

Two new species of *Ungella* Cobb, 1928 (Rhabditida: Drilonematoidea) from earthworms deposited in the Smithsonian Institution Natural History Museum

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Summary. Two new species of *Ungella* Cobb, 1928 are described from earthworms deposited in the collection of the Smithsonian Institution Natural History Museum. *Ungella burmensis* sp. n. is distinguished from *U. secta* Cobb, 1928 by having finely mammilated egg shells, smaller gubernaculum and more numerous pre-cloacal papillae. *Ungella mexicana* sp. n. differs from other species in the genus by having bifurcated spicule termini. The presence and absence of spicular apparatus within the ungelid genera is discussed.

Key words: Drilonematoidea, earthworm parasites, Ungellidae, *Ungella burmensis* sp. n., *U. mexicana* sp. n.

Specimens of earthworms deposited in the Smithsonian Institution Natural History Museum have been collected world-wide since the early 20th century until the mid-seventies. The majority of the collection contains lumbricid and acanthodrilid earthworms, both endemic and peregrine species, from USA. The remaining specimens comprise megascolecids, acanthodrilids, octochaetids and moniligastrids from Southeast Asia, mainly collected and identified by Dr. G.E. Gates, eudrilids and glossoscolecs from Africa, and some specimens representing other families from Caribbean and Far East islands, Europe, and Central America. In total 328 earthworms from the following families *Megascolecidae*, *Acanthodrilidae*, *Eudrilidae*, *Ocnerodrilidae*, *Microchaetidae*, *Lutodrilidae*, *Glossoscolecidae*, *Moniligastridae*, *Octochaetidae*, *Sparganophilidae* and *Lumbricidae* were dissected. Representatives of *Megascolecidae*, *Acanthodrilidae*, *Eudrilidae*, *Octochaetidae* and *Glossoscolecidae* were found to be infected by nematodes, including fourteen new species, of the superfamily *Drilonematoidea* Chitwood, 1959. Two of the new nematode species, belonging to the genus *Ungella* Cobb, 1928, from octochaetid and megascolecid earthworms from Southeast Asia and Central America, are described here.

MATERIALS AND METHODS

Two adult *Eutyphoeus bifovis* and nine *Howascolex* sp., earthworms, all formalin-preserved, were dissected. Both *E. bifovis* were found to be infected by *Ungella burmensis* containing 3 female and 1 male and 10 male and 10 female nematodes, respectively. Three males of *U. mexicana* were recovered from a single *Howascolex* specimen. Nematodes were processed to glycerol using a glycerol-ethanol method (Seinhorst, 1959) and mounted in glycerol. Drawings and measurements were made using a *camera lucida*. As several specimens had damaged terminal tips, absolute measurements were preferred to de Man ratios, where D is the mid-body diameter, Oes is the oesophagus length, Cd is the tail length and Ex is the distance from the anterior to the excretory pore.

DESCRIPTION

Ungella burmensis sp. n. (Figs. 1A-H & 2A-G)

Holotype male. L = 1531 μ m; D = 43 μ m; Oes = 159 μ m; Cd = 186 μ m; Ex = 165 μ m.

Paratype males (n=7): L = 1393 \pm 113 (1190-1531) μ m; D = 34 \pm 4.2 (30-43) μ m; Oes = 159 \pm 12.1

(142-175) μm ; Cd = 159 ± 33.2 (108-206) μm ; Ex = 182 ± 16.3 (161-202) μm .

Paratype females (n=10): L = 1583 ± 85.0 (1497-1773) μm ; D = 46 ± 3.4 (40-50) μm ; Oes = 163 ± 10.0 (150-175) μm ; Cd = 285 ± 34.5 (245-345) μm ; Ex = 192 ± 7.7 (175-200) μm ; V% = 46.1 ± 2.6 (42.5-49.2).

