

# Six new *Richtersia* species (Nematoda, Selachinematidae) from the Mediterranean Sea

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Accepted 24 June 1986

Soetaert, K. & Vincx, M. 1987. Six new *Richtersia* species (Nematoda, Selachinematidae) from the Mediterranean Sea.—*Zool. Scr.* 16: 125-142.

Six new species of the genus *Richtersia* Steiner, 1916 are described from the Mediterranean Sea: *R. bathyalis* sp.n., *R. spinosa* sp.n., *R. heipi* sp.n., *R. mediterranea* sp.n., *R. staresensis* sp.n. and *R. coomansi* sp.n. Some morphological adaptations of *R. bathyalis*, *R. spinosa* and *R. heipi* are discussed in relation to their small body size. The structure of the stomatal region, labial region and spicules is described in detail and probably holds for the entire genus.

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## Introduction

During an ecological and taxonomical study of the nematode fauna of the bay of Calvi (Corsica, Mediterranean Sea) and the adjacent continental slope and rise, many new and interesting free-living marine nematodes were found. Five new species of the genus *Richtersia* Steiner, 1916 are described from this area. Another new *Richtersia* species from the Mediterranean was obtained from Banyuls-sur-Mer (France).

## Material and methods

The samples were taken by divers or with the use of a Reineck box-corer (170 cm<sup>2</sup>), from which two subsamples (10 cm<sup>2</sup>) were drawn to study the meiofauna. These subsamples were fixed with a warm (70°C) 4% formalin-seawater solution. Nematodes were transferred to pure glycerine by the method of Seinhorst (1959). 'En face' views and other sections were mounted in glycerine jelly.

The drawings were made with the aid of a camera lucida on a Leitz dialux 20 EB.

The holotype and allotype are deposited in the collection of the Instituut voor Dierkunde, Rijksuniversiteit Gent, Belgium. Other type material is in the nematode collection of the Marine Biology Section.

Values in the formula indicate:

Head (nerve r) Phar.end W Vulva(♀) Anus Body length  
Corresponding diameter

W (largest body diameter) was also used in the female when largest body diameter was not at the vulval level. Its position in the formula indicates the position of maximum body width.

Head width for some species was measured at the maximal width of the cuticular collar (first value) and at the beginning of the annulation (second value).

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

## Abbreviations used in the text

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
L	body length

V	distance of vulva from anterior end as a percentage of body length
sp.	spiculum measured along the arc
l.sp.	length of left spiculum
r.sp.	length of right spiculum

## Abbreviations used in the figures

amph.	amphideal fovea
b.c.	buccal cavity
ch.	cheilostome
I.	intestine
inv.	invagination of labial region
l.	labial membrane
L.sp.	left spicule
ph.	pharynx
pri.	prism
R.sp.	right spicule
r.	rectum
sp.	spicule
sp.c.	sperm cell
tu.	tube
v.d.	vas deferens

## *Richtersia bathyalis* sp.n. (Figs. 1, 2, 5A-C, 6D-F)

**Type material.** Holotype male ♂1 (slide no. 736) and paratypes (juv1-2) from Mediterranean Sea, off Calvi, Corsica, 42°39'27"N, 08°39'45"E, 782 m, 1-2 cm into the sediment. Paratype (allotype) female ♀1 (slide no. 737) and other paratypes (♂6, ♀2, juv3-5) from 42°40'11"N, 08°39'18"E, 1000 m, 1-2 cm into the sediment. Paratypes (♂2-5, ♀3, juv6-8) from 42°41'15"N, 08°38'63"E, 1250 m, 0-1 cm into the sediment. At all stations, sediment consisted of more than 80% silt-clay. The median grain size was 2-3 µm. Samples taken on 6 May 1985.

## Measurements

♂: L = 290 µm; a = 5.7; b = 3.1; c = 4.9; c' = 3.1; sp. = 68 µm.

— ? W 95 231 290 µm  
32 24 ? 51 49 19

♀1: L = 300 µm; a = 5.2; b = 2.9; c = 5.0; c' = 3.2; V = 53.1%.

— ? 104 W 158 240 300 µm  
34 26 ? 56 58 56 19

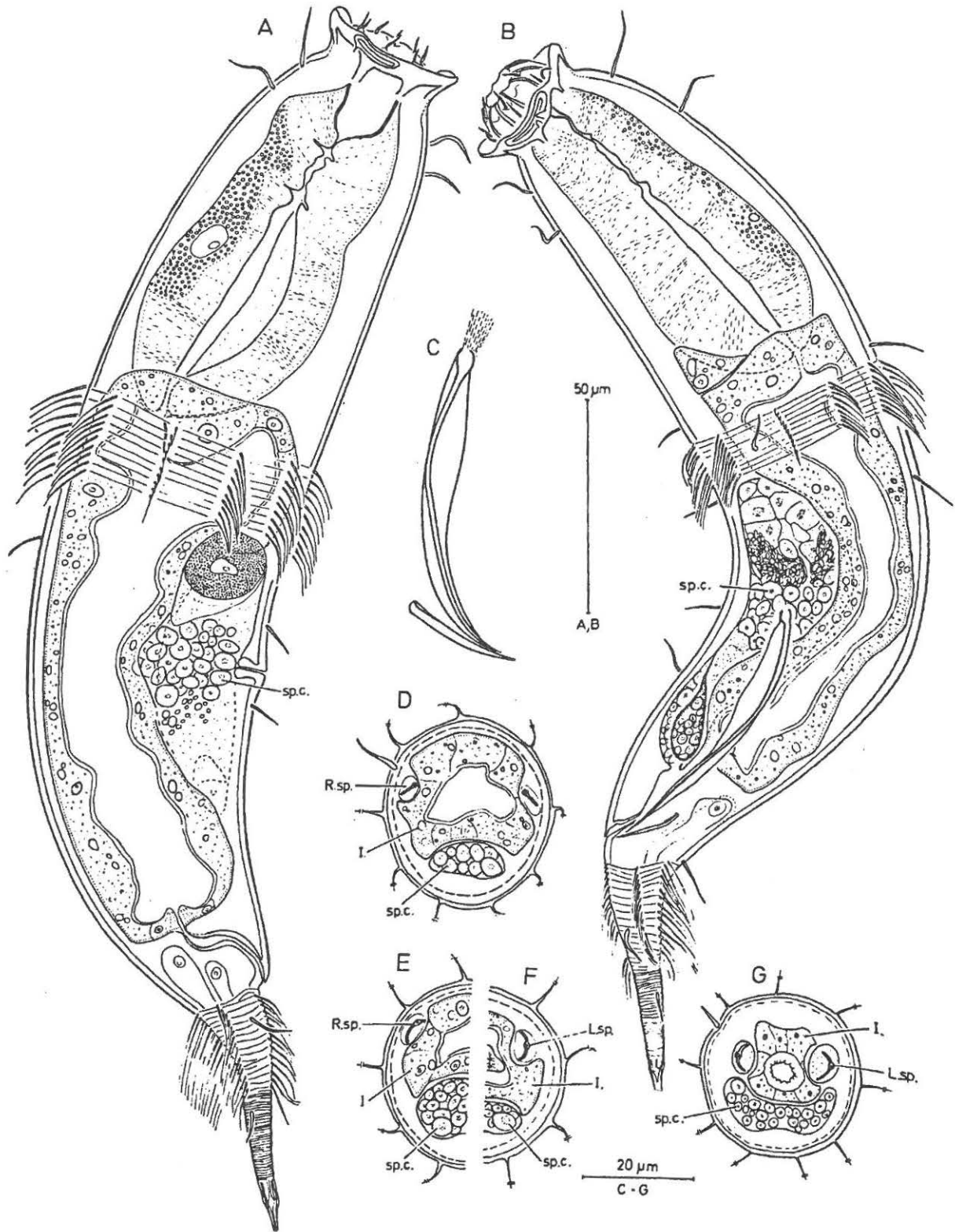


Fig. 1. *Richtersia bathyalis* sp.n.—A. Habitus ♀ 1.—B. Habitus ♂ 1.—C. Right spicule and gubernaculum ♂ 2.—D–G. Cross section through spicular apparatus, gut and vas deferens (D most anteriorly, G most posteriorly); dorsal is the upper side.

Other males:  $L = 260\text{--}330\ \mu\text{m}$ ;  $a = 5.5\text{--}7.1$ ;  $b = 2.8\text{--}3.3$ ;  $c = 4.3\text{--}5.5$ ;  $c' = 2.6\text{--}3.3$ ;  $sp. = 50\text{--}65\ \mu\text{m}$ .

Other females:  $L = 240\text{--}275\ \mu\text{m}$ ;  $a = 4.9\text{--}5.2$ ;  $b = 2.6\text{--}2.9$ ;  $c = 4.7\text{--}5.5$ ;  $c' = 2.4\text{--}2.5$ ;  $V = 55.8\text{--}55.9\%$ .

Juveniles:  $L = 155\text{--}205\ \mu\text{m}$ ;  $a = 5.0\text{--}5.8$ ;  $b = 2.2\text{--}2.8$ ;  $c = 4.1\text{--}4.6$ ;  $c' = 2.1\text{--}3.2$ .

**Description**

**Male.** Body short, clumsy, truncated anteriorly, tapering posteriorly. Largest width at end of pharynx. Tail long. Cuticle annulated, annules  $2\ \mu\text{m}$  wide. Each annule

