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PARACROBELES AND *ACROBELES* SPECIES FROM SOUTH WEST AFRICA/ NAMIBIA WITH DESCRIPTION OF A NEW *ACROBELES* SPECIES (NEMATODA: CEPHALOBIDAE)

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ABSTRACT

Key words: *Acrobeles,* morphology, *Paracrobeles,* SEM, taxonomy

Two known and one new species of *Acrobeles* von Linstow, 1877, are described and illustrated from SWA/Namibia. *Acrobeles seelyae* n. sp. closely resembles *Acrobeles sheasbyi* Heyns & Hogewind, 1969, in having a sunken vulva and the cuticle divided into blocks, but it can be distinguished by tail shape in both sexes, position of phasmid and by the shape and size of spicules and gubernaculum. *Acrobeles thornei* Heyns, 1963 was observed under SEM and some additional information is given. This species has been recorded only from South and South West Africa. *Acrobeles ciliatus* von Linstow, 1877, is compared with *Acrobeles singulus* Heyns, 1969 and the status of *A. singulus* is discussed. *Paracrobeles laterellus* Heyns, 1968 is reported for the first time since its original description from South Africa.

Uittreksel

PARACROBELES- *EN* ACROBELES-*SPESIES UIT SUIDWES-AFRIKA/NAMIBIË MET BESKRYWING VAN 'N NUWE* ACROBELES-*SPESIE (NEMATODA: CEPHALOBIDAE)*

Twee bekende en een nuwe spesie van Acrobeles *von Linstow, 1877 word uit SWA/Namibië beskryf.* Acrobeles seelyae *n. sp. is naverwant aan* Acrobeles sheasbyi *Heyns & Hogewind, 1969 en het ook 'n versonke vulva en 'n kutikula wat in blokke verdeel is, maar dit kan in beide geslagte onderskei word deur stertvorm, posisie van fasmied en in die mannetjie ook deur die vorm en grootte van die spikulums en gubernakulum.* Acrobeles thornei *Heyns, 1963 is met behulp van die skandeerelektronmikroskoop bestudeer, en bykomstige inligting omtrent die morfologie van hierdie spesie word verskaf. Hierdie spesie is slegs uit Suid- en Suidwes-Afrika bekend.* Acrobeles ciliatus *von Linstow, 1877 word met* Acrobeles singulus *Heyns, 1969 vergelyk, en die status van laasgenoemde spesie word bespreek. Hierdie is ook die eerste aanmelding van* Paracrobeles laterellus *Heyns, 1968 sedert die oorspronklike beskrywing daarvan uit Suid-Afrika.*

INTRODUCTION

Soil samples collected by J. Heyns and A. Coomans during 1986 from several localities in South West Africa/Namibia yielded 12 genera of Cephalobidae, of which *Acrobeles, Seleborca, Chiloplacus, Zeldia* and *Acrobeloides* were the most abundant. This paper is the first in a series on the Cephalobidae of SWA/Namibia and deals with the species of *Acrobeles* and *Paracrobeles*.

MATERIAL AND METHODS

The specimens were extracted with the sugar flotation technique (Jenkins, 1964), killed by gentle heat, fixed in F. A. A. and processed to anhydrous glycerine by a modified Seinhorst method (De Grisse, 1968). The nematodes were mounted on Cobb double coverslip aluminium slides. Preparation for SEM was done according to the technique described by Luc *et al.* (1987) and the specimens examined with an ISI-SS60 scanning electron microscope at 6 kV. Pharynx, nerve ring and excretory pore were measured from oral opening. Male testis measurements incorporate the flexure.

DESCRIPTIONS

Paracrobeles laterellus Heyns, 1968 (Fig. 1A–D)

Measurements

Female (n=1): L=0,57 mm; a=17,9; pharynx= 152 µm; b=3,7; tail=50 µm; c=11,4; c=2,2; V=58,5 %.

Female: Body almost straight, slightly ventrally curved in posterior region. Body annuli distinct, 4 µm wide at midbody, divided into rectangular blocks by longitudinal lines for the first 15 annuli behind the head end. Lateral field marked by three crenate incisures, originating as a single line but soon dividing into two lines (Fig. 1B), with a 3rd line appearing at the beginning of the isthmus. Lip region continuous with body contour, 13 µm wide. Labial probolae deeply bifurcate with rounded tips, not fringed. Cephalic probolae slender with rounded to pointed tips, unfringed. Labial papillae not observed; amphid aperture oval, situated at the base of the lateral cephalic probola. Stoma 11,5 µm long, lightly sclerotized, rhabdions not distinctly separated. Procorpus cylindrical, widening to an elongate metacorpus with thick-walled lumen, which dilates to form a large triquetrous chamber. Isthmus distinctly separated from corpus by transverse marking. Basal bulb pyriform with crescentic valves. Cardia 4,5 µm long, hemispheroid. Nerve ring situated at about 66 % of pharyngeal length, encircling anterior end of isthmus. Excretory pore 106,5 µm from oral opening, opposite nerve ring. Hemizonid distinct, two annuli long, just posterior to excretory pore. Deirid not observed.

Female reproductive system cephaloboid. Spermatheca distinct, empty, ovary short, straight posterior to vulva. Postvulval uterine sac 46 µm long.

Tail convex conoid with 18 annuli on ventral side, terminus rounded, not annulated. Phasmid at 44 % of tail length. Rectum 20 µm long, i.e. about one anal body diameter. Total body annuli 198, of which 48 annuli occur from head to base of pharynx, 64 from base of pharynx to vulva, 68 annuli between vulva and anus.

Habitat and locality: Gobabeb, Namib Desert. In moist sand in river bed en route to waterhole about 40 km east of Gobabeb, Kuiseb River.

Discussion: The single female specimen from South West Africa entirely corresponds with the description of the type population from South Africa as given by Heyns (1968). No males were found.