Body clear, long, cylindrical, tapered slightly to anterior end. Cuticle finely striated by longitudinal striae less than 1 μm apart. Transverse striae not observed. Lateral fields faint, 10-12 μm wide, bearing 8-10 longitudinal striae with central incisure marked by dots. Hypodermis finely granulated, up to 5 μm thick at anterior end and tail. Head slightly inclined dorsally, bluntly rounded, bearing paired claw-like submedian hooks or onchia. Each onchium with straight shaft and outward curving blade on dorsal side. Blade and shaft 5 and 12 μm long, respectively. Proximal 10 μm of shaft embedded in cephalic tissue and oesophageal musculature; muscles inserted on shaft enable movement of blade toward and away from saggital plane. Four cephalic papillae prominent in some specimens. Mouth shifted dorsad. Stoma not apparent. Amphids with transversely elliptical apertures 4-5 μm in diameter at mouth level or slightly posteriorly. Amphidial pouch 7 μm with long sensillae. Oesophagus muscular, with long corpus 8-10 μm wide and slight median swelling 12-14 μm wide; isthmus 10 μm wide and elongate basal bulb 16-17 x 20-21 μm slightly inclined dorsally with prominent dorsal gland nucleus near bulb base. Nerve ring surrounding isthmus 125-130 μm from labial surface. Cardium short, conical. Intestine narrow, well developed. Rectum with refractive lining. Three rectal glands present. Excretory pore 2 μm in diameter and situated 5-30 μm posterior to basal bulb. Excretory duct, 1-2 μm wide, directed 7-8 μm mesad, then turns posteriorly for 10-12 μm along body wall. Excretory cell large, extending to near mid-body with two meandering channels; anterior region of cell filled with well-defined granules and posterior region containing homogenous substances. Anterior half of tail conical, posterior half filamentous; right and left transversely elliptical suckers situated laterally near middle of conical portion of tail.

Male. Monorchic; testis reflexed at 200-500 μm from anterior end, flexure 120-150 μm . Two rows of spermatocytes at anterior end of testis; seminal vesicle with small spherical or ameboid spermatocytes; *vas deferens* posteriorly set off from muscular ejaculatory duct by constriction. Spicules paired, proximally cephalate, 22-25 μm long on arc and

19-20 μm on chord; each spiculum at its mid-length bent 90° laterad. Gubernaculum shallow, boat-shaped and parallel to spicules with narrow dorsal apophysis, two ventral projections and lateral sleeves embrace spicules, 13-16 μm long. Eight fine precloacal sensilla, 10-14 μm long, present on the right and left subventral surfaces. Adanal region with two pairs of shorter sensilla situated more laterally than precloacal sensilla. Tail with one right and one left subventral sensilla between cloacal aperture and sucker-like organ, and two sensillae each on right and left subventral surfaces between sucker and beginning of filamentous portion of tail. No distinct alae but loose cuticle over postcloacal sensillae on ventral side. Anteriorly, tail wider than cloacal body diameter; 60% of tail length conical and curved ventrad; remaining terminal portion filamentous. Copulatory muscles and *levator ani* muscle well-developed. Large vacuole-like structures and two longitudinally arranged ducts present in tail. Caudal suckers situated 2.5 cloacal body diameters posterior to cloaca; aperture of suckers 12-13 x 4-5 μm and each with thick, striated rim. Two prominent sensillae in sucker aperture.

Female. Transversal striation apparent on coiled specimens. Anterior end, oesophagus and excretory system as in males. Reproductive system monodelphic and prodelphic. Gonad tube lies straight to anterior end on dorsal side and reflexed 200-300 μm behind oesophageal base. Distal tip of ovary situated near anal aperture; seminal receptacle, 22-76 x 20-38 μm , situated distal to flexure and filled with numerous spherical spermatozoa. Oviduct and uterus thick-walled; uterus with one ovum, 68-95 x 30-34 μm , with thin (1 μm), mammilate chorion. Post-uterine sac absent. Vagina posteriorly inclined, muscular. Vulva in front of mid-body. A layer of large elongate cells 20 x 10-12 μm beneath body wall between vulva and anus on ventral side. Tail long, narrow, tapered uniformly to a fine obtuse tip. Sucker 15-17 x 6-7 μm , up to two third of tail diameter wide.

Type host and locality. *Euthyphoeus bifovis*, N° 26180, collected in Mandalay, University College, Burma, Sept.17, 1959, by H. M. Smith. Identified by G. E. Gates.

Type habitat. Coelomic cavity of segments ix-xiv.

Type material. Holotype male (T-538t) and paratypes (T4814p-T4826p) deposited in USNM, WRMEX-28180.

