

A reappraisal of Tylenchina (Nemata).

4. The family Anguinidae Nicoll, 1935 (1926) ⁽¹⁾

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SUMMARY

The family Anguinidae is redefined. The families and subfamilies Nothotylenchidae/inae, Sychnotylenchidae/inae, Halenchidae/inae, Pseudhalenchinae, Ditylenchidae/inae, Cynipanguininae, Neoditylenchinae, Nothanguininae and Thadinae are rejected. The genera *Anguina*, *Halenchus*, *Ditylenchus*, *Pseudhalenchus*, *Sychnotylenchus*, *Thada*, *Subanguina*, *Cynipanguina*, and *Pterotylenchus* are recognized as valid in Anguinidae. *Chitinotylenchus* is a *genus inquirendum* or *incertae sedis* in Anguinidae. The following new synonyms are proposed: *Nothotylenchus*, *Boleodoroides* and *Orrina* synonyms of *Ditylenchus*; *Nothanguina* synonym of *Anguina*; *Afrina* and *Mesoanguina* synonyms of *Subanguina*; and *Neoditylenchus* synonym of *Sychnotylenchus*. Hypotheses on the evolution within Anguinidae are presented. A tabular key is included to help identify the valid genera.

RÉSUMÉ

Réévaluation des Tylenchina (Nemata). 4. La famille des Anguinidae Nicoll, 1935 (1926).

La famille des Anguinidae est redéfinie. Les familles et sous-familles Nothotylenchidae/inae, Sychnotylenchidae/inae, Halenchidae/inae, Pseudhalenchinae, Ditylenchidae/inae, Cynipanguininae, Neoditylenchinae, Nothanguininae et Thadinae sont rejetées. Les genres *Anguina*, *Halenchus*, *Ditylenchus*, *Pseudhalenchus*, *Sychnotylenchus*, *Thada*, *Subanguina*, *Cynipanguina* et *Pterotylenchus* sont acceptés comme genres valides à l'intérieur d'Anguinidae. *Chitinotylenchus* est un *genus inquirendum* ou *incertae sedis*, dans les Anguinidae. Les synonymes suivants sont proposés: *Nothotylenchus*, *Boleodoroides* et *Orrina* synonymes de *Ditylenchus*, *Nothanguina* synonyme d'*Anguina*, *Afrina* et *Mesoanguina* synonymes de *Subanguina* et *Neoditylenchus* synonyme de *Sychnotylenchus*. Des hypothèses sur l'évolution probable des formes à l'intérieur des Anguinidae sont proposées, ainsi qu'une clef tabulaire pour aider à l'identification des genres valides de cette famille.

The name Anguinidae was first proposed by Nicoll (1935)**; in replacement of Anguillulinidae Baylis & Daubney, 1926.

When Baylis and Daubney (1926), then Nicoll (1935), proposed respectively Anguillulinidae and Anguinidae, they included in these families genera that are now in other families in Tylenchida (*Heterodera*, *Hoplolaimus*, *Tylenchulus*, etc.), or in other orders (*Aphelenchus* in Aphelenchida; *Tylopharynx* in Diplogasterida). The modern concept of Anguinidae was first recognized, and

proposed by Paramonov (1962) at subfamily level with the genera *Anguina*, *Paranguina*, and *Nothanguina*. The same author proposed the family Sychnotylenchidae for some insect-associate species (Paramonov, 1967).

Wu (1967a, b) studied the relationships between *Tylenchus*, *Ditylenchus*, and *Anguina*. She treated all three genera as members of Tylenchinae, but she laid the groundwork that eventually permitted the separation of *Tylenchus* from the other two genera.

Siddiqi (1971) placed *Ditylenchus* in Anguinidae. Golden (1971) separated the genera in Anguinidae into the subfamilies Ditylenchinae and Anguininae in Tylenchidae. This arrangement is not generally accepted (Brzeski, 1981). Siddiqi (1980) treated Anguinidae as a superfamily. Brzeski (1981) attempted to clarify the

** According to the International Code of Zoological Nomenclature, Article 40, a, the correct authority for this family is: Anguinidae Nicoll, 1935 (1926), see Fortuner (1984).

(1) This article is part of a study on the classification of Tylenchina by the present authors and E. Geraert (Rijksuniversiteit, Gent), M. Luc (ORSTOM, Paris), and D. J. Raski (University of California, Davis).

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status of the genera in Anguinidae. Siddiqi (1986) placed Anguinoidea in Hexatyliina. Maggenti *et al.* (1987) proposed to accept the family Anguinidae under Tylenchoidea in the suborder Tylenchina.

The validity and status of the genera and families of anguinids are here discussed according to the principles of Luc *et al.* (1987) and the general classification of Tylenchina of Maggenti *et al.* (1987).

Minimal list of species are given for some genera. Additional information on species nomenclature can be found in Fortuner (1987).

The family Anguinidae Nicoll, 1935 (1926)

- = Anguillulinidae Baylis & Daubney, 1926
- = Nothotylenchidae Thorne, 1941
- = Sychnotylenchidae Paramonov, 1967
- = Ditylenchidae Golden, 1971
- = Halenchidae Jairajpuri & Siddiqi, 1969 (n. syn.)

Synonym subfamilies :

- Anguillulininae Baylis & Daubney, 1926
- Nothotylenchinae Thorne, 1941 (n. syn.)
- Sychnotylenchinae Paramonov, 1967 (n. syn.)
- Halenchinae Jairajpuri & Siddiqi, 1969 (n. syn.)
- Pseudhalenchinae Siddiqi, 1971 (n. syn.)
- Ditylenchinae Golden, 1971
- Neoditylenchinae Kakuliya & Devdariani, 1975 (n. syn.)
- Cynipanguininae Fotedar & Handoo, 1978
- Nothanguininae Fotedar & Handoo, 1978 (n. syn.)
- Thadinae Siddiqi, 1986 (n. syn.)