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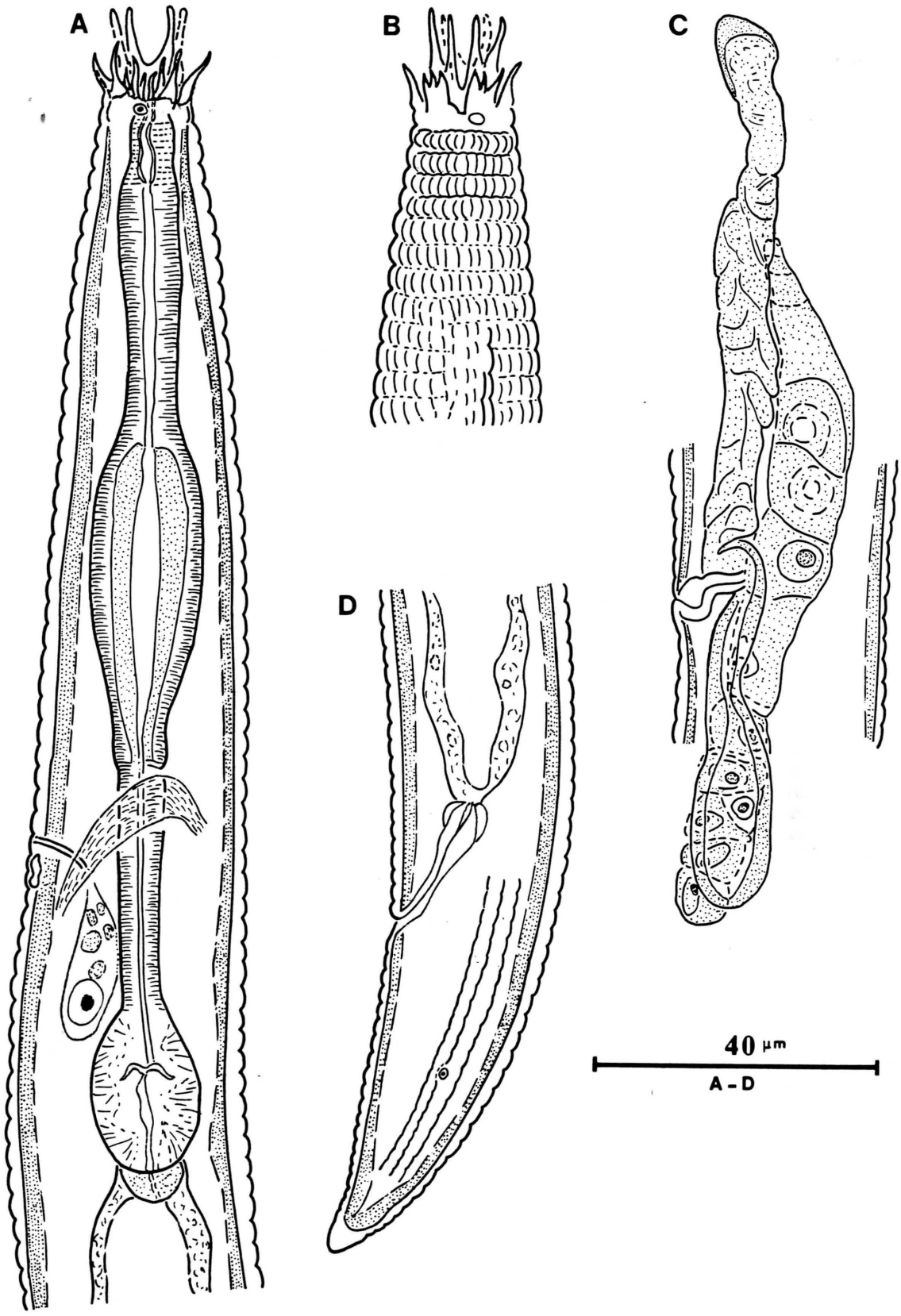

FIG. 1 *Paracrobeles laterellus*. A: Pharyngeal region; B: Head region (surface view); C: Female reproductive system; D: Female tail.

***Acrobeles ciliatus* von Linstow, 1877 (Fig. 2A–E)**

Measurements

Females (n=3): L=0,46 mm (0,41–0,49); a=17,7 (16–19,5); pharynx=123,5 µm (106,5– 134,5); b=3,7 (3,6–3,9); tail=41,4 µm (41– 42); c=11,2 (10,1–12,1); c′=2,6 (2,5–2,8); V=61,3 % (60,3–62,5).

Female: body slightly ventrally curved upon relaxation. Cuticle with distinct annuli, 2,5 µm wide. In one female cuticle with internal dots, most prominent in tail region (Fig. 2E). Lateral field marked by two simple or three crenate lines, extending beyond phasmid (Fig. 2 A and E). Head set off, distinctly wider than adjoining neck. Labial probolae straight,

