

## Three new draconematid species from Papua New Guinea\*

by W. DECRAEMER

### Summary

Three new draconematid species: *Prochaetosoma martensi* sp. n., *Paradraconema maggentii* sp. n. and *Tenuidraconema fiersi* gen. n., sp. n. are described. The new genus *Tenuidraconema* belongs to the subfamily Prochaetosomatinae but shows also affinities with the Draconematinae, the other subfamily of the Draconematidae. Some reflections are made on the phylogeny of the Draconematidae.

**Keywords:** Prochaetosomatinae, taxonomy, Papua New Guinea.

### Résumé

Trois nouvelles espèces de draconematides: *Prochaetosoma martensi* sp. n., *Paradraconema maggentii* sp. n. et *Tenuidraconema fiersi* gen. n., sp. n. sont décrites. Le nouveau genre *Tenuidraconema* appartient à la sous-famille Prochaetosomatinae mais montre aussi des affinités avec les Draconematinae, l'autre sous-famille des Draconematidae. Quelques remarques sont incluses sur la phylogénie des Draconematidae.

**Mots-clés:** Prochaetosomatinae, taxonomie, Papouasie Nouvelle-Guinée.

### Introduction

During a survey of the meiofauna of Papua New Guinea, a large number of samples were taken from littoral and sublittoral localities, the majority from Laing Island (reef flat or lagoon); a few samples were collected along mangroves. Draconematidae species from Laing Island and Duangit Reef have been described in previous papers (DECRAEMER, 1982, 1989).

Among the nematodes from a littoral sample from Megiar Harbour, six draconematid species were found: *Paradraconema floridense* ALLEN & NOFFSINGER, 1978 and five new species, two of them are described: *Prochaetosoma martensi* sp. n. and *Paradraconema maggentii* sp. n., the other species are only represented by juvenile specimens.

Of special taxonomic interest was a sample from a mangrove on Motupore Island, where apart from *Draconema haswelli* (IRWIN-SMITH, 1918) KREIS, 1938 and *Paradraconema floridense*, a new species of the Draconematidae was discovered: *Tenuidraconema fiersi* gen. n., sp. n. The new species belongs to *Tenuidraconema* a new genus of the Prochaetosomatinae, showing affinities with the Draconematinae.

### Material and Methods

The species of Draconematidae studied, were collected at: - Central district, near Port Moresby, Motupore Island, mangrove along the north-east shore: sample no 86 of sediment collected by hand dredging between roots of *Avicennia* sp., on 22.XI.1986 by J. VAN GOETHEM & F. FIERS; I.G. 27213: *Tenuidraconema fiersi* sp. n., 8 ♂♂, 11 ♀♀, 9 juv; *Paradraconema floridense*, 28 ♂♂, 26 ♀♀, 22 juv; *Draconema haswelli*, 16 ♂♂, 19 ♀♀, 22 juv.

- Madang Province, Megiar Harbour, north of the shipwharf: sample no 496 of coral sand from a shallow tide pool, on 21.VI.1981 by J. VAN GOETHEM; I.G. 26373: *Prochaetosoma martensi* sp. n., 38 ♂♂, 49 ♀♀, 40 juv; *Paradraconema floridense*, 10 ♂♂, 16 ♀♀, 3 juv; *Paradraconema* sp. 1, 1 juv; *Paradraconema* sp. 2, 1 juv; *Paradraconema* sp. 3, 1 juv.

Nematodes were mounted on slides in anhydrous glycerin. Type specimens are deposited in the nematode collection of the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels (KBIN), the University of California, Davis, U.S.A. (UCNC) and the Smithsonian Institution, National Museum of Natural History, Washington D.C., U.S.A. (USNM). The following specimens of nominal species from the nematode collection of the Rijksuniversiteit Gent (RUG) were examined: *Prochaetosoma mediterranicum*, 1 ♂ paratype, RUG slide 389; *P. vitielloi*, 6 ♂♂, 5 ♀♀, 5 juv paratypes, RUG slides 398-400; *P. cayense*, 1 ♂ paratype, RUG slide 388; *Paradraconema floridense*, 1 ♂, 1 ♀, 2 juv paratypes, RUG slides 393-395; *P. newelli*, 1 ♂, 1 ♀, 1 juv paratypes, RUG slides 391-392; *P. hopperi*, 1 ♂, 1 ♀ paratypes, RUG slides 396-397; *Dracograllus timmi*, 1 ♂, 1 ♀ paratypes, RUG slides 418-419; *D. filipjevi*, 1 ♂, 1 ♀ paratypes, RUG slides 386-387; *D. demani*, 1 ♀, 1 ♂, 1 juv, RUG slides 383-385; *D. stekhoveni*, 1 ♂, 1 ♀ paratypes, RUG slides 381-382. *Apenodraconema spinicaudum*, 1 juv paratype and *Paradraconema floridense*, 20 ♂♂, 1 ♀, slide UCNC 180 d.

\* Leopold III Biological Station, Laing Island, Contribution n° 188.

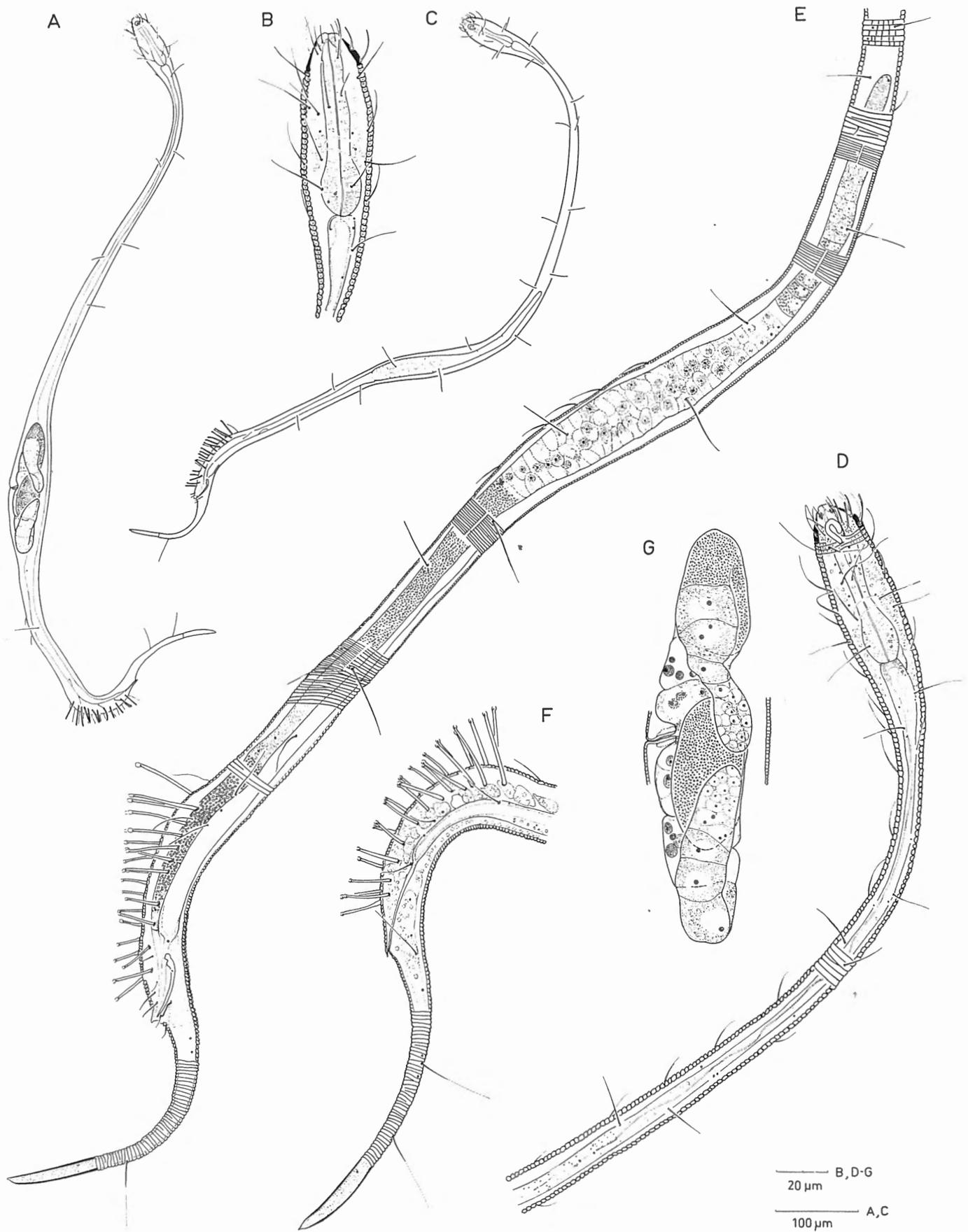


Fig. 1. *Tenuidraconema fiersi* sp.n. - A. Habitus paratype female. - B. Pharyngeal region (♀ paratype). - C. Habitus holotype ♂. - D, E. Holotype male in toto. - F. Posterior body region (paratype ♀). - G. Female genital system (paratype).

**Abbreviations used in the text**

ABD, anal body diameter  
 CAT, length of cephalic adhesion tubes  
 Ceph Acan-set, length of largest sublateral acanthiform setae on rostrum  
 Corn-set, length corniform setae  
 cs, length of cephalic setae  
 gub, length of gubernaculum  
 hl, maximum head length  
 hw, maximum head diameter  
 L, body length  
 mbd Ph, maximum body diameter in pharyngeal region  
 (mbd), minimum body diameter  
 mbd, maximum body diameter at mid body level  
 mbd V, body diameter at level of vulva  
 PAT, length posterior adhesion tubes  
 Ph, length of pharynx  
 SER, length swollen body area in pharyngeal region, expressed as % of body length  
 spic, length of spicule measured along the median line  
 SIAT1, SIAT2...SIATl, length of first, second and ...  
 last pair of sublateral adhesion tubes  
 SvAT1, SvAT2...SvATl, length of first, second and ...  
 last pair of subventral adhesion tubes  
 t, tail length  
 tmr, length of non-annulated tail end  
 VAT, length of medioventral posterior adhesion tubes  
 V, position of the vulva as a percentage of the total body length from anterior  
 a, b, c, c', proportions of DE MAN (1880)  
 All measurements are in  $\mu\text{m}$ ; mean value between brackets.

**Descriptions**

Family Prochaetosomatinae ALLEN & NOFFSINGER, 1978

Genus *Tenuidraconema* gen. n.

*Tenuidraconema fiersi* sp. n.

Figs 1 A-G, 2 A-E, 3 A-E.

**Type specimens:**

Holotype male, slide RIT 191. Paratypes: 11  $\sigma$   $\sigma$ , slides RIT 191-196; 7  $\text{♀}$   $\text{♀}$ , slides RIT 191-195; 9 juv., slides RIT 191, RIT 192, RIT 194, RIT 196.

**Type locality:**

Motupore Island, sample no 86 (see material and methods).

**Etymology:**

The generic name *Tenuidraconema* is a compound of 'tenui' (Latin, meaning thin) and *Draconema*. The name 'fiersi' is in honour of Dr. F. FIERS who collected a lot of nematode samples.

**MEASUREMENTS***Holotype male.*

L = 1015, CAT = 14, cs = 8.5, hd = 21 x 14, Ph = 68, mbd Ph = 27, (mbd) = 10, mbd = 30, t = 118, ABD = 18, tmr = 36, SIAT1 = 29, SIAT2 = 25, SIAT3 = 21, SIAT4 = 23, SIAT5 = 21, SIAT6 = 20, SIAT7 = 15, SIAT8 = 16, SIAT9 = 14, SIAT10 = 16, SIAT11 = 18, SvAT1 = 26, SvAT2 = 22, SvAT3 = 20, SvAT4 = 17, SvAT5 = 16, SvAT6 = 13, SvAT7 = 11, SvAT8 = 9, SvAT9 = 9.5, SvAT10 = 11, SvAT11 = 14, spic = 27, gub = 8.5; Nr SIAT = 10-11, Nr SvAT = 10-11, Nr CAT = 12, SER = 11%, a = 33.8, b = 14.9, c = 8.6.

*Paratype males (n = 10).*

L = 995-1080 (1005), CAT = 12-14, cs = 7.5-8.5, hd = 21-22 x 14-18, Ph = 67-71, mbd Ph = 27-29, (mbd) = 10-11, mbd = 21-30, t = 107-131, ABD = 16-20, tmr = 34-38, SIAT1 = 26-29, SIATl = 16-20, SvAT1 = 24-26, SvATl = 14-16, spic = 24-29 (27), gub = 8-10; Nr SIAT = 10-12 (11), Nr SvAT = 10-11, Nr CAT = 10-12, SER = 9.3-11.1%, a = 34.3-36.4, b = 13.7-15.0, c = 7.7-9.0.

