Procamacolaimus tubifer Gerlach, 1953, *Procamacolaimus africanus* sp.nov. and *Eontolaimus capensis* gen.nov., sp.nov., (Nematoda, Leptolaimidae) from South Africa

J.P. Furstenberg*
Department of Zoology, University of Port Elizabeth, P.O. Box 1600, Port Elizabeth, 6000 Republic of South Africa

Magda Vincx
Laboratorium voor Morfologie en Systematiek der Dieren, Instituut voor Dierkunde, K.L. Ledeganckstraat 35, B-9000 Gent, Belgium

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A female and three males of *Procamacolaimus tubifer* Gerlach, 1953 are described and illustrated from Cape Receife Beach, Port Elizabeth. *P. africanus* sp.nov. is also described from Cape Receife Beach. It is compared with *P. tubifer* which it resembles but from which it can be differentiated by length of the buccal cavity, amphid size and the shape of the spicules. *Eontolaimus capensis* gen.nov., sp.nov. is described, also from the same sandy beach. This new genus is related to *Deontolaimus papillatus* de Man, 1880 from which it can be distinguished, among other things, by the absence of a tooth-like structure in the buccal cavity and the presence of pre-anal tubuli.

'n Wyfie en drie mannetjies van *Procamacolaimus tubifer* Gerlach, 1953 word beskryf en geteken en is van Kaap Receifestrand, Port Elizabeth versamel. *P. africanus* sp.nov. is ook van Kaap Receifestrand versamel en word beskryf. Dit word vergelyk met *P. tubifer* waaraan dit verwant is maar verskil ten opsigte van die lengte van die buccale holte, die grootte van die amphiede en die vorm van die spicule. *Eontolaimus capensis* gen.nov., sp.nov. word beskryf en is ook versamel van dieselfde sandstrand. Hierdie nuwe genus is verwant aan *Deontolaimus papillatus* de Man, 1880 waarvan dit onder andere verskil ten opsigte van die afwesigheid van 'n tandagtige struktuur in die buccale holte en die teenwoordigheid van pre- anale tubuli.

*To whom correspondence should be addressed

All three species were collected from the same sandy beach at Cape Receife, 2 km south of Port Elizabeth (22°41'30"E / 34°0'30"S). Cape Receife is a sheltered beach with a steep slope and is partly protected from strong wave action which results in the deposition of seaweed into the intertidal zone. Particle size 300 µm.

Materials and methods

Intertidal sediment samples were taken with a copper corer 65 cm long and 3,6 cm wide. Samples were collected from LWS to HWS, ranging from 0–15, 15–30, 30–45, 45–60, 60–75 and 75–90 cm from the surface.

All samples were extracted by four decantations each. Specimens were fixed in hot (60°C) 6% formalin - seawater solution and mounted in glycerine after dehydration (Seinhorst 1959). 'En face' views and other sections were mounted in glycerine jelly. Drawings were made with the aid of a drawing tube on a Leitz Dialux 20 interference contrast microscope.

All measurements are in micrometres; curved structures are measured along the arc.

The holotype males and allotype females are deposited in the collection of the Instituut voor Dierkunde, Rijksuniversiteit Gent, Belgium. Other paratype material is kept in the Department of Zoology, University of Port Elizabeth, Port Elizabeth, South Africa. The specimens of *Procamacolaimus tubifer* are also deposited in the two Institutes.

Values in the formula used indicate the following:

$$\frac{\text{Head (Ceph. set.) Nerve ring Phar.end M/Vulva Anus}}{\text{Corresponding body diameter (µm)}} \quad \text{Body length}$$

Measurements above line of body length in µm from ant. end to measured organ.

M: (largest body diameter) was also used in the female when largest body diameter was not at the vulval level.

Body regions were named in accordance with Coomans (1979).

Abbreviations used in the text

L: body length
a: body length divided by greatest body width
b: body length divided by pharyngeal length
c: body length divided by tail length
c': tail length divided by anal body width
V: distance of vulva from ant. end as a percentage of body length.