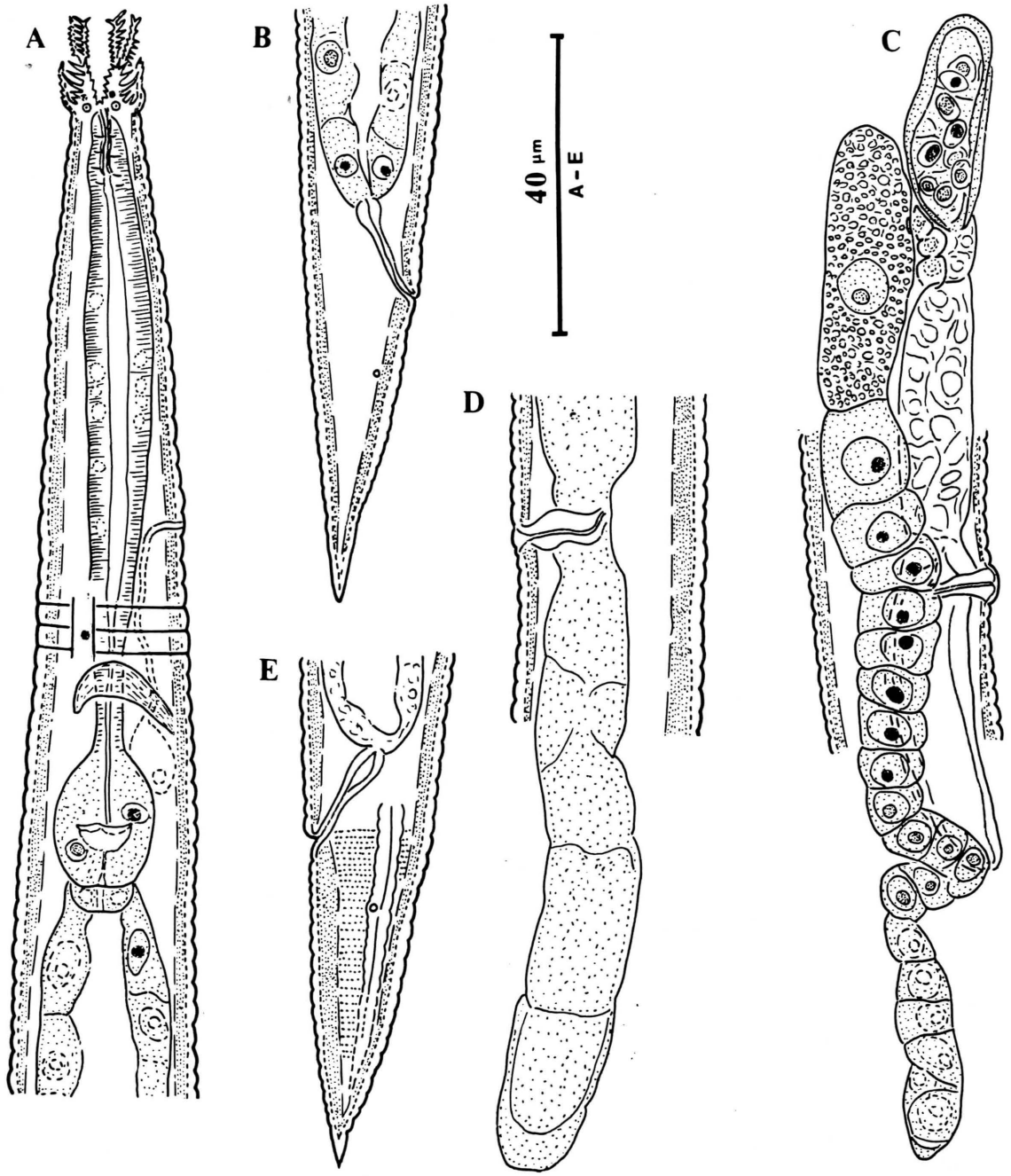

FIG. 2 *Acrobeles ciliatus* A: Female anterior region; B: Tail region; C: Female reproductive system; D: Vulval region, with long postvulval uterine sac; E: Female tail showing punctation and three incisures.

deeply bifurcate, fringed with 6–7 tines on each side of prong, apical tines unequal in length, directed anteriorly. Cephalic probolae with membranous fringes and 5–6 tines on each side. A long hooked tine, forwardly directed, at middle of each cephalic probola. Labial papillae on lateral probolae situated near base of long tine and rounded amphid aperture observed at base of lateral probolae. Stoma 9,5 µm (8,5–11,5) long, rhabdions with distinct subdivision within pharyngeal collar. Pharynx with wide lumen, corpus more or less fusiform, narrowing towards isthmus. Basal bulb ovate, with crescentic valves. Nerve ring encircling isthmus, 85 µm (82–87,5) from anterior end. Excretory pore opposite corpus at 29 µm (26–33) from oral opening. Hemizonid not seen. Deirid observed at about the level of isthmus, between lateral lines (Fig. 2A). Cardia 3,5 µm long, hemispheroid. Intestine with large cells, nuclei distinct.

Female reproductive system cephaloboid. Spermatheca well-developed, filled with spermatozoa. Ovary with double flexure posterior to vulva, oocytes in single row. Postvulval uterine branch variable in length, 57 µm (38,5–85,5) long (Fig. 2C and D).

Tail conoid, straight with finely rounded or acute terminus. Phasmid at 22–24 % of tail length (Fig. 2B and E). Rectum 16 µm (15–19) long. Total number of body annuli varies from 178 to 198, of which 36–50 occur from head to base of pharynx, 62–94 from base of pharynx to vulva, 52–54 between vulva and anus and 16–20 on ventral side of tail.

Habitats and localities: Gobabeb, Namib Desert near Kuiseb River, under *Welwitschia* plant.

Also found near water in moist sand next to Orange River at Echohoek in Augrabies Falls National Park, Republic of South Africa.