Differential diagnosis. The species resembles *U. secta* Cobb, 1928 in having a similar body shape,

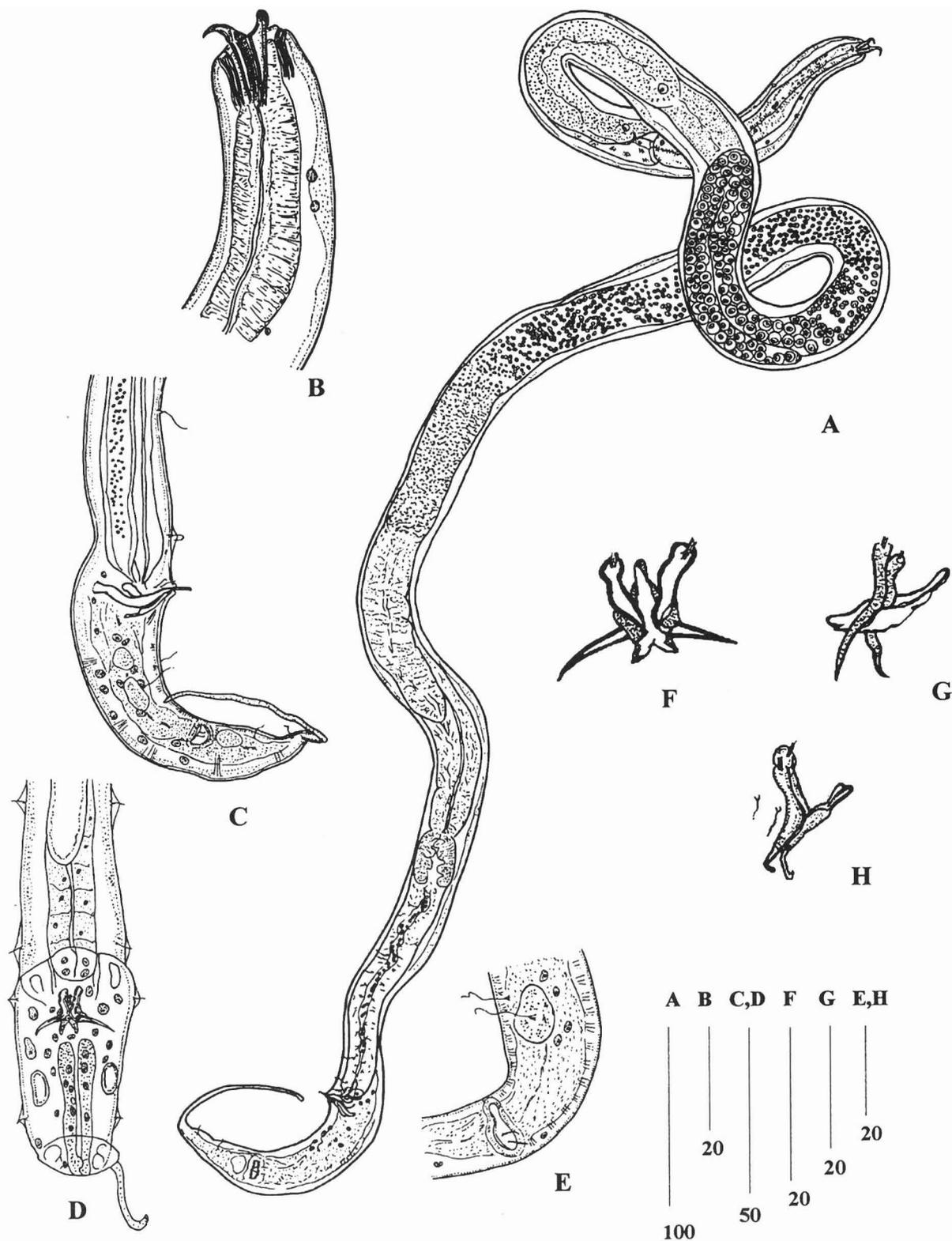


Fig. 1. *Ungella burmensis* sp. n., male. A: Entire body; B: Anterior end, dorsal view; C: Tail, lateral view; D: Tail, ventral view; E: Tail, sucker and papillae, lateral view; F: Copulatory apparatus, ventral view; G, H: Copulatory apparatus, lateral view. Scale bars in μm .

