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A REVIEW OF THE GENUS *ENCHODELUS* THORNE, 1939 WITH DESCRIPTIONS OF SPECIES FROM INDIA

by
MAQSOOD AHMAD
and
M. SHAMIM JAIRAJPURI

Issued by The Director
Zoological Survey of India, Calcutta

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By

MAQSOOD AHMAD AND M. SHAMIM JAIRAJPURI

Section of Nematology, Department of Zoology, Aligarh Muslim University, Aligarh, India.

(With 9 Text-figures)

INTRODUCTION

Enchodelus Thorne, 1939 is restricted in its distribution and has so far been recorded only from U.S.A., Italy, Sweden, Switzerland, Greenland, Signy Island, Faroc Island, India, Nepal, etc. The members of this genus are mostly found in high altitudes at elevations of 1,260-4,400 m or more above the sea level. Thorne (1939) has stated that they feed entirely on plants which is evident by the appearance of chlorophyll-like material within their intestine. However, no work has been done till now on their feeding behaviour, their biology and nature of parasitism etc., and as such the extent of damage and host-parasite relationship is unknown.

Enchodelus at present includes thirty species of which ten have been recorded from India. In 1964, Jairajpuri & A.H. Siddiqi reported for the first time *Enchodelus macrodoroides* (Steiner, 1914) Thorne, 1939 from soil around the roots of pine from Simla, Himachal Pradesh. Later Jairajpuri & Loof (1968) recorded the type species *E. macrodorus* (de Man, 1880) Thorne, 1939 in India and described three new species of *Enchodelus* from Nainital, Uttar Pradesh and Srinagar, Jammu & Kashmir. Recently, Baqri and Jairajpuri (1974) have reported five new species, viz. *E. satendri, E. thornei, E. parateres, E. maximus* and *E. microdoroides* from Himachal Pradesh.

The present work provides a revision of the genus *Enchodelus* and it includes the study of all the nine species of this genus that have so far been reported from India. In addition, a new species of the genus has been described and also the males of *E. microdoroides* Baqri & Jairajpuri, 1974 are reported for the first time. All the samples for the present work on these nematodes were collected at high altitudes in Uttar Pradesh and Jammu & Kashmir. From this study it was concluded that the genus *Enchodelus* is heterogeneous which contains species having lip region of different shapes, odontostyle of different sizes, odontophore with well developed or very poorly developed flanges at base, variable shapes of tail and different arrangements of supplements. Therefore, in order to solve the existing problem of diversity within *Enchodelus* it has been proposed to split the genus into five subgenera, viz., *Enchodelus* (Thorne, 1939) n. rank, *Rotundus* n. subg., *Heterodorus* (Altherr, 1952) n. rank, *Paraenchodelus* n. subg. and *Nepalus* n. subg. The diagnosis of each subgenus and keys for the identification of the species have also been provided.

This specimens were fixed in hot 4% formalin, dehydrated slowly in a desiccator and mounted in dehydrated glycerine.

The authors are thankful to Prof. S. Mashhood Alam, Head, Department of Zoology for providing necessary laboratory facilities. The first author also thanks the C.S.I.R., New Delhi for the award of a Research Fellowship.

THE GENUS *ENCHODELUS* THORNE, 1939

Systematic position of Enchodelus :

Class	Nematoda
Subclass	Adenophorea (Von Linstow, 1905) Chitwood, 1958
Order	Dorylaimida (de Man, 1876) Pearse, 1942
Suborder	Dorylaimina (de Man, 1876) Pearse, 1942
Superfamily	Dorylaimoidea (de Man, 1876) Thorne, 1934
Family	Nordiidae (Jairajpuri & Siddiqi, A.H., 1964) Siddiqi 1969
Subfamily	Pungentinae Siddiqi, 1969
Genus	**Enchodelus** Thorne, 1939

Diagnosis (emended) : Lip region slightly or distinctly set off by depression. Odontostyle long with a small aperture. Odontophore with

broad basal flanges or simple rod-like. Basal expanded part of oesophagus relatively small. Gonads amphidelphic, reflexed. Males having well developed spicules, lateral guiding pieces and 4-12 ventromedian supplements. Prerectum usually many times anal body-width. Rectum about one anal body-width long. Tails similar in both sexes, vary from short-conoid or elongate-conoid to hemispherical or rounded with or without saccate bodies.

Type species : *Enchodelus macrodorus* (de Man, 1880) Thorne 1939*

Other species :

E. altherri Vinciguerra & de Francisci, 1973
E. analatus (Ditlevsen, 1927) Thorne, 1939
E. arcuatus Thorne, 1939
E. brevidentatus Thorne, 1939
E. conicaudatus (Ditlevsen, 1927) Thorne, 1939
E. constrictus Jairajpuri & Loof, 1968*
E. distinctus n. sp*
E. faeroensis (Ditlevsen, 1928) Thorne, 1939
E. groenlandicus (Ditlevsen, 1927) Thorne, 1939
E. hopedoroides Altherr, 1963
E. hopedorus (Thorne, 1929) Thorne, 1939
E. irregularis Altherr, 1972
E. laevis Thorne, 1939
E. longidens Jairajpuri & Loof, 1968*
E. magnificus (Altherr, 1952) Altherr, 1963
E. maximus Baqri & Jairajpuri, 1974*
E. microdoroides Baqri & Jairajpuri, 1974*
E. nepalensis Zullini, 1973
E. parateres Baqri & Jairajpuri, 1974*
E. parvus Loof, 1971
E. rhaeticus Altherr, 1952
E. satendri Baqri & Jairajpuri, 1974*
E. signyensis Loof, 1975
E. striatus Thorne, 1939
E. teres Thorne, 1939

E. thornei Baqri & Jairajpuri, 1974*

E. vestibulifer Altherr, 1952

E. vesuvianus (Cobb, 1893) Thorne, 1939

E. zonatus Jairajpuri & Loof, 1968*

List of synonyms and transfers

E. microdorus Schiemer, 1965 (=*Rhyssocolpus microdorus* (Schiemer, 1965) Andrassy, 1971)

E. brasiliensis Meyl, 1957 (=*Rhyssocolpus brasiliensis* (=Meyl, 1957) Andrassy, 1971)

E. dolichurus Loos, 1946 (=*Prodorylaimus dolichurus* (Loos, 1946) Siddiqi, 1969)

E. minusculus Loos, 1946 (=*Eudorylaimus minusculus* (Loos, 1946) Siddiqi, 1969)

Species inquirendae

E. macrodoroides (Steiner, 1914) Thorne, 1939 by Jairajpuri & Loof, 1968*

E. hedicki (Pearse, 1941) Andrassy, 1960 by Zullini, 1973

The species recorded from India are marked with *

Relationship : The genus *Enchodelus* is related to the genera *Pungentus* Thorne & Swanger, 1936, *Rhyssocolpus* Andrassy, 1971 and *Enchodorus* Vinciguerra, 1976. From *Pungentus* it differs in the absence of four cuticularized pieces around the vestibule, well set off lip region and in the presence of well developed flanges at base of odontophore. It can be differentiated from *Rhyssocolpus* in the absence of peculiar striations near the vulval region and in possessing longer odontostyle. From *Enchodorus* it differs in having longer odontostyle and in having elongate-conoid or rounded tails (tail long filiform in *Enchodorus*).

NOTES ON THE MORPHOLOGY

The species of the genus *Enchodelus* have been reported from U.S.A., Italy, Sweden, Switzerland, Nepal, India, etc. They were mostly collected from high altitudes from soil around roots of mosses, grasses, etc. When killed with hot fixative they assume ventrally curved or C-shaped

postures. The size of body ranges from 0.59 mm (*E. parvus*) to 2.80 mm (*E. faeroensis*). The body is cylindrical tapering slightly towards extremities.

Although both sexes occur but in majority of the species males are rare. In some species like *E. parateres* males are as frequent as females. Both sexes are similar in shape and in basic morphology, but in some species the males have more ventrally curved tails.

Cuticle : The cuticle is marked usually with fine but rarely with coarse striations (*E. striatus*). Radial striations have also been seen in the tail region of some species (*E. macrodorus*). The thickness of the cuticle varies at different regions on the body, usually thickest on tail tip (23 μm in *E. maximus*). The lateral chords are granular, narrow, about one-eight to one-fourth of the body-width near middle.

Lip region : The lip region is either slightly set off by a depression (*E. vesuvianus*) or distinctly set off by a constriction (*E. parateres*). These differences are helpful in the identification of species. The contour of lip region may be angular (*E. hopedorus*) or rounded (*E. arcuatus*). The lip region bears six lips of equal size, each with a papilla on the inner as well as on the outer circlet. The submedian lips have an additional papilla on each. The subdorsal and subventral lips, therefore, bear two papillae on the outer circlet, but the laterals have only a single papilla. There are in all 6+10 papillae on both the circlets (*cf.*, Jairajpuri & Loof, 1968).

Amphids : The amphids are well developed, stirrup or cup-shaped, with curved slit-like apertures occupying about $\frac{1}{2}$—$\frac{3}{5}$ of the corresponding body-width. The amphidial pouch is followed by a canal which leads to the sensillar pouch. The sensillae inside the pouches are supposed to be chemoreceptors.

Feeding apparatus : The feeding apparatus consists of an odontostyle, odontophore, guiding sheath and guiding ring. The odontostyle or spear is long but attenuated. It develops in a cell which is located on the submedian wall of the anterior slender part of oesophagus. The odontostyle is forked at its junction with odontophore. The length of odontostyle ranges from 8 μm (*E. parvus*) to 70 μm (*E. nepalensis*), but in majority of the species, it is in the range of 25-45 μm. The length of odontostyle is one of the most important taxonomic characters in this genus. The odontophore or spear extension

is also well developed and provided with conspicuous flanges or small swelling at its base. Some species have simple rod-like or linear extension (*E. constrictus*, *E. zonatus*).

The flanges are three in number and are formed by the cuticular layers of oesophagus, which are embedded in the oesophageal tissues. In a cross-section, the flanges appear symmetrically arranged. The length of odontophore ranges from 9 μm (*E. parvus*) to 56μm (*E. maximus*). In majority of the species usually the length of odontophore is equal to that of odontostyle. The length and nature of development of odontophore is also very helpful in the identification of species. The guiding apparatus is present near the base of odontostyle and consists of two rings, one is fixed and the other is movable. The position of the fixed guiding ring is constant and therefore taxonomically important. The length of guiding sheath is variable corresponding to the length of the odontostyle. In some species like *E. macrodorus*, the stomal walls are very much thickened anterior to guiding ring. The guiding sheath becomes gradually thinner posteriorly and eventually fuses with odontostyle.

Oesophagus : The oesophagus is divided into an anterior slender and a posterior expanded portion. The nerve ring surrounds the anterior slender part of oesophagus at about 40-50% of neck length from anterior end. The lumen of basal expanded part is tripartite in cross-section. The basal expanded part of oesophagus comprises five oesophageal glands, one dorsal and two pairs of subventrals. All these glands open into the lumen of oesophagus near the placement. The dorsal gland and its nucleus is comparatively more developed than the others. Thorne (1939) reported only three oesophageal gland nuclei, one dorsal and a pair of subventrals in *E. macrodorus*. The position of gland nuclei and their orifices is also important taxonomically.

According to Loof & Coomans (1970) the genus *Enchodelus* has provisional characters as : distance DO-DN moderate to rather long: 4-6%, both S_1N very indistinct, S_1N in, or slightly behind the middle of the distance DN-S_2N, S_2N located anteriorly, 83-88%, DO anterior to level where oesophagus attains its full width, S_1N generally close together.

Cardia : Cardia is well developed and hangs in the intestinal tissues. It is usually elongate hemispheroidal but may be cylindrical (*E. teres*).

Intestine : Intestine is sac-like, consisting of six cells in circumference (*cf.* Thorne, 1939). Granules of various sizes and colours are present in it. The lumen of the intestine is filled with masses of green chlorophyll-like material which indicates that they may be parasites of plants.

Prerectum : Prerectum is separated from the intestine by a faint or deep constriction. The cells of prerectum are very similar to intestine. The length of prerectum is usually 1-5 times the anal body-width, but exceptionally it may be 7 anal body-widths long (*E. zonatus*). The length of prerectum in relation to anal body-width is an important taxonomic character.

Rectum : The rectum is dorsoventrally flattened, separated form the prerectum by a constriction. It is usually about one anal body-width long. The rectum opens to the exterior through anus.

Female reproductive organs : In all the species of *Enchodelus* reported so far the females are amphidelphic. Each sexual branch consists of an ovary, oviduct, uterus, vagina and vulva.

Ovary : The ovary is reflexed lying dorsally or ventrally to the oviduct. It consists of two zones, the distal germinal zone and the proximal growth zone. In the germinal zone the cells are small, restricted to the apical part where the proliferation of germ cells takes place (telogony). In the growth zone the oocytes are arranged in a single row increasing in size towards the proximal end of the ovary. Due to subterminal connection between the ovary and oviduct, the proximal part of the latter forms a blind sac (*cf.*, Coomans, 1964). The ripe oocytes grow in size in this region until they reach their full size. After maturation, they are passed on to the oviduct.

