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NEMATODES FROM TEA PLANTATIONS OF DEHRA DUN, INDIA

By

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(With 1 Table and 8 Text-figures)

Nematodes cause damage to the tea plantations particularly to plants at the nursery stage. The information available on nematode parasites of tea is not extensive and is naturally restricted to the countries where tea is being grown. Sivapalan (1972) has given an excellent review of the nematode pests of tea.

While working on the nematodes of plantations one of us (S.K.) went around the different tea estates of Dist. Dehra Dun (U.P.) to collect soil samples and study the nematodes, both parasitic and free living, found in the rhizosphere of tea plants. It may be mentioned here that the tea plantations of Dehra Dun are gradually disappearing; in fact some are lying neglected and a few others have been cleared in favour of other crops.

We thank the staff of the Northern Regional Station, Zoological Survey of India, Dehra Dun for assistance in the collection of soil samples.

SYSTEMATIC ACCOUNT

Order TYLENCHIDA

Family TYLENCHIDAE

1. Tylenchus (Filenchus) filiformis Bütschli,

Tylenchus filiformis Bütschli, 1873, *Nova Acta Acad. Caesor. Leop. Carol.* 36(5): 37; Thorne, 1961, *Principles of Nematology*: 97.

Material.—1 ♀, 2 ♂♂ ; Indian Institute of Petroleum and Mohkampur; 28. vi. 1972 and 26. i. 1973.

Measurements.—1 ♀ : Length=0.45 mm, a=26, b=5.5, c=3.2, V=58, stylet = 11 μm.

2 ♂♂ : Length=0.57 mm, a=37-41, b=5.7-6.3, c=3.0-3.2, stylet= 11-13 μm. spicula=14-15 μm, gubernaculum=6-7 μm.

Remarks.—Although the males are rare (Thorne, 1961, states that males are unknown), Das (1960) has described a male from the roots of *Sorghum vulgare* and recently Khera and Chaturvedi (1975) have recorded males.

The species has been found associated with tea for the first time. Another species, *Tylenchus agricola* de Man has been recorded from tea gardens in India whereas *Tylenchus* sp. has been associated with tea in E. Africa.

Family HOPLOLAIMIDAE

2. **Helicotylenchus digonicus** Perry

Helicotylenchus digonicus Perry, 1959, *Bull. Wis. agric. Exp. Stn.* **207**: 8; Sher, 1966, *Nematologica* **12**: 15.
Helicotylenchus broadbalkiensis Yuen, 1964, *Nematologica*, **10**: 374.

Material.—48 ♀♀; Indian Institute of Petroleum, Vikasnagar, Mohkampur, Herbertpur, East Hope Town and Harbanswala; 28. vi. 1972 and 26. i. 1973.

Measurements.—7 ♀♀ ; Length=0.51-0.63 mm, a=20-24, b=4.6- 5.9, b′=3.6-4.4, c=40-52, c′=0.8-0.9, V=66-68, stylet=25-28 μm, O=27. Phasmids 21-25 μm from tail tip, 7-8 annules anterior to anus.

Remarks.—Our specimens differ from the earlier descriptions of the species in the forward position of the phasmids and the position of vulva. Sher (1966) described phasmids at anus level or 1-5 annules anterior to anus and vulva at 58-65. The species is being recorded for the first time from India.

H. digonicus had not so far been associated with tea although *H. dihystera* (Cobb) had been recorded from tea in Sri Lanka and Japan, *H. erythrinae* (Zimmermann) from Japan and Taiwan and *Helicotylenchus* sp. from southern India, Bangladesh, Sri Lanka and E. Africa.

3. **Pratylenchus penetrans** (Cobb)

Tylenchus penetrans; Cobb, 1917, *J. agric. Res.* **11**: 32.
Tylenchus pratensis; Steiner, 1927, *J. agric. Res.* **35**: 961.
Tylenchus (*Chitinotylenchus*) *penetrans*; Rahm, 1928, *Brasil. Arch. Inst. Biol. S. Paulo* **1**: 239-251.
Pratylenchus penetrans; Chitwood and Oteifa, 1952, *A. Rev. Microbiol.* **6**: 151-184.

Material.—21 ♀♀, 4 ♂♂; East Hope Town, Arcadia, Mohkampur; 26.i.1973.

Measurements.—5 ♀♀ : Length=0.53-0.59 mm, a=29.0-32.8, b=4.6-7.3, c=18-19, V=80-82, stylet=13-18 μm.

3 ♂♂: Length=0.41-0.42 mm, a=32-33, b=3.2-3.8, c=18-19, stylet=13-14 μm, spicula = 13-14 μm, gubernaculum = 4-6 μm.

Remarks.—*P. brachyurus* (Godfrey) has been recorded from tea in north-eastern India, *P. loosi* Loof from Sri Lanka and Japan and *Pratylenchus* sp. from both north-eastern and southern India, Indonesia and Taiwan. *P. penetrans* has been found associated with tea for the first time.

After going through the literature we feel that *P. indicus* Das may be a synonym of *P. pratensis* (de Man). It would be worthwhile examining the type material of *P. indicus*.

Family CRICONEMATIDAE

4. **Hemicriconemoides mangiferae** Siddiqi

Hemicriconemoides mangiferae Siddiqi, 1961, *Proc. helminth. Soc. Wash.* **28**: 28; Das Gupta, Raski & Van Gundy, 1969, *J. Nematol.* **1**: 134.
Hemicriconemoides birchfieldi Edward, Misra & Singh, 1965, *Nematologica* **11**: 161.

Material.—8 ♀♀; East Hope Town and Mohkampur; 26.i.1973.

Measurements.—5 ♀♀: Length=0.47-0.56 mm, a=18-28, b=3.7-5.0, c=14-21, V=91-93, stylet=70-80 μm, VL/Vb=1.2-1.6, R=132-142, RV=12-13, R an=9-12.

Remarks.—The value of 'a' in the de Manian formula in our specimens is higher; so far it was recorded up to 24 by Dasgupta *et al.* (1969).

The species is recorded from the rhizosphere of tea plant for the first time. So far *H. kanayensis* Nakasono and Ichinohe has been found associated with tea and that, too, from Japan and Taiwan. The genus *Hemicriconemoides* Chitwood & Birchfield is being recorded from tea for the first time from India.

5. **Paratylenchus tenuicaudatus** Wu

Paratylenchus tenuicaudatus Wu, 1961, *Can. J. Zool.* **39**: 163; Geraert, 1965, *Nematologica* **11**: 312.

Material.—2 ♀♀; Mohkampur; 26.i.1973.

Measurements.—2 ♀♀: Length=0.34-0.39 mm, a=21-24, b=4.2, c=13.6-14.0, V=80-82, stylet=25-31 μm.

Remarks.—Considering the stylet length and the value of 'V', Geraert (1965) divided the species of *Paratylenchus* Micoletzky into ten groups. Our specimens fall within Group 2 and tally with the description of *P. tenuicaudatus* Wu.

The species is being recorded for the first time from India as well as from the rhizosphere of tea. So far *P. curvitatus* v. d. Linde has been associated with tea in north-eastern India, Sri Lanka and Japan and *Paratylenchus* sp. in southern India and E. Africa.

Family NEOTYLENCHIDAE

6. Neotylenchus latus Thorne

Neotylenchus latus Thorne, 1935, *J. Agric. Res. U.S. Dept. Agric.* **51** (6): 513.

Material.—1 ♂; Herbertpur; 26.i.1973.

Measurements.—1 ♂: Length=0.59 mm, a=30, b=4.4, c=21, stylet=13 μm, spicula=21 μm, gubernaculum=7 μm.

Remarks.—The genus *Neotylenchus* Steiner has been found in association with tea plant for the first time. The species is being recorded for the first time from India.

7. Boleodorus longistylus sp. n.

(Text-fig. 1)

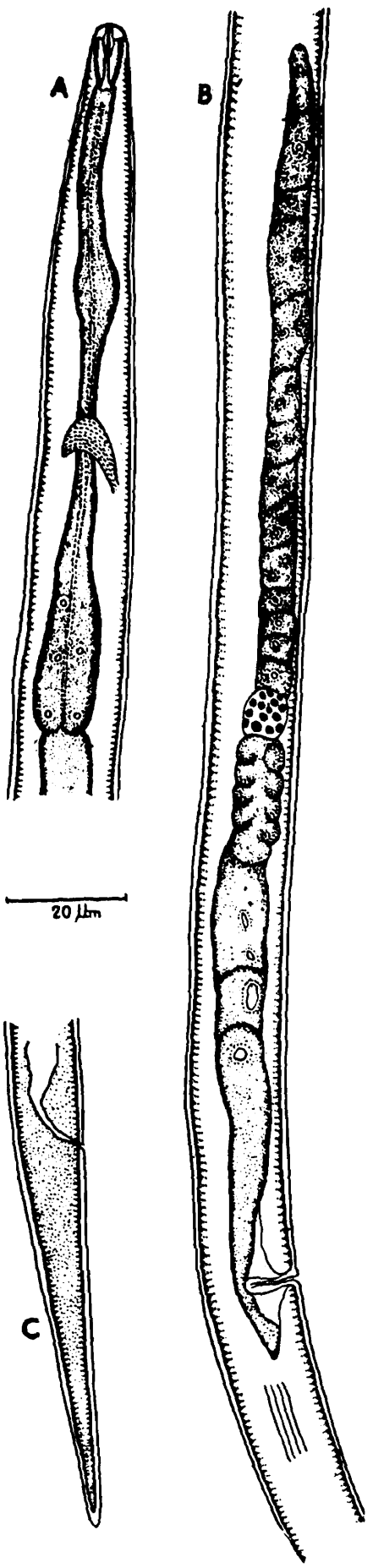
Material.—2 ♀♀; Indian Institute of Petroleum and Mohkampur; 28. vi. 1972 and 26.i.1973.

