

Travassosinema thyropygi sp. n. (Nematoda : Travassosinematidae) from a spirobolid millipede from Vietnam with SEM observations on *Heth imias* Spiridonov, 1989 (Nematoda : Hethidae)

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Summary – A new species of the genus *Travassosinema* Rao, 1958 is described and illustrated from the intestine of the spirobolid millipede *Thyropygus allevatus* (Karsch, 1881) collected in Vietnam. *T. thyropygi* sp. n. is characterized by the relatively long body (2.4-3.2 mm) with the tail occupying about 46 % of the body length and by the absence of lateral alae. It most closely resembles the type of the genus, *T. travassosi* Rao, 1958, but has a longer body and markedly smaller eggs. A key to the species is provided. SEM studies of the elaborate cervical armature of *Heth imias* Spiridonov, 1989, an unusual gut parasite from a *Rhinocricus* sp. from Cuba, are presented and the description of the female cervical region emended. The various forms and arrangements of the female cervical spination and their significance in the taxonomy of the genus are discussed. Although spination of the cervical collar can be used to divide the genus into two broad groups : Group 1 with numerous small spines with fused bases and Group 2 with fewer, larger, spines with separate bases; the former group can itself be subdivided on the basis of presence or absence of serrate lappets and on the presence or absence of spiny combs and spiny studs/button-like formations. Current knowledge of the variability in the genus is, however, too incomplete to allow definite conclusions as to the supraspecific value of these characters.

Résumé – *Travassosinema thyropygi* n. sp. (Nematoda : Travassosinematidae) provenant d'un mille-pattes spirobolide du Vietnam et observations au MEB sur *Heth imias* Spiridonov, 1989 (Nematoda : Hethidae). – Une nouvelle espèce du genre *Travassosinema* Rao, 1958 provenant de l'intestin d'un mille-pattes Spirobolide, *Thyropygus allevatus* (Karsch, 1881), collecté du Vietnam, est décrite et illustrée. *T. thyropygi* sp. n. est caractérisé par un corps relativement long (2,4-3,2 mm), la queue en occupant environ 46 %, et par l'absence d'ailes latérales. Il ressemble de près à l'espèce type du genre, *T. travassosi* Rao, 1958, mais son corps est plus long et ses œufs nettement plus petits. Une clé des espèces du genre *Travassosinema* est proposée. L'ornementation cervicale complexe de *Heth imias* Spiridonov, 1989 – un parasite rare de l'intestin d'un *Rhinocricus* sp. provenant de Cuba – a été étudiée au MEB et la description de la région cervicale de la femelle précisée et complétée. Les modes et dispositions variés de l'ornementation épineuse de la région cervicale de la femelle et leur signification pour la taxonomie du genre *Heth* sont rapportés et discutés. Bien que cette ornementation puisse être utilisée pour diviser le genre en deux groupes (Groupe 1 : nombreuses petites épines soudées par leur base; Groupe 2 : épines plus grandes, moins nombreuses et non soudées à la base – le premier groupe peut être lui-même subdivisé en se fondant sur la présence/absence de fanons denticulés et sur la présence/absence de formations en peignes épineux ou en forme de clou ou de bouton. Les connaissances actuelles relatives à la variabilité dans le genre sont cependant trop incomplètes pour permettre de conclure sur la valeur de ces caractères au niveau supraspécifique.

Key-words : Cuba, Diplopoda, *Heth*, SEM, taxonomy, *Travassosinema*, Vietnam.

The genus *Travassosinema* (Oxyurida : Travassosinematidae) was erected by Rao (1958) with the type and only species, *T. travassosi* Rao, 1958, from the gut of a spirostreptid millipede from India. Until 1987, this was a unique record, but recently a number of other species have been proposed and detailed studies on the morphology of the genus published. Adamson (1987) described *T. dechambrieri* from the diplopod *Scaphiostrepus seychellarum* from the Seychelles. He provided detailed morphological observations on the form of the cephalic umbraculum and made a phylogenetic analysis of *Travassosinema* Rao, 1958, *Indiana* Chakravarty, 1943 and *Pulchrocephala* Travassos, 1925, the three umbraculum bearing genera comprising the family Travassosinematidae. Hunt (1993) described two new species,

T. morobecola and *T. sulawesiense*, in diplopods from Papua New Guinea and Sulawesi and provided the first scanning electron micrographs of the structure of the cephalic umbraculum.

