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OBSERVATIONS ON *CAMPYDORA*
(NEMATODA: DORYLAIMIDA)

by

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In his classical paper on one hundred new nemas Cobb (1920) described an interesting and unique species of nematode, *Campydora demonstrans*, from the soil around roots of citrus trees from Corfu, Greece. He described the lip region, pharyngeal cavity, oesophagus including the basal bulb, intestine and tail, but illustrated only the anterior extremity and the tail tips (Fig. 1). The cuticle was described as being naked but provided with eight longitudinal lines running the entire length of the body and attaining the magnitude of « wings » in certain parts. Cobb stated that the labial papillae were similar to those seen in *Dorylaimus*, although not directly mentioning any affinities of the species with dorylaims. The tooth was described as a solid onchium placed axially or nearly so, with the apex bent considerably to the dorsal side and its protrusion controlled by means of longitudinal muscles of the pharyngeal bulb. The vulva was described as somewhat circular, the vagina cuticularized, the uterus extending forward and the ovary backwards past the vulva.

Thorne (1939) found specimens remarkably similar to those described by Cobb in the soil at the summit of Mt. Timpanogos, Utah, USA, and from the banks of Aspen Creek on the flank of the mountain. He described and illustrated (Fig. 1) these specimens and also remarked

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on the absence of the prerectum. The wing-like longitudinal striae on the cuticle described by Cobb were regarded as fixation artifacts by Thorne. The reproductive system was described as comprising an anterior sexual branch with its ovary reflexed almost as far back as the vulva and posterior sexual branch reduced to a rudimentary outstretched tube.

Altherr (1950) apparently found the same species in Switzerland and provided a brief description and illustrations (Fig. 1) but he was doubtful about several morphological features of this nematode. He described the dorsal tooth as being fixed on a spherical base, the gonads doubtfully paired and illustrated an anterior uterine sac (monopisthodelphic) and did not see the lateral chords with certainty.

Andrássy (1959) transferred *Desmolaimus balatonicus* Daday, 1894 from Lake Balaton, to this genus. *Campydora balatonicus* (Daday, 1894) Andrássy, 1959, though an interesting species of nematode, cannot belong in *Campydora* because of the shape of its lip region, feeding apparatus and outstretched gonads. It needs to be studied further in order to determine its exact taxonomic status. In his generic diagnosis of *Campydora*, Goodey (1963) described the reproductive organs as single, anterior and reflexed with a post-vulval uterine sac (mono-prodelphic). Andrássy (1976) has also mentioned that the reproductive system of *Campydora* is of the mono-prodelphic type. Nesterov (1979) recorded *C. demonstrans* from Moldavia, South-eastern USSR and described the reproductive organs to be of the mono-prodelphic type with a post-vulval uterine sac.

The above indicates the confusion concerning the various morphological features of *Campydora*, especially with regard to its feeding apparatus, oesophagus and reproductive organs.

In 1964, I found some specimens of *Campydora demonstrans* in soil samples collected in Kashmir, India but did not describe or illustrate the species at that time because the specimens appeared to be very similar to those described by Thorne (1939). During the last few years, I have found more specimens of this species from various other places in the Himalayan mountains. I have never found any specimen of this genus from the plains although I have examined several thousand soil samples from many different localities in India during the last twenty years. This confirms that *Campydora* prefers a colder climate in India, but according to Nesterov (1979) it is a warm loving species with preference for moist and light soils in Moldavia, USSR.

With the specimens collected in India and some received from the U. S. Department of Agriculture through the courtesy of Dr. A. Morgan Golden, it has been possible for me to study the morphology and systematic position of *C. demonstrans* in detail.

MORPHOLOGY OF *Campydora demonstrans* COBB, 1920
(Figs. 1 and 2)

Dimensions:

Females (25): L = 0.58-0.64 mm; a = 24-27; b = 2.7-3.0; c = 6-7;
V = 58-62.