Measurements.—Holotype: ♀: Length=0.65 mm, a=36, b=5.3, c=8.5, V=73, stylet=11 μm.

Paratype : 1 ♀: Length=0.54 mm, a=35, b=5.3, c=8.7, V=71, stylet=13 μm.

Description.—Body slender and straight with posterior end curved ventrally. Tail 62-76 μm long, conical, elongate with blunt (round) terminus, curved ventrally. Cuticle thin with fine transverse striae. Lateral field occupying ¼ the body diameter; with four incisures, inner incisures being feeble. Head not offset, narrower than body, low and flattened anteriorly without median involution. Amphids not observed. Lips amalgamated, lip region without striae. Labial framework with very poor sclerotization which could have been easily overlooked. Style slender, provided with basal flanges, anterior conical part about half of total length. Oesophagus 101-109 μm long with a corpus 39 μm long having a small fusiform valveless bulb 8-10 μm in diameter, total length of posterior oesophagus 62-70 μm comprising a long slender isthmus 31-35 μm long and a terminal bulb 31-35 μm long. The latter does not overlap the intestine. There appears to be a very small valve but it is not very distinct. Orifice of dorsal oesophageal gland lies 1.5 μm from stylet base. Intestine narrow and thin walled. Rectum about as long as the anal body width. Nerve ring surrounds isthmus at 71-72 μm and excretory pore at 77-78 μm from anterior end. Phasmids, deirids and hemizonids not observed.

Ovary anterior outstretched; oöcytes in single row towards proximal end, in two rows in the middle. Spermatheca with sperm. Post-vulvar



Text-fig. 1.—*Boleodorus longistylus* sp. n. (♀).
A—Anterior end, B—Middle part of body showing vulva, female gonad and incisures, C—Tail.

uterine sac ½ body width long. Vagina long and transverse, prominent. Vulva flush with body surface.

Male not found.

Diagnosis and Relationship.—According to Geraert (1971) there are three well-established species in the genus *Boleodorus* Thorne, viz. *B. thylactus* Thorne, *B. clavicaudatus* Thorne and *B. volutus* Lima and Siddiqi.

The new species differs from *B. clavicaudatus* by the absence of median involution on the head, non-clavate tail and more posteriorly placed vulva (V=80 in *B. clavicaudatus*) and from *B. thylactus* by the absence of median involution on the head, straight body and tail and position of vulva (V=52-70 in *B. thylactus*). The specimens resemble *B. volutus* in the body being without median involution, but differ in the body being straight, position of vulva (V=66-72 in *B. volutus*) and in having longer tail.

Holotype : ♀: U.P., Dehra Dun, Indian Institute of Petroleum, 28. vi. 1972; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 1 ♀: U.P., Dehra Dun, Mohkampur; 26.i.1973; other data as for holotype.

Remarks.—The genus *Boleodorus* Thorne is being recorded from the rhizosphere of tea for the first time from India.

8. **Boleodorus atypicus** sp. n.

(Text-fig. 2)

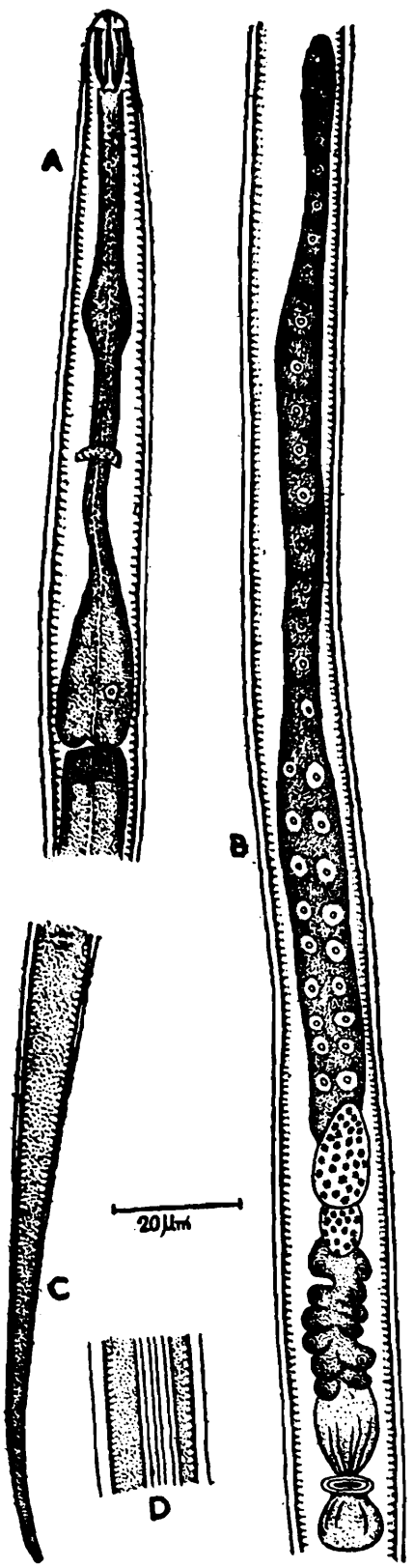
Material.—2 ♀ ♀; Mohkampur; 26.i.1973.

Measurements.—Holotype: ♀ : Length=0.67 mm, a=39, b=5.8, c=7.2, V=68, stylet=13 μm.

Paratype: 1 ♀ : Length=0.58 mm, a=31, b=4.8, c=8.9, V=69, Stylet=11 μm.

Description.—Body straight, cuticle thin with fine striations. Lips rounded, low, unstriated, not offset; stylet with basal part about 1/3 total length, bearing flanges. Cephalic framework poorly sclerotized. Lateral field occupying 1/3 the body width, starts in the oesophageal region; incisures 6, arranged in three bands of 2 each. Procorpus 28-29 μm long; median bulb 14 μm, valveless, fusiform; isthmus 21 μm long joining a terminal bulb 44-45 μm posterior end of terminal bulb not overlapping intestine; a rectangular or disc-like oesophago-intestinal valve present, but not very distinct; intestine obscured by granular bodies, Nerve ring 91 μm from anterior end.

Vulva postequatorial, vulvar lips slightly raised, vagina about 3/4 the vulvar body width; ovary anterior, outstretched, oöcytes in single row then in double row; spermatheca oval partially filled with sperm, crustaformeria consisting of 2 rows each with 4 cells, post-uterine sac



Text-fig. 2.—*Boleodorus atypicus* sp. n. (♀).
A—Anterior end, B—Middle part of body showing vulva and female gonad C—Tail, D—Incisures.

slightly more than ½ the body width. Tail conoid tapering to a pointed end, with an arcuate tendency. Phasmids not seen.

Male not found.

Diagnosis and Relationship.—The new species differs from all the three species of the genus recognised by Geraert (1971) in the number of incisures besides other characters. In possessing six incisures it resembles *B. typicus* Hussain and Khan (Geraert, *loc. cit.*, considers *B. typicus* closely allied to *B. thylactus*). The new species, however, differs from *B. typicus* by having a more anteriorly placed median bulb (procorpus including median bulb shorter than the isthmus and posterior bulb combined) and incisures being arranged in three bands.

Holotype : ♀; U.P., Dehra Dun, Mohkampur; 26.i. 1973; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 1 ♀; other data as for holotype.

Family APHELENCHIDAE

9. **Aphelenchus avenae** Bastian

(Text-fig. 3)

Aphelenchus avenae Bastian, 1865, *Trans. Linn. Soc. Lond.* **25**: 122; Goodey, 1963, *Soil and freshwater nematodes*: 134; Goodey and Hooper, 1965, *Nematologica* **11**: 55.

Material.—21 ♀♀ ; Indian Institute of Petroleum, Vikasnagar Arcadia, Herbertpur, East Hope Town and Mohkampur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.67-0.76 mm, a=29-30, b=7.0-7.9, c=28-30, V=72-77, stylet=8-10 µm.

Remarks.—The specimens fully agree with the previous descriptions of the species. However, some of them show interesting variation in the shape of the median bulb from ovoid to violin-shaped to double bulb, valve in the latter case being situated in the posterior bulb.