Procamacolaimus tubifer Gerlach, 1953 (Figure 1, A–H)

This is a redescription of *P. tubifer*. Three males and one female are recorded — all from Cape Receife Beach at depths of between 15–90 cm, HWS. The only female was extracted from a 75–90 cm sediment sample. Sampling date 12 August, 1986.

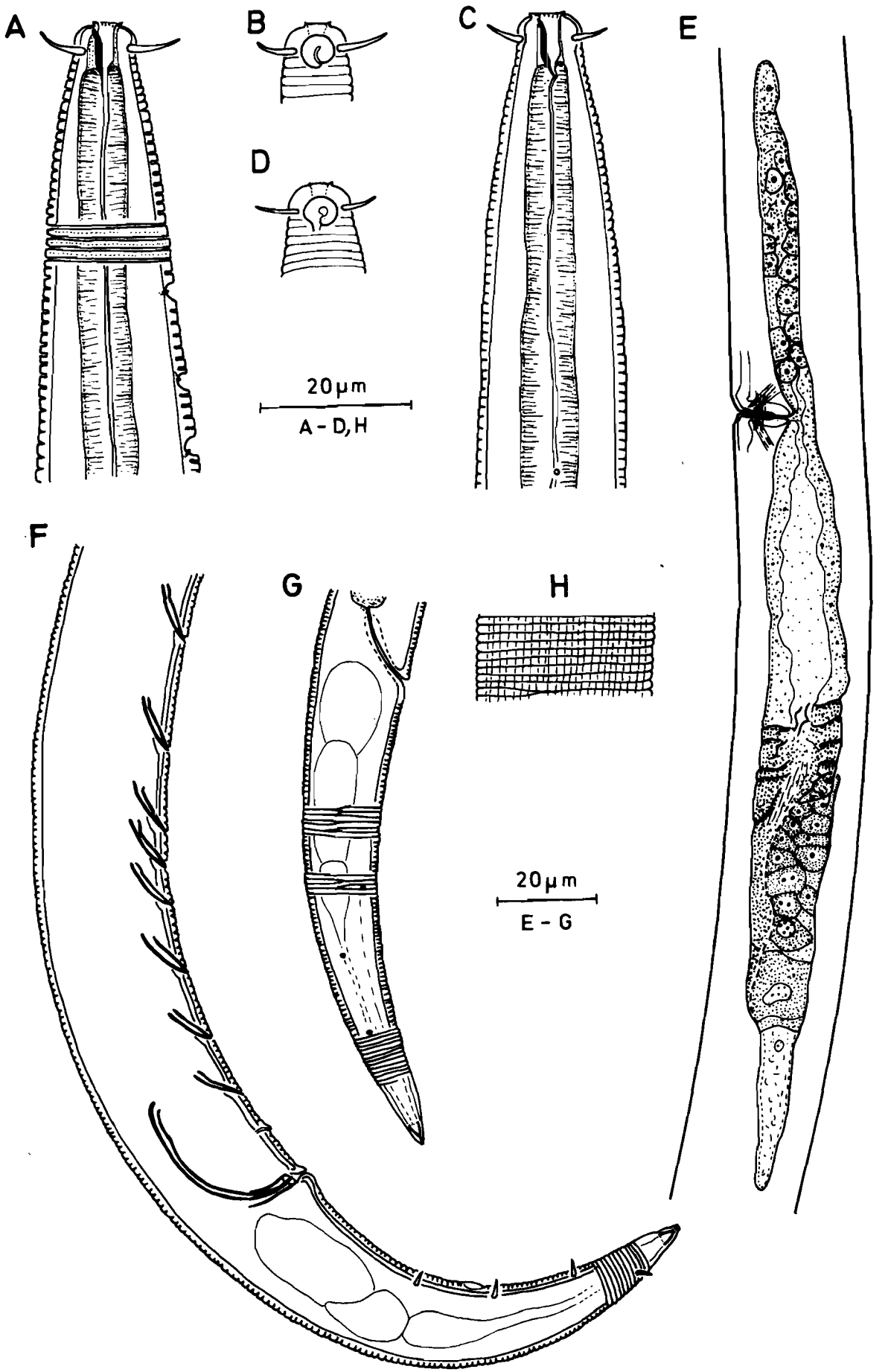

Figure 1 *Procamacolaimus tubifer* Gerlach, 1953. A: Anterior end of ♂1; B: Head end of ♂1; C: Anterior end of ♀1; D: Head end of ♀1; E: Genital system of ♀1; F: Tail region of ♂1; G: Tail of ♀1; H: Annulations ♀1.

Measurements

σ_1 $\frac{4\ \ 94\ \ 209\ \ M\ \ 988}{8\ \ 19\ \ 25\ \ 25\ \ 24}$ 1074 µm (slide no. 941)

a = 43,1; b = 5,1; c = 12,5; c′ = 3,6; spicule = 37 µm

φ_1 $\frac{4\ \ ?\ \ 193\ \ 479\ \ 878}{8\ \ ?\ \ 22\ \ 23\ \ 19}$ 970 µm (slide no. 942)

a = 42,2; b = 5,0; c = 10,5; c′ = 4,8; V = 49,4%

Other males: L = 1017; 1038 µm: a = 46,9; 47,5: b = 5,4; 5,6: c =12,1; 12,3: c′ = 3,7; 4,3: spicule = 36;42 µm.

Descriptions

Males: Body slender, tapering towards anterior end. Head slightly demarcated. Cuticle distinctly annulated. From the pharyngeal level on very faint longitudinal striae are present on the annules. Annules in pharyngeal region 1,5 µm wide; in the tail region annules are more demarcated. 35 to 48 anterior ventral supplements are developed; they consist of a concave invagination in the cuticle; at the bottom of each invagination is a small papilla which is connected with a glandular (?) duct. The anterior-most supplement is situated at 25–36 µm of the head end; less supplements are caused by a loss of the anterior ones. The distance between the supplements ranges between 9 and 12 µm; the posterior ones are situated at the level of the testis.

