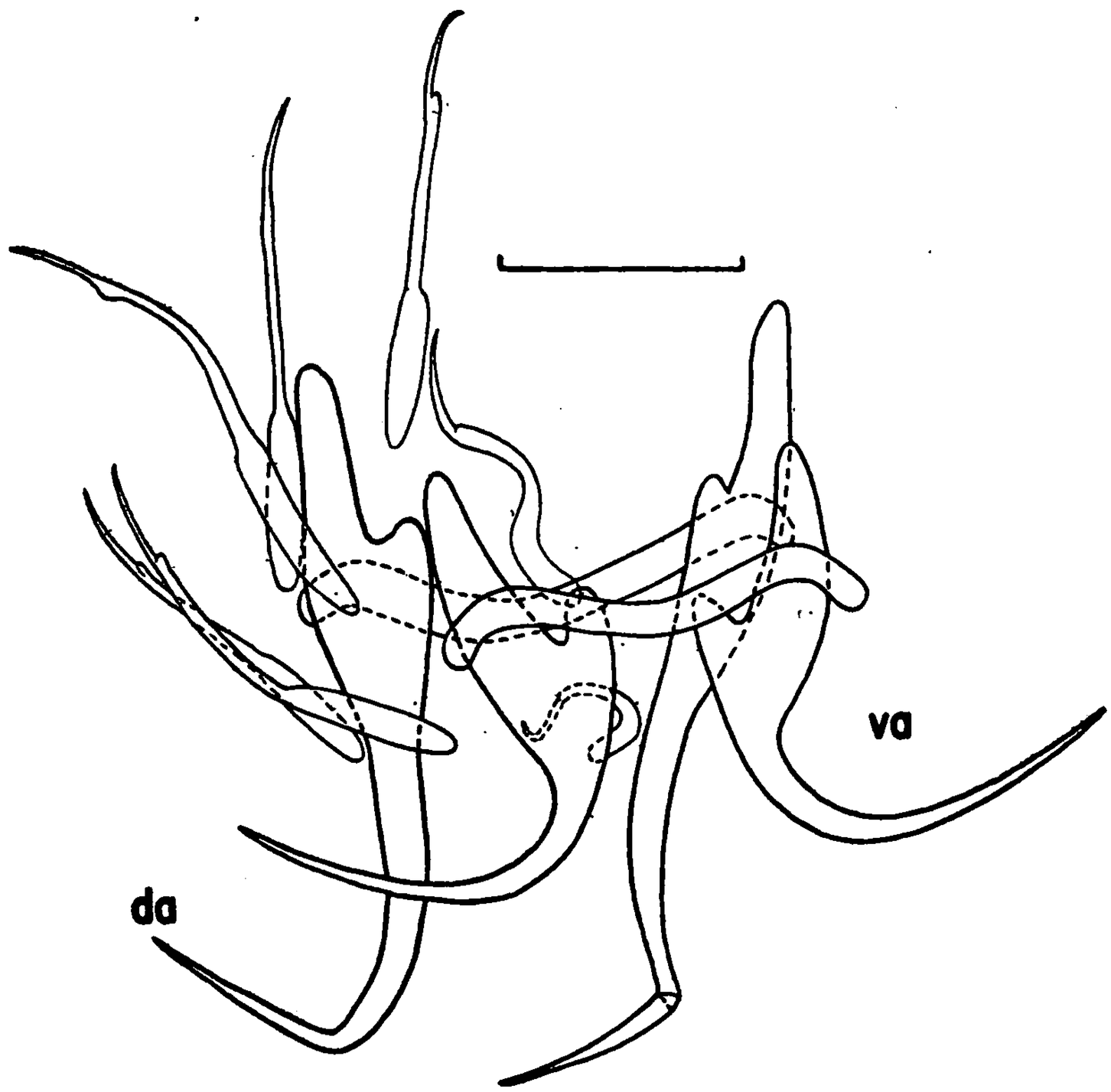



FIG. 10a



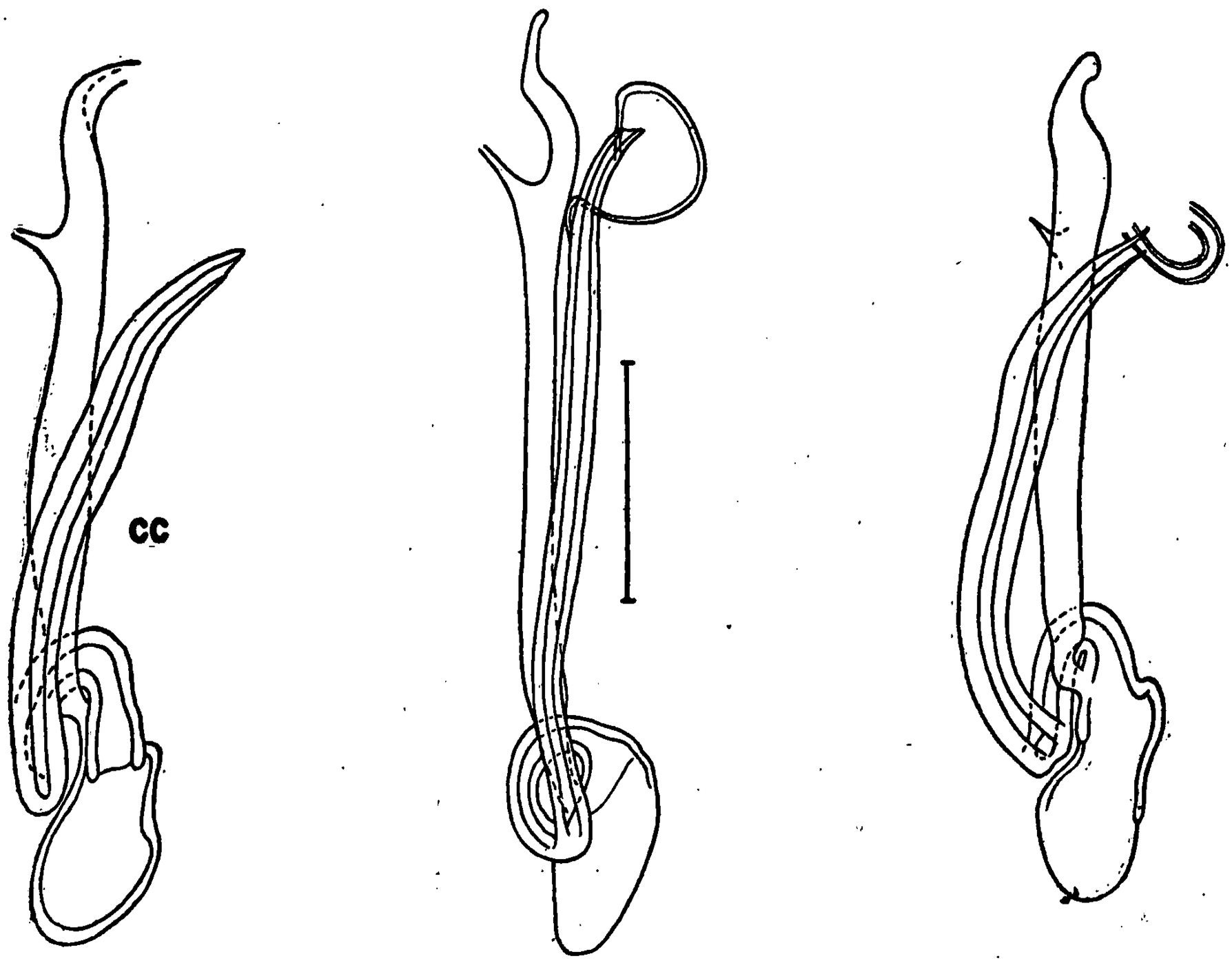




Fig. 11