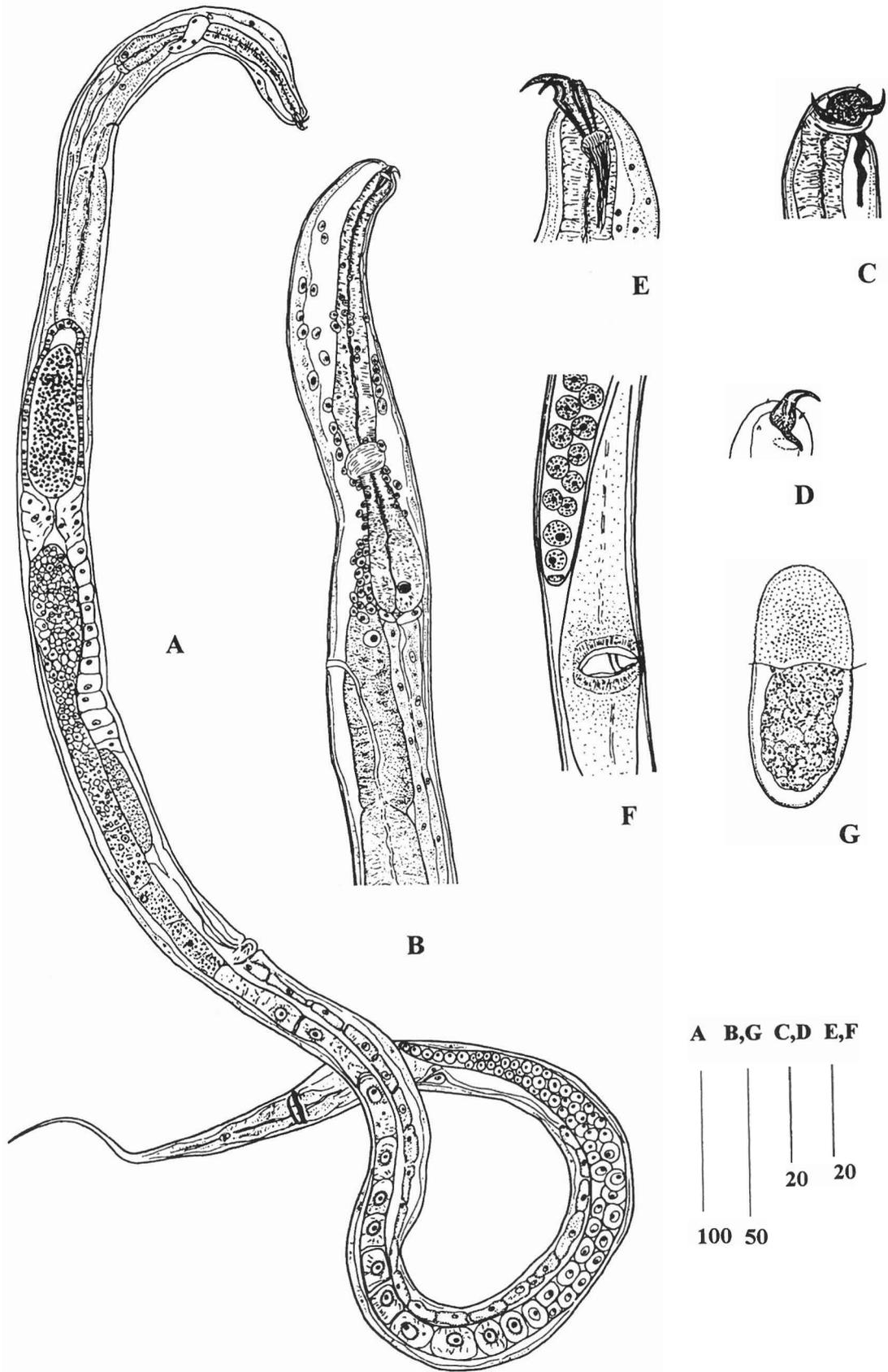


Fig. 2. *Ungella burmensis* sp. n., female. A: Entire body; B: Anterior end, lateral view; C, D: Head end, dorsal view; E: Head end, lateral view; F: Tail, sucker, lateral view; G: Egg. Scale bars in μm .