Lip region slightly elevated and forms a separate edge. Labial sensilla not visible. The four cephalic setae are 5–6 µm long. The amphideal fovea has a circular contour, but the spiral origin is obvious; it is 4 µm wide, i.e. 45% of corresponding body diameter;the amphid is ventrally wound with the exit of the amphideal nerve posteriorly visible. The buccal cavity is 5–7 µm deep and 3 µm wide. A hollow dorsal tooth is present, 5–6 µm long. Buccal cavity surrounded by only a narrow protrusion of the muscles of the pharynx. Pharynx muscular, slightly widened at base. Nerve ring approximately 45% of pharyngeal length. Ventral pore and ventral gland cell not found. Cardia 7 µm long. Diorchic, two 'anterior'; very short outstretched testes, situated at the right of the intestine.

Spicules paired, equal, arcuate and slender 36–42 µm long; gubernaculum formed a sheath around the distal tip of the spicule. Seven to eight pre-anal well sclerotized tubiform supplements not equidistant from each other. Distance of anterior and posterior pre-anal supplements from cloaca approximately 4,5 and 1 anal body width respectively. Between posterior pre-anal supplement and cloaca a less prominent papilla with duct is present.

Three caudal glands. Tail conical, tapered. Posterior 9 µm of 83–86 µm long tail not annulated. A well sclerotized spinneret is obvious. Three subventral setae present on the tail; two subdorsal setae near the tail tip. A papillae-like structure with no gland connections or ducts, is situated ventrally 1,5 anal widths posterior to the cloaca.

Female: Similar to males except in following respects: ventral supplements, the papillae-like structure on the tail and post cloacal setae absent.