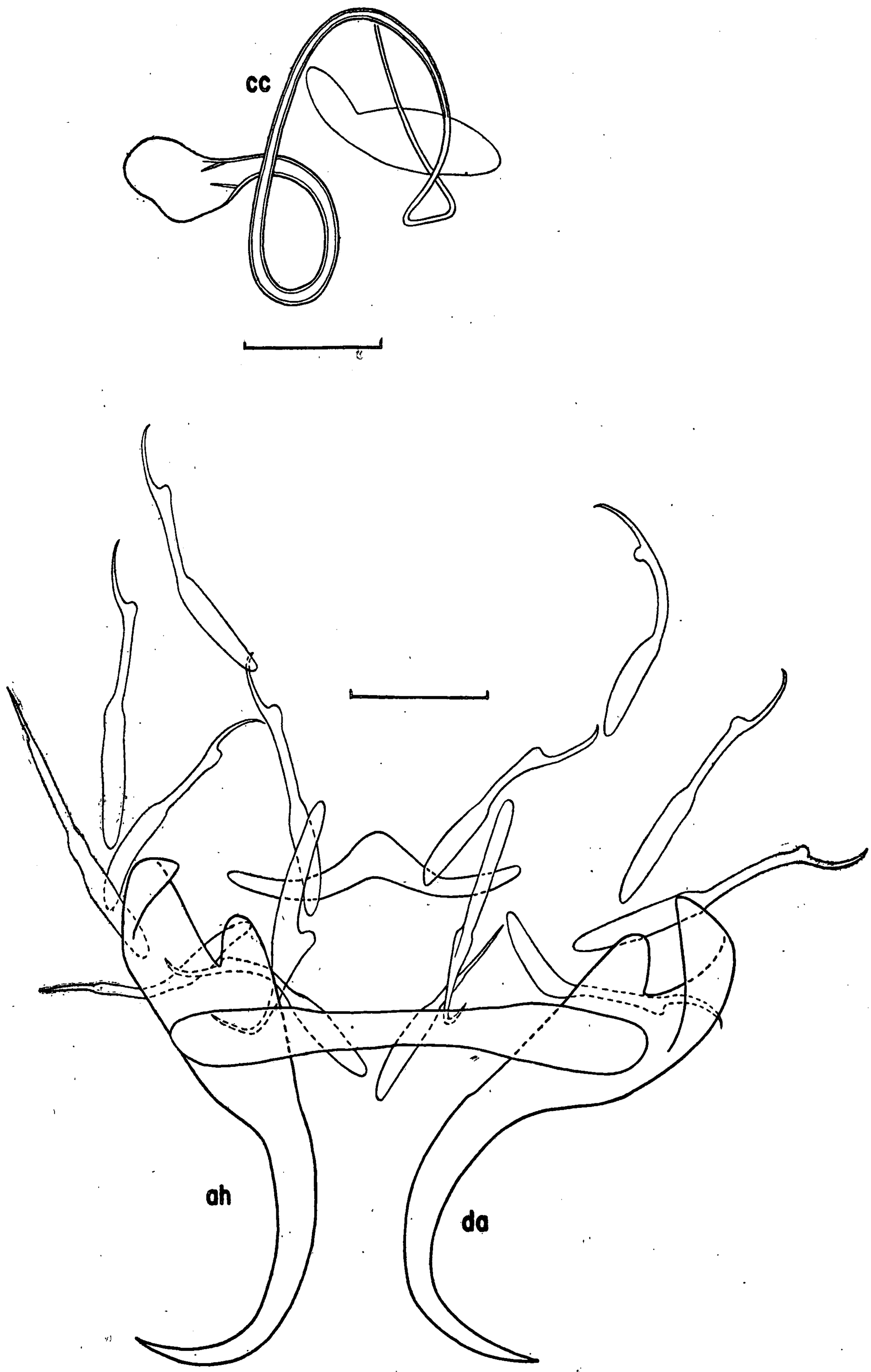



FIG. 12

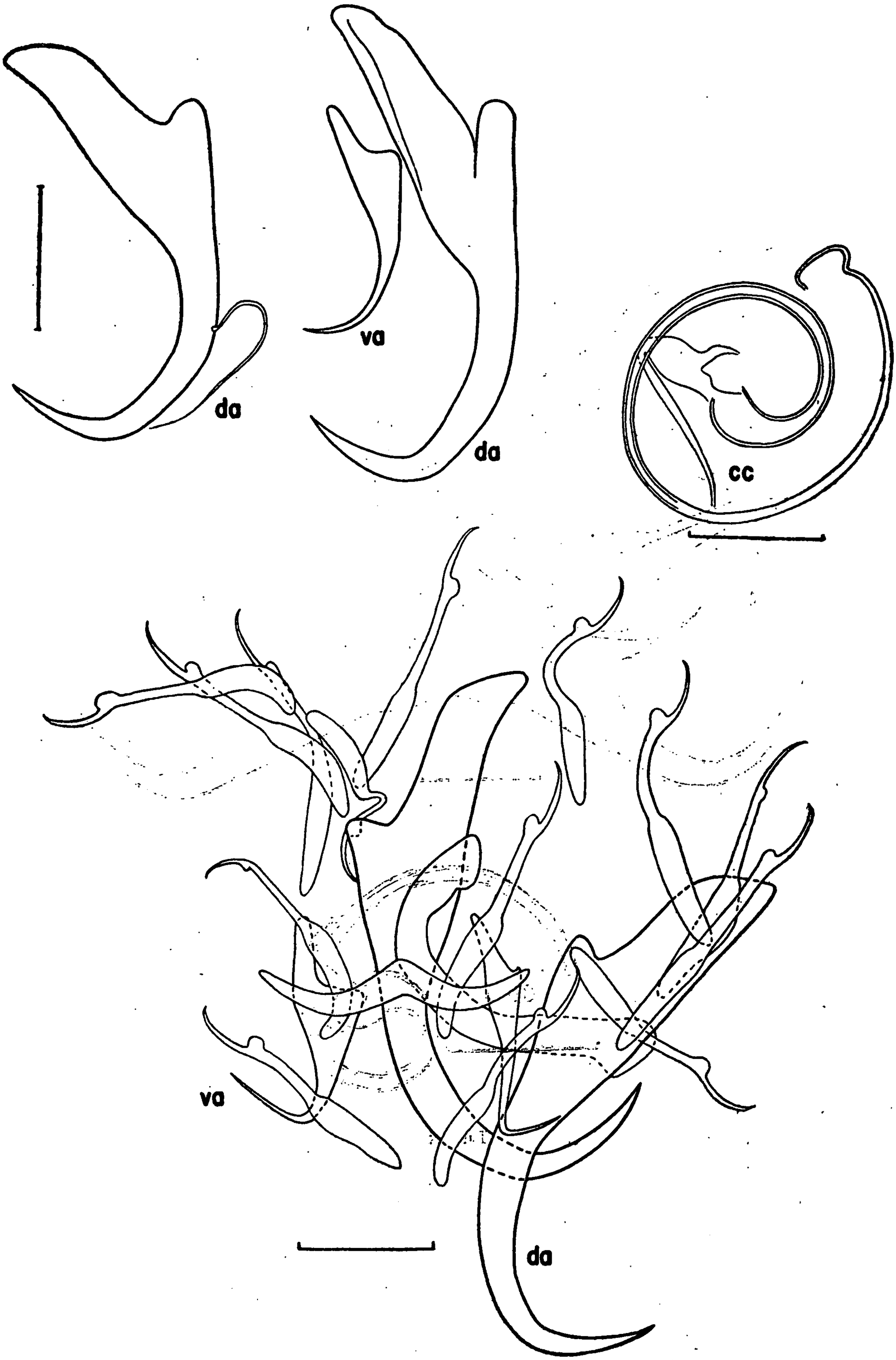



FIG. 12a

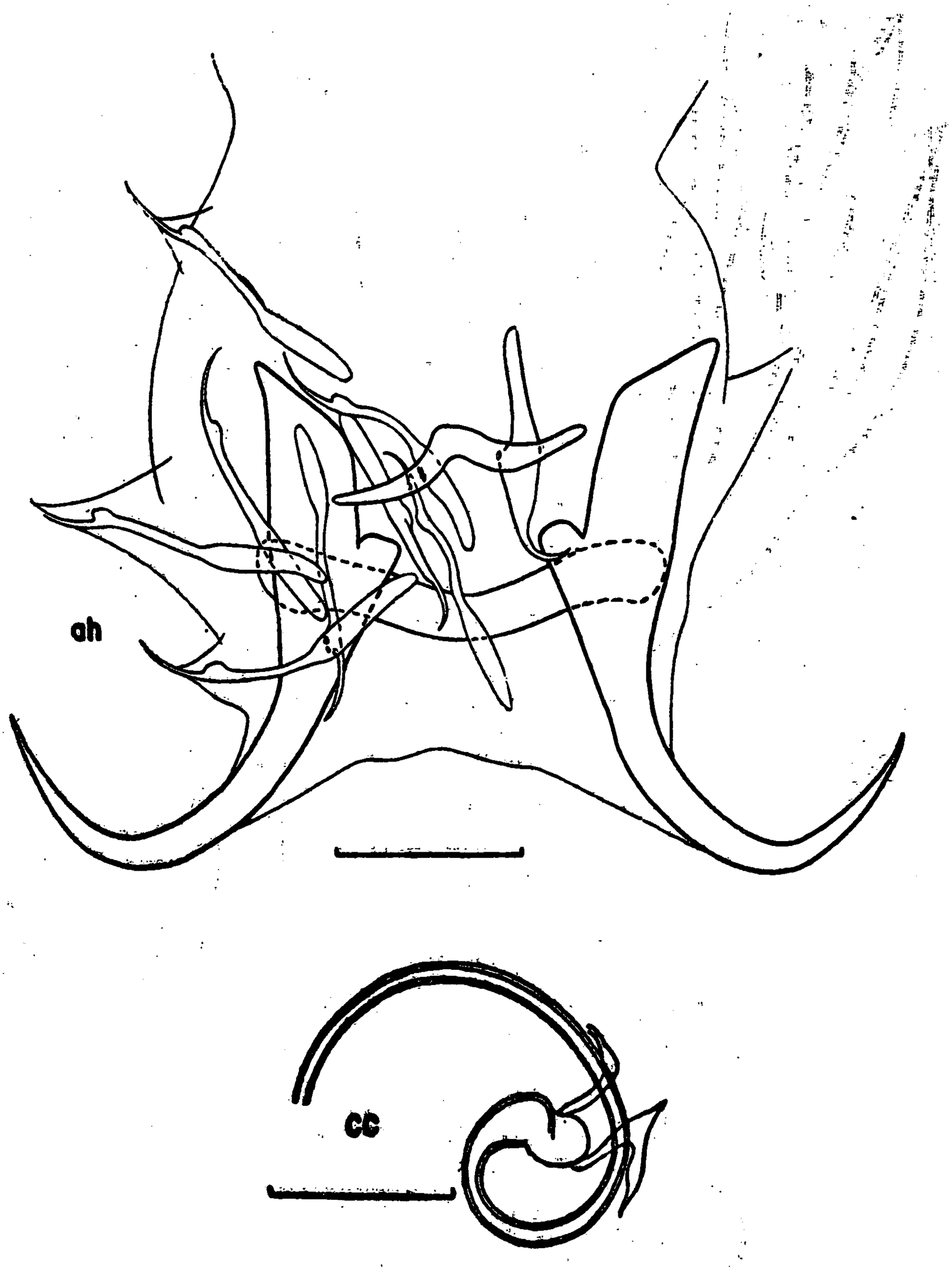



