

A reappraisal of Tylenchina (Nemata)

10. The superfamily Criconematoidea Taylor, 1936⁽¹⁾

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SUMMARY

Criconematina is reviewed and proposed at superfamily rank only, Criconematoidea, with two families : Criconematidae, with two subfamilies (Criconematinae, Hemicycliophorinae) and Tylenchulidae, with three subfamilies (Tylenchulinae, Paratylenchinae, Tylenchocriconematinae). Major synonymizations have left eight genera recognized in Criconematinae : *Criconema*, *Ogma*, *Criconemella*, *Nothocriconemoides*, *Bakernema*, *Blandicephalanema*, *Pateracephalanema*, and *Hemicriconemoides*. Two genera are recognized in Hemicycliophorinae : *Hemicycliophora* and *Caloosia*. New synonymies of genera include : *Crossonema* (*Seriespinula*), *Seriespinula*, *Crossonema* (*Crossonema*), *Neolobocriconema*, *Pseudocriconema*, *Syro*, *Paralobocriconema* and *Macrocriconema* all to *Ogma*; *Neobakernema*, *Crossonemoides* to *Criconemella*; *Colbranium* to *Hemicycliophora*; *Hemicaloosia* to *Caloosia*; *Paratylenchoides* to *Paratylenchus*; *Ivotylenchulus* to *Trophotylenchulus*; *Goodeyella* and *Tumiota* to *Sphaeronema*. Complete lists of species and synonymies or update and revisions of recent list of species are included.

RÉSUMÉ

Réévaluation des Tylenchina (Nemata). 10. La superfamille des Criconematoidea Taylor, 1936

Les Criconematina sont révisés et proposés au rang d'une superfamille, Criconematoidea, comprenant deux familles : Criconematidae, avec deux sous-familles (Criconematinae, Hemicycliophorinae), et Tylenchulidae, avec trois sous-familles (Tylenchulinae, Paratylenchinae, Tylenchocriconematinae). Les synonymisations effectuées conduisent à ne reconnaître que huit genres dans les Criconematinae : *Criconema*, *Ogma*, *Criconemella*, *Nothocriconemoides*, *Bakernema*, *Blandicephalanema*, *Pateracephalanema* et *Hemicriconemoides*; et deux genres dans les Hemicycliophorinae : *Hemicycliophora* et *Caloosia*. Les nouvelles synonymisations génériques sont les suivantes : *Crossonema* (*Seriespinula*), *Seriespinula*, *Crossonema* (*Crossonema*), *Neolobocriconema*, *Pseudocriconema*, *Syro*, *Paralobocriconema* et *Macrocriconema* sont considérés comme synonymes mineurs d'*Ogma*; *Neobakernema* et *Crossonemoides*, de *Criconemella*; *Colbranium* de *Hemicycliophora*; *Hemicaloosia* de *Caloosia*; *Paratylenchoides* de *Paratylenchus*; *Ivotylenchulus* de *Trophotylenchulus*; *Goodeyella* et *Tumiota* de *Sphaeronema*. Des listes complètes d'espèces, ou l'actualisation de listes récentes, sont données.

The history of this taxon had its beginning in 1882-1883 at the time of an international expedition headquartered at Orange Bay, Host Island, Chile. Some of the specimens collected there were sent to France and described by Certes (1889) as *Dorylaimus giardi* and as *Eubostrichus guernei*. These have proved to be the same species redescribed in detail as *Criconema giardi* by Raski, Luc and Valenzuela (1984).

Menzel in Hofmänner and Menzel (1914) proposed the genus *Criconema* based on specimens considered to be conspecific with *Eubostrichus guernei* Certes, 1889. His specimens were collected from Sphagnum from "Bolchen" at Jura near Basel, Switzerland. At the same time they described *Criconema morgense* as a new species in that genus collected from three localities in Switzerland.

Menzel (1917) later found descriptions of seven other species he judged related to the above. These were in the genera *Iota* (Cobb, 1913), *Ogma* (Southern, 1914), *Hoplolaimus* (Daday, 1905) and *Tylencholaimus* (de Man, 1876). All of these plus the two species above he assembled in the genus *Hoplolaimus*.

Taylor (1936) separated *Criconema* into two genera : *Criconema* to include those species with large transverse annuli provided with spine or scale-like appendages on the posterior edge, head of one or two annuli with or without spines; and *Criconemoides* to include those with large retrorse annuli, scales or spines absent in adult but present in some cases in larvae, head with two more or less modified annuli.

Taylor (1936) also synonymized *Iota* and *Ogma* with *Criconema* and proposed the subfamily Criconematinae

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to include *Criconema*, *Criconemoides*, *Paratylenchus* and *Procriconema* (now *Hemicycliophora*) in the family Anguilluliniidae. Thorne (1943) suggested a family taxon was needed to accommodate Criconematinae separate from a subfamily to include *Paratylenchus* and *Cacopaurus*. He used Criconematidae for just that purpose in his classification of the Tylenchida (1949) and proposed a new subfamily Paratylenchinae. Raski (1962) proposed family rank for Paratylenchinae in Tylenchoidea.

De Grisse and Loof (1965) proposed five new generic taxa in the Criconematinae (*Nothocriconema*, *Lobocriconema*, *Discocriconemella*, *Criconemella* and *Xenocriconemella*). Other genera have been proposed by various authors, all of which will be considered in turn later.

Paramonov (1967) proposed the taxon "Criconematini" intermediate between family and superfamily. He recognized four families Criconematidae, Paratylenchidae, Tylenchulidae and Sphaeronematidae and placed them in Criconematini along with Hoplolaimini all in Hoplolaimoidea. Geraert (1966) was the first to consider the superfamily Criconematoidea in which he recognized five families: Criconematidae, Paratylenchidae, Tylenchulidae, Hemicycliophoridae and Sphaeronematidae. Golden (1971) agreed in general but considered Hemicycliophoridae and Sphaeronematidae of subfamily rank. This was also followed by Andrassy (1976). An important change in our concept of Criconematidae was proposed by Raski and Siddiqi (1975) when Paratylenchidae was linked more closely to Tylenchulidae in a new superfamily Tylenchulidoidea (Tylenchuloidea). They also proposed the superfamily Tylenchocriconematoidea for a unique species, *Tylenchocriconema alleni*, showing some characters intermediate between criconematids and tylenchids. This relationship is followed here but at the subfamily and family levels, respectively. Siddiqi (1980) raised Criconematoidea one step to a suborder, Criconematina, with four superfamilies: Criconematoidea, Hemicycliophoroidea, Tylenchuloidea, and Tylenchocriconematoidea. Later, Siddiqi (1986) considered only the three first cited superfamilies in Criconematina, reducing Tylenchocriconematoidea to subfamily level, Tylenchocriconematinae. This is followed here. Thus, the basic classifications are fairly consistent, differing principally in the level of each taxon.

The study reported here concludes in agreement most closely with Geraert (1966) and Andrassy (1976) at the superfamily level for Criconematoidea but recognizes only two family categories in it. The paratylenchs are considered a subfamily according to the reviews which follow.

Looking at these species from a phylogenetic/evolutionary point of view they give the impression of being in a blind end or cul-de-sac so to speak. There seem to be endless variations in superficial external cuticular ornamentations but internally they are extremely homogeneous, basically similar in oesophageal and repro-

ductive systems, especially so in the Criconematidae. The males are consistently degenerate and probably do no feed.

Concerning the bionomics, all the members of this superfamily are parasites of higher plants, mostly woody trees and vines.

Superfamily **Criconematoidea** Taylor, 1936

= Criconematina Siddiqi, 1980

DIAGNOSIS

Tylenchina.

All stages usually under 1 mm long, rarely up to 1.9 mm (Hemicycliophorinae). Marked sexual dimorphism: male slender, female sausage-shaped, cylindrical or sphaeroidal.

Female and juvenile with very variable cuticle: thick with retrorse annuli lacking lateral field, provided or not with lobation, crenation, spines, scales; or thick with smooth, coarse, rounded annuli covered or not with an extra cuticular layer; or thin cuticle with fine rounded annuli and lateral fields often marked with lines (obliterated in swollen stages). Labial area in female and juvenile with usually one or two often modified annuli; oral aperture dorso-ventrally longitudinal on a raised area or labial disc. Amphidial apertures round to oval, close to labial disc area. Basically, there are six pseudolips of which the four submedian ones can bear each a submedian lobe; no sensillae visible on surface of lip area. Labial framework hexaradiate, with light to strong sclerotization. Deirids reported in thin-cuticled genera *Tylenchulus* and *Paratylenchus*. Phasmids absent. Females and most juveniles with well-developed stylet, often very long, with cone markedly longer than the shaft; basal knobs well-developed, either sloping backwards or anchor-shaped. Female and juvenile oesophagus with median bulb enormously developed, muscular, containing a large often elongated cuticular valvular apparatus and being amalgamated with procorpus which is usually broad and surrounds the basal region of the stylet; isthmus either slender and offset from glandular bulb or short and broad being amalgamated with glandular bulb. Oesophageal glandular bulb small, offset from intestine (except in *Sphaeronema whittoni* and *Meloidoderita kirjanovae* in which the glands are free). Orifice of dorsal oesophageal gland at a short distance (usually under 4 μ m) behind stylet base. Vulva transversely oval or slit-like, located posteriorly, usually at over 75 % of body length. Female genital tract: one branch, anterior, outstretched (may be coiled in swollen females). Post-vulval uterine sac absent. In juveniles: Female genital primordium showing no element of a posterior

branch. Spermatheca usually offset and inclined laterally or ventrally. Uterus with a distinct columned part, but number of rows of cells apparently not constant; in swollen females ovjector can have a thickened wall, transformed into a cyst in *Meloidoderita*. Swollen female may deposit numerous eggs in a gelatinous matrix produced by the excretory system. Intestine syncytial, lacking a definite lumen, often extending beyond anal level. Female anus a small pore, rarely absent.

Male : Small, slender. Cuticle thin, with narrow annuli; no extra cuticular layer; typical lateral field present. Stylet mostly absent, or degenerated and non-functional. Oesophagus degenerated, nonfunctional. One testis. Spicules often very long and setaceous, with small narrow head, elongate-slender shaft and finely pointed distal end; variable in shape but often arcuate. Gubernaculum linear or crescent-shaped in lateral view, not protrusible. Caudal alae when present, usually low, rarely peloderan; but well-developed, leptoderan in Tylenchocriconematinae and mostly Hemicycliophorinae. Cloacal lips usually narrow and elevated, or drawn out as a penial tube. Hypotygya present or absent.

BIONOMICS

Inhabitant of soil. Females an obligate plant root parasite. Juveniles feed on plant roots, with rare exceptions. Male nonfeeding, free-living in the soil.

TYPE FAMILY

Criconematidae Taylor, 1936.

OTHER FAMILY

Tylenchulidae Skarbilovich, 1947.

Family **Criconematidae** Taylor, 1936

- = Macroposthoniidae Skarbilovich, 1959.
- = Madinematidae Khan, Chawla & Saha, 1975.
- = Criconematoidea Siddiqi, 1980 (n. syn.)

DIAGNOSIS

Criconematoidea.

All stages vermiform : Small to large animals (up to 1.9 mm).

Female : Body sausage-shaped to cylindrical. Cuticle thick, lacking a typical lateral field (sometimes marked by irregularities in body annuli and/or superficial longitudinal lines very variable within the same species). Body annuli either retrorse, provided or not with lobation, crenation, scales or spines or rounded and covered or not with an extra cuticular layer. Labial area variously shaped; submedian lobes absent or variously developed.

Labial sclerotization strong. Stylet massive; cone much longer than base plus knobs; stylet knobs anchor-shaped or sloping backwards. Isthmus very short; oesophageal glandular bulb markedly reduced.

Male : No stylet. Spicules variously shaped. Caudal alae absent to well-developed.

Juveniles : Cuticle showing same range of variations as in female, but in some groups juvenile and female may have different ornamentation; cuticular spines or scales, if present, arranged in longitudinal rows, stylet nonreduced, functional (lacking in some male J4 of *Hemicycliophora* species).

BIONOMICS

Female and juveniles always ectoparasitic on plant roots.

TYPE SUBFAMILY

Criconematinae Taylor, 1936.

OTHER SUBFAMILY

Hemicycliophorinae Skarbilovich, 1959.

RELATIONSHIPS

Criconematidae is most closely related to the Tylenchulidae by the oesophagus with well-developed median bulbar area with massive valvular apparatus, short isthmus and small posterior glandular region symmetrically arranged, not overlapping intestine. Strong sexual dimorphism, males degenerate mostly without stylet. The families are distinguished by strong annulation and thick cuticle Criconematidae (fine annulations, mostly thin cuticle in Tylenchulidae); swollen females in many Tylenchulidae not found in Criconematidae.

Subfamily **Criconematinae** Taylor, 1936

- = Macroposthoniinae Skarbilovich, 1959
- = Madinematinae Khan, Chawla & Saha, 1975

DIAGNOSIS

Criconematidae.

Female : Mostly small, stout nematodes, up to 0.86 mm; annulation strongly developed with smooth or slightly crenate cuticle, or various scale/spine-like projections off posterior margins of annuli, ruffled or platelet-like extracuticular coverings or with film-like separate cuticle of various lengths and configurations; lateral field absent, or at most an irregular line formed by anastomosing annuli; submedian lobes present or absent; lip region with strong sclerotization, not set off

(*Criconemella*) or with first one or two annuli variously separated from succeeding body annuli; stylet massive, cone much longer than shaft plus knobs; procorpus merges gradually into metacorpus, isthmus very short, only slightly setting off reduced posterior bulb.

Male : Degenerate, stylet lacking; oesophagus lacking or rudimentary; fine to moderate annulation, lateral field two to four longitudinal lines, lacking cuticular ornamentation except rarely papilla-like projections on terminus (*Ogma seymouri*); spicules slightly curved, caudal alae if present weakly developed or absent (well developed in *Nothocriconemoides crenulatus*).

Juveniles : Similar to females, with smooth or slightly crenate annuli but most have elaborate cuticular ornamentation mostly as longitudinal rows of scales or spines.

HABITS

Ectoparasitic mostly on roots of perennial hosts.

TYPE GENUS

Criconema Hofmänner & Menzel, 1914

OTHER GENERA

Ogma Southern, 1914

Criconemella De Grisse & Loof, 1965

Discocriconemella De Grisse & Loof, 1965

Nothocriconemoides Maas, Loof & De Grisse, 1971

Bakernema Wu, 1964

Blandicephalanema Mehta & Rashi, 1971

Pateracephalanema Mehta & Raski, 1971

Hemicriconemoides Chitwood & Birchfield, 1957

RELATIONSHIPS

Criconematinae is most closely related to the Hemicyclophorinae, but is distinguished by the shorter sausage-shaped females (longer, more slender in Hemicyclophorinae) and by males with short tail, simple curved spicules, reduced caudal alae in Criconematinae (male tail longer, many with long, elaborately curved spicules and caudal alae prominent in Hemicyclophorinae).

THE GENERA OF CRICONEMATINAE TAYLOR, 1936

Criconema Hofmänner & Menzel, 1914

= *Lobocriconema* De Grisse & Loof, 1965

= *Nothocriconema* De Grisse & Loof, 1976

= *Merocriconema* Raski & Pinochet, 1976

= *Nenocriconema* Darekar & Khan, 1981

= *Notholetus* Ebsary, 1981

= *Nothocriconemella* Ebsary, 1981

= *Paracriconema* Ebsary, 1981

= *Amphisbaenema* Orton Williams, 1982

= *Cerchnotocriconema* Bernard, 1982

Diagnosis :

Criconematidae.

Female : Body small to rather large (0.24-0.74 mm). Annuli 24-134; smooth or variously ornamented : *i*) finely crenate; *ii*) scale-like projections, if present, only on posterior part of body; *iii*) irregular plate-like coverings on cuticle over entire body (*paradoxiger*, *shepherdiae*) or on part of annuli (*lamellatum*); *iv*) ruffled, ribbon-like ornamentation encircling annulus on anterior surface (*giardi*) or both anterior/posterior surfaces (*psephinum*); or *v*) cuticular fringe extending from posterior margin of annuli (*brevicaudatum*, *giardi*). Annuli of labial region smooth; usually with one annulus wider and clearly set off from next succeeding body annulus; occasionally separation is not distinct and labial region appears to bear two annuli. Labial region usually with six pseudolips rounded and projecting forward from first annulus. Stylet 40-132 μ m. Vulva on 4th-21st annulus from terminus, slit-like or completely closed by overhanging anterior lip. Tail conoid-pointed to bluntly rounded.

Male : Two to four lateral lines; bursa small, strongly reduced or lacking.

Juveniles : Cuticle with scale-like cuticular appendages over entire body, usually with refractive elements or spine-like extensions at distal ends, arranged in eight to twenty-four longitudinal rows.

Type species :

Criconema giardi (Certes, 1889) Micoletzky, 1925

= *Dorylaimus giardi* Certes, 1889

= *Eubostriachus guernei* Certes, 1889

= *Criconema guernei* (Certes, 1889) Menzel in Hofmänner & Menzel, 1914

= *Hoplolaimus guernei* (Certes, 1889) Menzel, 1917

= *Iota guernei* (Certes, 1889) Micoletzky, 1925

= *Ogma guernei* (Certes, 1889) Schuurmans Stekhoven & Teunissen, 1938.

Other species :

Raski and Luc (1985) gave a complete list of species; changes since then are reported here. For more detailed discussion on *C. aberrans* see under *Ogma* (p. 417).

C. aberrans (Jairajpuri & Siddiqi, 1963) n. comb.

= *Criconemoides aberrans* Jairajpuri & Siddiqi, 1963

= *Lobocriconema aberrans* (Jairajpuri & Siddiqi, 1963) De Grisse & Loof, 1965

= *Nothocriconema aberrans* (Jairajpuri & Siddiqi, 1963) Andrassy, 1979

= *Paralobocriconema aberrans* (Jairajpuri & Siddiqi, 1963) Minagawa, 1986 (n. syn.)

C. ananas (Heyns, 1970) Siddiqi, 1986

= *Discocriconemella ananas* Heyns, 1970

= *Nothocriconema ananas* (Heyns, 1970) Loof & De Grisse, 1973

= *Nothocriconemella ananas* (Heyns, 1970) van den Berg, 1984

C. astakoni (Ray & Das, 1982) Siddiqi, 1986

= *Nothocriconema astakoni* Ray & Das, 1986

- C. certesi* Raski & Valenzuela, 1986
C. cylindraceum (Ivanova & Shagalina, 1986) n. comb.
 = *Nothocriconemella cylindracea* Ivanova & Shagalina, 1986
C. lantanum (van den Berg, 1984) n. comb.
 = *Lobocriconema lantanum* van den Berg, 1984
C. lefodii (van den Berg, 1984) n. comb.
 = *Lobocriconema lefodii* van den Berg, 1984
C. montanum (Razjivin, 1985) Siddiqi, 1986
 = *Nothocriconema montanum* Razjivin, 1985
C. natalense (van den Berg, 1984) Siddiqi, 1986
 = *Notholetus natalensis* van den Berg, 1984
C. silvum (van den Berg, 1984) n. comb.
 = *Lobocriconema silvum* van den Berg, 1984
C. sulcitum (van den Berg, 1984) Siddiqi, 1986
 = *Nothocriconemella sulcita* van den Berg, 1984
C. talanum (van den Berg, 1984) Siddiqi, 1986
 = *Paracriconema talanum* van den Berg, 1984
C. varicaudatum (Eroshenko, 1980) Siddiqi, 1986
 = *Nothocriconema varicaudatum* Eroshenko, 1980
C. yakushimense Toida, 1983
 = *Nothocriconema yakushimense* Toida, 1983

Relationships :

Criconema is most closely related to *Ogma* by the set off annuli of the anterior end, developed pseudolips, submedian lobes rare (weakly developed when present), but these differ by smooth labial annuli and cuticular ornamentation reduced, lacking or confined to posterior part of body when present in *Criconema* (present over entire body, including occasionally on labial annuli in *Ogma*).

Comments :

Rediscovery of the type species, *Criconema giardi* (Certes, 1889) Micoletzky, 1925, has made possible a complete description of that species. This was published by Raski, Luc and Valenzuela (1984) followed by a review in depth of its consequences to other related genera by Raski and Luc (1985).

Ogma Southern, 1914

- = *Criconema (Variasquamata)* Mehta & Raski, 1971
 = *Variasquamata* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
 = *Crossonema (Seriespinula)* Mehta & Raski, 1971 (n. syn.)
 = *Seriespinula* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
 = *Crossonema (Crossonema)* Mehta & Raski, 1971 (n. syn.)
 = *Crossonema* Khan, Chawla & Saha, 1976 (n. syn.)
 = *Croserinema* Khan, Chawla & Saha, 1976
 = *Neolobocriconema* Mehta & Raski, 1971 (n. syn.)
 = *Neocrossonema* Ebsary, 1981

- = *Pseudocriconema* Minagawa, 1984
 = *Syro* Orton Williams, 1985 (n. syn.)
 = *Ogma (Homogma)* Siddiqi, 1986
 = *Paralobocriconema* Minagawa, 1986 (n. syn.)
 = *Macrocriconema* Minagawa, 1986 (n. syn.)