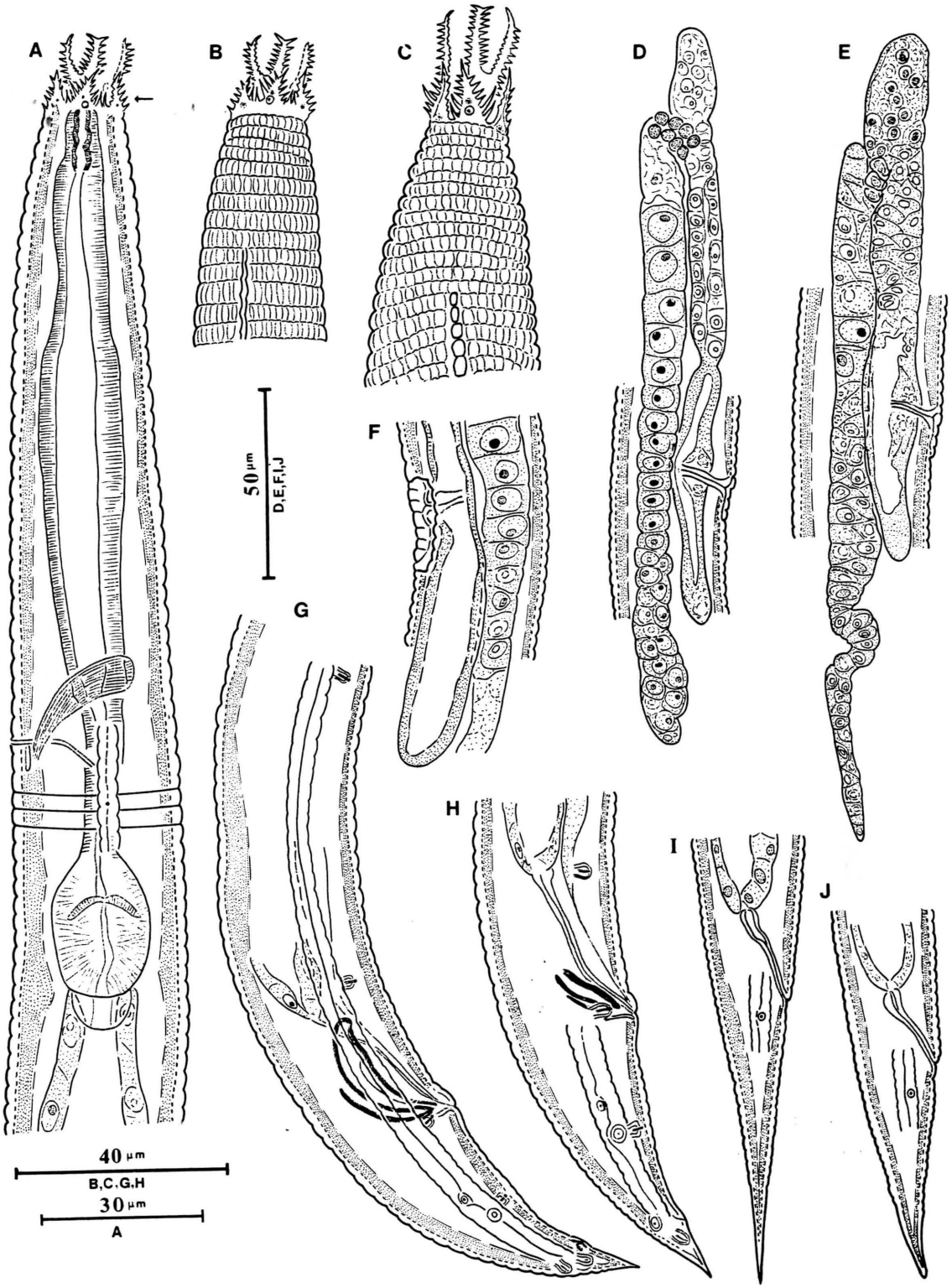

FIG. 3 *Acrobeles seelyae* n. sp. A: Female pharyngeal region; B and C: Head region (surface view) showing variation in length of labial probolae and origin of lateral lines; D and E: Female reproductive system; F: Vulval region with conspicuous cuticular flap around vulva; G: Male posterior region; H: Male tail with aberrant spicules; I and J: Variation in female tail.

Discussion: During this study we found four females, of which three agree with descriptions given for *A. ciliatus* von Linstow, 1877 (as redescribed by Thomas & Allen, 1965) whereas one female resembles *A. singulus* Heyns, 1969. The single female is not figured owing to bad fixation of anterior region. However, measurements were made: (n=1), L= 0,25 mm; a=12,6; pharynx=97 µm; b= 2,6; tail=32 µm; c=8,0; ć=2,8; V=60,7 %; postvulval uterine sac = 26 µm.

Andrássy (1985) synonymised *A. singulus* with *A. ciliatus*. Similarity in position of excretory pore, body length and vulva position suggested that they may be conspecific. However, comparison of the type specimens of *A. singulus* with our specimens of *A. ciliatus* showed distinct differences between the two species. Other populations of *A. singulus* were described from Brazil (Rashid *et al.*, 1985) and Krakatau region (Rashid *et al.*, 1989). All these populations of *A. singulus* differ from the description and