*Paratypes females (n = 7).*

L = 935-1105 (1015), CAT = 14-16, cs = 6-12 (7), hd = 21-23 x 19, Ph = 66-73, mbd Ph = 27-30, (mbd) = 9-12, mbd V = 28-46, t = 116-126, ABD = 14-17, tmr = 37-43, SIAT1 = 25-29, SIATl = 19-22, SvAT1 = 24-27, SvATl = 13-15, V% = 55.5-58; Nr SIAT = 10-12 (12), Nr SvAT = 12-13 (13), Nr CAT = 10-12, SER = 9.9-11.3%, a = 23.4-32.9, b = 13.6-15.1, c = 7.7-9.0.

*Paratype juveniles.*

*Fourth stage juvenile male moulting into adult (n = 1)*  
 L = 860, CAT = 12, cs = 8, hw = 19, mbd Ph = 33, (mbd) = 12, mbd = 28, t = 115, ABD = 20, tmr = 37, SIAT1 = 24, SIATl = 17, VAT1 = 22, VATl = 10; in male: spic = 26, gub = 8.5, t = 105, tmr = 36, hl = 22.

*Fourth stage juveniles (n = 6)*

L = 755-850, CAT = 11-15, cs = 6-7, hw = 19-22, Ph = 60-70, mbd Ph = 26-30, (mbd) = 10-12, mbd = 20-23, t = 100-107, ABD = 13-19, SIAT1 = 22-25, SIATl = 16-19, VAT1 = 20-23, VATl = 10-12; Nr SIAT = 6-8, Nr SvAT = 7, Nr CAT = 4, a = 26.0-29.0 (juv.  $\text{♀}$ ), 29.1-31.5 (juv.  $\sigma$ ), b = 11.6-13.7, c = 7.5-8.1.

*Third stage juveniles (n = 2)*

L = 515-535, CAT = 10-12, cs = 4.5-6, hw = 15-16, Ph = 52-54, mbd Ph = 23-24, (mbd) = 10, mbd = 16-18, t = 77-78, ABD = 12-13, tmr = 30-31; Nr PAT = 5, Nr CAT = 3, a = 22.3-25.0, b = 10.3-10.6, c = 6.9-7.4.

**DESCRIPTION***Males*

Body long, slender, shallow sigmoid. Pharyngeal region,

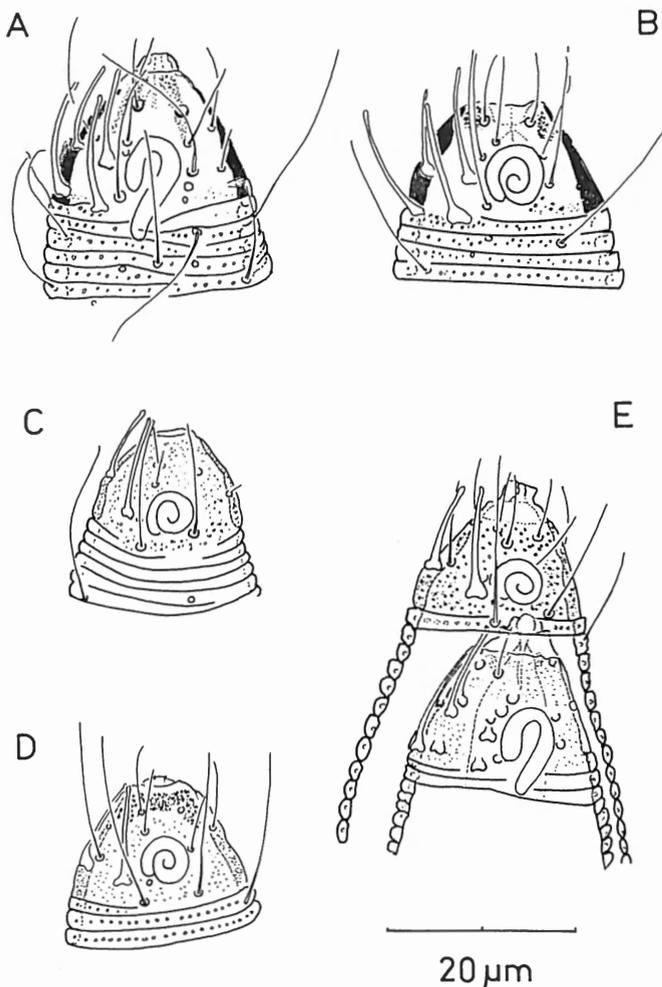


Fig. 2. *Tenuidraconema fiersi* sp.n. - Head region in surface view: A. Holotype male. - B. Female. - C. Third stage juvenile. - D. Fourth stage juvenile. - E. Young male, moulting specimen. B- E: paratypes.

9-11% of total body length, slightly swollen and about equally wide as mid-body region, tail narrow cylindrical-conoid. Body cuticle annulated, rings broader in anterior and posterior body regions. From about the level of the testis top (i.e. at 425  $\mu\text{m}$  from anterior end in holotype) and almost up to the level of the PAT (i.e. from 99  $\mu\text{m}$  anterior to SIAT1 in holotype) cuticle with fine annulation, laterally interrupted by a well marked narrow lateral field (Fig. 1 C). Annules in anterior body region ornamented with fine vacuoles, which becomes larger posteriorly and marked by cuticular bars; in mid-body region annules smooth; in anal region annules faintly vacuolated (Fig. 1 D, E). Posteriorly, a lot of small adhering particles may be present on the body cuticle. Somatic setae in eight longitudinal rows in the pharyngeal region, four rows posteriorly. Head rostrum 1/3 rd wider than long, with vacuolar ornamentation and numerous subcephalic setae. Lip region rarely extruded in fixed specimens, cheilostome reinforced by cheilorhabdia; six papiloid external labial sensilla. Four cephalic setae. Ten to twelve CAT in posterior head region, arranged in two transverse

rows. Amphidial fovea large loop-shaped, 10  $\mu\text{m}$  long, ventrally coiled, with the longer ventral arm reaching the anterior annule(s) (Fig. 2 A).

Stoma with small cheilostome and narrow unarmed pharyngostome, surrounded by cephalic glands with dark yellowish pigmented granules. Pharynx largely cylindrical (in some specimens with a slight anterior swelling opposite the head end), ending on a muscular posterior bulb without cuticularized valve. Cardia short, 3.5  $\mu\text{m}$  (Fig. 1 D). Intestine narrow cylindrical, located right from anterior part of the reproductive system and dorsally from the vas deferens.

Male reproductive system typical of the Draconematidae, with a single testis extending far anteriorly. Testis with long and narrow generative and growth zones; enlarged vesicula seminalis with numerous bright sperm cells with rounded coarsely granular nucleus and small nucleolus; vas deferens finely granular. Spicules small slightly curved, 24-29  $\mu\text{m}$  long, with knob-like capitulum, a small ventral apophysis and a weakly cuticularized velum. Gubernaculum, 8-10  $\mu\text{m}$  long, parallel to the spicules, consisting of a single distal part and two short proximal apophyses. Four pairs of sub-ventralanal setae: two preanal pairs, 10  $\mu\text{m}$  long, and two shorter (6-6.5  $\mu\text{m}$ ) curved postanal pairs. Anal flap, 2.5  $\mu\text{m}$  long, clearly protruding from the body wall (Fig. 1 E). Posterior adhesion tubes with developed bell-shaped end, all located anterior to the anus: 10-12 pairs of SIAT and 10-14 pairs of SvAT (in holotype SIAT and SvAT with 11 tubes on left side, 10 tubes on right side). No intermingling with somatic setae, except for a 16  $\mu\text{m}$  long seta between SIAT1-SIAT2.

Tail 6.6 anal body widths long, tapered to a very slender cylinder. Non-annulated end finely vacuolated (see punctuation), 27-32% of total tail. Caudal glands extending shortly beyond the cloacal opening.

#### Females

Similar to males in most respects, mid-body swelling more pronounced. Annulation and cuticular ornamentation as in male. Amphidial fovea spiral, with two coils and ventrally whirled, 6.5-7  $\mu\text{m}$  in diameter (Fig. 2 B). Reproductive system didelphic-amphidelphic, with the ovaries reflexed to the left side. No spermathecae, large bright sperm cells in uterus. Vagina consisting of a 3.5  $\mu\text{m}$  long distal part with well cuticularized wall, and a vagina vera 10  $\mu\text{m}$  long, with less cuticularized wall, surrounded by a well developed constrictor muscle. No paravulvar setae. Vulva at 55.5-58% of total body length from anterior. Developed oocyte 25 by 61  $\mu\text{m}$ . Posterior adhesion tubes with 11-12 pairs of SIAT and 12-13 pairs of SvAT, becoming shorter posteriorly, especially the SvAT, and except for the posteriormost tubes which are again longer.

Tail about 8 anal body widths long. Anal flap 2  $\mu\text{m}$  long. Non-annulated end with finely vacuolated cuticle, 31-34% of total tail, provided or not with a pair of sublateral somatic setae.

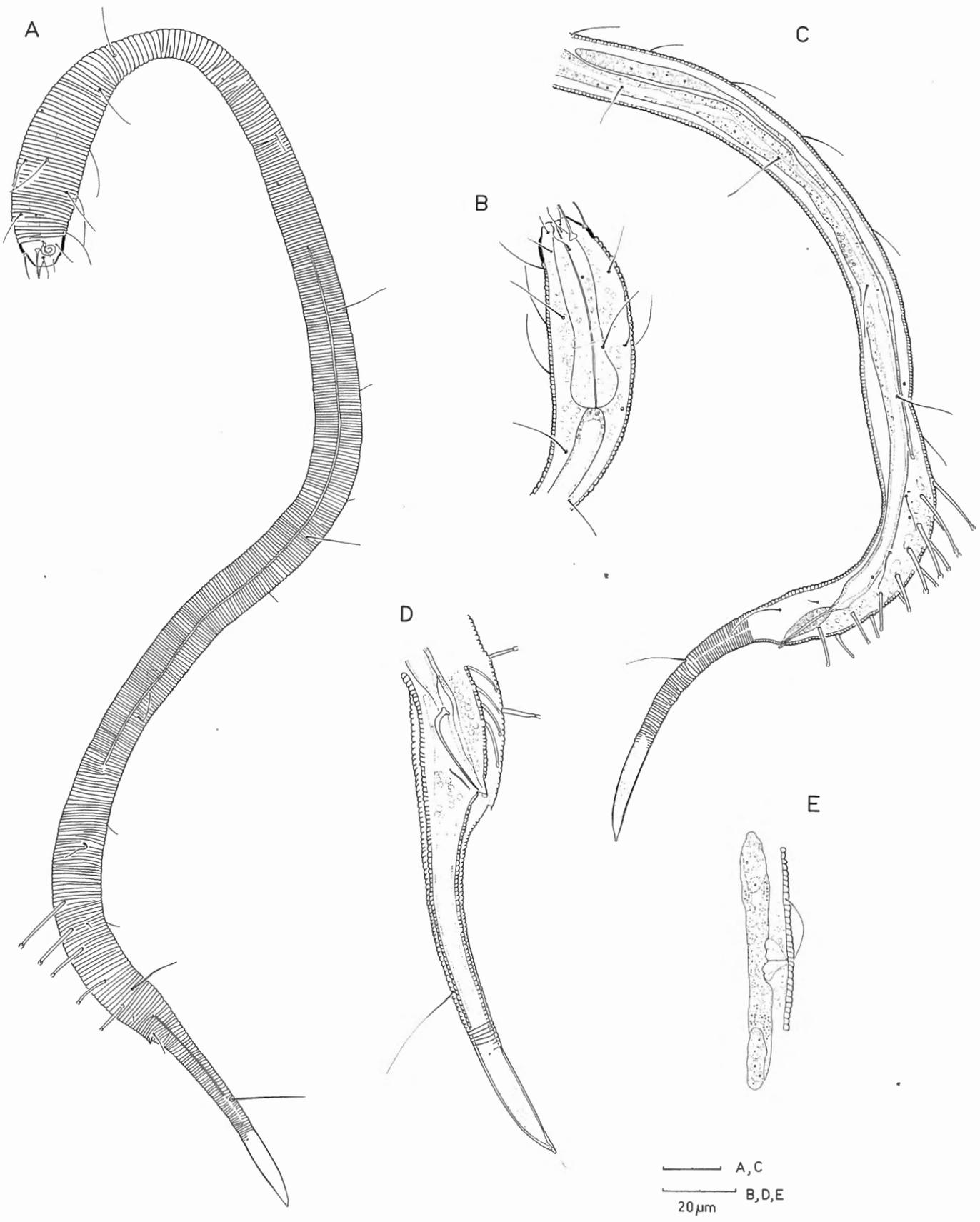


Fig. 3. *Tenuidraconema fiersi* sp.n. - Third stage juveniles: - A. Habitus. - B. Pharyngeal region. Fourth stage juveniles: - C. Posterior body region (young male). - D. Anal body region and tail (moulting young male specimen). - E. Reproductive system (young female).