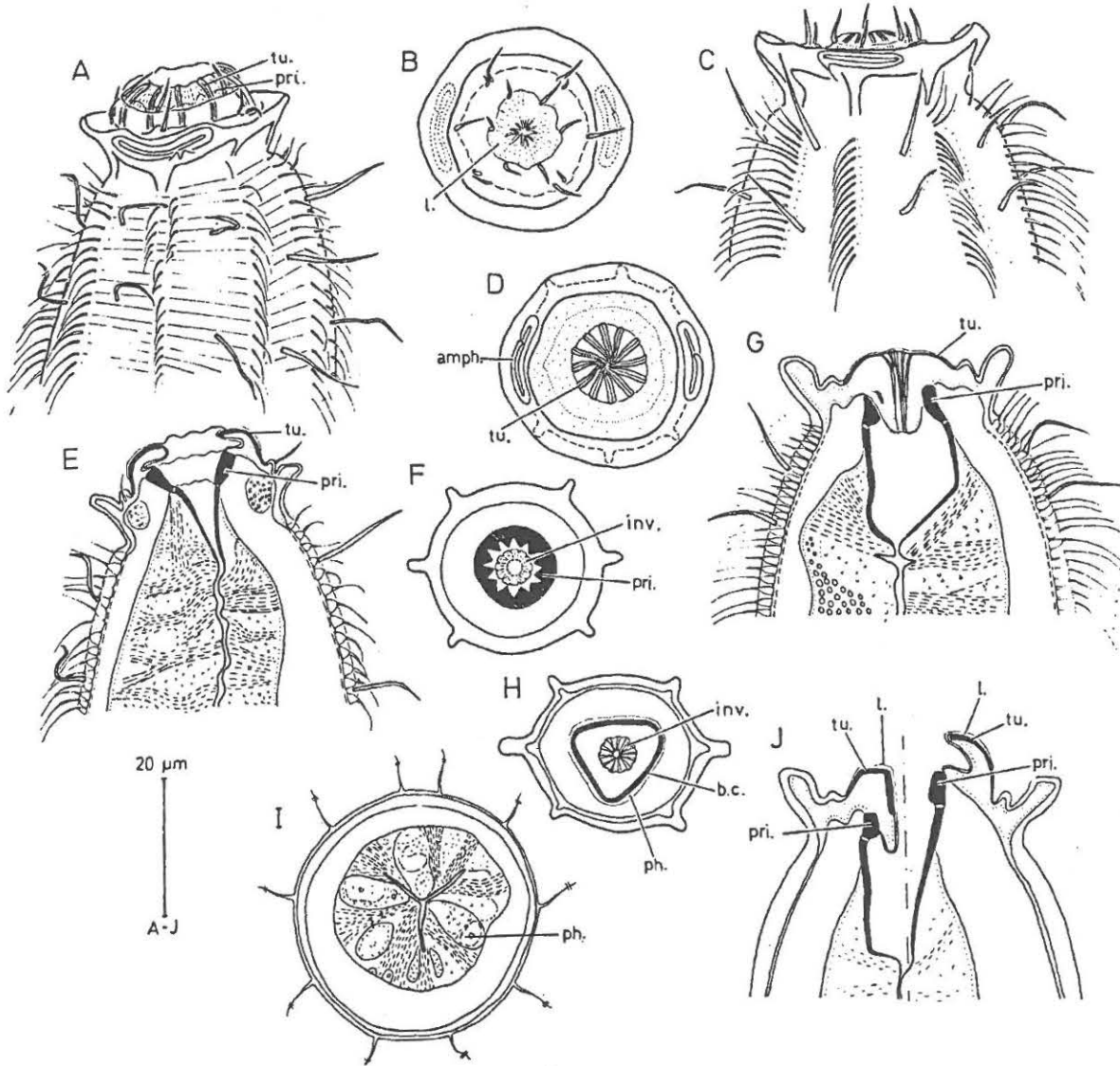


Fig. 2. *Richtersia bathyalis* sp.n.—A. Head end ♂1 (surface view).—B. Apical view of the labial membrane.—C. Head end ♀1 (surface view).—D. Apical view of the cuticular tubes and amphideal foveae.—E. Head end ♂1 (internal view).—F. Apical view of the prisms and invagination.—G. Head end ♀1 (internal view).—H. Apical view of the buccal cavity.—I. Cross section of the pharynx.—J. Schematic representation of the two extreme conditions of buccal morphology. B, D, F, H are from the same male with retracted lip region; I is from another specimen. Dorsal is the upper side.

with spines (10 μm long in cervical region, 18–20 μm long in cloacal region) arranged in ten longitudinal rows: two mediolateral, two laterodorsal, two lateroventral, two rows in subdorsal and two in subventral octants. In posterior half of body, rows in subdorsal octants fused to form one mediadorsal row, ending in cloacal region: only eight rows present at level of cloacal opening, reducing to six in anterior half of tail (♂1). In some other males, rows in subventral octants fused, but in all individuals, mediolateral and submedian rows extending to cloacal opening. No spines in posterior half of tail, but irregular annules present. Tip of tail not annulated.

Somatic setae (8–12 μm) situated irregularly between longitudinal rows of spines; ten pairs of somatic setae present in neck region; in remainder of body, a maximum of six longitudinal rows could be detected (setae apparently lacking in subventral and subdorsal octants). Spine-

less portion of tail carrying two setae, slightly to dorsal side.

Head sharply set off from body by a thick cuticular collar, forming a 'cup' in which lips and anterior setae are situated. This collar extending posteriorly as eight short longitudinal ridges: two mediolateral ridges behind amphideal fovea, two laterodorsal, two lateroventral, one mediadorsal and one medioventral (last two somewhat shorter than the others). Each longitudinal ridge giving rise to a longitudinal row of spines, with exception of mediadorsal and medioventral ones, corresponding each with two longitudinal rows. In left lateral quadrant, a rudimentary row of spines was observed, corresponding to a small cuticular thickening of collar just behind amphideal fovea (♂1).

Amphideal fovea, situated on cuticular collar, a ventrally wound, flattened spiral (width 45% of corresponding

body width). Spiral structure not always obvious. In some individuals fovea situated slightly towards dorsal side.

The six internal labial setae (6  $\mu\text{m}$ ) situated at base of labial membrane. The six external labial setae (6  $\mu\text{m}$ ) and the four cephalic setae (4  $\mu\text{m}$ ) situated on one cuticular ridge, parallel with cuticular collar. Gland cells (connected with external labial and cephalic setae?) giving collar its yellowish, granulated appearance.

Labial membrane striped, hyaline, twelve lobes around mouth opening (Fig. 2B). Lobes situated immediately above twelve cuticular tubes (Figs. 2D, 6D). Wall of cheilostome folded backward in  $\delta$  1 (Fig. 2E). In anterior half of stoma *s.s.*, cuticle having a zigzag lining internally, forming twelve continuous 'prisms' (maximal width 2  $\mu\text{m}$ , total length 5  $\mu\text{m}$ ) (Figs. 2E, F, 6E). Anterior undulated border of these prisms visible externally (Fig. 2A, *pri.*).

Stoma *s.s.* funnel-shaped (anterior portion kept open by rigid(?) 'prism' system), triangular in cross section and surrounded by pharyngeal tissue (Fig. 2H).

Pharynx (mainly muscular) occupying more than one third of total body length; enlarging posteriorly but no real bulb. Mediodorsal gland very obvious; ventrosublateral glands not observed. Triradial lumen of pharynx well cuticularized. Cardia not observed. Intestinal cells surrounding posterior part of pharynx and dorsal side of testis (Figs. 1D–F). Posteriorly a larger intestinal pouch located to the left of testis ( $\delta$  1). Lumen of intestine bordered by microvilli. Intestinal cells having large, coloured granules. Cloacal opening covered by a cuticular flap.

Nerve ring not observed. Ventral gland and pore not observed.

Reproductive system monorchic; outstretched testis (ventrally from intestine) not reaching pharyngeal region. Vas deferens with two distinct zones: anteriorly with small, sometimes oval granules, posteriorly with spherical spermatozoa, latter somewhat compressed in terminal part of vas deferens. Vas deferens surrounding end of intestine and rectum to the right and left (Fig. 1G). Spicules lying in depressions of intestinal wall (Figs. 1D–F), equal in size and shape and slightly bent. Capitulum set off. Velum present: its proximal part lying almost exclusively on ventral side of shaft (Fig. 1D). Halfway, shaft bending to ventral side, thus dividing velum into ventral and dorsal part (Figs. 1E–G). Outer surface of velum convex and, therefore, its boundary not always obvious in lateral view. Retractor of spicule extending from capitulum to lateral body wall; protractor surrounding spicule completely (Figs. 1D–F). Gubernaculum (16  $\mu\text{m}$ ) double, without apophysis.

Tail conical; probably three caudal glands, ending together.

*Female.* Only features different from those of male mentioned.

Largest width at anterior ovary.

Amphideal fovea, on cuticular collar, smaller than in male (width 35% of corresponding head width), but of same shape.

Lip region retracted into stoma ( $\delta$  1), thus forming a narrow canal at bottom of cuticular cup. Wall of this canal containing distal part of the twelve cuticular tubes, proxi-

mal part of these tubes lying externally as in male. Canal continuing as lumen of a thick walled invagination (Figs. 2F–H), protruding into stoma (which is cup-shaped here). Inner and outer walls of invagination formed by wall of cheilostome. Outer wall showing twelve ripples, each alternating with 'prisms' of stoma *s.s.* (Fig. 2G).

Intestine lying on the left of anterior ovary and dorsally of remainder of genital tract ( $\delta$  1). Opening towards rectum small and formed by intestinal cells, slightly protruding into intestinal lumen.

Reproductive system didelphic, amphidelphic; ovaries probably antidromously reflexed to the right. One large oocyte in anterior ovary. Posterior tract not obvious. Spermatozoa present in uterus ( $\delta$  1).

#### Diagnosis

*Richtersia bathyalis* is short and clumsy with a long tail (in comparison with other species of the genus). Longitudinal rows of prominent spines are present (ten rows anteriorly, reducing to about six in the tail region). The anterior cuticular collar contains the transversally flattened and spiral amphideal fovea; the anterior setae are situated within the 'collar' region. Two equal spicules with a pronounced velum are present.

#### Discussion

Within the genus *Richtersia*, only *Richtersia pilosa* (Kreis, 1938) is similar in the shape of the body ( $L < 400 \mu\text{m}$ ;  $a = 5-7$ ;  $c = 3-6$ ) and in the anterior cuticular collar. It differs from *R. bathyalis* by its (apparent) lack of amphideal fovea and anterior setae, the presence of 16–20 longitudinal rows of spines and the possession of outstretched(?) ovaries.

Boucher (1975) considered *R. pilosa* as a *species inquirenda*, since it was described from one female only. The number of longitudinal rows, however, makes it possible to distinguish the two species.

The number of longitudinal rows of spines varies within the genus *Richtersia*. A minimum number of eight longitudinal rows has been found in *R. erinacei* Gerlach, 1964, *R. spicana* Vitiello, 1973 and *R. iberica* Riemann & Schrage, 1977. The first two species have four sublateral rows, two rows in the subventral and two in the subdorsal octant. In *R. iberica* the arrangement of the eight longitudinal ridges on the collar of *R. bathyalis*: two mediolateral, two laterodorsal, two lateroventral, one mediodorsal and one medioventral. In *R. bathyalis*, the relationship between the eight longitudinal ridges on the collar and the ten longitudinal rows of spines in the anterior region suggests that the arrangement of spines has been derived from a scheme such as that in *R. iberica*, where there is a doubling of the mediodorsal and medioventral rows.

#### *Richtersia spinosa* sp.n. (Figs. 3, 4, 5D–J, 6A–C)

*Type material.* Holotype male  $\delta$  1 (slide no. 738) from Mediterranean Sea, off Calvi, Corsica, 42°38'33"N, 08°39'86"E, 305 m, 1–2 cm into the sediment. Sample taken on 8 Sep. 1982, sediment consisted of 44% silt-clay, with a median grain size of about 100  $\mu\text{m}$ . Paratype (allotype)