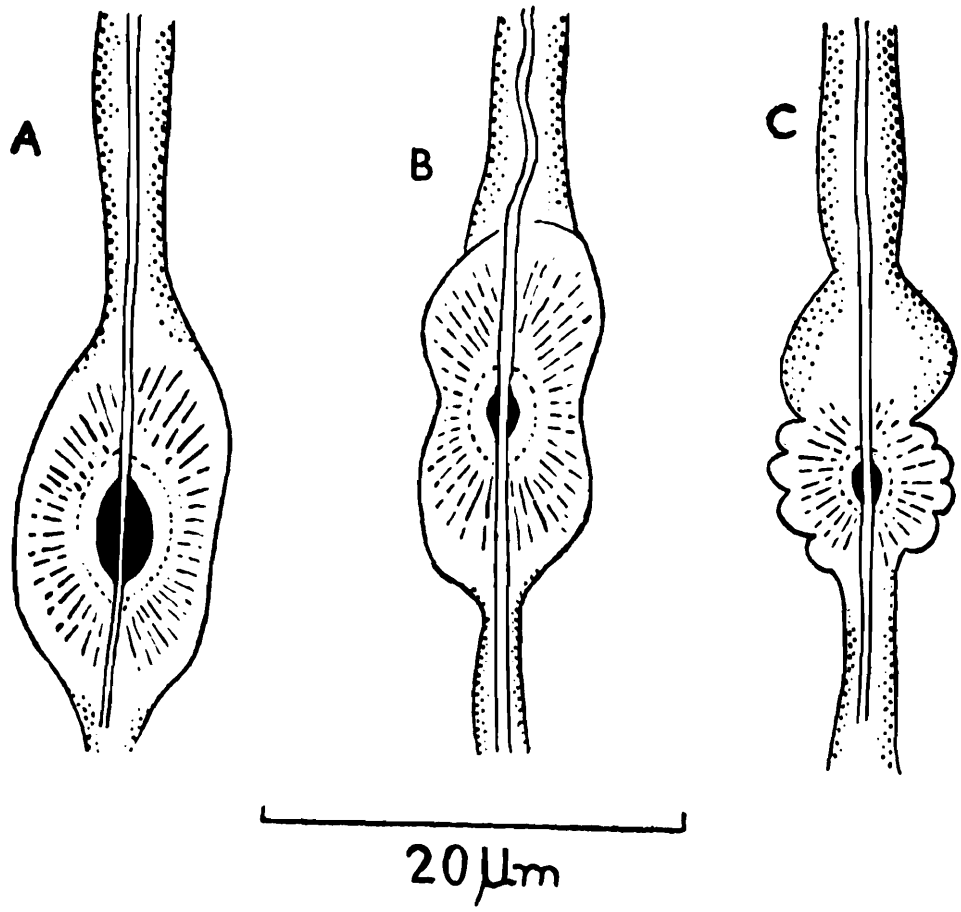
A cosmopolitan species. So far *A. agricola* de Man, (which is considered to be a synonym of *A. avenae* by Goodey, 1963) has been found in association with tea in north-eastern India.

Family APHELENCHOIDIDAE

10. **Aphelenchoides saprophilus** Franklin

Aphelenchoides saprophilus Franklin, 1957, *Nematologica* **2**: 309.

Material.—9 ♀♀, 1 ♂ (damaged), 1 juv; Vikasnagar, Arcadia, East Hope Town and Mohkampur; 26.i.1973.



Text-fig. 3.—*Aphelenchus avenae* Bastian.
A—Normal median bulb, B—Violin-shaped median bulb, C—"Double" median bulb.

Measurements.—5 ♀♀ : Length=0.63-0.65 mm, a=34-46, b=8.0-9.6 b'=4.4-4.6, c=13-16, V=69-71, stylet=11-12 µm.

Remarks.—The species was first recorded from India by Khera and Chaturvedi (1975) from the rhizosphere of banana and spinach. Now it is being recorded for the first time from the rhizosphere of tea plant. An allied species, *A. composticola* Franklin, has been found associated with tea in north-eastern India and E. Africa.

Order RHABDITIDA

Family RHABDITIDAE

11. Rhabditis (Uniovaria) cranganorensis Khera

Rhabditis (*Uniovaria*) *cranganorensis* Khera, 1968, *J. zool. Soc. India* **20**: 38.

Material.—35 ♀♀ ; Indian Institute of Petroleum, Arcadia, Herbertpur, East Hope Town, Harbanswala and Mohkampur; 28. vi. 1972 and 26.i.1973.

Measurements.—6 ♀♀ : Length=0.44-0.53 mm, a=16-18, b=3.0-4.2, c=8.0-12.5, V=72-80.

Remarks.—The specimens come close to the original description given by Khera (1968). These, however, differ from the original description in value of 'a' in the de Manian formula (a=28-31 in the original description). Further a greater variation has been observed in the value of 'b', 'c' and 'V' (b=3.5-3.7, c=9-10, V=73-76 in the original description).

Family PANAGROLAIMIDAE

12. Trilabiatus lignicolus (Körner)

Tricephalobus lignicolus Körner, 1954, *Zool. Jber. Neapel* 82 (3-4) : 245-353.
Tricephalobus franzi Rühm, 1956, *Parasit. SchrReihe* **6**: 312 (*New Synonymy*).
Trilabiatus franzi; Goodey, 1963, *Soil and freshwater nematodes*: 265..

Material.—1 ♂; Arcadia, 26.i.1973.

Measurements.— 1 ♂ : Length=0.59 mm, a=35, b=4.3, c=9.5, spicula=21 μm, gubernaculum=8 μm.

Spicula arcuate, cephalated and alate; gubernaculum bifid. Tail conical, tapering; one pair preanal and seven pairs postanal papillae.

Remarks.—The specimen before us resembles *T lignicolus* but for the knobbed tip of the spicula as given in the diagram by Goodey (1963) where the spicula protrude from the cloacal aperture. We, however, feel that spicula being alate, their tip could assume a knobbed appearance when thus protruded.

The structure and size of the stoma and the shape and size of the spicula and even other structures are similar in *T franzi* (Rühm) and *T. lignicolus*. The de Manian values of *T franzi* fall within the range given for *T lignicolus* by Goodey (1963). Therefore, it is proposed that *T. franzi* (Rühm) be considered a synonym of *T lignicolus* (Körner). The genus *Trilabiatus* Goodey is being recorded for the first time from India.

Family CEPHALOBIDAE

13. Acrobeloides buetschlii (de Man)

Cephalobus buetschlii de Man, 1884, Die frei neiderlandischen Fauna. Eine Systematischefaunistische Monographie, Leiden: 92; de Man, 1921, *Capita zool.* **1**: 21.

Cephalobus presegnis; Bütschli, 1873, *Nova Acta Acad. Caesar. Leop. Carol.* **36** (5) : 80; var. *buetschlii*, Micoletzky, 1922, *Arch. Naturgesch.* **87**:185.

Acrobeles (*Acrobeloides*) *buetschlii*; Thorne, 1925, *Trans. Amer. micros, Soc.*, **44**: 181.

Acrobeloides buetschlii; Steiner & Buhrer, 1933, Z. *ParasitKde.* **5**: 419; Goodey, 1963, *Soil and freshwater nematodes*: 276.

Material.—6 ♀♀, 2 juv; Indian Institute of Petroleum, East Hope Town and Herbertpur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.39-0.46 mm, a=13.8-17.0, b= 3.5-3.8, c = 17-18, V=63-66.

Remarks.—Except for minor variations, the specimens fit in well with the description of the species as given by Goodey (1963). The species has been associated with tea plant (Steiner & Buhrer, 1933).

14. **Chiloplacus** sp.

Material.—1 juv; Mohkampur, 26.i.1973.

Measurements.—1 juv. : Length=0.41 mm, a=8.7, b=3.8, c=22.

Order ARAEOLAIMIDA

Family PLECTIDAE

15. **Plectus prox. thornei** Rühm

Plectus thornei Rühm, 1956, *Parasit. SchrReihe* 6: 412; Maggenti, 1961. *Proc. helminth. Soc. Wash.* **28**: 146.

Material.—1 ♀; Herbertpur, 26. i. 1973.

Measurements.—1 ♀ : Length=0.44, a=24, b=3.5, c=9.4, V=50.

Description.—Body arcuate; cuticle transversely striated; lateral field marked with four incisures, inner pair feeble and with wider gap. Many glands open in the lateral field. Oesophagus cylindrical with a valvular terminal bulb, anterior to the terminal bulb, there is a swollen structure, difficult to explain or to identify.

Remarks.—Maggenti (1961) recorded only one species *P. thornei* Rühm with four longitudinal alae (=incisures) in each wing area (=lateral field). Our specimen comes close to *P. thornei* in this respect but differs from it by being longer and by the absence of body spines and knots on incisures and is being provisionally identified as *P. thornei.*

Family CAMACOLAIMIDAE

16. **Paraphanolaimus micoletzkyi** sp. n.