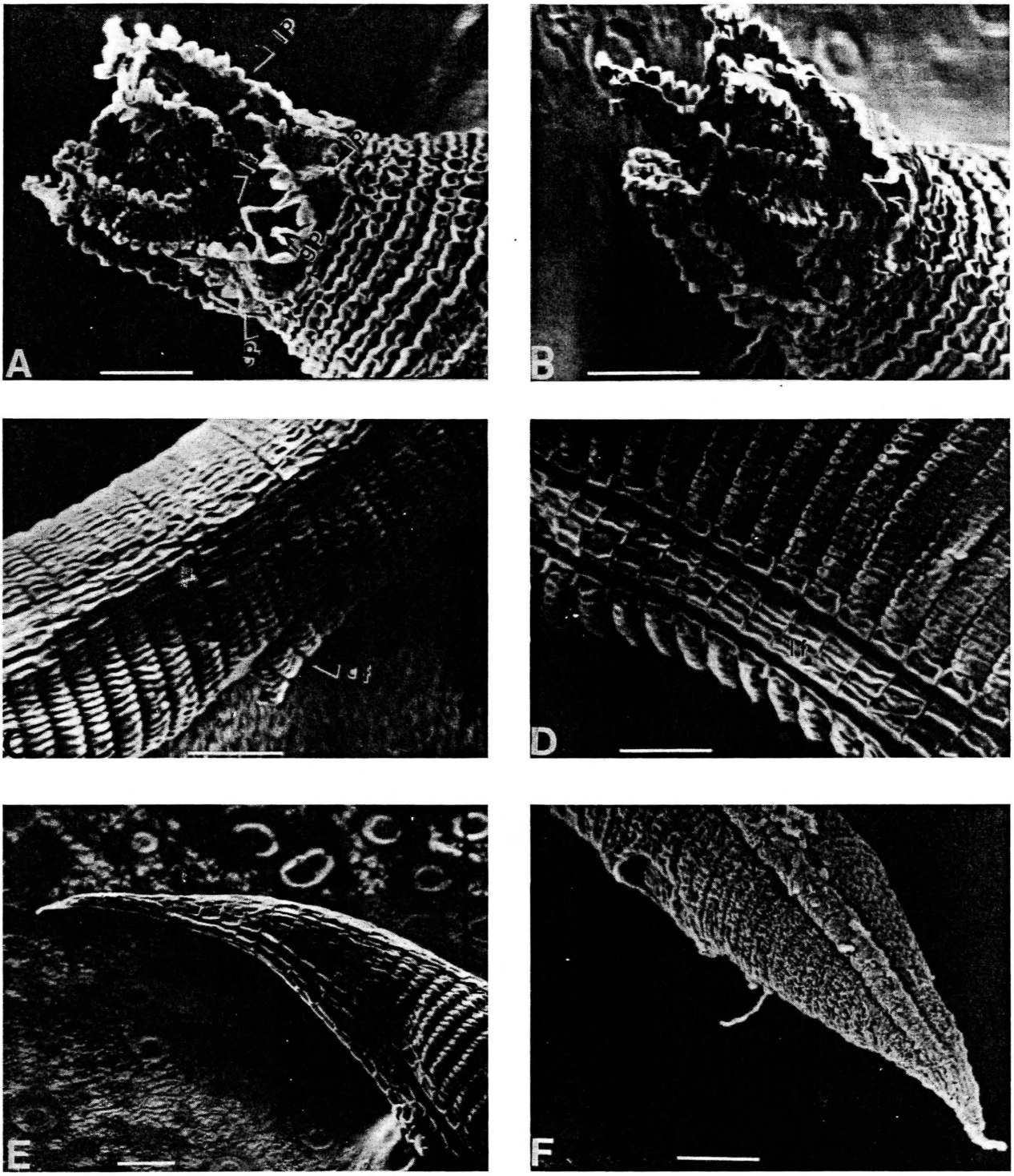

FIG. 4 *Acrobeles seelyae* n. sp. SEM: A and B: Female head (subdorsal): C: Vulva region; D: Lateral field; E and F: Female tails (lateral and subventral). Scale bars equal 5 µm. (lp=labial probola; cp=cephalic probola; gp=guard processes; p=papillae; lt=long tine; cf=cuticular flap; lf= lateral field).

present specimens of *A. ciliatus* in the following respects: postvulval uterine sac short against long, and spermatheca indistinct and empty compared with well-developed and filled with spermatozoa. Another difference is the presence of a long hooked tine on the cephalic probolae of *A. ciliatus*. This difference is confirmed by SEM study of the lip region of *A singulus* by Sauer & Annells (1984) and Rashid *et al.* (1989). We are therefore convinced that *A. singulus* is a valid species, distinct form *A. ciliatus*.

Acrobeles seelyae n. sp. (Fig. 3A–J and Fig. 4A–F)

Measurements

Holotype female: L=0,57 mm; a=18,8; pharynx =171 µm; b=3,3; tail=55 µm; c= 10,3; c'=2,5; V=65,3 %.

Paratype females (n=3): L=0,61 mm (0,54–0,66); a=18,2 (16,6–20,4); pharynx=175,5 µm; (173–186,5); b=3,5 (3,2–3,8); tail = 63 µm (55–74); c=10,0 (8,9–12,0); c'=3,0 (2,6–3,8); V=63,2 % (61,9–65,7)