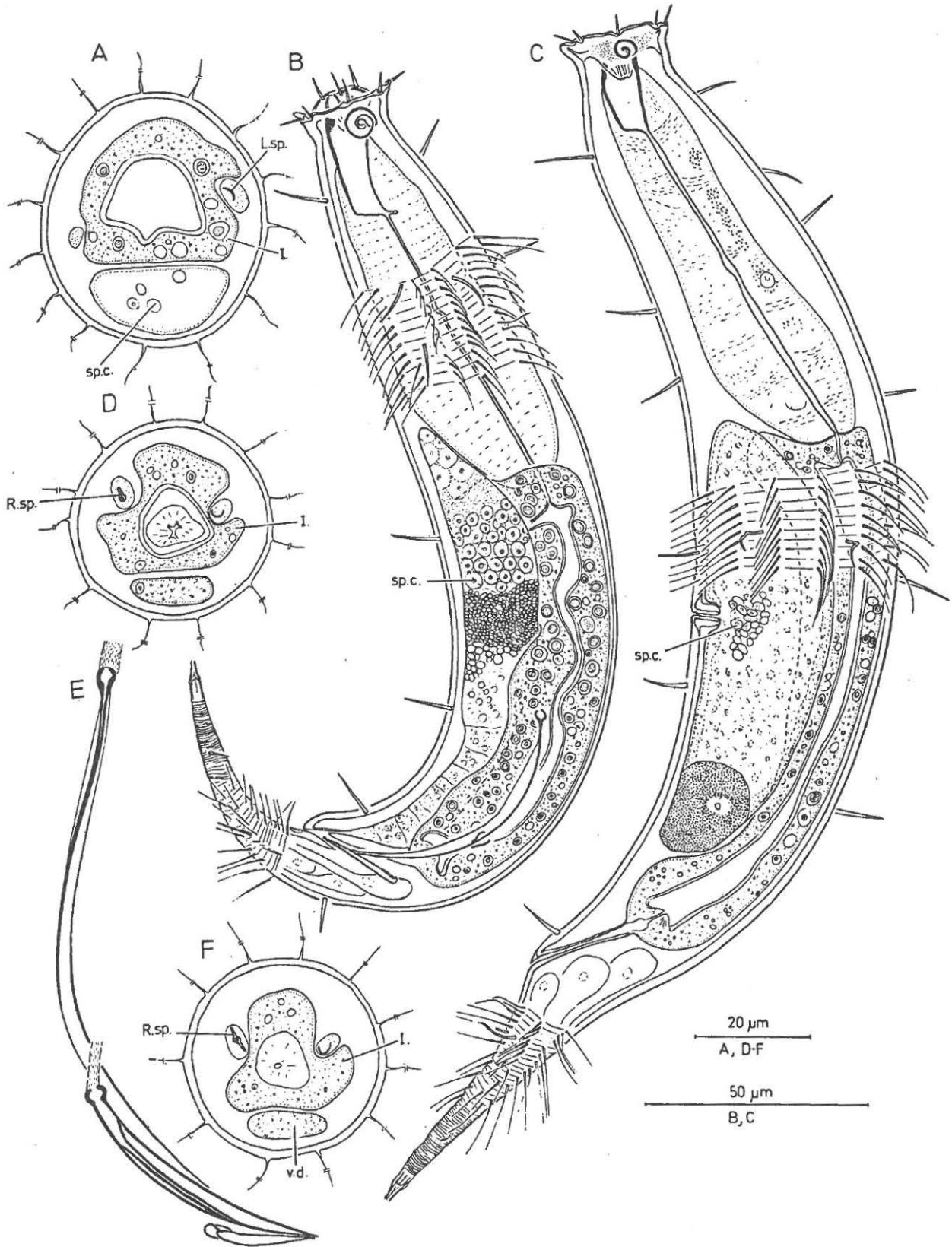


Fig. 3. *Richtersia spinosa* sp.n.—A. Cross section at the anterior part of the left spicule.—B. Habitus ♂ 1.—C. Habitus ♀ 1.—D. Cross section at the anterior part of the right spicule.—E. Copulatory apparatus of ♂ 2.—F. Cross section at the middle part of the right spicule.  
A, D, F: the dorsal is the upper side.

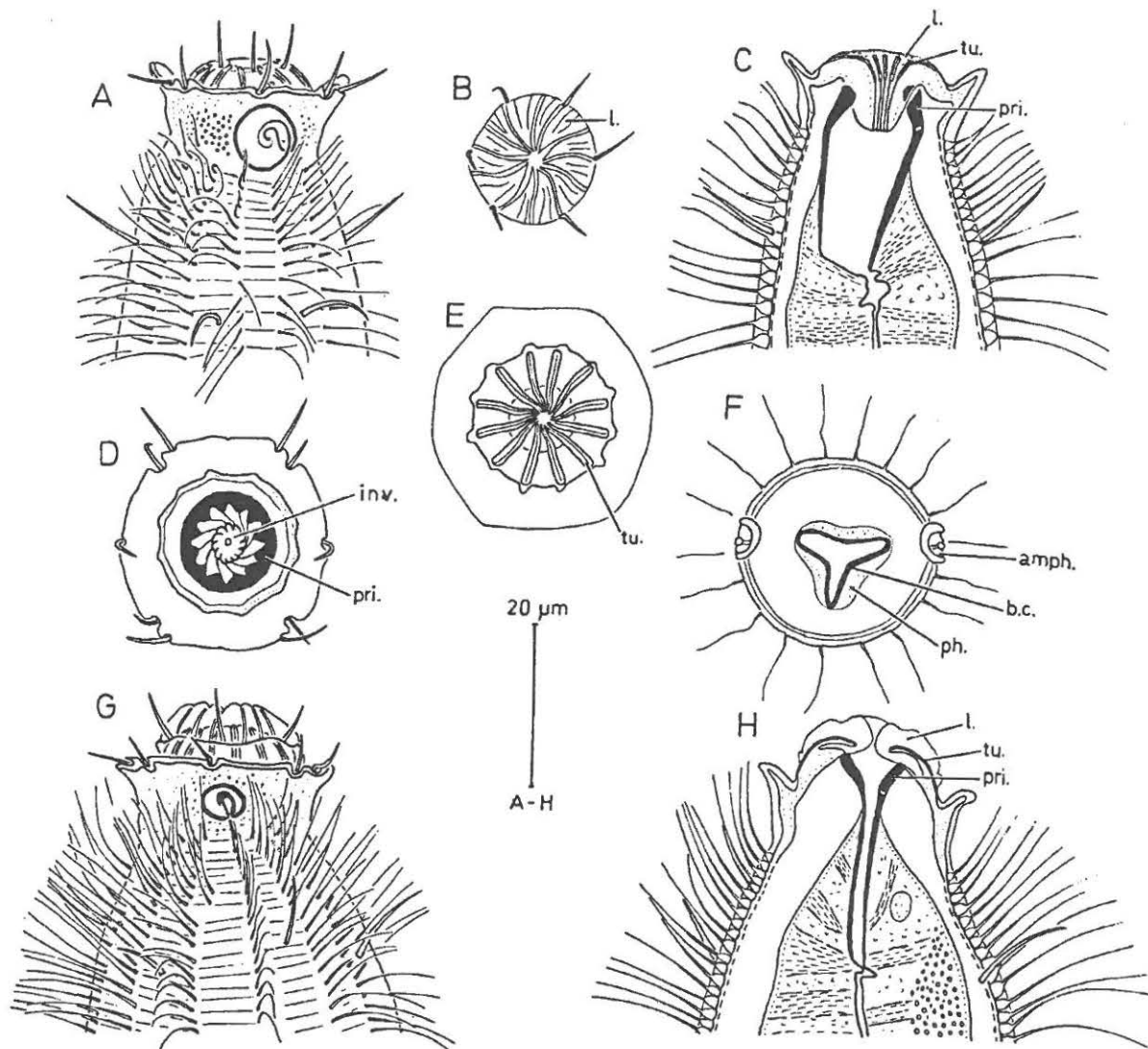


Fig. 4. *Richtersia spinosa* sp.n.—A. Head end ♂1 (surface view).—B. Apical view of labial membrane.—C. Head end ♂1 (internal view).—D. Apical view at the level of the prisms and invagination.—E. Apical view at the level of the cuticular tubes.—F. Apical view of the buccal cavity and amphideal fovea's.—G. Head end ♀2 (surface view).—H. Head end ♀2 (internal view).

B, D, E and F are from the same female, with lips slightly protruded. The dorsal is the upper side.

female ♀1 (slide no. 739) from 42°37'71"N, 08°40'28"E, 160 m, 0–1 cm into the sediment. Sample taken on 15 Apr. 1983, sediment contained 26% silt-clay, with a median grain size of 240 µm. Other paratypes (♂2–3, ♀2–3) from the same sample, but 1–2 cm into the sediment. Paratypes (Juv1–6) from 42°38'25"N, 08°39'94"E, 300 m. Sample taken on 20 Sep. 1985, sediment consisted of more than 40% silt-clay, with a median grain size of about 100 µm.

#### Measurements

♂1:  $L = 310 \mu\text{m}$ ;  $a = 7.1$ ;  $b = 2.6$ ;  $c = 5.3$ ;  $c' = 3.8$ ;  $r.sp. = 37 \mu\text{m}$ ;  $l.sp. = 71 \mu\text{m}$ ;  $l.sp./r.sp. = 1.9$ .

—	—	?	W	121	254	310
25	20	?	44	44	16	

♀1:  $L = 350 \mu\text{m}$ ;  $a = 6.9$ ;  $b = 3.0$ ;  $c = 5.0$ ;  $c' = 3.0$ ;  $V = 47.5\%$ .

—	—	?	117	W	167	281	350
28	24	?	50	51	48	20	

Other males:  $L = 300\text{--}305 \mu\text{m}$ ;  $a = 6.1$ ;  $b = 2.9\text{--}3.0$ ;  $c = 4.2\text{--}5.6$ ;  $c' = 2.9$ ;  $r.sp. = 37\text{--}48 \mu\text{m}$ ;  $l.sp. = 106\text{--}110 \mu\text{m}$ ;  $l.sp./r.sp. = 2.3\text{--}2.8$ .  
Other females:  $L = 285\text{--}305 \mu\text{m}$ ;  $a = 5.6\text{--}6.6$ ;  $b = 2.9$ ;  $c = 3.8\text{--}4.7$ ;  $c' = 3.5\text{--}4.0$ ;  $V = 48.4\text{--}50.9\%$ .

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Juveniles:  $L = 150\text{--}205 \mu\text{m}$ ;  $a = 5.3\text{--}7.0$ ;  $b = 2.4\text{--}3.0$ ;  $c = 3.4\text{--}4.6$ ;  $c' = 2.8\text{--}4.2$ .

#### Description

**Male.** Body short, plump, truncated anteriorly, tapering posteriorly; largest width at end of pharynx; tail long.

Cuticle annulated, annules 2 µm wide. Every annule carrying spines arranged in longitudinal rows: 15–16 rows in cervical region, 16–17 rows in mid-body region, 9–12 at level of cloacal opening. In anterior tail region, only 7–8 longitudinal rows present; posteriorly, arrangement of spines becoming more irregular (about one spine per two annules). Posterior half of tail without spines, but with irregular annules. Tail tip smooth. Only in cervical region, spines are pointing forward, elsewhere pointing backward. Spines becoming progressively larger from head region (10–15 µm) towards cloacal region (18–24 µm).

Somatic setae (12 µm) in six rows: one mediodorsal,

one medioventral, two dorsosublateral and two ventrosublateral. Two setae in spineless portion of tail.

Cephalic region with a thin, vacuolized, but prominent cuticular collar, carrying the amphideal fovea and the external circle of setae. Amphideal fovea (width 35–40% of corresponding head width) a round spiral, ventrally wound, two turns, shifted slightly towards dorsal side. The six internal labial setae (6–8  $\mu\text{m}$ ) situated at base of labial membrane; the six external labial (5–8  $\mu\text{m}$ ) and the four cephalic setae (4–6  $\mu\text{m}$ ) appearing on anterior edge of cuticular collar.

Lip region retracted, forming a pyramidal invagination of cheilostome wall into stoma *s.s.* (Figs. 4C, D). Labial membrane, with twelve lobes (Figs. 4B, 6A), supported by twelve cuticular tubes (Figs. 4E, 6B), lying closely under the membrane. Anterior wall of stoma *s.s.* strengthened by twelve triangular protrusions of its inner surface ('prisms') (Figs. 4C, D, 6C).

Stoma triangular, unarmed and surrounded by pharyngeal tissue.

Pharynx long and muscular; enlarged posteriorly, but without bulb. Cardia not observed. Intestine overlapping posterior part of pharynx, located to the right of testis and surrounding testis to the left only posteriorly. Intestinal cells containing large, dark granules. A microvillous boundary visible. Intestine–rectum transition narrowed by a protrusion of intestinal cells into gut lumen.

Nerve ring not observed. Ventral gland and pore not observed.

Reproductive system monorchic; testis outstretched, reaching into pharyngeal region. Anterior part of vas deferens with granules, posterior part scarcely filled with sperm cells. Two unequal spicules: left spicule twice the length of right (in some males up to three times length of right). Capitulum and velum present on both spicules. Shaft not present over total length in long spicule ( $\delta 1$ ) and curvature of its velum changing: anteriorly, convex side pointing outward (Fig. 3A), more posteriorly pointing towards ventral side (Figs. 3D, F). Gubernaculum (21.5  $\mu\text{m}$ ) double, without apophysis.