*Juveniles*

First and second stages not found.

*Fourth stage juveniles* (Fig. 3 C-E).

In many respects similar to adults. Swollen pharyngeal region 11-12% of total body length; mid-body region slightly swollen in juvenile females, not in juvenile males where the body is only slightly widening posteriorly. Annulation and ornamentation body cuticle as in adult. Four CAT on rostrum, one sublateral pair and one subdorsal pair. Four cephalic setae; subcephalic setae present. Amphidial fovea, 6  $\mu\text{m}$  diameter (33-39% of corresponding head width), double spiral as in female.

Reproductive system in juvenile female largely formed, both branches reflexed to the left side or anterior branch to the right side, posterior to the left side (Fig. 3 E); in juvenile males a well developed testis, a very narrow vas deferens and a spicular primordium was observed. In a moulting juvenile male, the reproductive system and copulatory apparatus were completely formed, spicules 26  $\mu\text{m}$  long (Fig. 3 D).

Posterior adhesion tubes in three longitudinal rows, all anterior to the anus: two rows of SIAT with 6-7 tubes and one medio-ventral row of adhesion tubes (VAT) of 7-8 tubes. Posterior adhesion tubes becoming shorter posteriorly.

Tail about 6.5 anal body widths long. Non-annulated, finely punctated end 33-38% of total tail; one pair of sublateral somatic setae (often only insertion mark visible) can be present.

*Third stage juveniles* (Fig. 2 A-B)

In many respects similar to the later stages. Body slender shallow sigmoid, almost equally wide, except for a swollen pharyngeal region (12-14% of total body length) and a slight postanal narrowing. Annulation and ornamentation of body cuticle as in adults. Rostrum with four cephalic setae; subcephalic setae present. Three CAT, one sublateral pair, one dorsal tube. Amphidial fovea as in female, spiral with two coils, ventrally whirled; 5  $\mu\text{m}$  diameter i.e. 31-36% of corresponding head width.

Reproductive system consisting of two short branches, 9.5-13  $\mu\text{m}$  long, of a few cells each.

Posterior adhesion tubes in two longitudinal subventral rows of five tubes, all situated anterior to the anal opening; tubes becoming shorter posteriorly.

Tail six anal diameter long. Short anal flap present. Non-annulated end, 39-40% of total tail, its cuticle finely punctated.

*Diagnosis*

*Tenuidraconema fiersi* sp. nov. is characterized by: - its habitus (long slender body), - 12 CAT on the rostrum, - large loop-shaped amphidial fovea in male, spiral-shaped in female and juveniles, - papilloid external labial sensilla, - shape, length and number of PAT: 10-12 pairs of SIAT, 10-11 ( $\sigma$ ), 12-13 ( $\text{♀}$ ) pairs of

SvAT, - shape of copulatory apparatus, - shape of the vagina and - a slender elongated cylindro-conoid tail shape.

*Tenuidraconema* gen. n.*Diagnosis*

Prochaetosomatinae. Body slender, shallow sigmoid; swollen pharyngeal region, 1/10th of total body length. Annulation body cuticle anteriorly and posteriorly with vacuolar ornamentation, at mid-body smooth and interrupted by a marked lateral field. CAT (12) on rostrum.

Amphidial fovea loop-shaped in male, spiral in female and juveniles. Pharynx with cylindrical corpus (with or without slight swelling at level head base) and posterior muscular bulb without cuticularized valve.

*Discussion*

Within the family Draconematidae FILIPJEV, 1918 two subfamilies are distinguished: the Draconematinae FILIPJEV, 1918 and the Prochaetosomatinae ALLEN & NOFFSINGER, 1978 (see LORENZEN, 1981, p. 188).

The new genus *Tenuidraconema* belongs to the subfamily of the Prochaetosomatinae, characterized by a more or less cylindrical shape of the pharynx, with or without terminal swelling, and different from the tripartite pharynx of the Draconematinae. In some specimens of *T. fiersi*, the pharyngeal corpus may be slightly swollen at the level of the posterior head end, but the swelling is less pronounced and more anteriorly than in species of the genus *Dracognomus* ALLEN & NOFFSINGER, 1978, another genus of the Prochaetosomatinae.

*Tenuidraconema* gen. n. shows some affinities with the Draconematinae in - 1. head shape: with narrow lipregion (usually intruded in fixed specimens), - 2. shape of amphidial fovea: spiral or large loop-shaped, - 3. position of the CAT on rostrum as in all Draconematidae and - 4. the presence of a narrow unarmed stoma.

Genus *Prochaetosoma* MICOLETZKY, 1922

*Prochaetosoma martensi* sp. n.

Figs 4 A-G, 5 A-B, 6 A-I, 7, 8 A-D

*Type specimens:*

Holotype male, slide RIT 302. Paratypes: 37  $\sigma$   $\sigma$ , 49  $\text{♀}$   $\text{♀}$ , 40 juv. fourth stage, 9 juv. third stage, 2 juv. second stage, slides RIT 302-318, RIT 325-329 (sectioned  $\sigma$ ,  $\text{♀}$ ), RUG slide 3255 (1  $\sigma$ , 2  $\text{♀}$   $\text{♀}$ ), UCNC (3  $\sigma$   $\sigma$ , 2  $\text{♀}$   $\text{♀}$ ), USDA (1  $\sigma$ , 4  $\text{♀}$   $\text{♀}$ ).

*Type locality:*

Madang Province, Megiar Harbour, sample no 496 (see material and methods).

*Etymology:*

The species is named in honour of Dr. L. Martens, lawyer.

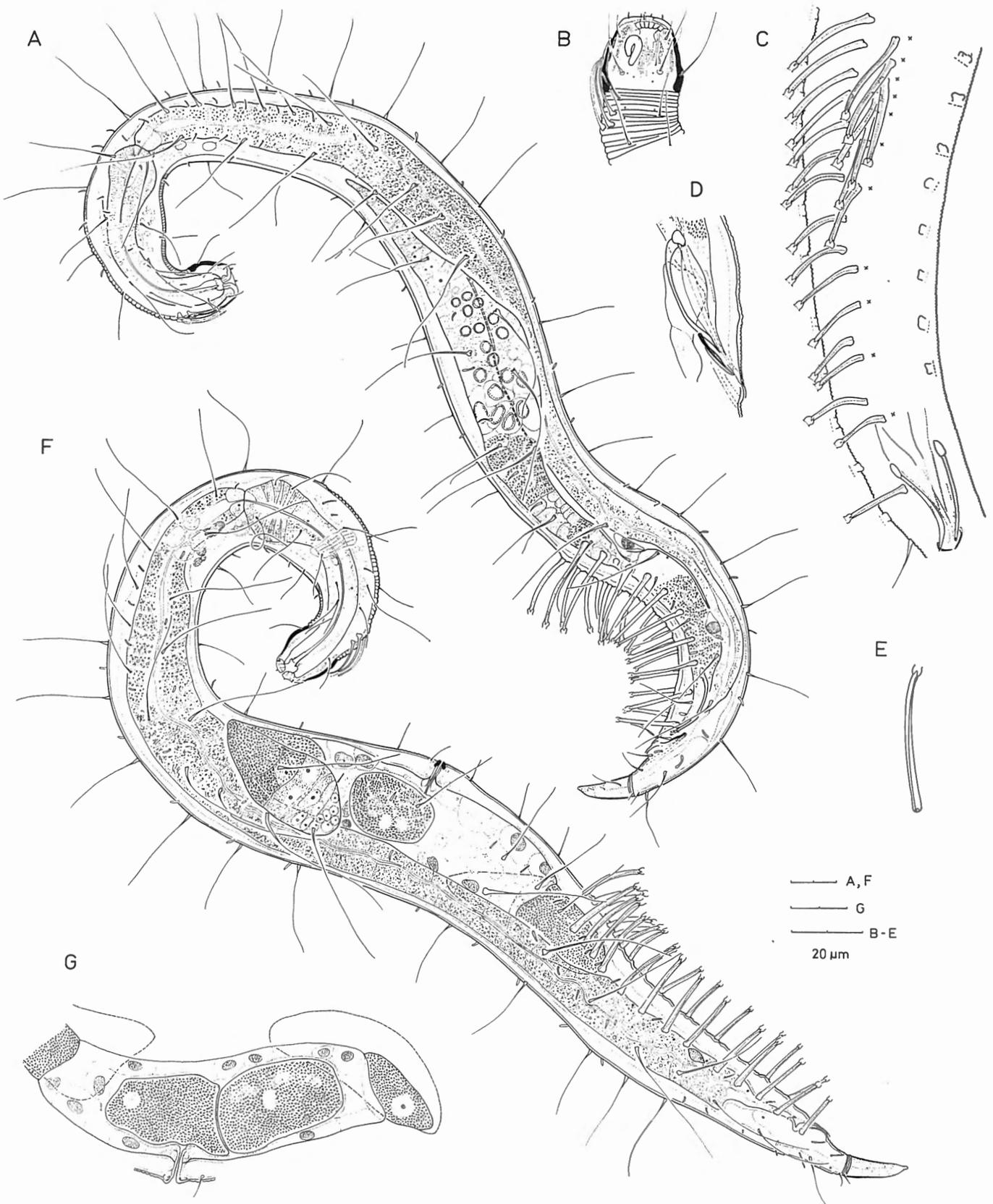


Fig. 4. *Prochaetosoma martensi* sp.n. - A. Holotype male in toto. - B. Surface view of head (♂ paratype). - C. Copulatory apparatus (♂ paratype). - D. Habitus female paratype. - E. Part of reproductive system (♀ paratype). - F. Transverse section at level vagina (paratype). - G. Dorso-ventral view of region posterior adhesion tubes (♂ paratype).

## MEASUREMENTS

*Holotype* ♂ 1

L = 800, CAT = 23, cs = 7, hw = 23, subcs = 19, amph d = 8 x 6, Ph = 109, Ph = 38, (mbd) = 30, mbd = 51, ABD = 17, t = 41, tmr = 24, SIAT1 = 41, SIATt = 29, SvAT1 = 21, SvATt = 30, spic = 39, gub = 13, Nr SIAT = 10-11, Nr SvAT = 11-12, Nr CAT = 9, a = 15.7, b = 7.3, c = 19.5; c' = 2.4.

*Paratype males* (n = 10)

L = 550-765 (635), CAT = 18-26 (23), cs = 6.5-7, hw = 22-25 (22), subcs = 19-23, 1 amph = 7-10, Ph = 106-113, mbd Ph = 37-42, (mbd) = 28-33, mbd = 40-56 (47), ABD = 16-19, t = 38-49 (45), tmr = 22-28 (25), SIAT1 = 38-44 (40), SIATt = 26-35 (29), SvAT1 = 28-33 (33), SvATt = 20-27 (22), spic = 37-49 (40), gub = 12-14, Nr SIAT = 10-11, Nr SvAT = 10-12, Nr CAT = 9; a = 11.0-15.6 (11.6), b = 5.2-7.0 (5.8), c = 12.5-20.1 (12.9), c' = 2.4-3.1 (2.6).

*Paratypes females* (n = 11).

L = 475-695 (595), CAT = 20-27, cs = 6-9.5, hw = 22-25, subcs = 18-27 (22), amph d = 6.5-8 x 4.5-6, Ph = 97-120, mbd Ph = 35-40 (38), (mbd) = 30-36 (32), mbd V = 52-67 (58), ABD = 13-16, t = 39-46 (42), tmr = 24-29 (26), SIAT1 = 37-42 (39), SIATt = 23-27 (25), SvAT1 = 27-31 (29), SvATt = 18-20 (19), V = 53-58% (55%), Nr SIAT = 12-13, Nr SvAT = 10-14, Nr CAT = 9; a = 8.5-12.7 (10.3), b = 4.4-6.6 (5.3), c = 11.6-17.4 (14.2), c' = 2.4-3.2.