Oviduct : The oviduct consists of a distal narrow tube with high columnar epithelium surrounded by a thin layer of connective tissue and an enlarged proximal part with low columnar epithelium. The proximal part is irregular in outline and may or may not contain ova. It is also quite flexible and may serve as spermatheca (*cf.*, Chitwood & Chitwood, 1950).

Sphincter : Usually the oviduct and uterus are separated by a well developed sphincter. The sphincter is more prominent in species like *E. longidens*, *E. distinctus* and *E. parateres*, etc. The sphincter may also be present at the junction of oviduct and ovary (*E. microdoroides.*)

Uterus : The uterus is the most variable part of female reproductive organs. Usually it consists of a proximal and a distal part. The proximal part consists of a single layer of columnar cell surrounded by a muscular layer. The distal part is narrow and highly muscular. The eggs are usually present in the proximal part of uterus where they are coated with a shell. The proximal parts of the two uteri join to form an ovijector. In some species, this region may be completely filled with sperm.

Vagina : The vagina extends to one-third or half of the corresponding body-width. Its lumen is narrow and usually at its proximal end it may be surrounded by cuticularization and at distal end by sphincter muscles. In some species, the sphincter muscles are not visible (*E. thornei*, *E. longidens*).

Vulva : The vulva is a ventral transverse slit. The slit is formed by invagination of body cuticle and is controlled by various muscles. Dilatator vulvae are clearly visible in some species (*E. satendri*).

Male reproductive organs : The male genital tract consists of two testes, vas deferens and a cloaca. The males are diorchic and both the testes lie left to the intestine. The testes are outstretched and telogonic, *i.e.*, the proliferation of germs cells takes place at the apical region. Each testis can be divided into a proximal germinal part and a distal growth part. The maturation of sperm takes place at the end of growth part. The vas deferens is joined with the testes ; it is made up of a tubular and a glandular region and is not differentiated into an anterior slender and a posterior ejaculatory duct. The cloaca is lined with cuticle and opens to the exterior through the cloacal aperture.

Besides primary sex organs as described above, the males are also provided with accessory structures which consists of spicules, lateral guiding pieces, ventromedian supplements and copulatory muscles.

Spicules : The paired spicules are similar in shape and size. These are stout, heavily sclerotized and bluntly tipped. The spicules are usually ventrally curved. Each spicule consists of a head or capitulum and a lamina. The length of spicules varies from 42 μm (*E. thornei*) to 60 μm (*E. nepalensis*). During action each spicule is guided by a set of protractor and retractor muscles. Two lateral guiding pieces, present on the distal end of spicules, taper distally and strengthen the spicules during copulation.

Supplements : The supplements consist of an adanal pair and a variable number of ventromedians spaced, regularly or irregularly. The latter may vary from four (*E. constrictus*) to twelve (*E. macrodorus*). They are very distinct and elevated and are supplied with nerve endings. The copulatory muscles are very prominent occupying the area up to the last supplement.

The shape and size of spicules, the shape and size of lateral guiding pieces, the number and arrangement of ventro-median supplements, the number and area occupied by the copulatory muscles are fairly useful characters in the taxonomy of *Enchodelus*.

Tail : The tails are similar in the two sexes of species of *Enchodelus* but the length and shape of tail are most variable in the species of this genus. It varies from elongate-conoid to completely hemispherical. The conoid tails may be short or long, straight (*E. conicaudatus*) or ventrally curved (*E. brevidentatus*) with acute (*E. faeroensis*), or blunt terminus (*E. zonatus*). The other type of tails may be convex-conoid (*E. microdoroides*), bluntly-conoid (*E. vesuvianus*) or smoothly rounded (*E. macrodorus*). In species like *E. teres*, *E. hopedorus* and *E. vestibulifer* saccate bodies are present in pairs on both the sides of tail. The number of these bodies is variable. Usually the tails of all the species are provided with a pair of caudal papillae on each side. The length and shape of tail is one of the most important taxonomic characters in this genus at species level.

SYSTEMATICS OF THE GENUS *ENCHODELUS* THORNE, 1939

Thorne (1939) proposed the genus *Enchodelus* for some species of *Dorylaimus* Dujardin, 1845 and *Dorylaimellus* Cobb, 1913 which possess well developed flanges at base of odontophore, double guiding ring, amphidelphic gonads. The new genus included *E. macrodorus* (de Man, 1880) as type species, seven species transferred from other genera and five new species. It was grouped under the subfamily Tylencholaiminae Filipjev, 1934 of the family Dorylaimidae de Man, 1876 along with other genera like *Tylencholaimus* and *Discomyctus*. Loos (1946) added two more species viz., *E. dolichurus* and *E. minusculus* to this genus.

Altherr (1952) described two new species, viz., *E. vestibulifer*, *E.*

E. vestibulifer, *E. rhaeticus* and proposed a new genus *Heterodorus* with the type *H. magnificus*. In 1963 he transferred *H. magnificus* to *Enchodelus* and synonymized *E. rhaeticus* with *E. magnificus*. Meyl (1957) and Schiemer (1965) also added *E. brasiliensis* and *E. microdorus* respectively.

Jairajpuri and A. H. Siddiqi (1964) proposed a new subfamily Nordiinae for the genus *Nordia*. Siddiqi (1969) gave family rank to Nordiinae, proposed a new subfamily Pungentinae and placed *Enchodelus* along with *Pungentus* under it. Siddiqi (l.c.) considered *E. dolichurus* Loos, 1946 and *E. minusculus* Loos, 1946 as *Prodorylaimus dolichurus* and *Eudorylaimus minusculus* respectively. In 1960, Andrássy reported *E. hedicki* which was considered as *species inquirenda* by Zullini (1973).

Jairajpuri & A. H. Siddiqi (1964) recorded the occurrence of this genus for the first time from India when they reported a single female of *E. macrodoroides* (Steiner, 1914) Thorne, 1939 from soil around roots of pine at Simla, Himachal Pradesh. Jairajpuri & Loof (1968) added three new species from India, viz., *E. longidens*, *E. zonatus* and *E. constrictus* to this genus and considered *E. macrodoroides* as *species inquirenda*.

Andrássy (1971) proposed a new genus *Rhyssocolpus* under Pungentinae for *E. microdorus* and *E. brasiliensis* because of peculiar striations in the cuticle at vulva region.

Recently more species have been added to the genus *Enchodelus* from various parts of the world : two by Altherr (1963 & '72), two by Loof (1971 & '75), five by Baqri & Jairajpuri (1974) and one each by Vinciguerra (1973) and Zullini (1973). While describing *E. nepalensis* from Nepal, Zullini (l.c.) discussed the synonymies and departures of species under *Enchodelus* and also provided a key to its species. A revised key was given by Baqri & Jairajpuri (1974).

More recently, Vinciguerra (1976) reported a closely related genus *Enchodorus* from around roots of mosses in Italy and also placed it in Pungentinae. *Enchodórus* differs from *Enchodelus* in having a shorter odontostyle, shorter odontophore without flanges or with inconspicuous swelling at base and a long filiform tail.

Enchodelus Thorne, 1939 contains two fairly distinct groups of species, one with conoid tails and the other with rounded tails. Altherr (1952) erected a genus *Heterodorus* for the type species *H. magnificus* having conoid tail and peculiar ovoid chamber in the gonads but later on in 1963 he synonymized it with *Enchodelus*. Siddiqi (1969) stated that the species of *Enchodelus* represent two distinct genera and he suggested that those having conoid tails may be kept under *Heterodorus* Altherr, 1952. Loof (1971) did not agree with this and considered that *Enchodelus* is not divisible because the species possess some common characters, like the long odontostyle with short apertures, thick-walled stoma and in the location of oesophageal gland nuclei etc. Zullini (1973) also agreed with the views of Loof (1971). Recently Vinciguerra (1976) has also suggested that the species of *Enchodelus* comprise two distinct groups differentiated on the shape of tails.

Enchodelus is heterogeneous containing species which have lip region of different shapes, odontostyle of different sizes, odontophore with well developed or very poorly developed flanges at base, variable shapes of tail and different arrangements of supplements. The characters shared by all the species are the long odontostyle with a small aperture, lip region set off from the body, relatively small expanded part of oesophagus, similar arrangement of oesophageal gland nuclei and their orifices and amphidelphic gonads. In order to solve the existing problem of diversity within *Enchodelus* it is proposed to split the genus into five groups and by giving each of these the status of a separate subgenus :

(i) Subgenus *Enchodelus* (Thorne, 1939) n. rank

(ii) Subgenus *Rotundus* nov.

(iii) Subgenus *Heterodorus* (Altherr, 1952) n. rank

(iv) Subgenus *Paraenchodelus* nov.

(v) Subgenus *Nepalus* nov.

KEY TO SUBGENERA OF GENUS *ENCHODELUS*

1. Tail hemispherical or bluntly-conoid ... 2
— Tail short-conoid or elongate-conoid ... 3
2. Odontostyle fairly long ; odontophore with broad basal flanges ... ... *Enchodelus*
— Odontostyle short ; odontophore without basal flanges ... ... *Rotundus*

3. Lip region not set off from body ; female gonads with a peculiar ovoid chamber ... *Heterodorus*

— Lip region slightly or distinctly set off from body ; peculiar ovoid chamber absent 4

4. Odontostyle over 50 μm ; odontophore with moderately developed basal flanges ... *Nepalus*

— Odontostyle less than 50 μm ; odontophore rod-like or with very poorly developed basal flanges ... ... *Paraenchodelus*

Relationship of the subgenera : The subgenus *Enchodelus* includes species with fairly long odontostyle, and well developed flanges at base of odontophore, tail bluntly-conoid or hemispherical, and the males having regularly spaced ventromedian supplements. *Rotundus* is closely related to it but differs in absence of flanges at base of odontophore and in the males having irregularly spaced ventromedian supplements. In the other three subgenera, viz., *Heterodorus*, *Paraenchodelus* and *Nepalus*, the tails are short-conoid to elongate-conoid. The subgenus *Heterodorus* has rod-like odontophore and a peculiar ovoid chamber in the female gonads. *Paraenchodelus* and *Nepalus* are quite closely related to each other. *Paraenchodelus* has simple rod-like or with very poorly developed flanges at base of odontophore while *Nepalus* has moderately developed flanges at base of odontophore. The lengths of body and odontostyle are comparatively longer in *Nepalus* than in other subgenera. In *Enchodelus* and *Rotundus* the ventromedian supplements are within the spicular range while in *Paraenchodelus* and *Nepalus* they begin above the range of spicules.

SUBGENUS *ENCHODELUS* (THORNE, 1939) N. RANK

Diagnosis : *Enchodelus*. Body length 1.1-2.5 mm. Lip region slightly or distinctly set off by a depression. Odontostyle fairly long. Odontophore with well developed and broad flanges at its base. Males with 9-12 ventromedian supplements, uniformly spaced beginning within the range of spicule. Tail in both sexes similar, hemispherical or bluntly-conoid.

Type species : *Enchodelus* (*Enchodelus*) *macrodorus* (de Man, 1880) Thorne, 1939

Other species :

E. altherri Vinciguerra & de Francisci, 1973

E. (*E.*) *distinctus* n. sp.

E. (*E.*) *groenlandicus* (Ditlevsen, 1927) Thorne, 1939

E. (*E.*) *hopedoroides* Altherr, 1963

E. (*E.*) *hopedorus* (Thorne, 1929) Thorne, 1939

E. (*E.*) *microdoroides* Baqri & Jairajpuri, 1974

E. (*E.*) *vesuvianus* (Cobb, 1893) Thorne, 1939

KEY TO SPECIES OF SUBGENUS *ENCHODELUS*

1.	Body length 2.5 mm	*groelandicus*
—	Body length under 2.0 mm	2
2.	Lip region slightly set off from body ...	4
—	Lip region distinctly set off from body ...	3
3.	Lips angular ; vulva pre-equatorial (V= 46—48)	*hopedoroides*
—	Lips hemispheroidal ; vulva post-equatorial (V=53)	*distinctus* n. sp.
4.	Odontostyle less than 2 head-widths long ; tail without saccate bodies	5
—	Odontostyle 2 head-widths or more long ; tail with saccate bodies	6
5.	Body length 1.1 mm ; odontophore about 2 times odontostyle length	*vesuvianus*
—	Body length 1.5-1.6 mm ; odontophore about 1.2 times odontostyle length ...	*macrodorus*
6.	Odontostyle 3 head-widths long ...	*microdoroides*
—	Odontostyle 2 head-widths long ...	7
7.	Body length 1.1-1.3 mm ; tail with 3-8 pairs of saccate bodies	*altherri*
—	Body length 1.4 mm ; tail with 10-15 pairs of saccate bodies	*hopedorus*

SUBGENUS *ROTUNDUS* NOV.

Diagnosis : *Enchodelus*. Body length 0.59-1.80 mm. Lip region slightly or distinctly set off by a depression. Odontostyle small. Odontophore rod-like without basal flanges. Males with 7-10 ventromedian supplements, irregulary spaced beginning from anterior end of spicules. Tail in both sexes similar, hemispheroid or bluntly-conoid.