Three caudal glands present, ending together.

**Female.** Only features different from those of male mentioned.

Amphid (width 25% of the corresponding head width) a ventrally wound spiral (1.5 turns).

Intestine lying dorsally to reproductive system, but paralleling anterior ovary to the right in  $\text{♀} 1$ .

Reproductive system didelphic, amphidelphic; ovaries probably antidromously reflexed to the right. Anterior tract reaching pharyngeal region. One large oocyte in posterior ovary; spherical spermatozoa present in uterus ( $\text{♀} 1$ ).

Lip region of  $\text{♀} 2$  protruded, with hyaline, striped labial membrane forming a large cushion at some distance in front of cuticular tubes (Figs. 4G, H). External attachment of labial membrane at level of internal labial setae, internal attachment probably at anterior margin of stoma *s.s.*: when the membrane is retracted into the stoma *s.s.*, in the same way as is the wall of the cheilostome, no cushion can be seen ( $\delta 1$ ,  $\text{♀} 1$ ).

### Diagnosis

*Richtersia spinosa* is characterized by its short, plump body with long tail (compared with other species of the genus) and 16–17 rows of long spines anteriorly, 9–12 rows at the level of the anus. It possesses a thin, but prominent, cuticular collar, which carries the multispiral amphideal fovea, the external labial and cephalic setae. There are two unequal spicules with a velum.

### Discussion

In the genus *Richtersia*, seven species with unequal spicules have been described: *R. erinacei*, *R. farcimen* Gerlach, 1964, *R. iberica*, *R. inaequalis* Riemann, 1966, *R. imparis* Gerlach, 1956, *R. spicana* and *R. deconincki* Vincx, 1981. None of these species has a cuticular collar like *R. spinosa* nor rounded, spiral amphids with 2 turns in the case of the male, 1.5 in the case of the female.

Another related species, *R. pilosa* (Kreis, 1938) has been described from a female only; it has a similar body shape ( $L < 400 \mu\text{m}$ ;  $a = 6\text{--}8$ ;  $c = 5$ ), but, in contrast to *R. spinosa*, no cephalic and labial setae and no amphids (very conspicuous in *R. spinosa*) have been described and the spines are shorter.

### *Richtersia heipi* sp.n. (Figs. 7, 11A, B)

**Type material.** Holotype male  $\delta 1$  (slide no. 740) and paratypes ( $\delta 2\text{--}5$ ,  $\text{♀} 2$ ) from Mediterranean Sea, off Calvi, Corsica, 42°38'33"N, 08°39'86"E, 305 m, 0–1 cm into the sediment, sample taken on 8 Sep. 1982. Paratype (allotype) female  $\text{♀} 1$  (slide no. 741) from 42°38'40"N, 08°39'76"E, 385 m, 0–1 cm into the sediment, sample taken on 8 Sep. 1982. Paratypes ( $\delta 6$ ,  $\text{♀} 3\text{--}5$ ) from 42°38'20"N, 08°39'98"E, 298 m, 0–1 cm into the sediment, sample taken on 15 Apr., 1983. Paratypes (juv1–3) from 42°38'25"N, 08°39'94"E, 300 m, sample taken on 20 Sep. 1985. At all stations, sediment consisted of more than 40% silt–clay, with a median grain size of about 100  $\mu\text{m}$ .

**Etymology.** The species is dedicated to Dr C. Heip, head of the Marine Biology Section of the Institute of Zoology, Ghent.

### Measurements

$\delta 1$ :  $L = 285 \mu\text{m}$ ;  $a = 8.8$ ;  $b = 3.4$ ;  $c = 3.9$ ;  $c' = 4.3$ ;  $sp. = 27 \mu\text{m}$ .

$$\frac{\begin{array}{r} \text{---} \text{---} 42 \text{ W } 84 \text{ 213} \\ 21 \text{ ---} 32 \text{ 33 } 17 \end{array}}{285 \mu\text{m}}$$

$\text{♀} 1$ :  $L = 310 \mu\text{m}$ ;  $a = 9.0$ ;  $b = 3.4$ ;  $c = 4.9$ ;  $c' = 4.6$ ;  $V = 52.7\%$ .

$$\frac{\begin{array}{r} \text{---} \text{---} ? \text{ W } 92 \text{ 163 } 246 \\ 16 \text{ ---} \text{---} 34 \text{ 32 } 34 \text{ 14} \end{array}}{310 \mu\text{m}}$$

Other males:  $L = 235\text{--}340 \mu\text{m}$ ;  $a = 7.6\text{--}9.4$ ;  $b = 3.0\text{--}3.9$ ;  $c = 3.9\text{--}4.4$ ;  $c' = 3.5\text{--}5.3$ ;  $sp. = 30\text{--}33 \mu\text{m}$ .

Other females:  $L = 265\text{--}290 \mu\text{m}$ ;  $a = 7.9\text{--}9.0$ ;  $b = 2.8\text{--}3.3$ ;  $c = 4.4\text{--}5.2$ ;  $c' = 3.6\text{--}4.5$ ;  $V = 53.4\text{--}59.2\%$ .

Juveniles:  $L = 170\text{--}225 \mu\text{m}$ ;  $a = 7.6\text{--}8.6$ ;  $b = 2.6\text{--}3.1$ ;  $c = 4.0\text{--}4.4$ ;  $c' = 3.5\text{--}3.9$ .

### Description

**Male.** Body short, cylindrical, slender, S-shaped, truncated anteriorly, tapering posteriorly, maximal body width at middle of pharynx, tail long.

Cuticle covered with epizoid microorganisms, annulated (annules 1  $\mu\text{m}$  wide), each annule carrying tiny spines (10  $\mu\text{m}$  long), only the base of which is prominent. In cervical region, these spines occur in numerous rows,



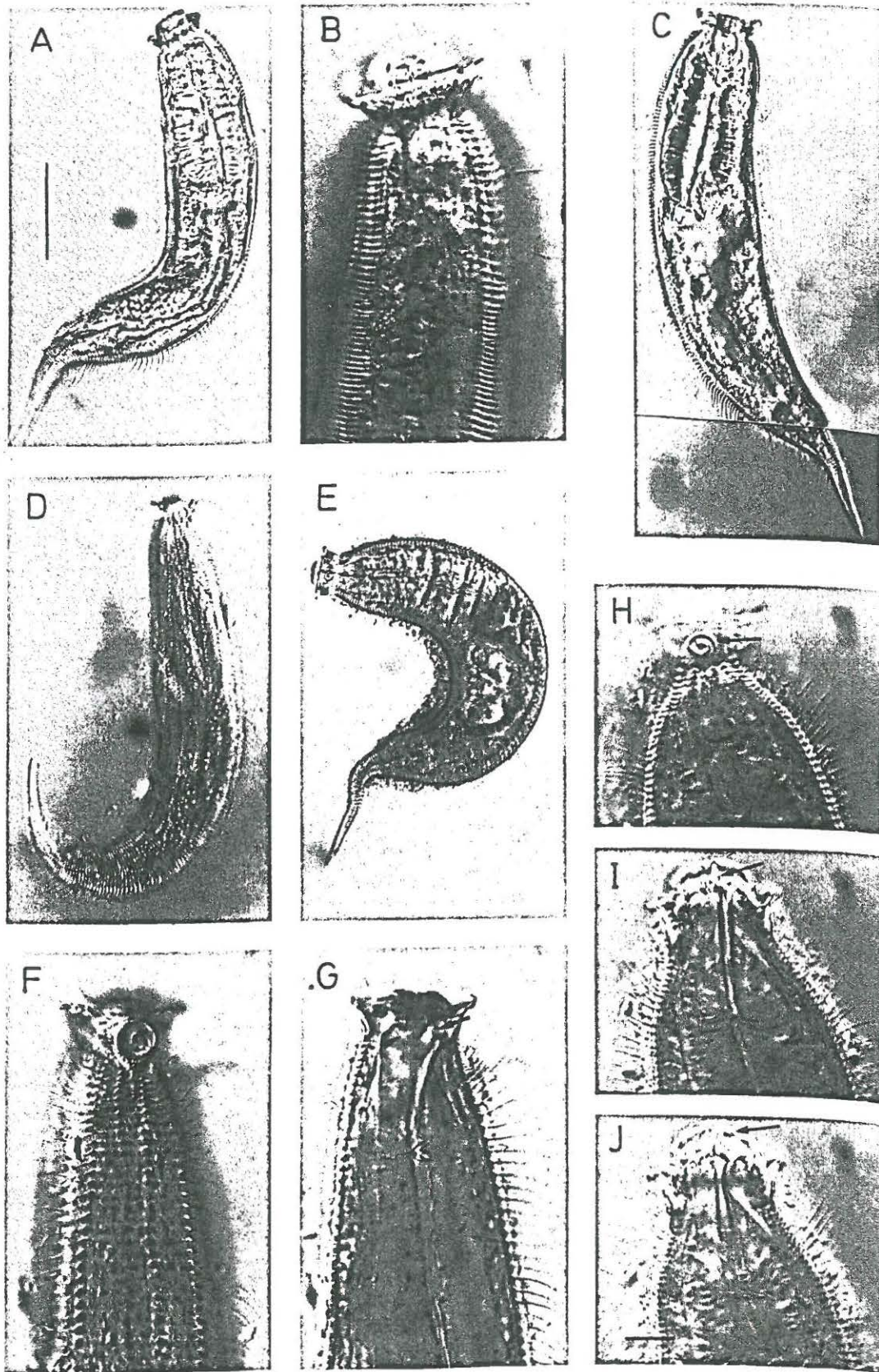


Fig. 5.—A–C. *Richtersia bathyalis* sp. n.—A. Habitus holotype ♂ 1.—B. Head end ♂ 1 (arrow indicates cuticular tubes).—C. Habitus ♀ 1.—D–J. *R. spinosa* sp. n.—D. Habitus holotype ♂ 1.—E. Habitus ♀ 2.—F. Head end ♂ 1 (surface view).—G. Head end ♂ 1 (internal view; arrow indicates 'prism', arrowhead indicates invagination).—H. Head end ♀ 2 (surface view; arrow indicates amphideal fovea).—I. Head end ♀ 2 (arrow indicates cuticular tubes).—J. Head end ♀ 2 (arrow indicates labial membrane).  
 For A, C–E scale bar on A is 50 µm; for B, F–J scale bar on J is 10 µm.



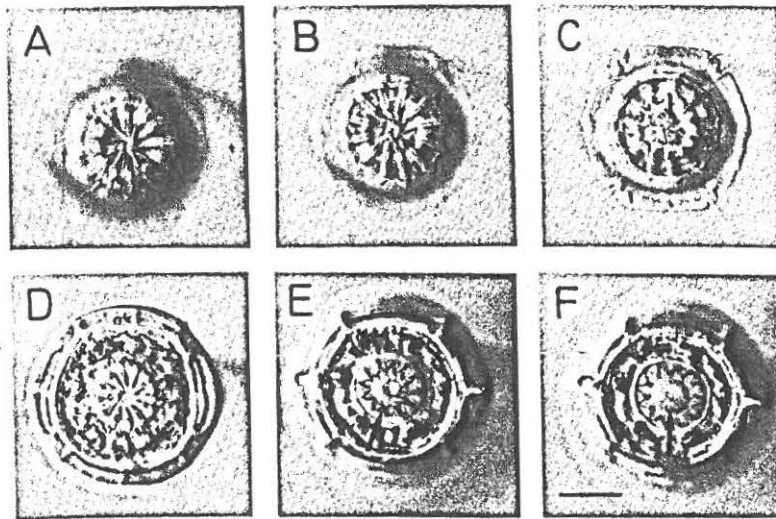


Fig. 6.—A–C. *Richtersia spinosa* sp.n., one female (cf. Fig. 4).—A. Apical view of labial membrane (arrow indicates internal labial setae).—B. Apical view at the level of the cuticular tubes.—C. Apical view at the level of the prisms and external labial and cephalic setae.—D–F. *R. bathyalis* sp.n., one male (cf. Fig. 2).—D. Apical view at the level of the cuticular tubes and amphideal foveae.—E. Apical view at the level of the prisms and invagination (arrow indicates prism).—F. Apical view at the level just posterior to level E (arrow indicates the invagination). For A–F dorsal is the upper side. Scale bar is 10  $\mu$ m.

not always with a straight course ( $\delta$  1); in first half of pharyngeal region, spines becoming arranged in 30–40 rows, pointing forward until cardiac region; pointing backward thereafter. In anterior half of tail, spines in 20 longitudinal rows, less regularly placed (about one spine per two annules). Posterior quarter of tail carrying annules only; tail tip smooth.