*Paratype juveniles**Fourth stage juveniles, moulting specimens* (n = 7)

L = 455-695.

*Fourth stage juveniles* (n = 7).

L = 360-470 (435), CAT = 21-23, cs = 6-6.5, hw = 21-23, subcs = 19-22, amph d = 4.5-5.5 x 6.5-7, Ph = 90-106 (97), mbd Ph = 29-37 (32), (mbd) = 25-31 (27), mbd = 29-46, ABD = 13-18, t = 38-45, tmr = 22-26, SIAT1 = 31-37 (33), SIATt = 22-27 (25), VAT1 = 24-27 (25), VATt = 18-20 (18), Nr SIAT = 6-7, Nr VAT = 9, Nr CAT = 4; a = 10.2-14.5 (12.6), b = 4.0-5.0, c = 8.8-12.2 (10.8), c' = 2.2-3.2 (2.4).

*Third stage juveniles* (n = 8).

L = 300-380 (345), CAT = 15-19, cs = 4.5-6.5, hw = 17-19, subcs = 15-20, amph d = 6-6.5 x 3.5-5, Ph = 73-85, mbd Ph = 21-31 (27), (mbd) = 17-26 (23), mbd = 20-35 (29), ABD = 11-16, t = 35-42 (38), tmr = 20-23 (22), SIAT1 = 23-30 (27), SIATt = 18-21 (20), Nr SIAT = 4-5, Nr CAT = 3; a = 9.7-15.0 (12.7), b = 4.1-4.7 (4.3), c = 7.7-9.7 (9.1), c' = 2.7-3.5 (2.6).

*Second stage juveniles* (n = 2).

L = 260-270, CAT = 15-17, cs = 5, hw = 14-15, subcs = 7-8, amph d = 5-5.5 x 3.5-4, Ph = 64-65, mbd Ph = 21-22, (mbd) = 17-18, mbd = 18-19, ABD = 11-12, t = 35-37, tmr = 16-18, SIAT1 = 23-24, SIAT2 = 20, Nr SIAT = 2, Nr CAT = 1; a = 12.9-16.4, b = 4.0-4.2, c = 7.0-7.7, c' = 3.1-3.2.

## DESCRIPTION

*Males*

Body long, shallow sigmoid, anterior part strongly curved ventrally. Pharyngeal region, 14-19% (14% in ♂ 1) of total body length, slightly to moderately swollen just anterior to the level of the pharyngeal bulb. Greatest body width at mid-body. Body cuticle finely annulated. Somatic setae very fine but clearly widened at their base, arranged in eight longitudinal rows in the pharyngeal region, in six rows (2 laterodorsal, 2 lateroventral, 1 mediodorsal, 1 medioventral) posteriorly, and connected with epidermal gland cells. Longest somatic setae (to 60  $\mu\text{m}$ ) inserted sublaterally; shortest setae situated medioventrally in posterior body region. The slender somatic setae alternate in all longitudinal rows with 1 or 2 short stumpy glandular setae, 3.5-7.5  $\mu\text{m}$  long (Fig. 4 A) rarely drawn in other species although present. Large obvious epidermal glands cells at the level of the anterior intestine.

Head with well cuticularized rostrum, not ornamented; greatest width subterminally, gradually tapering anteriorly to a broadly flattened border with protruding lipregion. Lipregion usually retracted in fixed specimens, bears and inner crown of six labial papillae and an outer crown of six fine short (2  $\mu\text{m}$ ) labial setae (Fig. 5 A, a). Labial sensilla disappearing posteriorly into yellowish granular accumulations, extending along the anterior part of the pharynx (Fig. 4 B). Four short cephalic setae, 6.5-7  $\mu\text{m}$  long. Posterior head region with six fine long (19-23  $\mu\text{m}$ ) subcephalic setae: 2 subventral and 4 sublateral with near their base 2 or 3 pores. Amphidial fovea elongate loop-shaped, lying dorsolaterally on rostrum in between the cephalic and subcephalic setae. Head in several specimens enveloped by numerous strands of paternoster-like algae (Fig. 8 A, B in juveniles; also in *P. vitielloi* Fig. 2 in MASSALES, 1985). Nine cephalic adhesion tubes (CAT), all posterior to rostrum: 4 subdorsal pairs and a single mediodorsal tube; the anteriormost tube inserted on the fifth (sixth) annule.

Buccal cavity formed by a narrow anterior cheilostome, reinforced by 12 cheilorhabdia and a dentate pharyngostome (Fig. 6 B). The pharyngostome consists of a wider anterior part with a moderately developed dorsal tooth and 6 ventrosublateral denticles at its base (Fig. 6 B, e), and a conical posterior part (telostome). Pharynx with terminal bulb with cuticularized valve. Dorsal pharyngeal gland outlet at base of dorsal tooth (Fig. 6 B). Both subventral pharyngeal glands debouching halfway the pharynx i.e. shortly in front of the nerve ring (Fig. 4 A: ♂, F: ♀).

Cardia 5.5-7  $\mu\text{m}$  long. Intestine narrow cylindrical anteriorly, widening posteriorly and located largely dorsally and partly right (at level vesicula seminalis) of the genital system. No ventral excretory glandcell, but ventrally to the anterior intestinal region by a few rounded opaque inclusions (Fig. 4 A, Fig. 8 D in

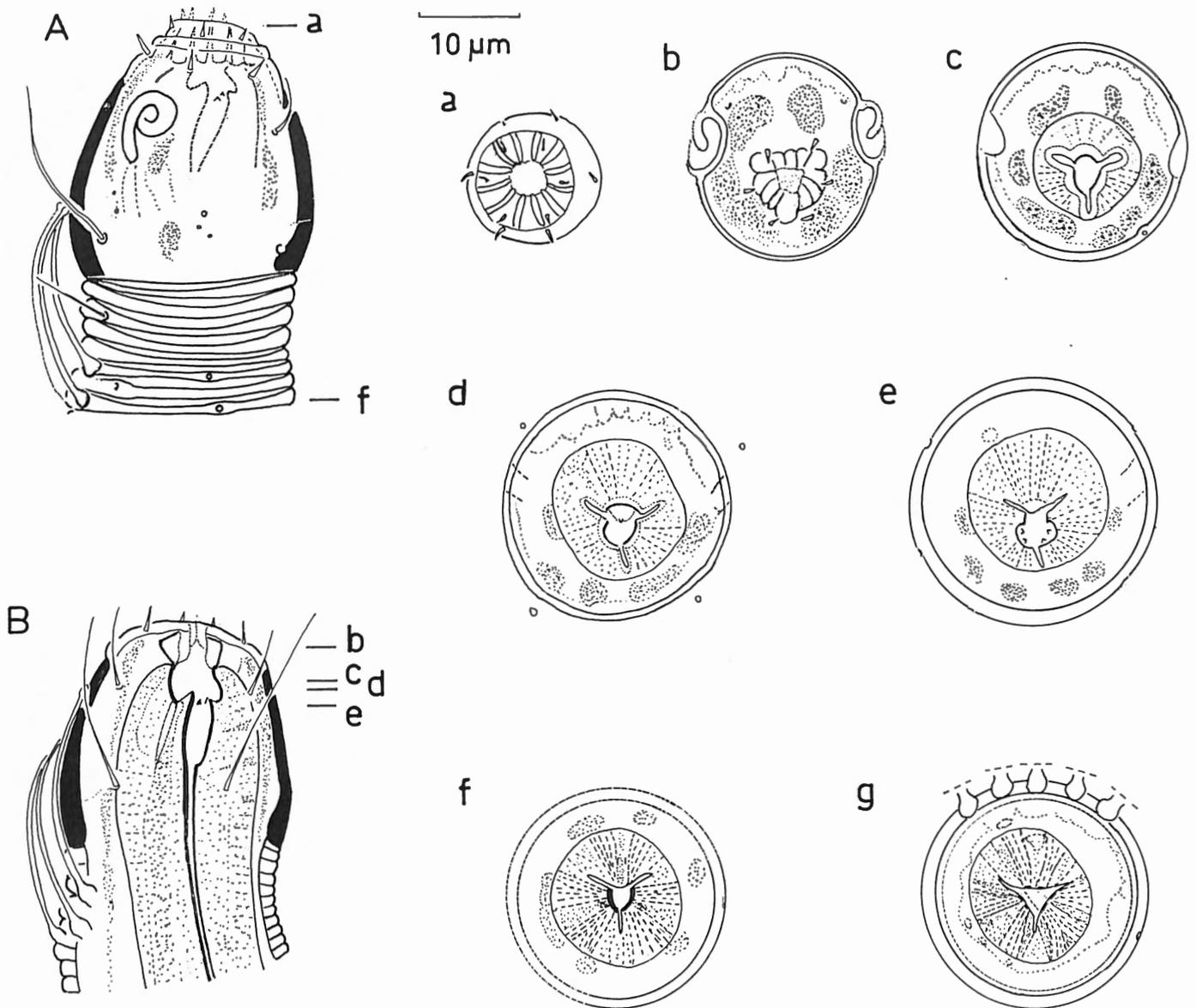


Fig. 5. *Prochaetosoma martensi* sp.n. - A. Surface view of head (♀ paratype) with indications a, f, g of the levels of the transverse optical sections in another specimen. - B. Head of male paratype with indications b-c of the levels at which transverse optical sections were made in another specimen. - a. 'en face' view. - b. At level of external labial setae. - c. At level pharyngostome. - d. At level dorsal tooth. - e. At level subventral teeth. - f. At level outlet dorsal pharyngeal gland. - g. At level cephalic adhesion tubes.

juvenile).

Male reproductive system monorchic. Testis extending relatively far anteriorly (31-35%, 26% in ♂ 1 of total body length from anterior), consisting of a short narrow germinal zone and a long gradually widening growth zone. Vesicula seminalis large, with numerous sperm cells with a large nucleus with obvious granular outerlayer. Vas deferens with different glandular zones consisting of granular cells, and a short zone of turgescient cells about halfway its length (Fig. 4 A).

Spicules 37-49 µm (40 µm) long, with an offset knob-like capitulum, a very slender gradually posteriorly tapering shaft and a somewhat broader posterior part (Fig. 4 D). Gubernaculum 12-14 µm long, with a narrow corpus laterally curved, and parallel to the spicules. Thin short cloacal flap lying over a slightly swollen body cuticle caudally of the cloacal opening.

Three pairs of anal setae, one preanal pair and two postanal ones, 9-13 µm long.

Posterior adhesion tubes with well developed goblet-shaped end containing a tong-like extension of the inner canal, widened at the insertion (Fig. 4 E). PAT shortening posteriorly. They all insert anterior to the cloacal opening: 10-11 SIAT and 2-12 SvAT on each side, some tubes may be broken. Subventral adhesion tubes anteriorly (i.e. anterior seven tubes) arranged in two clearly separate rows, posteriorly approaching one another, nearing a single row (Fig. 4 C). SIAT intermingled with the ventrosublateral row of long fine and short glandular somatic setae.