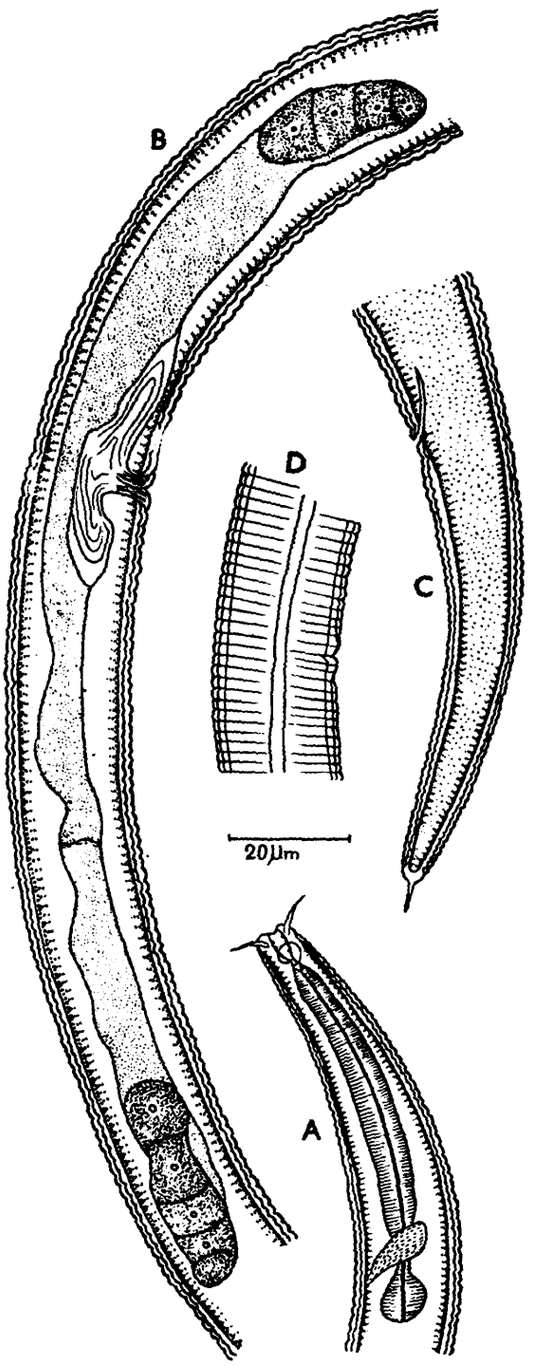
(Text-fig. 4)

Material.—1 ♀; Herbertpur; 27.vi.1972.

Measurements.—Holotype: ♀: Length=0.52 mm, a=25, b=7 7, c=5.7, V=51.

Description.—Body recurved ventrally on thermal death. Tail conical, gradually narrowing behind anus, with a narrow and pointed tip, ending in a terminal spike. Cuticle transversely striated, striations coarse, 1.6 μm apart in the vulvar region. Lateral field narrow, 1.5 μm wide; 2 incisures, crenate, beginning in the oesophageal region and continuing

far behind anus. Under the lateral field occur a series of gland cells, each connected to the exterior by a pore through the cuticle, 2 in the oesophageal region, 13 over the intestine, 1 opposite anus and 1 on the tail. Head not offset, rounded, lips and papillae obscure, 4 cephalic



Text-fig. 4.—*Paraphanolaimus micoletzkyi* sp. n. (♀).
A—Anterior end, B—Middle part of the body showing female gonads, C—Tail, D—Incisures.

setae, each 6 µm long. Amphids large, far forward on head, open spiral but almost ring-like. Stoma slightly less than one head width deep, tapering towards base and provided with 3 short local thickenings of

wall. Oesophagus cylindrical followed by a somewhat pear-shaped bulbl 91 μm long. Oesophago-intestinal cell 10 μm long. Excretory gland cel, at 63 μm from anterior end. Excretory pore not discernible. Vulva flush with body surface. Ovaries two, opposed and reflexed.

Male not known.

Diagnosis and Relationship.—The genus *Paraphanolaimus* Micoletzky is monotypic, being represented by *P. behningi* Micoletzky. This species was reported by Micoletzky (1923, 1925) from R. Volga and in certain Danish lakes.

The new species described differs from the type species in being about half the size in length (L=0.95-1.07 mm. in *M. behningi*), in having a conical tail (clavate tail in *M. behningi*) and slightly in the de Manian formula and the number and disposition of gland cells.

Holotype : ♀ : U.P., Dehra Dun, Herbertpur Tea Estate; 27.vi.1972; *S. Khera* Coll. Deposited at the Zoolcgical Survey of India, Calcutta.

Remarks.—The genus is being recorded for the first time from India. It has so far been recorded from temperate regions. It is now being recorded from the sub-mountainous region of the Himalaya. The species is about half the size of the type species which probably is in consonance with the phenomenon that specimens/species found in warmer climates tend to be smaller.

Order MONHYSTERIDA

Family MONHYSTERIDAE

17. **Prismatolaimus andrassyi** sp. n.

(Text-fig. 5)

Material.—4 ♀♀ : Herbertpur, Mohkampur; 26.i.1973.

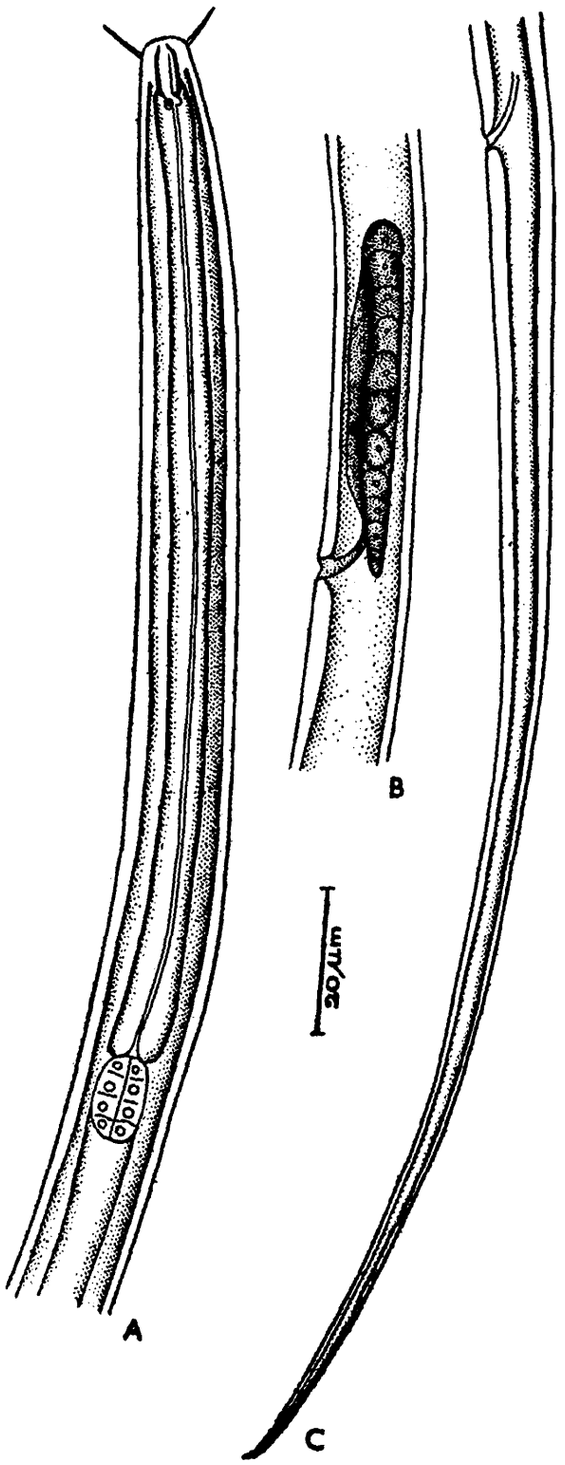
Measurements.—Holotype : ♀ : Length=0.64 mm, a=38, b=4, c=3.5, V=58.

Paratypes : 3 ♀♀: Length=0.63-0.66 mm, a = 34-36, b=4.0-4.4; c=3.3-3.6, V=55-57.

Description.—Body slender, curved ventrally after fixation, posterior end tapering more than the anterior end. Fine transverse striations. Head not offset, low and rounded anteriorly. Cephalic setae 10, in two circlets of 6 and 4, subterminal. Amphids obscure at 17 μm from anterior end. Stoma 8-10 μm long and 4 μm wide; walls cuticularized, posterior part narrow, provided with denticulate basal cushion and dorsal tooth. Oesophagus 143-158 μm long, cylindrical with slight expansion towards the posterior end. Oesophago-intestinal valve oval, 7 μm long with two rows of 4 cells. Intestinal lumen filled with granular bodies. Nerve ring at 70 μm from anterior end. Vulva flush with body

surface; vagina directed anteriad; ovary 56-70 μm long, anterior reflexed, ovarian flexure reaching up to vulva. Oöcytes arranged in single row. Tail 182-189 μm long, narrow and filiform with spinneret. Anal body diameter 12-15 μm.