Diagnosis :

Criconematinae.

Female : Body small to rather large (0.27-0.86 mm). Annuli 44-90 with various cuticular ornamentations over the entire body (simple scales or rounded or pointed appendages arranged in 8-18 longitudinal rows; each annulus bearing eight palmate lobes with two to six finger-shaped spines arranged alternating with spines on adjacent rows, single spines may appear scattered on annuli; scales or spines arranged in 9-20 (rarely 27) longitudinal lines, many bi- or multi-lobed (two to seven at tip); or with continuous fringe of scales or spines, bluntly rounded, unipointed, not arranged in rows, 24-90 in number on one annulus at midbody. Labial annuli two (exceptionally one) rather well set off from next succeeding annulus; with or without ornamentation; first usually wider than second but it may be about equal in width; submedian lobes absent or more or less developed when present. Stylet 48-130 µm. Vulva closed or open, on 3rd-19th annulus from terminus, anterior lip seldom longer than posterior one. Tail conoid-pointed to bluntly rounded.

Male : With three or four lines in lateral field; bursa rudimentary or lacking.

Juveniles : With scales in 8-18 longitudinal rows or rarely alternating with adjacent annuli.

Type species :

- O. murrayi* Southern, 1914
 = *Hoplolaimus murrayi* (Southern, 1914) Menzel, 1917
 = *Iota murrayi* (Southern, 1914) Micoletzky, 1925
 = *Criconema murrayi* (Southern, 1914) Taylor, 1936
 = *Criconema (Variasquamata) murrayi* (Southern, 1914) Mehta & Raski, 1971
 = *Variasquamata murrayi* (Southern, 1914) Khan, Chawla & Saha, 1976

Other species :

- O. abies* (Andrássy, 1979) n. comb.
 = *Crossonema abies* Andrássy, 1979
 = *Neocrossonema abies* (Andrássy, 1979) Ebsary, 1981
O. allantoideum (Eroshenko, 1980) n. comb.
 = *Neolobocriconema allantoideum* Eroshenko, 1980
O. allieri (Doucet, 1981) n. comb.
 = *Seriespinula allieri* Doucet, 1981
O. alternatum (Doucet, 1986) n. comb.
 = *Seriespinula alternata* Doucet, 1986
O. aquitanense (Fies, 1968) n. comb.
 = *Criconema aquitanense* Fies, 1968
 = *Crossonema aquitanense* (Fies, 1968) Mehta & Raski, 1971

- = *Neocrossonema aquitanense* (Fies, 1968) Ebsary, 1981
- O. brevistylum* Toida, 1983
- O. cactus* (Andrássy, 1979) Siddiqi, 1986
= *Seriespinula cactus* Andrásy, 1979
= *Blandicephalanema cactus* (Andrássy, 1979) Ebsary, 1981
- O. capitospinosum* (Ebsary, 1979) n. comb.
= *Crossonema capitospinosum* Ebsary, 1979
= *Neocrossonema capitospinosum* (Ebsary, 1979) Ebsary, 1981
- O. castellanum* Andrásy, 1985
- O. cataracticum* (Andrássy, 1979) n. comb.
= *Neolobocriconema cataracticum* Andrásy, 1979
= *Paralobocriconema cataracticum* (Andrássy, 1979) Minagawa, 1986 (n. syn.)
- O. centone* (Eroshenko, 1980) n. comb.
= *Crossonema centonis* Eroshenko, 1980
- O. chrisbarnardi* (Heyns, 1970) Andrásy, 1979
= *Criconema chrisbarnardi* Heyns, 1970
= *Crossonema (Seriespinula) chrisbarnardi* (Heyns, 1970) Loof & De Grisse, 1973
= *Syro chrisbarnardi* (Heyns, 1970) Orton Williams, 1985
- O. civellae* (Steiner, 1949) n. comb.
= *Criconema civellae* Steiner, 1949
= *Crossonema civellae* (Steiner, 1949) Mehta & Raski, 1971
= *Criconema celetum* Wu, 1960
= *Criconema eurysona* Golden & Friedman, 1964
= *Criconema vishwanatum* Edward & Misra, 1966
- O. cobbi* (Micoletzky, 1925) Siddiqi, 1986
= *Iota cobbi* Micoletzky, 1925
= *Criconema cobbi* (Micoletzky, 1925) Taylor, 1936
= *Crossonema (Seriespinula) cobbi* (Micoletzky, 1925) Mehta & Raski, 1971
= *Seriespinula cobbi* (Micoletzky, 1925) Khan, Chawla & Saha, 1976
= *Criconema cobbi duplex* De Coninck, 1945
= *Criconema cobbi multiplex* De Coninck, 1945
= *Criconema schuurmansstekhoveni* De Coninck, 1943
- O. coronatum* Sch. Stekhoven & Teunissen, 1938
= *Criconema coronatum* (Sch. Stekhoven & Teunissen, 1938) De Coninck, 1943
= *Crossonema coronatum* (Sch. Stekhoven & Teunissen, 1938) Mehta & Raski, 1971
= *Seriespinula coronatum* (Sch. Stekhoven & Teunissen, 1938) Andrásy, 1979
- = *Syro coronatus* (Sch. Stekhoven & Teunissen, 1938) Orton Williams, 1985
- O. danubiale* Andrásy, 1985
- O. decalineatum* (Chitwood, 1957) Andrásy, 1979*
= *Criconema decalineatum* Chitwood, 1957
= *Criconema (Variasquamatum) decalineatum* (Chitwood, 1957) Mehta & Raski, 1971
= *Criconema coffeae* Edward, Misra & Rai, 1970 (n. syn.)
= *Criconema (Variasquamata) gracile* Mehta & Raski, 1971
= *Variasquamata gracile* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
= *Ogma coffeae* (Edward, Misra & Rai, 1970) Andrásy, 1979 (n. syn.)
- O. dracomontanum* (van den Berg, 1983) Siddiqi, 1986
= *Crossonema dracomontanum* van den Berg, 1983
= *Syro dracomontanum* (van den Berg, 1983) Orton Williams, 1985
- O. dryum* (Minagawa, 1979) n. comb.
= *Crossonema dryum* Minagawa, 1979
- O. duodevigintilineatum* (Andrássy, 1968) Andrásy, 1979
= *Criconema duodevigintilineatum* Andrásy, 1968
= *Criconema (Variasquamata) duodevigintilineatum* (Andrássy, 1968) Mehta & Raski, 1971
= *Variasquamata duodevigintilineata* (Andrássy, 1968) Khan, Chawla & Saha, 1976
- O. fimbriatum* (Cobb in Taylor, 1936) n. comb.
= *Criconema fimbriatum* Cobb in Taylor, 1936
= *Crossonema fimbriatum* (Cobb in Taylor, 1936) Mehta & Raski, 1971
= *Neocrossonema fimbriatum* (Cobb in Taylor, 1936) Ebsary, 1981
- O. fimcivatum* (Khan, Chawla & Saha, 1976) n. comb.
= *Crossonema fimcivatum* Khan, Chawla & Saha, 1976
- O. fotedari* (Mahajan & Bijral, 1973) Andrásy, 1979
= *Criconema (Variasquamata) fotedari* Mahajan & Bijral, 1973
- O. goldeni* Handoo, 1981
- O. hirakuraense* (Minagawa, 1986) n. comb.
= *Neolobocriconema hirakuraense* Minagawa, 1986
- O. horridum* (Eroshenko, 1980) n. comb.
= *Crossonema horridum* Eroshenko, 1980
- O. hughdavidi* (Orton Williams, 1985) n. comb.
= *Syro hughdavidi* Orton Williams, 1985
- O. hungaricum* (Andrássy, 1962) Siddiqi, 1986
= *Criconema hungaricum* Andrásy, 1962
= *Crossonema (Seriespinula) hungaricum* (Andrássy, 1962) Mehta & Raski, 1971
= *Seriespinula hungarica* (Andrássy, 1962) Khan, Chawla & Saha, 1976
- O. inornatum* (van den Berg, 1983) Siddiqi, 1986
= *Crossonema inornatum* van den Berg, 1983
- O. insulicum* (Choi & Geraert, 1975) Siddiqi, 1986
= *Neolobocriconema insulicum* Choi & Geraert, 1975
= *Paralobocriconema insulicum* (Choi & Geraert, 1975) Minagawa, 1986 (n. syn.)
- O. japonicum* (Minagawa, 1984) Siddiqi, 1986
= *Pseudocriconema japonicum* Minagawa, 1984

* Andrásy (1979) has already synonymized *Criconema (V.) gracile* with *Ogma decalineatum* (Chitwood, 1957) based on crenate vs smooth labial annuli. In fact, the anterior vulvar lip of *gracile* is rounded in contrast to the vulvar lip of *decalineatum* which has two well-defined points. The illustrations of *Criconema* (= *Ogma*) *coffeae* show an intermediate development of two points on the anterior vulvar lip suggesting all three species are synonymous and are so accepted here as *Ogma decalineatum* (Chitwood, 1957).

- O. latens* (Mehta & Raski, 1971) n. comb.
= *Crossonema latens* Mehta & Raski, 1971
- O. laterale* (Khan & Siddiqi, 1964) n. comb.
= *Criconema laterale* Khan & Siddiqi, 1964
= *Lobocriconema laterale* (Khan & Siddiqi, 1964) De Grisse & Loof, 1965
= *Criconemoides lateralis* (Khan & Siddiqi, 1964) Raski & Golden, 1966
= *Neolobocriconema laterale* (Khan & Siddiqi, 1964) Mehta & Raski, 1971
- O. lentiforme* Sch. Stekhoven & Teunissen, 1938
= *Criconema lentiforme* (Sch. Stekhoven & Teunissen, 1938) De Coninck, 1943
= *Criconema (Variasquamata) lentiforme* (Sch. Stekhoven & Teunissen, 1938) Mehta & Raski, 1971
= *Variasquamata lentiformis* (Sch. Stekhoven & Teunissen, 1938) Khan, Chawla & Saha, 1976
= *Ogma tripus* Sch. Stekhoven & Teunissen, 1938
= *Criconema tripus* (Sch. Stekhoven & Teunissen, 1938) De Coninck, 1945
- O. melanesicum* (Andrássy, 1979) Siddiqi, 1986
= *Seriespinula melanesica* Andrassy, 1979
= *Syro melanesicus* (Andrássy, 1979) Orton Williams, 1985
- O. menzeli* (Stefanski, 1924) Sch. Stekhoven & Teunissen, 1938
= *Hoplolaimus menzeli* Stefanski, 1924
= *Iota menzeli* (Stefanski, 1924) Micoletzky, 1925
= *Criconema menzeli* (Stefanski, 1924) Taylor, 1936
= *Crossonema menzeli* (Stefanski, 1924) Mehta & Raski, 1971
= *Neocrossonema menzeli* (Stefanski, 1924) Ebsary, 1981
= *Iota aculeatum* Schneider, 1939
= *Criconema aculeatum* (Schneider, 1939) De Coninck, 1943
= *Crossonema aculeatum* (Schneider, 1939) Mehta & Raski, 1971
= *Criconema guernei apud* Menzel in Hofmänner & Menzel, 1914
= *Hoplolaimus guernei apud* Schneider, 1923
- O. octangulare* (Cobb, 1914) Sch. Stekhoven & Teunissen, 1938
= *Iota octangulare* Cobb, 1914
= *Hoplolaimus octangularis* (Cobb, 1914) Menzel, 1917
= *Criconema octangulare* (Cobb, 1914) Taylor, 1936
= *Criconema (Variasquamata) octangulare* (Cobb, 1914) Mehta & Raski, 1971
= *Variasquamata octangularis* (Cobb, 1914) Khan, Chawla & Saha, 1976
= *Criconema punici* Edward, Misra, Peter & Rai, 1971
= *Seriespinula punici* (Edward, Misra, Peter & Rai, 1971) Khan, Chawla & Saha, 1976
- O. octozonale* (Momota & Oshima, 1974) Siddiqi, 1986
= *Crossonema (Seriespinula) octozonale* Momota & Oshima, 1974
= *Seriespinula octozonalis* (Momota & Oshima, 1974) Khan, Chawla & Saha, 1976
= *Seriespinula sokliensis* Choi & Geraert, 1975
- O. olearum* (Hashim, 1984) n. comb.
= *Neolobocriconema olearum* Hashim, 1984
= *Paralobocriconema olearum* (Hashim, 1984) Minagawa, 1986 (n. syn.)
- O. orphreyifer* (Orton Williams, 1985) n. comb.
= *Syro orphreyifer* Orton Williams, 1985
- O. palmatum* (Siddiqi & Southey, 1962) Siddiqi, 1986
= *Criconema palmatum* Siddiqi & Southey, 1962
= *Crossonema palmatum* (Siddiqi & Southey, 1962) Mehta & Raski, 1971
= *Croserinema palmatum* (Siddiqi & Southey, 1962) Khan, Chawla & Saha, 1976
- O. proclive* (Hoffmann, 1973) n. comb.
= *Criconema proclive* Hoffmann, 1973
= *Crossonema proclive* (Hoffmann, 1973) Andrassy, 1979
= *Neocrossonema proclive* (Hoffmann, 1973) Ebsary, 1981
- O. querci* (Choi & Geraert, 1975) Andrassy, 1979
= *Criconema (Variasquamata) querci* Choi & Geraert, 1975
= *Crossonema querci* (Choi & Geraert, 1975) Ebsary, 1981
= *Macrocriconema querci* (Choi & Geraert, 1975) Minagawa, 1986 (n. syn.)
- O. racemispinosum* (Mehta, Raski & Valenzuela, 1983) Siddiqi, 1986
= *Seriespinula racemispinosa* Mehta, Raski & Valenzuela, 1983
- O. raskii* (Rahmani, Jairajpuri & Ahmad, 1985) n. comb.
= *Crossonema raskii* Rahmani, Jairajpuri & Ahmad, 1985
- O. regularis* (Rahmani, Jairajpuri & Ahmad, 1986) n. comb.
= *Neolobocriconema regulare* (Rahmani, Jairajpuri & Ahmad, 1986)
- O. rhombosquamatum* (Mehta & Raski, 1971) Andrassy, 1979
= *Criconema (Variasquamata) rhombosquamatum* Mehta & Raski, 1971
= *Variasquamata rhombosquamata* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
- O. serratum* (Khan & Siddiqi, 1963) n. comb.
= *Criconema serratum* Khan & Siddiqi, 1963
= *Lobocriconema serratum* (Khan & Siddiqi, 1963) De Grisse & Loof, 1965
= *Criconemoides serratus* (Khan & Siddiqi, 1963) Raski & Golden, 1966
= *Neolobocriconema serratum* (Khan & Siddiqi, 1963) Mehta & Raski, 1971
= *Criconema sulcatum* Golden & Friedman, 1964
= *Lobocriconema sulcatum* (Golden & Friedman, 1964) De Grisse & Loof, 1965
= *Criconemoides sulcatus* (Golden & Friedman, 1964) Raski & Golden, 1966
= *Paralobocriconema serratum* (Khan & Siddiqi, 1963) Minagawa, 1986, (n. syn.)
- O. seymouri* (Wu, 1965) Siddiqi, 1986
= *Criconema seymouri* Wu, 1965

- = *Crossonema (Seriespinula) seymouri* (Wu, 1965) Mehta & Raski, 1971
- = *Seriespinula seymouri* (Wu, 1965) Khan, Chawla & Saha, 1976
- O. simlaense* (Jairajpuri, 1963) Andrassy, 1979
 - = *Criconema simlaense* Jairajpuri, 1963
 - = *Criconema (Variasquamata) simlaense* (Jairajpuri, 1963) Mehta & Raski, 1971
 - = *Variasquamata simlaensis* (Jairajpuri, 1963) Khan, Chawla & Saha, 1976
 - = *Variasquamata rhosimum* Khan, Chawla & Saha, 1976
 - = *Ogma rhosimum* (Khan, Chawla & Saha, 1976) Andrassy, 1979
- O. spinosum* Andrassy, 1979
- O. squamiferum* (Heyns, 1970) Andrassy, 1979
 - = *Lobocriconema squamiferum* Heyns, 1970
 - = *Criconema squamiferum* (Heyns, 1970) Loof & De Grisse, 1973
- O. taylatum* (Khan, Chawla & Saha, 1976) Siddiqi, 1986
 - = *Crossonema taylatum* Khan, Chawla & Saha, 1976
- O. taylori* (Jairajpuri, 1964) Siddiqi, 1986
 - = *Criconema taylori* Jairajpuri, 1964
 - = *Crossonema taylori* (Jairajpuri, 1964) Mehta & Raski, 1971
- O. tenuicaudatum* (Siddiqi, 1961) Siddiqi, 1986
 - = *Criconema tenuicaudatum* Siddiqi, 1961
 - = *Crossonema (Seriespinula) tenuicaudatum* (Siddiqi, 1961) Mehta & Raski, 1971
 - = *Seriespinula tenuicaudata* (Siddiqi, 1961) Khan, Chawla & Saha, 1976
 - = *Seriespinula impar* Khan, Chawla & Saha, 1976
- O. terrestre* Raski & Valenzuela, 1986
- O. tobokaevi* (Gritsenko, 1979) n. comb.
 - = *Criconema (Seriespinula) tobokaevi* Gritsenko, 1979
- O. tripum* Sch. Stekhoven & Teunissen, 1983
 - = *Criconema tripum* Sch. Stekhoven & Teunissen, 1938a (De Conink, 1945)
- O. velutinum* (Eroshenko, 1980) Siddiqi, 1986
 - = *Crossonema velutina* Eroshenko, 1980
- O. venustum* (Mehta & Raski, 1971) Siddiqi, 1986
 - = *Crossonema (Seriespinula) venustum* Mehta & Raski, 1971
 - = *Seriespinula venusta* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976
- O. vexillatrix* (Orton Williams, 1985) n. comb.
 - = *Syro vexillatrix* Orton Williams, 1985
- O. villiferum* (Eroshenko, 1980) n. comb.
 - = *Crossonema villiferum* Eroshenko, 1980
- O. zernovi* Kirjanova, 1948
 - = *Criconema zernovi* (Kirjanova, 1948) Chitwood, 1957
 - = *Criconema (Variasquamata) zernovi* (Kirjanova, 1948) Mehta & Raski, 1971
 - = *Variasquamata zernovi* (Kirjanova, 1948) Khan, Chawla & Saha, 1976

Species inquirendae :

- O. boettgeri* (Meyl, 1954) n. comb.
 - = *Criconemoides boettgeri* Meyl, 1954
 - = *Criconema boettgeri* (Meyl, 1954) De Grisse & Loof, 1965
 - = *Crossonema boettgeri* (Meyl, 1954) Andrassy, 1979
- O. multisquamatum* Kirjanova, 1948
 - = *Criconema multisquamatum* (Kirjanova, 1948) Chitwood, 1957
 - = *Crossonema multisquamatum* (Kirjanova, 1948) Mehta & Raski, 1971
 - = *Criconema fimbriatum apud* Sveshnikova, 1940
- O. georgiense* (Kirjanova, 1958) n. comb.
 - = *Criconema georgiense* Kirjanova, 1958
 - = *Crossonema georgiense* (Kirjanova, 1958) Ivanova, 1976
- O. spasskii* (Nesterov & Lisetskaya, 1965) Andrassy, 1979
 - = *Criconema spasskii* Nesterov & Lisetskaya, 1965

Junior synonyms of *Ogma* :

Species presently included in the genus *Ogma sensu* Andrassy (1979) have been assigned to many different genera in the past. The genus *Criconema* was first proposed by Menzel in Hofmänner and Menzel (1914) based on specimens considered by them to be conspecific with *Eubostrichus guernei* Certes, 1889. At the same time they also described *Criconema morgense* collected from three localities in Switzerland as a new species in that genus.

Their concept of the taxon was based on : *i*) small, plump body shape; *ii*) cuticle heavily annulated; *iii*) annuli smooth or with spine-shaped appendages backwards directed; *iv*) head end scarcely set off, with or without bristles; *v*) with a long, fine stylet provided with knobs.

Taylor (1936) separated *Criconema* into two genera : *Criconema* to include those species with large transverse annuli provided with spine or scale-like appendages on the posterior edge; head of one or two annuli with or without spines; and *Criconemoides* to include those with large retrorse annuli, scales or spines absent in adult but present in some cases in larvae, head with two more or less modified annuli.

De Grisse and Loof (1965) proposed five new generic taxa (*Nothocriconema*, *Lobocriconema*, *Discocriconemella*, *Criconemella*, *Xenocriconemella*). *Criconema* was recognized as before and further characterized with juveniles having scales on posterior margins of annuli and adult females lacking submedian lobes. *Criconemoides morgensis* was declared *genus inquirendum* and *species inquirenda*. The remaining species of that genus were placed in *Macroposthonia* de Man, 1880, or one of the five new genera.