Somatic setae (4–6  $\mu$ m) arranged in 8(?) rows. Spineless portion of tail with two setae.

Head without cuticular collar, instead a thick, cuticular capsule present on which the transversally flattened amphideal fovea (width 95% of corresponding head width) is situated. The six internal labial setae (4  $\mu$ m) occurring on outer border of labial membrane. The six external labial setae (6–7  $\mu$ m) and the four cephalic setae (3  $\mu$ m) on a cuticular ridge, demarcating anterior border of head capsule.

Labial membrane (Fig. 7F), strengthened by twelve cuticular tubes (Fig. 7G), withdrawn into stoma, forming a cylindrical, broad invagination into stoma *s.s.*. Anterior part of triangular, unarmed stoma *s.s.* with an inner zigzag lining ('prisms') (Fig. 7H). Undulated anterior border of stoma *s.s.* visible externally ( $\delta$  1) (Fig. 7C, *pri.*).

Pharynx mainly muscular; widened posteriorly but without bulb; one ventrosublateral gland obvious. Cardia small. Intestine, apart from a small anterior protrusion ( $\delta$  1) dorsal from testis; intestinal cells with coloured granules and bordered by microvilli. Intestine–rectum transition small. Cloacal opening covered by a cuticular flap.

Nerve ring around middle of pharynx. Ventral gland and pore not found.

Reproductive system monorchic; testis (no differentiation?) outstretched, not reaching into pharyngeal region. Two equal spicules with narrow capitulum and very prominent ventral velum (Fig. 7E). Gubernaculum double without apophysis.

Three caudal glands, ending together.

*Female.* Only features differing from those of male mentioned.

Largest width in middle of pharynx and at level of vulva, slightly narrowing in between.

Amphideal fovea a ventrally wound, transversally flattened spiral (1 turn, width 25% of corresponding head width), surrounded by cuticular annulation.

Mediodorsal pharyngeal gland with ductus and ampulla visible; probably emptying into stoma ( $\delta$  1).

Intestine overlapping posterior part of pharynx; ventral inner wall of intestine showing anteriorly extensions into the lumen ( $\delta$  1).

Reproductive system didelphic, amphidelphic; ventral from intestine. Ovaries reflexed (?); uterus filled with spherical spermatozoa ( $\delta$  1); anterior tract not reaching pharyngeal region. Vaginal sphincter visible.

#### Diagnosis

*Richtersia heipi* is characterized by its short, cylindrical body with long tail (compared to other species of the genus), the presence and arrangement of tiny spines on the cuticle, the shape of the amphids (a large flattened spiral in the male, width 95% of corresponding head width; a much smaller ventrally wound spiral in the female) and the presence of two equal spicules with a pronounced velum.

#### Discussion

Only *R. kreisi* Boucher, 1975 has a similarly shaped amphid in the male, but the female has a multispiral amphid. This species differs from *R. heipi* by the presence of four subcephalic setae at the level of the cephalic setae in males, the presence of numerous subamphideal setae in

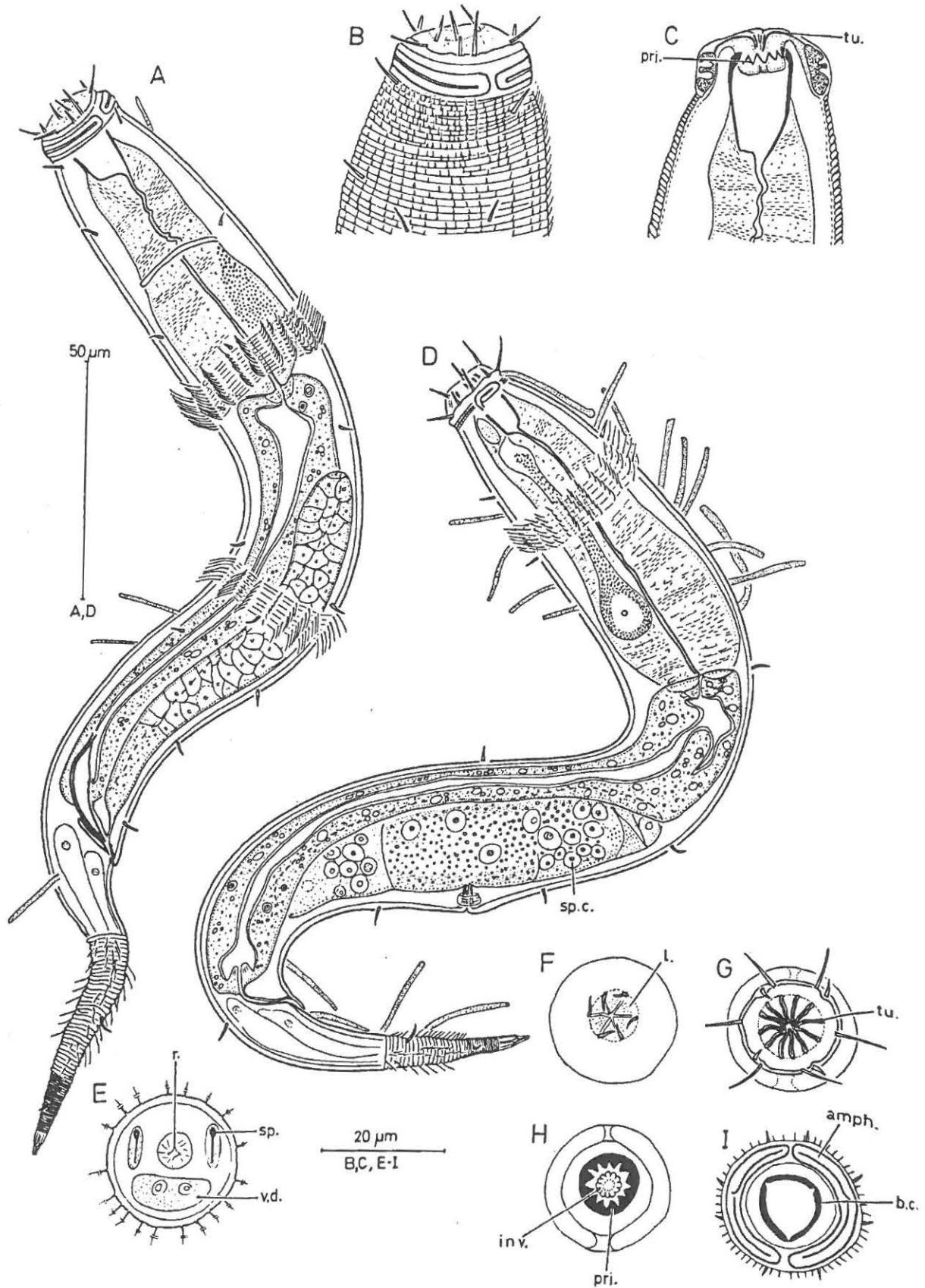


Fig. 7. *Richtersia heipi* sp. n.—A. Habitus ♂1.—B. Head end ♂1 (surface view).—C. Head end ♂1 (internal view).—D. Habitus ♀1.—E. Cross section at the level of the spicular apparatus.—F. Apical view of the labial membrane.—G. Apical view at the level of the cuticular tubes.—H. Apical view at the level of the prisms and invagination.—I. Apical view of the buccal cavity and amphidial fovea's. F–I are from the same male with lips slightly protruded. Dorsal is the upper side.

males, the number of rows of spines being smaller (26–32 rows as opposed to 30–40) and the shorter tail ( $c = 8.4$ – $17.5$  as opposed to  $3.9$ – $5.2$ ).

*Richtersia mediterranea* sp.n. (Figs. 8A–D, 11E, F)

*Type material.* Holotype male ♂ 1 (slide no. 742), paratype (allotype) female ♀ 1 (slide no. 743) and other paratypes (♂ 2–♂ 4, ♀ 2–♀ 4, juv1) all from the Mediterranean Sea, Banyuls-sur-Mer; clay. Material provided by Dr. G. Boucher and Dr F. De Bovée and mentioned as *R. botulus* in an ecological paper (Boucher 1972). Until now the species has not been described. Therefore we consider *R. botulus* as a *nomen nudum*.

*Measurements*

♂ 1:  $L = 575 \mu\text{m}$ ;  $a = 12.2$ ;  $b = 3.5$ ;  $c = 17.5$ ;  $c' = 1.4$ ;  $l.sp. = 108 \mu\text{m}$ ;  $r.sp. = 60 \mu\text{m}$ ;  $l.sp./r.sp. = 1.8$ .

$$\frac{--- ? 57 \ 165 \ W \ 542}{18 \ --- ? 42 \ 39 \ 47 \ 23} 575 \mu\text{m}$$

♀ 1:  $L = 460 \mu\text{m}$ ;  $a = 6.7$ ;  $b = 4.0$ ;  $c = 11.5$ ;  $c' = 1.9$ ;  $V = 58.7\%$ .

$$\frac{--- ? 46 \ 116 \ 270 \ 420}{20 \ --- ? 48 \ 55 \ 66 \ 21} 460 \mu\text{m}$$

Other males:  $L = 440$ – $490 \mu\text{m}$ ;  $a = 7.6$ – $10.4$ ;  $b = 3.3$ – $3.5$ ;  $c = 10.7$ – $14.1$ ;  $c' = 1.3$ – $1.4$ ; *short sp.* =  $57$ – $66 \mu\text{m}$ ; *long sp.* =  $90$ – $120 \mu\text{m}$ ; *long/short sp.* =  $1.6$ – $2.0$ .

Other females (female 4 could not be precisely measured):  $L = 470$ – $560 \mu\text{m}$ ;  $a = 7.4$ – $7.5$ ;  $b = 3.1$ – $3.2$ ;  $c = 11.9$ – $12.2$ ;  $c' = 1.4$ – $1.9$ ;  $V = 60.1\%$ .

Juvenile:  $L = 170 \mu\text{m}$ ;  $a = 11.7$ ;  $b = 2.6$ ;  $c = 5.4$ ;  $c' = 2.3$ .

*Description*

*Male.* Body short, slightly narrowing and rounded anteriorly, tapering posteriorly, largest width in mid-body region, tail short.

Cuticle annulated, annules  $1 \mu\text{m}$  wide. Anteriorly, each annule carrying numerous short, stout spines pointing backward. More posteriorly spines arranged in longitudinal rows. At middle of pharynx, about 20 rows, in mid-body region about 25 and at level of cloaca about 20. Posterior quarter of tail carrying no spines but irregular annules. Tail tip not annulated. Spines thicker in ventral region.

Somatic setae ( $4$ – $5 \mu\text{m}$ ) arranged in eight rows.