The additional species described herein was received as fixed material in June, 1994 by courtesy of Dr Sergei Spiridonov. The material was obtained in 1989 from the gut of specimens of the spirobolid millipede, *Thyropygus allevatus* (Karsch, 1881), collected in Vietnam by Dr Spiridonov.

Spiridonov (1989) described a number of new species of nematode from a Cuban spirobolid millipede of the genus *Rhinocricus*, including two unusual species of *Heth* Cobb, 1898, namely *H. baracoa* and *H. imias*. Both species exhibited an atypical cervical collar, quite unlike

that recorded for the other nominal species where it is either a continuous band of cuticle bearing numerous small spines on the posterior margin or a discontinuous ring of fewer, larger spines with separate bases. The species descriptions, although adequate in many respects, lacked detail of the armature of the female cervical region, particularly with respect to the form and distribution of the spiny combs and spiny studs/button-like formations. Fortunately, Dr Spiridonov was generous enough to offer and then supply fixed topotype material of *H. imias* for further study using the SEM.

Specimens for light microscope study were processed to anhydrous glycerol via a slow evaporation technique at 40 °C and mounted in the same medium. Specimens destined for scanning electron microscopy were post-fixed overnight in 1% osmium tetroxide, dehydrated through a graded series of ethanol, critical point dried with CO₂, mounted on stubs and sputter coated with a 750 Å layer of gold. They were examined at an accelerating voltage of 10 kV. Measurements are given in the form: mean ± standard deviation (range).

***Travassosinema thyropygi** sp. n.**
(Figs 1, 2)

MEASUREMENTS

Females (paratypes; n = 10): L = 2.78 ± 0.27 (2.41-3.05) mm; L'^{**} = 1.49 ± 0.18 (1.16-1.68) mm; width = 179 ± 18 (153-205) µm; oesophagus = 372 ± 21 (335-406) µm; tail = 1291 ± 135 (1094-1414) µm; head to vulva = 0.94 ± 0.13 (0.65-1.05) mm; stoma = 43 ± 3.2 (38-48) µm; a = 15.6 (13.5-17.8); b = 7.5 (6.6-8.2); c = 2.2 (1.9-2.3); V = 33.8 (27.1-36.2); V'^{**} = 63.0 (56.3-67.1).

Holotype (female): L = 3.21 mm; L' = 1.76 mm; width = 221 µm; oesophagus = 400 µm; tail = 1447 µm; head to vulva = 1.08 mm; stoma = 55 µm; a = 14.5; b = 8.0; c = 2.2; V = 33.7; V' = 61.4.

DESCRIPTION

Female: Plump, medium sized nematodes about 2.2 to 3.2 mm long bearing a cephalic umbraculum with three external elements emanating from the lips and three others from the interlabia intercalated. Cuticle heavily annulated posterior to point where cephalic umbraculum joins body, each annule slightly retrorse when not fully extended and about 25 µm apart in midbody region. Seventy to 75 annules present, those anterior to vulva, particularly in oesophageal region, markedly smaller than those between vulva and anus. Lateral alae absent; lateral fields immediately posterior to oesopha-