The revision of *Criconema* by Mehta and Raski (1971) proposed two subgenera for that genus *Criconema (Criconema)* with *C. guernei* as the type and only species and *Criconema (Variasquamata)* plus four new genera : *Blandicephalanema*, *Neolobocriconema*, *Pateracephala-*

nema and *Crossonema* [the last with two subgenera, *Crossonema* (*Crossonema*) and *Crossonema* (*Seriespinula*)]. Khan, Chawla and Saha (1976) proposed all the subgenera be raised to generic rank and proposed another new generic taxon (*Croserinema*) based upon a single species *Crossonema* (*C.*) *palmatum* (Siddiqi & Southey, 1962) Mehta & Raski, 1971. These authors placed *Lobocriconema* in the family Criconematidae with *Criconema* *et aff.* and *Nothocriconema* in a new family Madinematidae with *Criconemoides* *et aff.*

Andrássy (1979) rejected the proposed family Madinematidae instead considered two subfamilies in the Criconematidae: Macroposthoniinae and Criconematinae. He also proposed *Criconema guernei* must be considered *genus dubium* and *species dubia*. As a consequence he returned to the next available name, *Ogma* Southern, 1914, to include those species belonging to *Variasquamata*.

Beginning at the point of Andrássy's publication there were fifteen species in the genus *Ogma* distinguished as follows: *i*) small to moderate size (0.27-0.86 mm); *ii*) R = 51-88, ornamented with scales or with rounded or pointed (single-tipped) appendages in 8-18 longitudinal rows; *iii*) head with two annuli narrower than subsequent body annuli, devoid of appendages, both about same width, exceptionally first wider than second; *iv*) pseudolips with submedian lobes; *v*) juveniles with scales in 8-16 longitudinal rows. We now consider these fifteen species to be congeneric with *Seriespinula*, *Croserinema* and *Crossonema*.

Crossonema (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976 and *Seriespinula* (Mehta & Raski, 1971) Khan, Chawla & Saha, 1976 were first proposed as subgenera in the genus *Crossonema* Mehta & Raski, 1971, and later raised to generic rank by Khan, Chawla and Saha (1976). Originally *Crossonema* and *Seriespinula* were distinguished from *Variasquamata* by the absence of submedian lobes, presence of "continuous" fringe of "spines" or scales (*Crossonema*) or in 10-14 in which case some anterior-most and posterior-most annuli bear continuous fringe (*Seriespinula*). In fact, submedian lobes are present in *Seriespinula octozonale* as shown by Momota and Oshima (1974) with drawings and SEM photographs. Determination of presence or absence of submedian lobes can only be made with certainty by SEM photographs which are available only for a very few species.

The cuticular ornamentation seems significantly different between simple, uni-scales in widely separated rows (8-18, rarely 27), scales with multiple extremities in rows (10-18) or literally adjacent, and by continuous fringes of long finger-like scales. Yet, linking species are found in virtually every instance and the distinctions as separate genera are judged arbitrary and/or artificial.

Therefore, the four genera [*Ogma* (= *Variasquamata*) with eleven species, *Crossonema* and *Seriespinula* each with eleven species and *Croserinema* with a single spe-

cies] are considered as one genus together with the fifteen species of Andrássy for which the name *Ogma* applies with the type species *O. murrayi* Southern, 1914.

Neolobocriconema Mehta & Raski, 1971.

Five species have been assigned to this genus (*aberrans*, *cataracticum*, *insulicum*, *laterale* and *serratum*). The principal characters distinguishing this taxon are: *i*) lower number of body annuli; *ii*) presence of submedian lobes; *iii*) annuli with fine or heavy cuticular serrations or fringes, or at most irregularly lobed on posterior end; these are consistent with the genus *Crossonema* except for the finer serrations or fringes, a difference of degree not kind. The exception is *Neolobocriconema aberrans* which has irregular longitudinal breaks in cuticle on posterior-most annuli only. This is more consistent with *Criconema* (= *Nothocriconema*) and is transferred to that genus.

Our conclusion is the other four species of the *Neolobocriconema* are most closely related to the genus *Ogma* s. l. (see above) and are hereby transferred to that genus.

Recently, Hashim (1984) described *Neolobocriconema olearum* as a new species found in Jordan and reviewed the genus giving an emended diagnosis after proposing transfer of *Merocriconema braziliense* to that genus. The latter proposal is consistent with the report being presented here except *Neolobocriconema* is considered congeneric with *Ogma* (except for *N. aberrans*, see above). *N. olearum* is the most divergent of these species by virtue of the minimal cuticular projections of serrations on posterior margins of annuli and by the shape of first three annuli of the anterior end. The rows of cuticular scales on larvae are indicative of relationship with *Ogma* and *N. olearum* appears most closely related to *Ogma laterale*. Reference to larval characteristics of *Criconemella* suggest *N. olearum* may represent a linking species with *Criconemella* but in all other respects more closely related to *Ogma*. Therefore, transfer to *Ogma* is hereby proposed.

Neocrossonema Ebsary, 1981

This taxon was proposed by Ebsary (1981a) for species of *Crossonema* having undifferentiated body spines, conical tail of 8-16 annuli, protruding valvular lips and juveniles with 11-13 longitudinal rows of semicircular scales with subcylindrical finely spined posterior extensions. Five species (*fimbriatum*, *aquitansense*, *capitospinosum*, *menzeli*, *proclive*) were transferred from *Crossonema* to this new genus.

Our concept of a broader generic definition for *Ogma* is covered fully under that genus. Thus, *Neocrossonema* is joined with *Crossonema*, *Seriespinula* and *Croserinema* in proposing all four to be junior synonyms of *Ogma*. *Neocrossonema* represents still one more step in the process of narrower separations of genera based on superficial cuticular variations. In this case a group of species with similar characteristics are segregated under a separate identity without a sound basis for the proposal.

Ebsary (1981a) also rejected the synonymy of *Crossonema civellae* (Steiner, 1949) Mehta & Raski, 1971 with *Crossonema multisquamatum* (Kirjanova, 1948) Mehta & Raski, 1971 for good reasons. The descriptions and illustrations of *C. multisquamatum* were inadequate to recognize its identity by present day standards. Until type material is discovered or new specimens collected from the type locality are available for study and proper description and illustrations presented it should remain a *species inquirenda*. *C. civellae* is thereby restored as a valid species. Furthermore, Andrassy (1979) rejected without comment the proposed synonymy (Mehta & Raski, 1971) of *C. boettgeri* (as redescribed by Loof, 1968) with *C. civellae*. Loof (1968) distinguished *C. boettgeri* from related species partly on the continuous fringe of scales on the body annuli and absence of palmate scales on the tail. Specimens from the same collection studied by Loof are on deposit at UC Davis and show clearly presence of such palmate structures. Therefore, the synonymization of *C. boettgeri* with *C. civellae* was justified as proposed. However, the original description of *C. boettgeri* by Meyl (1954) was inadequate to establish its identity. The specimens reported on by Loof were not from the type locality which was the Island of Ischia. Until such time as type specimens are rediscovered and described we cannot be certain as to its identity. Therefore, it is proposed *Criconema boettgeri* Meyl, 1954 be placed in *species inquirendae*.

Pseudocriconema Minagawa, 1984

This taxon was proposed by Minagawa (1984) for a single species, *Pseudocriconema japonicum*, and judged most closely related to *Seriespinula* (Mehta & Raski, 1971). It was distinguished by its tri- and/or rectangular body scales, which rarely furcate and its well-developed submedian lobes. The diagnosis of *Ogma s. l.* as emended here with broadened definitions clearly embrace this species as congeneric. Therefore, *Pseudocriconema* is proposed synonymous with *Ogma* and *P. japonicum* is hereby transferred to that genus.

Paralobocriconema Minagawa, 1986

Minagawa (1986) proposed the genus *Paralobocriconema* to contain some species formerly placed in the genus *Neolobocriconema*, i. e., *P. serratum* (type species), *P. aberrans*, *P. insulicum*, *P. cataracticum*, *P. olearum*. *Paralobocriconema* is differentiated from *Neolobocriconema* by "moderately developed submedian lobes in the female and smooth scales in the juvenile stages". As discussed above for other genera, such slight variations cannot be considered at generic level. Consequently, *Paralobocriconema* is proposed as a junior synonym of *Ogma*.

Macrocriconema Minagawa, 1986

This genus has been also proposed by Minagawa (1986) with the only species *M. querci*. This genus is considered by its author as close to *Neolobocriconema*, but differing from it by the juveniles of which the cuticle bears membranous fringes. As considered above, such

variation in the ornamentation of the juvenile cuticle cannot be accepted as an essential character to separate genera. Consequently, *Macrocriconema* is proposed as a junior synonym of *Ogma*.

Syro Orton Williams, 1985

This taxon was proposed by Orton Williams (1985) for three new species collected in New Guinea and four others transferred to the new genus. The four principal distinguishing characteristics justifying this taxon are *i*) head with one annulus expanded anteriorly, collar-like posteriorly; pseudolips present, submedian lobes absent; *ii*) unequal arrangement of cuticular appendages around body; *iii*) elongate, dichotomously-branched appendages posterior to terminus; *iv*) short triangular postvulval region with strongly modified projecting vulva.

Similar head structures, unequal cuticular appendages (longer on ventral side than dorsal), dichotomy of branched appendages and short triangular tail are not uncommon amongst the species of *Ogma*. It is notable that in *S. orphreyifer* the appendages on every other annulus after the third body annulus covers only half the body circumference. However, within the broader definition of *Ogma s. l.* that characteristic is not considered of sufficient importance to represent a separate taxon. Therefore, *Syro* is judged a junior synonym of *Ogma* and the seven species assigned to *Syro* are transferred to *Ogma* as shown in list of species.

Ogma (Homogma) Siddiqi, 1986

Siddiqi (1986) proposed this subgeneric taxon for those species of *Ogma* with scales bearing spine-like projections in posterior region, scales arranged in rows (not alternating with those on adjacent annuli such alternation being present for species in his subgenus *Croserinema*); scales smooth, or at most serrated, at midbody and tail shape rounded or conoid-rounded (whereas, his subgenus *Seriespinula* has spines on scales at midbody and tail shape conoid, pointed).

These are rejected as bases for separate subgeneric taxa as noted repeatedly above. Variations in the cuticular ornamentations of most criconematids are reliable as indicators of specific differences but of increasingly less importance for higher taxa. The same is true for tail shapes as found in these variable groups in the broader sense and according to the principles and concepts guiding this study.

Therefore, *Homogma* is rejected as a separate taxon and judged a synonym of *Ogma s. l.*

Discussion :

Similarly, as with *Criconema*, this regrouping brings together many diverse forms previously in separate genera yet show linkage to form a series or continuum. These differences create no problem when considered in the context of broader generic limits which characterize these proposals.

For example, the gradations range from dense continuous fringes in *O. menzeli*, *O. fimbriatum*, etc., to

groups of pointed scales separated and arranged in rows (*O. melanesica*); or widely spaced but contiguous scales more or less in rows (*O. cobbi*); to distinct rows of scales but anterior and posterior annuli with close continuous fringes (*O. seymouri*); separate rounded scales throughout (*O. octangulare*); or separate scales that begin to bifurcate (*O. murrayi*) and may have uniform bifurcations of two four rounded projections (*O. octozonale*, *O. venustum*).

The generally saucer-shaped labial annuli show similar diversity from smooth to crenate, strongly crenate or short finger-like projections to elaborate fringes. None of these fall into clear or distinct patterns with other basic characters which could be interpreted as representing separate generic taxa.

Here again as in *Criconema* it is more prudent in our judgment to retain this wider concept as a single genus until more convincing evidence is developed to justify separate genera.

Criconemella De Grisse & Loof, 1965

- = *Macroposthonia apud* Loof & De Grisse, 1967; 1973
- = *Criconemoides apud* Loof & De Grisse, 1967; 1973; Raski & Golden, 1966 *p. parte*; Tarjan, 1966, *p. parte*; Luc, 1970, *p. parte*
- = *Xenocriconemella* De Grisse & Loof, 1965
- = *Mesocriconema* Andr ssy, 1965, *p. parte*
- = *Neocriconema* Diab & Jenkins, 1965
- = *Madinema* Khan, Chawla & Saha, 1976, *p. parte*
- = *Seshadriella* Darekar & Khan, 1981
- = *Neobakernema* Ebsary, 1981 (n. syn.)
- = *Crossonemoides* Eroshenko, 1981 (n. syn.)

Diagnosis :

Criconematinae.

Female : Body of variable length (0.20-1.00 mm). Annuli 42-200; posterior edge smooth to finely crenate. Submedian lobes generally well-developed, but may be poorly developed and even absent in some species; separated or connected in different ways; first annuli may be reduced or even divided into plates; in some species (*C. amorpha*, *C. axestis*, *C. citricola*) first annulus not retrorse but more or less forward directed. Vulval lips closely appressed (vulva "closed") to rather widely separated (vulva "open") anterior lip may be ornamented. Spear strong, rarely thin and flexible (*C. macrodora*, *C. longistyleta*), exceptionally short with rounded basal knobs (*C. microdora*).

Male : Head end rounded to conoid; generally four lateral lines, rarely three, exceptionally two (*C. oostenbrinski*); caudal alae distinct, exceptionally absent (*C. goodeyi*).

Juveniles : Annuli smooth to crenate, no rows of scales (except *C. meridiana*, *C. variabilis* and *C. incrassata*).

Type species :

- Criconemella parva* (Raski, 1952) De Grisse & Loof, 1965
- = *Criconemoides parvus* Raski, 1952
- = *Neocriconema adamsi* Diab & Jenkins, 1965
- = *Criconemoides microserratus* Raski & Golden, 1966

Other species :

An extensive list was reported by Luc and Raski (1981) and the following is an update with recent additions and changes :

- C. avicenniae* Nicolas & Stewart, 1984
- C. anastomoides* Maqbool & Shahina, 1985
- C. bilaspurensis* (Gupta & Gupta, 1981) n. comb.
- = *Macroposthonia bilaspurensis* Gupta & Gupta, 1981
- C. brevicauda* van den Berg & Spaull, 1985
- C. calvata* (Eroshenko, 1981) n. comb.
- = *Crossonemoides calvatus* Eroshenko, 1981
- C. canadensis* (Ebsary, 1981) Ebsary, 1982
- = *Macroposthonia canadensis* Ebsary, 1981
- C. citricola* (Siddiqi, 1965) Luc & Raski, 1981
- = *Criconemoides citricola* Siddiqi, 1965
- = *Macroposthonia citricola* (Siddiqi, 1965) De Grisse, 1967
- = *Madinema maglia* Khan, Chawla & Saha, 1976*
- C. crassiorbis* (Patil & Khan, 1983) n. comb.
- = *Macroposthonia crassiorbis* Patil & Khan, 1983
- C. cufeum* (Khan, Chawla & Saha, 1975) n. comb.
- = *Macroposthonia cufeum* Khan, Chawla & Saha, 1975
- C. curvata* (Raski, 1952) Luc & Raski, 1981
- = *Criconemoides curvatus* Raski, 1952
- = *Criconemoides tesorum* de Guiran, 1963
- = *Criconemoides nainitalensis* Edward & Misra, 1963
- = *Macroposthonia curvata* (Raski, 1952) De Grisse & Loof, 1965
- = *Macroposthonia tesorum* (de Guiran, 1963) De Grisse & Loof, 1965
- = *Macroposthonia nainitalensis* (Edward & Misra, 1963) De Grisse & Loof, 1965
- = *Macroposthonia coomansi* De Grisse, 1967
- = *Criconemoides dorsoflexus* Boonduang & Ratana-prapa, 1974
- = *Macroposthonia rusium* Khan, Chawla & Saha, 1976*
- C. douceti* (Siddiqi, 1986) n. comb.
- = *C. multiannulata* Doucet, 1982
- = *Macroposthonia douceti* Siddiqi, 1986
- C. echinopanaxi* (Mukhina, 1981) Siddiqi, 1986
- = *Criconemoides echinopanaxi* Mukhina, 1981
- C. eroshenkoi* (Siddiqi, 1986) n. comb.
- = *Criconemoides mutabilis* Eroshenko, 1980**
- = *Criconemoides eroshenkoi* Siddiqi, 1986

* Fide Orton Williams (1981).

** *Criconemoides mutabilis* Eroshenko, 1980 is a homonym of *Criconemoides mutabilis* Taylor, 1936 (now *Criconema mutabilis*).

- C. helica* (Eroshenko & Tkhan, 1981) n. comb.
 = *Criconemoides helicus* Eroshenko & Tkhan, 1981
- C. heliophila* Ivanova & Shagalina, 1986
- C. incrassata* (Raski & Golden, 1966) Luc & Raski, 1981*
 = *Criconemoides incrassatus* Raski & Golden, 1966
 = *Macroposthonia incrassata* (Raski & Golden, 1966)
 De Grisse, 1967
 = *Madinema incrassatum* (Raski & Golden, 1966)
 Khan, Chawla & Saha, 1976
- C. justa* (Eroshenko, 1981) n. comb.**
 = *Nothocriconemoides justus* Eroshenko, 1981
- C. magnifica* (Eroshenko & Thkan, 1981) n. comb.
 = *Macroposthonia magnifica* Eroshenko & Thkan,
 1981
- C. magnilobata* (Darekar & Khan, 1981) n. comb.
 = *Seshadriella magnilobata* Darekar & Khan, 1981
- C. meridiana* Mehta, Raski & Valenzuela, 1983*
- C. multiannulata* (Eroshenko, 1980) n. comb.
 = *Macroposthonia multiannulata* Eroshenko, 1980
- C. myungsugae* Choi & Geraert, 1975
- C. neoaxestis* (Jairajpuri & Siddiqi, 1963) Ebsary, 1982*
 = *Criconemoides neoaxestis* Jairajpuri & Siddiqi, 1963
 = *Lobocriconema neoaxeste* (Jairajpuri & Siddiqi,
 1963) De Grisse, 1967
- C. paragoodeyi* Choi & Geraert, 1975
- C. paranostri* (Deswal & Bajaj, 1987) n. comb.
 = *Macroposthonia paranostri* Deswal & Bajaj, 1987
- C. parareedi* (Ebsary, 1981) Ebsary, 1982
 = *Macroposthonia parareedi* Ebsary, 1981
- C. pilosa* van den Berg, 1984
- C. punica* (Deswal & Bajaj, 1987) n. comb.
 = *Criconemoides punicus* Deswal & Bajaj, 1987
- C. ritteri* (Doucet, 1980) n. comb.
 = *Macroposthonia ritteri* Doucet, 1980
- C. rustica* (Micoletzky, 1915) Luc & Raski, 1981
 = *Criconema rusticum* Micoletzky, 1915
 = *Hoplolaimus rusticus* (Micoletzky, 1915) Menzel,
 1917
 = *Criconemoides rusticus* (Micoletzky, 1915) Taylor,
 1936
 = *Criconema quadricorne* Kirjanova, 1948 (n. syn.)
 = *Criconemoides lobatus* Raski, 1952
 = *Macroposthonia rustica* (Micoletzky, 1915) De
 Grisse & Loof, 1965
 = *Criconemoides quadricornis* (Kirjanova, 1948)
 Raski, 1968
 = *Macroposthonia quadricornis* (Kirjanova, 1948)
 Ivanova, 1976
 = *Madinema loma* Khan, Chawla & Saha, 1976***
- C. sicula* (Vovlas, 1982) n. comb.
 = *Macroposthonia sicula* Vovlas, 1982
- C. sphaerocephaloides* (De Grisse, 1967) n. comb.
 = *Discocriconemella sphaerocephaloides* De Grisse,
 1967
- = *Macroposthonia sphaerocephaloides* (De Grisse,
 1967) Orton Williams, 1981
- C. striatella* (Eroshenko, 1980) n. comb.
 = *Macroposthonia striatella* Eroshenko, 1980
- C. talensis* Chaves, 1983
- C. teres* (Raski, 1951) Luc & Raski, 1981*
 = *Criconemoides teres* Raski, 1951
 = *Macroposthonia teres* (Raski, 1951) De Grisse &
 Loof, 1965
- C. variabile* (Raski & Golden, 1966) n. comb.
 = *Bakernema variabilis* Raski & Golden, 1966
 = *Neobakernema variabile* (Raski & Golden, 1966)
 Ebsary, 1981
- C. wolgogica* (Choi & Geraert, 1975) n. comb.
 = *Macroposthonia wolgogica* Choi & Geraert, 1975
- C. yukonensis* (Ebsary, 1982) n. comb.
 = *Bakernema yukonense* Ebsary, 1982

Relationships of the genus *Criconemella* :

Criconemella is most closely related to *Discocriconemella* and *Nothocriconemoides* by the basically smooth (at most finely crenate) annuli of adult females. *Criconemella* is distinguished by body annuli gradually narrowing to head which is not set off; submedian lobes well developed; pseudolips not prominent. *Discocriconemella* has a high cephalic (labial) annulus, well set off; submedian lobes lacking or poorly developed. *Nothocriconemoides* lacks pseudolips and submedian lobes protrude forward but merge dorsally and ventrally; more importantly the cephalic (labial) annulus is quite set off. In some aspects it appears intermediate between *Criconemella* and *Criconema*.