DIAGNOSIS

Tylenchoidea with low, flattened anterior end; with small, delicate stylet and labial framework; female genital system with long sixteen-celled tubular spermatheca, in line with genital tract; sperm cells with large amount of cytoplasm (except *Pseudhalenchus*).

Anguinidae differs from all families in Tylenchoidea except Tylenchidae by the aspect of its anterior extremity with low flattened end, and small, delicate stylet and labial framework. It differs from Tylenchidae by the characteristics of the genital system (Tylenchidae has spermatheca short, twelve-celled, rounded and sometimes off-set, and sperm cells with little cytoplasm) and by the oesophageal glands, often overlapping the beginning of the intestine.

LIST OF GENERA IN ANGUINIDAE

- Anguina* Scopoli, 1777
- Halenchus* Cobb, 1933
- Ditylenchus* Filip'ev, 1936
- Sychnotylenchus* Rühm, 1956
- Pseudhalenchus* Tarjan, 1958
- Thada* Thorne, 1941

Subanguina Paramonov, 1967

Cynipanguina Maggenti, Hart & Paxman, 1974

Pterotylenchus Siddiqi & Lenne, 1983

Genus *incertae sedis* or *inquirendum* in Anguinidae :
Chitinotylenchus Micoletzky, 1922

COMMENTS

Description of Anguinidae

Vermiform nematodes; mature females sometimes enlarged, but never globose or kidney-shaped. Lip region low, anteriorly flattened, not or slightly offset, not annulated or with faint annuli. First lip annulus not divided into sectors; amphid apertures small, elliptical, directed towards the oral opening. Lateral field with either four or six and more lines. Deirids and phasmids generally absent. Tail long, slender, often with last third ventrally bent; sometimes shorter and rounded.

Labial framework delicate. Stylet thin and short, about as long as basal lip annulus diameter; stylet knobs present, small, rounded. Stylet muscles parallel to stylet axis. Dorsal esophageal gland opens just below stylet base. Procorpus thin or wide, separated or not from the median bulb by a constriction. Median bulb (metacorpus) fusiform to rounded, rarely absent, with or without valve. Isthmus thin to wide. Esophageal glands short, pyriform, not overlapping the intestine, or longer, stopping short of the intestine, or overlapping it for a short or a long distance. Esophago-intestinal junction (cardia) with hyaline cells large, of same diameter as intestine.

One anterior genital branch; posterior branch reduced to a post-uterine sac (PUS) or absent. Ovary straight or with flexures, sometimes very long and reaching to the esophageal region; oocytes in either one or two rows, or in many rows. Oviduct with two rows of five cells. Spermatheca long, with sixteen cells, tubular, always in line with genital tract, shorter in *Pseudhalenchus*. Columnned uterus variable, with four rows of four or more cells, or with many small cells irregularly arranged. Sphincter present at the junction uterus-vagina. Vagina oblique or perpendicular to body axis; no vulval flaps (except in one genus) or epiptygma.

Males similar to females, no secondary sexual dimorphism except in species with enlarged adult females where males remain thin. Sperm cells with large amount of cytoplasm (except *Pseudhalenchus*). Caudal alae small adanal (leptoderan), ending at less than 1/3 of tail length, or longer, enveloping up to 2/3 of tail length, or completely enveloping tail (peloderan).

Biology. Mycetophagous, insect associates, or parasites of above ground parts of higher plants.

Discussion on synonymy of Anguinidae

In the present article, the genera in Anguinidae are not placed into separate subfamilies. The subfamily name Anguininae will not be used.

Nothotylenchus, the type genus of the family Nothotylenchidae, is proposed below as a junior synonym of *Ditylenchus*, a genus in Anguinidae. For the same reasons as those given for the synonymization at the generic level, Nothotylenchidae is here considered a junior synonym of Anguinidae, as already proposed by Brzeski (1981).

The family Ditylenchidae was differentiated from Anguinidae by Golden (1971) because of smaller size (but size is not a reliable generic or family character), slimmer body (there is a great variability in this feature), ovary without flexure (in fact long ovaries with flexures are observed in *D. dipsaci*, *D. angustus*, and *D. destructor*), and oocytes in one/two rows (but the genus *Subanguina* combines this characteristic with other features of the genital system closer to those in *Anguina*). Plant-parasite species of *Ditylenchus* cause stunting and swellings to plants, but no galls. Their cryptobiotic stage is the 4th juvenile stage. *Anguina* spp. cause galls or gall-like distortions to plants, and their cryptobiotic stage is the 2nd juvenile stage. These differences in biology do not support the validity of Ditylenchinae because not all species of the genera in Anguinidae follow to either one of the two above-defined schemes. Some *Ditylenchus* spp. for example are mycetophagous. The cryptobiotic stage is the adult stage in *Cynipanguina*. The biology of *Sychnotylenchus* is peculiar as discussed below. Using biology as a criterion for subfamilies within Anguinidae would lead to accept almost as many such taxa as there exist valid genera in the family. We prefer to follow Hooper (1978), Siddiqi (1980), and Ryss and Krall' (1981) and maintain *Ditylenchus* and *Anguina* in the same family.

The biology of *Sychnotylenchus* the type genus of Sychnotylenchidae is different from that of the other anguinids in that the species in this genus are always found associated with bark beetles. However, they are not insect parasites but feed on the fungi that grow in the frass of the beetles. Their general morphology is similar to that of the Anguinidae except for the shorter male and female tails. This is not enough to justify the placement of these forms in a family or a subfamily of their own. The family Sychnotylenchidae has already been treated as a junior synonym of Anguinidae by Siddiqi (1971), Golden (1971), and Andrásy (1976). The subfamily Sychnotylenchinae is here considered as a synonym of Anguinidae. Because *Neoditylenchus* is synonymized below with *Sychnotylenchus*, the subfamily Neoditylenchinae is also considered a synonym of Anguinidae.