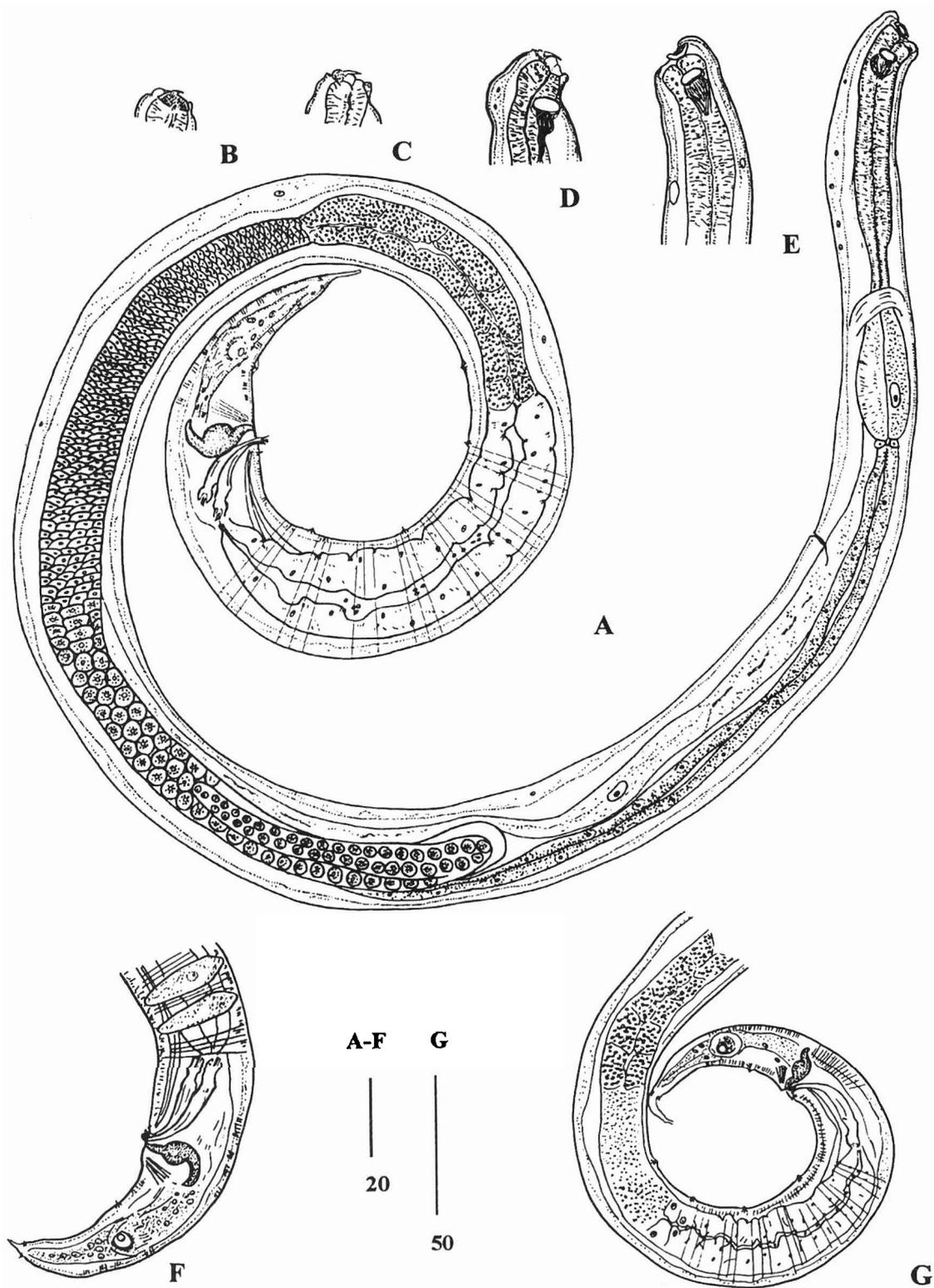


Fig. 3. *Ungella mexicana* sp. n., male. A: Entire body; B, C, D: Head end; E: Anterior end; F, G: Tail; All in lateral view. Scale bars in μm.

similar structure of the anterior end and oesophagus, and lacking a post-vulvar uterine sac. It differs in the egg shell being finely mammillate instead of smooth, the spicula and gubernaculum differ in structure, the gubernaculum is smaller, without bursa, there are fewer pre-cloacal sensillae, and the suckers are elliptical instead of round. The present species can be distinguished from *U. sucofera* Timm, 1962 by its larger size, the presence of single-pointed cephalic hooks vs bifid hooks, by elliptical suckers, vs circular ones.

