

## Two New Species of *Epsilonema* from South Indopacific (Nemata, Epsilonematidae)

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**Abstract:** Two new species of *Epsilonema* are described from coral sand from Polynesia and New Caledonia. *Epsilonema exoticum*, with ca. 131 annules, is characterized by heterogeneous vacuolar ornamentation, small amphid, and male with small field of tiny copulatory thorns. *Epsilonema enigmaticum*, with ca. 168 annules and small vacuoles and ridges on the cuticle, differs from all other species of the genus by the number (10-16) of subcephalic setae.

**Key words:** *Epsilonema*, marine nematode, nematode, taxonomy.

Within the family Epsilonematidae, the genus *Epsilonema* is the most diversified, with 19 known species collected worldwide, mostly from sandy ocean beaches. *Epsilonema* specimens were present in many of our samples from French Polynesia and New Caledonia. In this paper, two more species are described: *Epsilonema exoticum* sp. n. and *E. enigmaticum* sp. n.

### MATERIALS AND METHODS

Supralittoral interstitial samples from beach stations in Moorea and New Caledonia were taken with the Karaman-Chappuis digging method in which the interstitial fauna was concentrated by filtration through the water table from a hole dug deep into the sediment (3). Samples were fixed with 7% neutralized formalin, sorted by the elutriation-washing technique, and the nematodes mounted in anhydrous glycerin.

Type specimens are deposited in the nematode collections of the Muséum national d'Histoire naturelle, Paris (MNHN) and the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels (KBIN). Type specimens of *Epsilonema exoticum* only are deposited in the Smithsonian Institution, Washington, D.C., USA (USNM).

**List of abbreviations for Tables:** abd = body diameter at level of anus/cloacal opening;

amph % = amphid diameter as a percentage of the corresponding head diameter; Asl 1 = length of anteriormost ambulatory setae of external rows; cs = length of cephalic setae; gub = length of gubernaculum; hl = maximum head length; hw = maximum head width; L = body length; mbd = maximum body diameter at mid-body level; (mbd) = minimum body diameter; mbdph = body diameter at base of pharynx; N = number of body annules; spic = length of spicule measured along the median line; tmr = length of nonannulated tail region; v = distance of vulva to head apex; a, b, c = proportions of de Man; V = position of vulva as a percentage of total body length from anterior.

### SYSTEMATICS

Family Epsilonematidae Steiner, 1927  
Subfamily Epsilonematinae Steiner, 1927

Genus *Epsilonema* Steiner, 1927

*Epsilonema exoticum* sp. n.

(Fig. 1)

### Description

**Males:** Measurements of male holotype, 11 males from Polynesia and one male from New Caledonia in Table 1. Body epsilon-shaped, relatively small (305-435  $\mu\text{m}$ , one specimen reaching 520  $\mu\text{m}$ ), largest body width in the posterior region (a = 9.8-16.9). Cuticle with 129-134 annules overlapping with change in direction, ventrally at level of the anterior dorsal curvature, and dorsally at the second curvature. Cuticular ornamentation heterogeneous: first 6-7 annules smooth with a central lu-