geal region marked by breaks in annules. Oral opening triradiate with three strongly developed, almost contiguous, lips; one dorsal and two subventral. Three rounded interlabia, two subdorsal and one ventral. Four cephalic papillae present, two on dorsal lip and one on each of the two subventral lips, the latter also bearing the amphids. Cephalic umbraculum about 277 ± 22 (237-308) µm long, comprising six, radially arranged, posteriorly directed elements, one from each lip and interlabium. Each element consists of a strongly convex cuticular ala extending back to near level of nerve ring; somatic point of attachment being more anterior at about two-thirds of the procorpus. Three pairs of cuticular ribs of different lengths support the ala of each umbraculum element and, in addition, the underside of the apical hood of the three lipbased elements is supported by a number of slightly sinuate riblets running towards margin of hood. Oesophagus consisting of a narrow, tubular procorpus, barely demarcated from isthmus, and offset subspheroid basal bulb with valve plates and tripartite oesophago-intestinal valve. Muscle tissue surrounding procorpus just anterior to nerve ring with bundles of muscle fibres running forward and attaching to body wall near the cephalic extremity. Nerve ring located just anterior to bulb. Excretory pore situated about six annules posterior to basal bulb. Vulva located just anterior to posterior third of body (excluding tail); anterior vulval lip bearing small horn-like structure, clearer on some specimens than others. Muscular vagina directed anteriorly before flexing posteriorly for a short distance and joining uteri. Genital system amphidelphic and reflexed one or more times. Irregularly lobed spermatheca containing rounded sperm present near the point where posterior horn reflexes anteriorly. Spermatheca absent on anterior horn, suggesting that reproductive strategy involves haplodiploidy (for a study of this phenomenon in the Oxyurida see Adamson, 1984). Eggs numerous, showing varying degrees of development from undifferentiated cytoplasm to tadpole stage. Eggs subovoid with thin, smooth shells and dimensions of about 53 ± 1.6 × 39 ± 2.0 µm (n = 11). Anterior anal lip overhanging anus; posterior anal lip slightly protuberant. Several coelomocytes grouped around rectum. Tail about 1.3 mm long, constituting about 47 (43-52)% of total body length; proximally conoid, but rapidly becoming subulate and attenuating to a fine point. Phasmids on subulate part of tail, slightly posterior to conoid section. Tufts of fungi and/or bacterial plaques often present around anal region and elsewhere on body.

Male: Unknown.

DIAGNOSIS AND RELATIONSHIPS

T. thyropygi sp. n. is characterized by the long body and its proportionately long tail occupying about 47% of the body length and by the absence of lateral alae.

* Derived from *Thyropygus*, the generic epithet of the host.
** L' = distance from head to anus; V' = vulval position as % of L'.