***Ungella mexicana* sp. n.**
(Fig. 3A-G)

Holotype male. L = 935 μ m; D = 32 μ m; Oes = 130 μ m; Cd = 84 μ m; Ex = 149 μ m.

Paratype males (n = 2): L = 696-756 μ m; D = 30-38 μ m; Oes = 93-115 μ m; Cd = 57-60 μ m; Ex = 111-145 μ m.

Male. Body clear, short, slender, curved or coiled ventrally at tail. Truncate head slightly inclined dorsad. Cuticle with fine transversal and distinct longitudinal striae. Lateral fields faint, about 10 μ m wide, bearing dots and vacuole-like structures. Head bearing two small hooks rigidly joined at common base. Blades of hooks 2-3 μ m long, parallel to saggital head plane. Cephalic hooks attached to cephalic cuticle without shaft embedded in oesophageal tissue; proximal end of hooks 5 μ m wide and tapered to dorsally curved tips. Stoma wide, shallow and shifted dorsad. Four small cephalic papillae. Amphid with prominent transversely elliptical aperture surrounded by sclerotized rim 7 x 5 μ m, situated 7 μ m posterior to labial surface. Amphidal pouch 8 μ m long. Oesophagus with corpus, isthmus and bulb; corpus 67-80 μ m long and uniformly 8 μ m wide; isthmus 6 μ m wide and circumscribed by nerve ring; basal bulb 38 μ m long with maximum width of 16 μ m. Oesophagus anterior with almost rectangular profile. Short cardia. Excretory pore, about 2 μ m wide, situated at 17-23 μ m posterior to basal bulb. Excretory duct short, curving backward at right angle to body surface; large excretory cell. Testis reflexed at 120-160 μ m from the anterior, flexure 90-100 μ m long. Spicules distinctly cephalate with curved tips, 33-38 μ m long on arc, 30-31 μ m on chord. Tip of spicula bifurcated; points sharp and separated by 3 μ m deep cleft. Gubernaculum massive, boat-shaped, 15-18 μ m long, with narrow apophyses. Copulatory muscles and *levator ani* muscle prominent. Tail conical, curved ventrad, with digitate tip broken in all specimens. Five pairs of precloacal, subventral

sensillae present, each covered by loose cuticle, plus one subventral pair of adanal sensillae, one pair of caudal sensillae anterior to suckers, and two additional pairs of caudal sensillae situated at end of conical portion of tail. Suckers situated at two-thirds of tail length, 5-6 μ m in diameter with aperture 2-3 μ m in diameter, surrounded by thin, slightly protruding rim.

Type host and locality. *Howascolex* sp. N° 47895, collected and identified by W.N. Murchie, Vera Cruz State, Mexico, July 31, 1962.

Type habitat. Coelomic cavity of pre-clitellar segments.

Type material. Holotype (T-539t) male and paratype (T-4827t) male deposited in USNM, WRMEX-47895.

Differential diagnosis. The present species differs from *U. secta* and *U. burmensis* by its smaller size; small cephalic hooks, which are an elaboration of cephalic or labial cuticle and without a shaft enveloped by oesophageal musculature; by the different shape of the male tail; and by smaller caudal suckers. The present species resembles *U. sucofera* Timm, 1962 by the similar shape of the cephalic hooks and gubernaculum, whereas it differs by a shorter tail, presence of male genital sensillae; smaller, symmetrical suckers; and distally bifurcated spicula.

Taxonomic remarks. Cobb (1928) proposed the genus *Ungella* for nematodes inhabiting the body cavity and muscles of the tropical earthworm *Eutyphoeus rarus*, and characterised it as having head onchiaior hooks, special cervical gland, degenerate-diplogasteroid oesophagus, caudal pockets or "suckers", and the male with two equal spicula, a gubernaculum and an elongate ribbed bursa. The second [after description of *Dicelis* by Dujardin (1845)] nematode parasite of earthworms described was *Dionyx lacazii* Perrier, 1881, which was recovered from the muscle tissue of a *Pontodrilus* sp. and characterised as having cephalic hooks and copulatory apparatus (Perrier, 1881). Subsequently, *Synoechnema fragile* Magalhaes, 1905, a parasite of a *Pheretima* species, was described as having cephalic hooks but lacking a copulatory apparatus. Pierantoni (1916) transferred the latter species to *Dionyx* and characterised the genus as either being with or without a copulatory apparatus. Baylis and Doubney (1926) synonymized *Dionyx* Perrier, 1881 with *Synoechnema* Magalhaes, 1905 on the grounds that the name of the former genus was already in use for Coleoptera as *Dionyx* Peletier & Serville, 1825. Baylis