Synonymization of genera with *Criconemella* :

A rationale justifying synonymization of *Macroposthonia*, *Criconemoides* and *Xenocriconemella* with *Criconemella* was presented in detail by Luc and Raski (1981) which is consistent with the philosophy of general concepts *s. l.* presented by Luc *et al.* (1987). Since 1981 three new generic taxa have been proposed. *Seshadriella* by Darekar and Khan (1981). This was examined in detail by Raski and Luc (1984) leading to rejection of the taxon as representing a species belonging to *Criconemella*. The two others proposed in 1981 are considered below.

Neobakernema Ebsary, 1981

Ebsary (1981*b*) proposed this taxon for a single species, *N. variabile*, previously assigned to the genus *Bakernema*. In this present report (p. 425) *B. variabile* is transferred to the genus *Criconemella* for the reasons given there. As a consequence *Neobakernema* becomes a junior synonym of *Criconemella*.

Crossonemoides Eroshenko, 1981

This new taxon was proposed by Eroshenko (1981)

* See p. 421.

** See p. 425.

*** Fide Orton Williams (1981).

* See p. 421.

based upon a single species *C. calvatus*. The genus was distinguished by : *i*) labial region with two or three annuli; *ii*) labial disc with four submedian lobes; *iii*) body annuli smooth then crenulate near oesophagus becoming fringed protuberances midbody to posterior; *iv*) body covered from labial region to vulvar region with thin cuticular membrane (lacking in juvenile); *v*) juveniles with irregular, short, fringed protuberances not arranged in longitudinal rows.

This is a curious mixture of morphological characters difficult to evaluate confidently without study of specimens. However, a judgment can be made based on the published information that suggests it should be properly assigned to the genus *Criconemella* : *i*) the presence of an extra cuticular membrane is not a diagnostic character ruling out *Criconemella*. Elsewhere *Baker-nema variabile* is transferred to *Criconemella* yet it has a similar cuticular membrane. *Criconema giardi* likewise bears a cuticular membrane but properly belongs to *Criconema* where such a membrane is a rarity; *ii*) the labial annuli are most like *Criconemella*, especially the original Fig. 1 B — this is not so definite in Fig. 1 A where the first annulus is slightly set off on the left side but not so on the right side — a schematic drawing which cannot be firmly interpreted but accepting 1 B as more definitely drawn the aspect represents a species of *Criconemella*; *iii*) crenate to slightly fringed annuli are known in *Criconemella* adult females; *iv*) the irregular short protuberances of the larvae can easily be accommodated in *Criconemella* along with the patterns of *Criconemella incrassata* and *Criconemella variabilis*.

It is then judged this species is best transferred to the genus *Criconemella* as *Criconemella calvatus* (Eroshenko, 1981) n. comb.

Comments on some species of *Criconemella* :

Despite the broader limits of generic *sensu lato* concepts as proposed here there are a number of species that do not conform well.

- *Criconemella incrassata* is one which has long been known to have characteristics not well suited to existing generic taxa. Ebsary (1982) maintained *C. incrassata* does not belong in *Criconemella* because the juvenile cuticle has spines. Yet in all other attributes it shares relationships with *Criconemella* (Fig. 1 C, D). It is judged preferable to leave *incrassata* in *Criconemella* as an example of a variant in a quite variable genus.

- *Criconemella meridiana* Mehta, Raski & Valenzuela, 1982 is another species which leaves question as to its placement. It has no clearly defined submedian lobes in the female even when seen on SEM. Yet the juveniles have distinct submedian lobes. Also the juveniles have about 20 longitudinal rows of bluntly rounded cuticular protuberances (scales or spines). The same rationale applies here as with *incrassata*. In most other respects *meridiana* fits closet with *Criconemella* and is placed there.

- *C. teres* has always left doubts as to its placement because of absence of submedian lobes. It is listed here to satisfy those doubts by an SEM photograph which was taken from specimens recently collected in the type locality. This shows clearly that *C. teres* females have small, distinct submedian lobes (Fig. 1 F) and the species belongs in *Criconemella*.

- *Criconemella neoaxestis* Jairajpuri & Siddiqi, 1963 was first described as a species of *Criconemoides*. De Grisse (1967) transferred it to *Lobocriconema* after concluding (in agreement with author Jairajpuri) that the juveniles illustrated with cuticular spines in the original description were in fact respectively the male and larva of another species, probably *C. informis*, which occurred in the same population. Ebsary (1982) transferred *neoaxeste* to *Criconemella* without comment and until further information is available on juveniles as well as *en face* characteristics it is judged preferable to leave this species in *Criconemella*.

Discocriconemella De Grisse & Loof, 1965

- = *Neocriconema* Diab & Jenkins, 1965 *p. parte*
- = *Mesocriconema* Andrassy, 1965 *p. parte*
- = *Criconemoides* apud Luc, 1970 *p. parte*
- = *Madinema* Khan, Chawla & Saha, 1976 *p. parte*
- = *Acrozostron* Orton Williams, 1981

Diagnosis :

Criconematinae.

Female : Body generally curved ventrally. Posterior edge of body annuli smooth or finely crenate, never bearing scales or spines. "Cephalic" (= labial?) annulus high, forward directed, forming a flattened disc, often irregular (dorso-ventral and/or lateral indentations), and often constricted at its posterior part ("neck"). Submedian lobes, when present, poorly developed. Stylet of variable length, rigid or flexible. Vulva usually closed occasionally open. Post-vulval part rounded to elongate-conoid.

Male : Head end conoid, with an anterior projection. Lateral field variable (two to four lines); bursa present or not.

Juvenile : Annuli smooth to finely crenate, no longitudinal rows of scales or spines.

Type species :

- D. limitanea* (Luc, 1959) De Grisse & Loof, 1965
- = *Criconema limitaneum* Luc, 1959
- = *Criconemoides limitaneus* (Luc, 1959) Luc & de Guiran, 1960
- = *Neocriconema limitaneum* (Luc, 1959) Diab & Jenkins, 1965
- = *Mesocriconema limitaneum* (Luc, 1959) Andrassy, 1965
- = *Discocriconemella barberi* Chawla & Samathanam, 1980 (syn. n.)*

* See p. 424.

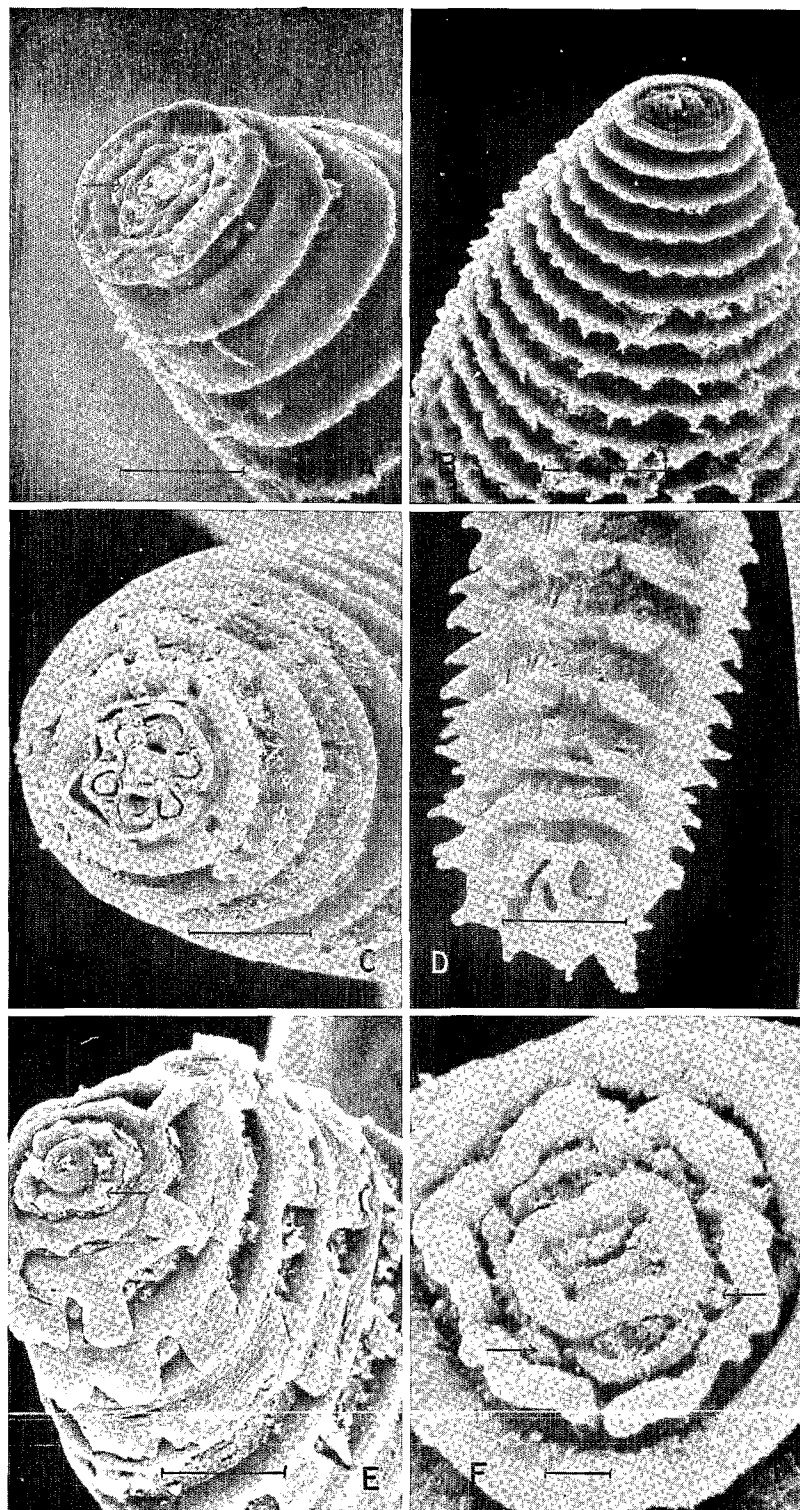


Fig. 1. *Criconemella variabile*. A : Female, face view; B : Juvenile, face view. - *Criconemella incrassata*. C : Female, face view; D : Juvenile; tail. - *Bakernema inaequale*; E : Female, face view. - *Criconemella teres*; F : Female, face view. Bar on A-E = 10 μ m; on F = 2 μ m. (Arrows indicate submedian lobes).

Other species :

- D. baforti* De Grisse, 1967
 = *Criconemoides baforti* (De Grisse, 1967) Luc, 1970
 = *Madinema baforti* (De Grisse, 1967) Khan, Chawla & Saha, 1976
- D. caudaventer* Orton Williams, 1979
 = *Acrozostron caudaventer* (Orton Williams, 1979) Orton Williams, 1981
- D. colbrani* (Luc, 1970) Loof & De Grisse, 1973
 = *Criconemoides colbrani* Luc, 1970
- D. degrissei* Loof & Sharma, 1980
- D. discolabia* (Diab & Jenkins, 1966) De Grisse, 1967
 = *Criconemoides discolabius* Diab & Jenkins, 1966
- D. glabrannulata* De Grisse, 1967
 = *Criconemoides glabrannulatus* (De Grisse, 1967) Luc, 1970
 = *Madinema glabrannulatum* (De Grisse, 1967) Khan, Chawla & Saha, 1976
- D. hengsungica* Choi & Geraert, 1975
 = *Acrozostron hengsungicum* (Choi & Geraert, 1975) Orton Williams, 1981
- D. inarata* Hoffman, 1974
- D. macramphidia* De Grisse, 1967
 = *Criconemoides macramphidia* (De Grisse, 1967) Luc, 1970
 = *Madinema macramphidia* (De Grisse, 1967) Khan, Chawla & Saha, 1976
 = *Acrozostron macramphidia* (De Grisse, 1967) Orton Williams, 1981
- D. mauritiensis* (Williams, 1960) De Grisse & Loof, 1965
 = *Criconemoides mauritiensis* Williams, 1960
- D. morelensis* Cid del Prado Vera & Loof, 1985
- D. pannosa* Sauer & Winoto, 1975
 = *Acrozostron pannosum* (Sauer & Winoto, 1975) Orton Williams, 1981
- D. perseae* Cid del Prado Vera & Loof, 1985
- D. recensi* Seshadri, Weischer & Mathen, 1971
 = *Madinema recensi* (Seshadri, Weischer & Mathen, 1981) Khan, Chawla & Saha, 1976
- D. repleta* Pinochet & Raski, 1976
 = *D. limitanea apud* Sauer & Winoto, 1975*
- D. retroversa* Sauer & Winoto, 1975
 = *Acrozostron retroversum* (Sauer & Winoto, 1975) Orton Williams, 1981
- D. theobromae* (Chawla & Samathanam, 1980) n. comb.*
 = *Madinema theobromi* Chawla & Samathanam, 1980

Relationships :

Discocriconemella appears most closely related to *Criconemella* (see under that genus above) by the absence of cuticular ornamentation (or a very discrete one) in both the females and the larvae. The main characters are the great development of the "cephalic" annulus in the female, and the particular profile of the lip area in the male, which shows a forward projection (lips?).

Comments on the genus *Discocriconemella* :

A review of this genus was made by Orton Williams (1981) which at that time held fifteen species. A total of twenty species have been described or transferred to *Discocriconemella* at one time or another. One of the fifteen species Orton Williams (1981) transferred to *Macroposthonia* and the remainder were assigned to two genera (nine species were retained in *Discocriconemella* and five assigned to a new genus, *Acrozostron*). Two other new species (*C. theobromae* and *C. degrissei*) were described later.

The genus *Acrozostron* is based primarily upon the following morphological characters : *i*) body annuli smooth, *vs* smooth or crenate in *Discocriconemella*; *ii*) *en face* configuration of labial disc and amphid apertures; and secondarily *iii*) upon number of body annuli; *iv*) length of stylet (short, rigid types in *Discocriconemella vs* long, thin, flexible in *Acrozostron*); *v*) tail shape (short, rounded in *Discocriconemella vs* longer, more conical, often with a dorsally directed terminus in *Acrozostron*); *vi*) male lateral field (two to four lines, caudal alae present or absent in *Discocriconemella vs* two lines, caudal alae absent in *Acrozostron*).

In fact, this proposal for a new taxon follows classically along the lines described earlier : identification of "groups" of species in a given taxon (genus) then attempting to maximize differences and consistencies as evidence supporting these new categories. Crenate or smooth body annuli is typical : all species are smooth in *Acrozostron* (though *caudaventer* is admittedly rough yet not regularly crenate). This case is weakened by the remaining *Discocriconemella* which may have smooth or crenate annuli.

Configuration of the labial disc is consistent in four of the species although inclusion of *D. hengsungica* must be by interpretation (doubtful at best) since no *en face* sections or SEM photographs are available. Addition of *D. theobromae* probably should be made on similarity of *en face* appearance. However, variability of disc in *Discocriconemella s. str.* is even greater than suggested by Orton Williams. Besides the simple circular disc of *D. discolabia*, there is the disc with dorso-ventro indents of *D. baforti*, *D. barberi*, *D. colbrani* and *D. repleta*. No *en face* views are available for the types of *D. limitanea*, *D. mauritiensis* or *D. recensi* leaving doubtful the exact nature of their disc structure. Collections of *D. limitanea* have been identified from many localities in Brazil, Fiji and Malaysia with differences in reports on the disc. Loof and Sharma (1980) report the same dorso-ventral indents by word description but Orton Williams illustrates *D. limitanea* with latero indents as well, giving a four-lobed outline. A similar outline is illustrated for *degrissei* (and to a lesser degree by *D. glabrannulata*). Such variability in *Discocriconemella* could easily be extended to include the outlines shown by *Acrozostron*. Besides, presence of "neck" annuli clearly setting off

* See p. 424.

first head annulus (*D. caudaventer*) vs no such neck (*D. mauritiensis*) has variability in both groups.

As to number of body annuli there is a great overlap (76-114 vs 65-118 for *Acrozostrom*). Similarly for length of stylet [33-66 µm for *Discocriconemella* (except on *D. baforti* : 99-113) µm vs 57-113 for *Acrozostrom*] the overlap and nonconformance of *D. baforti* makes this character doubtful for generic diagnosis. Finally, tail shape is a weak distinction because in both diagnoses the two defining shapes are only "generally" so (short-rounded vs elongate-conoid).

In conclusion, we judge there is not sufficient evidence to justify two genera and accept the action of Ebsary (1982) synonymizing *Acrozostrom* with *Discocriconemella*.

Comments on some species of *Discocriconemella* :

1. *Discocriconemella limitanea* and *D. repleta* are two very closely related species. On the basis of numerical data (L, R, RV, stylet length) of the populations recorded in Africa (Luc, 1959, 1970; Coomans, 1966), Malaysia (Sauer & Winoto, 1975) and Brazil (Loof & Sharma, 1980) for the former species and Brazil only for the latter (Pinochet & Raski, 1978; Loof & Sharma, 1980), *D. limitanea* and *D. repleta* cannot be separated (see Tab. 1). This situation has been considered as sufficient by Chawla and Samathanam (1980) to synonymize the two species.

We do not agree with this opinion because *D. repleta* represents a morphological character unique within the genus, i.e. a conspicuous constriction of the female body at level of vulva, the postvulval part being

notably narrower than the anterior part preceding the vulva. In all the other species of the genus, including *D. limitanea*, the ventral profile of the female is continuous at level of vulva, the only irregularity being the vulva opening.

For this reason, we consider that the population of *D. limitanea* recorded in Malaysia (Sauer & Winoto, 1975) pertains actually to *D. repleta* as showing this postvulval constriction.

On the other hand, *D. barberi* (Chawla & Samathanam, 1980) is described, from India, as "closely related to *D. limitanea*, but separated by having larger stylet and body which is also more slender". Concerning the first character, Table 1 shows that the figures recorded for *D. barberi* enter in the range of variation of both *D. limitanea* and *D. repleta*. Coefficient a, which characterizes the more or less pronounced slenderness of a nematode, cannot, in this case, be taken into consideration; it is too dependent on the status of nematodes in the slide (flattened or not); Coomans (1966) noted for *D. limitanea*, two ranges of figures for "a" : 5.7-6.7 and 7.6-11 after correction of the artificial flattening (Geraert, 1961).

As the ventral profile of *D. barberi* at level of vulva does not show any characteristic, we propose to consider the species as a minor synonym of *D. limitanea*.

2. *Discocriconemella theobromae* (Chawla & Samathanam, 1980) (syn. : = *Madinema theobromi* Chawla & Samathanam, 1980). This species pertains apparently to the genus *Discocriconemella* by the high and cup-shaped first annulus which is smoothly indented dorso-ventrally.

Table 1

Measurements of some populations described as *Discocriconemella limitanea*, *D. repleta* or *D. barberi*

	<i>D. limitanea</i> Ivory Coast (Luc, 1970)	<i>D. limitanea</i> Congo (Coomans, 1965)	<i>D. limitanea</i> Brazil (Loof & Sharma, 1980)	<i>D. repleta</i> (<i>D. limitanea</i>) Malaysia (Sauer & Winoto, 1975)	<i>D. repleta</i> Brazil (Pinochet & Raski, 1978)	<i>D. repleta</i> Brazil (Loof & Sharma, 1980)	<i>D. limitanea</i> (<i>D. barberi</i>) India (Chawla & Samathanam, 1980)
L	180-250	260-280	167-306	200-250	250-290	183-271	215-300
Spear	38-53	53-55	50-77	45-53 52*	59-66	43-56	52-60
RV	11-12	11-14	10-15	11-15	10-12	9-13	13-15
RVan	4	5-7	3-7	5-6	3-4	0-4	7?
Ran	7	6-8	5-9	?	7-8	6-10	7?
R	84-113	119-128	90-109	95-120	107-116	98-118	97-109
a	5.8-8	5.7-6.7 7.6-11	6.6-9.4	5.8**	7-8	6.8-8.8	7-10

* Chawla and Samathanam (1980).

** 58 in the original.

It appears to be a valid species, close to *D. discolabia* by the second annulus (= first body annulus) which is higher than the first and than the succeeding body annuli. But it differs from *D. discolabia* by body length (0.275-0.340 vs 0.240-0.300 mm); stylet length 65-81 μm vs 35-44 μm ; R = 95-104 vs 155-174).

Note also that *Theobroma* being feminine in gender, species name has been modified from *theobromi* to *theobromae*.

Nothocriconemoides Maas, Loof & De Grisse, 1971

Diagnosis :
Criconematinae.

Female : Annuli 57-64 (type species), with fine longitudinal striae, no anastomoses. First annulus elevated, cup-shaped; second annulus narrower than first one. Pseudolips well-developed, bearing four protruding submedian lobes. Labial plates present. Vulva "closed", anterior vulva lip bilobed, projecting backwards. Tail conoid.

Male : (*N. crenulatus*) four-lined lateral field; tail pointed; caudal alae well developed, reaching tail extremity.