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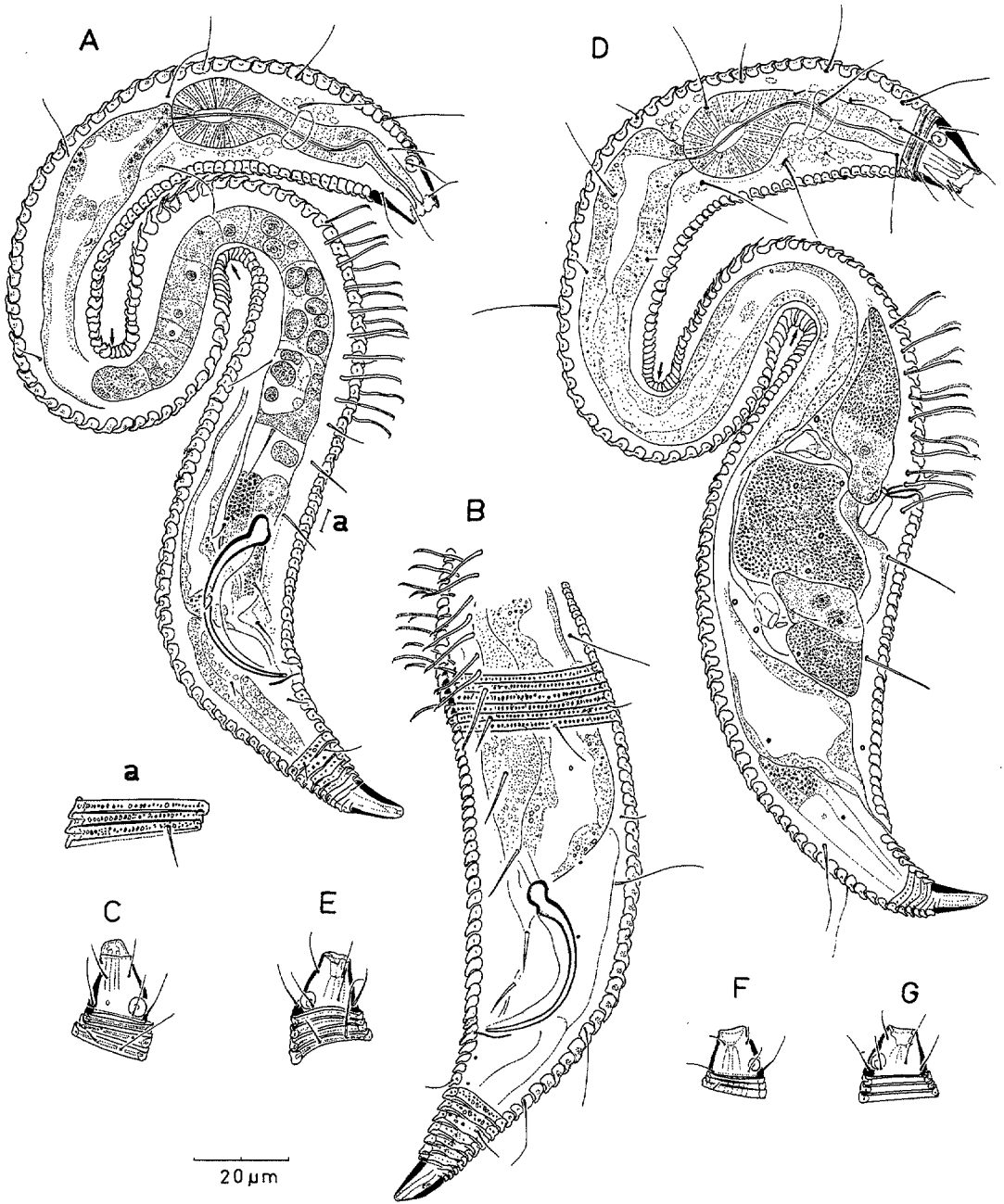


FIG. 1. *Epsilonema exoticum* sp. n. Male. A) Total view of holotype in longitudinal optical section with details (a) of the pharyngeal body cuticle in surface view. B) Tail and copulatory apparatus (paratype). C) Head in surface view (paratype). Female. D) Total view. E) Head in surface view. Juveniles. F) Head of a third-stage juvenile. G) Head of a fourth-stage juvenile. Arrows on total view of specimens indicate change in direction of body annules.

TABLE 1. Morphometrics of male holotype, 11 males, 11 females, five fourth-stage juveniles, and one third-stage juvenile of *Epsilonema exoticum* sp. n. from Moorea, and one male from New Caledonia.