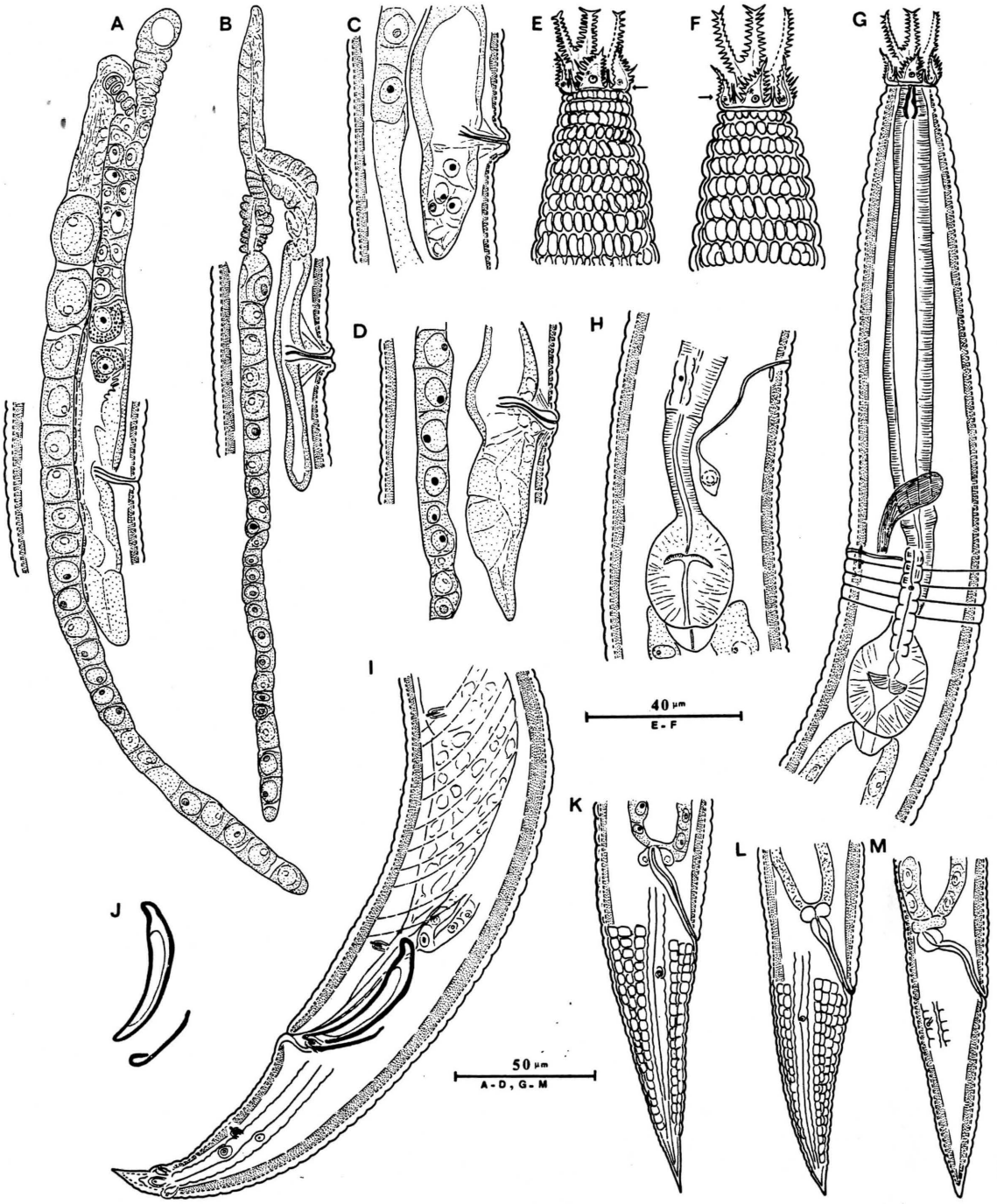

FIG. 5 *Acrobeles thornei*. A and B: Female reproductive system; C and D: Vulval region, showing variation in postvulval uterine sac; E and F: Surface view of head region (arrow indicates guard processes); G: Female anterior region; H: Pharyngeal region showing more anteriorly situated excretory pore; I: Male posterior region; J: Spicule and gubernaculum; K–M: Female tail region, showing variation.

Paratype males (n=6): L=0,58 mm (0,50– 0,67); a=19,8 (16,6–24,3); pharynx=165 µm (151–178,5); b=3,5 (3,3–3,8); tail=53 µm (50,5–56); c=11,3 (9,0–12,7); c'=2,2 (2,1– 2,5); T=56,4 % (51–62)

Other population

Female (n=1): L=0,65 mm; a=17,0; pharynx= 140,5 µm; b=4,6; tail=53 µm; c=12,2; c'=2,5; V=60,4 %

Female: Body slightly to strongly ventrally curved after relaxation. Cuticle 2,5 µm thick, annuli distinct, 4 µm wide. Cuticle divided into rectangular blocks by longitudinal striae over entire body (Fig. 3B and C and 4C and D). Lateral field marked by three incisures, crenate (Fig. 4D), originating as two crenate or block-like lines (Fig. 3B and C) 8–11 annuli from head end dividing into three opposite middle of corpus, extending up to tail terminus (Fig. 4E–F). Head as wide as adjoining neck or narrower (Fig. 3B and C and 4A). Labial probolae deeply bifurcate, variable in length (Fig. 3B and C and 4A–B), fringed with 8–11 tines on each side of prong, tines rounded to pointed, variable in length; cephalic probolae with membranous fringes and 5–6 tines on each side, with a long forwardly directed tine at dorsal edge of each probola (Fig. 3B–C and 4A–B). Cephalic axils guarded by two pointed processes (Fig. 3A–B and 4A–B). Lateral probolae each

with labial papilla and a rounded amphid at base. Stoma 12 µm (11,5–13) long, rhabdions distinct, metarhabdion with small dorsal tooth. Pharynx with wide lumen, corpus slender, widest at metacorpus, narrowing towards isthmus. Basal bulb oval with well-developed valves. Nerve ring varying in position from around posterior part of corpus to middle of isthmus, 51 % (48,6–76,2) of pharyngeal length. Excretory pore 111 µm (72–129) or about 32–35 annuli from oral aperture, located posterior to nerve ring. Hemizonid at the level of or just posterior to excretory pore. Deirid observed at level of isthmus. Cardia 6 µm (4,5–7) long, hemispheriod. Intestinal nuclei distinct.

Female reproductive system cephaloboid. Spermatheca distinct, filled with rounded spermatozoa. Ovary variable in length, with or without double flexure beyond vulva, oocytes arranged in single or multiple rows. Oviduct with four pairs of cells. Uterus with 16 cells, arranged in groups of two or four cells (Fig. 3D and E). Postvulval uterine sac variable in length, 47,2 µm (39,5–71) long (Fig. 3D–F). Vagina slightly oblique to body axis, about half vulval body width long. Vulva sunken, surrounded by cuticular flap (Fig. 3F and 4C).

Tail elongate, conoid, straight or slightly curved, annuli decreasing towards smooth tail tip, terminus finely rounded to acute (Fig. 3I and J and 4E–F). Phasmid situated at 11,6 % (7,2–14) of tail length, adanal to one annulus from anus. Rectum 23 µm (20,5–26) long. Anus an arcuate transverse slit (Fig. 4F). Total number of body annuli varies from 183 to 195, of which 39–63 occur between head and base of pharynx, 55–75 from base of pharynx to vulva and 49–63 from vulva to anus, and 16–20 ventrally on tail.

Male: Similar to female in general appearance. Monorchic, testis reflexed at anterior end. Spicules cephaloboid, 26,8 µm (26–27,5) long. Gubernaculum appearing rod-shaped, 17,8 µm (16–19) long. Three pairs of lateroventral papillae, last pair adanal, middle pair slightly anterior to proximal end of spicules (except in aberrant male, Fig. 3H) and anteriormost pair about three anal body diameters further forward. Five pairs of caudal papillae, three pairs closer to tail terminus and two pairs near phasmid (Fig. 3G and H).

Tail short, ventrally curved, terminus acute. Phasmid situated at 41,5 % (37–45) of tail length. Lateral field as in females (Fig. 3G and H). Rectum 29,5 µm (26,5–33).

Type locality and habitat: Gobabeb, Namib desert. East of Homeb, next to Kuiseb River under *Acacia albida* Dell and on sand dunes, about 40 km east of Gobabeb, under *Stipagrostis* grass.

Other habitat and locality: Caprivi, South-West Africa/Namibia. Between Katima Mulilo and Sabinda under grass and Cape teak [*Strychnos decussata* (Pappe) Gilg.].

Type specimens: Holotype female, one paratype female and five paratype males deposited in the Nematode Collection of the Rand Afrikaans University, Johannesburg, South Africa. One female and one male paratype in the Collection of the Instituut voor Dierkunde, Rijksuniversiteit Gent, Belgium.