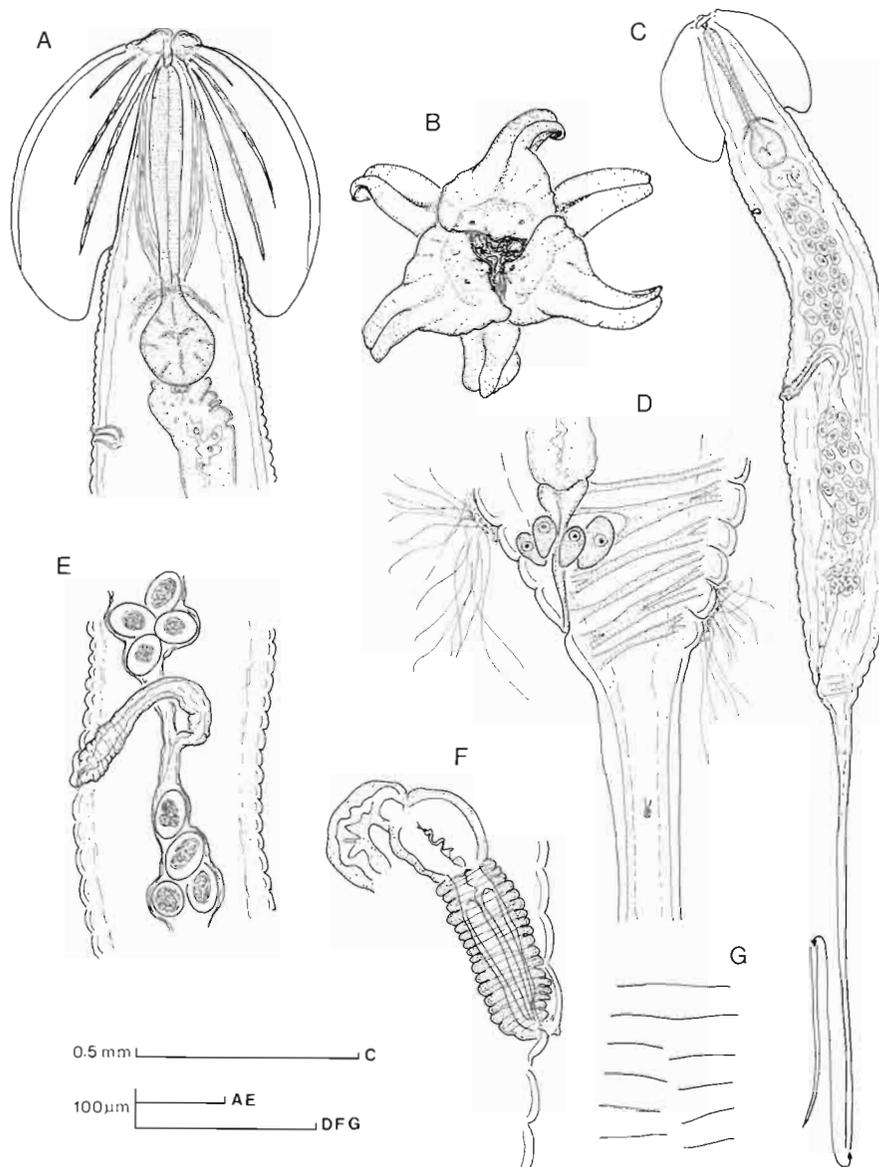


Fig. 1. *Travassosinema thyropygi* sp. n. A : Oesophageal region; B : Schematic en face view of the cephalic umbraculum; C : Entire; D : Tail region; E, F : Vulval region; G : Annules showing lateral interruptions in the striae.

It is most similar to the type of the genus, *T. travassosi* Rao, 1958 which was described from an unidentified spirostreptid millipede from India, but differs by : longer body (2.41-3.21 mm vs 2.2-2.6 mm); cephalic umbraculum extending to about the anterior level of the basal bulb as opposed to its mid-point; a more posterior nerve ring located just anterior to the basal bulb as opposed to around the procorpus/isthmus junction; markedly smaller eggs ($53 \times 38.5 \mu\text{m}$ vs $70 \times 60 \mu\text{m}$). According

to the description by Rao (1958) the oesophagus of *T. travassosi* is 0.13 mm long, which is very short and suggests a "b" value of about 18. This probably represents either an error in calibration or, more likely, a *lapsus calami* as calculation from the excellent illustration indicates an oesophageal length of about $320 \mu\text{m}$ with a "b" value of 7.4; values which are much more credible and of the same order as the corresponding parameters for the other nominal species. Of the other three nomi-