	Holotype male	Males		Females		Fourth-stage juveniles (range)	Third-stage juvenile	Male (N. Caledonia)
		Mean	SD	Mean	SD			
L ( $\mu\text{m}$ )	335	368.6	62.6	337.8	20.5	265–330	225	350
N	134	131.8	1.6	132.8	2.4	140–154	143	132
amph %	30.7	30.1	2.7	31.1	3.5	26.3–33.3	33.0	26.9
cs ( $\mu\text{m}$ )	7.5	6.7	1.1	7.4	0.9	6.7–8.3	8.0	8.5
hl ( $\mu\text{m}$ )	12.0	14.2	0.9	13.1	1.9	10.0–12.2	10.5	12.8
hw ( $\mu\text{m}$ )	15.0	15.9	1.1	14.3	1.3	11.1–13.3	11.0	14.4
mbd ph ( $\mu\text{m}$ )	24.0	24.4	1.9	25.2	2.5	22.6–26.7	23.0	25.0
mbd ( $\mu\text{m}$ )	29.0	30.5	1.2	38.7	4.7	22.8–30.6	21.0	30.0
(mbd) ( $\mu\text{m}$ )	19.0	18.0	1.2	18.0	2.3	16.1–19.4	15.0	17.8
As11 ( $\mu\text{m}$ )	13.5	12.3	0.5	13.6	1.1	11.7–13.3	13.0	12.8
tmr ( $\mu\text{m}$ )	13.0	12.3	0.8	12.4	1.0	11.1–12.2	11.0	12.8
abd ( $\mu\text{m}$ )	18.0	20.3	0.9	16.9	1.3	17.2–19.4	15.5	17.8
spic ( $\mu\text{m}$ )	45.0	48.1	2.7					50.0
gub or v ( $\mu\text{m}$ )	7.0	7.9	0.9	221.9	11.2			
a	11.5	12.1	2.2	8.8	1.1	9.8–12.5	9.8	11.7
b	5.2	5.5	0.8	5.2	0.4	5.0–5.7	4.2	5.2
c	9.6	8.9	1.9	10	0.8	8.0–9.1	7.5	9.5
V				65.8	2.1			

men dividing progressively into small irregular vacuoles; at level of the dorsal curvature vacuoles becoming larger and at ventral curvature appearing as a single transverse row of small round vacuoles; from cloacal region on, vacuoles heterogeneous. Cuticular spines present at ventral curvature and some sparse spines occurring to the level of the dorsal curvature. Somatic setae fine, long, and sparse. Ambulatory setae in five longitudinal rows of 3–5 ventral setae, 7–8 internal setae, and 7–9 external setae followed by 4–5 small setae; 2–3 adanal setae present.

Sclerotized head capsule as long as wide; lip region withdrawn on fixed specimens. Four cephalic setae and eight subcephalic setae. Amphidial fovea an obscure spiral with circular outline. Buccal cavity with only a small dorsal tooth noticeable. Pharynx typical for the genus.

Tail with 13 annules; 3–5 partial annules on dorsal part of the end ring. Three caudal glands extending anteriorly past the cloacal region.

Reproductive system reaching anterior dorsal curvature. Copulatory thorns consisting of a small field of 4–8 very tiny

spines, each about 2  $\mu\text{m}$  long, at level of posterior ambulatory setae. Posterior part of vas deferens glandular and often folded. Spicules 43–52  $\mu\text{m}$  long, semi-circular, bent with strong capitulum, slender corpus, and ventral velum; gubernaculum short.

*Females:* Measurements of 11 females in Table 1. Body shape similar to males in most respects: same cuticular pattern but with smaller amphid and wider posterior body region ( $a = 8.3$ – $10$ ). Same number of ambulatory setae as in male; 9–10 external ambulatory setae, of which 1–2 post-vulval, followed by 2–3 supporting setae similar to ambulatory setae except for the open tip.

Tail with 9–10 annules. Reproductive system didelphic, amphidelphic with reflexed ovaries, both branches bent to left or to right. Vagina bipartite, length of cuticularized part about half (6.5  $\mu\text{m}$ ) that of the internal part (11.5  $\mu\text{m}$ ).

*Fourth-stage juvenile females:* Measurements of five J4 in Table 1. Similar to female in habitus, but different cuticular pattern: small vacuoles present at level of the anterior dorsal curvature to tail end

and flanked by ridges protruding as small spines at posterior border of each annule. Ambulatory setae in four rows of six internal setae and nine external setae followed by one supporting seta. Four cephalic setae and eight subcephalic setae. Amphid spiral with circular outline. Tail with 13 annules; caudal glands anterior to level of anus. Reproductive system well developed.

*Third-stage juvenile*: Measurements of one J3 in Table 1. Similar to fourth-stage juvenile, but two longitudinal rows of 4–5 ambulatory setae; one pair of supporting setae. Four cephalic setae and 3–4 subcephalic setae. Amphid with circular outline.

First- and second-stage juveniles not found.