Differential diagnosis: *Acrobeles seelyae* n. sp. closely resembles *A. sheasbyi* Heyns & Hogewind, 1969 in having a sunken vulva and the cuticle divided into blocks. Although females of both species are difficult to separate, the new species can be distinguished by relatively smaller body, position of phasmid and tail shape. Males are distinguished by the shape of the spicules (slightly curved against strongly arcuate) as well as the size of the spicules (26–27,5 µm compared with 37,5–47 µm), by the gubernaculum appearing simple rod-like, 16–19 µm long compared with 19–28 µm and curved at proximal end, and by the tail terminus being acute, not set off against distinctly set off, forming a sword-like process. This comparison is based on a study of the type population of *A. sheasbyi*. In the original description of *A. sheasbyi* only 4 pairs of caudal papillae were described but during the present study of paratype males 5 pairs were observed. In having a block-like cuticle the new species also resembles *A. undulatus* Loof, 1964 and *A. thornei* Heyns, 1963, but it differs from both species in having a sunken vulva.

This species is named after Dr. Mary Seely, Director of the Desert Ecological Research Unit at Gobabeb in recognition of her helpfulness during the collecting trip in the Namib.

Acrobeles thornei Heyns, 1963 (Fig. 5A–M and Fig. 6A–H)

Measurements

Female (n=19): L=0,92 mm (0,75–1,04); a=17,1 (13,7–19,9); pharynx=227 µm (197– 225,5); b=4,0 (3,5–5,1); tail=87,5 µm (70– 99); c=10,7 (9,3–12,5); c=2,6 (2,3–3,3); V=62,3 % (60,3–64,5).

Males (n=22): L=0,92 mm (0,81–1,03); a=16,2 (13,2–20,4); pharynx=226 µm (204,5–246); b=4,0 (3,8–4,3); tail=88 µm (72,5–99); c=10,5 (9,7–12,2); c′=2,0 (1,7–2,3); T=70 % (60,4–78).

Female: Body straight to "C" shaped upon fixation. Cuticle 2,2 µm thick, annuli 5–7,5 µm wide, divided into rectangular blocks by longitudinal striae over entire body (Fig. 5E, F, K and L). Inner cuticular layer with minute pores (Fig. 6G). Lateral field marked by three incisures, the outer ones crenate, starting as two lines 8–12 annuli from head, a third line appearing at about mid-corpus level, extending up to tail terminus (Fig. 5K and L and 6B–D). Cuticle alongside lateral field somewhat different from remainder, giving the impression of two additional areolated ridges (Fig. 6B and D). Lip region about as wide as body contour. Labial probolae straight, deeply bifurcate with membranous fringes, 7–11 tines on each side of prong, tines rounded to pointed. Cephalic probolae with membranous fringes, 7–10 tines on either side, rounded to pointed. A longer hooked, forwardly directed tine at middle of each cephalic probola (Fig. 5E and F and 6A). Cephalic axils provided with two sharply pointed guard processes (Fig. 5E and F and 6A, indicated by arrows). Labial papilla near hooked tine, rounded amphid at base of lateral probola distinct (Fig. 5E and F and 6A). Stoma 15 µm (12–17,5) long, rhabdions distinctly marked by subdivision, dorsal metarhabdion with small tooth. Pharynx subcylindrical to fusiform with wide lumen. Isthmus short, distinctly separated from corpus by a transverse marking. Basal bulb pyriform to spherical with welldeveloped crescentic valves. Nerve ring variable in position, encircling pharynx from middle to base of corpus. Excretory pore 146 µm (125,5–182,5) from oral opening, opposite metacorpus to the beginning of basal bulb. Hemizonid at level of excretory pore. Deirids observed from level of metacorpus to level of isthmus (Fig. 5G and H). Cardia conoid to hemispheriod, 7–9 µm long. Intestinal nuclei distinct.