Male not found.



Text-fig. 5—*Prismatolaimus andrassyi* sp. n. (♀),
A—Anterior end, B—Middle part of the body showing female gonads,
C—Tail.

Diagnosis and Relationship.—In possessing monoprodelphic reflexed gonad and a spinneret, *P. andrassyi* sp. n. resembles *P. hsuei* Wu and Hoeppli, *P. intermedius* (Bütschli), *P. parvus* Milne and *P. indicus* Ali, Suryawanshi and Chisty, but differs from these in the presence of a basal cushion in stoma. In the latter character it resembles *P. verrucosus* Hirschmann which differs from the new species in having paired, opposed gonads and in the value of 'V' (V=40-42 in *P. verrucosus*).

Holotype : ♀; U.P., Dehra Dun, Herbertpur Tea Estate; 26.i.1973; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratypes : 3 ♀♀; U.P., Dehra Dun, Mohkampur; 26.i.1973; other data as for the holotype.

Order CHROMADORIDA

Family CYATHOLAIMIDAE

18. Achromadora ruricola (de Man)

Cyatholaimus ruricola de Man, 1880, *Tijdschr. ned. dierk. Vereen.* **5** (1-2): 18.
Achromadora ruricola; Micoletzky, 1925, *K. danske. Vidensk. Selsk. Skr. Naturv Og Math.* Afd. 8 R. **10**.(2): 133.

Material.—2 ♀♀; Mohkampur; 26.i.1973.

Measurement.—2 ♀♀: Length=0.41-0.72 mm, a=23-24, b=5.5- 6.2, c=6.5-8.5, V=47-49.

Remarks.—The specimens tally with the description of the species given by Goodey (1963). However, they show slight variation in the value of 'b' and 'c' (b=5.4-5.9, c=5.9-7.4 in Goodey's account).

19. Odontolaimus aquaticus Schneider

Odontolaimus aquaticus W. Schneider, 1937, *Arch. Hydrobiol.* Suppl. **15**(1): 86.

Material.—1 ♀; Herbertpur; 26.i. 1973.

Measurements.—1 ♀ : Length=0.72 mm, a=36, b=6.3, c=2.8, V=38

Remarks.—The specimen differs slightly from the original description in the de Manian formula (L=0.762 mm, a=39.2, b=7, c=2.2,V =29). The species was recorded by Schneider (1937) from Java. The genus *Odontolaimus* is being recorded for the first time from India.

Order ENOPLIDA

Family ONCHULIDAE

20. Onchulus longicauda (Daday)

Monhystera longicauda Daday, 1899, *Math. Term. tud. Akad. Bpest-* **17**: 560; Daday, 1901, *Termeszett. Fuz.* **24**, : 3.
Onchulus longicaudatus; Cobb, 1920, *Contr. Sci. Nematol.* **9**; 313; Goodey, 1963, *Soil and freshwater nematodes:* 377.
Onchulus longicauda: Andrássy, 1964, *Opusc. zool. Bpest.* **5**: 29; Ali, Suryawanshi & Chisty, 1972, *Indian J. Nematol.* **2**: 9.

Material.—1 ♀; Vikasnagar; 26.i.1973.

Measurements.—1 ♀: Length=0.92 mm, a=48, b=5.2, c=2.7, V=38.

Remarks.—Andrássy (1964) gave a redescription of *O. longicauda.* The specimen before us fits in with Andrássy's description except for the value of 'V' in the de Manian formula (V=43-46 in Andrássy's account). Ali *et al.* (1972) recorded this species from India (Maharashtra: Dist. Osmanabad, Ahmedpur) for the first time, the value of 'V' in their specimen being 43-45. Our specimen extends the lower limit of this value.

Family TRIPYLIDAE

21. **Tripyla affinis** de Man

Tripyla affinis de Man, 1880, *Tijdschr. ned. dierk. Vereen.* **5**(1-2): 12.

Material.—5 juv; Herbertpur, Vikasnagar, East Hope Town and Arcadia; 26.i.1973.

Measurements.—4 juv. : Length=0.60-0.97 mm, a = 25-29, b=3.8-5.0, c=7 7.

Remarks.—Two specimens show genital primordium ? vulva position) at 66%, 68%. In general characters the specimens resemble *T. affinis*

Family IRONIDAE

22. **Ironus ignavus** Bastian

Ironus ignavus Bastian, 1865, *Trans. Linn. Soc. Lond.* **25**: 104. var. *typicus* Brakenhoff, 1914, *Abh. naturw. Ver. Bremen* **22**(2): 278.

Material.—12 juv., 6 ♀♀; Vikasnagar, Herbertpur and Mohkampur; 26.i.1973.

Measurements.—6 juv. : Length=1.06-1 16 mm, a=48-54, b=5.2-5.5, c=3.1-3.3.

3 ♀♀: Length=1.40-1.54 mm, a=40-50, b=5.2-5.9, c=4.7-5.3, V=45-49.

23. **Cryptonchus abnormis** (Allgén)

Cylindrolaimus abnormis Allgén, 1933, *Zool. Anz.* 103(11-12): 317.

Cryptonchus abnormis; Schuurmans Stekhoven, 1951, *Mem. Inst. r. Sci. nat. Belg.* **2** (39): 39; Goodey, 1961, *Soil and freshwater nematodes*: 392.

Gymnolaimus axilis; Goodey, 1951, *Soil and freshwater nematodes*: 203; Andrássy, 1956, *Opusc. zool. Bpest.* **1**: 9.

Material.—2 ♀♀; Herbertpur and Mohkampur; 27.vi.1972 and 26.i.1973.

Measurements.—2 ♀♀. Length=0.98-1.06 mm, a=44-47, b=4.6-4.7, c=3.3-3.4, V=43-44.

Remarks.—It would be worthwhile examining the types of the genera ***Cryptonchus*** Cobb and *Gymnolaimus* Cobb and *Isolaimium* Cobb as the three seem to be very closely related.

Order DORYLAIMIDA

Family DORYLAIMIDAE

24. Aporcelaimellus maitai Yeates

Aporcelaimellus maitai Yeates, 1967, *N. Z. Jl. Sci.* 10 : 757.

Material.—1 ♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—1 ♀: Length=1 1 mm, a = 23, b=3.4, c=36, V=52, stylet=20 μm, stylet aperture=55%.

Remarks.—Tjepkema *et al.* (1971) recognised 20 species of the genus. Our specimen comes close to *A. maitai* except for the stylet length which is 11-13μm in *A. maitai.*

The species is being recorded for the first time from India.

25. Amphidorylaimus infecundus (Cobb)

Dorylaimus infecundus Cobb in Thorne & Swanger, 1936, *Capita. zool.* 6(4): 31.
Amphidorylaimus infecundus; Andrássy, 1960, *Acta zool. hung.* 6 (1-2): 1-28.

Material.—2 ♀♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—2 ♀♀; Length=0.90-0.95 mm, a=45, b=4.3, c=3.5-3.7, V=36-37, stylet=10-11 μm.

Remarks.—The specimens fit well in the original description of the species but for the higher value of 'a' (a=33 for female in the original description). The species is being recorded for the first time from India.

26. Thornenema cavalcantii (Lordello)

Dorylaimus cavalcantii Lordello, 1955, *Revta. bras. Biol.* 15 (2): 216.
Thornenema cavalcantii; Andrássy, 1959, *Acta. zool. hung.* 5(3-4): 196.
Thornenema cavalcanti; Goodey, 1963, *Soil and freshwater nematodes* : 424.

Material.—1 ♀; Indian Institute of Petroleum; 28.vi.1972.

Measurements.—1 ♀: Length=1.24 mm, a=33, b=4, c=12, V=46, stylet=12.6 μm.

27. Thornenema mauritianum (Williams)

Chrysonema mauritiana Williams, 1959, *Occ. Pap. Maurit. Sug. Ind. Res. Inst.* 3: 28.
Thornenema viriosum Williams, 1964, *Nematologica* 10.: 346.
Thornenema filiforme Siddiqi, 1965, *Labdev. J. Sci. Tech.* 3: 129.
Thornenema africanum Andrássy, 1965, *Opusc. zool, Bpest* 2: 139.
Thornenema delhiensis Prasad & Chawla, 1965, *Indian J. Ent.* 27: 140.
Thornenema mauritianum; Baqri and Jairajpuri, 1967, *Nematologica* 13: 358,

Material.— 1 ♀ ; Mohkampur; 26.i.1973.

Measurements.—1 ♀: Length=1.55 mm, a=46, b=4, c=5.5, V=31, stylet=11.2 μm.

Remarks.—The species has been recorded from northern and southern India as well as from the Andamans by Baqri & Jairajpuri (1967).