Juveniles : Annuli crenate, devoid of scales or spines. First annulus not offset.

Type species :

Nothocriconemoides lineolatus Maas, Loof & De Grisse, 1971.

Other species :

Nothocriconemoides crenulatus Ivanova, 1984.

Relationships :

See *Criconemella* (p. 420).

Comments :

The genus *Nothocriconemoides* was synonymized with *Criconemella* by Ebsary (1982) but rather appears a distinctive one by the structure of the first and second annuli (see diagnosis), recalling many species of *Criconema*. But instead, pseudolips and submedian lobes are well-developed, labial "plates" are present as in many species of *Criconemella*. Other noticeable characters are the low number of body annuli, their length (thickness?) (8 μm ; calculated by L/R on holotype), and the juveniles without scales but showing a continuous serration on the posterior edge of annuli.

Eroshenko (1981) described *Nothocriconemoides justus* as a new species assigned to this genus. However, the anteriormost annuli gradually decrease in diameter, also the first and/or second (lip?) annuli are not distinctly set off but resemble the body annuli only different in being thinner and narrower. Four submedian lobes and two labial plates are reported present. No information is given regarding males or juveniles. It is judged to be more properly assigned to the genus *Criconemella* and is

hereby transferred to that genus as *Criconemella justus* (Eroshenko, 1981) comb. n.

Ivanova (1984) described a new species, *Nothocriconemoides crenulatus*, which like *N. lineolatus* seems intermediate between *Criconemella* and *Criconema*. A single thin, cephalic annulus is set off from body annuli, but no pseudolips are evident and submedian lobes are rather prominent although fused dorsally and ventrally as in *justus*. It is judged more like *lineolatus* and left in that genus as proposed by Ivanova (1984).

Bakernema Wu, 1964

Diagnosis :
Criconematinae.

Female : Body stout, fusiform, 0.42-0.55 mm; annuli 63-70, cuticle thick bearing membranous cuticular structures on posterior margins. Labial area not set off, with three annuli, submedian lobes small. Labial framework thickly sclerotized. Stylet 64-72 μm . Vulva with strongly developed overlapping anterior vulval lip. Vulva on 4th to 7th annulus from terminus, anus on third annulus. Tail bluntly rounded.

Male : Lateral incisures four, caudal alae small, spicules 36-48 μm .

Juveniles : Annuli without cuticular ornamentation, roughly irregular or uneven at most.

Type and only species :

- Bakernema inaequale* (Taylor, 1936) Mehta & Raski, 1971
- = *Criconema inaequale* Taylor, 1936
- = *Criconema bakeri* Wu, 1964
- = *Bakernema bakeri* Wu, 1964

Relationships :

This taxon is most closely related to *Ogma*, *Blandicephalanema* and *Pateracephalanema* by its very elaborate cuticular fringes on head and body annuli. It is unique by its unusual thick sclerotization of head framework and by gradually reducing annuli onto head, delicate submedian lobes seen only on SEM and prominent circular oral plate.

Comments :

Four species have been assigned to this genus, *Bakernema inaequale* (Taylor, 1936) Mehta & Raski, 1971, *B. variabile* Raski & Golden, 1966, *B. yukonense* Ebsary, 1982 and *B. velatum* Mehta, Raski & Valenzuela, 1983.

The most important distinguishing characters for this taxon (comprised at that time of *B. inaequale* and *B. variabile*) according to Andrassy (1979) are : *i*) cuticle bearing thin, transparent, membranous extensions irregularly disposed, not arranged in definite longitudinal rows; *ii*) "head" with one annulus, not set off, also similarly ornamented; submedian lobes weakly developed or lacking; *iii*) larval cuticular structure similar to adults but scales (appendages) heavier, cuticularized, not

arranged in rows (pertains only to *B. variabile* since no descriptions of larvae of *B. inaequale* were then available).

These four species clearly are not all congeneric. Even from the first descriptions *B. variabile* showed a head structure different from *B. inaequale*. *Bakernema yukonense* curiously appears more closely related to *B. variabile* with similar minimal cephalic sclerotization and small cuticular fringe on the annuli but was not placed in the same genus with *B. variabile*. Primary emphasis on both species was placed on the film-like cuticle similar in kind but not degree with *B. inaequale*. Since then, the rediscovery of *Criconema giardi*, typical of the genus *Criconema* in every sense except it possesses a definite film-like cuticular extension over the entire body, raises serious question as to the value of such a cuticular structure for distinguishing genera.

Yet the proper placement of these three species still is not entirely clear. All three have weakly developed submedian lobes [Ebsary (1981) confirmed here by SEM photographs of *B. variabile* in Fig. 1 A, B]. However, the juveniles of *B. inaequale* have no definite ornamentation being roughly irregular or uneven (unpublished observations on juveniles loaned by A. M. Golden) whereas *B. yukonensis* juveniles are described as having annuli crenate with extra cuticular layer present not elaborated into spines. *B. variabile* on the other hand has larvae with short numerous cuticular ornamentations, crenate near anterior end but short, triangular in outline on the body. In all three species the head annuli diminish in size as in *Criconemella*, but *B. inaequale* differs significantly in the very heavily developed cephalic sclerotization not usually found in *Criconemella*. This unusually strong cephalic framework argues for its retention in a taxon separate from *Criconemella*.

B. variabile and *B. yukonense* are different in having a "labial area" even more like a *Criconemella*, including less sclerotized cephalic framework. These more logically show closer relationship to *Criconemella* to which both species are hereby transferred.

Bakernema velatum Mehta, Raski & Valenzuela, 1983 was described from specimens collected in Tierra del Fuego, Chile. They were assigned to this genus again principally because adult females have a cuticular fringe much like the fringe present on the annuli of *B. variabile*, a labial region more like those of *Criconema* and juveniles have long cuticular scales with refractive elements at their extremity. The recent discovery of *Criconema giardi* at Orange Bay, Hoste Island, Chile not far from Tierra del Fuego revealed a similar cuticular fringe present on the annuli of that species which quite clearly belongs to the genus *Nothocriconema* (= *Criconema*). These collections rule out use of such cuticular characteristic for generic distinction. For these reasons, *Bakernema velatum* is transferred to the genus *Criconema*.

Blandicephalanema Mehta & Raski, 1971

Diagnosis :

Criconematinae.

Female : Body short, stout, 0.36–0.56 mm; annuli 70–80, strongly retrorse. Head offset, with one small, reduced, basal annulus, bearing a very large, rounded lip region. Lip region of six large lips, the two lateral lips with spacious cavities in their sclerotization and extending beyond it. Stylet 63–90 μ m. Body marked by 8–28 rows of scales, with a thick basal portion and thin elongated drawn-out posterior region to form a spine. A very light, delicate "fringe" of cuticle may be present. Tail conoid, with the scales more enlarged.

Male : Lateral lines three. Spicules 48 μ m. Caudal alae small or lacking. Tail conoid.

Juvenile : Known only for *B. serratum*. Head and tail resemble adult female. Cuticular ornamentation as ten rows of scales at midbody decreasing in number anteriorly and posteriorly. Each scale with flat pentagonal-shaped anterior base, rounded U-shaped posterior part with three to five fine serrations at tip.

Type species :

Blandicephalanema serratum Mehta & Raski, 1971

Other species :

Blandicephalanema pilatum Mehta & Raski, 1971

Relationships :

This taxon is most closely related to *Pateracephalanema* and *Ogma*. In all three genera, there are elaborate cuticular fringes on all the body annuli. *Blandicephalanema* is unique in its small, smooth head with small, basal annulus; lacking submedian lobes and pseudolips. *Pateracephalanema* is distinguished by its rows of elaborate cuticular scales, its large discoid basal annulus, or when two head annuli present the first is large, discoid with or without elaborate fringes.

Comments :

Only two species have been described in this genus which basically resemble those species belonging to *Ogma* by virtue of the distinct, longitudinal rows of scales with long pointed extensions on the scales. The very unique, small head structure with one narrow, basal head annulus bearing a high rounded lip region apparently devoid of submedian lobes argues strongly to retain this as a separate taxon.

Ebsary (1981) transferred *Seriespinula cactus* Andr assy, 1979 to this genus without comment or explanation. In fact, it is not at all related to the two species presently comprising *Blandicephalanema*. Considering the annuli of the labial area, the first is wider than the second, rounded, saucer-shaped with low rounded pseudolips; the second narrower, sloping inward followed by retrorse body annuli. These have close paral-

els with species of *Ogma s.l.* and this species is hereby transferred to that genus.

***Pateracephalanema* Mehta & Raski, 1971**
= *Pateracephalanema (Pellipecten)* Siddiqi, 1986

Diagnosis :
Criconematinae.

Female : Body stout straight or curved ventrally to form an open "C", bluntly rounded at both ends; 0.23-0.50 mm. Labial region distinctly set off from body with one large discoid basal annulus, or with two annuli, the first large and discoid. Submedian lobes absent. Stylet 50-89 µm. Body annuli 55-98, with scales arrayed in 8-16 longitudinal rows at midbody. Scales flat, smooth and rectangular, or semicircular or elaborately fringed with 7-10 setiform projections or continuous fringe of dense comb-like spines.

Male : Lateral lines four. Spicules 31-34 µm. Caudal alae small; tail conoid.

Juvenile : Described only for *P. australe*. Annuli with cuticular scales as in female but each scale rounded and bearing small projections.

Type species :
Pateracephalanema imbricatum (Colbran, 1965) Mehta & Raski, 1971
= *Criconema imbricatum* Colbran, 1965

Other species :
P. alticola (Colbran, 1965) Mehta & Raski, 1971
= *Criconema alticola* Colbran, 1965
P. australe (Colbran, 1963) Mehta & Raski, 1971
= *Criconema australe* Colbran, 1963
P. pectinatum (Colbran, 1962) Mehta & Raski, 1971
= *Criconema pectinatum* Colbran, 1962
= *Crossonema pectinatum* (Colbran, 1962) Ebsary, 1981
P. pellitum Andrassy, 1979
= *Crossonema pellitum* (Andrassy, 1979) Ebsary, 1981

Relationships :
See *Blandicephalanema* above.

Comments :
Siddiqi (1986) proposed a new subgenus *Pellipecten* for two of the above species, *P. pectinatum* and *P. pellitum*. Cuticular scales on these species are fringed with many spines whereas, species left assigned to *Pateracephalanema* have simple, rounded, contiguous scales. Consistent with judgments made above in the case of *Ogma*, such cuticular characteristics are not significant enough to justify a separate subgeneric taxon. Therefore, these two species are returned to the genus *Pateracephalanema* and the subgenus *Pellipecten* declared a synonym of that genus.

Five species have been described in this genus all collected in Australia. They are closely related to *Ogma*

s.l. but the saucer-shaped first annulus, cuticular appendages closely appressed to body and curved strongly backward plus the bluntly rounded body posterior to vulva are persuasive these should be retained in a separate taxon.

***Hemicriconemoides* Chitwood & Birchfield, 1957**

Diagnosis :
Criconematinae.

Female : Animal of small to medium size (0.29-0.67) mm. Body plump, straight or slightly ventrally curved, tapering on short distance at both ends. Number of annuli 51-164. Cuticle with two detached layers, closely adpressed; annulation strong, not retrorse; lateral field not marked. Vulva posterior. Vulval lips plain; vulval flaps occasionally present. Tail short, conoid to rounded. Labial framework heavily sclerotized. First anterior annuli not or weakly differentiated. No submedian lobes. Amphidial aperture slit-like. Stylet strong; basal knobs forward directed, generally with a jointed anterior process; rarely rounded; never sloping backwards.

Male : Slender; oesophagus degenerated; stylet absent. Spicules slender, slightly curved; gubernaculum short and plain. Caudal alae rarely present, if so weakly, developed. Penial tube rarely present, if so, short.

Juveniles : One-layered cuticle; submedian lobes sometimes present, weakly developed; strong annulation; each annulus bears six, ten, or twelve scales conoid or provided with short denticles; when six on an annulus, alternate with the following annulus (twelve rows).

Type species :
H. wessoni Chitwood & Birchfield, 1957
= *Hemicycliophora wessoni* (Chitwood & Birchfield, 1957) Goodey, 1963

Other species :
H. aberrans Phukan & Sanwal, 1983
H. affinis Germani & Luc, 1970
H. alexis Vovlas, 1980
H. annulatus Pinochet & Raski, 1975
H. brachyurus (Loof, 1949) Chitwood & Birchfield, 1957
= *Criconemoides brachyurus* Loof, 1949
= *Hemicycliophora brachyurus* (Loof, 1949) Goodey, 1963
= *H. sacchariae* Heyns, 1970
H. brevicaudatus Dasgupta, Raski & Van Gundy, 1969
H. californianus Pinochet & Raski, 1975
H. cocophilus (Loof, 1949) Chitwood & Birchfield, 1957
= *Criconemoides cocophilus* Loof, 1949
= *Hemicycliophora cocophila* (Loof, 1949) Goodey, 1963
= *Hemicriconemoides microdoratus* Dasgupta, Raski & Van Gundy, 1975

- H. communis* Edward & Misra, 1963
 = *Criconema mangiferae* Edward & Misra, 1963*
H. conicaudatus Phukan & Sanwal, 1983
H. coronatus Reay & Colbran, 1986
H. digitatus Reay & Colbran, 1986
H. gabrici (Yeates, 1973) Raski, 1975
 = *Paratylenchus gabrici* Yeates, 1973
H. gaddi (Loof, 1949) Chitwood & Birchfield, 1957
 = *Criconemoides gaddi* Loof, 1949
 = *Hemicycliophora gaddi* (Loof, 1949) Goodey, 1963
H. ghaffari Maqbool, 1982
H. insignis Dasgupta, Raski & Van Gundy, 1969
H. intermedius Dasgupta, Raski & Van Gundy, 1969
H. kanayensis Nakasono & Ichinohe, 1961
 = *H. ureshinoensis* Yokoo, 1963
H. litchi Edward & Misra, 1963
H. mangiferae Siddiqi, 1961
 = *H. birchfieldi* Edward, Misra & Singh, 1965
H. mehdii Suryawanshi, 1971
H. minor Brzeski & Reay, 1982
H. minutus Esser, 1960
 = *Hemicycliophora minuta* (Esser, 1960) Goodey, 1963
H. neobrachyurus Dhanachand & Jairajpuri, 1979
H. nitida Pinochet & Raski, 1975
H. obtusus Colbran, 1962
 = *Criconemoides obtusus* (Colbran, 1962) Siddiqi & Goodey, 1963
H. parvus Dasgupta, Raski & Van Gundy, 1969
H. promissus Vovlas, 1980
H. pseudobrachyurus De Grisse, 1964
H. snoeki Van Doorselaere & Samsoen, 1982
H. strictathecatus Esser, 1960
H. sunderbanensis Ganguly & Khan, 1981
H. taiwanensis Pinochet & Raski, 1975
H. varionodus Choi & Geraert, 1972

Species inquirenda :

- H. squamosus* (Cobb, 1913) Siddiqi & Goodey, 1963**
 = *Iota squamosum* Cobb, 1913
 = *Hoplolaimus squamosus* (Cobb, 1913) Menzel, 1917

* In a personal communication to one of the authors (D. J. R.), Edward admitted that the specimens described as *Criconema mangiferae* were actually juveniles of *H. communis*.

** Siddiqi and Goodey (1963), after examination of published and unpublished drawings of Cobb, claimed that *Iota squamosus* is actually an *Hemicriconemoides*; they add that *H. mangiferae* and *H. strictathecatus* are both junior synonyms of this species. If it can be stated with some certainty that *I. squamosum* pertains to *Hemicriconemoides*, data appear as nonsufficient to characterize the species, and even less to synonymize well-defined species with it. It seems preferable to designate this species as a *species inquirenda* until material from type host (mango tree) and type locality (Bangalore, India) can be examined.

Relationships :

Hemicriconemoides was for many years placed with *Hemicycliophora* and related forms because of the extra cuticle found on adult females. However, it is judged most closely related to the Criconematinae by virtue of the males being very similar to those of *Criconemella* and other related genera which are very different from *Hemicycliophora* males in spicules, caudal alae and tail. It remains unique amongst the Criconematinae as the only group with double cuticle in the adult female.

Remarks on *Hemicriconemoides* :

The double cuticle in the females as well as the weak differentiation of the anterior annuli are reminiscent of *Hemicycliophora* and for this reason some species of *Hemicriconemoides* have been transferred to *Hemicycliophora*. But many more characters link *Hemicriconemoides* to genera classified into the Criconematinae : in the female the strong stylet, with developed basal knobs never sloping backwards, the short vulval part and tail. The number of annuli is moderate. Males are not discernable from males of other genera of Criconematinae, and as such very different from those of *Hemicycliophorinae*. Juvenile has four submedian lobes so far not at all known in *Hemicycliophorinae*; also cuticle is one layered and bears longitudinal rows of scales. Considering these anatomical-morphological features it seems justified to consider *Hemicriconemoides* as pertaining to the Criconematinae and not sufficiently differentiated to be judged a separate subfamily.

Subfamily **Hemicycliophorinae**
 Skarbilovich, 1959.

- = *Hemicycliophoroidea* Skarbilovich, 1959
 = *Hemicycliophoridae* Skarbilovich, 1959
 = *Caloosiidae* Siddiqi, 1980 (n. syn.)

DIAGNOSIS

Criconematidae.

All stages : Moderate to large animals (female : 0.60-1.72 mm).

Female : Body cylindrical. Cuticle with round, coarse, non-retrorse annuli, usually numbering over 200, devoid of lobes, spines, scales, but sometimes provided with superficial ornamentation; extra cuticular layer present, except in some species of *Caloosia*; typical lateral field lacking, but often irregularities in body annuli or various longitudinal markings are present, very variable within the same species. Labial area with generally two, exceptionally three annuli, generally weakly differentiated.

Submedian lobes absent*. Stylet elongated (over 50 µm), basal knobs rounded, posteriorly sloping. Vulval lips usually modified. Tail usually elongated (rounded in some species).

Male : Tail elongated, tapering, with conspicuous caudal alae extending beyond its middle. Spicules setaceous, long, straight, arcuate, semi-circular, U- or hook-shaped. Cloacal lips forming a penial tube in several species. Hypopygium often present.

Juveniles : Having the same characters as corresponding female (except for reproductive system). Male juveniles of fourth-stage lacking stylet in some species of *Hemicycliophora*.

BIONOMICS

Ectoparasitic on roots of plants, mostly perennial. Some cause hypertrophy and/or hyperplasia in host tissue.

TYPE GENUS

Hemicycliophora de Man, 1921

OTHER GENUS

Caloosia Siddiqi & Goodey, 1964

COMMENTS

The subfamily Hemicycliophorinae has often been considered as a family (Geraert, 1966; Eroshenko, 1976), and, more recently, as a superfamily (Siddiqi, 1980). It contains a low number of genera of which the species have been nearly all originally described as *Hemicycliophora*. These genera are : *Hemicycliophora* de Man, 1921; *Caloosia* Siddiqi & Goodey, 1964; *Hemicaloosia* Ray & Das, 1978; *Colbranium* Andrassy, 1979; *Aulosphora* Siddiqi, 1980; *Loofia* Siddiqi, 1980. Siddiqi (1980) grouped *Caloosia* and *Hemicaloosia* in the family Caloosidae Siddiqi, 1980, whereas other genera remain in Hemicycliophoridae, both families being grouped in Hemicycliophoroidea.

The characters elected to differentiate these two families appear sound, but our opinion is they have to be considered at genus level, and not family level. Thus, we propose to recognize only two genera, *Hemicycliophora* and *Caloosia* (see p. 431), grouped in the subfamily Hemicycliophorinae. Characters used to differentiate these two genera (Tab. 2), are from different

* Submedian lobes have been reported in *Caloosia delpradi* and *C. luci* but illustrations provided in both cases are far from being conclusive. Moreover, in this study by SEM of the face of 20 species of *Hemicycliophora* Loof (1985) did not observe submedian lobes in any of these species.

Table 2

Characters differentiating *Hemicycliophorus* s. auct. from *Caloosia* s. auct.

	<i>Hemicycliophora</i> s. auct.	<i>Caloosia</i> s. auct.
Cuticle, female and juvenile	two layers, well-separated and of equal importance	outer layer if present thin, membranous closely adpressed
Labial annulus (female)	not modified, not set off (except <i>H. hesperis</i> and <i>H. truncata</i>)	usually modified, set off
Vagina	straight or curved	sigmoid
Spicules	arcuate to hook-shaped	straight
Penial tube	present	absent
J4 males	no stylet	stylet present
Male tail	shorter than female tail	longer than female tail

categories (labial area, cuticle, sexual apparatus, etc.), thus these genera are founded on a large basis.

***Hemicycliophora* de Man, 1921**

- = *Procriconema* Micoletzky, 1925
- = *Colbranium* Andrassy, 1979 (n. syn.)
- = *Aulosphora* Siddiqi, 1980
- = *Loofia* Siddiqi, 1980

Diagnosis :

Hemicycliophorinae.