Type species : *Enchodelus* (*Rotundus*) *parateres* Baqri & Jairajpuri, 1974

Other species :

E. (*R.*) *analatus* (Ditlevsen, 1927) Thorne, 1939

E. (*R*) *laevis* Thorne, 1939

E. (*R*) *parvus* Loof, 1971

E. (*R*) *signyensis* Loof, 1975

E. (*R*) *teres* Thorne, 1939

KEY TO SPECIES OF *ROTUNDUS* N. SUBG.

1.	Body length under 1.0 mm	*parvus*
—	Body length over 1.0 mm	2
2.	Odontostyle one head-width long ...	*laevis*
—	Odontostyle over one head-width long ...	3
3.	Tail with saccate bodies	4
—	Tail without saccate bodies	5
4.	Lips angular ; slightly set off from body contour	*teres*
—	Lips rounded ; distinctly set off from body contour	*signyensis*
5.	Lip region slightly set off from body contour ; odontostyle 30-35 μm long ...	*analatus*
—	Lip region distinctly set off from body contour ; odontostyle 21-22 μm long ...	*parateres*

SUBGENUS *HETERODORUS* (ALTHERR, 1952) N. RANK

Diagnosis : *Enchodelus*. Body length 1.8-2.6 mm. Lip region not offset, angular. Four cuticularized pieces said to be present around oral aperture. Odontophore rod-like without basal flanges. Peculiar ovoid chamber present at junction of ovary and oviduct. Male not known. Female tail elongate-conoid.

Type and only species : *Enchodelus* (*Heterodorus*) *magnificus* (Altherr, 1952) Altherr, 1963

SUBGENUS *PARAENCHODELUS* NOV.

Diagnosis : Enchodelus. Body length 1.2-2.8 mm. Lip region slightly or distinctly set off by a depression. Odontophore rod-like, basal flanges absent or very poorly developed. Males with 4-9 ventromedian supplements regularly or irregularly spaced, the series beginning well above the spicular range. Tail in both sexes similar, short-conoid or elongate-conoid, straight or ventrally arcuate.

Type species : *Enchodelus* (*Paraenchodelus*) *constrictus* Jairajpuri & Loof, 1968

Other species :

E. (*P.*) *arcuatus* Thorne, 1939
E. (*P.*) *brevidentatus* Thorne, 1939
E. (*P.*) *conicaudatus* (Ditlevsen, 1927) Thorne, 1939
E. (*P.*) *faeroensis* (Ditlevsen, 1928) Thorne, 1939
E. (*P.*) *irregularis* Altherr, 1972
E. (*P.*) *longidens* Jairajpuri & Loof, 1968
E. (*P.*) *rhaeticus* Altherr, 1952*
E. (*P.*) *satendri* Baqri & Jairajpuri, 1968
E. (*P.*) *striatus* Thorne, 1939
E. (*P.*) *thornei* Baqri & Jairajpuri, 1974
E. (*P.*) *vestibulifer* Altherr, 1952
E. (*P.*) *zonatus* Jairajpuri & Loof, 1968

KEY TO SPECIES OF *PARAENCHODELUS* N. SUBG.

1.	Tail straight, conoid	2
—	Tail arcuate, conoid	3
2.	Odontostyle 34 μm or 2 head-widths long	*zonatus*
—	Odontostyle 18 μm or 1.5 head-widths long	*conicaudatus*
3.	Odontostyle about one head-width long ...	*brevidentatus*
—	Odontostyle over 1.4 head-widths long ...	4
4.	Body cuticle with coarse striations ...	*striatus*
—	Body cuticle without coarse striations ...	5
5.	Body length 2.8 mm ; tail digitate ...	*faeroensis*
—	Body length under 2.6 mm ; tail not digitate	6
6.	Odontostyle over 40 μm or more than 3 head-widths long	*longidens*
—	Odontostyle less than 40 μm or less than 3 head-widths long	7
7.	Odontostyle over 1.5 head-widths long ...	8
—	Odontostyle 1.5 or less head-widths long ...	10
8.	Odontophore rod-like	9

* Altherr (1963) synonymised *E. rhaeticus* Altherr, 1952 with *E. magnificus* (Altherr, 1952) Altherr, 1963. The peculiar ovoid chamber in female gonads and four cuticularized pieces around the oral aperture are absent in *E. rhaeticus*. Therefore, the authors do not consider it as a synonym of *E. magnificus* and accept it as a valid species as was also indicated by Jairajpuri & Loof (1968).

—	Odontophore with poorly developed basal flanges	*satendri*
9.	Body length 1.2-1.4 mm ; vulva post-equatorial (V = 51-55)	*constrictus*
—	Body length 1.6-2.0 mm ; vulva pre-equatorial (V = 39-41)	*rhaeticus*
10.	Odontophore rod-like	11
—	Odontophore with poorly developed basal flanges	*thronei*
11.	Tail with saccate bodies	*vestibulifer*
—	Tail without saccate bodies	12
12.	Vulva pre-equatorial (V = 41-44) ...	*irregularis*
—	Vulva post-equatorial (V = 53) ...	*arcuatus*

SUBGENUS *NEPALUS* NOV.

Diagnosis : *Enchodelus*. Body length 2.1-2.5 mm. Lip region cap-like, well set off from body. Odontostyle very long. Odontophore with moderately developed basal flanges. Male with 5 ventromedian supplements, regularly spaced, beginning anterior to spicular range. Tail in both sexes similar, elongate-conoid, ventrally curved.

Type species : *Enchodelus* (*Nepalus*) *nepalensis* Zullini, 1973

Other species :

E. (*N.*) *maximus* Baqri & Jairajpuri, 1974

DESCRIPTIONS OF SPECIES OF *ENCHODELUS* FROM INDIA

1. **Enchodelus (Enchodelus) macrodorus** (De Man, 1880) Thorne, 1939

(Fig. 1, A-F)

Dimensions :

Females (15) : L=1.42-1.79 mm ; a=24-32 ; b=4.5-5.2 ; c=55-75 ; V=40-45 ; G_1=13-16 ; G_2=13-18

Description :

Female : Body ventrally curved upon fixation. Cuticle finely striated, 3μm thick on body, 10-12 μm on tail. Dorsal, ventral and lateral body pores not visible.

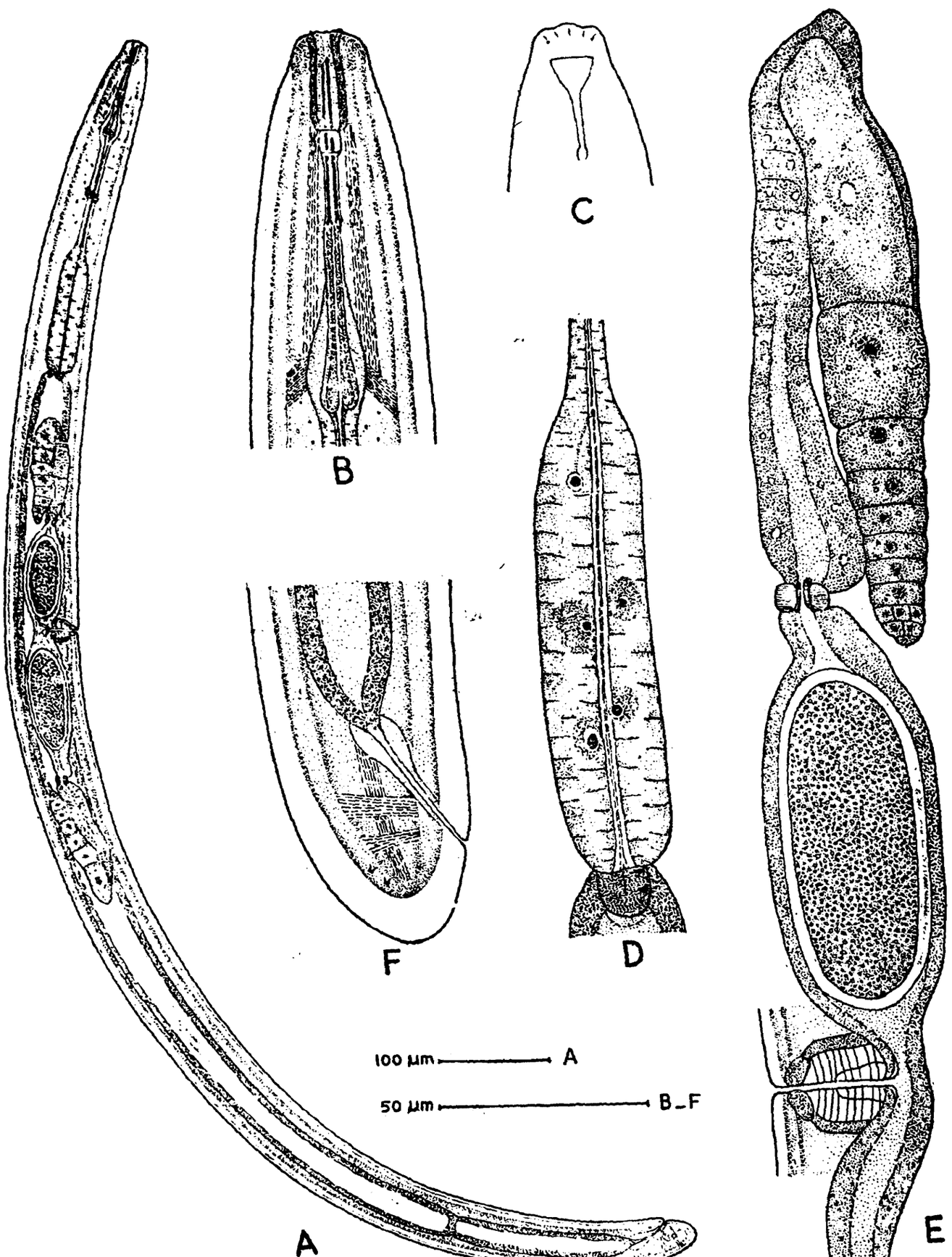

Fig. 1. — *Enchodelus* (*Enchodelus*) *macrodorus* (A) Entire female (B) Head end, (C) Head end showing amphid, (D) Expanded part of oesophagus, (E) Anterior female sexual branch, (F) Female tail end.

Lip region set off from body by slight depression, 1/4th as wide as body at base of oesophagus, about thrice as wide as high. Amphids cup-shaped with slit-like apertures occupying about two-thirds of lip-width. Odontostyle 41-42 μm or 2.7-2.8 times of lip-width, its aperture about 1/19th of its length. Guiding ring 1.5 lip-widths from anterior end. The stomal wall anterior to guiding ring are much thickened. Odontophore 43-46 μm, nearly equal to odontostyle length and provided with broad flanges at its base. Maximum width of flanges 7-8 μm.

Basal expanded part of oesophagus occupying about 38% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at about 40% of neck length from anterior end of body. Cardia hemispheroid, 11-14 μm long, surrounded by intestinal tissues. Rectum about one anal body-width long. Pre-rectum 4-5 times as long as rectum.

Vulva a transverse slit, vagina about one half body-width deep with cuticularization around it. Gonads amphidelphic, opposed and reflexed. A well developed sphincter present between uterus and oviduct. Uterine eggs measuring 90-91 × 31-39 μm in size. In young females, in which the eggs are not formed, a sphincter is visible between the ovary and oviduct.

Tails 0.6-0.7 anal body-width long, convex-conoid with well developed anal muscles and two caudal pores on each side.

Male : Not found.

Habitat and locality : Soil around roots of *Pinus sativus* from Tang Marg, Srinagar, Jammu & Kashmir.

Remarks : De Man (1880) described this species as *Dorylaimus macrodorus* having a long odontostyle with small aperture, double guiding ring, odontophore with broad basal flanges. Thorne (1939) proposed a new genus *Enchodelus* for a number of species of *Dorylaimus* and *Dorylaimellus* with *E. macrodorus* as type species. Thorne (1. c.) stated that this species was cosmopoliton in distribution.

Jairajpuri & Loof (1968) recorded a single female of this species from soil around the roots of apple from Srinagar, Jammu & Kashmir.