FIG. 12b

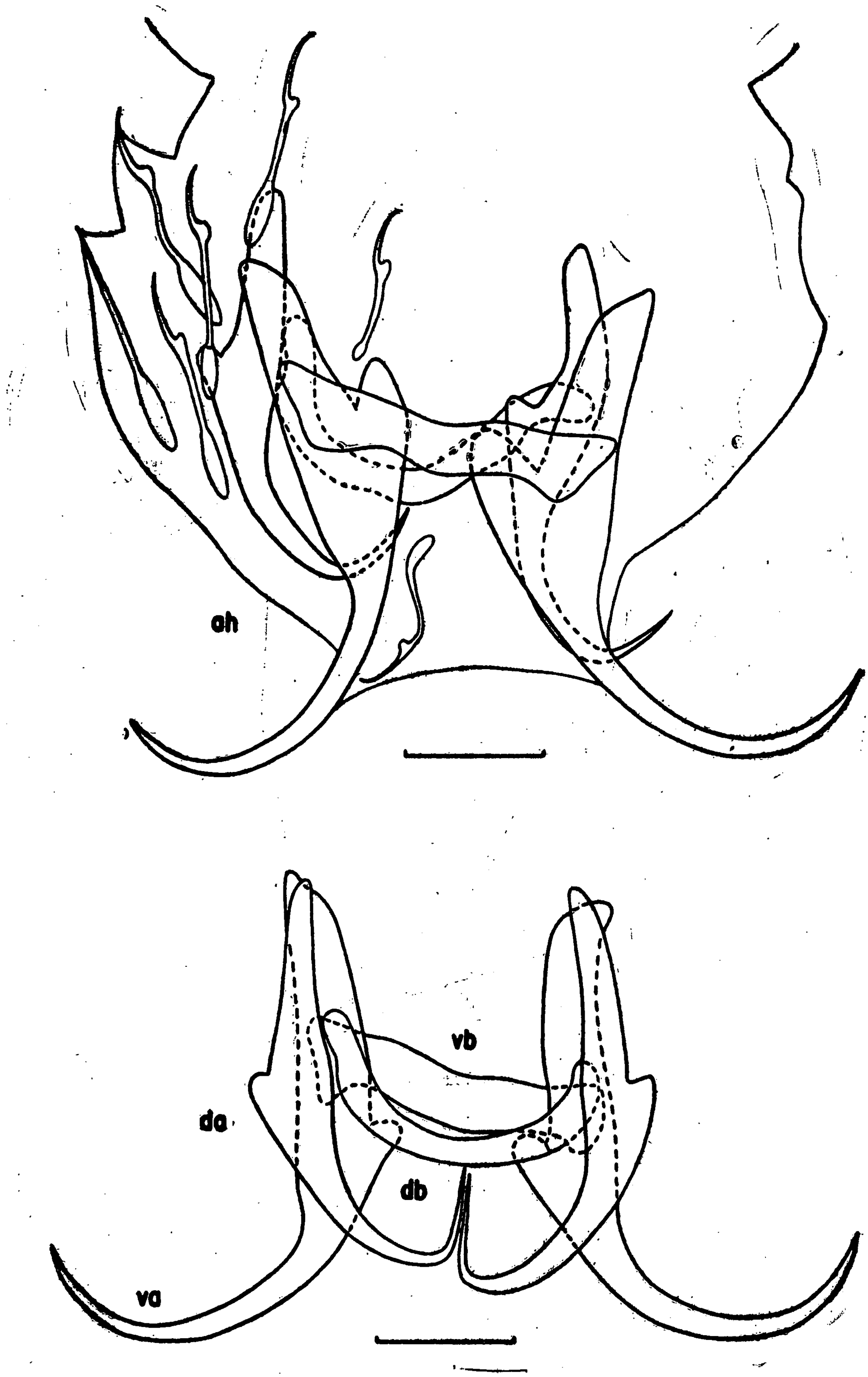



Fig. 13

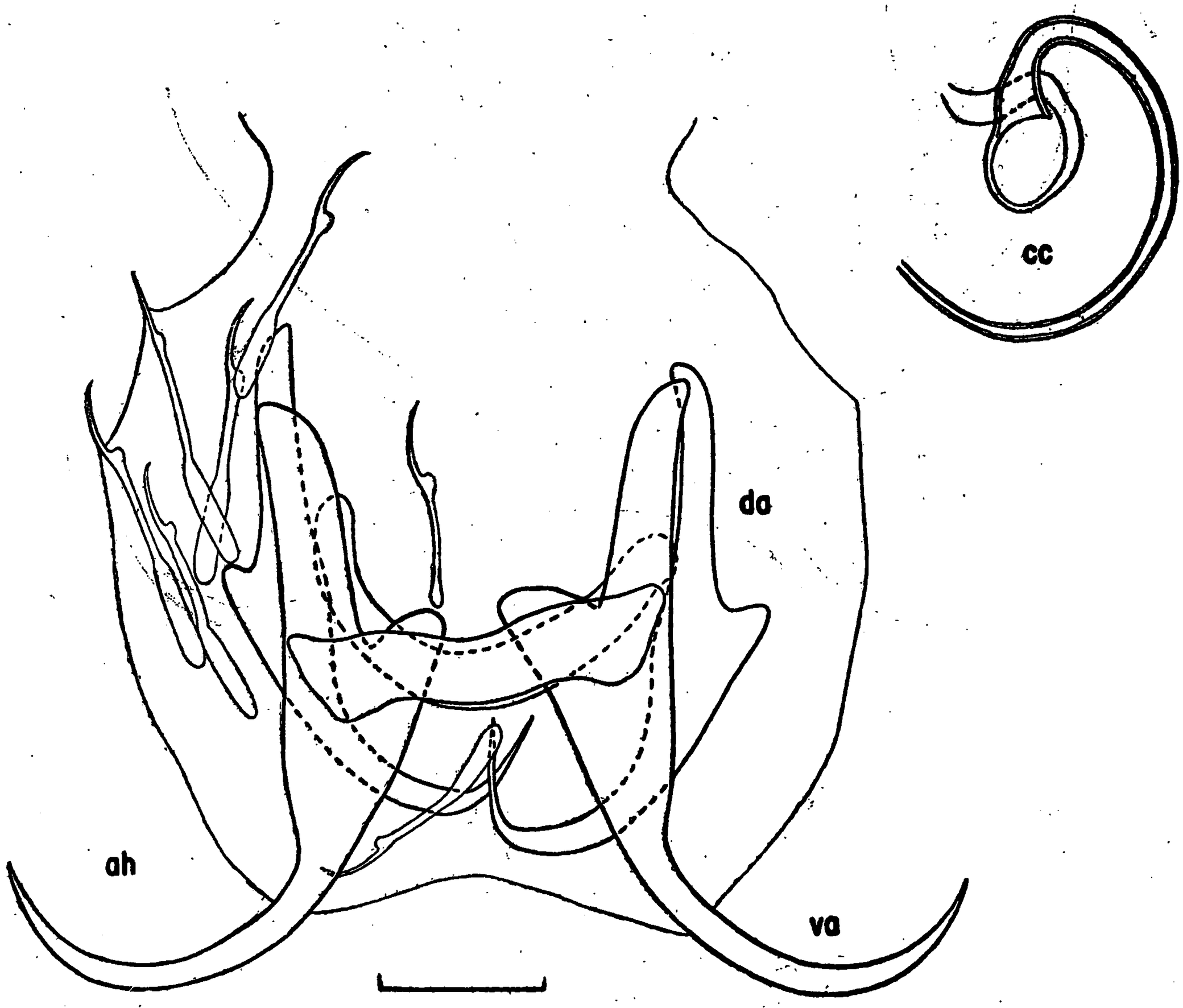



FIG. 13a