#### *Type specimens*

Holotype male, slide no. BN221; paratype males, females, and juveniles on slide nos. BN221–222, 224, 226 (MNHN), RIT 358, 436–437 (KBIN), and 168 044 (USNM), collected from French Polynesia, Moorea Island, Station 12: Motu Fareone. Additional specimens on slide nos. BN223, 225, 227–230, collected in Polynesia, Moorea Island, stations 2, 3, 5, 8, 9, 10–13. All these specimens (30 males, 20 females, 20 juveniles) were listed by Gourbault and Decraemer (1) as *Epsilonema* aff. *pustulatum* Gerlach. One male, on slide no. BN231, was collected from New Caledonia, Yaté, March 1987.

#### *Etymology*

The species name is from the Greek (and Latin) *exoticus* (exotic).

#### *Diagnosis*

*Epsilonema exoticum* sp. n. is characterized by the heterogeneous vacuolar ornamentation of the body annules and the small subspirals with circular outline. The male is distinguished by the small field of tiny copulatory thorns and the long, strongly curved spicules.

#### *Relationships*

The new species is very close to *E. pustulatum* (Gerlach, 1952) but differs from it by the cuticular ornamentation of small vacuoles (large, regular vacuoles and long dorsal spines in *E. pustulatum*) and the lack of distinct copulatory thorns on the cloacal annules in the male (observed in *E. pustulatum* on loan from the Lorenzen collection).

*Epsilonema enigmaticum* sp. n.  
(Figs. 2–3)

#### *Description*

*Males*: Measurements of male holotype and 10 male paratypes in Table 2. Body epsilon-shaped, large (510–685  $\mu\text{m}$ ) and rather slender, largest body width in posterior body region ( $a = 13.7\text{--}20.1$ ). Cuticle with 161–173 annules, slightly overlapping with change in direction, ventrally at the dorsal curvature and dorsally at the ventral curvature. Four anterior annules smooth with narrow lumen and posterior-most annules with irregular, small vacuoles; ornamentation of all other annules consisting of large vacuoles separated by ridges. Somatic setae 17–26  $\mu\text{m}$  long and very slender, alternating with very short setae 6.5  $\mu\text{m}$  long arranged in eight longitudinal rows most obvious in the anterior region. Ambulatory setae with bent tips, in five longitudinal rows of 7–8 setae in ventral row, 14 setae in internal rows, and 10–12 setae in external rows followed by four curved setae (14  $\mu\text{m}$  long). Cuticular spines present at level of posterior ventral curvature and in the region of the ambulatory setae as a field of very faint copulatory thorns.

Head capsule as long as wide; lip region withdrawn in fixed specimens. Four cephalic setae and a variable number (10 or 16) of subcephalic setae, about 12  $\mu\text{m}$  long: one subventral, three ventrolateral, three laterodorsal close to the amphid and one subdorsal. Some setae of the group of three ventrolateral or laterodorsal setae sometimes shifted to first annule. Spiral amphidial fovea with circular outline. Buc-