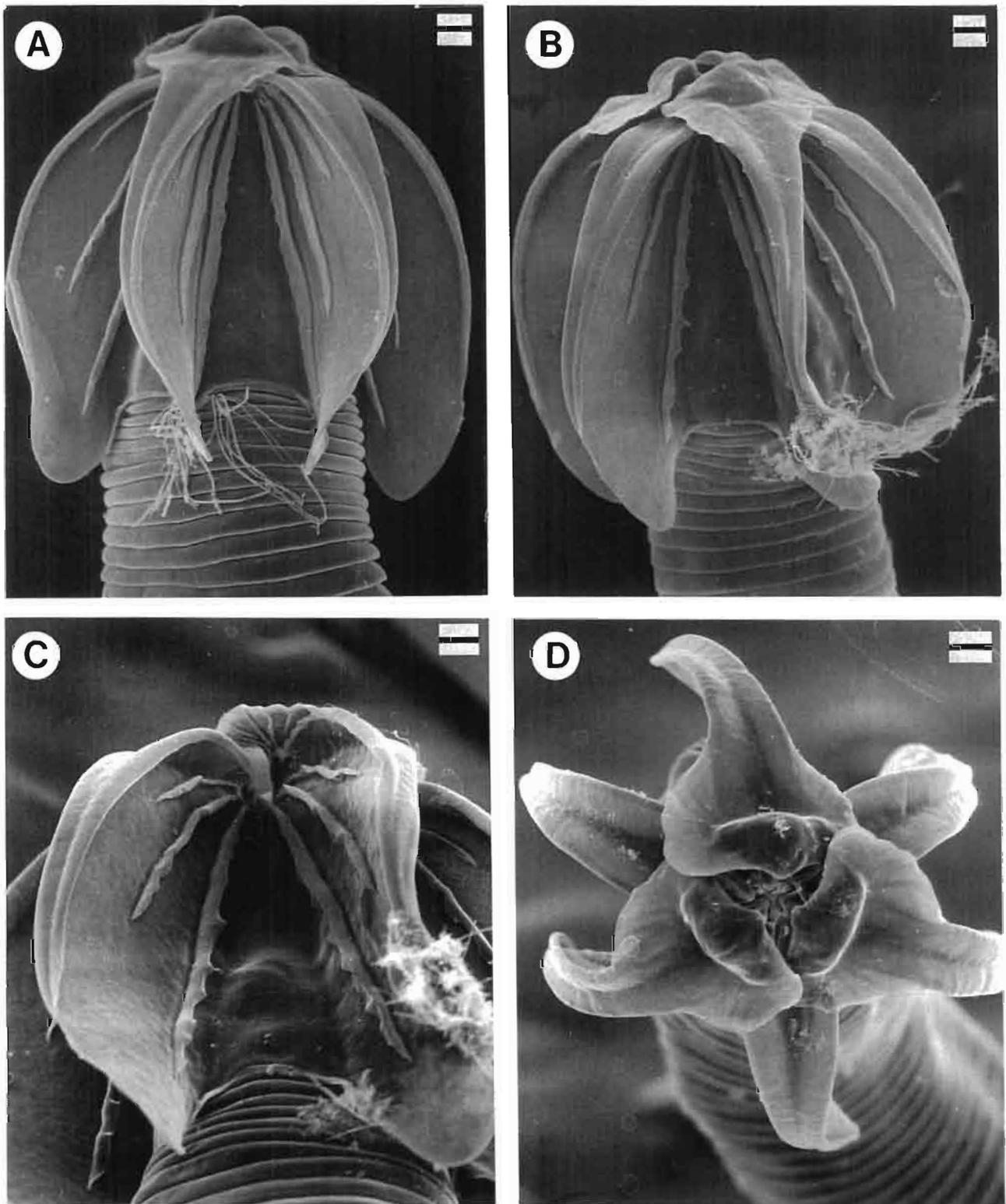


Fig. 2. *Travassosinema thyropygi* sp. n. SEM studies. A, B : Cephalic umbraculum; C : View of umbracular elements showing supporting ribs; D : En face view (Scale bars = 20 μ m).

nal species, *T. dechambrieri* Adamson, 1987 is much smaller at 1.66 ± 0.25 mm and has the body strongly contracted immediately posterior to the vulva; *T. morobecola* Hunt, 1993 is smaller at 1.98 (1.73-2.26) mm with a relatively shorter tail and well developed lateral alae and *T. sulawesiense* Hunt, 1993 is longer at 3.35 (3.29-3.43) mm with well developed lateral alae and a relatively shorter tail.

TYPE HOST AND LOCALITY

Intestine of the spirobolid millipede *Thyropygus allevatus* (Diplopoda: Spirobolida) collected in January, 1989 by Dr S. Spiridonov in Khanh-Hoc, Nha-Trang, Vietnam.

TYPE MATERIAL

Holotype female and six paratype females (slide numbers T 516/3/1 - T 516/3/7) in the type collection of the International Institute of Parasitology, St Albans, UK and four paratype females in the type collection of the Entomology/Nematology Department, Rothamsted Experimental Station, Harpenden, Herts., UK.