Halenchinae was proposed in Nothotylenchidae by Jairajpuri and Siddiqi (1969), and elevated to family rank by Siddiqi (1986). It was differentiated from Nothotylenchinae by esophageal glands overlapping intestine, and tail tip strongly hooked. Overlapping versus abutting glands is not accepted as a family or generic criterion (Fortuner, 1982); hooked tails similar to that of

Halenchus fucicola are present in *Ditylenchus* (*D. drepanocercus*). Halenchidae was characterized by Siddiqi (1986) by sclerotization of excretory canal, "prehensile" tail, and marine habitat. Sclerotization can vary. *H. dumnonicus* has excretory duct not quite so heavily cuticularized as in the type species (*H. fucicola*). Hooked tails exist, for example, in *Ditylenchus drepanocercus*. Differences in habitat cannot be accepted for family characterization (this would lead to an excessive multiplication of families). Because of their variability and because they are irrelevant at family level, the criteria used by Siddiqi cannot be used and the family Halenchidae is here rejected.

The subfamily Pseudhalenchinae was proposed by Siddiqi (1971) after the transfer of *Pseudhalenchus* in Tylenchinae because this genus is markedly different from all other genera in the latter subfamily. *Pseudhalenchus* is here considered in Anguinidae. Within this family, the only remarkable character of the genus are the small sperm cells with little cytoplasm. A single character is not considered to be diagnostic at family level and Pseudhalenchinae is here rejected.

The subfamily Cynipanguinae was proposed by Fotedar and Handoo (1978) because of the stem-like process at the posterior end of the esophageal glands. The other morphological characters of *Cynipanguina* are close to *Anguina* to such an extent that Brzeski (1981) synonymized the genera *Cynipanguina* and *Anguina*. These genera are here considered valid separate taxa, but the morphological differences between them are too slight to warrant the creation of a separate subfamily for *Cynipanguina*.

Nothanguina is proposed below as a synonym of *Anguina*. This makes the subfamily Nothanguinae Fotedar & Handoo, 1978 a synonym of Anguinidae.

Thadinae was proposed by Siddiqi (1986) to accommodate *Thada* and *Neothada* in Tylenchidae. *Thada* is here placed in Anguinidae very close to *Ditylenchus* as shown below. This closeness makes the creation of Thadinae unnecessary and this subfamily is here rejected.

The genera in Anguinidae

Pseudhalenchus Tarjan, 1958

DIAGNOSIS

Anguinidae. Amphids as longitudinal slits. Median bulb with valve; isthmus not separated from glandular bulb by a constriction; glandular bulb long, overlapping intestine. Ovary short; oocytes in one/two rows; spermatheca short; columned uterus with four rows of four cells; post-uterine sac (PUS) present. Testes without flexures; caudal alae leptoderan, short, adanal. Sperm cells small, with little cytoplasm. Mature females not swollen. Feeding habits unknown.

TYPE SPECIES

P. minutus Tarjan, 1958

OTHER SPECIES

P. hylobii Massey, 1967

DISCUSSION

Pseudhalenchus was originally proposed by Tarjan (1958) for two new species, *P. minutus* and *P. anchilisposomus*, and placed in Tylenchinae by its author. It was transferred to a new subfamily, Telotylenchinae by Siddiqi (1960). This action was rejected by Loof (1963). Siddiqi (1971) later created a monotypic subfamily, Pseudhalenchinae in Anguinidae, for *Pseudhalenchus*. At the same time, Golden (1971) placed this genus in Ditylenchinae. Siddiqi (1980) transferred *P. anchilisposomus* and several other species to a new genus, *Safianema* in Anguininae, and placed what was left of *Pseudhalenchus* and the family Pseudhalenchinae in Tylenchidae. Ryss and Krall' (1981) transferred this subfamily to Belonolaimidae. Fortuner (1982) accepted the transfer of *Pseudhalenchus* to Tylenchidae, but rejected Pseudhalenchinae.

The unsettled classification of *Pseudhalenchus* is a direct consequence of its systematic position, intermediate between Tylenchidae and Anguinidae. Fortuner (1982) placed it in Tylenchidae because of the structure of the sperm cells, small and with small amount of cytoplasm, a character of Tylenchidae. However, Raski (pers. comm.) pointed out that its long glandular overlap is quite unknown in all Tylenchidae (with the exception of *Epicharinema* with a very slight overlap), whereas many species in Anguinidae have a long glandular overlap. Face views of a population of *P. minutus* from Brazil were observed with SEM by Raski. Amphids appear as small longitudinal slits (i.e., pointing towards the oral opening) and are generally similar to face views of *Anguina* and *Ditylenchus* (as shown in Raski & Maggenti, 1983). Face views in Tylenchidae are quite different. Only *Filenchus* has small slits, but they are dorso-ventrally directed (Raski & Geraert, 1987).

Pseudhalenchus can be seen as a form evolving towards the typical anguinids. It already had some characteristics of this family (face view, glandular overlap), but it still shows ancestral characters found in Tylenchidae (sperm cells). Because classification should be based on derived, rather than ancestral characters, *Pseudhalenchus* is now reinstated in Anguinidae. The subfamily Pseudhalenchinae has been rejected (see above).

***Ditylenchus* Filip'ev, 1936**

- = *Anguillulina* (*Ditylenchus*) Filip'ev, 1936
- = *Nothotylenchus* Thorne, 1941 (n. syn.)
- = *Boleodoroides* Mathur, Khan & Prasad, 1966 (n. syn.)

- = *Diptenchus* Khan, Chawla, & Seshadri, 1969
- = *Safianema* Siddiqi, 1980
- = *Orrina* Brzeski, 1981 (n. syn.)

DIAGNOSIS

Anguinidae. Median bulb with or without valve; isthmus not separated from glandular bulb by a constriction; glandular bulb short or long, when long may overlap the intestine for a short or long distance. Ovary short or long, sometimes reaching esophageal region and/or flexed; oocytes in one/two rows; columned uterus with four rows of four cells; post-uterine sac (PUS) present or absent. Testes usually without flexures; caudal alae leptoderan, short adanal or long, but never reaching tail end. Mature female not or slightly swollen. Mycetophagous or parasites of higher plants, found in soil or above ground.