Monodelphic with posterior ovary antidromously reflexed to the right. The whole genital system is situated at the left side of the intestine. The vagina is well sclerotized and 12 µm long. A prevulvar spermatheca has approximately the length of the uterus and is filled with numerous globular sperm cells.

Discussion

In most aspects, the South African specimens of *Procamacolaimus tubifer* Gerlach, 1953 are similar to the specimens described by Gerlach from Madagascar (type locality) (1953), Maldive Islands (1962) and the Red Sea (1967). The specimens described here are nevertheless 20% longer and the number of pre-anal supplements is 7 to 8. Gerlach's specimens have 5 to 7 pre-anal supplements, which indicates the intraspecific variation of this character state.

***Procamacolaimus africanus* sp.nov.** (Figure 2, A–J)

Type material: one male, one female.
Holotype ♂; paratype ♀, all from Cape Receife Beach, depth 60–75 cm from surface at HWS. Sampling date 12 August, 1986.

Measurements

Holotype

σ_1 $\frac{3\ \ 74\ \ 150\ \ M\ \ 708}{7\ \ 18\ \ 19\ \ 20\ \ 19}$ 783 µm (slide no. 943)

a = 39,2; b = 5,2; c = 10,4; c′ = 4,0.

Paratype

φ_1 $\frac{3\ \ 62\ \ 149\ \ 346\ \ 659}{7\ \ 16\ \ 18\ \ 22\ \ 16}$ 744 µm (slide no. 944)

a = 33,8; b = 5,0; c = 8,8; c′ = 5,3; V = 46,5%

Description

Male: Body slender, tapering towards anterior end with pointed conical tail. Ventral papillae prominent, 42 in number, with the most anterior papillae 30 µm from lips. Fifty-five per cent of body length bears ventral papillae.

Cuticle with conspicuous annulation, from the level of the cephalic sensilla to the tail (except the tip). Annules in the pharyngeal region slightly more than 1 µm wide. Mouth is surrounded by an elevated lip region, cap-like in appearance. Each lip bears an inner labial papillae. Lateral external papillae are visible (*cf.* Figure 2D). Four cephalic setae, 5 µm long. A large circular amphid is present, in diameter almost 80% of corresponding body width; 6 µm wide. Exit of the amphideal nerve posteriorly visible which indicates the spiral origin of the amphid. The amphideal fovea consists of a deep invagination (Figure 2E) which almost reaches the borders of the buccal cavity.

The buccal cavity is 10 µm long and 3 µm wide and contains a hollow dorsal tooth almost 9 µm long.