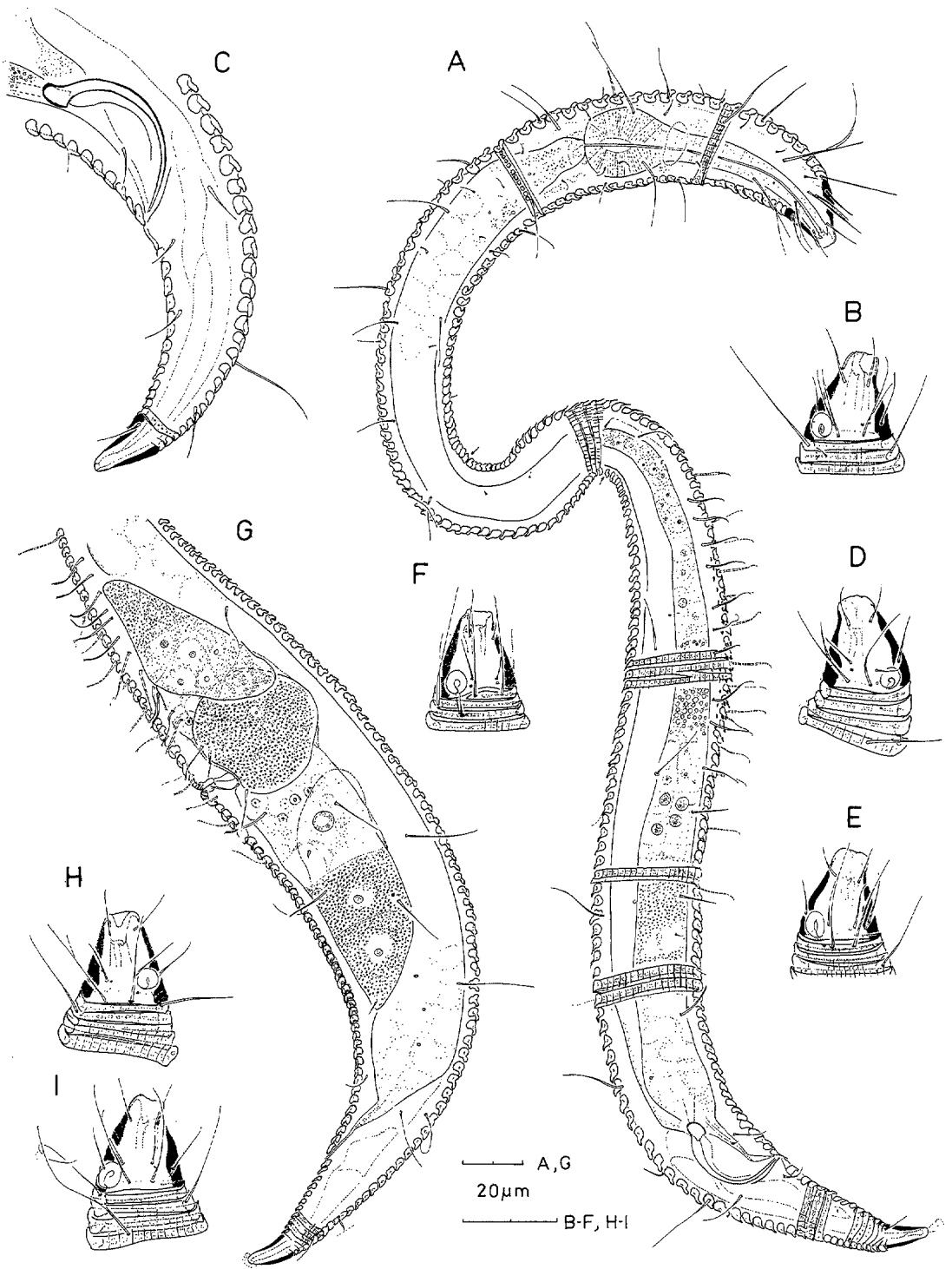


FIG. 2. *Epsilonema enigmaticum* sp. n. Male. A) Total view of holotype in longitudinal optical section with details of the body cuticle in surface view. B) Head in surface view (holotype). C) Tail and copulatory apparatus (paratype). D, E, F) Head in surface view (paratypes). Female. G) Posterior body region with genital system. H, I) Head in surface view.