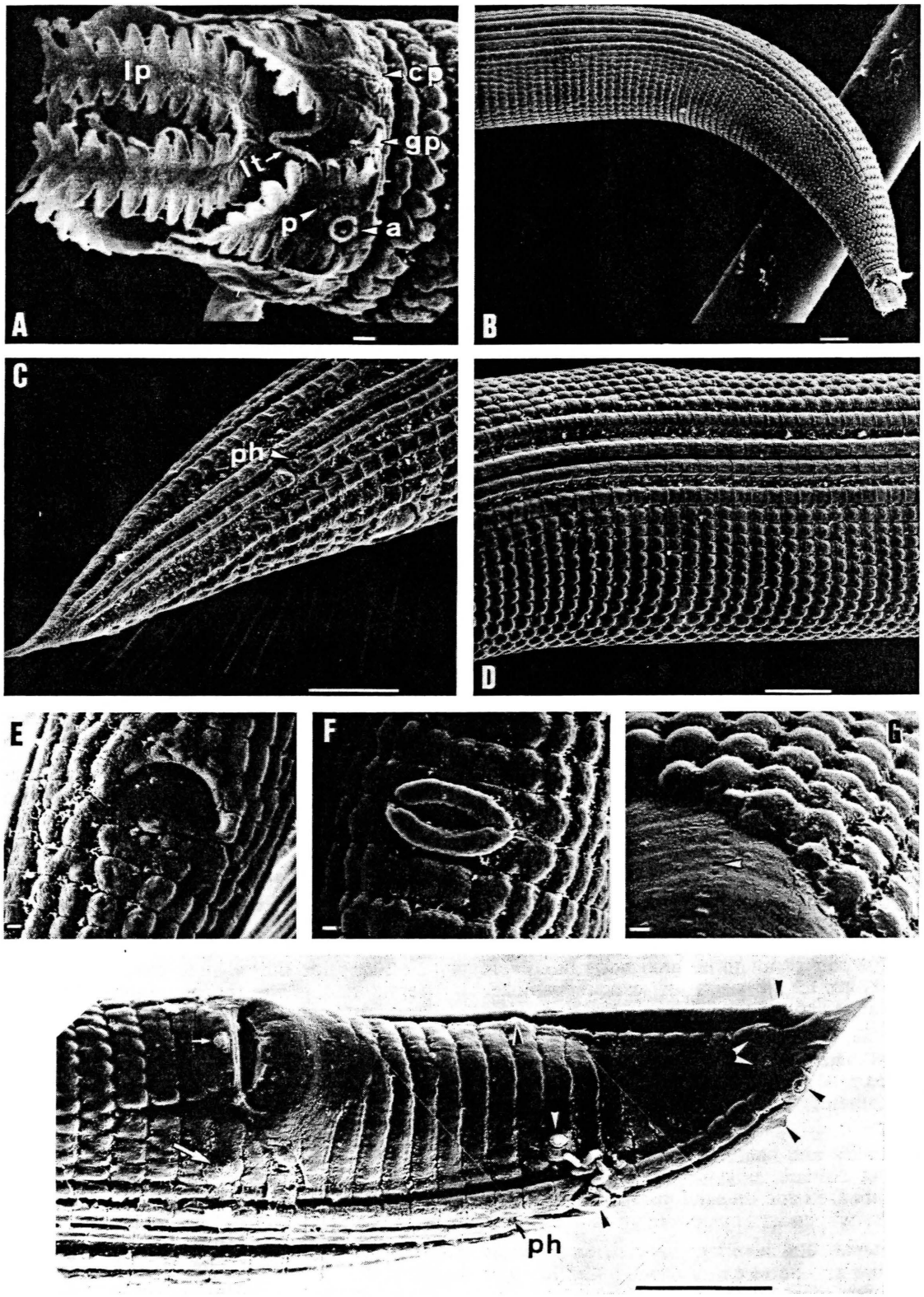

FIG. 6 *Acrobeles thornei*. SEM: A: Female head end (sublateral); B: Anterior body region; C: Female tail; D: Cuticle with lateral field at mid-body; E: Female anus; F: Vulva; G: Cuticle showing outer layer with blocks and smooth inner layer with pores (arrowhead); H: Male tail in subventral view, with mediventral papillae on anterior cloacal lip (small arrow), one of the adanal lateroventral papillae (large arrow) and eight of the ten caudal papillae (arrowheads); scale bars equal 1 µm (A,E–G) or 10 µm (B,C,D,H). (a=amphid; cp=cephalic probola; gp=guarding piece; lp=labial papilla; lt=long tine; p=cephalic papilla; ph=phasmid).

Female reproductive system cephaloboid. Spermatheca well-developed, elongate to rounded, usually empty (Fig. 5A and B). Ovary with or without double flexure posterior to vulva, oocytes arranged in single row. Oviduct with 5 pairs of cells. Vagina straight or slightly oblique towards anterior, less than one-half body diameter long. Vulva a transverse slit, lips protruding (Fig. 6C). Uterus variable in length, 16 cells observed in some specimens (Fig. 5A), alternately arranged. Postvulval uterine sac 56,5 µm (39,5–78) long, variable in shape (Fig. 5A–D).

Tail conical, straight, terminus acute to finely rounded, not annulated (Fig. 5K–M and 6C). Phasmid 1–5 annuli from anus, or at 19 % (11,6–35,9) of tail length. Rectum 34 µm (24,5–40) long. Anus a transverse arcuate slit (Fig. 6E).

Total number of body annuli varies from 174 to 204, of which 40–54 occur between head and base of pharynx, 59–83 from base of pharynx to vulva, 46–62 from vulva to anus and 17–21 ventrally on tail.

Male: corresponds to females in general structure but body more curved in posterior region. Total number of body annuli smaller than in females, 160–186. Spicules 53 µm (43,5–61) long, slightly ventrally curved. Gubernaculum appearing rod-shaped with hooked distal end (Fig. 5J), 28,5 µm (23–32,5) long. Three pairs of lateroventral papillae, last adanal, second opposite or 2–4 annuli posterior to the proximal end of the spicules, anteriormost about 16–20 annuli in front of second pair. A small medioventral papilla is present on the anterior cloacal lip (Fig. 6H). Copulatory muscles observed in some specimens (Fig. 5I). Tail ventrally curved, 16–22 annuli on ventral side, terminus pointed to finely rounded; with 5 pairs of papillae. Phasmid at about middle of tail or 37,5 % (31,6–58,6) of tail length. Rectum 53 µm (42–61) long, longer than in females. Lateral field similar to that of females.

Habitats and localities: Caprivi: between Katima Mulilo and Sabinda under grass and *Strychnos decussata* (Pappe) Gilg. (Cape teak) and in sandy soil under grasses north of Sabinda. Also 25 km from Keetmanshoop in soil under quiver trees (*Aloe dichotoma* Mass.) *Acacia* trees, grasses and succulents. Omaruru: under grasses in dry gravel and sand, 21 km north of Omaruru on road to Otjiwarongo.

Discussion: Our specimens correspond well with the descriptions given by Heyns (1963; 1969). Similar variations were observed in position of excretory pore, deirid and nerve ring. However, some differences occur in length of postvulval uterine sac (more than one body diameter against less than one body diameter), range of spicule length (43,5–61 µm against 54–58 µm) and in position of ventrolateral papillae. *A. thornei* resembles *A. seelyae* n. sp., *A. sheasbyi* Heyns & Hogewind, 1969, and *A. undulatus* Loof, 1964 in having the cuticle divided into blocks. It differs from the first two species by its vulval structure and its wider annules. Loof (1964) distinguished *A. undulatus* by its smaller size, absence of long tine on cephalic probolae, position of excretory pore, phasmid and narrower body annuli. According to the present study the position of the excretory pore and the phasmid is variable in *A. thornei,* but body length (0,69–1,04 µm compared with 0,49–0,65 µm) and width of annuli (5–7,5 µm compared with 3 µm) differ from *A. undulatus*. The type specimens of *A. undulatus* were available for comparison but they are not in good condition, so that the absence of a long tine in *A. undulatus* remains unconfirmed.

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