Tail 2.5 (mean) anal body widths long, and cylindrical conoid. Non-annulated end 56% (mean) of the total tail length, with a finely vacuolated cuticle (cf punctated outlook), provided with a few short setae. Three caudal

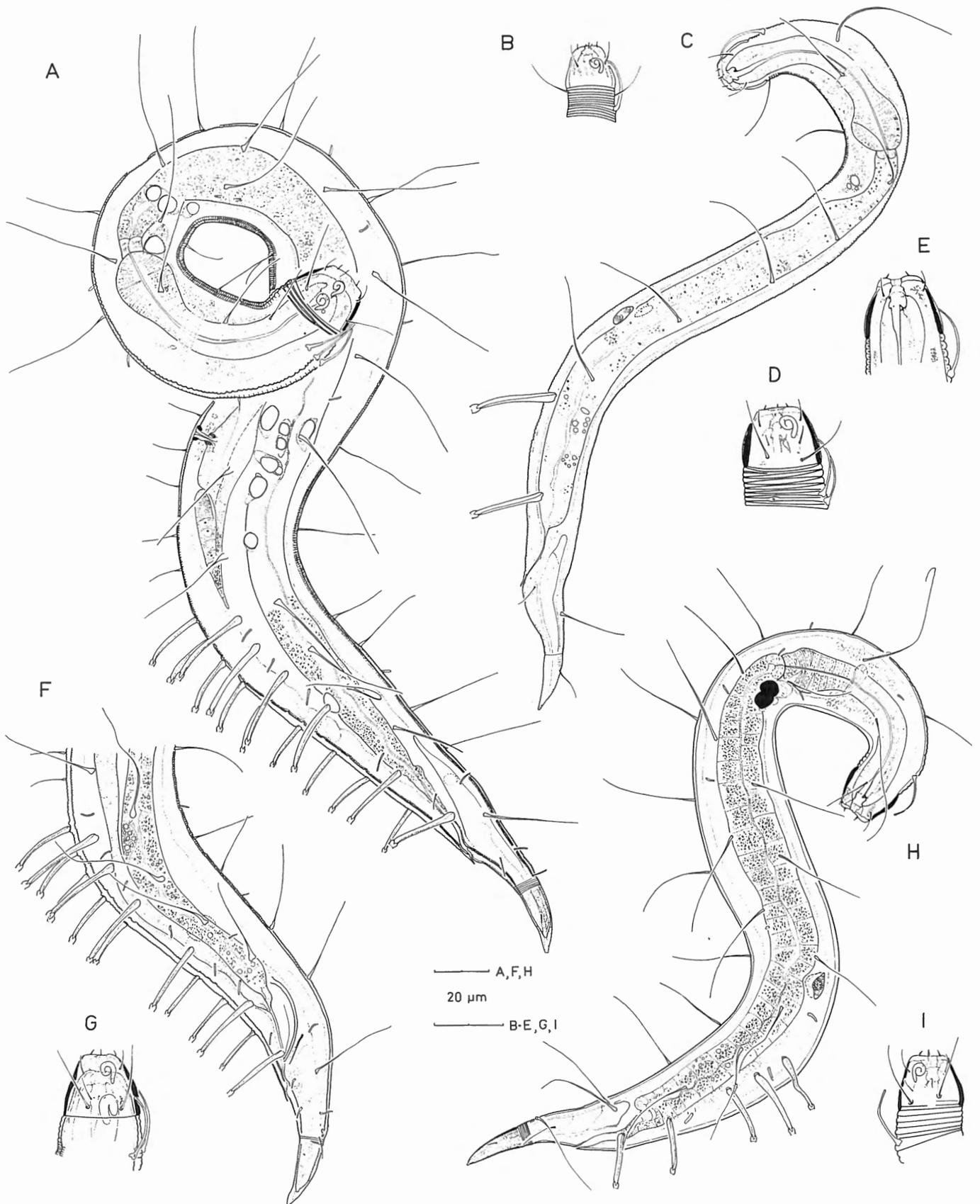


Fig. 6. *Prochaetosoma martensi* sp. n. - Fourth stage juvenile female paratype, moulting specimen: - A. Habitus with head in surface view. - E. Buccal cavity. - D. Surface view of head of fourth stage juvenile female. - Fourth stage juvenile male, moulting specimen: - F. Posterior body region. - G. Head in surface view. - Second stage juvenile: - B. Head. - C. Habitus. - Third stage juvenile: - H. habitus. - I. Head in surface view.



Fig. 7. *Prochaetosoma martensi* sp.n.: section through the uterus. Bar is 10  $\mu$ m.

glands extending beyond the cloaca and posteriorly ending on a well developed spinneret.

#### Females

Similar to males in many respects, but displaying sexual dimorphism in: - a more pronounced swelling of the mid-body region with greatest width at the level of the vulva, and - a spiral to slightly shephard's crook shaped amphidial fovea, slightly over two whirls, 4.5-6  $\mu$ m in diameter and located in the anterior half of the head at the level of the cephalic setae, reaching almost to the anterior rostrum border (Fig. 5 A).

Reproductive system amphidelphic and diovarial, with ovaries reflexed to the same side (right or left) or to opposite sides. Anterior reflexed branch 72-108  $\mu$ m long, posterior branch 82-130  $\mu$ m long. No differentiated spermathecae observed. Uterus in most specimens with large sperm cells with large finely granular nucleus and one or two nucleoli, i.e. sperm cells with a different nucleus than the sperm cells observed in the vesicula seminalis in male (Fig.4 G). Striking is the almost continuous arrangement of the sperm cells along the uterus wall and not in the center of the uterus, independent of the presence or absence of an oocyte. The uterus wall is thin membrane like (Fig. 7: transverse section at level of vulva). Developed oocyte 45 by 28  $\mu$ m. Vulva at 53-58% (55%) of total body length from anterior. Vagina 11-15  $\mu$ m long, with a short, 3.5  $\mu$ m distal part surrounded by a stronger cuticularized ring seen as oval pieces in longitudinal optical section, and a thin longer proximal part halfway surrounded by a well developed constrictor muscle (Fig. 4 D-E).

Posterior adhesion tubes with 12-13 SIAT and 10-14 SvAT, all anterior to the anus. Small anal flap present.

#### Juveniles

First stage not found.

*Fourth stage juveniles* (Fig. 6 A, D-G; 8 A-B, D).

In many respects similar to adults. Pharyngeal region slightly swollen, mid-body as large or less pronounced depending on the degree of development of the genital system, especially in young females (Fig. 6 A). Four CAT, one subdorsal pair and one dorsosublateral pair; anteriormost tubes inserted on the fifth annule as in adults (Fig. 6 D). Labial and cephalic sensilla as in adult. Subcephalic setae more or less arranged in two transverse rows: an anterior row with four short setae and a posterior row with four elongated setae: two dorsosublateral and two ventrosublateral setae. Amphidial fovea more or less shephard's crook-shaped, ventrally whirled with 1.5 coils as in female. Reproductive system largely formed in both sexes. Young females with reflexed branches, the anterior one 21-36  $\mu$ m long, the posterior branch 19-61  $\mu$ m long. In moulting females, the vagina is completely formed (Fig. 6 A). In moulting males, the reproductive system and copulatory apparatus completely formed (Fig. 6 F).

Posterior adhesion tubes all anterior to the anus and arranged in three longitudinal rows: two rows of 6 or 7 SIAT and one row of 9 VAT; tubes becoming shorter posteriorly.

*Third stage juveniles* (Fig. 6 H, I).

Resembling fourth stage juveniles in several respects. Body somewhat smaller and slenderer, with less pronounced swelling of the pharyngeal and mid-body regions than in the fourth stage and adults (Fig. 6 H). Three CAT, one subdorsal pair and a single dorsal tube. Obvious inclusions present ventrally along the anterior intestine as in other juvenile stages. Genital system little developed, 8-20  $\mu$ m long. Posterior adhesion tubes arranged in two longitudinal subventral rows of 4 tubes each, exceptionally 5 tubes. Tail 2.7-3.5 anal diameter long.

*Second stage juveniles* (Fig. 6 B, C).

Similar to the further developed stages but body slenderer and almost equally wide (Fig. 6 C). One dorsal CAT, about 8 annules posterior to rostrum. Four long subcephalic setae inserted on the second annule posterior to the rostrum. Genital system 5-8.5  $\mu$ m long, consisting of two small groups of a few cells. Posterior adhesion tubes arranged in two subventral longitudinal rows of two tubes each. Tail somewhat longer than in the other stages.

#### Diagnosis

*Prochaetosoma martensi* sp. n. is characterized by - the shape of the amphidial fovea displaying sexual dimorphism: loop-shaped in male, spiral to shephard's crook shaped in female; - the number of CAT: 9 in both sexes;

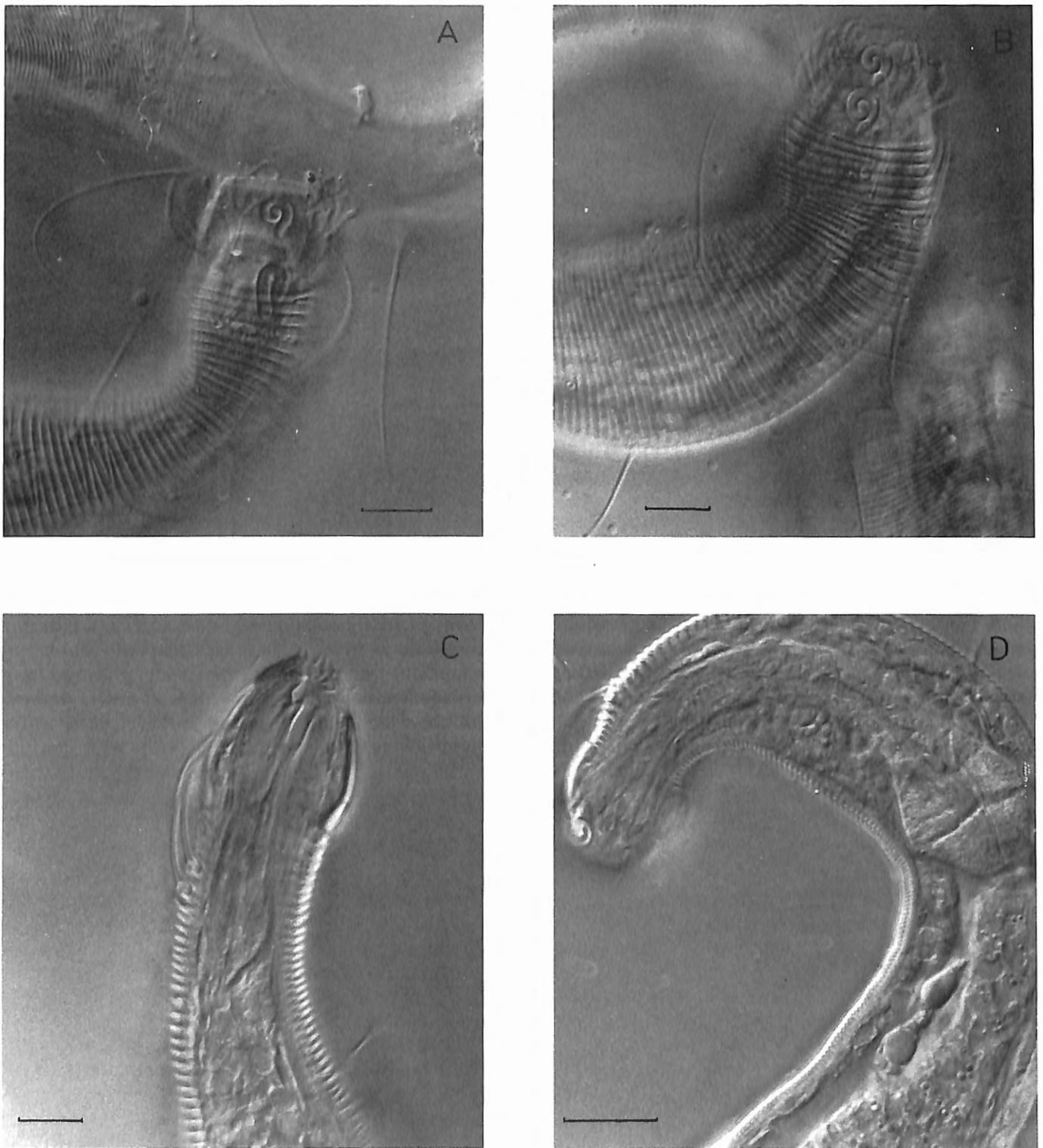


Fig. 8. *Prochaetosoma martensi* sp.n. - Head in surface view in moulting fourth stage juveniles: - A. Young male. - B. Young female. - C. Head female paratype in longitudinal optical section. - D. Rounded inclusions ventrally, along anterior intestine in a fourth stage juvenile.

- the number of PAT: SIAT, 10-11 in male / 12-13 in female, SvAT, 10-12 in male / 10-14 in female; - the shape of the copulatory apparatus; - the tail shape and the structure of the sperm cells and their arrangement in the uterus.

*Differential diagnosis*

The new species is closest to *P. vitielloi* ALLEN &

NOFFSINGER, 1978 in general habitus, head-shape and the nearly single row arrangement of the posterior subventral adhesion tubes. *P. martensi* sp. n. differs from *P. vitielloi* by the features mentioned in the diagnosis of the new species.

Subfamily Draconematinae FILIPJEV, 1918  
 Genus *Paradraconema* ALLEN & NOFFSINGER, 1978  
*Paradraconema maggentii* sp. n.  
 Fig. 9 A-H, Fig. 10 D-F

*Type specimens:*

Holotype male, slide RIT 197. Paratypes: 14 ♀ ♀, 8 ♂ ♂, 3 juveniles, slides RIT 197, RIT 309-310, RIT 319-324; 1 ♂, 2 ♀ ♀, paratypes, slide UCNC.

*Type locality:*

Madang Province, Megiar Harbour, sample no 496 (see material and methods).