TABLE 1 Dimensions of *Enchodelus (Enchodelus) microdoroldes* Baqri & Jairajpuri, 1974

Populations	L mm	a	b	c	V/T	G_1	G_2	Cut. at m.b. (μm)	Cut. at tail (μm)	Amphid width (μm)	Pre-rectum (μm)	Rectum (μm)	Odonto-style (μm)
Total Mean	1.10	23	4.6	60	49	20	20	4	7.5	8	85	28	40
Entire range 44 ♀♀	0.94-1 26	19-27	3.5-5.6	47-73	43-55	15-25	16-22	3-5	5-10	6-10	48-122	23-33	37-42
Entire range 2 ♂♂	1.24-1.28	26-27	4.6-4.8	52-54	60	—	—	3	5-6	6-9	60-80	26-36	38-40
(i) Mean	1.06	22	4.5	60	49	19	19	3.5	8	8.5	79	27	40
Range 32 ♀♀	0.94-1.18	19-25	4-5	48-73	44-55	15-23	16-23	3-4	6-10	7-10	58-100	27-31	37-42
(ii) Mean	1.04	23	4.2	52	47	20	21	3.5	7	7	69.5	28	40
Range 4 ♀♀	0.98-1.25	20-27	3.5-5.0	47-58	43-52	15-25	18-24	3-4	6-8	6-8	57-82	27-29	39-41
(iii) Mean	1.16	22	4.5	63	50	18	18	3.5	7	7	73	27	39
Range 4 ♀♀	1.10-1.23	20-24	4-5	60-65	48-51	16-22	17-19	3-4	6-7	6-8	48-98	25-30	37-40
1 ♂	1.28	27	4.8	52	60	—	—	3	5	6	60	26	40
(iv) 1 ♀	1.17	27	4.5	58	46	17	18	3	6	9	86	32	37.5
1 ♂	1.24	27	4.6	54	60	—	—	3	6	9	80	36	40
(v) Mean	1.12	20	4.7	60	49	22	21	4	5.5	9	93	31	41
Range 3 ♀♀	0.98-1.26	19-22	3.8-5.6	58-63	48-50	19-24	18-23	3-5	5-6	8-10	65-122	29-33	40-42

Habitats and localities:

i) Soil around roots of grasses from Municipal Gardens, Mussoorie, Uttar Pradesh.
ii) Soil around roots of *Marchantia* sp., from Tallital, Nainital, Uttar Pradesh.
iii) Soil around roots of *Marchantia* sp., from Tiphintop, Nainital, Uttar Pradesh.
iv) Soil around roots of *Marchantia* sp., from Jeolikot, Nainital, Uttar Pradesh.
v) Soil around roots of mosses from Pauri Road, Lansdowne, Garhwal, Uttar Pradesh.

Odonto-phore (μm)	ABD (μm)	Tail/ ABD	Spi-cule (μm)	No. of Copul. muscle	No. of v.m. supp.
47.5	27,5	0.65	—	—	—
45-50	25-30	0 5-0.8	—	—	—
45-46	26-30	0.7-0.8	45-50	30-32	10
46	27.5	0.65	—	—	—
45-48	27-30	0.5-0.8	—	—	—
48	28	0.75	—	—	—
46-49	25-30	0.7-0.8	—	—	—
47	25.5	0.74	—	—	—
46-48	25-26	0.71-0.77	—	—	—
45	30	0.8	50.5	32	10
46	26	0.77	—	—	—
46	27	0.70	45	30	10
49	26.5	0.70	—	—	—
48-50	26-27	0.65-0.78	—	—	—

The present specimens were also collected in Srinagar. They agree fairly well with the description of *E. macrodorus* as given by Thorne (1939) and Jairajpuri & Loof (1968). However, they differ from the specimen previously collected from Srinagar in having longer body (L=1.47 mm) and more posterior vulva (V=37).

The values in parentheses are of single specimen of *E. macrodorus* as given by Jairajpuri & Loof.

II. **Enchodelus (Enchodelus) microdoroides** Baqri & Jairajpuri, 1974

(Fig. 2. A—K)

Dimensions : Table 1

Description :

Female : Body ventrally curved upon fixation. Cuticle finely striated, its thickness 2-3 μm on body and 6-9 μm on tail tip. Body pores indistinct.

Lip region set off from body by a slight depression, 1/3rd as wide as body at the base of oesophagus, about thrice as wide as high. Amphids cup-shaped with slit-like apertures occupying more than 2/3rds of lip-width. Odontostyle 38-42 μm or 3 times of lip-width, its aperture about 1/16th of its length. Guiding ring 2.0-2.5 head-widths from anterior end. Odontophore nearly equal to odontostyle length with very prominent flanges at its base. Maximum width of flanges 7-8 μm.

Basal expanded part of oesophagus occupying about 1/3rd of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding anterior slender part of oesophagus near middle of neck length. Cardia hemispheroid, about 8-10 μm long, surrounded by intestinal tissues. Prerectum about 2.4-3.0 and rectum about one anal body-width long.

Vulva a transverse slit, vagina about one half body-width deep and with cuticularization. Gonads amphidelphic. A well developed sphincter present between uterus and oviduct. Ovaries reflexed, oocytes arranged in a single row except in the growth region. Uterine eggs measure 55×25 μm.

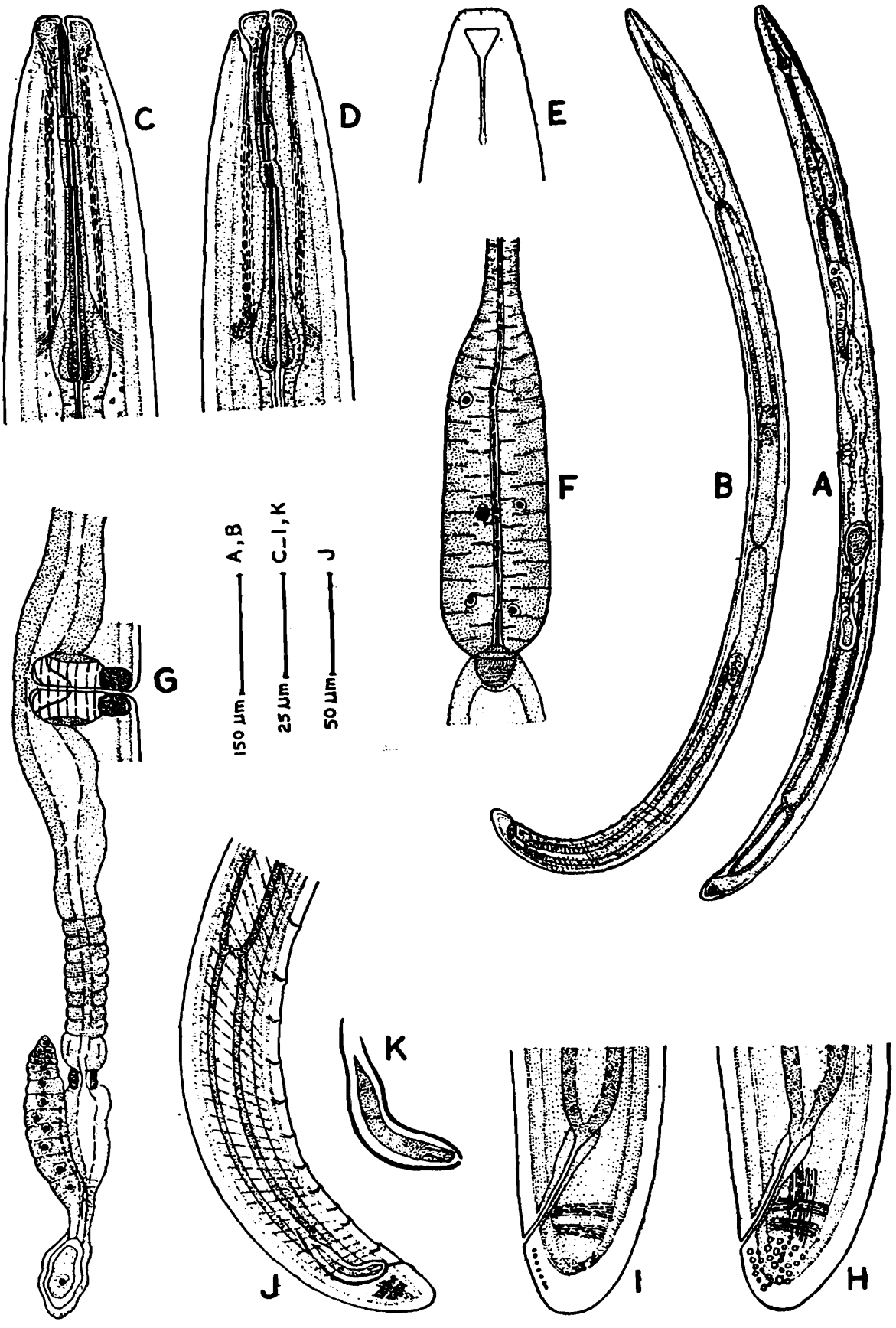

Fig. 2. — *Enchodelus* (*Enchodelus*) *microdoroides* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end (dorsoventral), (E) Head end showing amphid, (F) Expanded part of oesophagus, (G) Posterior female sexual branch, (H & I) Female tail ends, (J) Male tail end, (K) Spicule.

Tail 0.6-0.8 anal body-width long, convex-conoid with well developed anal muscle and two caudal pores on each side. There are 10-30 pairs of saccate bodies present on both sides of the tail in majority of the specimens, but in some these may be absent.

Male : Supplements an adanal pair and 10 ventromedians, the latter spaced at irregular intervals extending to about 7 tail lengths. Spicules 45-50 μm along median axis. Well developed lateral guiding pieces present. Copulatory muscle bands occupying the area up to the last ventromedian supplement. Prerectum begins from the third ventromedian supplement, about four anal body-widths long.

Habitats and localities : Table I.

Remarks : Five populations of this species were collected from high altitudes in different parts of Uttar Pradesh. In all 46 specimens including two males were found. This is the first record of the males of this species. The females of these five populations agree well with the description of the species as given by Baqri & Jairajpuri (1974) based on the specimens collected in Bharmar and Dalhousie, Himachal Pradesh. However, there are minor variations in body dimensions between these populations and those studied by Baqri & Jairajpuri (l.c.). The tails of the present populations are usually provided on both the sides with a variable number (10-30 pairs) of saccate bodies which were not recorded in the type population. Not only the number of these peculiar structures was variable but also they were totally absent on some specimens which indicates their highly variable nature. Some authors have used their presence/absence and, if present, their numbers as important specific characters. The present observations show that it is not a reliable character.

III. **Enchodelus (Enchodelus) distinctus** n. sp.

(Fig. 3, A—G)

Dimensions :

Holotype female : L = 1.85 mm ; a = 20 ; b = 5.1 ; c = 58 ; c^1=0.76 V = 53 ; G_1 = 16 ; G_2=17.

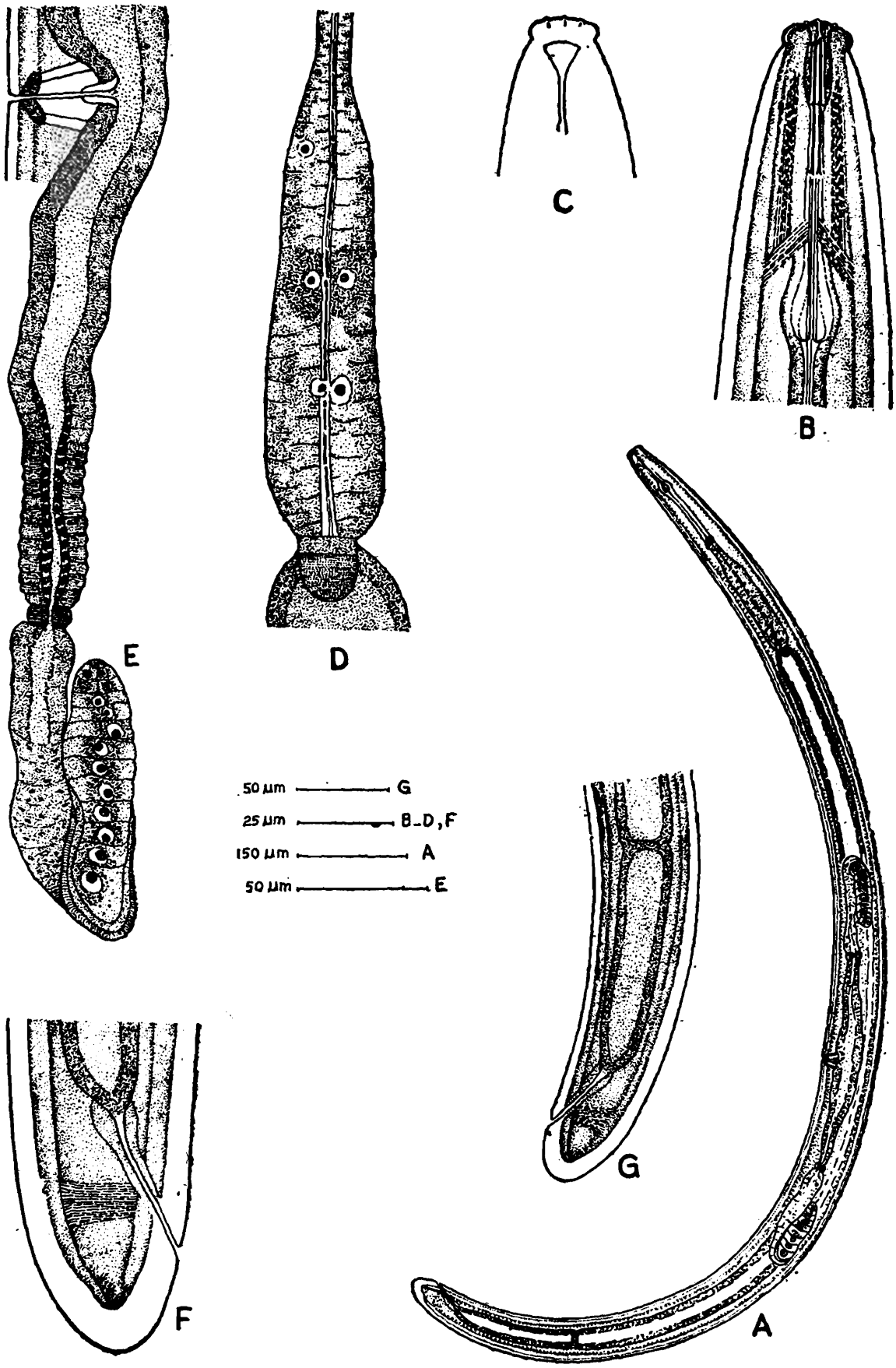

Fig. 3. — *Enchodelus* (*Enchodelus*) *distinctus* n. sp. (A) Entire female, (B) Head end, (C) Head end showing amphid, (D) Expanded part of oesophagus, (E) Posterior female sexual branch, (F) Female tail end.