TYPE SPECIES

D. dipsaci (Kühn, 1857) Filip'ev, 1936

OTHER SPECIES

- Ditylenchus acris* (Thorne, 1941) n. comb.
- = *Nothotylenchus acris* Thorne, 1941
- Ditylenchus acuminatus* nom. novum
- = *Pseudhalenchus acutus* Khan & Nanjappa, 1972
- = *Ditylenchus acutus* (Khan & Nanjappa, 1972) Fortuner, 1982 nec *Nothotylenchus acutus* Khan, 1965
- Ditylenchus acutus* (Khan, 1965) n. comb.
- = *Nothotylenchus acutus* Khan, 1965
- Ditylenchus adasi* (Sykes, 1980) n. comb.
- = *Nothotylenchus adasi* Sykes, 1980
- Ditylenchus affinis* (Thorne, 1941) n. comb.
- = *Nothotylenchus affinis* Thorne, 1941
- Ditylenchus alliphilus* nom. novum
- = *Nothotylenchus allii* Khan & Siddiqi, 1968 nec *Ditylenchus allii* (Beijerinck, 1883) Filip'ev & Schuurmans-Stekhoven, 1941
- Ditylenchus anchilisposomus* (Tarjan, 1958) Fortuner, 1982
- Ditylenchus angustus* (Butler, 1913) Filip'ev, 1936
- Ditylenchus antricolus* (Andrássy, 1961) n. comb.
- = *Nothotylenchus antricolus* Andrássy 1961
- Ditylenchus attenuatus* (Mulvey, 1969) n. comb.
- = *Nothotylenchus attenuatus* Mulvey, 1969
- Ditylenchus atypicus* (Khera & Chaturvedi, 1977) n. comb.
- = *Boleodoroides atypicus* Khera & Chaturvedi, 1977
- = *Nothotylencus atypicus* (Khera & Chaturvedi, 1977) Siddiqi, 1986
- Ditylenchus ausafi* Husain & Khan, 1967
- Ditylenchus basiri* (Khan, 1965) n. comb.
- = *Nothotylenchus basiri* Khan, 1965
- Ditylenchus bhatnagari* (Tikyani & Khera, 1969) n. comb.
- = *Nothotylenchus bhatnagari* Tikyani & Khera, 1969
- Ditylenchus brassicae* Husain & Khan, 1976
- Ditylenchus buckleyi* (Das, 1960) n. comb.
- = *Nothotylenchus buckleyi* Das, 1960