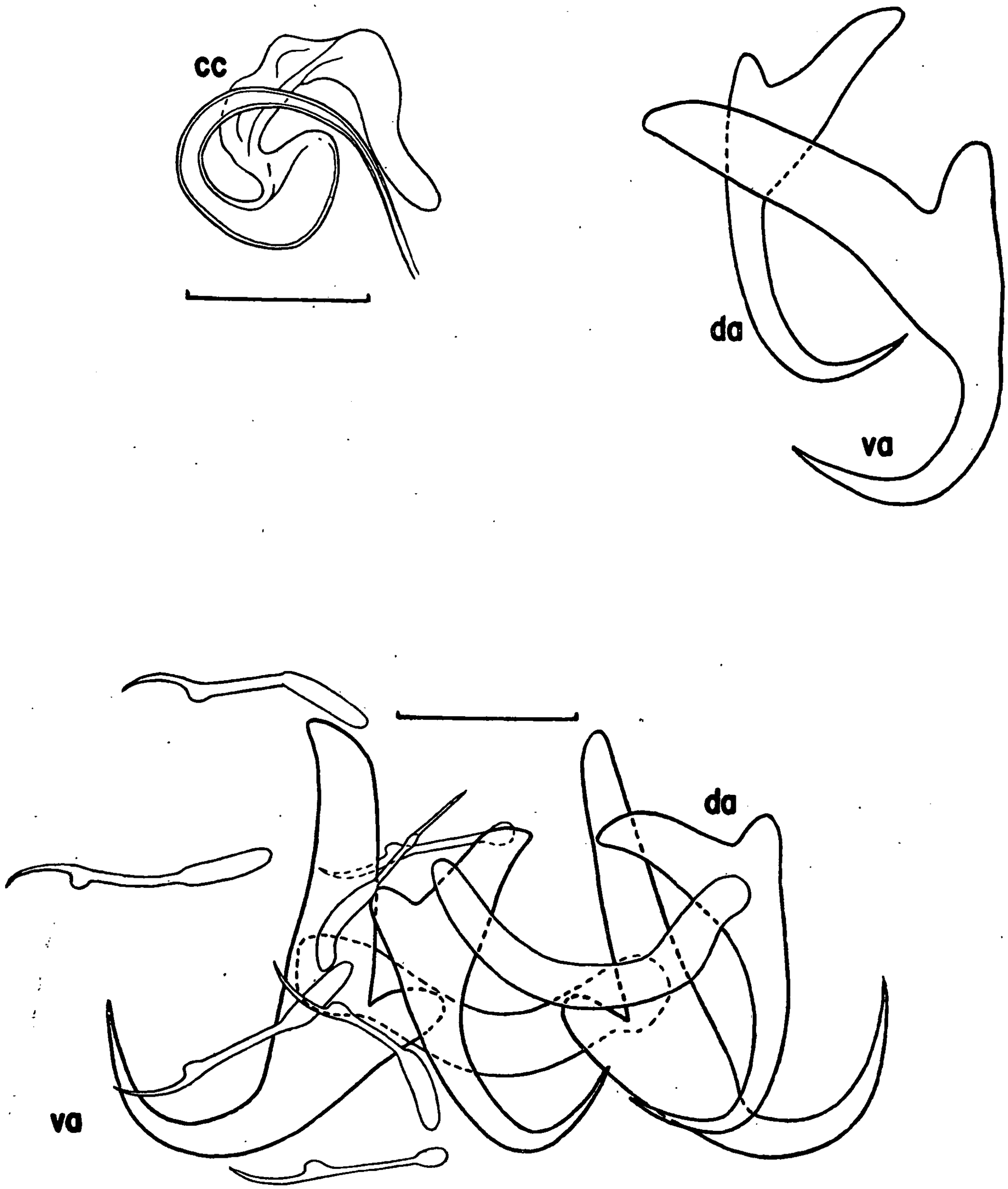



FIG. 14

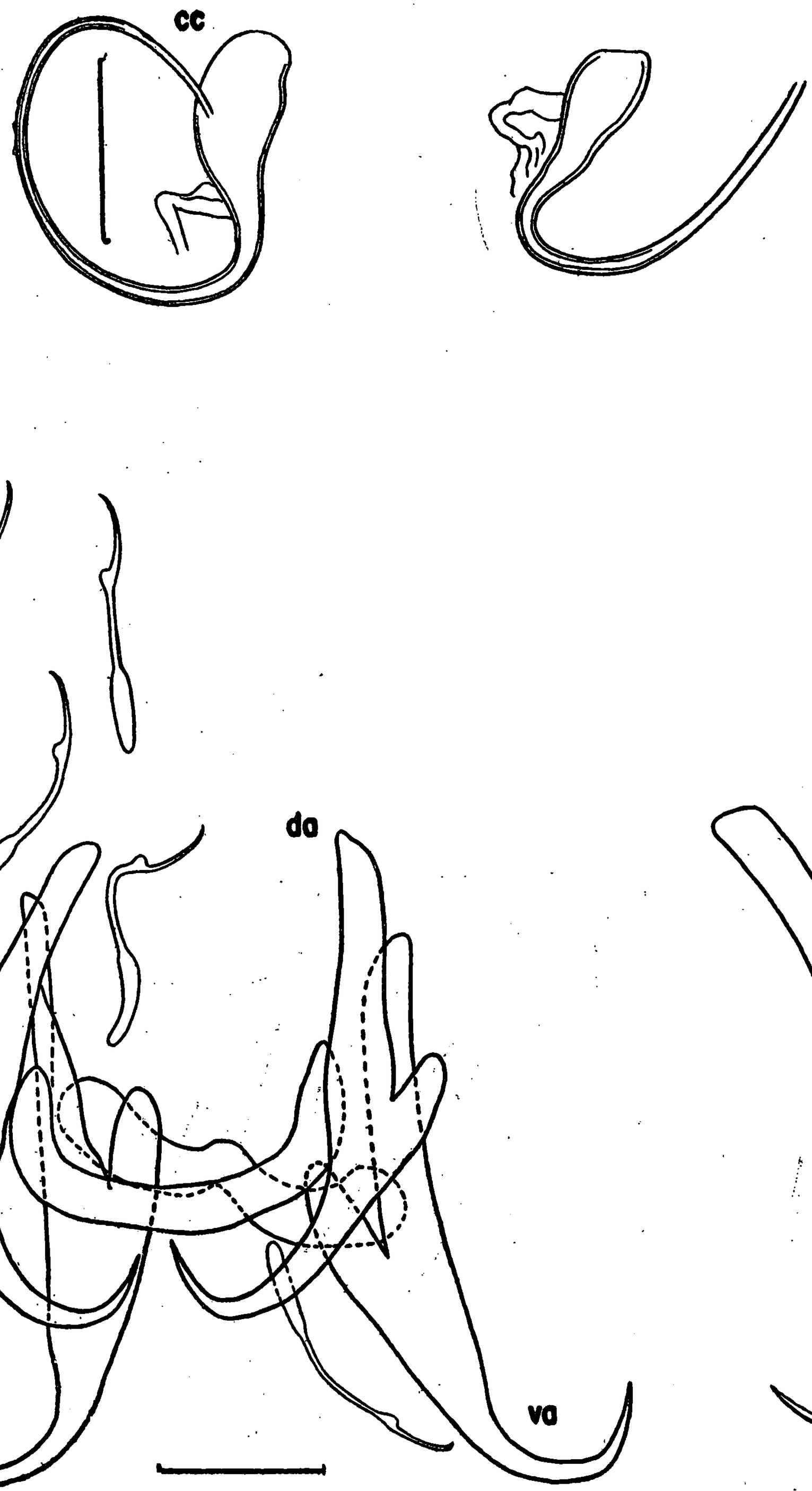
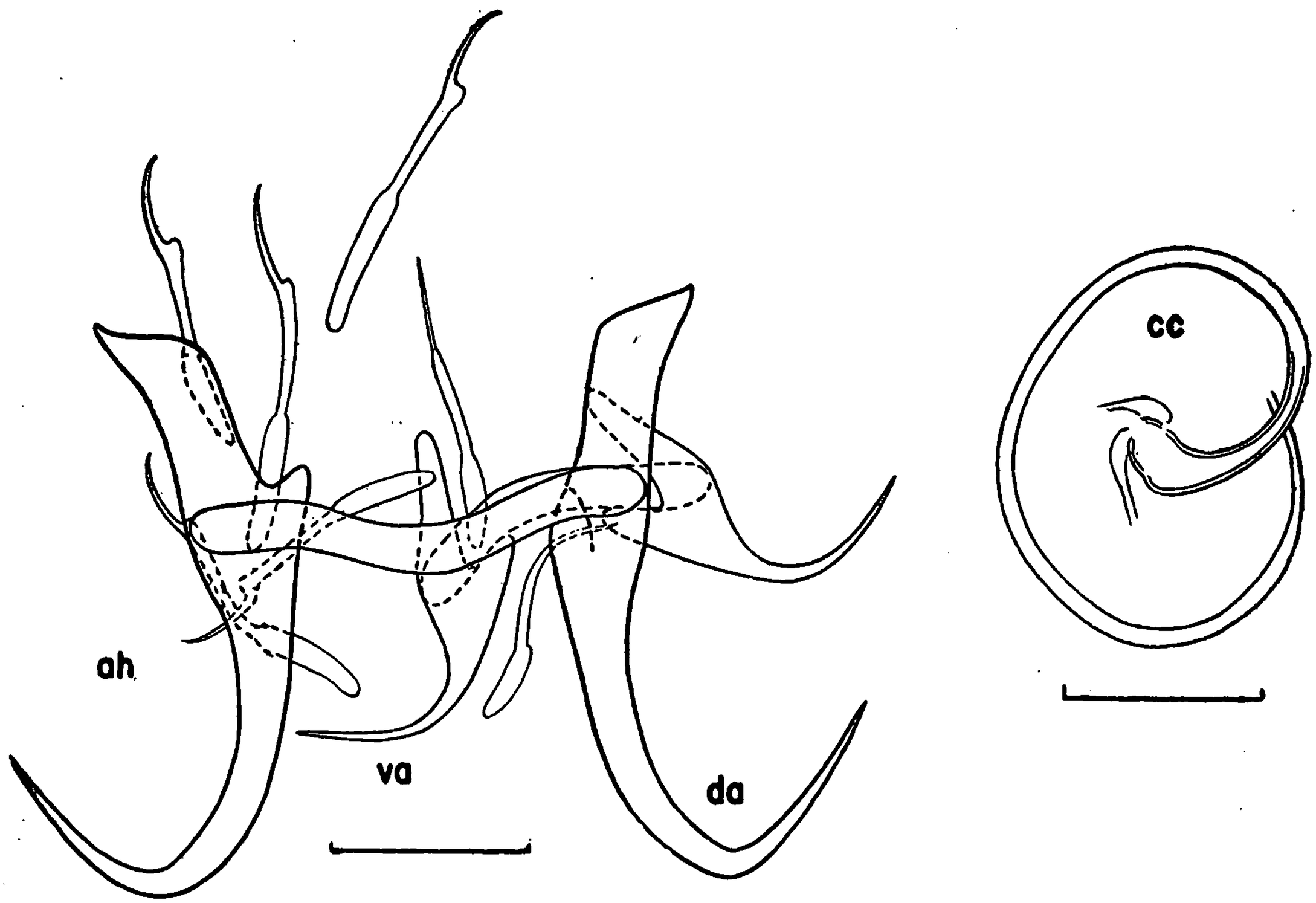