Description :

Female : Body upon fixation ventrally curved, more so in posterior third, tapering towards extremities. Cuticle finely striated, its thickness on body 4 μm on tail tip 12 μm. Dorsal, ventral and lateral body pores indistinct.

Lip region distinctly set off from the body, 1/5th as wide as body at base of oesophagus. Amphids cup-shaped with curved slit-like apertures occupying about one half of corresponding body-width. Odontostyle 36 μm or 2.2 head-widths long with an aperture about 1/20 of its length. Guiding ring 1.4 head-width from anterior end. Odontophore 46 μm or 1.3 times the odontostyle length. Maximum width of flanges 7 μm.

Basal expanded part of oesophagus occupying about 44% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at 50% of neck length from anterior end of body. Cardia hemispheroid, surrounded by intestinal tissues. A well developed oesophago-intestinal disc present. Prerectum about three and rectum about one anal body-width long.

Vulva a transverse slit. Vagina extending one half across the body, encircled proximally by cuticularization and distally by sphincter muscles. Gonads amphidelphic. Uterus divided into a proximal glandular and distal muscular part. Ovaries short reflexed, oocytes arranged in single row except in growth region.

Tail 0.8 anal body-width long, hemispheroid, with two caudal papillae on each side.

Male : Not found

Type habitat and locality : Soil around roots of unidentified grasses, Rohtang Pass, (altitudes approx. 4,400 m) district Kulu, Himachal Pradesh.

Type specimen : Holotype female mounted on slides H.A.5/ *Enchodelus distinctus* n. sp./1 ; deposited in the Department of Zoology, Aligarh Muslim University.

Differential diagnosis : *Enchodelus distinctus* n. sp. comes close to *E. microdoroides* Baqri & Jairajpuri, 1974 and *E. macrodorus* (de Man, 1880) Thorne, 1939 but differs from *E. microdoroides* in having a longer body and distinctly set off lip region and more posterior vulva (V=53). From *E. macrodorus* it differs in having a distinctly set off lip region and more posterior vulva (V=42 in *E. macrodorus*).

IV. **Enchodelus (Rotundus) parateres** Baqri & Jairajpuri, 1974

(Fig. 4, A-M)

Dimensions :

Females (5) : L=1.13-1.34 mm ; a=23-28 ; b=4.5-5.0 ; c=46-56 ; V=51-53 ; G_1=18-21 ; G_2=17-20.

Males (3) : L=1.16-1.46 mm ; a=26-30 ; b=4.9-5.2 ; c=51-56 ; T=63-74 ; spicules=46-48 μm.

Description :

Female : Body ventrally curved upon fixation, tapering slightly towards extremities, curvature more pronounced in posterior part of body. Cuticle finely striated, 2 μm thick on body, 7-10 μm on tail tip. Dorsal, ventral and lateral body pores indistinct.

Lip region distinctly set off from body, 1/4th as wide as body at base of oesophagus. Amphids cup-shaped with slit-like apertures occupying about 2/3rd of corresponding body width. Odontostyle 20-23 μm or 1.6-1.7 head-widths long with an aperture about 1/8th of its length. Guiding ring 1.0-1.2 head-widths from anterior end. Odontophore 22-26 μm or 1.1-1.3 times the odontostyle length with very small swellings at its base. Maximum width of swellings 3-4 μm.

Basal expanded part of oesophagus occupies about 37-40% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding anterior slender part of oesophagus at 45-50% of neck length from anterior end of body. Cardia hemispheroid, 8-10 μm long, surrounded by intestinal tissues. A well developed oesophago-intestinal disc present. Prerectum 3.6-3.9, and rectum 1.0-1.2 anal body-widths long.

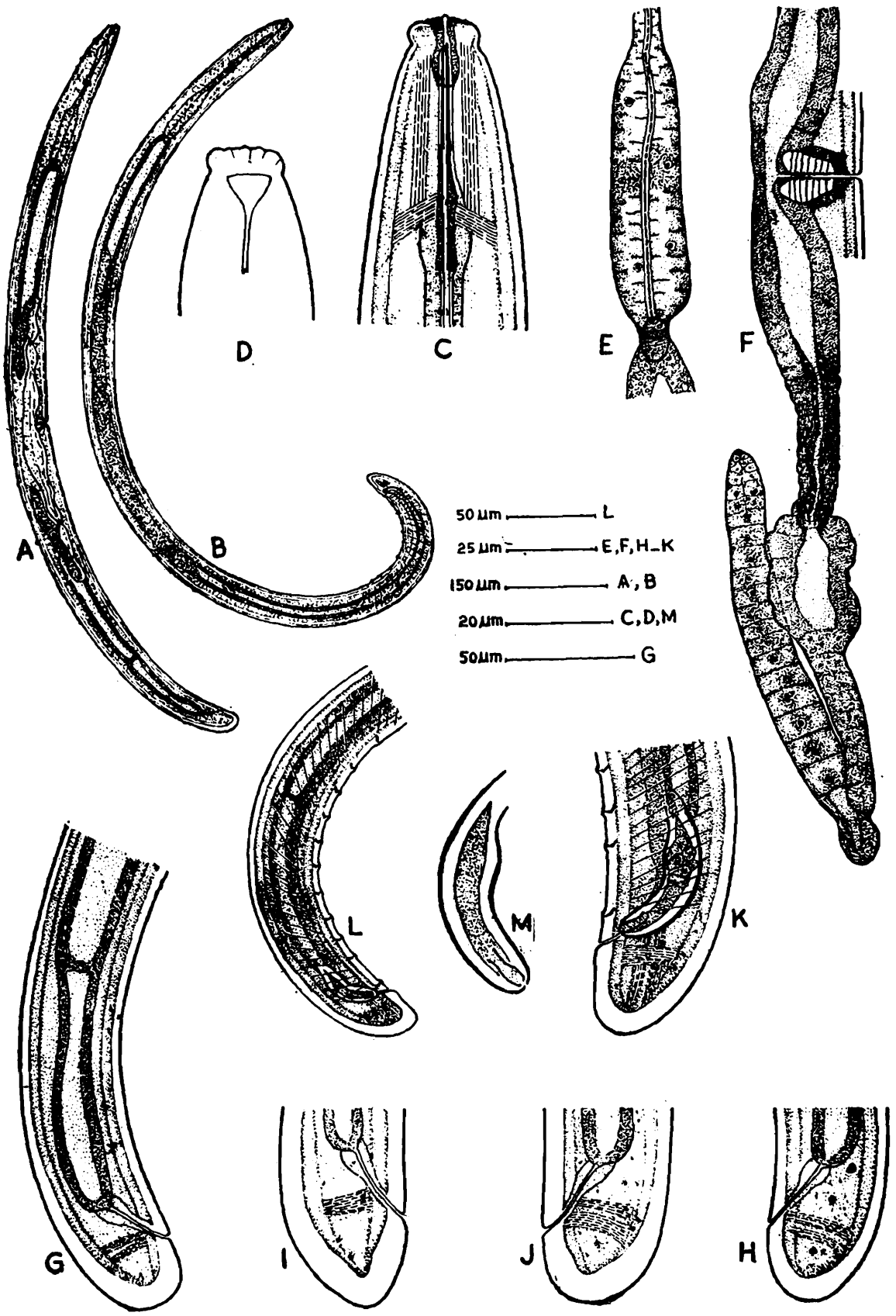

Fig. 4. — *Enchodelus* (*Rotundus*) *parateres* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end showing amphid, (E) Expanded part of oesophagus, (F) Posterior female sexual branch, (G-I) Female tail ends, (K & L) Male tail ends, (M) Spicule.

Vulva a transverse slit. Vagina extending 1/3rd across the body, encircled proximally by cuticularization and distally by sphincter muscles. Gonads amphidelphic. Uterus divided into a proximal glandular and distal muscular part. Ovaries reflexed, oocytes arranged in a single row except in growth region.

Tail 0.6-1.2 anal body-widths long, bluntly conoid or hemispheroid with two caudal pores on each side.

Male : Supplements an adanal pair and 9-10 ventromedians, the latter irregularly spaced. Spicules about 1.7-1.8 anal body-widths along median axis. Lateral guiding pieces well developed, 8-9 μm along median axis. Copulatory muscle bands occupying the area up to last ventromedian supplement. Prerectum starts from second ventromedian supplement, about 3.5-3.8 anal body-widths long.

Habitat and locality : Soil around the roots of wild fruit tree, near Degree College, Lansdowne (altitude approx. 1,415 m), Uttar Pradesh.

Remarks : *E. parateres* was described by Baqri & Jairajpuri (1974) from soil around roots of weeds and mosses from Manali, Himachal Pradesh. The present specimens were collected from soil around roots of wild fruit trees from Lansdowne, Uttar Pradesh. They agree fairly well with the description of *E. parateres* as given by Baqri & Jairajpuri (1974). However, there are minor variations in body dimensions of these specimens. The length of odontostyle is 20-23 μm (21-22μm) while the length of odontophore is 22-26 (23-28 μm) in these specimens. The number of ventromedian supplements is 9-10 (7).

The values in parentheses are of the type specimens of *E. parateres* as given by Baqri & Jairajpuri.

V **Enchodelus (Paraenchodelus) constrictus** Jairajpuri & Loof, 1968

(Fig. 5, A-J)

Dimensions :

Female : L=1.40 mm ; a=24 ; b=5.2 ; c=36 ; c^1=1.5 ; V=51 ; G_1=26 ; G_2=30.

Male : L=1.19 mm ; a=23 ; b=5.1 ; c=32 ; c^1=1.6 ; T=51.

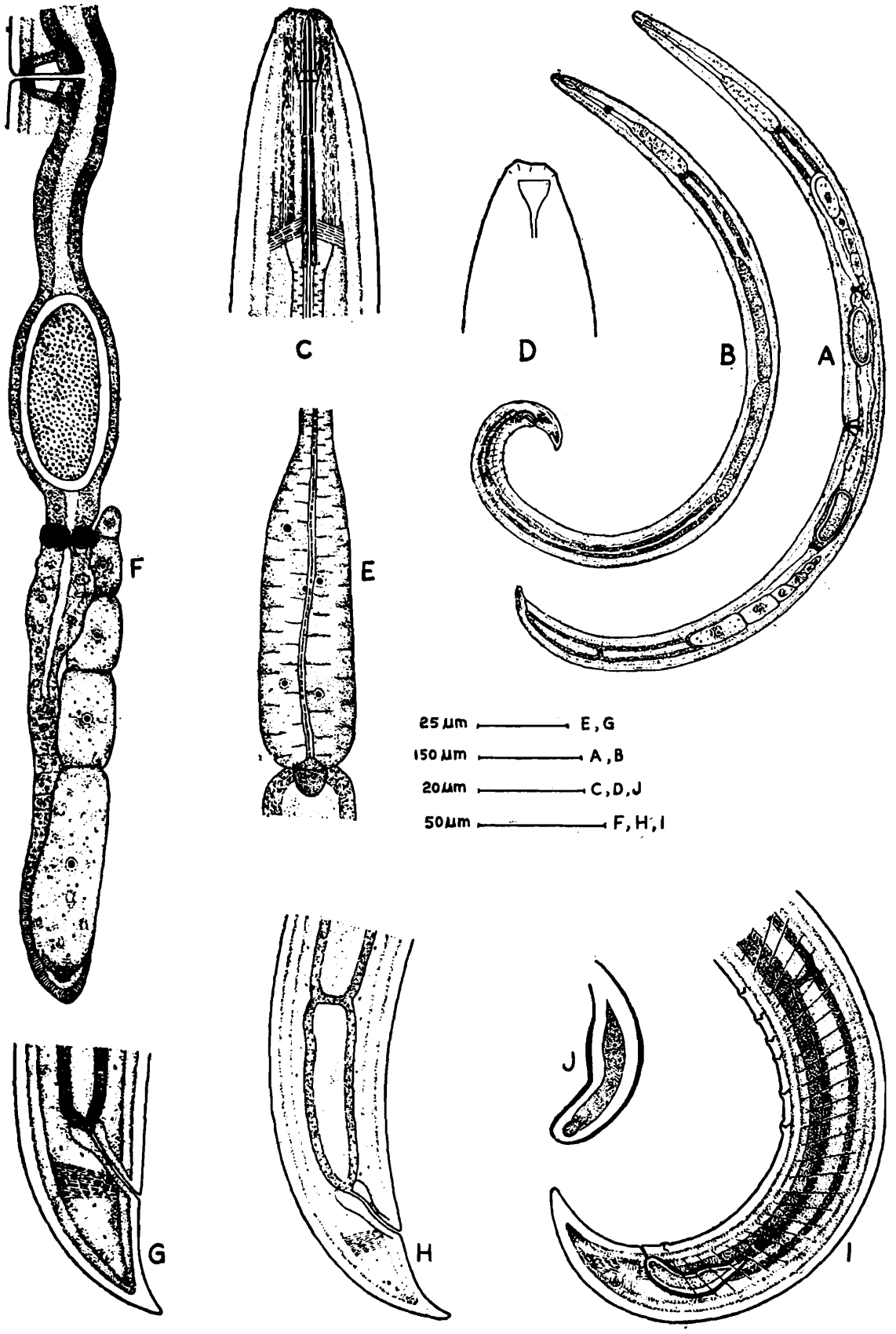

Fig. 5. — *Enchodelus* (*Paraenchodelus*) *constrictus* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end showing amphid, (E) Expanded part of oesophagus, (F) Posterior female sexual branch, (G & H) Female tail ends, (I) Male tail end, (J) Spicule.