(1943) later recognized that the genus *Dionyx* should be restored, but because *Dionyx* is a junior homonym, he renamed the genus *Onychonema*, comprising *O. lacazii* (Perrier, 1881), *O. cognettii* (Pierantoni, 1916), *O. minutum* (Pierantoni, 1916), *O. acutifrons* (Pierantoni, 1916) and *O. guineense* (Pierantoni, 1916). Timm (1962) synonymized *O. acutifrons* and *O. guineense* with *Synoeconema acutifrons* and *S. guineensis*, and also discussed the possible synonymy of *Onychonema* Baylis, 1943 with *Ungella* Cobb, 1928. He considered the structure, referred to as "cervical gland" in Cobb's description, as the excretory sinus cell and the dorsal pore as the mouth and mentioned that the delicate cuticle of drilonematids can easily rise to produce folds due to poor preservation, and these may be interpreted as caudal alae. However, he considered the absence of suckers in *Onychonema* as an obstacle to synonymising *Onychonema* with *Ungella*. *Dicelis pleurochaeta* Beddard, 1883, having a single mouth papilla according to Timm (1962), fits better in *Ungella* than in *Dicelis*.

The family *Ungellidae* includes 11 genera. Of these, *Onychonema*, *Ungella* and *Plesiungella* Yeates, *et al.*, 1998 possess a male copulatory apparatus. Representatives of these genera have many morphological features of the Drilonematidae, the most primitive family in Drilonematoidea. Cobb (1928) considered the oesophagus of *Ungella secta* as being closely related to the oesophagus of *Diplogaster*, and that of all other free-living genera. The long, slender body and well-developed muscle layer of *Ungella* may be correlated with their mobility. *Plesiungella* differs from *Ungella* and *Onychonema* by having a single spicule with bifurcated tip (Yeates *et al.*, 1998), swollen posterior end in both sexes, and no gubernaculum. Besides *Plesiungella* and *U. mexicana* n. sp., bifurcated spicule ends were observed among Drilonematoidea in *Scolecophilus lumbricola*, *S. gatesi* and *S. mus* (Scolecophilidae) (Baylis & Doubney, 1922; Timm, 1967) and *Pharyngonema mecongianum* and *Filiponema baviense* (Drilonematidae) (Spiridonov, 1994; Spiridonov & Ivanova, 1997). The characteristic shape and arrangement of spicules and gubernaculum of *U. burmensis*, except for the non-bifurcated spicule tips, strongly resembles the spicula and gubernaculum of *S. lumbricola*, *S. gatesi* and *S. mus*, whereas the remainder of the morphology of these genera is quite different. The bifurcated spicule ends is a peculiarity of the non-related superfamily *Trichostrongyloidea* Cram, 1927 (Strongylida), and Dujardin (1845) treated *Dicelis* as 'Strongyliens'.

The other ungelid genera (*Synoeconema*, *Siconema* Timm, 1966, *Sucamphida* Timm, 1966, *Adungella* Timm, 1967, *Timmungella* Timm, 1967, *Sicone-*

mella Timm, 1967, *Siconemoides* Timm, 1967, *Thainema* Ivanova *et al.*, 1987) have lost a male copulatory apparatus and genital papillae and have acquired a thinner cuticle, and sexual dimorphism in size is present. A copulatory papilla where the intestine and ejaculatory duct open was reported for several species of *Siconema*, *Synoeconema*, *Siconemoides* and *Siconemella* (Timm, 1962, 1966, 1967). Most of the ungelids that lack the copulatory apparatus are characterised by having a degenerate intestine and inconspicuous anus (Timm, 1959, 1966), and they developed a large excretory system and very large phasmids, that cause a swelling of the caudal part of the nematodes. As an inhabitant of the earthworm coelom cavity, ungelid nematodes are strongly attached to pharyngeal muscles and septa by their head hooks and are in a permanent state of copulation. Observations on living *Synoeconema tuliemense* Ivanova & Pham Van Luc, 1989 and *S. hirsutum* Timm, 1959 confirmed the almost sedentary nature of these parasites (unpublished data). Their morphology apparently demonstrates a higher level of specialization than that of the genera possessing a copulatory apparatus, and the genus *Plesiungella* seems to be an intermediate form between both groups of genera due to the reduction of one spicule and the gubernaculum, and swelling of the posterior end.