Fig. 15



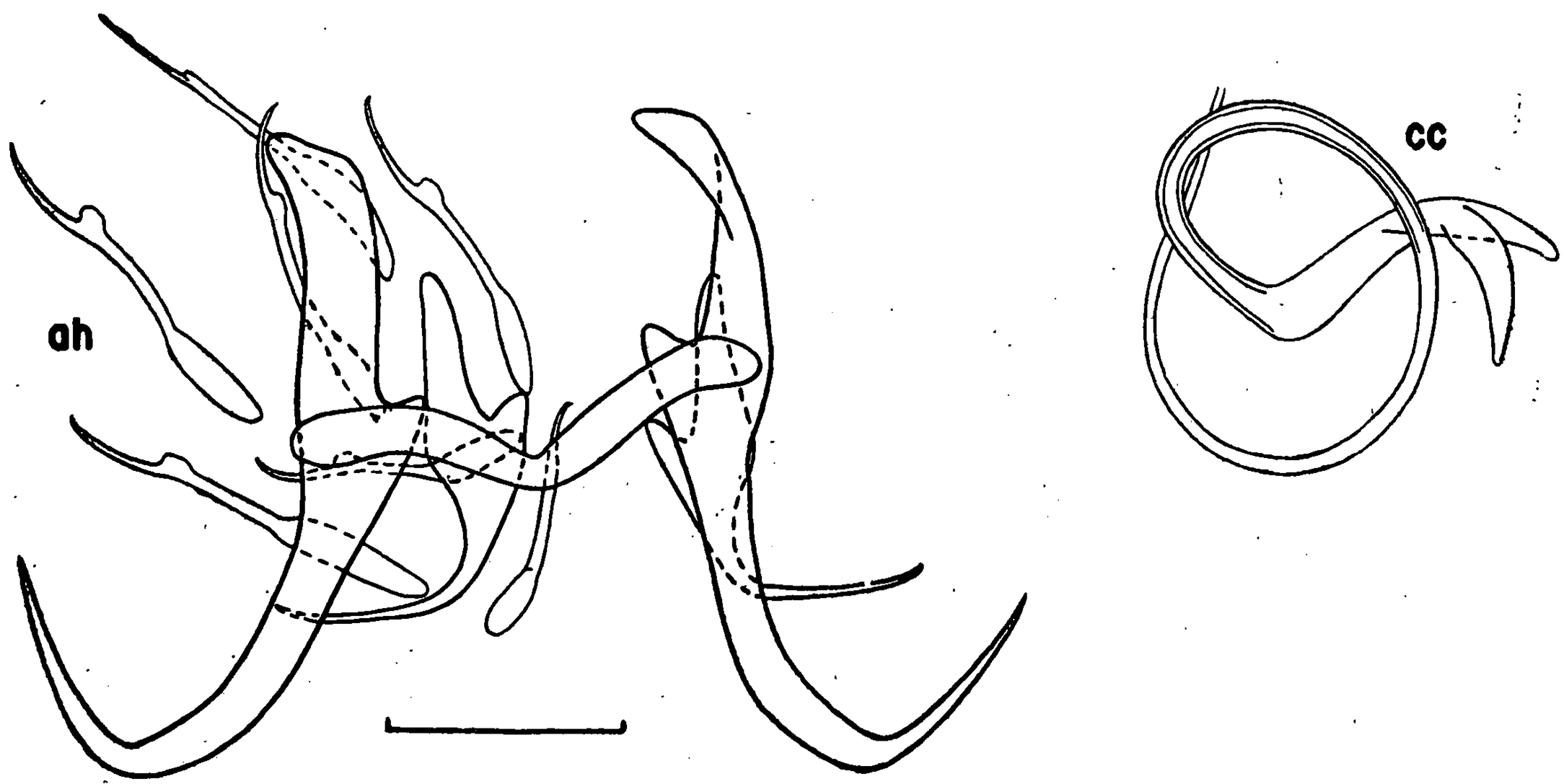




FIG. 16

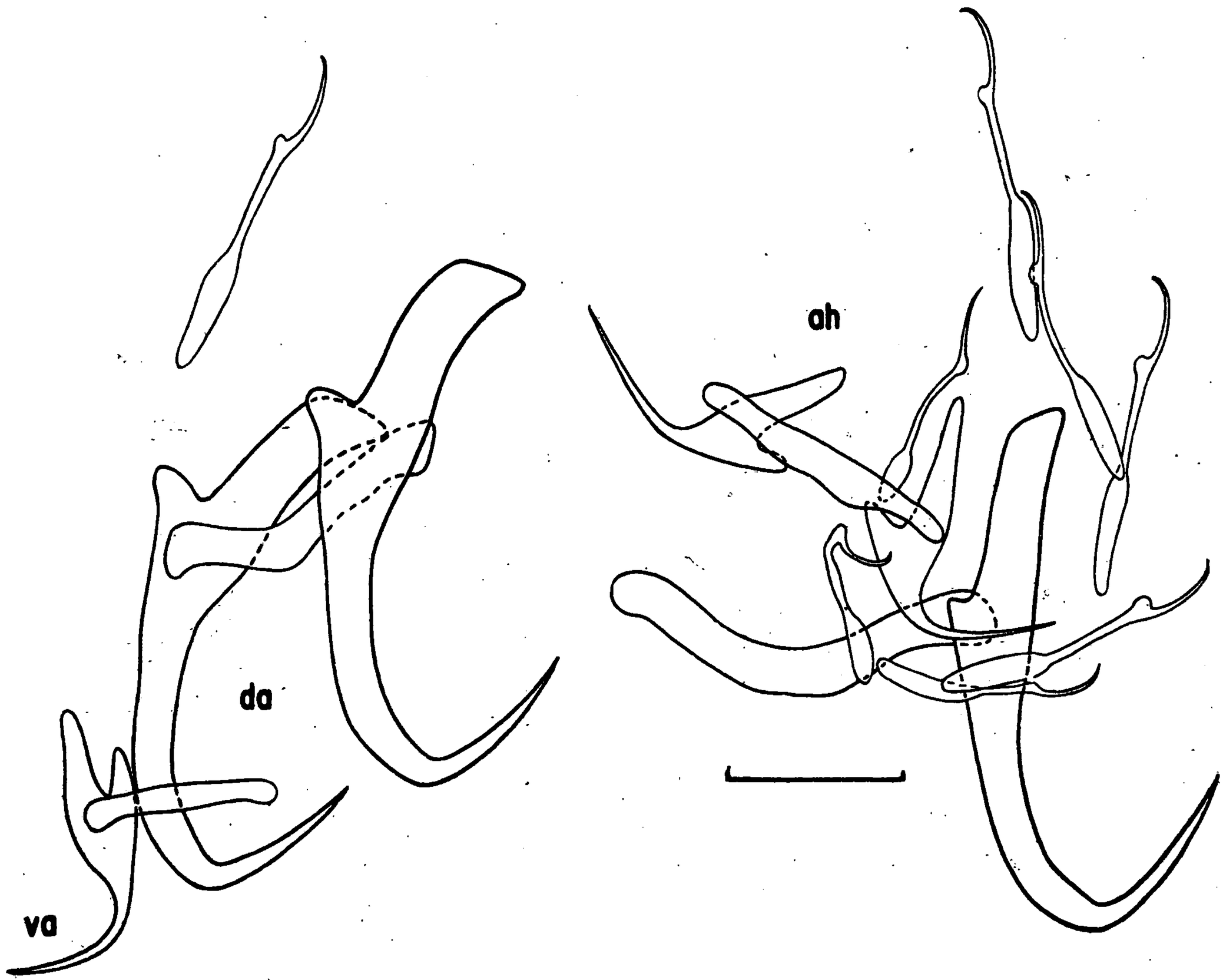



FIG. 16a