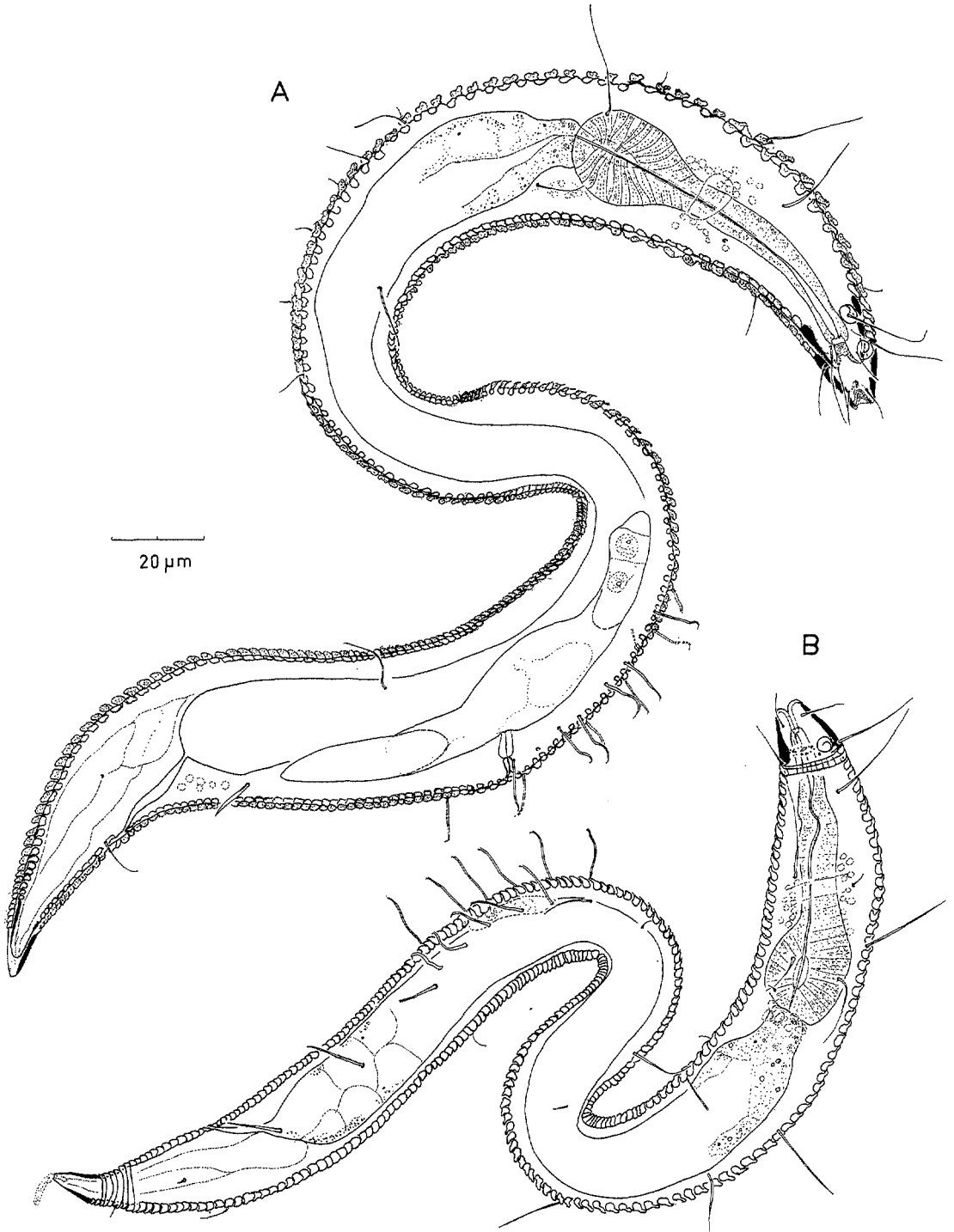


FIG. 3. *Epsilonema enigmaticum* sp. n. Juveniles. A) Fourth-stage juvenile, moult. B) Third-stage juvenile.

TABLE 2. Morphometrics of male holotype, 10 male paratypes, 10 female paratypes, five fourth-stage juveniles, and two third-stage juveniles of *Epsilonema enigmaticum* sp. n.

	Holotype male	Paratype males		Paratype females		Fourth-stage juveniles (range)	Third-stage juveniles
		Mean	SD	Mean	SD		
L ( $\mu\text{m}$ )	635	618.3	62.5	595.0	74.9	375–540	345–360
N	161	168	3.0	169	2.0	172–182	192
amph %	30.5	30.0	2.8	32.1	2.0	28.0–37.0	29.0
cs ( $\mu\text{m}$ )	11.0	10.2	0.9	10.5	1.4	7.0–9.5	10.0
hw ( $\mu\text{m}$ )	19.0	19.2	0.8	18.3	0.9	15.4–17.0	14.0
mbd ph ( $\mu\text{m}$ )	34.0	32.0	1.6	35.2	2.3	32.0–41.0	27.0
mbd ( $\mu\text{m}$ )	37.0	37.8	2.2	51.2	8.5	31.0–46.0	22.0
(mbd) ( $\mu\text{m}$ )	24.0	23.2	0.9	24.0	1.3	24.0–31.0	19.0
Asl1 ( $\mu\text{m}$ )	14.0	13.1	1.6	15.0	1.5	12.5	16.0
tmr ( $\mu\text{m}$ )	16.0	16.3	1.1	16.8	0.8	12.6–14.8	11.0
abd ( $\mu\text{m}$ )	26.0	25.2	1.3	22.4	1.1	22.5–25.3	19.4
spic ( $\mu\text{m}$ )	43.5	47.3	2.7				
gub or v ( $\mu\text{m}$ )	11.5	11.8	1.6	387.6	28.8	394	
a	17.2	16.4	2.1	11.7	1.1	10.1–15.6	15.7
b	6.5	6.0	0.3	5.6	0.5	4.7–6.4	4.9
c	10.7	10.0	0.6	12.2	2.1	8.2	11.8
V				65.6	3.5	69.7	

cal cavity with distinct dorsal tooth and two minute subventral teeth. Pharynx typical for genus.