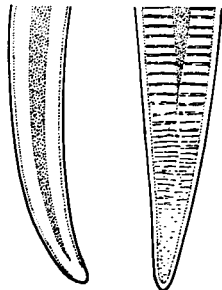
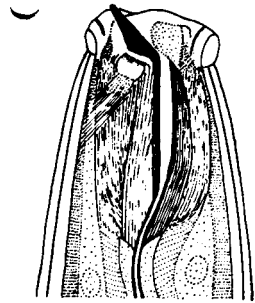
Description:

Body small, almost straight, tapering only slightly anteriorly but quite markedly towards the tail. Cuticle 1.4 μ m thick. Outer cuticle apparently smooth but fine striae may be visible on the sub-surface, especially in the region of tail. Inner cuticle very finely striated. Lateral chords absent. Eight longitudinal lines in anterior region of the body, difficult to discern on mounted specimens. Lip region well set off from the body, knob or cap-like, wider than adjoining body and about one-half of body width at base of oesophagus. Lips exceptionally large, hyaline and mammiform, labial papillae distinct. Amphids very small and obscure, their apertures about one-fifth of the lip region width. Pharyngeal cavity narrow and tubular, 18-23 μ m long or about twice the lip region width. Pharyngeal muscles well developed. Onchium or mural tooth 4-5 μ m long, slender, acute and hollow, and located subdorsally in the pharyngeal cavity which becomes slightly wider in this region. A small, faint, rounded to oval swelling may be visible just at the base of the tooth, usually in live or freshly killed specimens, giving the tooth a hammer-shaped appearance (cf. Altherr, 1950). When the specimens are processed in glycerine, the swelling may become hyaline and disappears. Oesophagus begins as a narrow tube, 7-12 μ m wide or nearly one-third of the corresponding body width, gradually or often suddenly widening posteriorly and ending in a basal bulb measuring 25-32 \times 17-24 μ m occupying nearly three-fourth of the corresponding body width (nearly one-sixth to one-eighth of the total oesophageal length). Width of oesophagus just above the basal bulb is nearly one-half of the corresponding body

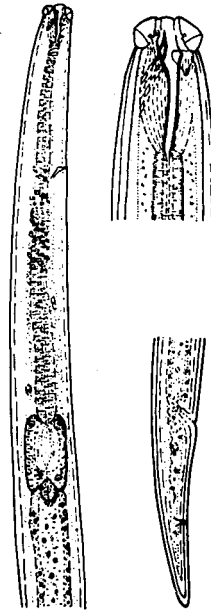
width. The entire oesophagus, including the basal bulb, is highly muscular. Lumen of oesophagus is narrow, measuring 3-4 μm , until just before the basal bulb when it is 5-6 μm wide, whereas in the basal bulb it increased to 13-17 μm , occupying 80-90% of its width and forming a distinct, triquetrous chamber (cf. Thorne, 1939). Oesophageal glands and their orifices are obscure due to the strong oesophageal musculature and the extended lumen of the basal bulb. Cardia large, bluntly conoid, measuring 7-10 μm . Nerve ring situated at 35-40% of the oesophageal length or 80-100 μm from the anterior end of the body. Excretory pore and excretory duct situated a little above the nerve ring, 62-75 μm from the anterior end of the body. Intestine sac-like with a wide lumen. Prerectum absent. Rectum 13-17 μm or about one anal body-width long and connected dorsally to the intestine. Reproductive system didelphic, amphidelphic, with reflexed ovaries. Anterior sexual branch usually more developed, its reflexed ovary extending beyond the vulva and masking the posterior sexual branch either partially or completely. However, in some specimens the posterior branch may be equally developed or rarely more developed than the anterior branch; in the latter case, it may overlap the anterior branch. Ovary large but with only a few oocytes; the oviduct and the uterus are very short and undifferentiated. Vagina thick-walled; vulva transverse with a small flap. Eggs 40-70 \times 13-20 μm , exceptionally large for such a small nematode. Tail elongate-conoid, 5-7 anal body width long, sharply tapering to an acute or subacute terminus. A single caudal papilla is present on either side, near the middle of the tail.

Males were not found and the uteri did not contain any sperms which suggest that the species reproduces by parthenogenesis.