Internal labial setae ( $6$ – $8 \mu\text{m}$ ) situated on hyaline labial membrane. The six external labial setae ( $6$ – $8 \mu\text{m}$ , segmented?) separated from the four cephalic setae ( $4$ – $6 \mu\text{m}$ ) by a cuticular ring. Four subcephalic setae ( $4$ – $6 \mu\text{m}$ ) present, at same level of cephalic setae.

Amphideal fovea, surrounded by spines, a large (width  $70$ – $80\%$  of corresponding head width), transversally flattened, ventrally wound spiral (1.5 turns).

Labial membrane at some distance in front of the twelve cuticular tubes.

Triradial stoma unarmed.

Pharynx cylindrical, with crenated wall. Cardia well developed ( $8 \mu\text{m}$  long). Intestine a simple tube, its cells with small granules. Intestine–rectum transition small. Cloacal opening covered by a cuticular flap.

Nerve ring at  $35\%$  of pharyngeal length. Ventral gland and pore not observed.

Reproductive system monorchic; outstretched testis ventrally from intestine. Vas deferens anteriorly with

small, posteriorly with larger granules arranged in transverse bands. Spicules unequal in size: left spicule twice as long as the right one (two males), both with a rounded capitulum and narrow velum. In other two males, right spicule longest. Gubernaculum ( $25 \mu\text{m}$ ) without apophysis. Glandular(?) cells, associated with spicules (Fig. 8A).

Tail short, three caudal glands, ending together.

*Female.* Only features different from those of male mentioned.

More clumsy than male.

No subcephalic setae. Amphideal fovea (width  $40$ – $55\%$  of corresponding head width) a transversally flattened ovoid; spiral structure not obvious.

Reproductive system didelphic, amphidelphic; ovaries antidromously reflexed to the right; one large oocyte in both ovaries. Spherical spermatozoa(?) in uterus (♀ 1).

*Diagnosis*

*Richtersia mediterranea* is characterized by the presence of transversally flattened amphids in the male (width  $70$ – $80\%$  of corresponding head width) and the female ( $40$ – $50\%$ ), the presence of four subcephalic setae in the male, the arrangement of the short spines (irregular in the cervical region, about 30 rows more posteriorly). There are two unequal spicules with a narrow velum and a capitulum.

*Discussion*

A head structure similar to that of *R. mediterranea* (amphid–subcephalic setae) has been found in the male of *R. kreisi*. In this species, however, the female has a rounded, spiral amphid and the number of spines in the anterior body region is much smaller.

Another related species, *R. heipi*, described above, also has slit-like amphids in the male, but no subcephalic setae are present; the body shape is different and the spines are longer.

*Richtersia staresensis* sp.n. (Figs. 8E–I, 11C, D)

*Type material.* Holotype male ♂ 1 (slide no. 744) and paratypes (♂ 2, ♀ 2–3) from Mediterranean Sea, off Calvi, Corsica  $42^{\circ}36'25''\text{N}$ ,  $08^{\circ}46'00''\text{E}$ , 75 m. The sediment contained 50% silt–clay, with a median grain size of  $63 \mu\text{m}$ . Paratype (allotype) female ♀ 1 (slide no. 745) from  $42^{\circ}35'58''\text{N}$ ,  $08^{\circ}44'48''\text{E}$ , 190 m. Sediment contained 26% silt–clay, with a median grain size of  $240 \mu\text{m}$ . Both samples taken on 9 Sep. 1983.

*Etymology.* The species is named after the 'Station de Recherches Sous-Marines et Oceanographiques', the biological station of the University of Liege in Calvi, from where the samples off Calvi were taken.

*Measurements*

♂ 1:  $L = 510 \mu\text{m}$ ;  $a = 15.4$ ;  $b = 3.4$ ;  $c = 12.6$ ;  $c' = 2.1$ ;  $l.sp. = 46 \mu\text{m}$ ;  $r.sp. = 87 \mu\text{m}$ ;  $l.sp./r.sp. = 1.9$ .

$$\frac{--- 47 \ 149 \ M \ 470}{18 \ --- 33 \ 31 \ 33 \ 19} 510 \mu\text{m}$$

♀ 1:  $L = 525 \mu\text{m}$ ;  $a = 11.4$ ;  $b = 3.1$ ;  $c = 11.2$ ;  $c' = 2.6$ ;  $V = 60.4\%$ .

$$\frac{--- 52 \ 172 \ 317 \ 478}{20 \ --- 45 \ 44 \ 46 \ 18} 525 \mu\text{m}$$



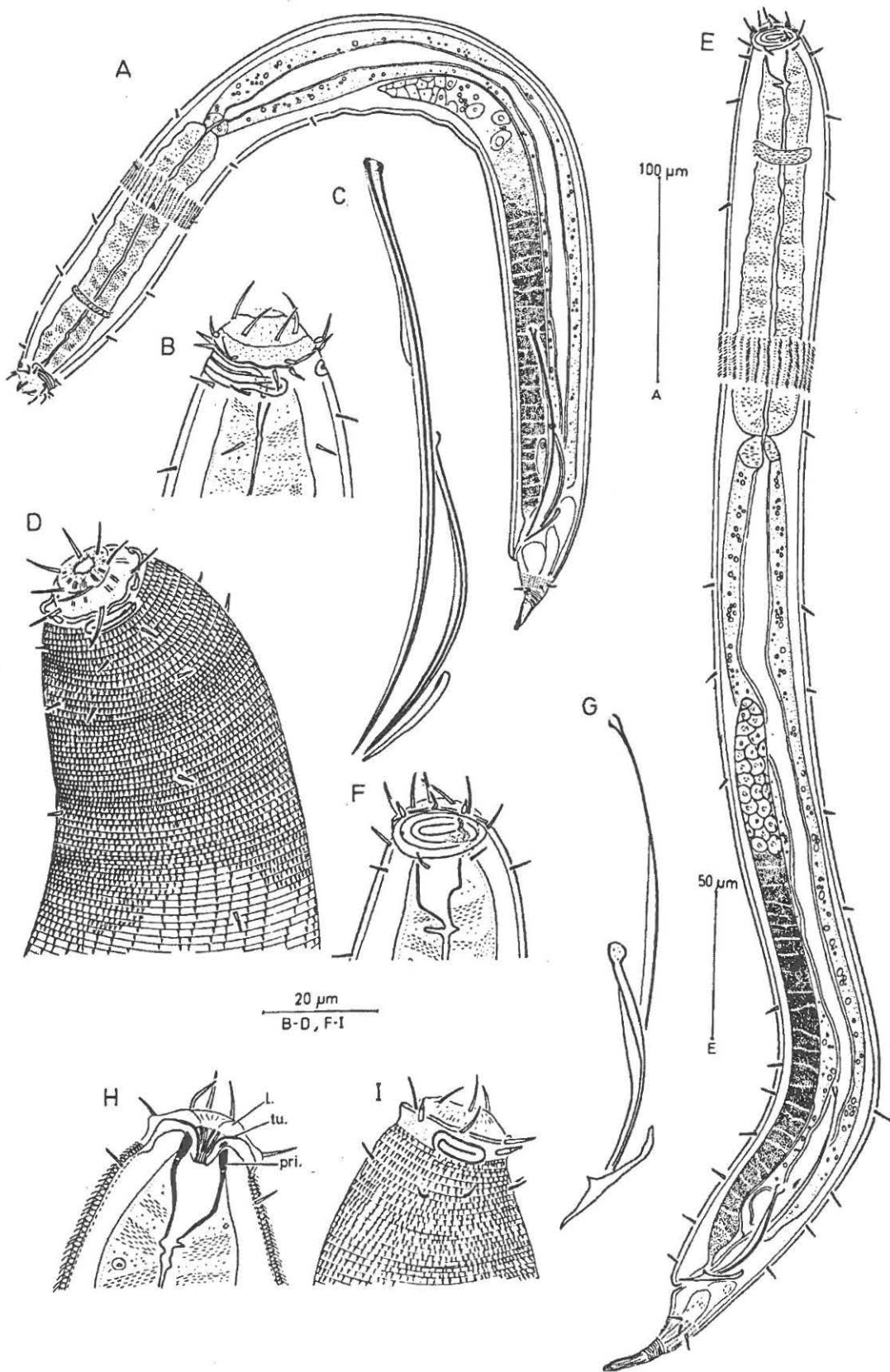


Fig. 8.—A–D. *Richtersia mediterranea* sp.n.—A. Habitus ♂ 1.—B. Head end ♂ 1.—C. Copulatory apparatus ♂ 1.—D. Head end ♀ 1.—E–I. *R. staresensis* sp.n.—E. Habitus ♂ 1.—F. Head end ♂ 1.—G. Copulatory apparatus ♂ 1.—H. Head end ♀ 1 (internal view).—I. Head end ♀ 1 (surface view).

Other male (only the spicules could be measured): *l.sp.* = 41  $\mu\text{m}$ ; *r.sp.* = 93  $\mu\text{m}$ ; *r.sp./l.sp.* = 2.3.  
Other females: *L* = 480–485  $\mu\text{m}$ ; *a* = 10.7–12.6; *b* = 2.8–3.0; *c* = 11.0–12.8; *c'* = 2.1–2.3; *V* = 60.4–62.3%.

### Description

**Male.** Body cylindrical, slender, slightly narrowing and rounded anteriorly, tapering posteriorly, largest width in mid-body region, tail short.

Cuticle annulated, annules 1  $\mu\text{m}$  wide. Behind amphids, each annule carrying numerous short, stout spines (2  $\mu\text{m}$ ) pointing backward. These spines becoming arranged in regular longitudinal rows: about 30 rows in middle of pharynx, about 25 in mid-body region, about 20 in front of cloacal opening. Spines more pronounced in ventral region. In anterior tail region, spines difficult to detect. Posterior half of tail without spines, but with irregular annules. Tip of the tail smooth.

Somatic setae (3–5  $\mu\text{m}$ ) in eight rows.

The six internal labial setae (7–9  $\mu\text{m}$ ) situated on the hyaline, striped labial membrane (twelve lobes). The six external labial setae (5–7  $\mu\text{m}$ , segmented?) separated from the four cephalic setae (4–5  $\mu\text{m}$ , with prominent base) by a cuticular ring. Four subcephalic setae present, one at each side of amphids.

Amphideal fovea a large (width 90% of corresponding head width), ventrally wound, transversally flattened spiral (4 turns). In holotype corpus gelatum visible as a ribbon. Fovea surrounded by spines.

Stoma *s.s.* triangular, unarmed, but anteriorly strengthened by twelve triangular protrusions of its inner wall.

Pharynx cylindrical with crenated wall. Cardia prominent (8  $\mu\text{m}$ ). Intestine a simple tube, its cells with coloured granules and bordered by microvilli. Intestine-rectum transition small. Cloacal opening covered by a cuticular flap.

Nerve ring at 32% of the pharyngeal length. Ventral gland and pore not observed.

Reproductive system monorchic; outstretched testis lying ventrally from intestine. Vas deferens containing anteriorly small, posteriorly larger granules, placed in transverse bands. Spicules unequal in size: right spicule twice as long as the left one, both with a rounded capitulum and a narrow velum. Gubernaculum (23  $\mu\text{m}$ ) double, enclosing distal end of spicules and with an anterior apophysis at each side.

Tail short, three caudal glands, ending together.

**Female.** Only features different from those of male mentioned.

More clumsy than male.

Amphideal fovea (width 40–50% of corresponding head width) a transversally flattened, ventrally wound spiral, one turn.

Reproductive system didelphic, amphidelphic; ovaries probably antidromously reflexed.