Family MONONCHIDAE

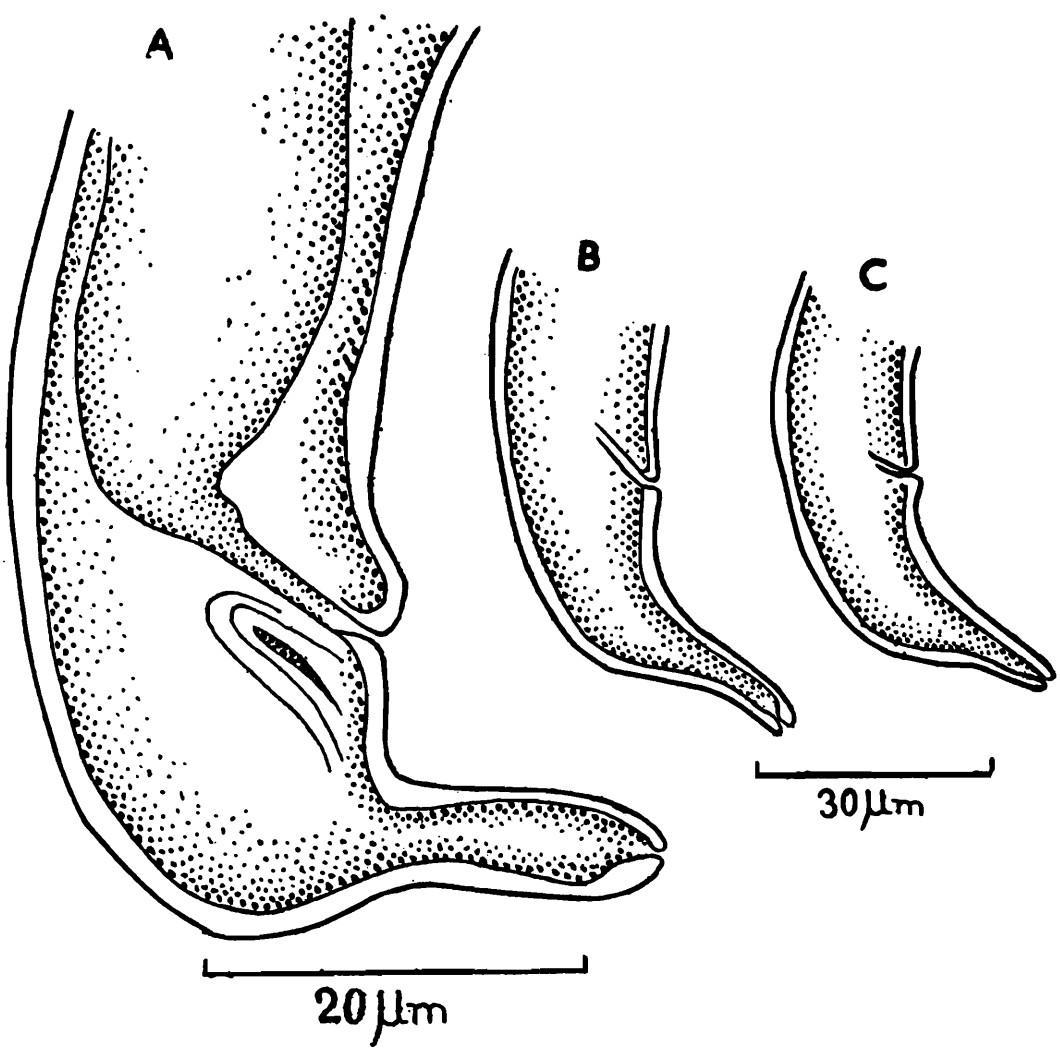
28. Mylonchulus index Cobb

(Text-fig. 6)

Mononchus (Mylonchulus) index Cobb, 1906, *Bull. Div. Path. and Physiol. Hawaiian Sug. Plrs' Ass. Exp. Stn.*, 2nd ed. (5): 180.
Mylonchulus index; Andrássy, 1958, *Annls. hist. nat. Mus. natn. hung.* n.s. **9**:

Material.—6 ♀♀; Arcadia, Mohkampur and Herbertpur; 26.i.1973.

Measurements.—4 ♀♀: Length=0.82-0.95 mm, a=34-39, b=2.7-3.0, c=21-27, V=72-77.



Text-fig. 6.—*Mylonchulus index* (Cobb) (♀).
Variations in tail shape.

Remarks.—The tail shows variations in the shape as depicted in the text-figure 6. Jairajpuri (1970) recorded *M. index* from roots of coconut in the Andamans. This is the first record of the species from the Indian mainland.

29. Mylonchulus incurvus Cobb

Monochus (*Mylonchulus*) *incurvus* Cobb, 1917, *Soil Science* 3(5): 468.
Mylonchulus incurvus; Andrássy, 1958, *Annls. hist. nat. Mus. natn. hung.* 50:
Mylonchulus hawaiiensis Cassidy, 1931, *Hawaii. Plrs' Rec.* 35: 326.

Material.—3 ♀♀ ; Vikasnagar and Herbertpur; 26.i.1973.

Measurements.—2 ♀♀; Length=1.05-1 16 mm, a=27-32, b=3.1-3.2, c=31-32, V=60-61.

Remarks.—Mulvey (1961) considers *M. hawaiiensis* as a synonym of *M. incurvus*. Jairajpuri (1970), however, considers it a valid species. We follow Mulvey (*loc. cit.*) in this regard.

30. Iotonchus sp.

Material.—30 juv.; Indian Institute of Petroleum, Vikasnagar, Arcadia, Mohkampur, East Hope Town and Harbanswala; 28.vi.1972 and 26.i.1973.

Measurements.— 12 juv.; Length=0.86-1.43 mm, a=29-35, b=3.3—5.5, c=6-11.

Remarks.—Jairajpuri (1970) recorded *I. monhystera* (Cobb) from tea from Jorhat, Assam. The life cycle studies of the nematode could be promising since the adults were not obtained in the acme of summer and winter.

Family ALAIMIDAE

31. Alaimus jaulasali Siddiqi & Husain

Alaimus jaulasali Siddiqi & Husain, 1967, *Proc. helminth. Soc. Wash.* 34(2): 159.

Material.—1 ♀; Arcadia, 26.i.1973.

Measurements.—1 ♀: Length=1.02 mm, a=60, b=4.3, c=5.6, V=41.

Description.—Body tapering towards both ends, arcuate after death. Tail elongate, tapering to a pointed terminus. Transverse cuticular striations fine. Head rounded, not offset. Amphid aperture inconspicuous. Stoma reduced. Oesophagus narrow and tubular, posterior fifth expanded into a bulb. Excretory pore not visible. Ovary single, posterior, reflexed. Oesophagus-vulvar distance 70 μm longer than neck.

Remarks.—The specimen shows some variation in the values of 'b and 'c' and in the de Manian formula (b=4.8-5.3, c=7.0-8.6 in original

description). The species was recorded by Siddiqi and Husain (1967) from sal trees. Now it is being recorded from tea.

32. Amphidelus dolichurus (de Man)

Monhystera? *dolichura* de Man, 1876, *Tijdschr. ned. dierk. Vereen.* **2**: 100.
Alaimus dolichurus; de Man, 1880, *Tijdschr. ned. dierk. Vereen.* **5**(1-2): 3.
Amphidelus dolichurus; Thorne, 1939, *Capita zool.* **8**(5): 175.

Material.—6 ♀♀; Vikasnagar, Arcadia, Harbanswala and East Hope Town; 26.i.1973.

5 ♂♂; Indian Institute of Petroleum, Vikasnagar, Mohkampur and Herbertpur; 28.vi.1972 and 26.i.1973.

Measurements.—4 ♀♀ : Length=0.87-1.01 mm, a=56-57, b=4.0-4.5, c=3.8-8.0, V=35-41.

4 ♂♂: Length=1.03-1.17 mm, a=65-71, b=3.0-3.9, c=7.0-7.9, spicula=11-13 μm.

Remarks.—In the specimens before us there is a considerable variation in the value of 'c' in the females; this was also observed by Thorne (1939). He, however, suggested that the two populations with long tail and with short tail might represent two different species. We differ from him as we have found that the variability in the value of 'c' in the long tailed species of nematodes is generally quite considerable.

33. Amphidelus loofi sp. n.

(Text-fig. 7)

Material.—3 ♀♀; Mohkampur and Arcadia; 26.i.1973.