Pharynx muscular, slightly widened at base; the

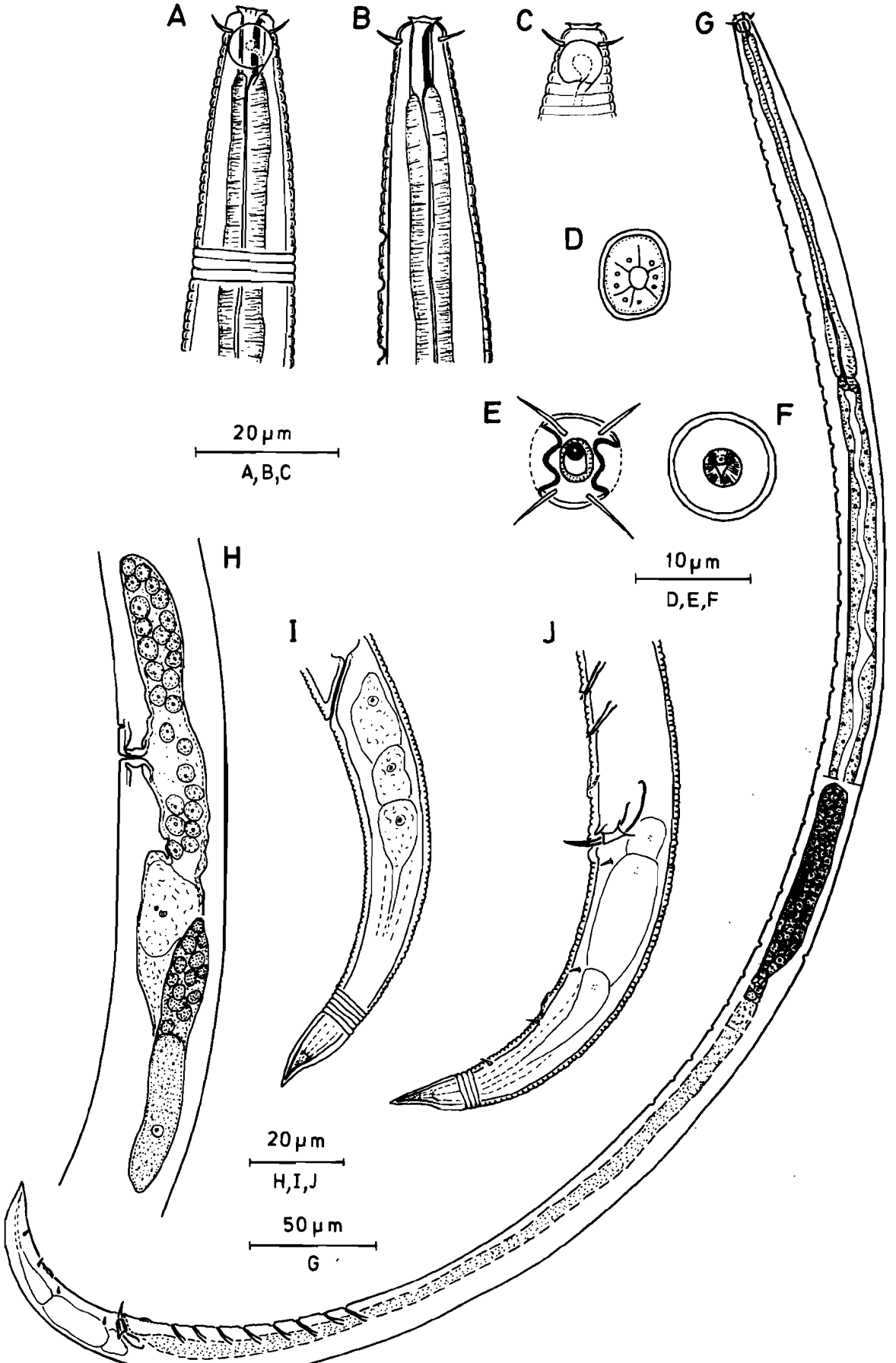

Figure 2 *Procamacolaimus africanus* sp.nov. A: Anterior end of paratype ♀$_1$; B: Anterior end of holotype ♂$_1$; C: Head end of holotype ♂$_1$; D: En face view of a juvenile (top-level); E: En face view of a juvenile (level of amphideal fovea and hollow 'tooth'); F: En face view of a juvenile (pharyngeal level); G: Total view of holotype ♂$_1$; H: Genital system of paratype ♀$_1$; I: Tail of paratype ♀$_1$; J: Tail region of holotype ♂$_1$.

pharynx is very narrow around the buccal cavity and becomes very muscular from the posterior end of the buccal cavity on.

Nerve ring at 49% of pharyngeal length. Ventral pore and ventral gland cell not found. Cardia 5 µm long.

Reproductive system with two outstretched testes; the anterior one is situated at the left, the posterior one is very short and is situated at the right of the intestine. Spicules are paired, equal and arcuate, 24 µm long and 3,2 µm at the widest point. They expand in width gradually to the proximal end. Gubernaculum surrounds the distal part of the spicule. Eight pre-anal tubiform sclerotized supplements present. Distance of anterior and posterior pre-anal supplement from cloaca five body widths and one body width respectively. Between the posterior pre-anal papilla and cloaca a prominent papilla with duct is found. Four ventrally and latero-ventrally post-cloacal setae. A papilla-like structure with no gland connection or duct is situated ventrally two anal widths from cloaca. Three caudal glands. Tail conical, with the last 9 µm of the tail conspicuously tapered to a sharp point. Last 13 µm of 82 µm long tail without annulation.