Female : Extra cuticular layer always present, generally loose, never membranous. Labial annuli two (exceptionally three) not modified or separated (except in *H. hesperis* and *H. truncata*). Vulva a transverse slit over half of body diameter long. Vagina straight or curved but not sigmoid.

Male : Labial region marked by a discontinuity in body annulation, usually offset; labial framework in lateral view appearing as "spectacle mark". Spicules arcuate, semi-circular, U- or hook-shaped. Lips of cloaca forming a penial tube bearing a single hypopygium at its tip. Caudal alae covering less than one-third of the tail. Tail longer than that of female.

Juvenile : Fourth-stage male juvenile without stylet.

Type species :

- Hemicycliophora typica* de Man, 1921
- = *Procriconema membranifer* Micoletzky, 1925
- = *Hemicycliophora membranifer* (Micoletzky, 1925) Loof, 1948
- = *Hemicycliophora transvaalensis* Heyns, 1962

Other species :

- Hemicycliophora aberrans* Thorne, 1955
H. acuta (Reay, 1985) n. comb.
 = *Loofia acuta* Reay, 1985
H. amchitkaensis Bernard, 1982
H. andrassyi Brzeski, 1974
H. aquatica (Micoletzky, 1913) Loof, 1948
 = *Tylencholaimus aquaticus* Micoletzky, 1913
H. arcuata Thorne, 1955
H. arenaria Raski, 1958
H. argiensis Khan & Nanjappa, 1972
H. belemnii Germani & Luc, 1973
H. biloculata Colbran, 1969
H. brevicauda Sauer, 1958
H. brevis Thorne, 1955
H. brzeskii Barber & Geraert, 1980
 = *Aulosphora brzeskii* (Barbez & Geraert, 1980) Siddiqi, 1980
H. californica Brzeski, 1974
H. charlestoni Reay, 1985
H. chathamii Yeates, 1978
 = *H. chathamii chathamii* Yeates, 1978
H. chilensis Brzeski, 1974
 = *H. thienemanni apud* Andrassy, 1967
H. conida Thorne, 1955
 = *H. typica apud* Goodey, 1951
H. corbetti Siddiqi, 1980
H. dahomensis Germani & Luc, 1976
 = *Aulosphora dahomensis* (Germani & Luc, 1976) Siddiqi, 1980
H. dhirendri Husain & Khan, 1967
H. diolaensis Germani & Luc, 1973
H. ekdavicii Darekar & Khan, 1981
H. ekrami Sultan & Singh, 1982
H. epicharis Raski, 1958
H. epicharoides Loof, 1968
H. eucalypti Reay, 1985
H. eugeniae Khan & Basir, 1963
H. ferrisae Brzeski, 1974
 = *Loofia ferrisae* (Brzeski, 1974) Siddiqi, 1980
H. floridensis (Chitwood & Birchfield, 1957) Goodey, 1963
 = *Hemicriconemoides floridensis* Chitwood & Birchfield, 1957
 = *Hemicriconemoides biformis* Chitwood & Birchfield, 1957
 = *Hemicycliophora biformis* (Chitwood & Birchfield, 1957) Goodey, 1963
H. garhwalensis Gupta & Gupta, 1982
H. gigas Thorne, 1955
 = *Loofia gigas* (Thorne, 1955) Siddiqi, 1980
H. gracilis Thorne, 1955
H. guptai Duggal & Kool, 1985
H. halophila Yeates, 1967
H. hesperis Raski, 1958
H. indica Siddiqi, 1961
 = *H. musae* Khan & Nanjappa, 1972
 = *Aulosphora indica* (Siddiqi, 1961) Siddiqi, 1980
H. iranica Loof, 1984
H. italiae Brzeski & Ivanova, 1978
H. iwia Brzeski, 1974
H. juglandis Choi & Geraert, 1975
H. karachiensis (Maqbool, Shahina & Zarina, 1986) n. comb.
 = *Aulosphora karachiensis* Maqbool, Shahina & Zarina, 1986
H. koreana Choi & Geraert, 1971
H. labiata Colbran, 1960
H. litoralis Reay, 1985
H. loofi Maas, 1970
H. lutosa Loof & Heyns, 1969
H. lutosoides Loof, 1984
H. macristhmus Loof, 1968
H. macrodorata Raski & Valenzuela, 1986
H. madagascariensis Germani & Luc, 1973
H. major Yeates 1978 (n. grad.)
 = *H. chathamii major* Yeates, 1978
*H. mangiferae** Misra & Edward, 1971
H. megalodiscus Loof, 1984
H. mettlerei Jenkins & Reed, 1964
H. micoletzkyi Goffart, 1951
H. minor Wu, 1966
H. montana Eroshenko, 1980
H. monticola Mehta, Raski & Valenzuela, 1983
H. nana Thorne, 1955
H. natalensis Loof & Heyns, 1969
H. nigeriensis Germani & Luc, 1973
H. nortoni Brzeski, 1974
H. nucleata Loof, 1968
H. nyanzae Schoemaker, 1968
H. obesa Thorne, 1955
H. obtusa Thorne, 1955
H. oostenbrinki Luc, 1958
 = *Aulosphora oostenbrinki* (Luc, 1958) Siddiqi, 1980
H. osmani Das & Shivaswamy, 1977
 = *Aulosphora osmani* (Das & Shivaswamy, 1977) Siddiqi, 1980
H. ovata Colbran, 1962
H. parvana Tarjan, 1952
H. pauciannulata Luc, 1958
H. penetrans Thorne, 1955
 = *Aulosphora penetrans* (Thorne, 1955) Siddiqi, 1980
H. pinocheti Mehta & Raski, 1984
H. poranga Monteiro & Lordello, 1978
H. pruni Kirjanova & Shagalina, 1974
H. pseudochiliensis Barbez & Geraert, 1980
H. punensis Darekar & Khan, 1980
H. quercea Mehta & Raski, 1984
H. raskii Brzeski, 1974
H. ripa van den Berg, 1981
H. ritteri Brizuela, 1963
H. robusta Loof, 1968
 = *Loofia robusta* (Loof, 1968) Siddiqi, 1980
H. rotundicauda Thorne, 1955
H. saueri Brzeski, 1974
H. sculpturata Loof, 1984

* Emended from *mangiferum* : *Mangifera* being feminine in gender, the genitive case is ending in *ae*.

- H. shepherdii* Wu, 1966
H. sheri Brzeski, 1974
H. siddiqii Deswal & Bajaj, 1987
H. signata Orton Williams, 1978
H. similis Thorne, 1955
H. spinituberculata Loof, 1984
H. spinosa Colbran, 1969
H. straturata Germani & Luc, 1973
H. striatula Thorne, 1955
H. sturhani Loof, 1984
H. subaolica Jairajpuri & Baqri, 1973
H. tarjani Khan & Basir, 1963
H. tenuis Thorne, 1955
 = *H. tessellata** Sauer, 1958
H. thienemanni (Schneider, 1925) Loos, 1948
 = *Hoplolaimus thienemanni* Schneider, 1925
 = *Procriconema thienemanni* (Schneider, 1925) Micoletzky, 1925
 = *Hemicycliophora salicis* Sofrygina, 1972
 = *Loofia thienemanni* (Schneider, 1925) Siddiqi, 1980
H. thornei Goodey, 1963
 = *H. typica apud* Thorne, 1955
H. triangulum Loof, 1968
 = *H. utkali* Ray & Das, 1981
H. truncata Colbran, 1956
 = *Colbranium truncatum* (Colbran, 1956) Andrassy, 1979
H. uniformis Thorne, 1955
 = *Loofia uniformis* (Thorne, 1955) Siddiqi, 1980
*H. vaccinii*** Reed & Jenkins, 1963
 = *Loofia vaccinii* (Reed & Jenkins, 1963) Siddiqi, 1980
H. vidua Raski, 1958
 = *H. silvestris* Jenkins & Reed, 1964
 = *H. vivida* Wu, 1966
H. vitiensis Orton Williams, 1978
H. wallacei Reay, 1985
H. zuckermani Brzeski, 1963

***Caloosia* Siddiqi & Goodey, 1964**
 = *Hemicaloosia* Ray & Das, 1978 (n. syn.)

Diagnosis :
 Hemicycliophorinae.

Female : Cuticle with or without an extra cuticular layer; if present membranous, much thinner than body cuticle and closely adpressed to it. Lateral field absent in female without extra cuticular layer; in others nearly always present as superficial markings. Labial annuli separated, usually modified. Vulva transversely oval, less than half body diameter long, depressed and flush with

body contour (no discontinuity of body contour near vulva). Anterior vulva lip modified, partly overhanging vulva. Vagina sigmoid. Tail elongate, filiform.

Male : Labial region continuous, framework not as "spectacle mark". Spicules straight. No penial tube. A single hypopygium projecting ventrally. Caudal alae covering more than one-third of the tail. Tail shorter than that of female.

Juvenile : Cuticle and labial area as in corresponding female. Fourth-stage male juvenile with stylet.

Type species :

Caloosia longicaudata (Loof, 1948) Siddiqi & Goodey, 1964
 = *Hemicycliophora longicaudata* Loos, 1948

Other species :

- C. americana* (Ray & Das, 1978) n. comb.
 = *Hemicaloosia americana* Ray & Das, 1978
C. brevicaudata Khan, Chawla & Saha, 1979
C. delpradi Maas, 1970
 = *Hemicaloosia delpradi* (Maas, 1970) Siddiqi, 1980
C. exilis Mathur, Khan, Nand & Prasad, 1969
 = *C. indica* Chawla & Samathanam, 1980
C. luci (Dhanachand & Jairajpuri, 1980) n. comb.
 = *Hemicaloosia luci* Dhanachand & Jairajpuri, 1980
C. nudata (Colbran, 1963) Brzeski, 1974
 = *Hemicycliophora nudata* Colbran, 1963
 = *Hemicaloosia nudata* (Colbran, 1963) Ray & Das, 1978
C. paradoxa (Luc, 1958) Brzeski, 1974
 = *Hemicycliophora paradoxa* Luc, 1958
 = *Hemicaloosia paradoxa* (Luc, 1958) Ray & Das, 1978
C. paralongicaudata Siddiqi & Goodey, 1964
C. parlonga Khan, Chawla & Saha, 1979
C. paxi Mathur, Khan, Nand & Prasad, 1969
 = *C. heterocephala* Rao & Mohandas, 1976
 = *C. parapaxi* Phukan & Sanwal, 1980
C. triannulata Ray & Das, 1981

COMMENTS ON GENERA IN HEMICYCLIOPHORINAE;
 SYNONYMYZATIONS

Aulosphora

Differences between *Hemicycliophora sensu* Siddiqi, 1980 (= here "*Hemicycliophora*") and *Aulosphora* Siddiqi, 1980 appears as not sufficiently constant and consistent to be retained, even at a subgeneric level. These characters, all related to the genital area, are given in Table 3.

"*Hemicycliophora*" retained the majority of the species, whereas five species were placed in *Aulosphora* (*A. penetrans*, type species, *A. dahomensis*, *A. indica*, *A. osmani*, *A. oostenbrinki*) to which *H. brzeskii* is very close, if we consider the spicule shape.

The first character (development and shape of vulva lip) is difficult to appreciate : for example, "*H.*" *corbetti* has vulva lips appearing as backward directed (as in

* *Hemicycliophora tessellata* Boonduong & Ratanaprapa, 1974, junior homonym of Sauer's species, is too succinctly described and illustrated to be associated to *Hemicycliophora* or *Caloosia*.

** Emended from *Vaccinium*, the host plant, of which the genitive case is *vaccinii*.

Table 3
 Characters differentiating "*Hemicycliophora*"
 (*sensu* Siddiqi, 1980) from *Aulosphora*

	" <i>Hemicycliophora</i> " <i>sensu</i> Siddiqi, 1980	<i>Aulosphora</i>
Vulval lips	elongated, but shorter than three body annuli; usually divergent	elongated, more than three body annuli; parallel directed backwards
Body behind vulva	deeply recessed	slightly recessed
Spicules	semi-circular	often very long (more than 100 µm), U-or hook-shaped
Penial tube	shorter than one body diameter; directed outward and forward	longer than one body diameter; directed forward; often touching ventral body
Body in front of penial tube	deeply recessed	not deeply recessed
Bursa	pre-anal/post-anal stretches = 1/1	pre-anal/post-anal stretches = 3-4/1
Female tail	elongate tapering, filiform, cylindrical or rarely hemispherical	elongate-tapering

Aulosphora), very slightly divergent and 2-2.5 body annuli long. Moreover, illustrations concerning species attributed to *Aulosphora* do not always permit recognition of shape and development of vulva lips; thus reexamination of type material would have been necessary to determine accurately differences on that point. Note too that *H. brzeskii* presented backward directed and parallel vulva lips, but only as long as 1.5-2 body annuli.

The second character is not consistent (recession or not behind vulva) : many "*Hemicycliophora*" species have no or very slight recession after vulva, such as *H. nucleata*, *H. salicis*, *H. striatula* and *H. transvaalensis* (now considered as a minor synonym of *H. typica*).

Shape of the spicules appears more consistent, being semi-circular in "*Hemicycliophora*" and U- or hook-shaped in *Aulosphora*; nevertheless, *H. oostenbrinki* constitutes a good link between these groups as the spicules correspond to 3/4 of a circle.

The two following characters appear to be linked with the spicule length; when spicules are long, the penial tube is long too, and the deep recession of the body annuli may be considered as a kind of mechanical compensation for short spicules and short penial tubes.

Concerning the caudal alae, and more particularly its

anterior and posterior development relative to cloaca, the excellent study of Siddiqi (1980) of the development of spicular area in *H. penetrans* shows clearly that the penial tube extremity is attached, before last molting, to the rectum, so that in the adult the cloacal opening is actually at the extremity of the penial tube. Thus, if we consider caudal alae parts anterior and posterior to the level of the cloacal opening so precised, the ratios are about the same for both "*Hemicycliophora*" and *Aulosphora*.

The last character, referring to the shape of the female, is not consistent at all, this being reinforced by considering *H. brzeskii* which shows a short conical tail.

On these bases we agree with Loof (1985) that the five species discarded from *Hemicycliophora* to constitute the genus *Aulosphora* have to be replaced again in the first genus of which the latter one becomes a minor synonym.

Loofia

The genus *Loofia* Siddiqi, 1980 was characterized by *i*) the vulva lips rounded, low and not modified; *ii*) the spicules arcuate, but not semi-circular or hook-shaped; *iii*) the penial tube short (less than three body annuli long); *iv*) the male body not recessed in front of the penial tube; *v*) the long caudal alae. Moreover, the two cuticular layers are generally more closely adpressed than in "*Hemicycliophora*". Seven species have been placed in that genus : *H. acuta*, *H. ferrisae*, *H. gigas*, *H. robusta*, *H. thiennemanni*, *H. uniformis* and *H. vaccini*.

The nonprotruding vulva lips appear a character linked with the more closely adpressed cuticular layers. But many variations exist in "*Hemicycliophora*" and a clear cut with *Loofia* appears difficult to establish : for example, *H. arenaria*, left in "*Hemicycliophora*" by Siddiqi (1980) shows vulva lips low, not modified. On the other hand, as underlined by Loof (1985), the majority of characters used to define *Loofia* are those of male; actually, males are known in only one of the species placed in *Loofia*, i.e., *H. thiennemanni*, and they are extremely rare. Examination of the face of females using SEM by Loof (1985; see below) in two species of *Loofia* (*H. thiennemanni* and *H. robusta*) revealed that they pertain to two different "types", as defined by Loof (1985); concerning the face, each of these species appears closer to some species of "*Hemicycliophora*" than each other.

For all these reasons, we agree with Loof (1985) in considering *Loofia* as a junior synonym of *Hemicycliophora*.

Note that species formerly placed in *Aulosphora* appear the closest to *Caloosia*, mainly to *C. luci*, in which, to the contrary of other *Caloosia*, the cephalic annuli are only weakly differentiated. The status of this species would have to be precised.

Colbranium

The genus *Colbranium* Andrassy, 1979, represented

by a single species, *C. truncatum*, was characterized by i) a very short, rounded post-vulval part, deeply recessed at vulva level; ii) the labial area separated from the rest of the body by a pronounced groove*.

We estimate that the shortening of the post-vulval part represents a tendency in the genus *Hemicycliophora*, as many typical species present a rounded terminus coupled with a vulva in rather posterior position (ex. : *H. arenaria*, *H. hesperis*, *H. nana*, *H. obtusa*...). The constriction at the base of the labial area is in the genus, but *H. hesperis* shows a similar structure, all other characters conforming to those of the genus. Thus, this character cannot be used to justify a separate genus.

According to these observations, *Colbranium* is proposed as a junior synonym of *Hemicycliophora*.

Caloosia and *Hemicaloosia* have been separated mainly on the fact that in *Caloosia* the extracuticular layer is absent whereas present in *Hemicaloosia*. However, in the latter genus this layer appears very different from that of *Hemicycliophora* : it is thinner, membranous and in some species (*C. delpradi*, *C. nudata*) so difficult to discern that it has been overlooked in the original description. The other differential characters appear as not very important and/or consistent; they are related to the lateral field in female (two lines in *Hemicaloosia*, but absent in *H. delpradi*); head of male marked by interruption in body annuli (but said to have four annuli in *H. americana*). For these reasons we estimate that *Hemicaloosia* must be considered a minor synonym of *Caloosia*.

Note that all species of *Caloosia* s. auct. have been described from tropical area, whereas *Hemicycliophora* s. auct. species are found in any climatic area.

NOTE OF THE FACE IN *HEMICYCLIOPHORA*

Loof (1985) performed a very interesting study of the face as seen by SEM in 20 species of *Hemicycliophora*. He distinguished three types (although he confessed that types 1 and 2 are not distinguishable!) :

Type 1 : Amphid apertures wide open. Oral disc often raised distinctly above first head annulus. In the light microscope such a lip region looks truncate.

Type 2 : Amphid apertures covered by plates. Oral disc protruding beyond the plane of these plates. Under the light microscope such a lip region looks truncate.

Type 3 : Amphid apertures covered by plates. Oral disc in the same plane as these plates. Under the light microscope such a lip region looks conoid.

* Siddiqi (1980) rediagnosing this genus cited male characters. No male has been originally described, but Siddiqi (1980) reported he studied the male on original material sent by the authors. No further details are given.

These three (or two) types do not fit with the genera created by the splitting of *Hemicycliophora* i.e., "*Hemicycliophora*"; *Aulosphora* and *Loofia* (no material of *Colbranium* was available). Loof's observations thus reinforce the arguments against validity of this splitting. They indicate also a possible way to try to understand the evolution inside the genus *Hemicycliophora* and perhaps to realize more natural groupings, if really needed.

Family **Tylenchulidae** Skarbilovich, 1947

DIAGNOSIS

Criconematoidea.

Female : Small (except *Tylenchocriconema* : up to 0.83 mm). Body slender, swollen or globose. Cuticle thin, except in some swollen or globose forms; without ornamentation, except some species with fine punctation (*Paratylenchus*) or minute spines (*Meloidoderita*). Typical lateral field present except in some swollen or globose forms. Weakly developed labial framework. Submedian lobes exceptional, very weakly developed. Stylet delicate, of variable length; basal knobs rounded to sloping backwards. Isthmus clearly marked; oesophageal glandular bulb slightly reduced to medium size.

Male : Stylet degenerate or absent. Caudal alae absent except *Tylenchocriconema*. Lateral field identical to females.

Juvenile : Slender. Cuticle thin, without ornamentation. Lateral field identical to female. Stylet present, functional (except fourth stage of *Paratylenchus*).

BIONOMICS

Ectoparasitic mostly on roots of higher plants, in some cases under bark of perennial host roots (some species of *Gracilacus*); exceptionally (*Tylenchocriconema*) on leaves and in crowns (mostly below waterline) of bromeliads.

TYPE SUBFAMILY

Tylenchulinae Skarbilovich, 1947

OTHER SUBFAMILIES

Paratylenchinae Thorne, 1949

Tylenchocriconematinæ Raski & Siddiqi, 1975

Subfamily **Paratylenchinae** Thorne, 1949

= Paratylenchidae Thorne, 1949

DIAGNOSIS

Tylenchulidae.

Female : Small, slender nematodes, up to 0.50 mm; annulation fine; lateral field with two to four lines; lip region weakly sclerotized, bluntly rounded or with various shapes from small lip-like projections near oral aperture; stylet length variable (12-119 μm); conus longer than shaft plus knobs; procorpus gradually merges into metacorpus; isthmus long, slender; posterior bulb distinctly set off; spermatheca well-developed offset from anterior end of uterus, with or without sperms.

Male : Degenerate; stylet if present weakly developed; oesophagus reduced; spicules slightly curved; no caudal alae (except weakly developed in *Cacopaurus*).

Juvenile : Similar to females but mostly with shorter stylet [lacking or very reduced, rudimentary in fourth-stage (dauer) juvenile].

BIONOMICS

Long stylet species become swollen as sedentary feeders, some under bark of perennial host roots; most others ectoparasitic on roots.