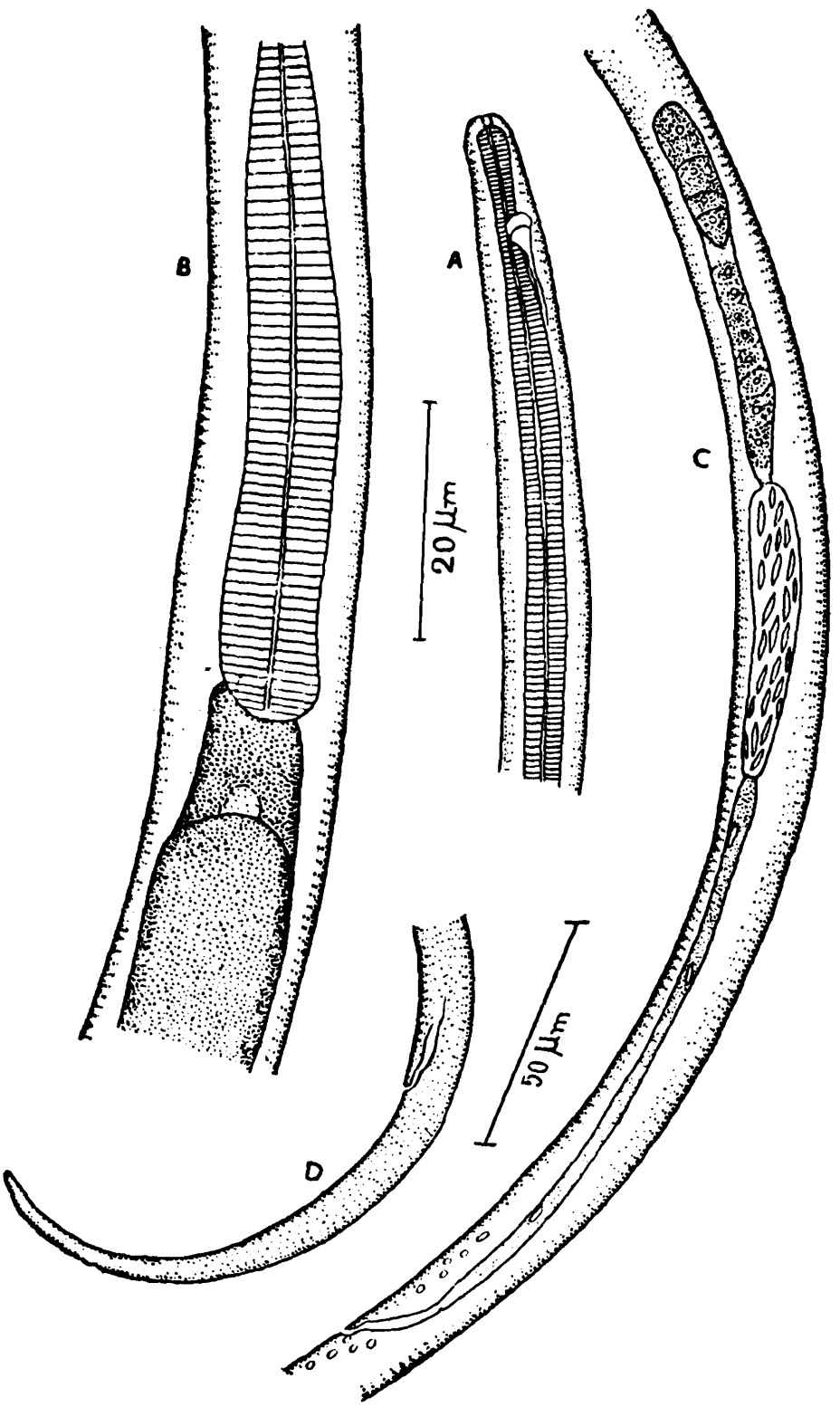
Measurements.—Holotype : ♀ : Length=1.37 mm, a=75, b=3.9, c=11.6, V=65.

Paratype : 2 ♀♀ : Length=1.03-1.04 mm, a=67-74, b=3.3, c= 8.9, V=65-67.

Description.—Body long, slender, tapering towards either end, more so posteriorly; curved ventrally or a loose spiral. Tail elongate 116-119 μm long, tapering gradually to filiform. Head not offset, lip region rounded, wide about 1/4 the neck base. Stoma much reduced and inconspicuous. Amphid goblet-shaped, aperture about half as wide as lip region, 8-10 μm from anterior end. Oesophagus narrow and tubular, expanding in posterior fourth. Oesophago-intestinal valve well developed in the holotype but small and rectangular in two paratypes. Nerve ring at 126-133 μm from anterior end. Intestine filled with granular bodies on its two ends. Vulva flush with body surface. Ovary single, anterior and

reflexed; oöoytes arranged in single row. A long spermatheca filled with elongate sperm. Vagina oblique.

Male not found.



Text-fig. 7.—*Amphidelus loofi* sp. n. (♀).

A—Anterior end, B—Part of the body showing oesophago-intestinal junction, C—Part of body showing female gonad, D—Tail.

Remarks.—Only two species of the genus *Amphidelus* Thorne, viz. *A. dolichurus* (de Man) and *A. pusillus* Thorne are monodelphic. The

ovary, however, is posterior in both the species. The new species differs from these in having a prodelphic ovary.

Holotype : ♀; U.P., Dehra Dun, Mohkampur; 26.i.1973; *S. Khera* Coll. Deposited at the Zoological Survey of India, Calcutta.

Paratype : 2 ♀♀ ; Arcadia; other data as for holotype.

Family DIPHTHEROPHORIDAE

34. **Diphtherophora communis** de Man

Diphtherophora communis de Man, 1880, *Tijdschr. ned. dierk. Vereen.* **5**(1-2): 63; Micoletzky, 1922, *Arch. Naturgesch.* **87**: 422, Thorne, 1939, *Capita zool.* **8**(5): 156.

Chaolaimus pellucidus Cobb, 1893, *Agric. Gaz. N. S. W.* **4**(10): 44.

Diphtherophora obesus Thorne, 1939, *Capita zool.* **8**(5): 157. (*New Synonymy*).

Material.—3 ♀♀ ; Lakhanwala and Vikasnagar; 26.i.1973.

Measurements.—3 ♀♀ : Length=0.42 mm, a=16-17, b=3.3-3.7, c=15-18, V=56-63, stylet=15.5 μm.

Description.—Amphid aperture ellipsoidal, 4μm wide, just below the conical elevations of the cephalic papillae at 4 μm from anterior end. Excretory pore a prominent feature, 90-97 μm from anterior end. Tail 22-27 μm long being about 1½ times the anal body diameter, conoid with a stumpy, slightly digitate, blunt terminus.

Remarks.—The measurements, de Manian formula, etc., of our specimens fall in between those of *D. communis* de Man and *D. obesus* Thorne. The value of tail length/anal body diameter being 1.5 is intermediate to that of the two species. We, therefore, feel that the measurements, de Manian formulae, etc., as given for the two species, actually represent two extremes of the same species, viz. the type species, *D. communis*. It is proposed that *D. obesus* Thorne be considered a synonym of *D. communis* de Man.

Family TRICHODORIDAE

35. **Trichodorus** sp.

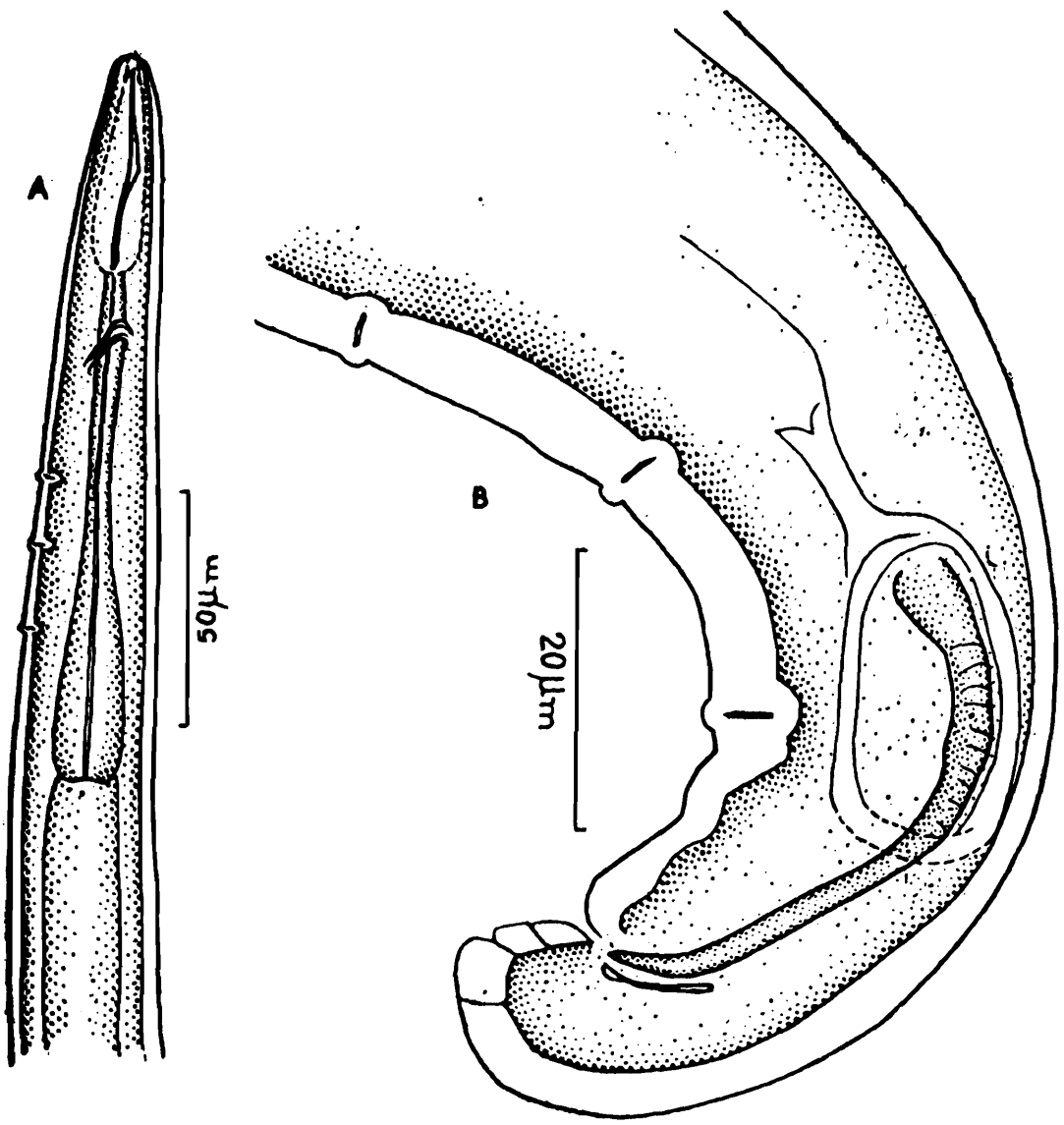
(Text-fig. 8)