### Diagnosis

*Richtersia staresensis* is characterized by the presence of multispiral amphids in the male (4 turns, width 90% of

corresponding head width) and unispiral amphids in the female (40–50%) and by the arrangement of the short spines (irregular in the cervical region, 30–40 rows in the mid-body region). There are two unequal spicules with a narrow velum and a capitulum. The gubernaculum has anterior apophyses.

### Discussion

In the genus *Richtersia* a pattern of the spines in the anterior region similar to that in *R. staresensis* has also been found in *R. imparis* and *R. mediterranea*. *Richtersia imparis* is more clumsy than *R. staresensis*, the male amphid is smaller and the gubernaculum possesses no apophysis. The male amphid of *R. mediterranea* consists of a flattened spiral with 1.5 turns.

*Richtersia staresensis* also shows some similarities with *R. elongata* Schuurmans Stekhoven, 1950: the presence of a multispiral amphid in the (juvenile) male and the presence of many spines, irregularly placed near the head end. However, as this species has been described for juveniles only, it could not be thoroughly compared with *R. staresensis*. The juveniles of *R. elongata* are nevertheless larger than the adults of *R. staresensis* and the amphid of the juvenile male is smaller than in *R. staresensis*. Boucher (1975) considered *R. elongata* as a species *inquerenda*.

### *Richtersia coomansi* sp.n. (Figs. 9, 10, 11G–L)

**Type material.** Holotype male  $\delta$  1 (slide no. 746), paratype (allotype) female  $\varphi$  1 (slide no. 747) and other paratypes ( $\delta$  2–4,  $\varphi$  2–4, juv1–4) from Mediterranean Sea, bay of Calvi, Corsica. Samples taken on 29 June 1983. Sediment contained 2% silt and had a median grain size of 185  $\mu\text{m}$ .

**Etymology.** The species is dedicated to Prof. A. Coomans, director of the Institute of Zoology, Ghent.

### Measurements

$\delta$  1: *L* = 1065  $\mu\text{m}$ ; *a* = 12.3; *b* = 3.7; *c* = 12.8; *c'* = 1.9; *l.sp.* = 185  $\mu\text{m}$ ; *r.sp.* = 85  $\mu\text{m}$ ; *l.sp./r.sp.* = 2.2.

— — ? 78 286 W 983	1065 $\mu\text{m}$
37 — ? 60 67 87 44	

$\varphi$  1: *L* = 1160  $\mu\text{m}$ ; *a* = 13.2; *b* = 3.4; *c* = 16.2; *c'* = 1.9; *V* = 60.7%.

— — ? 85 341 703 1086	1160 $\mu\text{m}$
34 — ? 59 67 88 37	

Other males: *L* = 760–970  $\mu\text{m}$ ; *a* = 10.9–17.8; *b* = 3.8–4.3; *c* = 12.1–14.2; *c'* = 1.8–2.2; *longest sp.* = 124–143  $\mu\text{m}$ ; *shortest sp.* = 66–80  $\mu\text{m}$ ; *longest/shortest sp.* = 1.6–2.1.

Other females: *L* = 685–850  $\mu\text{m}$ ; *a* = 8.2–11.1; *b* = 3.2–3.4; *c* = 10.2–15.8; *V* = 66.1–65.7%.

Juveniles: *L* = 375–680  $\mu\text{m}$ ; *a* = 9.0–13.9; *b* = 2.7–3.5; *c* = 7.9–10.2; *c'* = 2.1–3.2.

### Description

**Male.** Large; body cylindrical, truncated anteriorly, tapering posteriorly; slender, largest width in mid-body region; tail short.

Cuticle annulated, each annule (width 1  $\mu\text{m}$ ) carrying backward pointing spines (6  $\mu\text{m}$ ): about 20 rows behind amphid, diminishing to about 15 rows in front of cloaca. In anterior 2/3 of tail about 12 rows of spines, posterior 1/3 carrying only irregular annules.

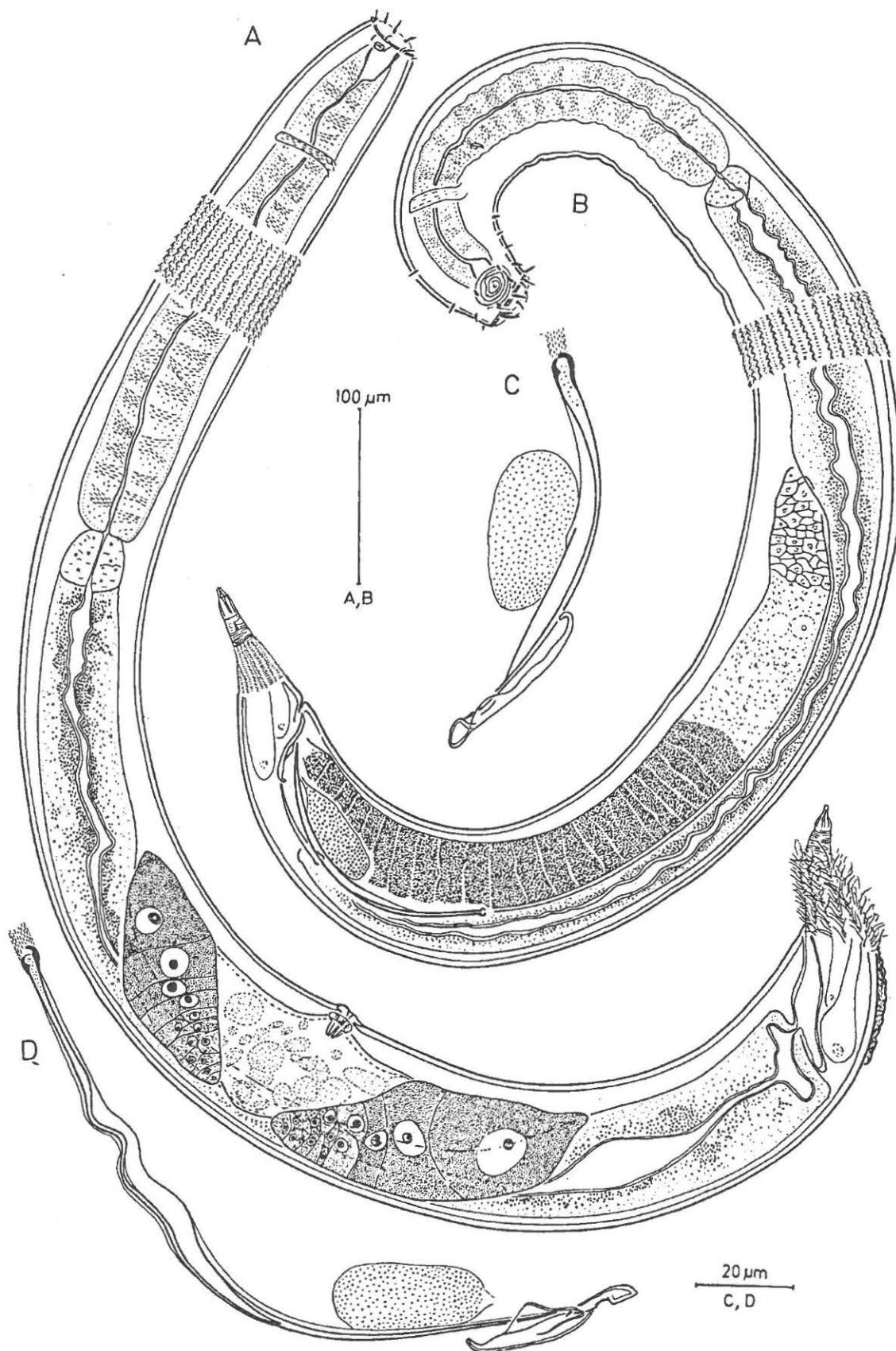


Fig. 9. *Richtersia coomansi* sp. n.—A. Habitus ♀ 1.—B. Habitus ♂ 1.—C. Left spicule and gubernaculum ♂ 2.—D. Right spicule and gubernaculum ♂ 2.



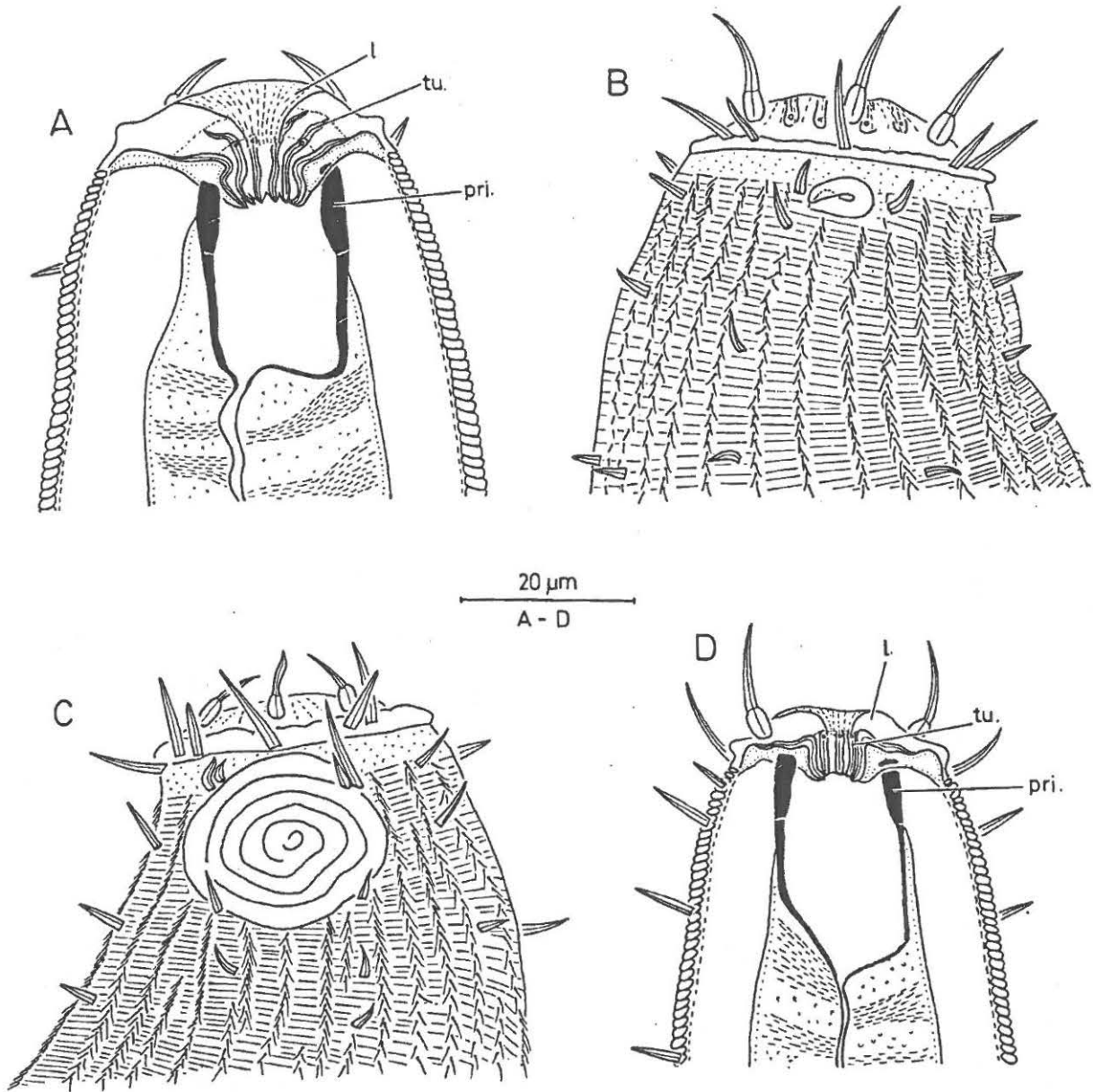


Fig. 10. *Richtersia coomansi* sp.n.—A. Head end ♀1 (internal view).—B. Head end ♀2 (surface view).—C. Head end ♂1 (surface view).—D. Head end ♂2 (internal view).