TYPE GENUS

Paratylenchus Micoletzky, 1922

OTHER GENERA

Cacopaurus Thorne, 1943

Gracilacus Raski, 1962

COMMENTS ON GENERA IN PARATYLENCHINAE

The genus *Paratylenchus* was proposed by Micoletzky (1922) based on a single specimen which he named *P. bukowinensis*. That specimen survives but in a very poor condition of preservation. It was used as the basis for a redescription by Loof and Oostenbrink (1968) who also designated it as holotype.

More recently Brzeski, Zepp and D'Ezzico (1976) reported life-history studies on material identified as *P. bukowinensis* from Poland which gives a more complete picture on the morphology of this species including description of males. Although it is not type material, the morphology closely fits *P. bukowinensis* and serves well to establish more firmly the type species of the genus.

Before proceeding, it may be more efficient to consider here two other genera, *Gracilacus* Raski, 1962 and *Paratylenchoides* Raski, 1973. Many species have been described in the former genus but transferred later to *Paratylenchus* and vice-versa. Only two species have been identified and described as *Paratylenchoides*.

Gracilacus is a taxon that was proposed on the following basic characteristics : *i*) small species up to 0.50 mm; *ii*) female slender to obese with stylet 49-119 μm ; *iii*) body posterior to vulva elongate; *iv*)

cuticle finely annulated, without ornamentation; *v*) excretory pore near valve of median bulb or more anteriorly but may be near nerve ring. It was distinguished from *Cacopaurus* which has punctate ornamentation and a very short, blunt body shape posterior to the vulva. From *Paratylenchus* it was diagnosed by the long stylet (up to 36 μm in *Paratylenchus*); the position of the excretory pore (near nerve ring or more posteriorly in *Paratylenchus*); and by well-developed stylet in younger larval stages of *Gracilacus*.

Subsequent descriptions of new species have extended the range of stylet length in both *Gracilacus* and *Paratylenchus* until the separation is very narrow. Position of the excretory pore further anteriorly in most (or all) *Gracilacus* spp. has been another distinguishing characteristic. However, this is more likely a function of elongating stylet and procorpus. Perhaps more compelling characteristics are the extremely swollen body shapes and various cuticular ornamentations, mostly as minute tubercles found in some species of *Gracilacus*. These are not found in *Paratylenchus*. A recent study by Cid del Prado Vera and Maggenti (in press) reports a new species of *Gracilacus* present in large numbers under the bark of redwood roots. Included are many swollen females which represents a feeding habit very distinctive from *Paratylenchus* which does not produce swollen females and feeds only on cells of root surfaces. This is considered sufficient evidence to justify a separate taxon for the long stylet species defined as *Gracilacus*.

The genus *Paratylenchoides* was diagnosed as distinct from *Paratylenchus* based on *i*) stronger head sclerotization; *ii*) female head narrower dorso-ventrally; *iii*) small, narrow, rounded protrusion on anterior surface of conoid lip region in males, females and larvae. The configurations of lip regions in *Paratylenchus* are quite variable and can readily accommodate as still another variation the shape found in these two species. The strong head sclerotization is a matter of degree only. There remains only the dorso-ventrally flattened head shape and this is judged not sufficient to justify a separate generic taxon. *Paratylenchoides sheri* and *P. israelensis* are hereby transferred to *Paratylenchus* and the genus *Paratylenchoides* proposed a junior synonym of *Paratylenchus*. Siddiqi (1986) proposed a subgeneric taxon for *Paratylenchoides* in the genus *Paratylenchus*. The rationale above is justification for synonymizing also the subgenus *Paratylenchoides* with *Paratylenchus* since the differences described are minor and easily accepted in one genus. Therefore, the subgeneric taxon is rejected and declared a junior synonym of *Paratylenchus*.

The genus *Cacopaurus* also should be considered here. Two species have been assigned to this genus, *C. pestis* Thorne, 1943, type species, and *C. epacris* Allen & Jensen, 1950, later transferred to *Gracilacus* (Raski, 1962) and then to *Paratylenchus* (Goodey, 1963). This

leaves *Cacopaurus* a monotypic genus. The principal distinguishing characters for *Cacopaurus* are : *i*) the obese females with rows of refractive, punctate markings all over the body; *ii*) females with elongate stylet, 92-110 µm; *iii*) body posterior to vulva short, very bluntly rounded. The fact that cuticles of female are found persisting in the soil, slightly tannish in color, suggests some biological or physiological difference not found in other species of *Paratylenchus* or *Gracilacus* has been noted.

Refractive elements are found also in *Paratylenchus mutabilis* which has a long, conoid tail on swollen females. *P. crenatus* is also reported as having crenate or tuberculate aerolations across the lateral field in older specimens. However, the blunt rounded tail of *C. pestis* is unlike any other species in the other two genera and maintenance of *Cacopaurus* as a separate monotypic genus is proposed here.

Paratylenchus Micoletzky, 1922
= *Paratylenchoides* Raski, 1973

Diagnosis :

Paratylenchinae.

Female : Small, under 0.5 mm, vermiform, not abnormally swollen. Labial framework weakly sclerotized (except *P. israelensis* and *P. sheri* where stronger). Stylet small to medium sized (12-40 µm), not flexible. Excretory pore from level of nerve ring to level of oesophago-intestinal junction. Annuli smooth.

Juvenile : Resembling female. Stylet rarely present; if so, weak in J4 only.

Type species :

Paratylenchus bukowinensis Micoletzky, 1922

Other species :

- P. acti* Eroshenko, 1978
- P. alleni* Raski, 1975
- P. amundseni* Bernard, 1982
- P. aquaticus* Merny, 1966
= *P. humilis* Raski, 1975
- P. arcuatus* Luc & de Guiran, 1962
- P. besoekianus* Bally & Reydon, 1931
- P. baldacci* Raski, 1975
- P. brevihastus* Wu, 1962
- P. breviculus* Raski, 1975
- P. ciccaronei* Raski, 1975
- P. colbrani* Raski, 1975
- P. concavus* Eroshenko, 1978
- P. coronatus* Colbran, 1965
- P. dianthus* Jenkins & Taylor, 1956
- P. elachistus* Steiner, 1949
- P. emarginatus* Eroshenko, 1978
- P. fueguensis* Raski & Valenzuela, 1986
- P. flectospiculus* Huang & Raski, 1987
- P. goldeni* Raski, 1975
- P. halophilus* Wouts, 1966

- P. hamatus* Thorne, 1950
- P. holdemani* Raski, 1975
- P. israelensis* (Raski, 1973) Siddiqi, 1986
= *Paratylenchoides israelensis* Raski, 1973
- P. italiensis* Raski, 1975
- P. labiosus* Anderson & Kimpinski, 1977
- P. leiodermis* Raski, 1975
- P. lepidus* Raski, 1975
- P. leptos* Raski, 1975
- P. longicaudatus* Raski, 1975
- P. mexicanus* Raski, 1975
- P. microdorus* Andrassy, 1959
- P. mimulus* Raski, 1975
- P. minusculus* Tarjan, 1960
- P. minutus* Linford in Linford, Oliveira & Ishii, 1949
- P. morius* Yokoo, 1970
- P. nainianus* Edward & Mistra, 1963
- P. nanus* Cobb, 1923
- P. nawadus* Khan, Prasad & Mathur, 1967
- P. neoamblycephalus* Geraert, 1965
- P. neonanus* Mathur, Khan & Prasad, 1967
- P. neoprojectus* Wu & Hawn, 1975
- P. obtusicaudatus* Raski, 1975
- P. pandus* Pinochet & Raski, 1977
- P. paramonovi* Bagaturia & Solovyova, 1972
- P. perlatus* Raski, 1975
- P. pesticus* Thorne & Malek, 1968
- P. platyurus* Eroshenko, 1978
- P. projectus* Jenkins, 1956
= *P. amblycephalus* Reuver, 1959
- P. pseuduncinatus* Phukan & Sanwal, 1979
- P. rostrocaudatus* Huang & Raski, 1987
- P. salubris* Raski, 1975
- P. serricaudatus* Raski, 1975
- P. sheri* (Raski, 1973) Siddiqi, 1986
= *Paratylenchoides sheri* Raski, 1973
- P. similis* Khan, Prasad & Mathur, 1967
- P. tateae* Wu & Townshend, 1973
- P. tenuicaudatus* Wu, 1961
- P. tui* Orton Williams, 1985
- P. uncinatus* Samibaeva, 1966
- P. vandenbrandei* De Grisse, 1962
- P. variabilis* Raski, 1975
- P. variatus* Jairajpuri, 1982
- P. veruculatus* Wu, 1962
- P. vexans* Thorne & Malek, 1968

Species inquirendae :

- P. curvatus* van der Linde, 1938
- P. macrophallus* (de Man, 1880) Goodey, 1934 (*pro parte*)
= *Tylenchus macrophallus* de Man, 1880
= *Anguillulina macrophallus* (de Man, 1880) Goodey, 1932 (*pro parte*)
- P. strenzkei* (Volz, 1951) Oostenbrink, 1960
= *Hemicycliophora* (= *Procriconema*) *strenzkei* Volz, 1951

Gracilacus Raski, 1962

Diagnosis :

Paratylenchinae.

Female : Small, under 0.5 mm, vermiform or swollen in prevulval region. Labial framework weakly sclerotized. Stylet long (41-119 µm), flexible. Excretory pore from level of base of stylet to level of nerve ring. Annuli smooth, more rarely (three species) with small tubercles.

Juvenile : Resembling female. Stylet generally present, well developed.

Type species :

- Gracilacus epacris* (Allen & Jensen, 1950) Raski, 1962
- = *Cacopaurus epacris* Allen & Jensen, 1950
- = *Paratylenchus epacris* (Allen & Jensen, 1950) Goodey, 1963

Other species :

- G. abietis* (Eroshenko, 1974) Raski, 1976
- = *Paratylenchus abietis* Eroshenko, 1974
- G. acicula* (Brown, 1959) Raski, 1962
- = *Paratylenchus aciculus* Brown, 1959
- G. aculeata* (Brown, 1959) Raski, 1962
- = *Paratylenchus aculeatus* Brown, 1959
- G. anceps* (Cobb, 1923) Raski, 1962
- = *Paratylenchus anceps* Cobb, 1923
- G. aonli* (Misra & Edward, 1971) Raski, 1976
- = *Paratylenchus aonli* Misra & Edward, 1971
- G. capitata* Adams & Eichenmuller, 1962
- = *Paratylenchus capitatus* (Adams & Eichenmuller, 1962) Siddiqi & Goodey, 1963
- G. colina* Huang & Raski, 1986
- G. costata* Raski, 1976
- = *Paratylenchus costatus* (Raski, 1976) Siddiqi, 1986
- G. crenata* (Corbett, 1966) Raski, 1976
- = *Paratylenchus crenatus* Corbett, 1966
- G. elegans* Raski, 1962
- = *Paratylenchus elegans* (Raski, 1962) Siddiqi & Goodey, 1963
- G. enata* Raski, 1976
- = *Paratylenchus enatus* (Raski, 1986) Siddiqi, 1986
- G. esculenta* (Brown, 1959) Raski, 1962
- = *Paratylenchus esculentus* Brown, 1959
- G. goodeyi* (Oostenbrink, 1953) Raski, 1962
- = *Paratylenchus goodeyi* Oostenbrink, 1953
- G. idalima* Raski, 1962
- = *Paratylenchus idalimus* (Raski, 1962) Siddiqi & Goodey, 1963
- G. intermedia* Raski, 1962
- = *Paratylenchus intermedius* (Raski, 1962) Siddiqi & Goodey, 1963
- G. ivorensis* (Luc & de Guiran, 1962) Raski, 1976
- = *Paratylenchus ivorensis* Luc & de Guiran, 1962
- G. janai* Baqri, 1979
- = *Paratylenchus janai* (Baqri, 1979) Siddiqi, 1986
- G. latescens* Raski, 1976
- = *Paratylenchus latescens* (Raski, 1949) Siddiqi, 1986
- G. longilabiata* Huang & Raski, 1986
- G. macrodorus* (Brzeski, 1963) Raski, 1976
- = *Paratylenchus macrodorus* Brzeski, 1963
- = *Paratylenchus longistylusa* (Dement'eva, 1972)
- = *Gracilacus longistylusa* (Dement'eva, 1972) Nestorov, 1979

- G. marylandica* (Jenkins, 1960) Raski, 1962
- = *Paratylenchus marylandicus* Jenkins, 1960
- G. micoletzkyi* (Edward, Misra & Singh, 1961) Raski, 1976
- = *Paratylenchus micoletzkyi* Edward, Misra & Singh, 1961
- G. mira* Raski, 1962
- = *Paratylenchus mirus* (Raski, 1962) Siddiqi & Goodey, 1963
- G. mutabilis* (Colbran, 1969) Raski, 1976
- = *Paratylenchus mutabilis* Colbran, 1969
- G. oostenbrinki* (Misra & Edward, 1971) Raski, 1976
- = *Paratylenchus oostenbrinki* Misra & Edward, 1971
- G. pandata* Raski, 1976
- = *Paratylenchus pandatus* (Raski, 1976) Siddiqi, 1986
- G. parvula* Raski, 1976
- = *Paratylenchus parvulus* (Raski, 1976) Siddiqi, 1986
- G. peperpotti* Schoemaker, 1963
- = *Paratylenchus peperpotti* (Schoemaker, 1963) Siddiqi & Goodey, 1963
- G. peratica* Raski, 1962
- = *Paratylenchus peraticus* (Raski, 1962) Siddiqi & Goodey, 1963
- G. punctata* Huang & Raski, 1983
- G. raskii* Phukan & Sanwal, 1979
- = *Paratylenchus raskii* (Phukan & Sanwal) Siddiqi, 1986
- G. robusta* (Wu, 1974) Raski, 1976
- = *Paratylenchus robustus* Wu, 1974
- G. solivaga* Raski, 1976
- = *Paratylenchus solivagus* (Raski, 1986) Siddiqi, 1986
- G. steineri* (Golden, 1961) Raski, 1962
- = *Paratylenchus steineri* Golden, 1961
- G. straeleni* (De Coninck, 1931) Raski, 1976
- = *Procriconema straeleni* De Coninck, 1931
- = *Hemicycliophora straeleni* (De Coninck, 1931) Loos, 1948
- = *Paratylenchus straeleni* (De Coninck, 1931) Oostenbrink, 1960
- = *Paratylenchus audriellus* Brown, 1959
- = *Gracilacus audriella* (Brown, 1959) Raski, 1962
- = *Paratylenchus sarissa* Tarjan, 1960
- = *Gracilacus sarissa* (Tarjan, 1960) Raski, 1962
- G. teres* Raski, 1976
- G. yokooi* Toida, Ohshima & Hirata, 1983

***Cacopaurus* Thorne, 1943**

Diagnosis :
Paratylenchinae.

Female : Body very small (0.2-0.3 mm), cylindroid-obese (a = 5-8). Cuticle thin, bearing minute tubercles. Lateral field with four lines, ornamented with rows of tubercles. Labial framework weakly developed. Stylet very long (92-102 µm) in regard to body size. Vulva very posteriorly situated; postvulval part very short, conoid. Uterus thick walled.

Male : No stylet. Œsophagus degenerated. Caudal alae weakly developed, adanal.

Juvenile : Stylet well developed.

Bionomics :

Females sedentary on roots of woody plants.

Type and only species :

Cacopaurus pestis Thorne, 1943

Subfamily Tylenhocriconematinae

Raski & Siddiqui, 1975

= Tylenhocriconematoidea Raski & Siddiqui, 1975

= Tylenhocriconematidae Raski & Siddiqui, 1975

DIAGNOSIS

Tylenchulidae.

Female : Long, slender nematodes, 0.50-0.83 mm; labial area with weak sclerotization, anterior surface flattened bearing squarish plate with H-shaped oral aperture, four small submedian lobes at corners of plate (Figs 2A, 3A); stylet prominent, conus longer than shaft plus knobs, becomes very slender in anterior half; procarpus enlarges gradually to large muscular metacarpus followed by long, slender isthmus and elongate posterior bulb with enclosed glands; body annulation very fine, lateral field slightly raised from contour of body, appears as two longitudinal lines but SEM photograph (Fig. 3B) shows four equally-spaced lines; post-vulvar body very long, conoid; spermatheca off-set, distinct, at anterior end of uterus; vulva a broad slit with slightly overhanging anterior lip, SEM photograph (Fig. 3B) shows prominent lateral vulval membranes.

Male : Slender, slightly shorter than female, 0.42-0.65 mm; labial area without discernible sclerotization, unusual oblique anterior surface sloping ventrad with small, distinct submedian lobes (Figs 2A-D; 4A, B); stylet absent; oesophagus degenerate; lateral field with four equally-spaced lines (Fig. 4C, E) spicules long, curved; caudal alae long slender, extending to terminus (Fig. 4D, F).

Juvenile : Similar to female in general aspect and stylet structure (Fig. 3C-F).

HABITS

Feeds on leaf surfaces and in the crowns of the bromeliad, *Tillandsia flabellata* Bak. The largest numbers are reported in the crowns just below waterline (Brinkman, 1985; Lehman, 1986).

TYPE AND ONLY GENUS

Tylenhocriconema Raski & Siddiqui, 1975

Tylenhocriconema Raski & Siddiqui, 1975

Diagnosis :

Having characters of the subfamily.

Type and only species :

Tylenhocriconema alleni Raski & Siddiqui, 1975.

Comments on *Tylenhocriconema* :

This monotypic genus shares characteristics of both Criconematoidea *s. str.* and Tylenchoidea.

From Criconematoidea *s. str.*, this species shows numerous characters as follows : *Female* : *i*) oesophagus paratylenchoid-type; *ii*) presence of discrete but conspicuous submedian lobes; *iii*) vulva posterior (80 %) and a long transverse slit; *iv*) vagina oblique; *v*) anterior genital branch with lateral spermatheca; *vi*) no evidence of a post-uterine sac. *Male* : *vii*) degeneration of stylet and oesophagus; *viii*) presence of a spicular sheath.

From Tylenchoidea : *Female* : *i*) stylet with conus/shaft ratio about 2/3; *ii*) conus effiliated, needle-like. *Male* : *iii*) tail long with caudal alae well-developed, terminal.

Moreover, both female and male are very slender; a = 40-70 and 42-63, respectively, which are values not uncommon within Tylenchoidea and unknown within other Criconematoidea.

Taking into consideration this mixing of characters, Raski and Siddiqui (1975) proposed the superfamily Tylenhocriconematoidea and the family Tylenhocriconematidae to accommodate this very unusual taxon.

Reexamination of the characteristics of *T. alleni* led us to conclude that the criconematoid morphological data are more important than the tylenchoid ones, especially the presence of submedian lobes, recently confirmed by scanning electron microscopy, which are rather similar to those observed in *Paratylenchus neoamblycephalus* (Raski, 1975). Nevertheless, this genus appears sufficiently different from the genera *Paratylenchus* and *Gracilacus* to be considered as pertaining to a different subfamily, Tylenhocriconematinae Raski & Siddiqui, 1975.

Subfamily Tylenchulinae

= Sphaeronematinae Raski & Sher, 1952

= Sphaeronematidae Raski & Sher, 1952

= Meloidoderitidae Kirjanova & Pogosyan, 1973

DIAGNOSIS :

Tylenchulidae.

All stages : Labial sclerotization discrete; stylet, when present, short, with rounded basal knobs. Excretory pore at very variable distance from anterior end. Strong sexual dimorphism.