- Ditylenchus callidus* (Izatullaeva, 1967) n. comb.
= *Nothotylenchus callidus* Izatullaeva, 1967
- Ditylenchus caudatus* Thorne & Malek, 1968
- Ditylenchus citri* (Varaprasad, Khan & Lal, 1981) n. comb.
= *Paurodontus citri* Varaprasad, Khan & Lal, 1981
= *Nothotylenchus citri* (Varaprasad, Khan & Lal, 1981) Siddiqi, 1986
- Ditylenchus clarus* Thorne & Malek, 1968
- Ditylenchus compactus* (Massey, 1974) n. comb.
= *Nothotylenchus compactus* Massey, 1974
- Ditylenchus convallariae* Sturhan & Friedman, 1965
- Ditylenchus cylindricollis* (Thorne, 1941) n. comb.
= *Nothotylenchus cylindricollis* Thorne, 1941
- Ditylenchus cylindricus* (Khan & Siddiqi, 1968) n. comb.
= *Nothotylenchus cylindricus* Khan & Siddiqi 1968
- Ditylenchus cyperi* Husain & Khan, 1967
- Ditylenchus damnatus* (Massey, 1966) Fortuner, 1982
- Ditylenchus danubialis* (Andrássy, 1960) n. comb.
= *Nothotylenchus danubialis* Andrásy, 1960
- Ditylenchus deiridus* Thorne & Malek, 1968
- Ditylenchus destructor* Thorne, 1945
- Ditylenchus dipsacoides* (Andrássy, 1952) Andrásy, 1956
- Ditylenchus drepanocercus* (Goodey, 1953)
- Ditylenchus dryadis* Anderson & Mulvey, 1980
- Ditylenchus elongatus* (Husain & Khan, 1974) n. comb.
= *Nothotylenchus elongatus* Husain & Khan, 1974
- Ditylenchus emus* Khan, Chawla & Prasad, 1969
- Ditylenchus equalis* Heyns, 1964
- Ditylenchus exiguus* (Andrássy, 1958) n. comb.
= *Nothotylenchus exiguus* Andrásy, 1958
- Ditylenchus dipsaci falcariae* Pogosyan, 1967
- Ditylenchus ferepolitor* (Kazachenko, 1980) n. comb.
= *Nothotylenchus ferepolitor* Kazachenko, 1980
- Ditylenchus filimus* Anderson, 1983
- Ditylenchus fotedari* (Mahajan, 1977) n. comb.
= *Nothotylenchus fotedari* Mahajan, 1977
- Ditylenchus galeopsidis* Teploukhova, 1968
- Ditylenchus goldeni* (Maqbool, 1982) n. comb.
= *Nothotylenchus goldeni* Maqbool, 1982
- Ditylenchus hexaglyphus* (Khan & Siddiqi, 1968) n. comb.
= *Nothotylenchus hexaglyphus* Khan & Siddiqi, 1968
- Ditylenchus indicus* (Sethi & Swarup, 1967) Fortuner, 1982
- Ditylenchus innuptus* (Andrássy, 1961) n. comb.
= *Nothotylenchus innuptus* Andrásy, 1961
- Ditylenchus inobservabilis* (Kir'yanova, 1938) Kir'yanova, 1951
- Ditylenchus istatae* Samibaeva, 1966
- Ditylenchus khani* Fortuner, 1982
- Ditylenchus kheirii* nom. novum.
= *Nothotylenchus geraerti* Kheiri, 1971 nec *Ditylenchus geraerti* (Paramonov, 1970) Bello & Geraert in Bello, 1971
- Ditylenchus loksai* (Andrássy, 1959) n. comb.
= *Nothotylenchus loksai* Andrásy, 1959
- Ditylenchus longistylus* (Khera & Chaturvedi, 1977) n. comb.
= *Boleodorus longistylus* Khera & Chaturvedi, 1977
= *Nothotylenchus longistylus* (Khera & Chaturvedi, 1977) Siddiqi, 1986
- Ditylenchus lutonensis* (Siddiqi, 1980) Fortuner, 1982
- Ditylenchus maleki* nom. nov.
= *Nothotylenchus major* Thorne & Malek, 1968 nec *Ditylenchus major* (Fuchs, 1915) Filip'ev, 1936
- Ditylenchus medians* (Thorne & Malek, 1968) n. comb.
= *Nothotylenchus medians* Thorne & Malek, 1968
- Ditylenchus medicaginis* Wasilewska, 1965
- Ditylenchus melongena* Bhatnagar & Kadyan, 1969
- Ditylenchus microdens* Thorne & Malek, 1968
- Ditylenchus minutus* Husain & Khan, 1967
- Ditylenchus mirus* Siddiqi, 1963
- Ditylenchus myceliophagus* Goodey, 1958
- Ditylenchus nanus* Siddiqi, 1963
- Ditylenchus nortoni* (Elmiligy, 1971) Bello & Geraert, 1972
= *Basiroides nortoni* Elmiligy, 1971
= *Basiria nortoni* (Elmiligy, 1971) Fotedar & Mahajan, 1973
- Ditylenchus obesus* Thorne & Malek, 1968
- Ditylenchus oryzae* (Mathur, Khan & Prasad, 1966) n. comb.
= *Boleodoroides oryzae* Mathur, Khan & Prasad, 1966
= *Paurodontus oryzae* (Mathur *et al.*, 1966) Sumenkova, 1975
= *Nothotylenchus oryzae* (Mathur *et al.*, 1966) Siddiqi, 1986
- Ditylenchus paramonovi* (Gagarin, 1974) n. comb.
= *Nothotylenchus paramonovi* Gagarin, 1974
- Ditylenchus parasimilis* (Massey, 1974) n. comb.
= *Nothotylenchus parasimilis* Massey, 1974
- Ditylenchus petilus* (Massey, 1974) n. comb.
= *Nothotylenchus petilus* Massey, 1974
- Ditylenchus phyllobius* (Thorne, 1934) Filip'ev, 1936
= *Anguillulina phyllobia* Thorne, 1934
= *Orrina phyllobia* (Thorne, 1934) Brzeski, 1981
- Ditylenchus saxenai* nom. nov.
= *Nothotylenchus indicus* Saxena, Chhabra & Joshi, 1973 nec *Ditylenchus indicus* (Sethi & Swarup, 1967) Fortuner, 1982
- Ditylenchus sibiricus* German, 1969
- Ditylenchus silvestris* (Kazachenko, 1980) n. comb.
= *Nothotylenchus silvestris* Kazachenko, 1980
- Ditylenchus similis* (Thorne & Malek, 1968) n. comb.
= *Nothotylenchus similis* Thorne & Malek, 1968
- Ditylenchus singhi* (Das & Shivaswamy, 1980) n. comb.
= *Nothotylenchus singhi* Das & Shivaswamy, 1980
- Ditylenchus solani* Husain & Khan, 1976
- Ditylenchus sonchophila* (Kir'yanova, 1958)
- Ditylenchus srinagarensis* (Fotedar & Mahajan, 1974) n. comb.
= *Nothotylenchus srinagarensis* Fotedar & Mahajan, 1974
- Ditylenchus taleolus* (Kir'yanova, 1938) Kir'yanova, 1961
- Ditylenchus tausaghyzatus* (Kir'yanova, 1938) Kir'yanova, 1961
- Ditylenchus taylori* (Husain & Khan, 1974) n. comb.
= *Nothotylenchus taylori* Husain & Khan, 1974
- Ditylenchus tenuidens* Gritsenko, 1971
- Ditylenchus thornei* (Andrássy, 1958) n. comb.
= *Nothotylenchus thornei* Andrásy, 1958
- Ditylenchus triformis* Hirschmann & Sasser, 1955
- Ditylenchus truncatus* (Eliashvili & Vacheishvili, 1980) n. comb.

- = *Nothotylenchus truncatus* Eliashvili & Vacheishvili, 1980
- Ditylenchus tuberosus* (Kheiri, 1971) n. comb.
- = *Nothotylenchus tuberosus* Kheiri, 1971
- Ditylenchus turfus* (Yokoo, 1968) n. comb.
- = *Neotylenchus turfus* Yokoo, 1968
- = *Nothotylenchus turfus* (Yokoo, 1968) Siddiqi, 1986
- Ditylenchus uniformis* (Truskova & Eroshenko, 1977) n. comb.
- = *Nothotylenchus uniformis* Truskova & Eroshenko, 1977
- Ditylenchus utschini* (Gagarin, 1974) n. comb.
- = *Nothotylenchus utschini* Gagarin, 1974
- Ditylenchus valveus* Thorne & Malek, 1968
- Ditylenchus virtudesae* Tobar-Jimenez, 1964
- Ditylenchus varaprasadi* nom. nov.
- = *Paurodontus solani* Varaprasad, Khan & Lal, 1981
- = *Nothotylenchus solani* (Varaprasad *et al.*, 1981) Siddiqi, 1986 nec *D. solani* Husain & Khan, 1976

The name *Nothotylenchus strictus* proposed in a thesis by Kapoor (1982), is not available. *Neotylenchus nitidus* Massey, 1969, was transferred by Siddiqi (1986) to *Nothotylenchus* under the erroneous authority "Massey, 1974". This decision is not accepted here in view of the columned uterus illustrated by Massey as closer to that in *Subanguina*. *Boleodorus typicus* Husain & Khan, 1967 was also transferred to *Nothotylenchus* by Siddiqi (1986). Oocytes were said to be arranged in multiple rows in this species. Both species will have to be investigated further before their taxonomic position can be decided. For the moment they are considered *incertae sedis*.