Material.—1 ♂; Lakhanwala; 26.i.1973.

Measurements.—1 ♂: Length=0.62 mm, a=17, b=4, c=44, onchiostyle=42 μm, spicula=47 μm, gubernaculum=8 μm.

Description.—Body tapering anteriorly, cuticle much swollen in posterior part, subcuticle finely striated. Lip region about 6 μm in diameter, continuous. Amphid aperture 7 μm from anterior end. Onchiostyle tripartite in the middle. Three ventromedian cervical papillae opposite

the posterior part of oesophagus, placed equidistantly at about 15 μm from each other, first one 89 μm away from anterior end. Oesophagus with a terminal bulb with two nuclei. Nerve ring 60 μm from anterior end. Supplements comprising 3 ventromedian papillae, extended to a distance about two spicular lengths from cloaca, the posterior-most opposite the anterior quarter of spicula. Spicules with striated markings. Caudal alae absent.



Text-fig. 8.—*Trichodorus* sp. (de Man) (♂).
A—Anterior end, B—Posterior end.

Remarks.—Recently Siddiqi (1974) has split the genus *Trichodorus* Cobb, in two genera and has given useful keys to the species of these genera. Loof (1975) has made slight modifications to the keys.

The specimen before us seems to take up an intermediate position between *T pakistanensis* Siddiqi and *T kurumeensis* Yokoo.

The genus *Trichodorus* is being recorded from the rhizosphere of tea for the first time. The genus is known to be a vector of viruses and as such the association of this nematode with tea has to be taken seriously.

General Remarks

Sivapalan (1972) has listed twenty plant parasitic (tylenchid and dorylaimid) nematodes of tea indentified up to specific level. The species and genera so far reported from India and those being added to the list have been shown in the Table 1. The genera *Hemicriconemoides* Chitwood & Birchfield, *Neotylenchus* Steiner and *Trichodorus* Cobb, are being reported from tea for the first time. The association of the last named genus has to be taken seriously since it is a proven vector of viruses. The tylenchid species, *Paratylenchus tenuicaudatus*, *Neotylenchus latus* are recorded for the first time from tea as well as from India.

Most of the species of *Meloidogyne* Goeldi, except *M. brevicauda* Loos, are associated only with nursery plants. Since the nursery plants and for that matter even the roots in the mature tea fields were not examined, nothing can be said about the existence or otherwise of *Meloidogyne* spp. in the tea estates of Dehra Dun, although, it must be added that the plants appeared to be quite healthy.

The study of the geographical distribution of plant parastitic nematodes poses certain problems. These are: (1) the discontinuous distribution of crops and vegetative matter over the globe, (2) the non-host-specificity of most of the ectoparasitic and some endoparasitic nematodes, (3) the movement of plants with soil by human agency even across the seas, and (4) the vast areas in the world which have not yet been surveyed. As such it is difficult and much too premature to take up the study of the geographical distribution of the plant parasitic nematodes. We, however, feel that most of the plant parasitic species reported would be cosmopolitan, each species parasitising on a variety of hosts.

Amongst the free living nematodes, the genera *Rhabditis* Dujardin, *Acrobeloides* (Cobb), *Plectus* Bastian, *Achromadora* Cobb, *Tripyla* Bastian, *Ironus* Bastian, *Cryptonchus* Cobb, *Aporcelaimellus* Heyns, *Thornenema* Andrássy, *Mylonchulus* Cobb, *Iotonchus* Cobb, *Alaimus* de Man, *Amphidelus* Thorne, and *Diphtherophora* de Man, are, despite inadequate global survey studies, fairly well distributed throughout the world. Other genera like *Trilabiatus* J.B. Goodey, *Paraphanolaimus* Micoletzky, *Prismatolaimus* de Man, *Odontolaimus* de Man, *Onchulus* Cobb, and *Amphidorylaimus* Andrássy have distinctly discontinuous distribution which could either be attributed to inadequate surveys in the intervening areas or to the movement of the plant and the attendant soil material by human agency. It is interesting to note that the genus *Tobrilus* Andrássy, species of which are commonly found in the soil samples in India, was not encountered.

Dehra Dun is located in the submountainous region of the N.W. Himalaya and two of the nematode genera, viz. *Trilabiatus* and *Para-*

phanolaimus and four species, viz. *Acrobeloides buetschlii*, *Plectus thornei*, *Amphidorylaimus infecundus* and *Amphidelus dolichurus* are palaearctic in distribution. Species like *Rhabditis* (*Uniovaria*) *cranganorensis*, *Odontolaimus aquaticus* and *Alaimus jaulasali* are of Oriental region. *Aporcelaimellus maitai* and *Thornenema cavalcantii* belong to the Australian and Neotropical regions respectively. No nematode strictly Ethiopian or Neoarctic has been found. All other species are cosmpolitan in their distribution. This analysis is, of course, based on the present day knowledge of the distribution of these free living nematodes; it may change with more survey work and further knowledge.

SUMMARY

Thirty-five species of nematodes have been found in the rhizosphere of tea plants in Dehra Dun. Ten species belong to the order Tylenchida; most of the species have been found in association with tea for the first time. *Trichodorus* sp. a proven virus vector, and *Diphtherophora communis* have also been recorded. The genera *Paraphanolaimus*, *Odontolaimus*, *Trilabiatus* and the species *Helicotylenchus digonicus*, *Paratylenchus tenuicaudatus*, *Neotylenchus latus*, *Aporcelaimellus maitai*, *Amphidorylaimus infecundus*, have been recorded for the first time from India. Five new species, *Boleodorus longistylus*, *B. atypicus*, *Paraphanolaimus micoletzkyi*, *Prismatolaimus andrassyi* and *Amphidelus loofi* have been described. Systematic status of a number of species has been discussed.

TABLE 1: Plant parasitic Nematodes associated with Tea

Nematode species (1)	*Countries other than India* (*After Sivapalan*, 1972) (2)	*India* (*After Sivapalan*, 1972) (3)	*New records in this paper* (4)
Tylenchus agricola		+	
T. filiformis			+
Tylenchus sp.	+		
Ditylenchus sp.	+		
Tylenchorhynchus sp.	+	+	
Pratylenchus loosi	+		
P. brachyurus		+	
Pratylenchus penetrans			+
Pratylenchus sp.	+	+	
Radopholus similis	+		
Pratylenchoides sp.	+		

Nematode species	*Countries other than India (After Sivapalan,* 1972)	*India (After Sivapalan,* 1972)	*New records in this paper*
Rotylenchulus sp.	+		
Rotylenchus sp.	+	+	
Helicotylenchus dihystera	+		
H. erythrinae	+		
H. digonicus			+
Helicotylenchus sp.	+	+	
Scutellonema brachyurum	+	+	
Scutellonema sp.	+		
Hoplolaimus columbus		+	
Hoplolaimus sp.	+		
Neotylenchus latus			+
Boleodorus longistylus			+
B. atypicus			+
Boleodorus sp.	+		
Meloidogyne javanica	+	+	
M. incognita	+	+	
M. arenaria	+		
M. hapla		+	
M. brevicauda	+	+	
Meloidodera floridensis		+	
Hemicriconemoides kanayaensis	+		
H. mangiferae			+
Paratylenchus curvitatus	+	+	
P. tenuicaudatus			+
Paratylenchus sp.	+	+	
Macroposthonis ornata (?)		+	
Trophotylenchulus sp.	+		
Aphelenchus agricola		+	
A. avenae			+
Aphelenchoides composticola	+	+	
A. saprophilus			+
Xiphinema insigne		+	
Xiphinema sp.	+		
Longidorus sp.	+		
Trichodorus sp.			+

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