Body setae (3–7  $\mu\text{m}$ ) present in 8 rows; two setae in spineless portion.

Lip region demarcated from rest of body by a cuticular ring carrying outer circle of setae. The six internal labial setae (12  $\mu\text{m}$ ) occurring at border of labial membrane each having a prominent base. Cephalic setae (5  $\mu\text{m}$ ) almost at same level as external labial setae (9  $\mu\text{m}$ ). Subcephalic setae present (along anterior side of amphid). Nerve could be traced in all head setae.

Amphideal fovea a ventrally wound spiral (5.25 turns, width 60% of corresponding head width) surrounded by cuticular annulations (Fig. 9C).

Striped labial membrane with twelve lobes and supported by twelve cuticular tubes. Tubes undulated and retracted into stoma (Figs. 10A, D). External wall of invagination (formed by retracted lip region) with twelve

prominent lobes, alternating with twelve triangular protrusions ('prisms') of inner wall of stoma *s.s.* (Figs. 10A, D).

Stoma *s.s.* unarmed, triangular, surrounded by pharyngeal tissue.

Pharynx with crenated wall. Cardia prominent (18  $\mu\text{m}$ ). Intestine dorsal from testis. Cells with small, coloured granules in various positions: sometimes exclusively in neighbourhood of lumen, sometimes more evenly placed. Intestinal lumen bordered by microvilli. Intestine-rectum transition small.

Nerve ring at 27% of the pharyngeal length. Ventral gland and pore not observed.

Reproductive system monorchic, with outstretched testis. Vas deferens with small granules arranged in transverse bands. Two unequal spicules: in holotype and one other

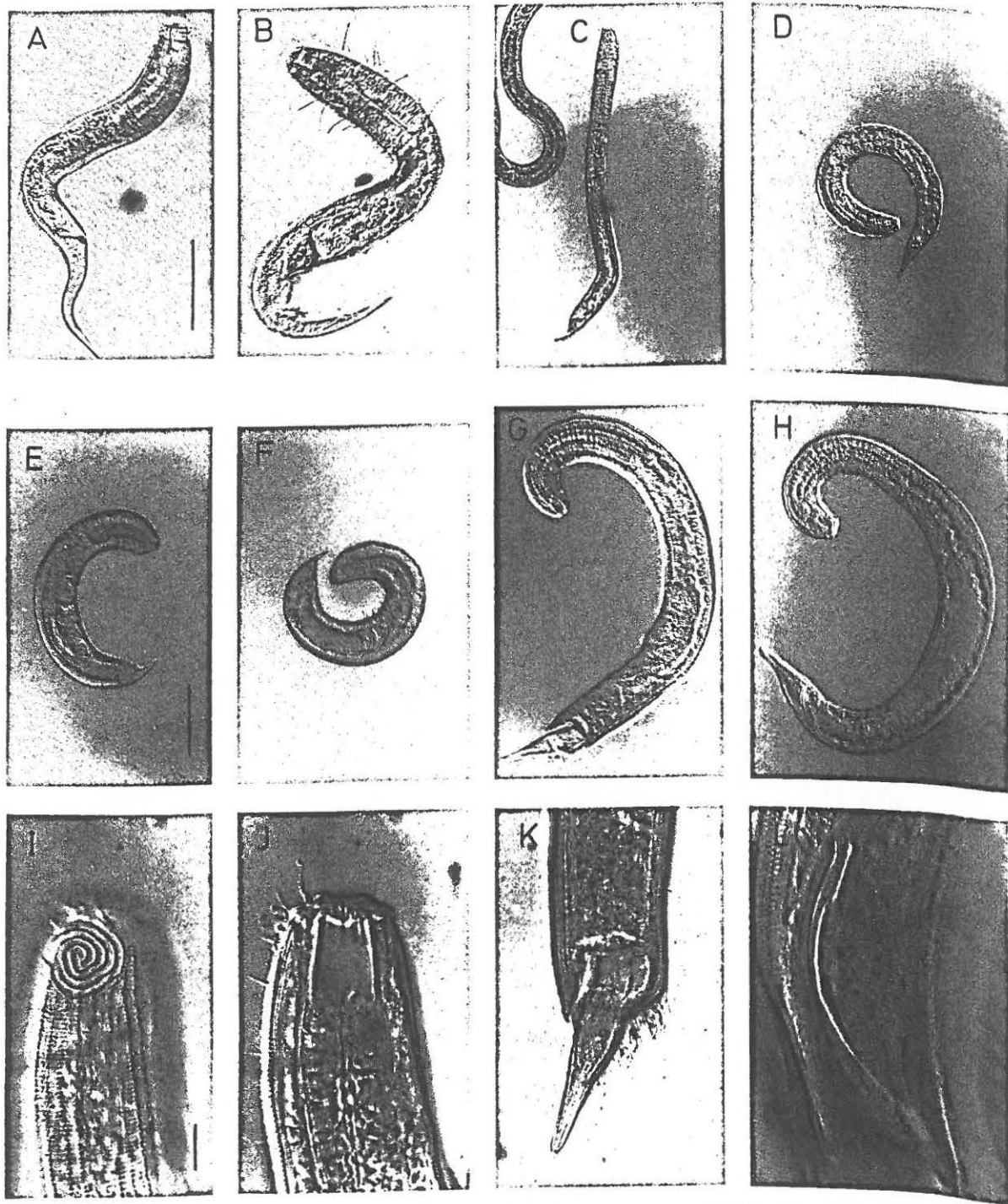


Fig. 11.—A, B. *Richtersia heipi* sp.n.—A. Habitus ♂2.—B. Habitus ♀1.—C, D. *R. staresensis* sp.n.—C. Habitus ♂1.—D. Habitus ♀1.—E, F. *R. mediterranea* sp.n.—E. Habitus ♀2.—F. Habitus ♂2.—G—L. *R. coomansi* sp.n.—G. Habitus ♀2.—H. Habitus ♂1.—I. Head end ♂1 (surface view).—J. Head end ♂1 (internal view).—K. Tail ♀2.—L. Right spicule ♂1.  
For A, B scale bar on A is 50 μm; for C—H, K scale bar on E is 100 μm; for I, J, L scale bar on I is 10 μm.

male left spiculum about twice as long as the right. In other two males right spiculum longest. Both spicules with capitulum and velum. A large gland, probably emptying into cloaca, ventral from each spicule. Gubernaculum (36 μm) double, with an anterior projection.  
Three caudal glands ending together.

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**Female.** Only features different from those of male mentioned.

More clumsy than male. Tail 'hairy' due to numerous rows of very prominent spines (25 μm), in which substratum particles can be caught (Fig. 9A). Tail mostly sharply set off (Fig. 11K).

Amphideal fovea a small, ventrally wound spiral (1 turn, width 20% of corresponding head width).

Intestine lying to the left of genital tract.

Reproductive system didelphic, amphidelphic; ovaries antidromously reflexed to the right (in one female one ovary reflexed to the left, the other to the right). Vaginal sphincter visible.

#### Diagnosis

*Richtersia coomansi* is characterized by the shape of the amphid (ventrally wound spiral, 5.25 turns, 60%), the presence of subcephalic setae and of two unequal spicules in the male, and by the shape of the amphid (ventrally wound spiral, 1 turn) and the presence of a 'hairy' tail in the female. Both sexes have internal labial setae with a prominent base.

#### Discussion

The combination of a multispiral amphid in the male, unequal spicules and rows of short spines was described in *R. deconincki* Vincx, 1981, *R. imparis*, *R. inaequalis* and *R. mediterranea*. *R. imparis* and *R. mediterranea* are smaller than *R. coomansi*, the arrangement of anterior spines and the male amphid (3 turns, smaller; 4 turns, larger; respectively) are different. *Richtersia deconincki* is more slender, its male amphid has only three turns and the arrangement of its subcephalic setae is different. In *R. inaequalis* the tail of the female also has longer hairs, although they are not so prominent as in *R. coomansi*. Differences are that in *R. inaequalis* the male amphid has only 3.5 turns, the individuals are smaller and in the male the spines are thicker in the precloacal ventral region.

The presence of longer hairs in the tail region has also been described in *R. demani* Schuurmans Stekhoven, 1935 (♀) and in *R. farcimen* (♀ + ♂). Internal labial setae with a prominent base are present in *R. farcimen*.

#### General discussion

The morphology of the stomatal and labial region, similar to that described for *R. bathyalis*, *R. spinosa*, *R. heipi*, *R. mediterranea*, *R. staresensis* and *R. coomansi*, has also been observed by us in *R. spicana*, *R. kreisi*, *R. inaequalis* and *R. deconincki*.

Several authors have already stressed the fact that in *Richtersia* the lips can be retracted into the stoma (Chitwood 1936; Gerlach 1964; Vitiello 1973; Vincx 1981). Kreis (1929) stated in his description of *R. tenuis*: "Vorne wird die Mundhöhle durch ein in Zick-zacklinie verlaufendes Balkenwerk abgeschlossen, vordem ein sehr enges Vestibulum sich befindet.". This resembles the description of a retracted lip region, the 'Balkenwerk' probably being the 'prism' system in the anterior part of the stoma *s.s.*

The drawings of *R. kreisi* by Boucher (1975) suggest the same structure and that author stated "six lèvres charnues entourant une couronne cheilorhabdiale constituée de 12 baguettes". In the present study, these 'baguettes' have been named 'cuticular tubes', since they are hollow.

It is therefore reasonable to believe that in the genus *Richtersia* two extreme features of buccal morphology are present. In Fig. 2J a schematic representation of these two forms is shown for *R. bathyalis*.

It is not known whether a retraction of lips may also occur in living specimens or whether it is due to fixation.

The presence of a velum on the spicules, as seen in all species described herein, is also confirmed in *R. spicana*, *R. kreisi*, *R. inaequalis* and *R. deconincki* (own observations). Inglis (1968) mentioned alae on the spicules of *R. discorda* Inglis, 1968, which is probably equivalent to the velum. The drawings of *R. spicana* (Vitiello 1973), *R. kreisi* (Boucher 1975) and *R. iberica* (Riemann & Schrage 1977) suggest the same structure.

*Richtersia bathyalis*, *R. spinosa* and *R. heipi* have a body length of about 300 µm and therefore belong to the smallest marine nematodes. According to Roggen (1971) the pharynx of very small nematodes would have to be very large in relation to the body size to overcome the hydrostatic pressure when food is pressed into the gut. A large pharynx would leave little room for the gut and one would expect these nematodes to have a reduced hydrostatic pressure and thus an atypical way of locomotion (Roggen 1971). In the three species mentioned the pharynx occupies more than one third of the total body length; this, combined with the relatively long tail implies very little room for the intestine. It is probably to increase its absorbing capacity that the gut shows outpackings and surrounds organs which occur in that region (the posterior part of the pharynx, the gonads, the spicules). Another example of efficient use of space is provided in *R. bathyalis*: in the terminal intestinal region, the vas deferens is extended to the left and to the right, whereas in the prerectal region its space is limited by the expansion of the gut.

#### Acknowledgements

We thank the Nationaal Fonds voor Wetenschappelijk Onderzoek, which made this work possible, Prof. A. Coomans for critically reading the manuscript, W. Gyselink for making permanent slides and R. Van Driessche for making head and spicular sections, D. Van Gansbeke, Dr C. Heip and the members of the biological station STARESO for their help in the sampling process, Dr P. Martens and Dr F. De Bovée for supplying information and material and Dr G. Boucher for providing us with a new species and type material.

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