Female: Similar to male except in following aspects: ventral papillae, the papilla-like structure on the tail and the postcloacal setae are absent.

Reproductive system: monodelphic, with antidromously reflexed (to the left) posterior ovary. A prevulvar spermatheca, filled with globular sperm cells is almost as long as the uterus, which is also provided with sperm cells. Vagina well sclerotized and 6 µm long. One ventral papilla (*cf.* structure of papillae in the males) is situated at 6 µm anterior of the vulva.

Differential diagnosis

Procamacolaimus africanus sp.nov. is closely related to *P. tubifer* Gerlach, 1953 but differs in the shape of the spicules; the buccal cavity being longer and cylindrical in shape in the new species; shorter cephalic setae, larger amphids and a peculiar tapered tail shape are also characteristic for *P. africanus* sp. nov.

Only *P. africanus* sp.nov. and *P. tubifer* of the genus *Procamacolaimus* have ventral papillae in the males.

Eontolaimus capensis **gen. nov., sp. nov.** (Figure 3, A–G)

Eontolaimus **gen. nov.**

Diagnosis

With the characters of the subfamily Camacolaiminae (fam. Leptolaimidae) (see Lorenzen 1981).

Distinctive characters of the new genus are a cylindrical stoma without teeth or thickened walls, the presence of pre-anal tubuli and anterior ventral papillae in males and one reflexed posterior ovary.

Type species: *Eontolaimus capensis* sp.nov.

Eontolaimus capensis **sp.nov.**

Type material: Five males, five females. Holotype male σ'_1, paratype (allotype) female φ_1 and other paratypes (σ'_{2-4}; φ_{2-4}) from Cape Receife Beach, Port Elizabeth. Samples taken at HWS at 60–75 cm and 75-90 cm depths. Sampling date 12 August, 1986.

Measurements

Holotype

σ'_1 $\frac{1,3 \quad 81 \quad 161 \quad M \quad 629}{4 \quad 17 \quad 18 \quad 18 \quad 17}$ 720 µm (slide no. 945)

a = 40,0; b = 4,5; c = 7,9; c′ = 5,4 spicules 23 µm

Paratype

φ_1 $\frac{1,5 \quad 76 \quad 150 \quad 310 \quad 606}{4 \quad 16 \quad 18 \quad 20 \quad 15}$ 701 µm (slide no. 946)

a = 35,1; b = 4,7; c = 7,4; c′ = 6,3; V = 44,2%.

Other paratypes

Males (σ'_{2-4}): 680–765; a = 38–41; b = 4,3–4,7; c = 8,1–8,8; c′ = 4,5–5,8; spicules 22–25 µm.

Females (φ_{2-4}): 611–671; a = 34,8–35,1; b = 4,7–4,9; c = 7,1–7,5; c′ = 5,7–6,8; V = 44,0–45,1%.

Description

Males: Body tapering towards extremities. Head only 4 µm wide at the level of the cephalic setae. Cuticle annulated. Anterior ventral papillae (n = 12–19) conspicuous in all male specimens. The last papilla is situated between the cardia and the anterior border of the anterior testis.

Labial sensilla not found. Four cephalic setae, 2 µm long and situated at the anterior border of the amphideal fovea. The latter has a circular contour, but the spiral origin is obvious by a posterior dorsal interruption; ventrally wound. The amphid is 4 µm wide, i.e. 83% of corresponding diameter.

Buccal cavity cylindrical without teeth or thickened walls; twice head diameter in length i.e. 8 µm. Pharynx muscular, slightly widened at base. Nerve ring at approximately 50% of pharyngeal length. Ventral pore and ventral gland cell not found. Cardia 4 µm long.