DISCUSSION

Ditylenchus is the genus in Anguinidae that is closest to the Tylenchidae, except *Pseudhalenchus*. Many *Ditylenchus* spp. have an esophageal region similar to that in Tylenchidae with fusiform median bulb and short pyriform glands. The female genital system is the least derived among Anguinidae with oocytes in one or two rows and columned uterus as four rows of four cells. Many males have short leptoderan caudal alae, as in Tylenchidae. It may be difficult to differentiate some species in *Ditylenchus* (with short pyriform glands, short ovary, and males with short caudal alae) from members of Tylenchidae. Wu (1967) showed that the spermatheca always long, tubular, and in-line with the genital tract in *Ditylenchus* was a good character to differentiate this genus from tylenchids with spermatheca small, round, and often offset from the genital tract. The size of sperm cells visible in the spermatheca (always large with a large amount of cytoplasm in *Ditylenchus*) is another good differentiating character from tylenchids (with small sperm cells with reduced cytoplasm).

Other members of the genus show some derived characters: reduction and disappearance of the median

bulb valve, elongation of the esophageal glands that may overlap the intestine, regression of the post-uterine sac. Such species are easier to differentiate from the tylenchids, and sometimes have been removed from *Ditylenchus* to other genera.

Safianema and *Diptenchus* were proposed as junior synonyms of *Ditylenchus* by Fortuner (1982). *Safianema* was differentiated from *Ditylenchus* primarily because of the long esophageal gland overlap over the intestine. This character is variable within the same species and even varies during the life of the same specimen (Fortuner, 1982). *Diptenchus* was differentiated primarily because of the absence of a PUS. These two synonymizations were rejected by Siddiqi (1986) without argument or justification.

Thorne (1941) described *Nothotylenchus* in Neotylenchidae because of the valveless median esophageal bulb. He noted in the diagnosis that the species in *Nothotylenchus* "may easily be mistaken for *Ditylenchus dipsaci* (Kühn) Filipjev or *D. intermedius* (de Man) Filipjev, especially since they are so frequently associated with alfalfa crown where these two species often are found."

The description of *Nothotylenchus* given by Thorne (1941) fits *Ditylenchus*, except for the absence of valves. This description was left unemended until Brzeski (1981) added a few details (isthmus not separated by a constriction; columned uterus with four rows of four cells; etc.). These features also are present in *Ditylenchus*. The biology of species in *Nothotylenchus* is not well known. Most are suspected to be mycetophagous. Some are found in the frass of bark beetles. At least one species, *N. acris*, has been associated with a disease of strawberry in Japan (Nishizawa & Iyatomi, 1955). Geraert (1976) wrote that *Nothotylenchus* was probably synonymous with *Ditylenchus*. Sumenkova (1974) and Brzeski (1981) were also of the opinion that these two may be congeneric.

The only morphological difference remaining between *Ditylenchus* and *Nothotylenchus* is the absence of median bulb valves in the latter genus. Some species of *Ditylenchus* have large, well distinct, valves (*D. dipsaci*, *D. destructor*, etc.). Many other have smaller valves. African populations of *D. myceliophagus* have weak valves that often become invisible in fixed specimens (Fortuner, 1982). There is no well-marked difference for this character between the two genera, but we observe a continuum of specific forms where valves, at first strong and well-marked, regress and eventually disappear completely.

Because there is no marked difference in the biology and the morphology of the two genera; because *Nothotylenchus* and *Ditylenchus* differ by a single character; because different species in *Ditylenchus* present successive stages in the regression, from typical clearly valvate *Ditylenchus* to typical valveless *Nothotylenchus*; and because a regressed character is not a sound basis for

systematic differentiation, *Nothotylenchus* Thorne, 1941 is here proposed as a synonym of *Ditylenchus* Filip'ev, 1936.

Boleodoroides was originally described in Boleodoriinae, close to *Boleodorus* and other genera now in Tylenchidae, and to *Nothotylenchus* now a synonym of *Ditylenchus* in Anguinidae.

Khera (1970) reduced *Boleodoroides* as a subgenus under *Boleodorus*. Geraert (1971) studied paratypes of *Boleodoroides oryzae* (type of species) and found many differences from the original description. He concluded that *Boleodoroides* does not resemble *Boleodorus* at all, but is much closer to *Paurodontus*. Jairajpuri (1982) agreed that *B. oryzae* and *B. brevistylus* do not belong to the *Boleodorus* group, and he preferred to consider *Boleodoroides* as a genus *incertae sedis*.

There is no esophageal stem in *B. oryzae*, so this species differs from *Paurodontus*. Some characters resemble *Ditylenchus* and the anguinids (head shape, female gonad, and particularly the spermatheca). The esophagus resembles that of *Nothotylenchus*. Siddiqi (1986) gave new illustrations of *B. oryzae* (type of species) and proposed to synonymize *Boleodoroides* to *Nothotylenchus*. His action is accepted here, but because *Nothotylenchus* is here treated as a junior synonym of *Ditylenchus*, *Boleodoroides* is proposed as a new synonym of this latter genus.

Orrina was differentiated from the rest of the Anguinidae "by having overlapping oesophageal lobe" (Brzeski, 1981). An esophageal overlap exists in some species of *Ditylenchus* (Fortuner, 1982). The type and only species in the genus, *O. phyllobia* is very close to *Ditylenchus*, and in fact was long known as *D. phyllobius* (Thorne, 1934) Filip'ev, 1936. It has many characteristics of the genus, including stout female body, general shape of anterior and posterior ends, female genital tract, male caudal alae and tail. The type species is an above-ground plant parasite and produces leaf galls on the weed *Solanum elaeagnifolium*. It differs from typical members of *Ditylenchus* by the complete absence of a valve and median esophageal bulb. It has been discussed above that regression of valves was not a good justification for the differentiation of the genus *Nothotylenchus* which was synonymized to *Ditylenchus*. The absence of the median bulb itself is a better character, but some species in *Nothotylenchus* now in *Ditylenchus* also have no median bulb at all (*N. antricolus*, *N. cylindricus*, and *N. cylindricus*).