Key to species of *Travassosinema*

- 1 - Lateral alae prominent 2
 - Lateral alae absent; lateral fields marked only by breaks in the striae 3
- 2 - Body small, 1.98 (1.73-2.26) mm; lateral alae commencing just posterior to the umbraculum *T. morobecola* Hunt, 1993
 - Body longer, 3.35 (3.29-3.43) mm; lateral alae commencing just anterior to excretory pore *T. sulawesiense* Hunt, 1993
- 3 - Body markedly contracted posterior to vulva; average body length 1.66 ± 0.25 mm *T. dechambrieri* Adamson, 1987
 - Body not markedly contracted posterior to vulva; average body length greater than 2.2 mm 4
- 4 - Body 2.78 (2.41-3.21) mm long; eggs averaging $53 \times 39 \mu\text{m}$ in size *T. thyropygi* sp. n.
 - Body (2.2-2.6) mm long; eggs averaging $70 \times 60 \mu\text{m}$ in size *T. travassosi* Rao, 1958

Heth imias Spiridonov, 1989

REDESCRIPTION OF THE CERVICAL REGION IN FEMALE (Fig. 3)

Cephalic extremity with two, slightly convex, pseudolabial plates of lateral origin overhanging oral aperture. Pseudolabial plates attached to body tissue for a short distance laterally, but free along remaining edges, thus forming two broad apertures - one dorsal, one ventral - joined by a dorso-ventral slit. Dorsal and ventral angles of each pseudolabial plate usually touching correspond-

ing angles of other plate. Free margins of pseudolabia finely pectinate. Body tissue beneath dorsal and ventral quartiles of pseudolabia extended to form four, slightly concave, somatic flanges with pectinate margins. Each somatic flange mirroring the pseudolabial quartiles also bearing, on the posterior subdorsal and subventral margins, two recurved spines directed posteriorly, i.e. a total of eight spines. Cervical collar, which has a substantial dorsal and ventral hiatus, of extremely unusual form, consisting of a retrorse band of smooth cuticle extending as dorsal and ventral limbs from first pair of lateral spines (the bases of which are contiguous), each limb terminating in a short, posteriorly directed, solitary spine. Posterior to pair of lateral spines attached to collar are two additional pairs of smooth, delicate spines, making a total of three pairs on each side of body. Bases of second and third spine pairs separate and not contiguous. First pair of spines short; second and third pairs longer. Cervical region bearing spiny combs and spiny studs/button-like formations. Just posterior to somatic flanges are four cervical combs, two located latero-subdorsally and two latero-subventrally. Each cervical comb consisting of an elongate cuticular plate bearing from eight to twelve spines on posterior margin and central somatic sensilla. Posterior to combs, but anterior to cervical collar, are four smaller combs, two subdorsal and two subventral, shorter and more rounded than anterior combs and bearing about nine spines on posterior margin. They are innervated in a similar fashion to the anterior combs. Spiny studs or button-like formations continue in about twelve irregular lines posterior to the cervical collar: two subdorsal, two subventral, four in ventrolateral region, four in dorsolateral region. Anteriormost studs with four to seven spines, this number decreasing posteriorly, initially to three or four and then to a single spine. Concomitant with decreasing spine number is a reduction in development of cuticular attachment plate. Lateral alae low, commencing at about level of last spines.

OBSERVATIONS ON THE MALE TAIL

Arrangement of copulatory papillae as described by Spiridonov (1989), the hypertrophied pair nearest the ventral sucker showing exceptional development and being remarkably mammiform in shape. A similar development was recorded by Hunt (1994) for a *Heth* species from Papua New Guinea.