Description :

Female : Body ventrally curved upon fixation more strongly in posterior half. Cuticle finely striated, its thickness on body 3 μm and on tail tip 4 μm. Dorsal, ventral and lateral body pores indistinct.

Lip region slightly set off from body, somewhat angular in contour, about 1/6th of body-width at base of oesophagus. Amphids stirrup-shaped more than half as wide as lip-width. Odontostyle 25 μm or 2.7 head-widths long. Guiding ring 1.5 head-widths from anterior end of body, wall of stoma anterior to guiding ring thickened. Odontophore linear, not flanged, 29 μm or 3.2 head-widths long.

Basal expanded part of oesophagus occupying about 41% of neck length. The location of the oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at 50% of neck length from anterior end of body. Cardia rounded, surrounded by intestinal tissues. Prerectum 2.7 and rectum about one anal body-width long.

Vulva a transverse slit, vagina extending inwards less than one half of corresponding body-width and distinctly sclerotized. Gonads amphidelphic. A well developed sphincter present between uterus and oviduct. Uterine egg measures 82 × 23 μm. Ovaries reflexed, oocytes arranged in a single row.

Tail conoid, ventrally curved, 1.5 anal body-widths long with two caudal pores on each side.

Male : Supplements an adanal pair and 5 ventromedians, spaced as in Fig. 5, I. The posterior three more closer together than the others. Spicules 40 μm or 1.7 anal body-widths along median axis, stout, heavily sclerotized with lateral guiding pieces. Copulatory muscle bands occupying the area up to the last ventromedian supplement. Prerectum begins after the last ventromedian supplement.

Habitat and locality : Soil around roots of ferns from Nainital, Uttar Pradesh.

Remarks : The specimens for this study were taken from the Nematode Collection of the Department of Zoology, Aligarh Muslim University.

VI. **Enchodelus (Paraenchodelus) longidens** Jairajpuri & Loof, 1968 (Fig, 6, A—I)

Dimensions :

Females (2) : L=1.59-1.75 mm ; a = 35 ; b = 4.5-5.3 ; c = 32-35 ; c^1 = 1.6-1.8 ; V= 48-51 ; G_1 = 18 ; G_2 = 20.

Male : L = 1.64 mm ; a = 33 ; b = 5.2 ; c = 29 ; c^1 = 1.8 ; T = 65.

Description :

Female : Body ventrally curved to C-shaped upon fixation, tapering gradually in neck region. Cuticle finely striated, its thickness 2-4 μm on body, 5-6 μm on tail. Dorsal, ventral and lateral body pores not distinct.

Lip region set off from body by a slight depression, about 1/4th body-width at base of oesophagus and about twice as wide as high. Amphids cup-shaped with slit-like apertures. Odontostyle 43-48 μm or 3.7-4.0 head-widths long ; its aperture 1/21-1/16th of its length. Guiding ring 1.6-1.8 head-widths from anterior end of body. Odontophore linear without flanges, nearly as long as odontostyle.

Basal expanded part of oesophagus occupying 29-31% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding anterior slender part of oesophagus at 45-50% of neck length from anterior end of body. Cardia hemispheroid, surrounded by intestinal tissues. Prerectum about three and rectum about one anal body-width long.

Vulva a transverse slit, extending 1/3-1/2 across the body, encircled proximally by conspicuous sclerotization. Gonads amphidelphic. Uterus divided into a proximal glandular and a distal muscular part. Oviduct and uterus distinctly separated by a sphincter. Ovaries short, reflexed ; oocytes arranged in a single row except in growth region.

Tail 1.5-1.7 anal body-widths long, conoid, bent ventrally and provided with two caudal pores on each side.

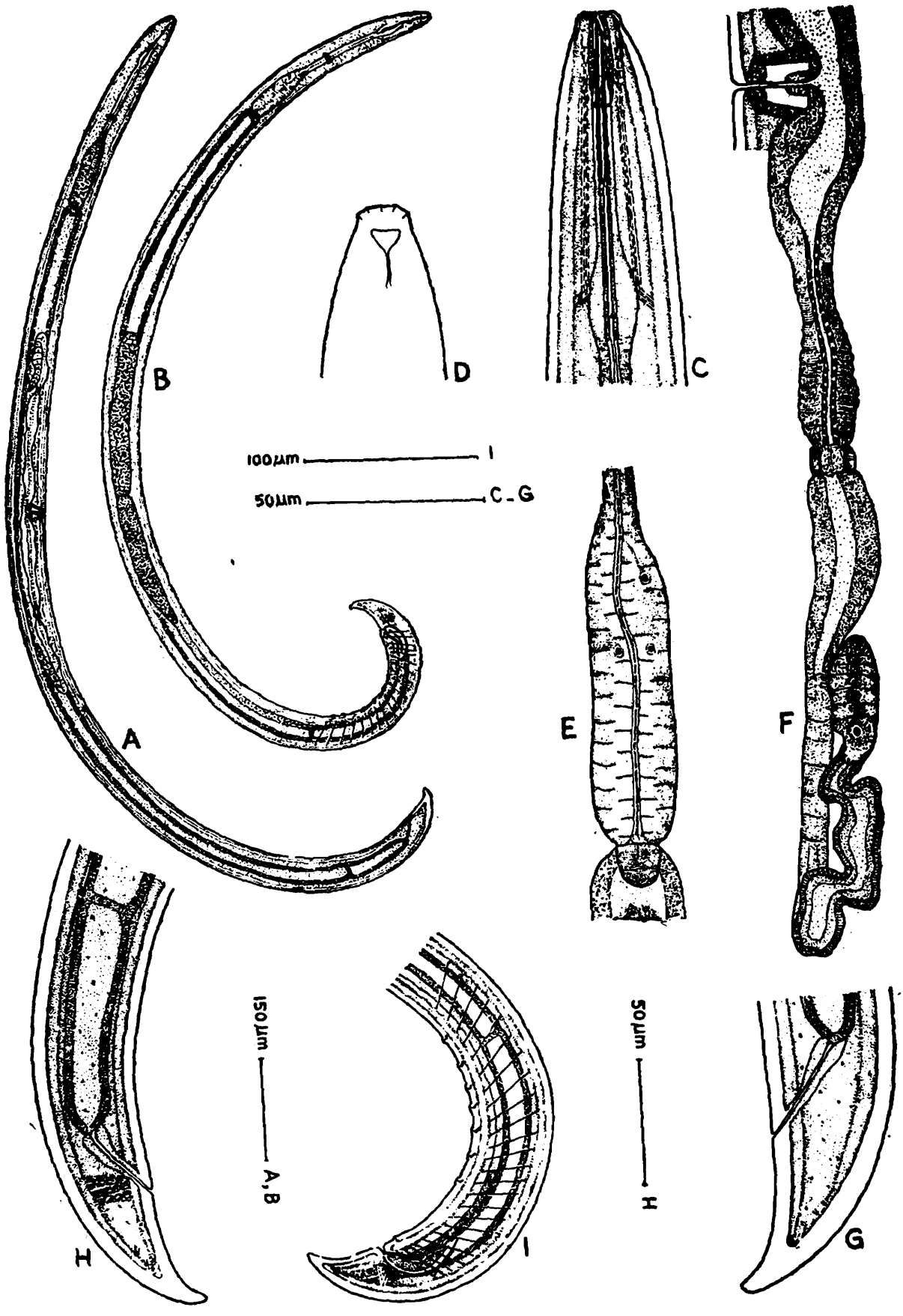

Fig. 6. — *Enchodelus* (*Paraenchodelus*) *longidens* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end showing amphid, (E) Expanded part of oesophagus, (F) Posterior female sexual branch, (G & H) Female tail ends, (I) Male tail end.

Male : Supplements an adanal pair and seven ventromedians spaced almost at regular intervals. Spicules 48 μm or 1.5 anal body-widths along median axis. Lateral guiding pieces present. Copulatory muscle bands occupying the area up to the last ventromedian supplement. Prerectum begins after the last ventromedian supplement and is about five anal body-widths long.

Habitat and locality : Soil around the roots of unidentified grasses from Nainital, Uttar pradesh.

Remarks : The present study is based on specimens from the Nematode Collection in the Department of Zoology, Aligarh Muslim University.

VII. **Enchodelus (Paraenchodelus) satendri** Baqri & Jairajpuri, 1974

(Fig. 7, A-M)

Dimensions : Table 2.

Description :

Female : Body ventrally curved upon fixation, more strongly in posterior half. Cuticle finely striated, its thickness on body 3.5 μm and on tail tip 14-20 μm. Body pores indistinct.

Lip region set off from body by a depression, 1/4th as wide as body at base of oesophagus, about thrice as wide as high. Amphids cup-shaped with slit-like apertures occupying more than 2/3rds of lip-width. Odontostyle 24-27 μm or 1.9-2.1 head widths long. Guiding ring 1.2-1.3 head-widths from anterior end. Odontophore linear with small swellings at its base, 29-33 μm or 1.2 of odontostyle length. Maximum width of swellings 3-4 μm.

Basal expanded part of oesophagus occupying about 33-45% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at 45-50% of neck from anterior end of body. Cardia hemispheroid, 10-12 μm long, surrounded by intestinal tissues. Prerectum 3.5-4.2 and rectum 1.2-1.3 anal body-widths long.

Vulva a transverse slit, vagina extending 1/3-2/5 across the body, encircled proximally by cuticularization. Gonads amphidelphic, uterus

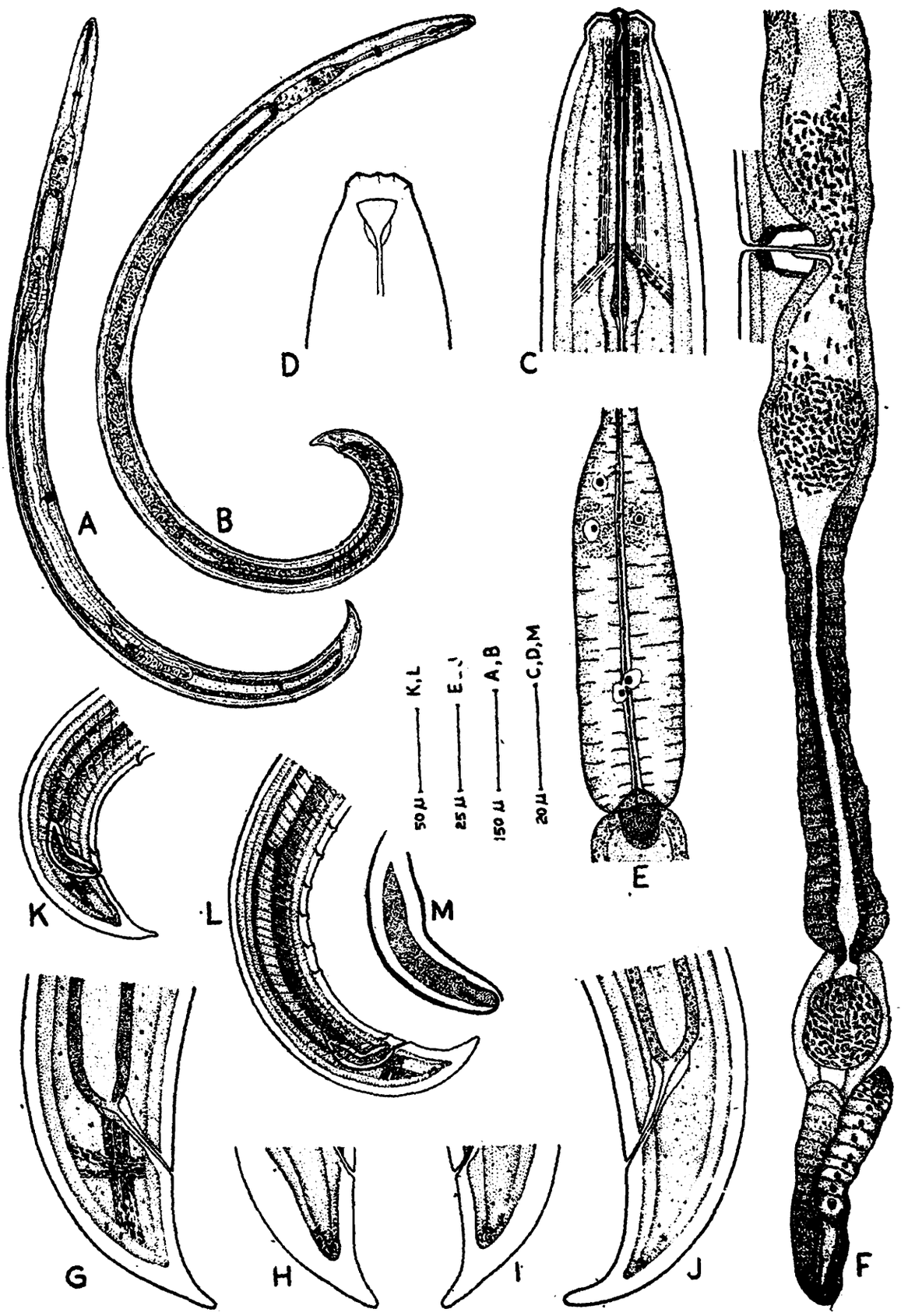

Fig. 7. — *Enchodelus* (*Paraenchodelus*) *satendri* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end showing amphid, (E) Expanded part of oesophagus, (F) Posterior female sexual branch, (G-J) Female tail ends, (K & L) Male tail ends, (M) Spicule.