Absence of median bulb occurs in many unrelated species. Regression of this organ in insect associates and parasites and in plant parasites needs to be investigated and its taxonomic significance evaluated. In the meantime, because of its general appearance and biology, *D. phyllobia* is transferred back to *Ditylenchus phyllobius* and the genus *Orrina* is proposed as a junior synonym of *Ditylenchus*.

Thada Thorne, 1941

DIAGNOSIS

Anguinidae. Similar to *Ditylenchus*. Wide (2.5-3 μm) well marked body annuli. Stylet knobs as small swellings at the end of the shaft. DGO at more than 4 μm from stylet base. Median bulb without valve. Deirids present. Spicules cephalated.

TYPE AND ONLY SPECIES

T. striata Thorne, 1941

COMMENTS

Thada was originally differentiated by Thorne (1941) because of its unusually thick, deeply striated cuticle, cap-like valvular apparatus at the esophago-intestinal junction, and ovate cephalation of the spicules.

Geraert (1974) found that the cuticle of type material of the two species described by Thorne (1941) in the new genus *Thada* (*T. striata*, type species, and *T. cancellata*) was no thicker than in other Tylenchida (0.5 to 1.5 μm thick compared to about 0.7, up to 2 μm , in Tylenchida).

Geraert (1974) commented that *Thada* is a "disturbing mixture" of characteristics of tylenchids and of *Ditylenchus*. The anterior end and esophageal region is typical of the tylenchids. The genital system is closer to *Ditylenchus*. *Thada* has wide, well-marked body annuli, sometimes with longitudinal striae (*T. cancellata*), and a conical tail with a rounded end (Geraert, 1974). The taxonomic position of *Thada* becomes clearer if the species that have been placed in this genus are considered separately.

The genital system of *T. cancellata*, as illustrated by Geraert (1974) with round spermatheca filled with small sperms resembles genital systems in tylenchids. The species *T. cancellata*, with slit-like amphids and deep longitudinal and transversal striae as in *Coslenchus* for example, is a typical member of Tylenchinae. *T. cancellata* and *T. tatra* Thorne & Malek, 1968 have been transferred to a different genus, *Neothada* Khan, 1973. *Neothada* belongs to Tylenchidae (Raski & Geraert, 1987).

T. striata is now the only species left in *Thada*. The genital system of *T. striata*, as illustrated by Geraert (1974) is identical to the genital system in *Ditylenchus*, with elongate spermatheca filled with large sperms. The amphid apertures in *T. striata* are certainly smaller than in *T. cancellata* and it is even questionable that they are "slit-like". Face view, preferably studied with SEM, are needed to define the exact shape of this feature. *T. striata* has wide annuli (2.5-3 μm), but no longitudinal striae. The esophago-intestinal junction and the tail shape are not very different from the similar structures

in *Ditylenchus*. The spicules are said to be cephalated, but so are the spicules in some *Ditylenchus* spp. (*D. dipsaci*, *D. destructor*, etc.).

Because of the structure of its genital system, *T. striata*, type species of the genus *Thada*, belongs to the Anguinidae. The differences between *T. striata* and the species in *Ditylenchus* are small: possibly different amphid apertures, smaller stylet knobs, DGO farther from the stylet, wider body annuli, slightly different spicule shape. Additional collections of *T. striata* need to be studied to decide if *T. striata*, and the genus *Thada*, are different from *Ditylenchus*. In the meantime, it seems best to accept *Thada* as a valid genus within Anguinidae.

Pterotylenchus Siddiqi & Lenne, 1984

DIAGNOSIS

Anguinidae. Median bulb not differentiated, valve lacking. Deirids present. Vulva partly covered by large cuticular flaps. Ovary straight with oocytes mostly in single file; columned uterus with four rows of 8-9 cells. Males unknown.

TYPE AND ONLY SPECIES

P. cecidogenus Siddiqi & Lenne, 1984.

The type species forms galls on the stems of a tropical pasture legume, *Desmodium ovalifolium*.

COMMENTS

Pterotylenchus is close to *Ditylenchus* by its general appearance, its esophagus, similar to some species formerly in *Nothotylenchus* and *Orrina*, and its ovary. It differs from *Ditylenchus* mostly in the columned uterus similar to *Subanguina*, and the presence of cuticular flaps.

Halenchus Cobb, 1933

DIAGNOSIS

Anguinidae. Labial region slightly offset and narrower than body. Corpus without distinct median bulb, valveless. Esophageal glands a long overlapping lobe. Excretory duct wide. Oocytes in one/two rows. Caudal alae short, adanal. Tail of both sexes with hooked tip.

Marine nematodes; form galls on seaweeds (*Ascophyllum*, *Fucus*).

TYPE SPECIES

H. fucicola (de Man & Barton in de Man, 1892) Cobb, 1933.

OTHER SPECIES

H. dumnonicus Coles, 1958

H. mediterraneus (Micoletzky, 1922) Cobb, 1933.

COMMENTS

Halenchus, originally described in Tylenchinae, was transferred to Nothotylenchinae by Thorne (1949) because of the absence of median bulb valve. Jairajpuri and Siddiqi (1969) placed it in a separate subfamily, Halenchinae, in Nothotylenchidae, because of the gland overlap and of the hooked tail tip. Sumenkova (1974) argued that esophagus structure should form the basis for classification of Neotylenchoidea. She transferred *Halenchus* to Neotylenchidae characterized by isthmus reduced, esophageal glands separated from esophagus proper, and intestine joining directly with corpus. Siddiqi (1980) considered *Halenchus* as related to Nothotylenchinae, in Anguinoidea.

The esophagus of *Halenchus* is different from that of neotylenchids (*Hexatyphus*). It has no well-defined median bulb (similar in this respect to some *Ditylenchus* spp.), a well defined isthmus encircled by nerve ring, and intestine seemingly joining esophagus in the glandular area. Glandular overlap is very long, but no different from that of some *Ditylenchus* spp.