*Etymology:*

The species is named in honour of Prof. Dr. Armant Maggenti, University of California, Davis.

MEASUREMENTS

*Holotype male* ♂

1 L = 630, CAT = 23, cs = 15-16, hw = 29, 1 amph = 11, Ph = 65, mbd Ph = 47, (mbd) = 9.5, mbd = 25, ABD = 14, t = 107, tmr = 32, SIAT1 = 38, SIAT2 = 35, SIAT3 = 35, SIAT4 = 32, SIAT5 = 29, SIAT6 = 24, SIAT7 = 23, SIAT8 = 22, SvAT1 = 32, SvAT2 = 31, SvAT3 = 31, SvAT4 = 28, SvAT5 = 27, SvAT6 = 24, SvAT7 = 24, SvAT8 = 23, SvAT9 = 21, SvAT10 = 20, SvAT11 = 17, SvAT12 = 16, SvAT13 = 14, SvAT14 = 13, SvAT15 = 15, SvAT16 = 14, spic = 31, gub = 10, Nr SIAT = 8, Nr SvAT = 16, Nr CAT = 12; a = 13.4, b = 9.7, c = 5.9; c' = 7.6.

*Paratype males* (n = 6)

L = 640-690, CAT = 20-23, cs = 10-17(14), hw = 27-30, hl = 16-18 (n = 2), 1 amph = 11-13, Ph = 66-73 (71), mbd Ph = 45-51, (mbd) = 9.5-11, mbd = 26-33 (30), ABD = 13-14, t = 97-103, tmr = 28-32, SIAT1 = 35-40, SIATl = 19-24, SvAT1 = 29-33, SvATl = 11-14, spic = 32-37 (34,5), gub = 10-12, Nr SIAT = 8, Nr SvAT = 14-16, Nr CAT = 12; a = 13.3-15.3 (14.1), b = 9.3-9.8, c = 6.5-7.1 (6.8), c' = 6.9-7.8 (7.3).

*Paratype females* (n = 8).

L = 630-735 (680), CAT = 20-21, cs = 15-16, hw = 29-26 (32), hl = 18 (n = 1), amph d = 11-13 x 7-9.5, Ph = 74-90 (81), mbd Ph = 50-59, (mbd) = 11-13, mbd V = 44-51, ABD = 10-12, t = 97-110, tmr = 29-34, SIAT1 = 33-40 (36), SIATl = 17-20 (19), SvAT1 = 27-34 (31), SvATl = 12-17 (14), V = 54-57% (55%), Nr SIAT = 9-12 (11), Nr SvAT = 15-18 (17), Nr CAT = 12; a = 11.6-12.6 (12.2), b = 7.7-9.2 (8.4), c = 6.0-7.2 (6.4), c' = 8.6-11.0 (9.3).

*Paratype juveniles*

*Fourth stage juvenile, moulting female specimen* (n = 1)

L = 490, CAT = 19, mbd Ph = 48, mbd V = 28, V =

54%, SIAT1 = 31, SIAT5 = 21, VAT1 = 27, VAT8 = 14, Nr SIAT = 5, Nr VAT = 8, Nr CAT = 4, a = 10.2. *Fourth stage juveniles* (= 2).

L = 480-530, CAT = 18-20, cs = 13-15, hw = 29-31, hl = 16 (n = 1), amph d = 8-8.5, Ph = 62-69, mbd Ph = 41-54, (mbd) = 10-11, mbd = 18-28, ABD = 10-16, t = 84-89, tmr = 28, SIAT1 = 33-34, SIATl = 21, VAT1 = 30, VATl = 13-14, Nr SIAT = 5, Nr VAT = 9, Nr CAT = 4; a = 9.8-11.7, b = 7.7, c = 5.7-6.0, c' = 5.6-8.4.

DESCRIPTION

*Males*

Body slender, whit short strongly swollen pharyngeal region, 12% of total body length; greatest body width at the level of the pharyngeal region in both sexes. Cuticle annulated; the annules are widest in the pharyngeal region, may slightly overlap and display slightly fringing borders and have a less cuticularized center part; at mid-body annulation fine, laterally interrupted by a narrow, smooth lateral field (Fig. 9 A).

Longest somatic setae on swollen anterior part. Somatic setae, hairlike with broadened base, varying in length from mainly long (to 50  $\mu\text{m}$ ) to very short (5  $\mu\text{m}$ ) setae, with marked insertions and more or less arranged in ten longitudinal rows in the pharyngeal region, in six longitudinal rows with less pronounced insertion posteriorly. Rostrum with fine vacuolar ornamentation near the posterior border. Amphidial fovea large loop-shaped, ventral arm slightly longer than dorsal arm (Fig. 9 B). Twelve CAT arranged in two transverse rows, subterminally on rostrum. Subcephalic setae in two transverse rows, one shortly behind the cephalic setae and a second row near posterior head end. One pair of small thorns, the Ceph Acan-set, situated subventrally at mid rostrum. Rather inconspicuous eyespots present subdorsally at level of CAT (Fig. 9 A). Four cephalic setae, 15-16  $\mu\text{m}$  long with marked insertion near anterior end of helmet. Lipregion introverted in most fixed specimens, when extruded, a crown of six external labial setae, 4.5-5  $\mu\text{m}$  long becomes visible, as well as the frame-work of the cheilostome (Fig. 9 B). Obvious yellow-brownish glands present at level of cephalic setae.

Stoma narrow, unarmed. Pharynx with enlarged corpus, separated by a short isthmus from a muscular posterior bulb; nerve ring at level of isthmus. Cardia short (5  $\mu\text{m}$ ). Intestine narrow cylindrical, gradually widening posteriorly, and lying dorsally of the genital system. Reproductive system typical of the Draconematidae, with a single anterior testis. Vesicula seminalis with sperm cells (8  $\mu\text{m}$   $\varnothing$ ) and a nucleus (3  $\mu\text{m}$   $\varnothing$ ). Spicules 32-37  $\mu\text{m}$  long, arcuate; corpus very slender slightly wider at both extremities and ventrally with a broad weakly sclerotized velum; capitulum offset, with a ventral apophysis (Fig. 9 C). Gubernaculum 10-12  $\mu\text{m}$  long, thin, parallel to the spicules and apparently with two thin proximal apophyses. Three pairs of anal

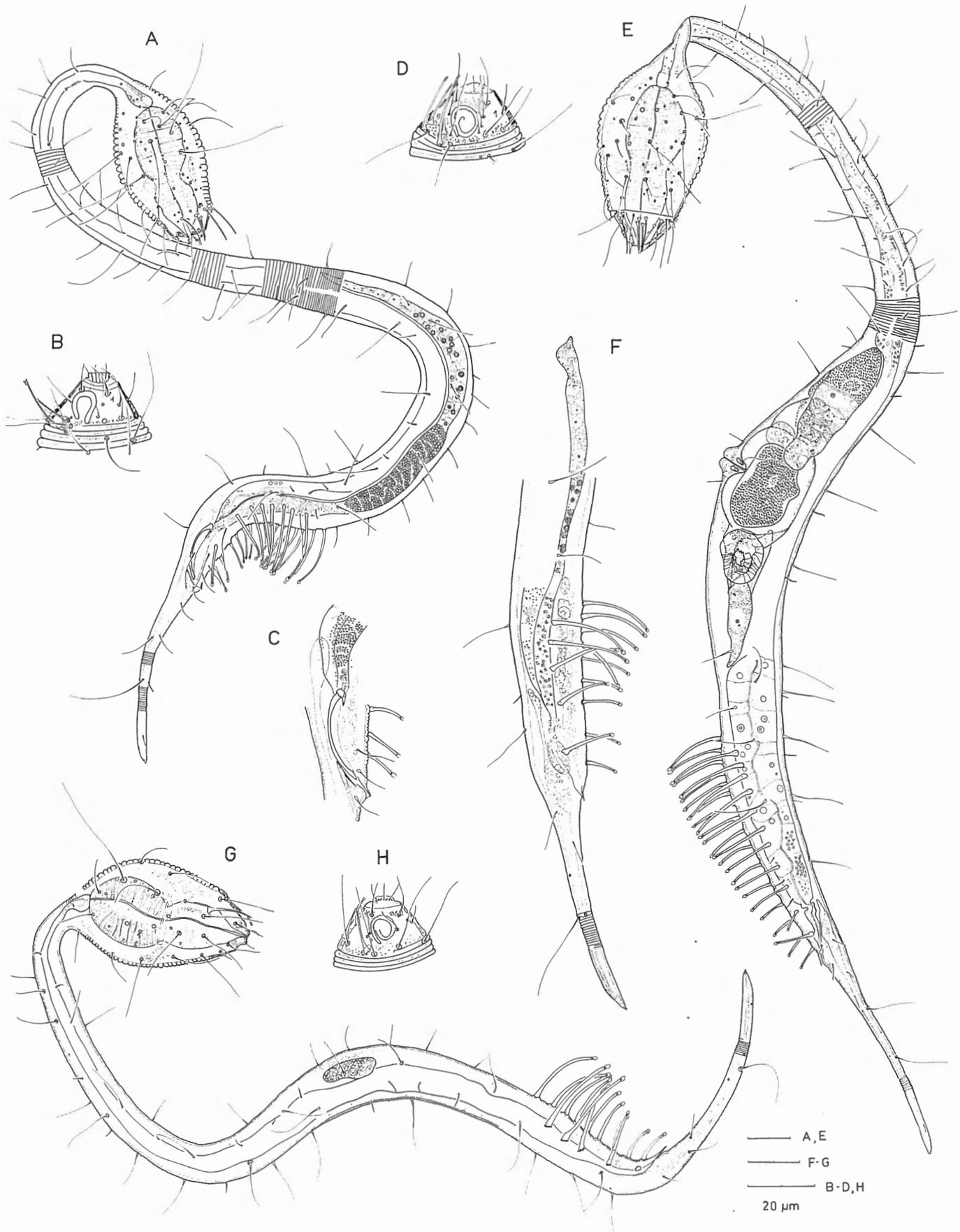


Fig. 9. *Paradraconema maggentii* sp.n. - A. Habitus holotype male. - B. Head in surface view (♂ paratype). - C. Copulatory apparatus (paratype). - D. Head in surface view (♀ paratype). - E. Habitus paratype female. - Fourth stage juvenile paratypes: - F. Posterior body region (young male). - G. Habitus young female. - H. Head in surface view (young female).

setae, two preanally, one postanally, 9-13  $\mu\text{m}$  long. Anal flap present, 2.5-3  $\mu\text{m}$  (Fig. 9 C).

All posterior adhesion tubes with well marked bell-shaped end and situated precloacally. Eight sublateral adhesion tubes and usually 16 (14 to 16) subventral adhesion tubes. Posterior adhesion tubes becoming shorter caudally.

Three caudal glands, extending a short distance beyond the cloacal opening. Tail narrow (5  $\mu\text{m}$ ) cylindrical, 6.9-7.8 anal diameter long. Non-annulated end, 30% (mean) of total tail length, its cuticle finely vacuolated.

#### Females

Similar to males in most respects. Swelling mid-body region pronounced; protruding vulval lips. Amphidial fovea spiral, ventrally whirled, slightly over one coil. (Fig. 9 E). Reproductive system amphidelphic and diovarial, with ovaries reflexed to the same side or to opposite sides. The whole tract is situated ventrally to the intestine. Two very thickwalled yellow-brownish pigmented spermathecae with folded appearance present. Each spermatheca connected with the uterus at the level of the junction oviduct/uterus and a connection of the uterus with a bilobed (on both sides of the uterus) sac usually containing refractive granules (Fig. 10 D-F). Sperms observed in uterus and spermathecae. Two pairs of paravulvar setae, one pair anterior and one pair posterior to the vulva.

Nine to twelve sublateral adhesion tubes and fifteen to eighteen subventral adhesion tubes. Posterior adhesion tubes becoming shorter caudally, all tubes preanal. Anal flap present.

#### Juveniles

First, second and third stages not found.

*Fourth stage juveniles* (Fig. 9 G-H).

In many respects similar to adults. One pair of minute Ceph Acan-set (Fig. 9 H). Four CAT. Subcephalic setae more or less arranged in two transverse rows. Amphidial fovea spiral as in females (Fig. 9 H). Reproductive system well developed in a young male specimen, (spicular primordium present Fig. 9 F) but relative little developed in a young female (Fig. 9 G). Posterior adhesion tubes in three longitudinal rows, all anterior to the anus: two rows of five SIAT and one row of nine VAT; tubes shortening posteriorly.