Comments on the genus *Heth* Cobb, 1898

Adamson (1983) divided the species of *Heth* into two groups based on the armature of the female cervical region: Group 1 with the cervical collar consisting of a band of cuticle bearing numerous retrorse spines with contiguous bases and Group 2 with the collar comprising fewer, larger spines with separate bases. The situa-

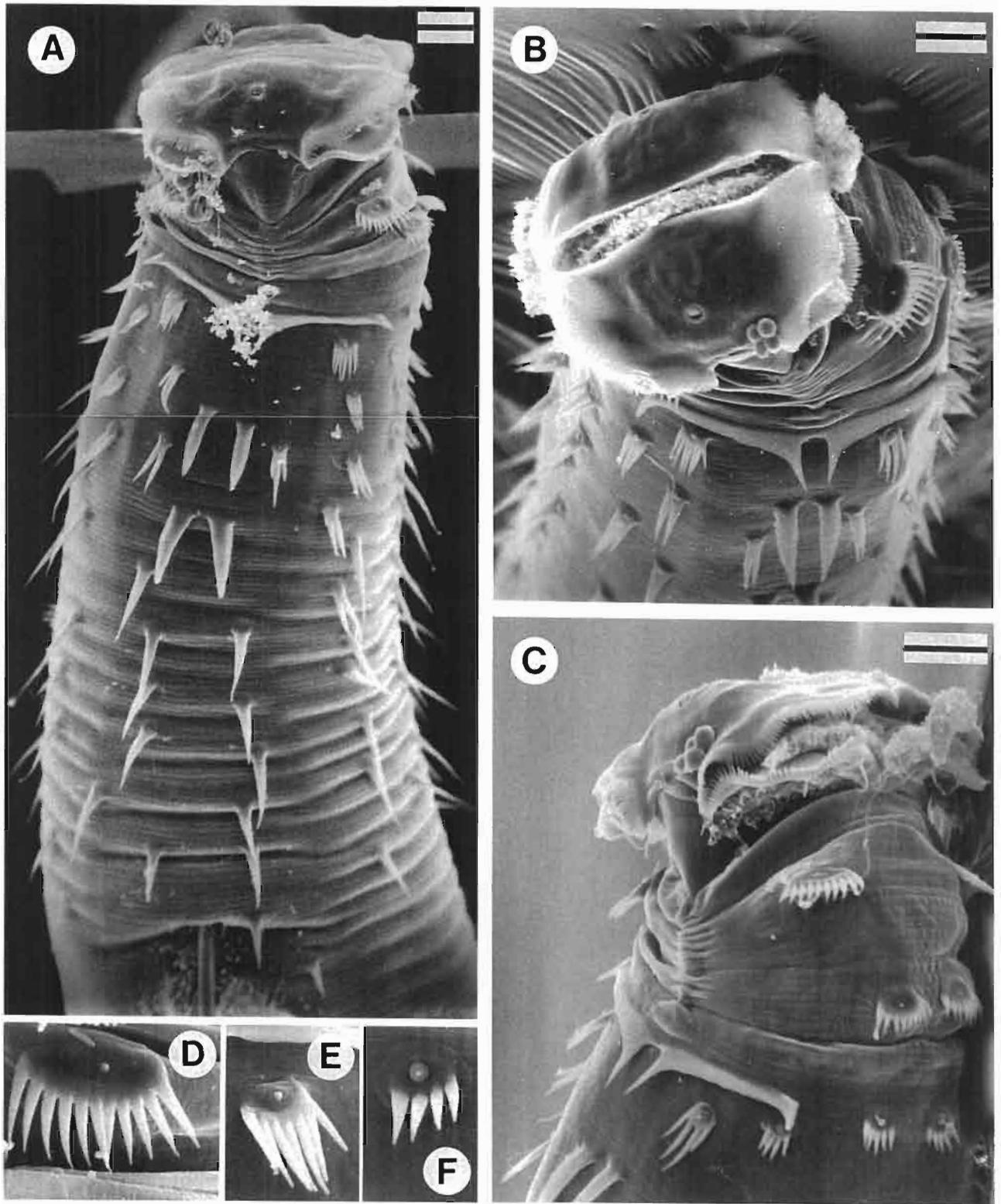


Fig. 3. *Heth imias* Spiridonov, 1989. SEM studies. *A* : Cervical region, lateral view; *B* : En face and cervical region; *C* : Subdorsal view of cervical region; *D* : Cervical comb; *E*, *F* : Cervical studs (Scale bars = 10 μ m).

tion is, in reality, somewhat more complex as Group 1 itself contains several characteristic subdivisions and, in addition, Spiridonov (1989), described two species from Cuba (one of which is redescribed herein) where the cervical collar consists of a retrorse band of cuticle, incomplete dorsally and ventrally and lacking spines except for a single one at the dorsal and ventral extremities. These Cuban species are best regarded as belonging to Group 1.