Tail rather long with 16 annules; three partial annules dorsally; three caudal glands extending anteriorly to cloaca. Reproductive system with single outstretched testis reaching to ventral curvature; spicules strongly curved, corpus tapering with knoblike capitulum and ventral velum; gubernaculum a thin plate parallel to spicules. Small spines present on precloacal annule.

*Females:* Measurements of 10 female paratypes in Table 2. Habitus similar to male in most respects, but with wider posterior body region (a = 10.3–13.8). Ambulatory setae in five longitudinal rows: nine ventral setae in irregular line, 16 internal setae, and 13–16 external setae followed by two weakly differentiated supporting setae. Tail with 11 annules, shorter than in male. Reproductive system didelphic, amphidelphic, ovaries reflexed, anterior branch to left, posterior branch to right. Vagina short and bipartite.

*Fourth-stage juveniles:* Measurements of five J4 in Table 2. Cuticle as in adults but vacuolation less distinct and ridges more

pronounced, spines less numerous and narrow lumen present on smooth posteriormost annules. Ambulatory setae in four rows: seven setae in internal rows and nine setae in external rows, followed by one supporting seta. Head capsule with small vacuoles at base; eight subcephalic setae; setae absent from first annule. Tail with 15 annules.

*Third-stage juveniles:* Measurements of two J3 in Table 2. Habitus similar to fourth stage. Vacuoles present on head, amphid spiral; 4–5 subcephalic setae: one dorsal, one subventral pair, and one sublateral pair close to amphid. Two longitudinal rows of six ambulatory setae followed by 1–2 supporting setae. Tail with 19 annules and several partial annules.

First- and second-stage juveniles not found.

#### *Type specimens*

Holotype male, slide no. BN216; paratypes (9 males, 11 females, 10 juveniles): BN216–BN220 (MNHN) and RIT 434–435 (KBIN), collected on New Caledonia, Ilot Kouaré, S-E Nouméa, March 1987, coll. C. and F. Monniot.

### Etymology

The species name is derived from the Greek (and Latin) word *aenigmaticus* meaning puzzling.

### Diagnosis

*Epsilonema enigmaticum* sp. n. is characterized by the habitus, the cuticular ornamentation consisting of vacuoles and striae, the high number of annules (ca. 168), and the number and location of the subcephalic setae (10 or 16, on the cephalic capsule and the first annule).

### Relationships

*Epsilonema enigmaticum* sp. n. resembles *E. docidocricum* (Steiner, 1931) in size and number of annules. However, the cuticular ornamentation is more striated and spiny in *E. docidocricum* and the amphid is a clear spiral structure. Moreover, *Epsilonema enigmaticum* sp. n. differs from all other *Epsilonema* species by the high number of subcephalic setae.

### DISCUSSION

Two new genera of Epsilonematidae from Kenya have been proposed recently (6) for two species possessing more than eight subcephalic setae: *Pternepsilonema servaesae* Verschelde & Vincx, 1993 (14–16 setae in one circle), and *Polkepsilonema mombasae* Verschelde & Vincx, 1993. A second species of *Polkepsilonema* occurs in

New Caledonia: *P. firmatum* Gourbault & Decraemer, 1994 (18–21 setae, some anterior to the amphids).

*Epsilonema enigmaticum* sp. n. cannot be considered as a representative of any of these genera, which are characterized by the ambulatory setae in 6–7 longitudinal rows, in the female situated on both sides of the vulva, or in the male with differentiated external rows. The shape of the amphid in male (derived spiral with a circular outline) is also a differentiating character; amphid is loop-shaped in the two *Polkepsilonema* species and is a pore in *Pternepsilonema*.

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