Female : Fixed into the root (totally or partially); body

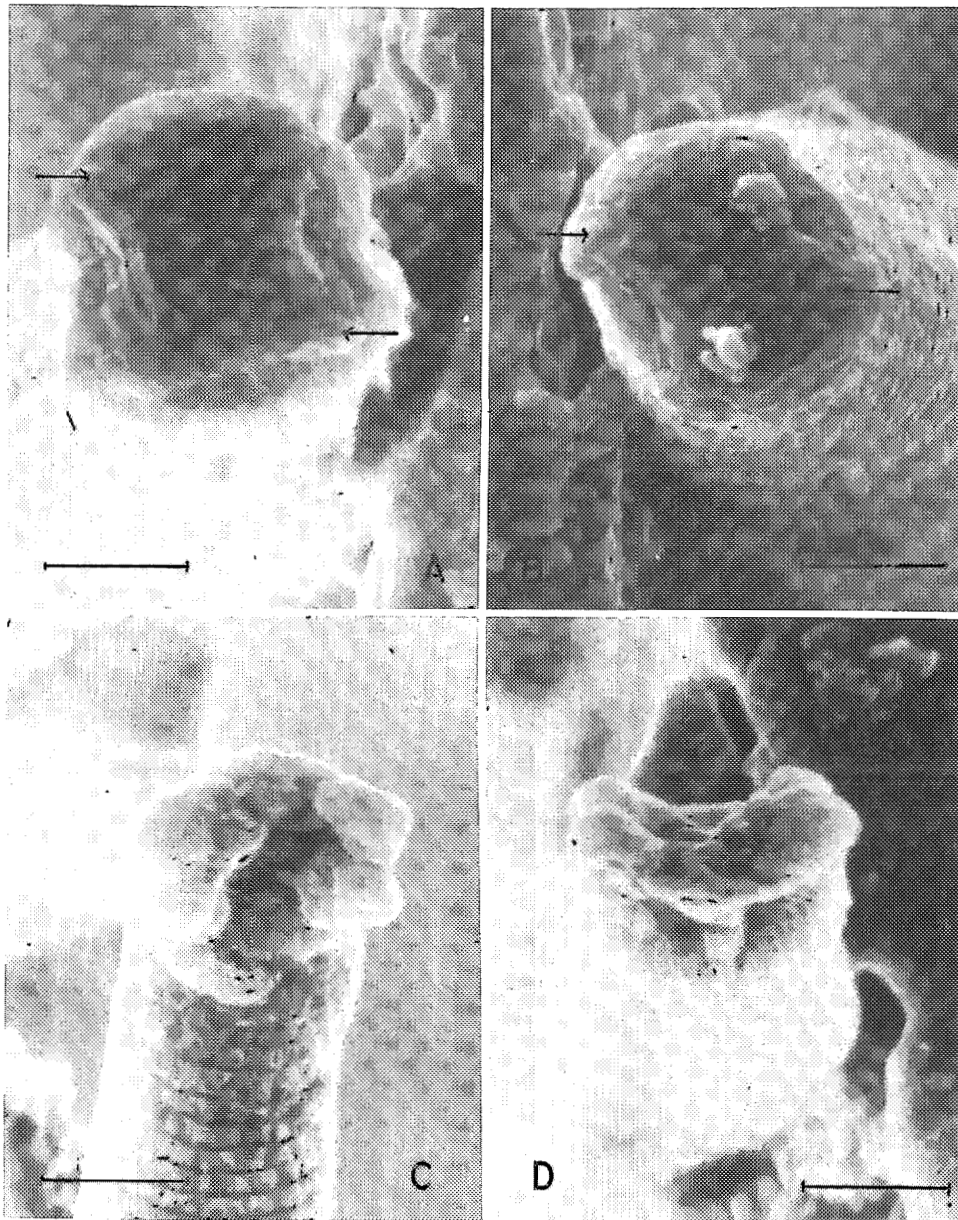


Fig. 2. *Tylenchocriconema alleni*; A : Female, face view; B : Juvenile, face view (Arrows indicate submedian lobes); D-E : Male, head end. Bar on A-D = 2 μ m. (Photos by Arnold Bell, University of California, Riverside).

obese. Excretory gland very developed producing a gelatinous matrix. Vulva very posterior to terminal. Uterine wall often thickened, transformed into a cyst in *Meloidoderita*. Anus and rectum often obscure, sometimes absent. Eggs embedded in a gelatinous matrix.

Male : Vermiform. Stylet degenerate or absent. Oesophagus degenerate. Penial tube, if present, very short. Tail elongated. No caudal alae.

Juvenile : All stages provided with a functional stylet. (Deirids present in males and juveniles of some species).

TYPE GENUS

Tylenchulus Cobb, 1913

OTHER GENERA

Sphaeronema Raski & Sher, 1952

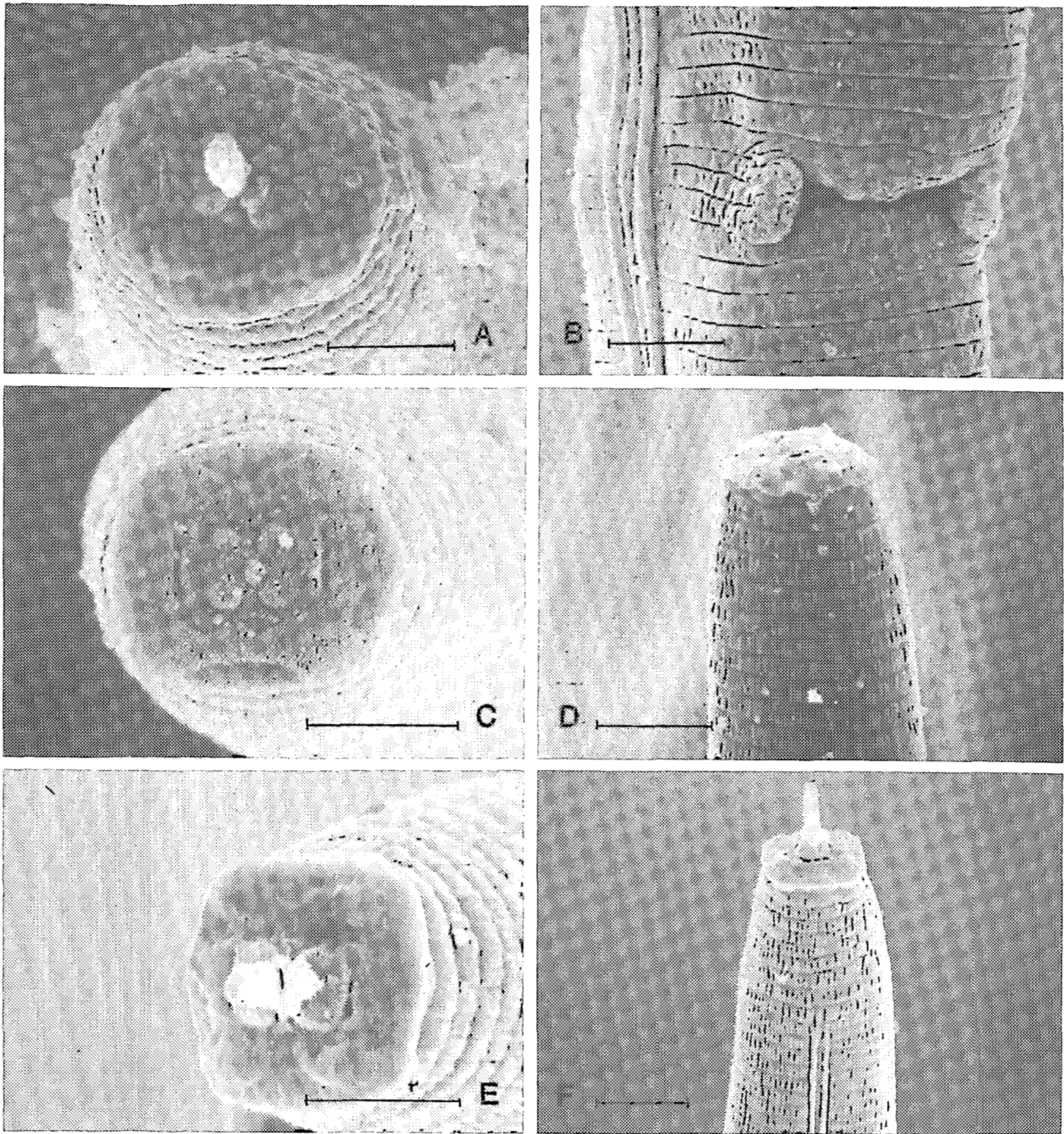


Fig. 3. *Tylenchocriconema alleni*. Female. A : Face view; B : Lateral field, vulva - Juvenile (3rd, 4th stage?); C : Face view; D : Head, lateral view - Juvenile (2nd stage); E = Face view; F = Head, lateral view. Bar on A, C, E = 2 µm; on B, D, F = 3 µm.

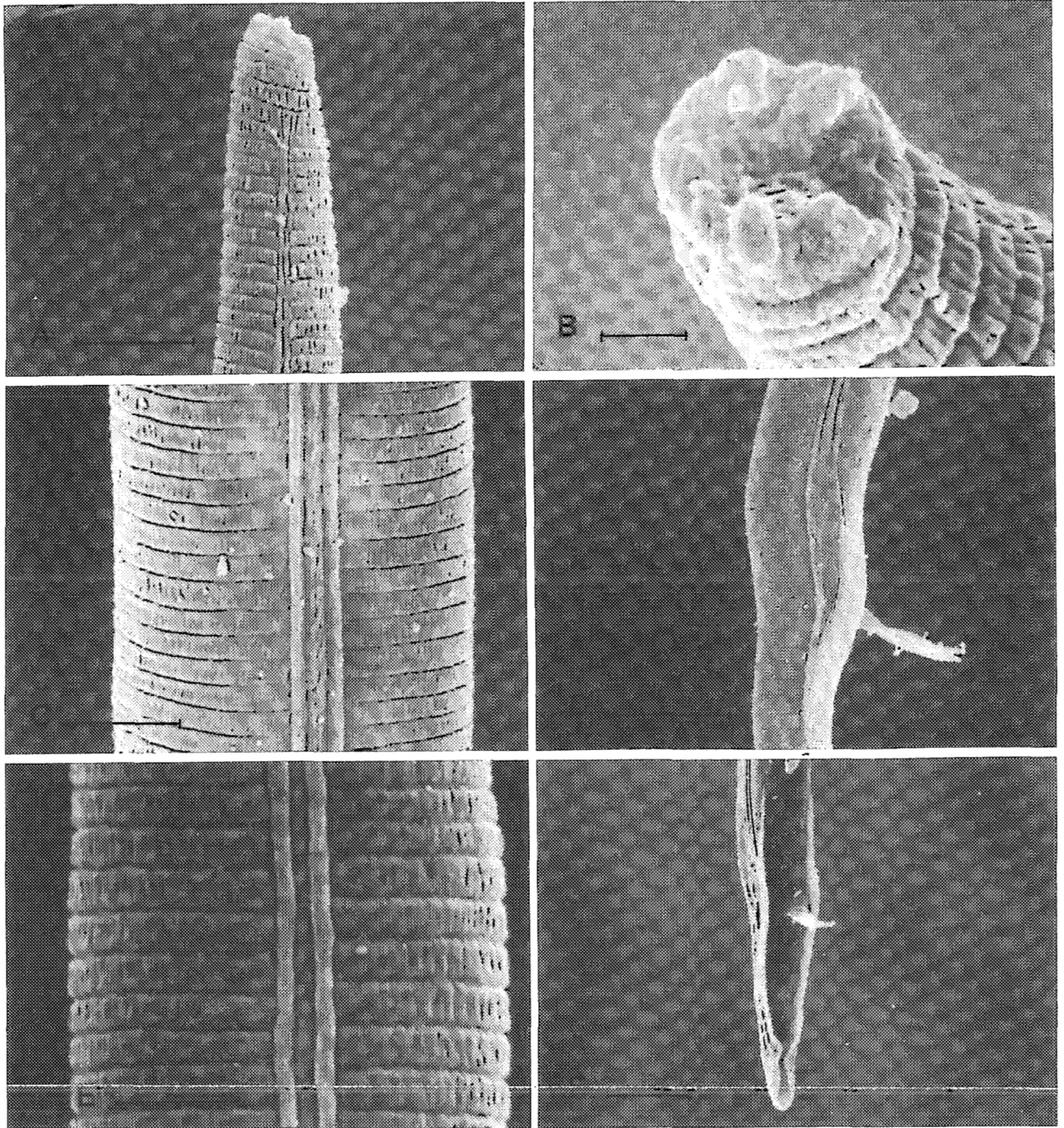


Fig. 4. *Tylenchocriciconema alleni*. Male. A : Anterior end; B : Face view; C, E : Two different aspects of lateral field; D, F : Caudal alae, spicular sheath, lateral field merging with caudal alae. Bar on A = 5 μ m; on B = 1 μ m; on C = 3 μ m; on E = 2 μ m; on D, F = 10 μ m.

Trophonema Raski, 1957
Trophotylenchulus Raski, 1957
Meloidoderita Pogosyan, 1966

COMMENTS ON TYLENCHULINAE

The Tylenchulinae can be considered as the most evolved among Criconematoidea: the sexual dimorphism is stronger than in any other group of this superfamily; the females, obese, are fixed into the roots; the males have no caudal alae, and no stylet or a degenerated one; eggs, often very voluminous in regard to the volume of body female, are laid in a gelatinous matrix which has been proven (for some species) to arise from the excretory system; in the genus *Meloidoderita* some eggs are in addition retained in a cyst formed by the tanning of the uterine wall; in species of *Sphaeronema* this uterine wall is also abnormally thickened.

The five genera included differ essentially by the body shape of the female, the position of the excretory pore in adult and juvenile forms, the position of the vulva, the presence of a uterine cyst, the presence or absence of a stylet (always degenerated) in male and also (*Tylenchulus* and *Trophotylenchulus*) the host reaction.

Some females in genus *Sphaeronema* and *Meloidoderita*, as well as juveniles of *S. whittoni*, show oesophageal glands overlapping the intestine; this confirms this trend is present in all groups of Tylenchina, and here is realized only in the more evolved forms. On the contrary, presence of deirids, considered as more ancestral than their absence, has been detected in juveniles and males of some species of *Tylenchulus*. Moreover, juveniles of *S. whittoni* lack a valve in the oesophageal median bulb.

THE GENERA OF TYLENCHULINAE

***Tylenchulus* Cobb, 1913**

Diagnosis :
 Tylenchulinae.

All stages : Excretory pore situated very posteriorly (68-85 % of body length); pore surrounded by small, irregularly shaped lobes; excretory duct forward directed.

Female : Fixed into the root by its anterior part only. Body slightly crescent-shaped. Vulva posterior, but not terminal. Postvulval part short, tapering, ventrally curved and bluntly rounded (*T. semipenetrans*); almost straight, conoid, finely rounded (*T. furcus*). Anus obscure or absent (*T. semipenetrans*). No uterine cyst.

Male : Stylet degenerate. No penial tube. Lateral field with two lines (*T. semipenetrans*) or two plus two faint inner lines (*T. furcus*).

Type species :
T. semipenetrans Cobb, 1913

Other species :
T. furcus van den Berg & Spaull, 1982

***Trophotylenchulus* Raski, 1957**
 = *Ivotylenchulus* Hashim, 1983 (n. syn.)

Diagnosis :
 Tylenchulinae.

All stages : Excretory pore situated posteriorly (33-61 % of body length), excretory duct variable, apparently perpendicular to body line (*T. clavicaudatus*, *T. piperis*, *T. saltensis*), forward, directed (*T. floridensis*, *T. obscurus*), or posteriorly directed (*T. mangenoti*). Tail long, slender-conoid, finely rounded tip. Encapsulated in round, brittle structure.

Female : Fixed into root by anterior part only. Body swells on ventral side, curls tightly more than 360 degrees. Circumoral disc protrudes prominently. Anus obscure, lips of anus slightly raised. No uterine cyst.

Juvenile : Circumoral disc present. Lateral field with two lines (four in *T. piperis*).

Type species :
Trophotylenchulus floridensis Raski, 1957
 = *Tylenchulus floridensis* (Raski, 1957) Maggenti, 1962

Other species :
T. andhraensis Muthukrishnan & Shariff, 1986
T. clavicaudatus (Colbran, 1966) Hashim, 1983
 = *Tyl. clavicaudatus* Colbran, 1966
T. mangenoti (Luc, 1957) Goodey, 1963
 = *Tyl. mangenoti* Luc, 1957
 = *Ivotylenchulus mangenoti* (Luc, 1957) Hashim, 1983 (n. syn.)
T. obscurus (Colbran, 1961) Hashim, 1983
 = *Tyl. obscurus* Colbran, 1961
T. piperis Mohandas, Ravana & Raski, 1985
T. saltensis Hashim, 1983

Comments on *Trophotylenchulus* :

Maggenti (1962) studied the internal anatomy of *Tylenchulus semipenetrans* and *Trophotylenchulus floridensis* especially the extensive development of the renette cell in each. He concluded they were essentially similar and proposed synonymizing the two genera. Thus, *Trophotylenchulus* was considered a junior synonym of *Tylenchulus*. Samsoen and Ali (1978) concurred. Hashim (1983) considered the more anterior position of the excretory pore and presence of "circumoral elevation" in both females and juveniles justification for a separate taxon and resurrected the genus *Trophotylenchulus*. To it he transferred all the *Tylenchulus* spp. except. *T. semipenetrans* and *T. furcus*. *T. mangenoti* Luc, 1957 was transferred to a new genus, *Ivotylenchulus*, based on a protrusible gubernaculum (only one male is known) and absence of spicular sheath. Those two characteristics do not have sufficient significance to

justify a separate generic taxon particularly in view of the many positive similarities with *Trophotylenchulus*. Therefore, it is concluded *T. manganoti* is best returned to *Trophotylenchulus* and *Ivotylenchulus* be declared a junior synonym of *Trophotylenchulus*. Cohn and Kaplan (1983) studied the parasitic habits of *T. floridensis* and concluded the host-parasite relationship found with *Trophotylenchulus* spp. in which a brittle, capsule-like structure (apparently produced by the host) covers larvae, males and females, was sufficient justification to distinguish a separate taxon. This supported the action of Hashim (1983) and is accepted here.

Sphaeronema Raski & Sher, 1952
= *Goodeyella* Siddiqi, 1986 (n. syn.)
= *Tumiota* Siddiqi, 1986 (n. syn.)

Diagnosis :
Tylenchulinae.

All stages : Excretory pore situated close to nerve ring level.

Female : Globose. Vulva appearing as terminal, and anus as dorsal, when located. Uterine wall thickened.

Male : No stylet. Spicular sheath present.

Type species :
Sphaeronema californicum Raski & Sher, 1952

Other species :
S. alni Turkina & Chizhov, 1986
S. camelliae Aihara, 1985
S. cornubiense van den Berg & Spaull, 1982
S. minutissimum Goodey, 1958
= *Goodeyella minutissima* (Goodey, 1958) Siddiqi, 1986 (n. syn.)
S. rumicis Kirjanova, 1970
S. sasseri Eisenback & Hartman, 1985
S. whittoni Sledge & Christie, 1962
= *Tumiota whittoni* (Sledge & Christie, 1962) Siddiqi, 1986 (n. syn.)

Comment on *Sphaeronema* :

Siddiqi (1986) proposed two new genera based on species originally described in the genus *Sphaeronema*. *Goodeyella* Siddiqi, 1986 was proposed for *S. minutissima* which in fact has general aspects very similar to other species of *Sphaeronema* including *i*) an elongated neck, only part in plant tissue; *ii*) a small body, exterior to the plant; *iii*) a gross uterus; and *iv*) an oesophagus differing only in spatulate *vs* rounded bulbar region. It differs in having *i*) elevated lip region (similar variations are present in the genus *Paratylenchus*) and judged a specific character only; and *ii*) vulva flush with body. The above similarities including also life habits are judged more significant than the differences. Consistent with our philosophical approach this species should remain in *Sphaeronema* and *Goodeyella* is proposed a junior synonym of *Sphaeronema*.

Tumiota was proposed for *Sphaeronema whittoni* Sledge and Christie, 1962 for which regarding general aspect the same is true as for *S. minutissimum* except *i*) the oesophageal glandular region was not seen in females of *S. whittoni*; and *ii*) the oesophageal glands overlap in the juvenile illustrated. The vulva also is flush as for *S. minutissimum*.

The nature and degree of overlap of the oesophageal glands in juveniles of *S. whittoni* are not clear. Furthermore, the isthmus and posterior glandular region of the adult female are not described or illustrated. These are critical characters and lack of details regarding them preclude any justification for proposing a new generic taxon separate from *Sphaeronema*. In fact, it could be judged as evidence to consider *S. whittoni* as a species *incertae sedis*. However, there are many other characters in *S. whittoni* similar to those characteristics which distinguish *Sphaeronema* : *i*) female with very small spherical body, protruding neck, prominent stylet, thick cuticle, long cylindrical procorpus, large valvated median bulb; thick walls on greatly expanded uterus; *ii*) male with general and most particular aspects similar to *Sphaeronema*; *iii*) juvenile likewise in general aspects resemble *Sphaeronema*. In view of these characteristics it is judged preferable to leave this in *Sphaeronema* as originally described and declare *Tumiota* a junior synonym of *Sphaeronema*.

Trophonema Raski, 1957

Diagnosis :
Tylenchulinae.

All stages : Excretory pore at level of nerve ring.

Female : Fixed into the root by their anterior portion. Body coiled, regularly inflated at the median part. Vulva posterior, but not terminal; post-vulval part tapering, ventrally curved; anus and rectum present. Uterus wall not thickened. No uterine cyst.

Male : No stylet. Penial tube short.

Type species :
Trophonema arenarium (Raski, 1956) Raski, 1957
= *Sphaeronema arenarium* Raski, 1956

Other species :
T. asoense Minagawa, 1983
T. okamotoi Minagawa, 1983

Meloidoderita Pogosyan, 1966

Diagnosis :
Tylenchulinae.

All stages : Excretory pore situated around nerve ring level.

Female : Globose. Vulva appearing as terminal and anus as dorsal. Cuticle bearing numerous small spines. Uterus wall greatly thickened, transformed into a cyst which retains part of the eggs.

Male : No stylet. Penial tube short (*M. polygoni*) or absent (*M. kirjanovae*).

Type species :

Meloidoderita kirjanovae Pogosyan, 1966

Other species :

M. polygoni Golden & Handoo, 1984

M. safrica van den Berg & Spaul, 1982

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