Group 1 can be divided into two broad categories, one with spined combs and studs developed around the cervical somatic pores (*H. amazonensis* Kloss, 1965; *H. baracoa* Spiridonov, 1989; *H. bifidispiculum* Adamson, 1982; *H. clunyi* Adamson, 1985; *H. duvidosum* Artigas, 1929 [species inquirenda]; *H. imias* Spiridonov, 1989; *H. mauriesi* Adamson, 1982; *H. perarmatum* Dollfus, 1952; *H. spinosum* Artigas, 1929) and one without such developments around the somatic pores (*H. costata* Hunt, 1994; *H. dimorphum* Chitwood, 1935; *H. hamatus* Bowie, 1986; *H. hexaspinosum* Chitwood, 1935; *H. insularis* Kloss, 1965; *H. juli* Cobb, 1898; *H. maicuru* Kloss, 1961; *H. orthopori* Adamson, 1987; *H. ortowilliamsi* Hunt, 1994; *H. sutherlandi* Hunt, 1994; *H. xaniophora* Hunt, 1994; *H. zeuglocantha* Hunt, 1994). Most species in the latter subdivision have the first pair of lateral spines in the form of serrate lappets and occur in the Australasian/Pacific region, whereas species of the former subdivision have the first pair of lateral spines simple and come from South and Central America and the West Indies. There are, however, several exceptions to this scheme: *H. zeuglocantha*, from Papua New Guinea, lacks serrate lappets (all other nominal species from the island have serrate lappets); both *H. maicuru*, which has two additional spiny collars posterior to the cervical collar and *H. orthopori*, which sports transverse rows of spinelets, lack lappets and come from South America whilst *H. insularis* apparently has serrate lappets (the illustration is rather poor) yet comes from South America. Both species described from Cuba (*H. baracoa*, *H. imias*) lack serrate lappets and bear spiny combs and studs, thus indicating an affinity with the other Neotropical species, yet the cervical collar differs in that, although being a continuous band of cuticle (except for a dorsal and ventral hiatus) as in Group 1, it is not spiniferous. These two species may represent a distinct lineage endemic to Cuba or merely another aspect of the remarkable variability in the female cervical region of this genus.

Species of Group 2 (*H. arigasi* Dollfus, 1952; *H. macrocephala* Kloss, 1965; *H. magnavulvaris* Adamson, 1985; *H. multiplus* Kloss, 1965; *H. parartigasi* Adamson, 1985; *H. sinediscus* Kloss, 1965; *H. spinalium* Kloss, 1965; *H. travassosi* Dollfus, 1952; *H. travilhoi* Dollfus, 1952; *H. tuzetae* Dollfus, 1952) are rather more uniform in spination. The cervical region lacks serrate lappets, spiny combs and studs (although *H. sinediscus* has additional spine collars and *H. spinalium* has addi-

tional spinelets) and all the species come from South America.

Thus, species with serrate lappets possess neither spiny combs nor studs and are found almost exclusively in the Australasian/Pacific region, whereas species with spiny combs and studs (the two developments always occur together) come from the Neotropical region and have a cervical collar formed from a band of cuticle which, in all but the Cuban species, bears numerous small spines on its posterior margin. Although some of these cuticular characters are linked, there remain sufficient exceptions to cast doubt on their validity as generic markers and such a move would be premature. It is possible that plesiomorphic male characters such as buccal structure and caudal papillae arrangement may reinforce some of these groupings, but unfortunately very few males have been described, still less reliably ascribed to females.

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