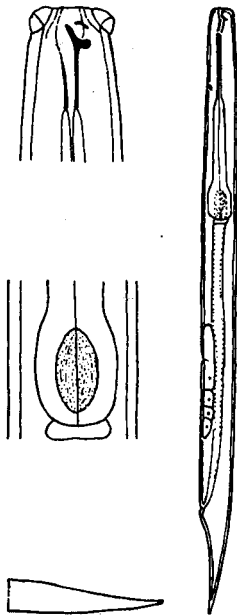
Fig. 1 - *Campydora demonstrans*: Head and tails after Cobb (1920); Oesophageal region, head and tail after Thorne (1939); entire female, head, basal oesophageal region and tail after Altherr (1950); and anterior of body, reproductive organs and tail after Nesterov (1979).



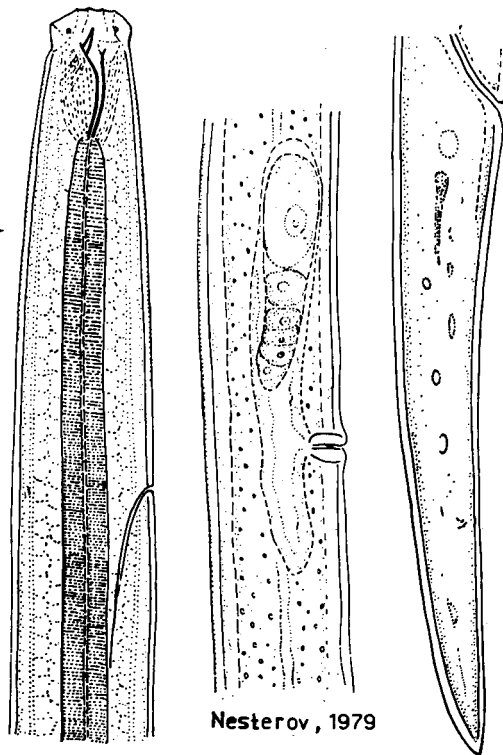
Cobb, 1920



Thorne, 1939



Altherr, 1950



Nesterov, 1979

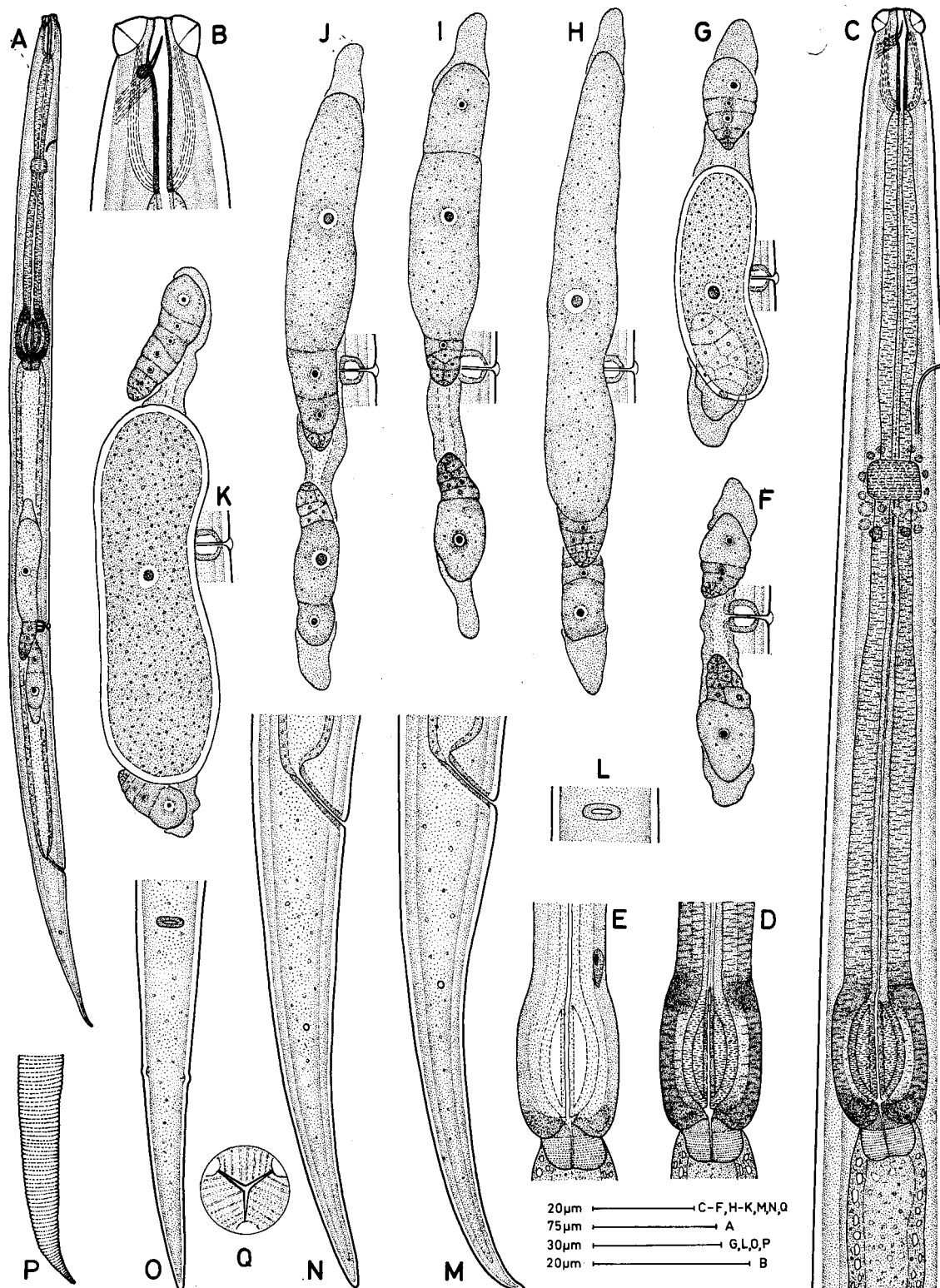


Fig. 2 - *Campydora demonstrans*: A, Entire female; B, Head; C, Oesophageal region; D and E, Basal part of oesophagus; F-K, Female reproductive organs; L, Vulva (ventral); M and N, Tail (lateral); O, Tail (ventral); P, Posterior half of tail showing striations; Q, T.S. basal part of oesophagus.

Remarks

The present study clarifies some existing uncertainties about the morphological features of *Campydora demonstrans*, the type and only species of the genus. The longitudinal 'wing-like' striae described by Cobb (1920) were seen neither by Thorne (1939) nor Altherr (1950). The present author often saw eight faint longitudinal lines to be present in the anterior region of body. The lateral chords are absent in the Indian specimens. The onchium or mural tooth is not solid as described by Cobb or as shown by Altherr. It is hollow, slender, acute and without an aperture. The solid, spherical swelling below the tooth depicted by Altherr was visible in live specimens or in those freshly killed but it was only rarely visible in specimens processed in glycerine. The oesophagus is entirely muscular and the anterior part is similar in appearance to the basal bulb which is only slightly marked off from the rest of