TABLE 2 Dimensions of *Enchodelus* (*Paraenchodelus*) *satendri* Baqri & Jairajpuri, 1974

Populations	L mm	a	b	c	V/T	G_1	G_2	Odonto-style (μm)	Odonto-phore (μm)	Cut. at m.b. (μm)	Cut. at tail (μm)	Amphid width (μm)	Pos Am (μm
Total Mean	1.39	27	5.1	29	53	21	20	25	30.5	3.5	14	8.5	4
Entire range 29 ♀ ♀	1.21-1.58	23-32	4.3-5.9	23-35	49-58	16-27	12-28	23-27	26-35	2-5	7-21	7-10	3-
Total Mean	1.33	26	5.1	27	62	—	—	23.5	31.5	3.5	14.5	8.5	4
Entire range 13 ♂ ♂	1.14-1.52	23-30	4.1-6.1	23-32	45-80	—	—	22-25	30-33	2-5	9-20	7-10	3-5
(i) Mean	1.36	25	5.3	31	55	17	15	25.5	30.5	3.5	13	8.5	4.5
Range 5 ♀ ♀	1.26-1.47	23-27	5-5.6	26-35	52-58	16-18	12-18	24-27	29-32	3-4	7-19	7-10	4-5
(ii) Mean	1.19	26	5	27	51	—	—	23.5	32	3.5	9.5	9.5	4.5
Range 2 ♂ ♂	1.14-1.25	26-27	4.2-5.2	29-30	45-57	—	—	22-25	31-33	3-4	9-10	9-10	4-5
1 ♀	1.44	32	5.2	34	52	21.5	21	24.5	29	3	13	7.2	4
(iii) Mean	1.39	27	5.0	28	53	22	22	25	31.5	4	11	8.5	4.5
Range 17 ♀ ♀	1.21-1.58	22-32	4.3-5.7	23-33	49-57	17-27	18-27	23-27	26-35	3-5	9-13	7-10	4-5
Mean	1.36	26	5.0	29	72	—	—	24	32	3.5	9.5	8 5	4.5
Range 6 ♂ ♂	1.26-1.47	23-29	4.1-5.9	26-32	64-80	—	—	23-25	31-33	3-4	9-10	7-10	4-5
(iv) Mean	1.45	30	5.7	32	53	18	19	25	31	4	11	9	4.5
Range 3 ♀ ♀	1.42-1.49	30-31	5.5-5.9	30-34	51-55	15-21	17-21	24-26	30-32	3-5	9-13	8-10	4-5
Mean	1.41	28	5.3	29	63	—	—	24	31	4	10	8.5	4
Range 3 ♂ ♂	1.31-1.52	27-30	5.1-5.6	29-30	57-69	—	—	23-25	30-32	3-5	8-12	7-10	3-5
(v) Mean	1.43	27	5.3	27	51.5	25	26	24	33.5	3	19	8	4
Range 3 ♀ ♀	1.35-1.52	25-30	5-5.6	23-32	51-52	24-26	25-28	23.5-24.5	33-34	2-4	17-21	7-9	3-5
Mean	1.45	28	5.8	25	66	—	—	23.7	31	3	17.5	8.5	4
Range 2 ♂ ♂	1.39-1.51	26-30	5.5-6.1	23-26	62-70	—	—	23-24.5	30-32	2-4	15-20	7-10	3-5

Habitats and localities:

i) Soil around roots of grasses from Municipal Gardens, Mussoorie, Uttar Pradesh.
ii) Soil around roots of *Marchantia* sp., from Tallital, Nainital, Uttar Pradesh.
iii) Soil around roots of *Marchantia* sp., from Tiphintop, Nainital, Uttar Pradesh.
iv) Soil around roots of *Marchantia* sp., from Jeolikot, Nainital, Uttar Pradesh.
v) Soil around roots of mosses from Pauri Road, Lansdowne, Garhwal, Uttar Pradesh.

ion of hid	Rectum (μm)	Pre-rectum (μm)	ABD	Tail/ ABD	Spicules (μm)	No. of v.m. supp.
	36	100	32.5	1.5	—	—
	26-46	50-150	26-39	1.1-2.0	—	—
	39	126	30.5	1.6	48	6
	32-46	80-173	26-35	1.4-1.9	42-53	5-6
	33	94	34	1.4	—	—
	28-38	72-116	29-39	1.1-1.7	—	—
	34	108	27.5	1.6	45	6
	32-36	100-115	26-29	1.4-1.9	42-48	6
	26	101	26	1.4	—	—
	37	105	31	1.6	—	—
	28-46	60-150	26-36	1.3-2.0	—	—
	40.9	144	31.5	1.5	49	6
	35-46	123-165	30-33	1.4-1.6	45-53	6
	31	79	30	1.5	—	—
	27-35	50-108	29-31	1.4-1.6	—	—
	38	105	31.5	1.5	43	5
	33-43	80-130	30-33	1.4-1.6	42-44	5
	31	86.5	31.5	1.6	—	—
	26-36	79-94	30-33	1.2-2.0	—	—
	38	144	34	1.5	44.5	6
	36-40	115-173	33-35	1.4-1.6	43-46	6

divided into a proximal glandular and a distal muscular part. Oviduct and uterus distinctly separated by sphincter. Ovaries reflexed, oocytes arranged in single row except in growth region. Sperms are seen in the proximal part of uterus.

Tail 1.4-1.6 anal body-widths long, conoid with rounded terminus, slightly ventrally curved with two caudal pores on each side.

Male : Supplements an adanal pair and 5-6 ventromedians, the latter spaced nearly at regular intervals. Spicules 42-53 μm or about two anal body-widths along median axis. Lateral guiding pieces well developed. Capulatory muscle bands occupy the area up to the last ventromedian supplement. Prerectum about four and rectum about one anal body-width long.

Habitat and localities : Table II.

Remarks : *E. satendri* was described by Baqri & Jairajpuri (1974) from soil from the sulphur springs, Manali, Himachal Pradesh. The present populations were collected from Kumaon and Garhwal hills in Uttar Pradesh. They agree fairly well with the description of *E. satendri* as given by Baqri & Jairajpuri. However, there are minor variations in body dimensions of these specimens. The length of body is comparatively shorter (1.38 -1.88 mm). The length of odontophore is also short (34-40) μm.

The values in parentheses are of the type specimens as given by Baqri & Jairajpuri (1974).

VIII. **Enchodelus (Paraenchodelus) thornei** Baqri & Jairajpuri (1974)

(Fig. 8, A-I)

Dimensions :

Female : L=1.23 mm ; a=31 ; b=4.7 ; c=24 ; c^1=2.2 V=52 ; G_1=20 ; G_2=18.

Male : L=1.38 mm ; a=35 ; b=5.2 ; c=28 ; c^1=1.5 ; T=52.

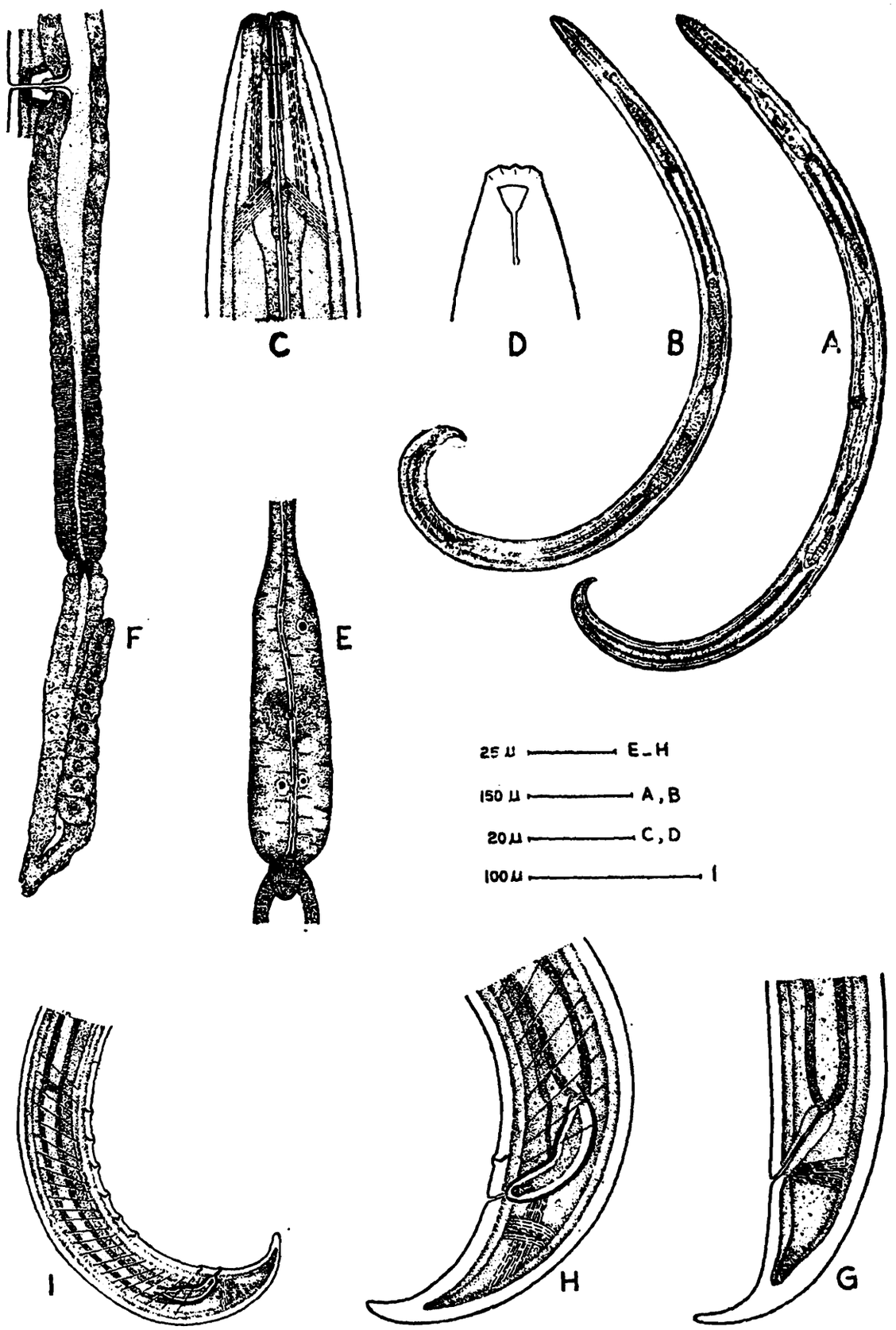

Fig. 8. — *Enchodelus* (*Paraenchodelus*) *thornei* (A) Entire female, (B) Entire male, (C) Head end, (D) Head end showing amphid, (E) Expanded part of oesophagus, (F) Posterior female sexual branch, (G) Female tail end, (H & I) Male tail ends.

Description :

Female : Body ventrally curved upon fixation, more strongly in posterior half, tapering gradually in neck region. Cuticle finely striated, its thickness on body 3 μm and on tail tip 13 μm. Dorsal, ventral and lateral body pores indistinct.

Lip region set off from body by a slight depression, about 1/3rd body-width at base of oesophagus. Amphids cup-shaped with curved slit-like apertures occupying about 2/3rd of corresponding body-width. Odontostyle 17 μm or 1.4 head-widths long, its aperture about 1/8th of its length. Guiding ring one head-width from anterior end. Odontophore 25 μm long or 1.4 times the odontostyle length.