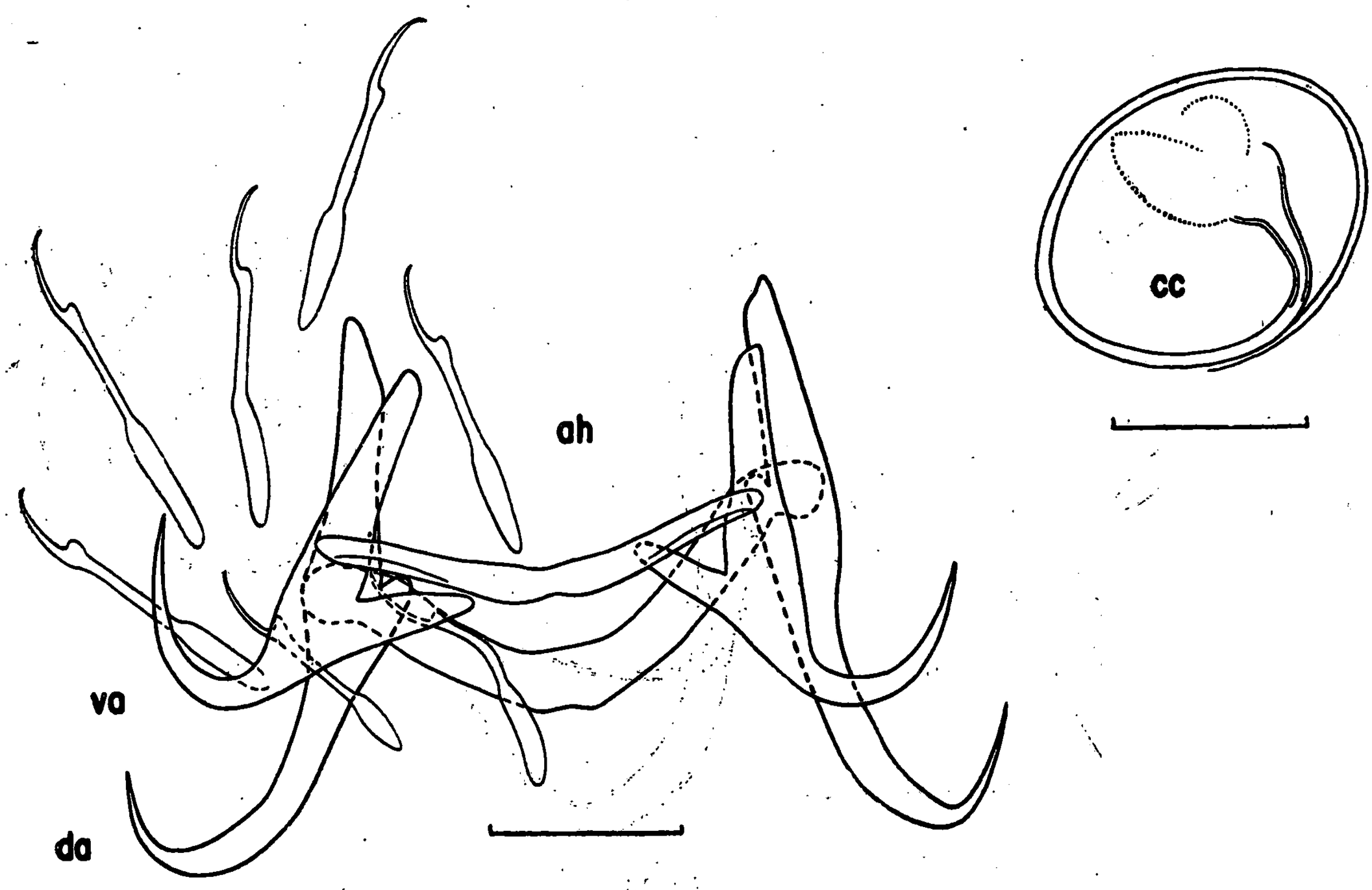
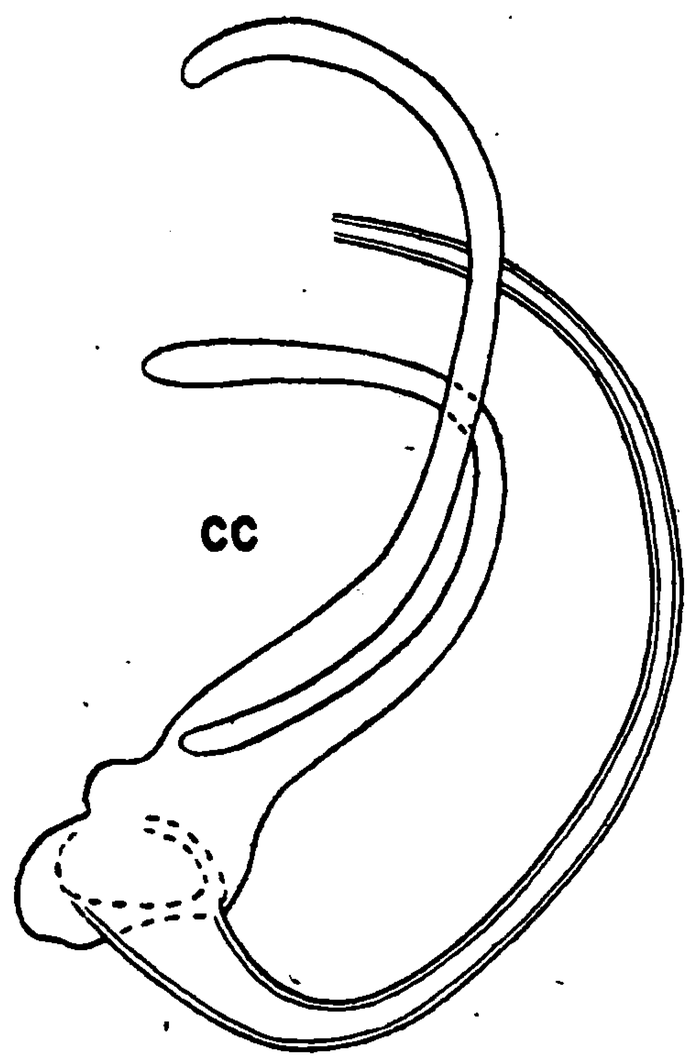
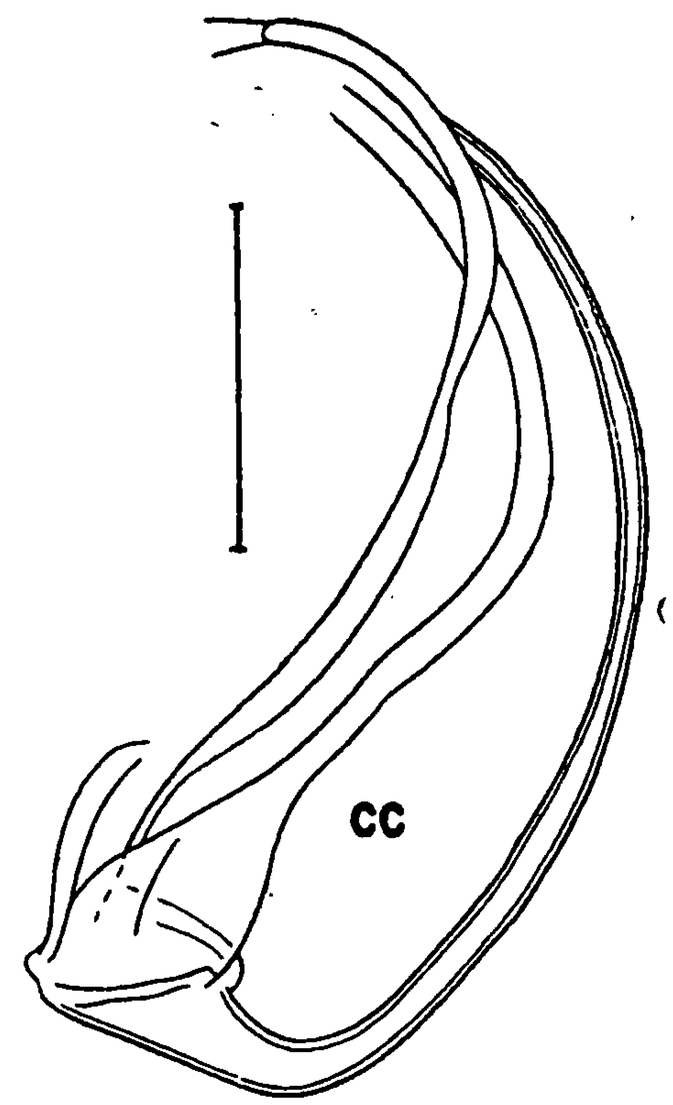