the oesophagus. There is also no significant difference in the tissues or musculature of the two regions of the oesophagus. The basal bulb structure encloses the expanded oesophageal lumen (triquetrous chamber) and is entirely different from the basal bulb structure of the leptonchid nematodes.

The reproductive system is didelphic, amphidelphic, with large reflexed ovaries. The same is also true of Thorne's material which I received from USDA. However, both Cobb and Thorne report that the posterior sexual branch is rudimentary and only the anterior gonad is normally developed. This appears to be incorrect as the Indian specimens which consist of young as well as old females clearly show both gonads to be developed, although somewhat unequally. In many specimens, one of the ovaries, usually of the anterior reproductive branch, is larger and reflexed beyond the vulva, overlapping partially or fully the other gonad. This may have been the reason why Cobb and Thorne regarded only one gonad to be functional and the other rudimentary. The position of the vulva is identical in the Indian specimens and those studied by Cobb and Thorne; this strongly supports the possibility that the type of gonad is also the same. Altherr (1950) had only reported the presence of the posterior sexual branch with the anterior branch represented by a sac. He had, however, illustrated the anterior branch as fully extending past the vulva, masking the posterior gonad. Goodey (1963), Andrassy (1976) and Nesterov (1979) have described the reproductive organs as mono-

prodelphic, which is not correct. The ovaries, oocytes and the eggs are very large considering the body size of the nematode.