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REFERENCES

- Baylis, H.A. 1943. Some nematode parasite of earthworms from the Indo-Malay region. *Parasitology* 35 (3): 112-127.
- Baylis, H.A. & Doubney, R. 1922. Nematodes parasitic in various vertebrates, collection of the Zoological Survey of India. *Memoirs of the Indian Museum* 7 (4): 263-347.
- Baylis, H.A. & Doubney, R. 1926. *A Synopsis of the Families and Genera of Nematoda*. London, British Museum. 277 pp.
- Cobb, N.A. 1928. *Ungella secta* n. gen. n. sp., a nematode parasite of the Burmese Oligochaete (earthworm) *Eutyphoeus rarus*. *Journal of the Washington Academy of Sciences. Contribution to the Science of Nematology* 18: 394-397.

- Dujardin, F. 1845.** *Histoire naturelle des helminthes ou vers intestinaux*. Paris. 654 pp.
- Perrier, E. 1881.** Etudes sur l'organisation des lombriciens terrestres. *Archives de Zoologie Experimentale et Generale* 9: 175-248.
- Pierantoni, U. 1916.** I nematodi parassiti degli oligochaeti. *Bolletino della Societa dei Naturalisti in Napoli* 29: 139-163.
- Seinhorst, J.W. 1959.** A rapid method for the transfer of nematodes from fixative to anhydrous glycerin. *Nematologica* 4: 67-69.
- Spiridonov, S.E. 1994.** New and little known Drilonematidae (Rhabditida) from Laos. *Afro-Asian Journal of Nematology* 4: 54-60.
- Spiridonov, S.E. & Ivanova, E.S., 1997.** *Filiponema baviense* sp. n. (Rhabditida: Drilonematoidea), a parasite of megascolecid earthworms from the BaVi National Park, Vietnam. *Russian Journal of Nematology* 5: 127-130.
- Timm, R.W. 1959.** Observations on *Synoeconema* (Nematoda, Ungellidae), with a description of 2 new species. *Pakistan Journal of Scientific Research* 11: 58-62.
- Timm, R.W. 1962.** Nematode parasites of the coelomic cavity of earthworms. I. The genera *Synoeconema* and *Ungella*. *Biologia (Dacca)* 8: 1-7.
- Timm, R.W. 1966.** Nematode parasites of the coelomic cavity of earthworms IV. *Siconema* new genus (Drilonematoidea: Ungellidae) with a description of 10 new species. *Biologia (Dacca)* 12: 7-21.
- Timm, R.W. 1967.** Nematode parasites of the coelomic cavity of earthworms IX. The family *Scolecophilidae*. *Pakistan Journal of Biological and Agricultural Science* 10: 22-24.
- Yeates, G.W., Spiridonov, S.E. & Blakemore, R. 1998.** *Plesiungella kathleenae* gen. et sp. n. (Nematoda: Drilonematoidea) from the Australian endemic megascolecid earthworm *Fletcherodrilus unicus* (Fletcher, 1889). *New Zealand Journal of Zoology* 25: 205-212.

Иванова Е.С., Хоуп В.Д. Два новых вида *Ungella* Cobb, 1928 (Rhabditida: Drilonematoidea) из коллекции дождевых червей Музея естественной истории Смитсоновского института.

Резюме. Приводятся описания двух новых видов *Ungella* Cobb, 1928 из коллекции дождевых червей, хранящихся в Музее естественной истории Смитсоновского института. *Ungella burmensis* sp. n. отличается от близкого вида *U. secta* Cobb, 1928 оболочкой яиц, покрытой мелкими сосочками, рульком меньшего размера и большими числом преклоакальных папилл. *Ungella mexicana* sp. n. отличается от других видов рода раздвоенными концами спикул. Обсуждается морфология родов унгеллид, имеющих спиккулярный аппарат и лишенных его.