FIG. 17



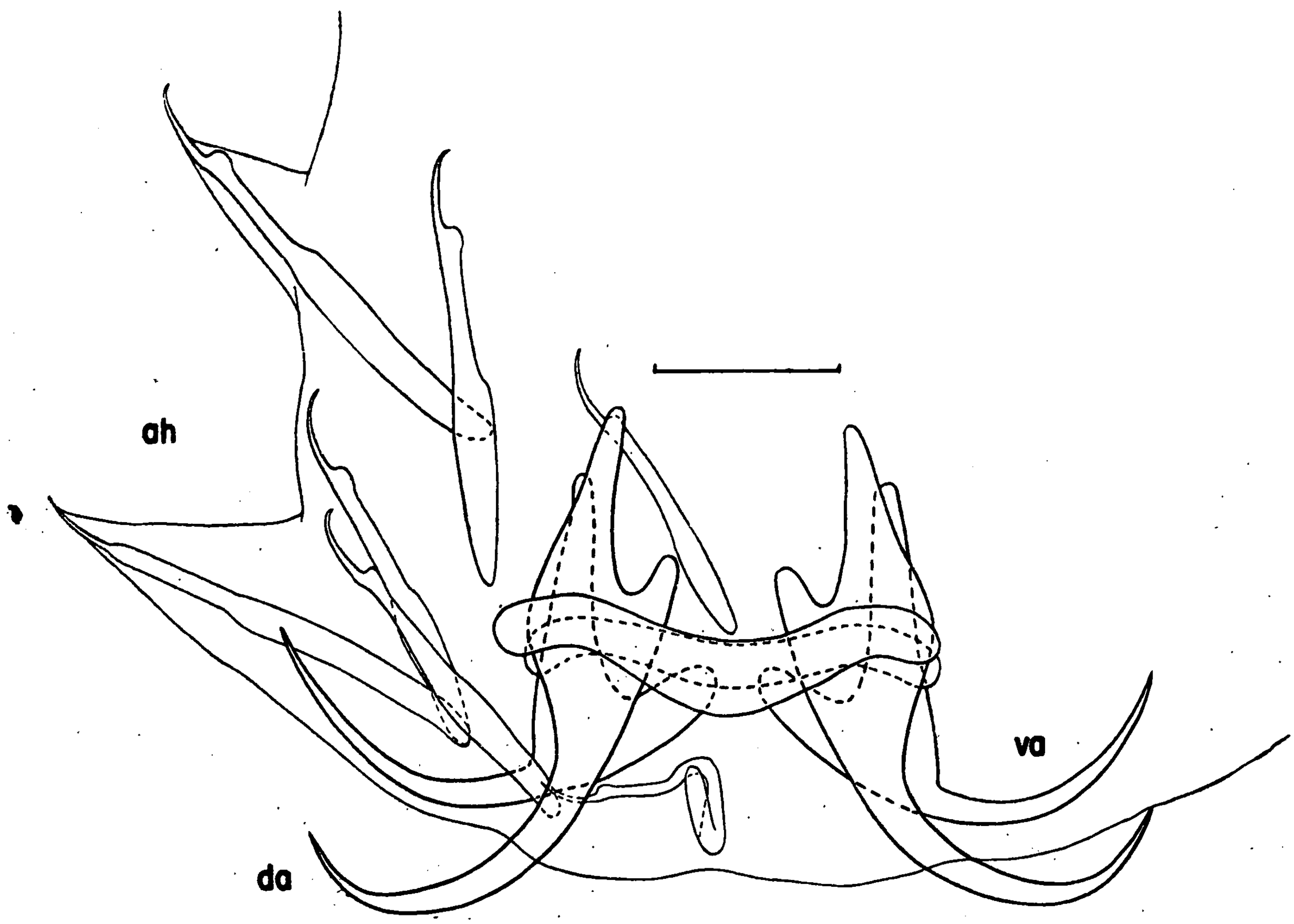




FIG. 18

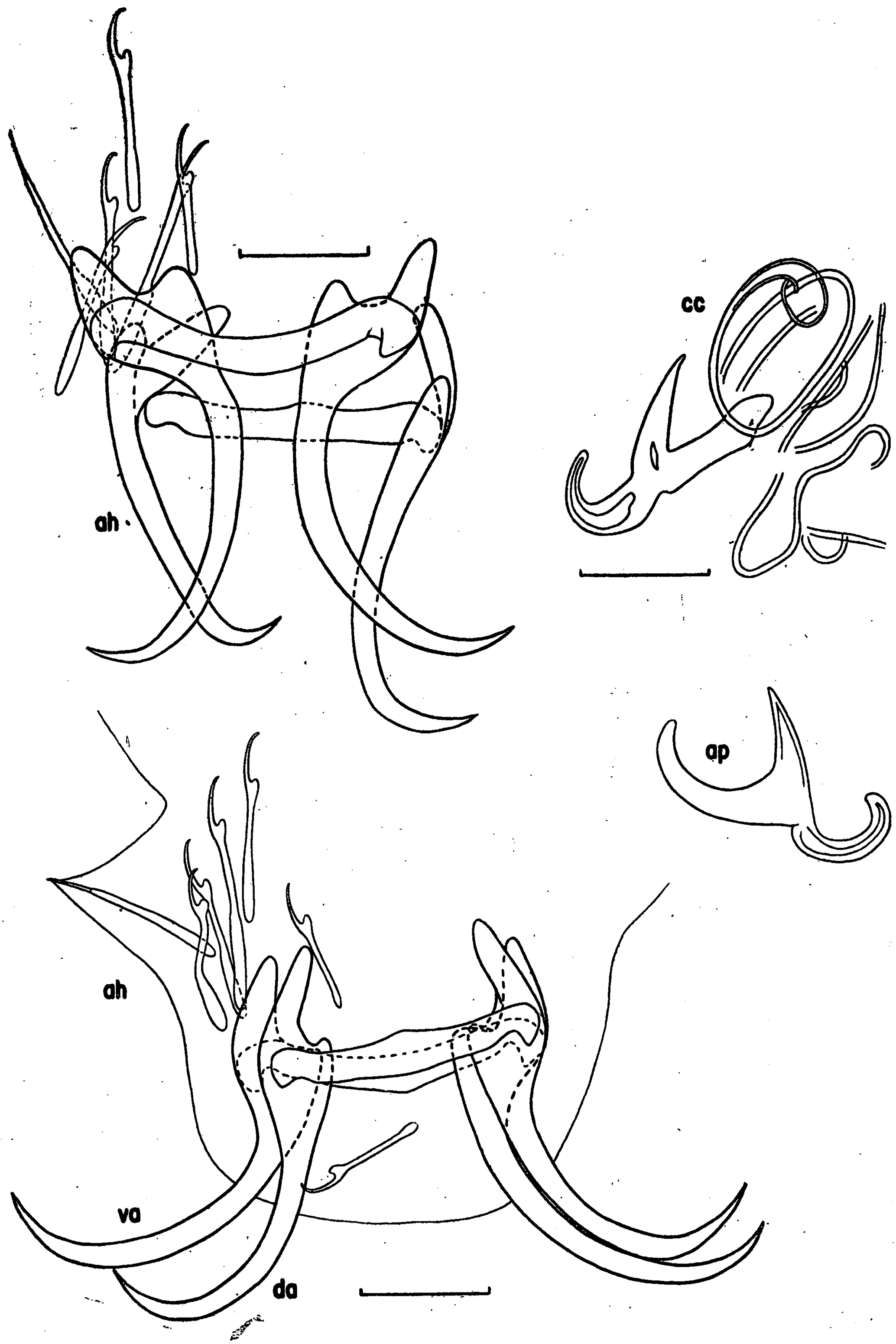



FIG. 19