Reproductive system: two outstretched testes are situated at the right of the intestine. Spicules paired, equal, 22–25 µm long and 3 µm wide in the middle. Gubernaculum 6–8 µm long. Two well sclerotized and tubiform pre-anal supplements present. Distance of anterior and posterior pre-anal supplements from cloaca 3 and 1,6 anal body widths respectively. Between posterior pre-anal supplement and cloaca a prominent papilla with duct.

Three caudal glands inconspicuous. Tail conical, tapered. No post cloacal setae or other somatic setae found. A papilla-like structure is situated ventrally in middle of tail.

Females: Similar to males except in following aspects: ventral papilla, pre-anal tubuli and papilla-like structure on tail absent.

Reproductive system with one reflexed (to the right)

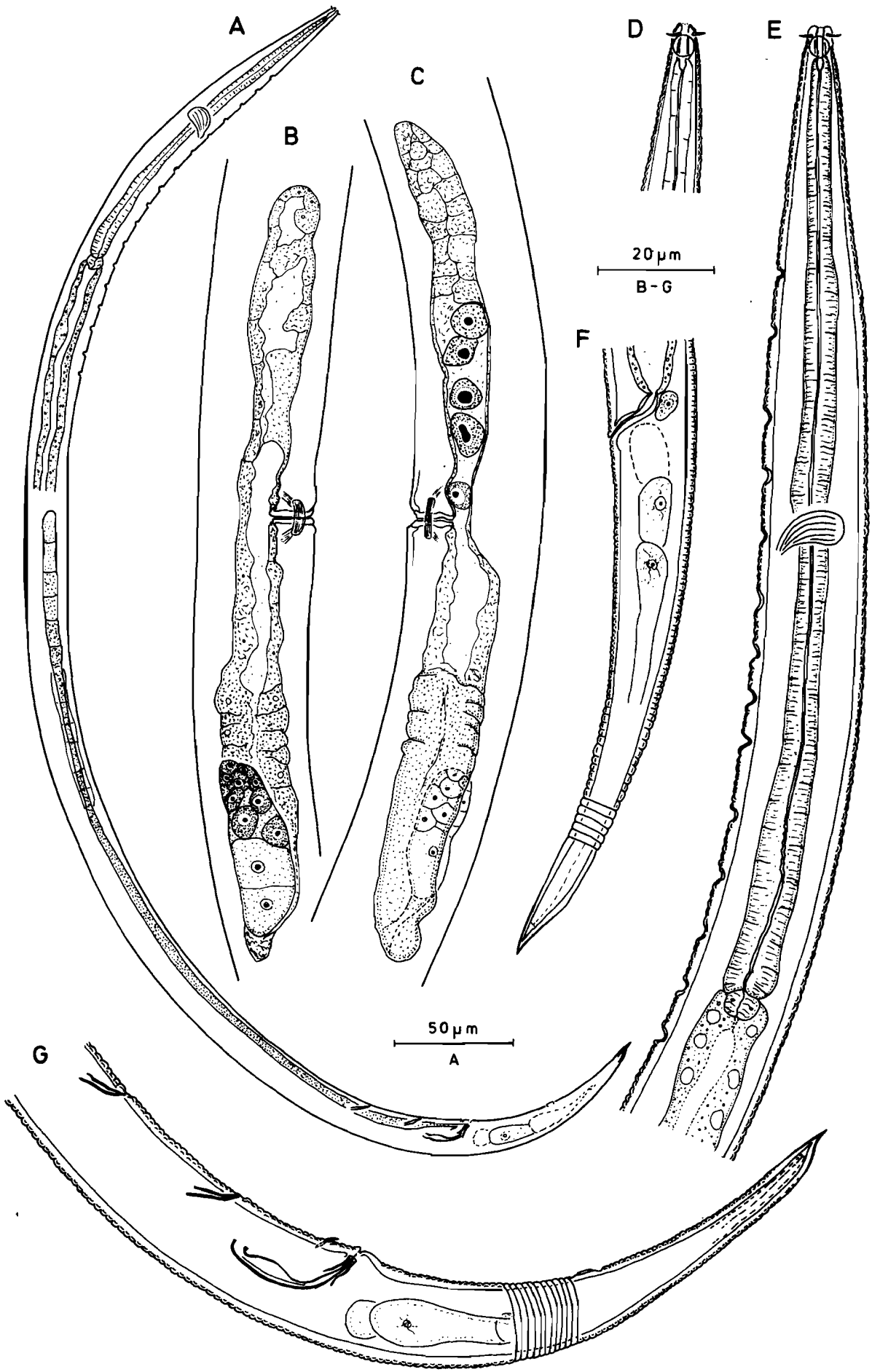

Figure 3 *Eontolaimus capensis* gen.nov., sp.nov. A: Total view of paratype ♂2; B: Genital system of paratype ♀1 (right side); C: Genital system of paratype ♀1 (left side); D: Anterior end of paratype ♀1; E: Anterior end of holotype ♂1; F: Tail of paratype ♀1; G: Tail region of holotype ♂1.

posterior ovary; an anterior, thick-walled spermatheca is as long as the posterior branch of the genital system. The vagina is 8 µm long and is obviously sclerotized. The anterior branch of the genital system is situated at the right of the intestine; the posterior branch is situated at the left of the intestine.

Discussion

Eontolaimus capensis gen. nov., sp.nov. belongs to the Leptolaimidae Örley, 1880 (as redefined by Lorenzen 1981). Lorenzen (1981) recognized three subfamilies in the Leptolaimidae: Leptolaiminae Örley, 1880, Anonchinae Andrássy, 1973 and Camacolaiminae Micoletzky, 1924. These three subfamilies are not very well defined.

In general, the species of the Leptolaiminae and the Anonchinae are characterized by the presence of a buccal cavity without a spear-like tooth (at most very small teeth in some genera) and the presence of a rounded, mostly swollen tail tip. The species of the Camacolaiminae are characterized by the presence of a dorsal spear-like tooth in the buccal cavity of most species and a sharp, pointed tail-tip.