#### Diagnosis

*Paradraconema maggentii* sp. n. is characterized by -length (31-37  $\mu\text{m}$ ) and shape of the copulatory apparatus, - ornamentation of the body cuticle, - a pair of small cephalic acantiform setae at mid rostrum, - relative obscure eyespots, - the absence of preanal corniform setae in male, - the structure of the reproductive system in female and the number of posterior adhesion tubes: 8 SIAT, 14-16 SvAT ( $\sigma$ ), 9- 12 (11) SIAT, 15-17 (17) SvAT ( $\text{♀}$ ).

#### Remark

At present, nine species have been described in the genus *Paradraconema* ALLEN & NOFFSINGER, 1978, but few studies have been published paying attention to the structure of the female reproductive system. ALLEN & NOFFSINGER (1978) restricted the information to some features mentioned in the diagnosis of the Suborder Draconematina DE CONINCK, 1965: 'Female amphidelphic, didelphic, ovaries reflexed, vulva near mid-body'. No evidence was found in the literature of the presence of a spermatheca in *Paradraconema* species except for *P. floridense* in DECRAEMER (1982) and possibly for *D. meridionalis* (= *P. meridionalis*) in KREIS (1938) where, although not described, Fig. 2D gives a more complicated structure of the reflexed genital tract with additional to ovary, oviduct and uterus indications of the presence of a possible spermatheca.

During this study, three species were examined based on type material and other specimens: *P. floridense* ALLEN & NOFFSINGER, 1978, *P. hopperi* ALLEN & NOFFSINGER, 1978 and *P. maggentii* sp. n. All three species possess a large spermatheca, though different in appearance according to the species (e.g. folded in *P. maggentii*), in connection with a usually bilobed (with right and left part) sac filled or not with refractive granules (Fig. 10 B, D-F). Sperm cells are found in the large spermatheca and in the uterus. However, the female genital system of *P. maggentii* (Fig. 9 E, 10 D-F) differs from that of *P. floridense* (Fig. 10 A-D) and *P. hopperi* (Fig. 10 C) by the absence of a well developed muscular tube developed between the level of the junction of oviduct/spermatheca and the uterus. In *P. floridense*, a refractive triangular structure has been observed in the lumen of the tubular structure.

#### Some reflections on the phylogeny of the Draconematidae

The superfamily Desmodoroidea is a monophyletic group based on the synapomorphy: presence of a single anterior testis (LORENZEN, 1981). The superfamily comprises three families: the Desmodoridae, Epsilonematidae and the Draconematidae, the first family is considered a paraphyletic taxon, the last two families are monophyletic (= holophyletic sensu LORENZEN, 1981). The position and taxonomic status of the Desmodoroidea were discussed by VINCX (1987) in a revision and phylogenetic study of the superfamily, treated as a taxon with six families.

Within the Draconematidae, two subfamilies are distinguished: the Draconematinae and the Prochaetosomatinae. Originally, they were given family rank (ALLEN & NOFFSINGER, 1978), but the higher ranking was not accepted by LORENZEN (1981). Up to now, their phylogenetic status has not been discussed.

The Draconematidae FILIPJEV, 1918 form a mono-

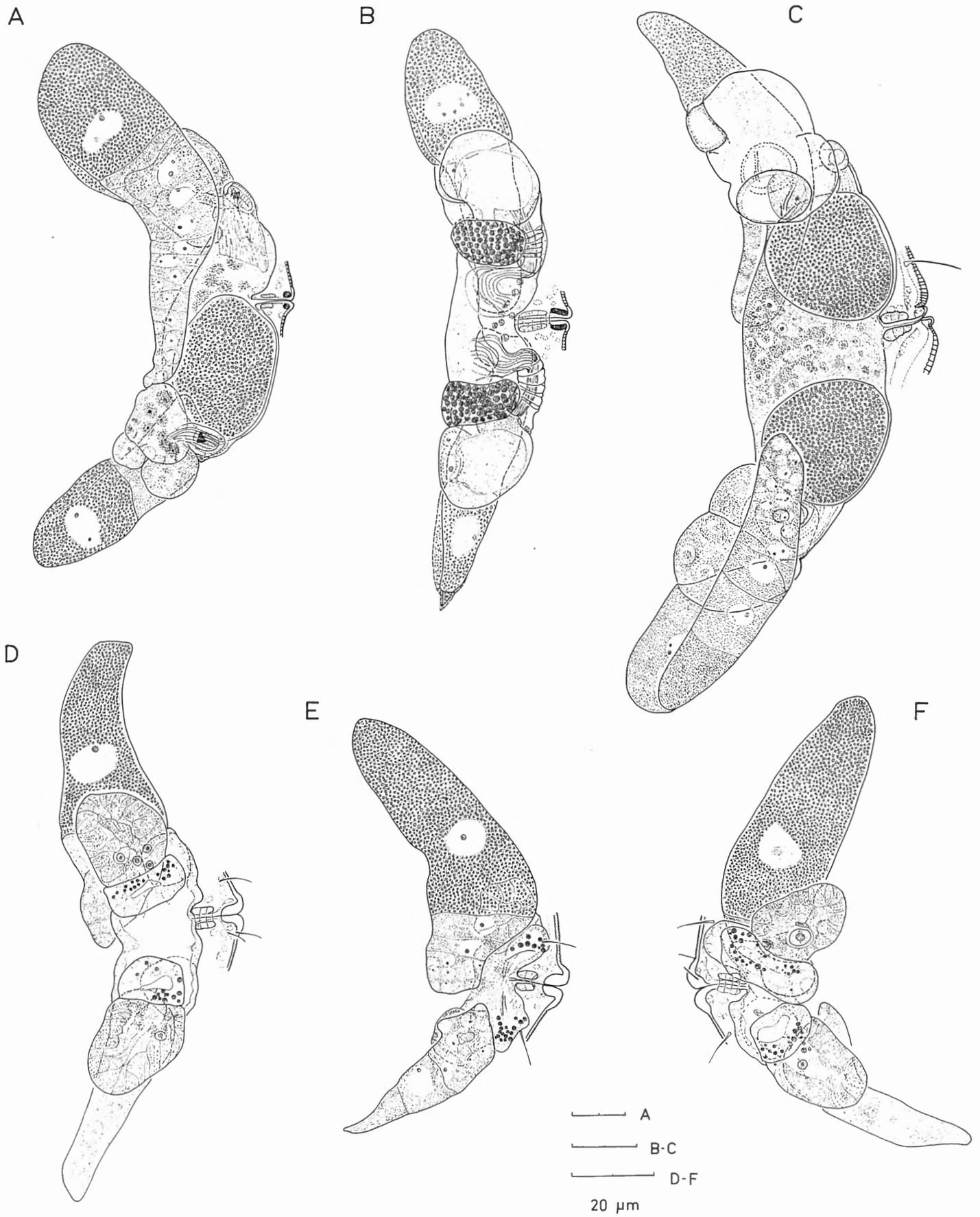


Fig. 10. Female reproductive system. - A, B. *Paradraconema floridense*. - C. *P. hopperi*. - D, F. *P. maggentii* sp.n.

phyletic group based on three synapomorphies:

- 1. female genital system situated in the mid-part of the S-shaped body i.e. anterior to the ventral curvature;
- 2. the subventral adhesion tubes are posterior to the ovary region i.e. in the posterior part of the S-shaped body;
- 3. anterior body end dorsally provided with cephalic adhesion tubes (see also LORENZEN, 1981; VINCX, 1987).

#### *Character analysis within the Draconematinae*

The Draconematinae are characterized by - 1. a three-part pharynx with easily discerned corpus (swollen), isthmus (narrow) and posterior bulb (expanded); and - 2. a narrow stoma, unarmed. In the study on the phylogenetic status of both subfamilies, the polarity of some characters was determined, considering the family Desmodoridae as an outgroup.

1. - Nemic pharynx though variable in shape and reflective of feeding habits, have proved to be useful taxonomic and phylogenetic tools (MAGGENTI, 1981). All nemic pharynx can be divided into two parts, the anterior corpus and the postcorpus, identifiable by the change of tissue and location of the glands even in a cylindrical pharynx. In a derived pharynx, a narrow isthmus (= anterior part of postcorpus) devoid of nuclei and surrounded by the nerve ring may be present (DE CONINCK, 1965; MAGGENTI, 1981).

The chromadorid pharynx is sometimes divisible into three parts, not always easy to distinguish in gross outline, sometimes only by a change in pharyngeal tissue (MAGGENTI, 1981). Within the Draconematinae, the three parts of the pharynx are indicated by a well marked outline, differentiating the subfamily from its sister group, the Prochaetosomatinae as well as from the Desmodoridae and Epsilonematidae. The three latter groups are characterized by a largely cylindrical pharynx (at most with a minor swelling in the metacorporal region as e.g. in *Metepsilonema* STEINER, 1916, *Dracognomus* ALLEN & NOFFSINGER, 1978) ending on a muscular bulb. I have tried to examine if the distinction between both subfamilies of the Draconematidae is purely based on a structural diversity (shape) or also on internal morphology? As far as I could observe by light microscopy, the pharynx in Prochaetosomatinae is usually twopartite, no real isthmus could be discerned. Possible transitionforms towards the Draconematinae pharynx type could be found among species of *Dracognomus*, especially *D. marioni* and *D. notohalensis*.

In *D. marioni* ALLEN & NOFFSINGER, 1978 the pharyngostome extent far backwards in the anterior corpus of the pharynx, which becomes swollen posterior to the telostome. The anterior corpus of the pharynx is separated from the postcorpus (enlarged to a well developed endbulb with valve) by a short narrow region (isthmus?) apparently different in tissue as far as discernable by light microscopy (Fig. 178 in ALLEN &

NOFFSINGER, 1978; Fig. 7 in DECRAEMER & GOURBAULT, 1986). No type material or other specimens of *D. notohalensis* ALLEN & NOFFSINGER, 1978 were examined, but a similar structure of the pharynx as in *D. marioni* is likely as can be deduced from the original description and Figs 181, 183. In *D. tinae* JENSEN, 1981 the pharyngostome is shorter, the swelling of the anterior corpus more anteriorly (near the head base) than in the former species of the genus, and the pharynx shows no evidence of an isthmus. In *D. simplex* (GERLACH, 1954), the pharyngostome is narrower and less sclerotized than in the other species; the anterior pharynx region shows a slight narrowing at the level of the nerve ring in front of the postcorpus bulb, but morphologically only two parts of the pharynx can be distinguished. Warwick (1977) noted that in *Draconema arcticum* KREIS, 1963, the anterior part of the pharynx is only slightly swollen and the species is therefore in some respects intermediate between *Notochaetosoma* and *Draconema*. Meanwhile ALLEN & NOFFSINGER (1978) arranged the species tentatively in the genus *Prochaetosoma* until more specimens become available.

The tripartite pharynx is considered a synapomorphy for the Draconematinae. It represents a character unique in combination with the body shape with a strongly swollen pharyngeal region, the greatest body width in *Draconema* and *Paradraconema* males, or as wide as or nearly as wide as the conspicuously swollen mid-body region in Draconematinae females and *Dracograllus* males. Prochaetosomatinae species have a slender draconematid body shape (cf LORENZEN, 1981) with the pharyngeal region not swollen or only slightly to moderately swollen as in *Dracognomus* species; or their width is nearly equal over the entire body as in *Notochaetosoma*.

2. - The Draconematinae have an unarmed stomatal region, little developed i.e. a rudimentary cheilostome, a coincident unexpanded pharyngostome, a condition often described as buccal cavity inconspicuous, collapsed. The Prochaetosomatinae mainly have a moderately developed stomatal region, armed with a conspicuous dorsal tooth with or without minute ventrosublateral teeth: *Prochaetosoma* species, *Draconactus suillus* (ALLGEN, 1932), *Cygnonema* species, *Dracognomus* species (except *D. simplex*) or an inconspicuous dorsal tooth in an inconspicuous, partially collapsed buccal cavity: *Draconactus cutus* ALLEN & NOFFSINGER, 1978, *Apenodraconema* species, *Dracognomus simplex* (GERLACH, 1954) (see DECRAEMER & GOURBAULT, 1986; in GERLACH (1954) tooth not observed). Three genera: *Notochaetosoma* IRWIN-SMITH, 1918 (3 species), *Dracogalerus* ALLEN & NOFFSINGER, 1978 (with 4 species) and *Tenuidraconema* gen.n. (monotypic) have an unarmed, weakly, collapsed (*Notochaetosoma*) or a weakly to moderately developed buccal cavity (*Dracogalerus*). Based on this feature and on the possession of a very thick cuticle, the first two genera

were differentiated from the other Prochaetosomatidae and placed in a separate taxon (subfamily Notochaetosomatinae of the family Prochaetosomatidae) by ALLEN & NOFFSINGER (1978).