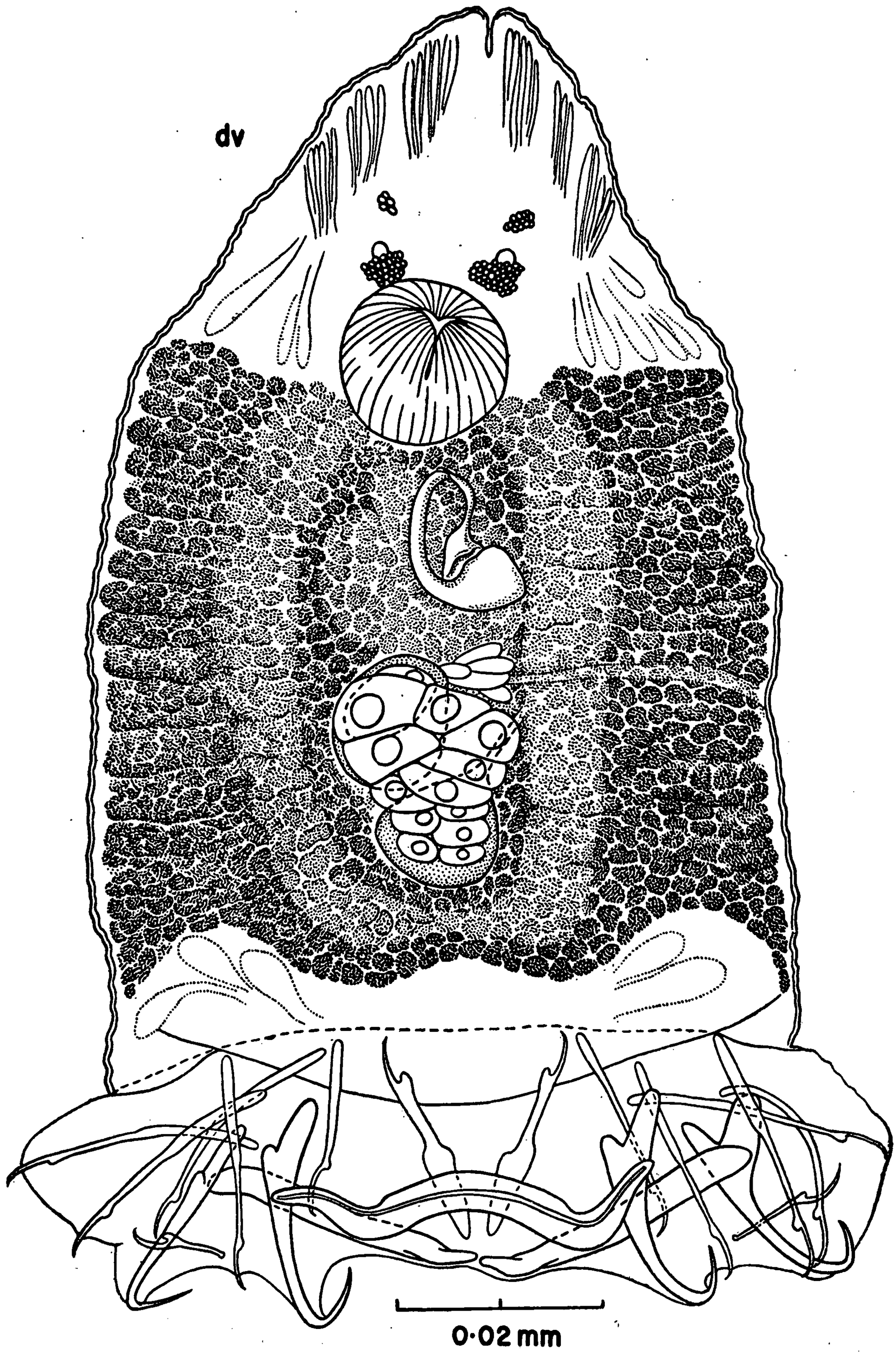



FIG. 20

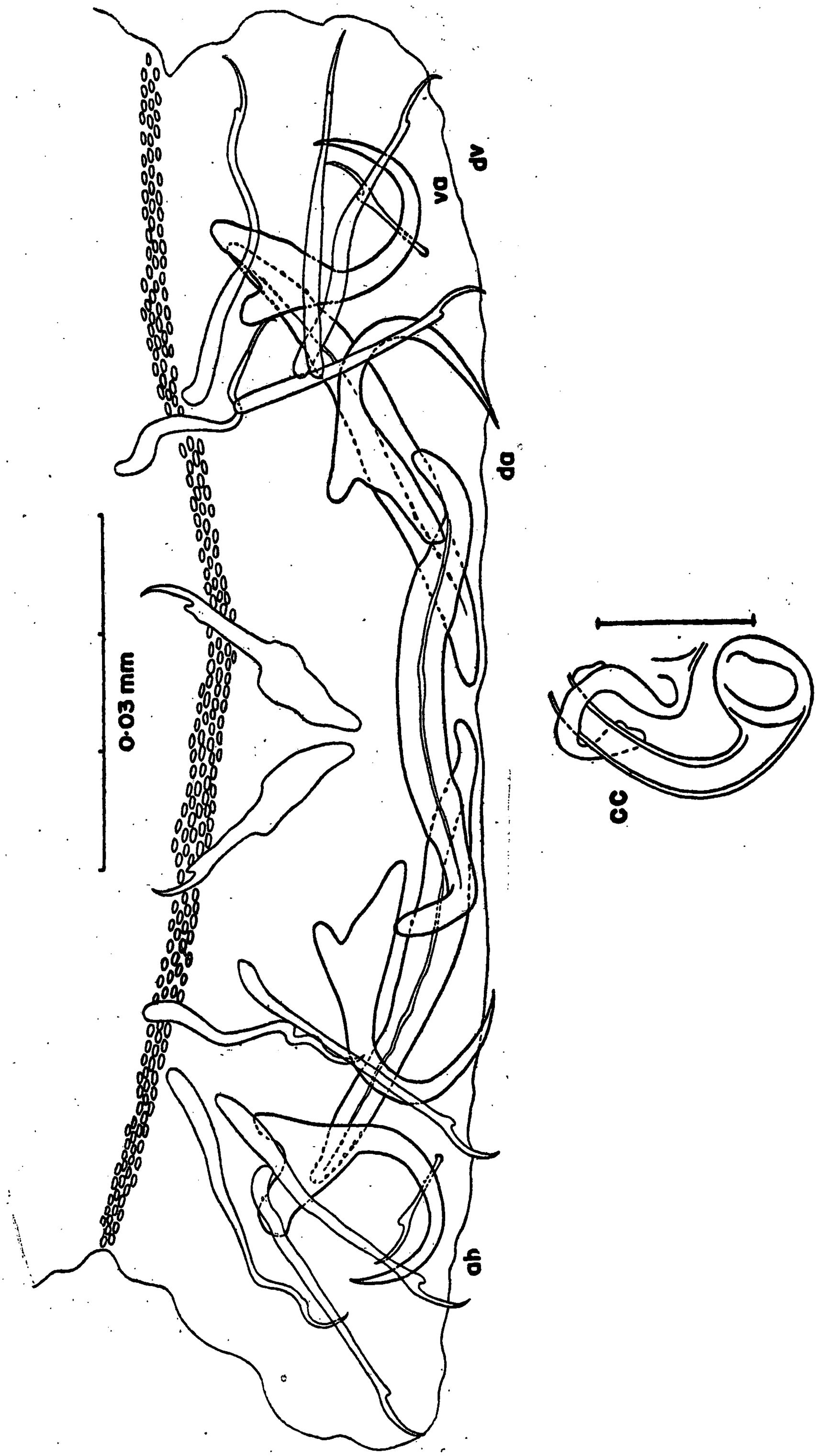



FIG. 20a

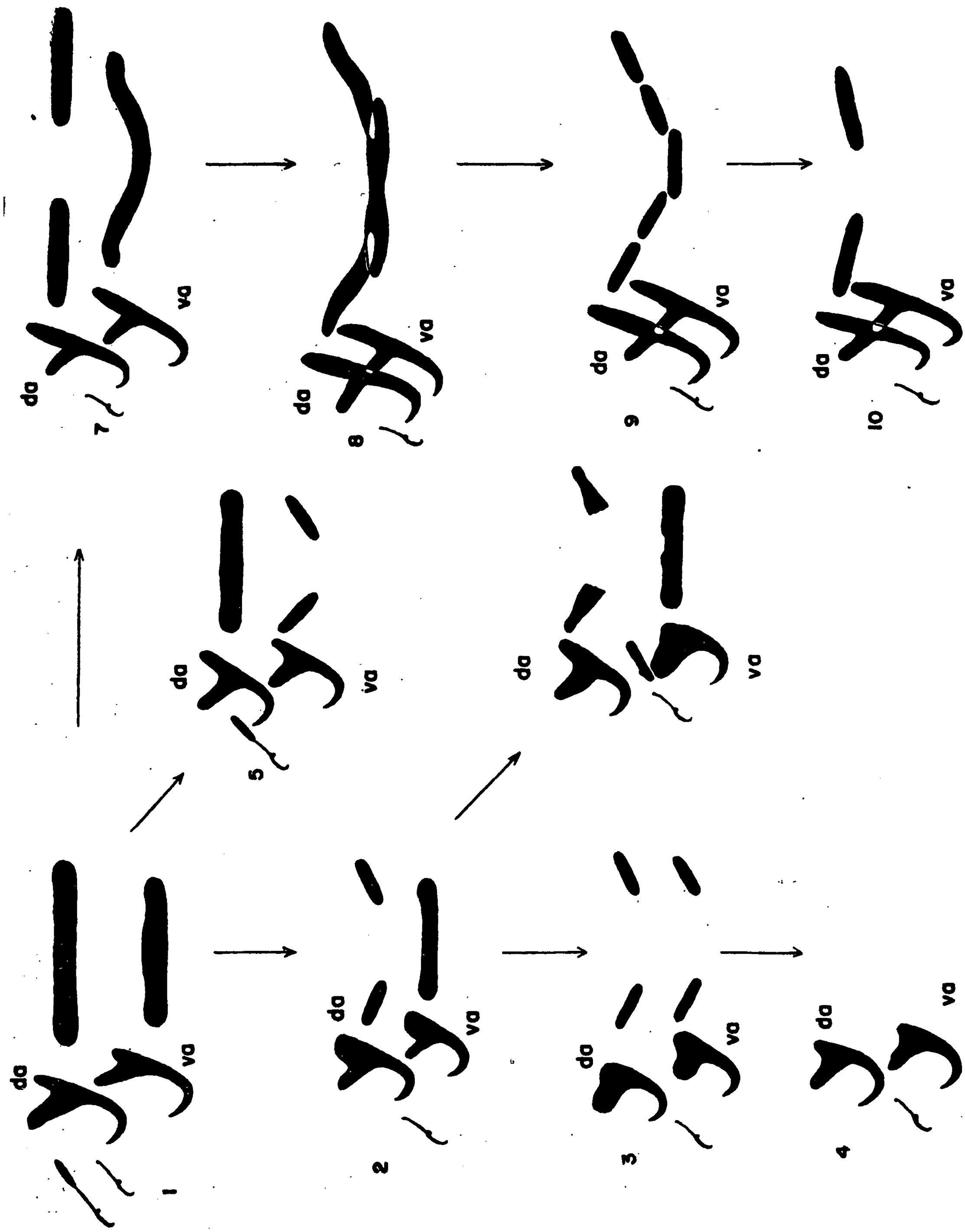



FIG. 21