The absence of a prerectum and the presence of an excretory pore associated with a cuticularized excretory duct are important and unique features of this nematode.

SYSTEMATIC POSITION OF *Campydora*

Cobb (1920) placed *Campydora* in the order Anaxonchia but mentioned that its labial papillae are like those of *Dorylaimus*. Thorne (1935) placed it under a new subfamily Campydorinae but in 1939 grouped this subfamily under the family Leptonchidae, superfamily Dorylaimoidea, suborder Dorylaimina of the order Enoplida, presumably because of the formation of a basal bulb in the oesophagus, although he had also remarked on the nygolaimoid features of this nematode. Clark (1961) raised Campydorinae to the rank of a family, included in it the genera *Tyleptus* Thorne, 1939 and *Aulolaimoides* Micoletzky, 1915, and placed it side by side with Leptonchinae. This unusual grouping, also accepted by Goodey (1963), was perhaps due to the fact that all the three genera possess small basal oesophageal bulbs which are provided with triquetrous chambers. However, apart from this, the three genera have nothing in common. Jairajpuri (1964) removed *Aulolaimoides* from this group and proposed a new family Aulolaimoididae for it. He shifted *Tyleptus* to Leptonchidae under a new subfamily Tyleptinae and left out only *Campydora* under Campydoridae for which he also gave an emended diagnosis. Loof (1964) also transferred *Tyleptus* back to Leptonchidae. Khera (1970) suppressed Campydoridae to a subfamily under Leptonchidae but Ferris (1971) supported Jairajpuri (1964) although she retained Campydoridae under the new superfamily Leptonchoidea. Jairajpuri *et al.* (1976) took Campydoridae out of Leptonchoidea and raised it to an independent superfamily, Campydoroidea, because of its peculiar morphological features. Ahmad and Jairajpuri (1979) proposed a new suborder Nygolaimina by combining the superfamilies Nygolaimoidea and Campydoroidea.

From the study of *Campydora* it becomes quite obvious that it is unique in many respects, viz. the shape of its lip region, the sub-dorsally placed mural tooth, the structure of the oesophagus and the oesophageal lumen forming an enormously developed triquetrous

chamber, the presence of well-developed cardia, excretory pore and excretory duct, the peculiar type of overlapping reproductive system and the absence of a praeectum.

The structure of the oesophagus leaves no doubt that the nematode is not a leptonchid nor does it have even remote affinities to this group. Because of the presence of the mural tooth and the pharyngeal cavity, Ahmad and Jairajpuri (1979) regarded it as a nygolaim. However, the subdorsally placed mural tooth, the type of lips and labial papillae, the structure of the oesophagus, the short, overlapping type of reproductive system and the absence of praeectum make its position untenable in this group also. It therefore appears more logical to remove *Campydora* from Nygolaimina and place it in a new suborder, Campydorina.

Suborder Campydorina new suborder

Diagnosis: Dorylaimida. Lips large, mammiform; labial papillae prominent. Lateral chords absent. Mural tooth hollow, acute and subdorsally located in the pharyngeal cavity. Oesophagus muscular, oesophageal lumen greatly extended to form a large triquetrous chamber in basal part of oesophagus. Reproductive system amphidelphic, reflexed, sexual branches extending beyond vulva. Excretory pore and cuticularized excretory duct present. Praeectum absent. Males not known.

Type and only genus: *Campydora* Cobb, 1920.

Relationship: Campydorina differs from the other two suborders, Dorylaimina and Nygolaimina of the order Dorylaimida in the structure of the feeding apparatus and oesophagus, in the presence of excretory pore and cuticularized excretory duct and in the absence of lateral chords and the praeectum.

S U M M A R Y

The morphology of *Campydora demonstrans* Cobb, 1920 has been studied in detail, especially its feeding apparatus and digestive and reproductive organs. The systematic position of the genus *Campydora* Cobb, 1920 is discussed and a new suborder, Campydorina, under Dorylaimida, is proposed for this genus, based on the shape of the lips, structure of the feeding apparatus, digestive and reproductive organs. The absence of lateral chords, preectum and the presence of excretory pore and cuticularized excretory duct are also characteristic.

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Accepted for publication on 16 November 1982.