A 12-folded vestibulum (cheilostome) is typical for the Chromadorina and defines the monophyly of the suborder. The absence of this feature in some species as e.g. in part of the Draconematidae, is considered a secondary condition (LORENZEN, 1981, p. 159). According to ALLEN & NOFFSINGER (1978, p. 11) the Draconematidae (= Draconematinae) possess a lipregion with an internal cuticularized framework consisting of 12 outwardly projecting ribs; in Prochaetosomatidae (Prochaetosomatinae) there is an internal framework below the lipregion that is not well developed in most genera. However, a clear 12-folded vestibulum is present in *Prochaetosoma martensi* sp.n. (Fig. 5 A, a). Species from both subfamilies of the Draconematidae may occur in the same sample. The type of stoma, armed or not, corresponds with their food preferences; they probably have different micro-environments. One dorsal tooth and two ventrosublateral teeth, a character state shared by nearly all Chromadorida, seem to be the ancestral arrangement in the Desmodoridae (VINCX, 1987). Occasionally, teeth were also lacking in the Prochaetosomatinae (*Tenuidraconema*) and other taxa of the Desmodoroidea as in Stilbonematidae and Epsilonematidae. However, when teeth are absent, the buccal cavity is always very minute (LORENZEN, 1981). A minute buccal cavity without or with minute teeth was considered a plesiomorph feature in the character analysis of the Desmodoridae in VINCX (1987), a similar polarity of the character is given for the Draconematidae.

A. - The genus *Draconema* (6 species) is characterized by an anterior differentiation in the annulation of the body cuticle, with larger annules, anteriorly directed and showing a more pronounced ornamentation. This feature is considered as an apomorphic feature for the genus based upon ontogenetic evidence: in the first juvenile stage the entire body is finely annulated (ALLEN & NOFFSINGER, 1978). The cuticular differentiation (annular enlargement and ornamentation) develops from the second stage on, but is in the fourth stage, still not as distinct as in adults.

B. - *Paradraconema* (9 species) is characterized by the presence of one or two pairs of sublateral cephalic acanthiform setae. At present, first stage juveniles are unknown in this genus. The cephalic acanthiform setae are minute (*P. floridense*) or absent in the second stage, hardly developed in the third stage but well developed in the fourth stage, similar in number as the adults. Although, this character was also observed in one species of the related genus *Dracograllus* (*D. stekhoveni* ALLEN & NOFFSINGER, 1978) I still consider it an apomorphy on generic level. *Paradraconema* species also possess a pair of dorsosublateral eyespots near or in the rostral region, conspicuous or inconspicuous,

oval-shaped, yellowish and apparently solid or amorphous pigment bodies without lense-like structures as in ocelli. Up to now, no ontogenetic evidence is found which could directly determine the polarity of this character. Eyespots are already present in the second stage juvenile (first stage unknown). To my knowledge, eyespots do not occur in the other genera of the Draconematidae nor in the Desmodoroidea, their presence in *Paradraconema* is considered an synapomorphy for the genus.

C. - *Dracograllus* (23 species) is distinguished from both other genera of the Draconematinae by the lack of an annular differentiation of the body cuticle as in *Draconema* and the lack of cephalic acanthiform setae (except for *D. stekhoveni*) and the absence of eyespots. No apomorphic features could be found for this genus.

#### *Character analysis within the Prochaetosomatinae*

The subfamily Prochaetosomatinae is considered a paraphyletic taxon characterized by a cylindrical pharynx with endbulb, a feature shared by nearly all Desmodoridae species (VINCX, 1987). Prochaetosomatinae also possess an armed stoma as nearly all species belonging to the order Chromadorina, with at least one distinct dorsal tooth in the majority of the species. The subventral teeth are absent or if present, they are usually very minute and their number and arrangement is often obscure and needs further investigation in many species. *P. martensi* has a moderately developed dorsal tooth and six ventrosublateral denticles; *P. vitielloi* and *P. mediterranicum* are described with one subventral tooth: *P. lugubre* with two minute ventral teeth. No subventral teeth were described in other Prochaetosomatinae species except for *Dracognomus tinae* with 2 small subventral teeth.

The phylogenetic status of the genera of the Prochaetosomatinae is hard to determine. At present, the majority of the genera have few species, and the larval stages are not always known, and so the determination of the polarity is difficult. Most Draconematidae have a body configuration dorsally and ventrally arched into a shallow sigmoid shape with greatest body width usually in the pharyngeal and mid-body regions. *Notochaetosoma* and *Dracogalerus* have a body almost equally wide over the entire length, and possess a thick body cuticle. Both features are rare in the Draconematidae, but occur in some species of the Desmodorinae; both characters are considered as plesiomorphic.

A. - The genus *Dracognomus* (4 species) is characterized by an inconspicuous inverted 'U' shaped (staple-shaped) amphid, also described as a tubular amphidial groove at the base of the rostrum, and extending through the first few body annules. The shape and backward position of the amphidial fovea is a unique feature in the Draconematidae where males usually have a well developed (wider) loop-shaped amphidial fovea and females and juveniles a spiral or loop-shaped one. The spiral origin of the amphidial fovea is not

obvious in *Dracognomus*. In *Cygnonema steineri*, the amphid shape in female was also described as inconspicuous tubular-shaped, but not figured; an examination of type specimens is necessary to compare the structure of the amphid with that in *Dracognomus*. The far backward position of the amphidial fovea is considered a plesiomorphic character (LORENZEN, 1981). *Dracognomus* species also have modified adhesion tubes, i.e. finer setae without bell-shaped enlargement, absent in all other genera of the family; this feature is considered as an apomorphy for the genus. The pharynx in *Dracognomus* shows a median swelling, absent in other Prochaetosomatinae; a slight anterior swelling was observed in *Tenuidraconema*, a strong muscular swelling of the anterior pharynx in the head region in *Apenodraconema*. Together with *Prochaetosoma*, *Dracognomus* species have a pharyngeal bulb with cuticularized valve, not observed in other Draconematidae, and considered as an apomorphic feature. A weak to strongly sclerotized lumen in the pharyngeal endbulb occurs in some genera of the Desmodoridae; a stronger sclerotization of the lumen in the endbulb of the pharynx is considered apomorphic (VINCX, 1987).

B. - The monotypic genus *Cygnonema* differs from the other Prochaetosomatinae by the long slender anterior body, 50-59% of the total length, and by the arrangement of the cephalic adhesive tubes posterior to the rostrum, to three rostral widths. The stout tube-like paravulvar setae in female are typical for the genus. No apomorphics could be found for the genus.

C. - *Draconactus* (2 species) is characterized by the conical shaped rostrum and the prominent dorsal swelling of the pharyngeal region, in lesser extend also present in other draconematids. No apomorphic features were found characterizing the phylogenetic status of the genus.

D. - *Apenodraconema* (2 species) is different from the other genera of the subfamily by the obvious spine-like ornamentation of the body cuticle. This strong spine-like ornamentation of the annule borders is unique within the Draconematidae, but occurs in other taxa of the Desmodoroidea as e.g. in Epsilonematidae species although not with the same structure as in *Apenodraconema*. Less marked spiny ornamentation is present in *Dracograllus* species (DECRAEMER, 1988). The

spine-like ornamentation in *Apenodraconema* is already present and well developed in the second juvenile stage (first stage juveniles unknown in *Apenodraconema*). The genus is also characterized by the tail shape with sexual dimorphism in shape: female with tail long, largely cylindrical-conoid, spike-like, anteriorly with only 3-4 annules; male with a ventrally bent tail with more rings and in the posterior half of the non-annulated tail region an obvious ventral protuberance (? kind of sucker) at the level of a dorsal knick. Juveniles have more annules than females, except for young females in the fourth stage. Young males show from the third stage on a slight dorsal knick of the non-annular tail region, with the formation of the ventral protuberance in the fourth stage. The tail shape is considered an apomorphy for the genus.

E. - *Tenuidraconema* gen.n. (monotypic) is characterized by its very slender body with moderate pharyngeal and mid-body swellings and by the unarmed stoma and a possible slight anterior swelling of the pharynx. No apomorphic characters were found to support the genus as a monophyletic group, it possesses characters of both subfamilies (see higher remarks on the genus).

F. - *Prochaetosoma* (10 valid species) has a moderately developed stoma with a distinct dorsal tooth, a rostrum broadly flattened anteriorly, pharyngeal region only slightly swollen, and a pharyngeal bulb with cuticularized valve as in *Dracognomus*. No apomorphic characters were found to determine the genus as a separate phylogenetic entity.

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#### References

ALLEN, M.W. & NOFFSINGER, E.M., 1978. A revision of the marine nematodes of the superfamily Draconematidae FILIPJEV, 1918 (Nematoda: Draconematina). *University of California Publications in Zoology*, 109: 1-333.

ALLGEN, C., 1932. Weitere Beiträge zur Kenntnis der marinen Nematodenfauna der Campbellinsel. *Nyt Magazin for Naturvidenskaberne*, 70: 97-198.

DE CONINCK, L.A., 1965. Systématique des Nématodes. In: *Traité de zoologie, Anatomie, Systématique, Biologie. Némathelminthes (Nématodes)*. Masson et Cie, Paris, 4 (2): 1-731.

DECRAEMER, W., 1982. Draconematidae and Epsilonematidae (Nematoda) from Laing Island, Papua New Guinea, with one new genus and three new species. *Bulletin van het*

*Koninklijk Belgisch Instituut voor Natuurwetenschappen: Biologie*, 54 (1): 1-19, 8 pls.

DECRAEMER, W., 1988. *Dracograllus* (Nematoda: Draconematinae) from Papua New Guinea, with descriptions of new species. Leopold III Biological Station, Laing Island-Contribution no. 158. *Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen: Biologie*, 58: 5-27, 8 pls.

DECRAEMER, W. & GOURBAULT, N., 1986. Marine nematodes from Guadeloupe and other Caribbean Islands. II. Draconematidae. *Zoologica Scripta*, 15 (2): 107-118.

FILIPJEV, I.N., 1918. Free-living marine nematodes of the Sevastopol area. Part 1. *Travaux du Laboratoire Zoologie et de la Station Biologique de Sébastopol près l'Académie des Sciences de Russie*, II (4): 1-350.

GERLACH, S.A., 1954. Nouveaux nématodes libres des eaux souterraines littorales françaises. *Vie et Milieu*, 4 (1): 95-110.

IRWIN-SMITH, V.A., 1918. On the Chaetosomatidae, with descriptions of new species, and new genus from the coast of New South Wales. *The Proceedings of the Linnean Society of New South Wales*, 42: 757-814.

JENSEN, P., 1981. Description of the freeliving marine nematode *Dracognomus tinae* n.sp. (Draconematoidea: Prochaetosomatidae). *Cahiers de Biologie marine*, 22: 285-289.

KREIS, H.A., 1938. Neue Nematoden aus der Südsee. (Papers from Dr. Th. Mortensen's Pacific Expedition 1914-1916). *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i Kobenhavn*, 101: 153-181.

KREIS, H.A., 1963. Marine Nematoda. *The Zoology of Iceland*, 2 (14): 1-68.

LORENZEN, S., 1981. Entwurf eines phylogenetischen Systems der freilebenden Nematoden. *Veröffentlichungen des Instituts für Meeresforschung in Bremerhaven*, Supplement 7: 1-472.

MAGGENTI, A.R., 1981. *General Nematology*. Springer Verlag, New York, Heidelberg, Berlin: 1-372.

DE MAN, J.G., 1880. Die einheimischen, frei in der reinen Erde und im süßen Wasser lebende Nematoden monographisch bearbeitet. Vorläufiger Bericht und descriptiv-systematischer Theil. *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, 5: 1-104.

STEINER, G., 1916. Freilebende Nematoden aus der Barentsee. *Zoologische Jahrbücher Abteilung für Systematik, Geographie und Biologie der Tiere*, 39 (5-6): 511-676.

VINCX, M., 1987. *Free-living marine nematodes from the Southern Bight of the North Sea*. Doctoral thesis, 618 p.

WARWICK, R.M., 1977. Some free-living marine nematodes from the Isles of Scilly. *Journal of natural History*, 11: 381-392.

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