Eontolaimus capensis sp.nov. has characteristics of the three subfamilies. But the very typical pointed tail-tip, the shape of the spicules and pre-anal tubuli and the presence of prominent anterior ventral papillae in the males suggest the position within the Camacolaiminae.

Because of the presence of the anterior ventral papillae in the males, a ventral papilla on the tail and two anterior outstretched testes, the new species is related to the only species of the genus *Deontolaimus* de Man, 1880 of tbe Camacolaiminae. Important differences with *Deontolaimus papillatus* de Man, 1880 are:

— absence of tooth-like structures in the buccal cavity
— absence of a non-annulated lateral field
— presence of pre-anal tubuli in the males
— only one posterior antidromously reflexed ovary (*D. papillatus* has two antidromously reflexed ovaries).

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References

COOMANS, A. 1979. A proposal for a more precise terminology of the body regions in the nematode. *Annls. Soc. r. Zool. Belg.* 108: 115–117.

GERLACH, S.A. 1953. Recherches sur la faune des eaux interstitielles de Madagascar. III. Sur quelques Nématodes libres des eaux souterraines littorales de Madagascar. *Mém. Inst. scient. Madagascar* (A) 8: 73–86.

GERLACH, S.A. 1962. Freilebende Meeresnematoden von den Malediven. *Kieler Meeresforsch.* 18: 81–108.

GERLACH, S.A. 1967. Die Fauna des Küstengrundwassers am Strand der Insel Sarso (Rotes Meer). *Meteor – Forschungsergebnisse* (D) 2: 7–18.

LORENZEN, S. 1981. Entwurf eines phylogenetischen Systems der freilebenden Nematoden. *Veröff. Inst. Meeresforsch. Bremerhaven. Suppl.* 7: 1–472.

SEINHORST, J.W. 1959. A rapid method for the transfer of nematodes from fixative to anhydrous glycerine. *Nematologica* 4: 67–69.