Basal expanded part of oesophagus occupying about 40% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at 50% of neck length from anterior end of body. Cardia tongue-shaped, surrounded by intestinal tissues. Oesophago-intestinal disc present. Prerectum about four and rectum about one anal body-width long.

Vulva a transverse slit. Vagina extending inwards about 1/3rd of corresponding body-width, encircled by cuticularization. Gonads amphidelphic. Uterus divided into a proximal glandular and distal muscular part. Oviduct and uterus separated by a distinct sphincter. Ovaries reflexed, oocytes arranged in a single row except in growth region.

Tail 2.2 anal body-widths long with two caudal pores on each side, conoid, ventrally arcuate, with rounded terminus.

Male : Supplements an adanal pair and 6 ventromedians, the latter spaced nearly at regular intervals. Spicules about 1.3 anal body-widths along median axis. Lateral guiding pieces well developed. Copulatory muscle bands occupy the area up to last ventromedian supplement. Prerectum about 4 anal body-widths long, extending up to the last ventromedian supplement.

Habitat and locality: Collected from soil around roots of deodar, *Cedrus deodara* from Naggar (altitude approx. 1,825 m), district Kulu, Himachal Pradesh.

Remarks: The above study is based on a female and a male specimens from the Nematode Collection of the Department of Zoology, Aligarh Muslim University.

IX. **Enchodelus (Paraenchodelus) zonatus** Jairajpuri & Loof, 1968

(Fig. 9, A-E)

Dimensions:

Females (7): L=1.77-2.00 mm ; a=35-39 ; b=4.6-5.8 ; c=28-36 ; V=46-48 ; G_1=9-17 ; G_2=10-19.

Description:

Female: Body slender, ventrally curved upon fixation. Cuticle finely striated, 3 μm thick on body, 10-14 μm on tail. Dorsal, ventral and lateral body pores are not visible.

Lip region set off from the body by a constriction, 1/3rd as wide as body at base of oesophagus, about twice as wide as high. Amphids cup-shaped with slit-like apertures occupying about 2/3rds of lip-width. Odontostyle 34-35 μm or 2 times of lip-width, its aperture about 1/20th of its length. Guiding ring 1.2-1.3 lip-widths from anterior end. Odontophore rod-like, 38-39 μm or about one odontostyle length with small knobs at its base.

Basal expanded part of oesophagus occupying about 40% of neck length. Location of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding anterior slender part of oesophagus at 40% of neck length. Cardia hemispheroid, 11-15 μm surrounded by intestinal tissues. An oesophago-intestinal disc present. Rectum about one anal body-width long, prerectum 7-8 times as long as rectum.

Vulva a transverse slit, vagina about one half of body-width deep with cuticularization around it. Gonads amphidelphic. A well developed sphincter present between uterus and oviduct. Sperms not seen in any part of uterus or oviduct.

Tail 1.9-2.2 anal body-widths long, straight, conoid with blunt tip and two caudal pores on each side.

Male : Not found.

Habitat and locality : Soil around roots of pinus, *Pinus sativus* from Tang Marg, Srinagar, Jammu & Kashmir.

Remarks : *Enchodelus zonatus* was described by Jairajpuri & Loof (1968) on a single female from soil around roots of apple from Srinagar, Jammu & Kashmir. The present specimens were also collected in Srinagar. They agree fairly well with the description of *E. zonatus* as given by Jairajpuri & Loof. However, they have a longer body (1.73 mm), more posterior vulva (V=46) and indistinct hemizonid. The location of oesophageal gland nuclei and their orifices, which were not described earlier, are given in Table III. The gonads have also been studied in detail.

The values in parentheses are of the holotype specimen of *E. zonatus* as given by Jairajpuri & Loof.

X. **Enchodelus (Nepalus) maximus** Baqri & Jairajpuri, 1974

(Fig. 9, F-J)

Dimensions :

Female : L=2.60 mm ; a=41 ; b=6.0 ; c=43 ; V=49 ; G_1= 15 ; G_2=15.

Description :

Female : Body ventrally curved in posterior half when fixed and tapering slightly in neck region. Cuticle finely striated, its thickness on body 5 μm and on tail tip 23 μm. Dorsal, ventral and lateral body pores not visible.

Lip region distinctly set off from body, about 1/4th body-width at base of oesophagus. Amphids cup-shaped, irregulary curved slit-like apertures occupying about 3/4th of corresponding body-width.

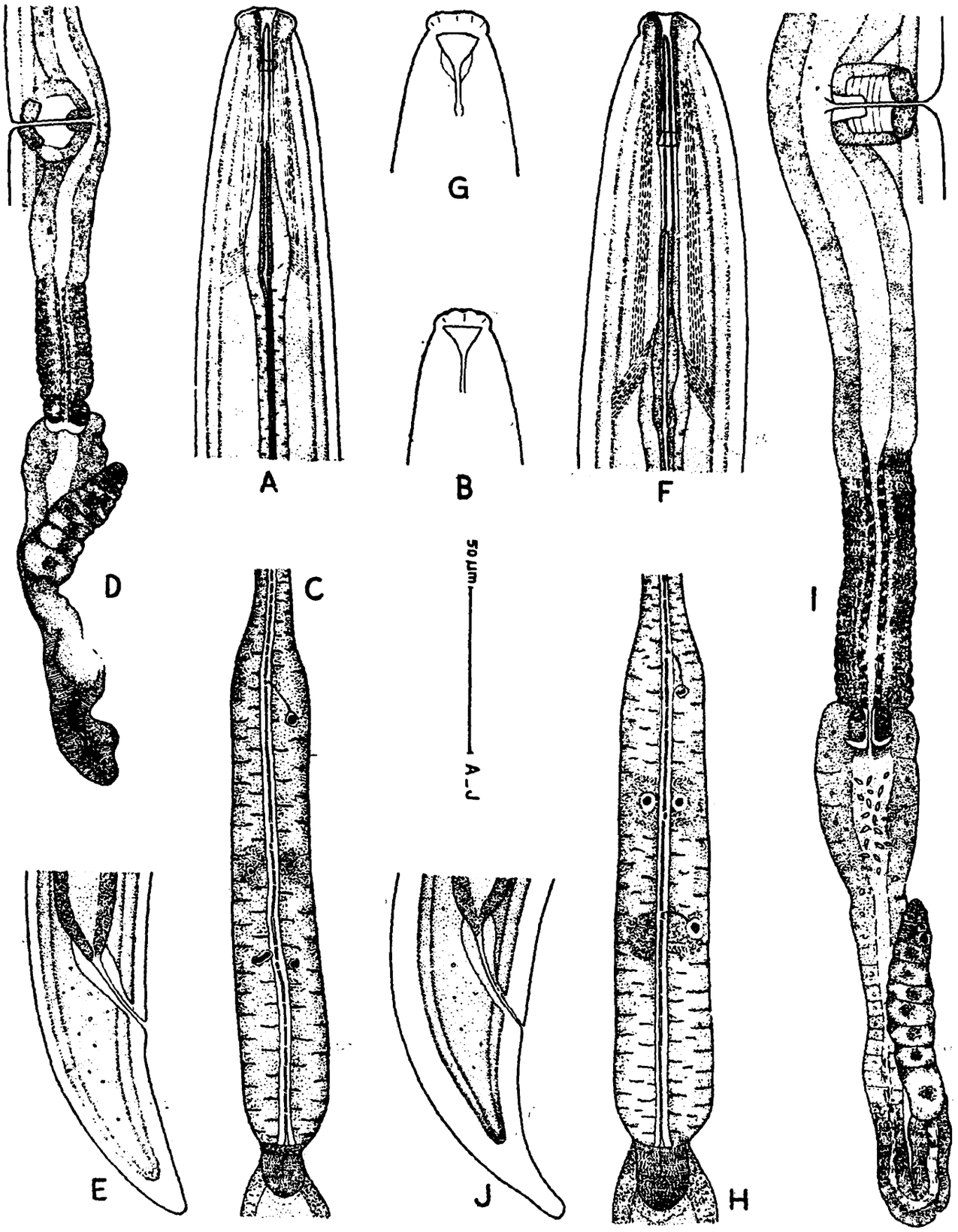

Fig. 9. — A-E *Enchodelus* (*Paraenchodelus*) *zonatus* (A) Head end, (B) Head end showing amphid, (C) Expanded part of oesophagus, (D) Posterior female sexual branch, (E) Female tail end. F - J *Enchodelus* (*Nepalus*) *maximus* (F) Head end, (G) Head end showing amphid, (H) Expanded part of oesophagus, (I) Posterior female sexual branch, (J) Female tail end.

TABLE 3 Location of oesophageal gland nuclei and their orifices in ***Enchodelus*** species.

	Subgenus *Enchodelus*			***Rotundus*** n. subg.			*Paraenchod*
	E. (E.) macrodorus	*E. (E.) microdoroides*	*E. (E.) distinctus*	***E. (R.) parateres***	*E. (P.) satendri*	*E. (P.) thornei*	*E. (constr*
DO	63-65	67-71	70.8	67-68	66-73	69.2	71.
DN	67-70	73-77	73.6	71-73	70-70.5	73	75
DO-DN	3.6-4.6	5.2-6.2	2.8	4-5.5	2.2-5	3.8	3
S_1N_1	86-88.5	76-84	83	80-82	78-83	83.4	80
S_1N_2	87-90	77-85	83.3	82-84	78-84	84.6	80
S_2N	92.4-95.7	86-88	90.2	88-90	83-93	91.5	94
S_2O	93.5-96.7	88-89	91.6	90-92	84-94	92.3	94

lus n. subg.			*Nepalus* n. subg.
P.) *ctus*	*E. (P.)* *longidens*	*E. (P.)* *zonatus*	*E. (N.)* *maximus*
4	75.3	63-68	62.7
	80	67-73	65.9
7	4.6	3.7-6	3.2
7	85.2	76-82.5	78.8
3	85.5	77-83	79.3
	—	79-94	82
3	—	80-95	82.7

Odontostyle 54 μm or 3½ head-widths long, its aperture about 1/20th of its length. Guiding ring 2.3 head-widths from anterior end. Odontophore about equal to odontostyle length, linear with moderately developed flanges at its base. Maximum width of flanges 6μm.

Basal expanded part of oesophagus occupying about 37% of neck length. Locations of oesophageal gland nuclei and their orifices as given in Table III. Nerve ring surrounding the anterior slender part of oesophagus at 43% of neck length from anterior end of body. Cardia rounded, surrounded by intestinal tissues. Prerectum 5½ and rectum about one anal body-width long.

Vulva a transverse slit. Vagina extending about 2/5th of width across the body, encircled at proximal end by cuticularization and at distal end by sphincter. Gonads amphidelphic. Uterus divided into a proximal glandular and a distal muscular part. Oviduct and uterus distinctly separated by sphincter. Spindle-shaped sperms present in uterus and oviduct. Ovaries reflexed ; oocytes arranged first in single, then in double rows.

Tail about two anal body-widths long, conoid, ventrally curved with rounded terminus and with 2 caudal pores on each side.

Male : Not found.

Habitat and locality : Soil around roots of deodar, *Cedrus deodara* from Naggar (altitude approx. 1,825 m) district Kulu, Himachal Pradesh.

Remarks : The above observations are based on a female specimen from the Nematode Collection of Department of Zoology, Aligarh Muslim University, which was studied in detail.

SUMMARY

The present work provides a detailed account of the morphology and systematics of *Enchodelus* Thorne, 1939. The genus *Enchodelus* is heterogeneous and in order to solve the existing problem of diversity within this genus it has been proposed to split the genus into the following five subgenera : *Enchodelus* (Thorne, 1939) n. rank ;

Rotundus n. subg. ; *Heterodorus* (Altherr, 1952) n. rank ; *Paraenchodelus* n. subg. and *Nepalus* n. subg. The subgenera have been diagnosed and identification keys for *Enchodelus*, *Rotundus* and *Paraenchodelus* have been provided. The descriptions of all the species of the genus *Enchodelus* so far recorded from India based either on the type material or fresh material or both have been provided. The description of each species is followed by remarks on its relationship with other species and its geographical distribution. In all, the following 9 known species and one new species under four subgenera were recorded from this country : *E.* (*E.*) *macrodorus* (De Man, 1880) Thorne, 1939, *E.* (*E.*) *microdoroides* Baqri & Jairajpuri, 1974, *E.* (*E.*) *distinctus* n. sp., *E.* (*R.*) *parateres* Baqri & Jairajpuri, 1974, *E.* (*P.*) *constrictus* Jairajpuri & Loof, 1968, *E.* (*P.*) *longidens* Jairajpuri & Loof, 1968, *E.* (*P.*) *satendri* Baqri & Jairajpuri, 1974, *E.* (*P.*) *thornei* Baqri & Jairajpuri 1974, *E.* (*P.*) *zonatus* Jairajpuri & Loof, 1968 and *E.* (*N.*) *maximus* Baqri & Jairajpuri, 1974. The males of *E.* (*E.*) *microdoroides* have been described for the first time.

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