Halenchus fits well in the family Anguinidae as already recognized by Siddiqi (1980): female gonad, male large sperms, small caudal alae, tail of both sexes. It is close to *Ditylenchus* and *Thada* by oocytes in one or two rows, and esophagus with non constrictions. SEM face views are needed to better differentiate these three genera.

The marine habitat of *Halenchus* is unique in Anguinidae. In Tylenchina, only some *Hirschmanniella* spp. (Pratylenchidae) are known marine nematodes. *H. mexicana* and *H. zoostericola* were once placed in *Halenchus*. This genus differs from *Hirschmanniella* by shape of labial area, stylet more slender, median bulb not well defined, monodelphic female gonad, large sperms in tubular elongate spermatheca, and tail shape.

Subanguina Paramonov, 1967

= *Heteroanguina* Chizhov, 1980

= *Afrina* Brzeski, 1981 (n. syn.)

= *Mesoanguina* Chizhov & Subbotin, 1985 (n. syn.)

DIAGNOSIS

Anguinidae. Median bulb with valves; isthmus may be separated from glandular bulb by a constriction, esophageal glands may or may not overlap the beginning of the intestine. Oocytes in one/two rows; columned uterus with four long rows of cells (about eight/twelve cells per row). Testes usually without flexures; bursa medium sized to long but not reaching tail end.

Mature females swollen or not swollen. Form galls on root and/or above ground parts of higher plants.

TYPE SPECIES

S. radiculicola (Greef, 1872) Paramonov, 1968

OTHER SPECIES

A list of species in *Subanguina* has recently been given by Brzeski (1981). To this list must be added :

- Subanguina hyparrheniae* (Corbett, 1966) comb.
- = *Anguina hyparrheniae* Corbett, 1966
- = *Afrina hyparrheniae* (Corbett, 1966) Brzeski, 1981
- Subanguina tumefaciens* (Cobb, 1932) comb.
- = *Tylenchus tumefaciens* Cobb, 1932
- = *Afrina tumefaciens* (Cobb, 1932) Brzeski, 1981

COMMENTS

The synonymy of *Heteroanguina* and *Subanguina* has been proposed by Brzeski (1981). The morphology of *S. graminophila* given as type species of *Heteroanguina* is different from *Anguina* as indicated by Chizhov (1980), but is no different from *Subanguina* as redefined by Brzeski (1981).

The genus *Afrina* was proposed by Brzeski (1981) for *A. hyparrheniae* (Corbett), type species and *A. tumefaciens* (Cobb). It was said to be intermediate between *Anguina* and *Subanguina* because it presents some characters of either genera (esophagus, ovary, and flexed testis as in *Anguina*, columned uterus as in *Subanguina*).

Examination of paratypes of *A. hyparrheniae* revealed that the female genital system is identical to that in *Subanguina*. In the ovary, after a zone of multiplication, the oocytes are arranged in two rows, and even in a single file at the end of the ovary of some specimens, not in multiple rows as in typical *Anguina*. Characteristics of esophagus and testis may be variable in *Anguina* and *Subanguina*. Some *Anguina* have no constriction between isthmus and glandular bulb (*A. agrostis*, *A. graminis*, *A. microlaenae*, etc.). The testis of *S. radiculicola* are flexed and no different from the testis in *Anguina*.

Because the structure of the female genital system is the best differentiating character between *Subanguina* and *Anguina* and because the structure of this system in *A. hyparrheniae*, type species of *Afrina* is similar to *Subanguina*, the genus *Afrina* is here proposed as a junior synonym of *Subanguina*.

Mesoanguina was proposed by Chizhov and Subbotin (1985) for *M. millefolii* (type species) and a dozen other anguinid species (*M. amsinckia*, *M. balsamophila*, *M. centaureae*, *M. chartolepidis*, *M. cousiniae*, *M. kopetdaghica*, *M. mobilis*, *M. montana*, *M. moxae*, *M. pharangii*, *M. picridis*, *M. plantaginis* and *M. varsobica*). The new

genus was characterized by : *i*) being parasitic on dicotyledons only (*vs* monocotyledons only or both monocotyledons); *ii*) having third stage larvae as the infective stage (*vs* second or fourth stage); *iii*) forming unstained galls with well-marked cavity (*vs* partially or completely stained galls without well-marked cavity) and; *iv*) having two morphologically distinct generations in the galls (*vs* one generation only).

Differences in host list should not be used as generic criteria. If they were, other genera would have to be split. In *Ditylenchus*, for example, some species feed on fungi, others can feed on both fungi and higher plants (*D. destructor*), while *D. dipsaci* can survive on only two fungus species (Maggenti, 1981).

The authors of *Mesoanguina* use differences in infective larval stages to justify the proposal of this new genus. In the same article (Chizhov & Subbotin, 1985), they reject *Cynipanguina* which is the only anguinid genus with adults as the infective stage (Maggenti, Hart & Paxman, 1974). *Cynipanguina* is accepted here because of morphological differentiations.

Gall stains are not necessarily caused by the parasite, but more often by the reaction of the plant to the presence of the parasite. Some other factors may also induce gall stains. *Corynebacterium*, for example, turn galls into a bright yellow.

Two generations of *Anguillulina millefolii* (= *Mesoanguina millefolii*, type species) were described by Goodey (1938). They differ in body proportions and in some morphological details. The first generation is larger, with spiral habitus and reflexed ovary. The smaller second generation has straighter body and ovary mostly outstretched. Chizhov and Subbotin (1985) proposed *Mesoanguina* with first generation adults smaller, straighter, and with ovary straight or reflexed. They also differentiate the arrangement of oocytes in the ovary, in a single row (first generation) *vs* two or three rows (second generation). From the study of Goodey (1938), the maturation areas of both generations look remarkably similar with oocytes in one row. Mature oocytes do seem to crowd each other at the proximal end of the ovary in the first generation females, but the aspect is quite different from that in *Anguina sensu stricto*. This alternance of generations is said by Hooper and Southey (1978) to be characteristic of *A. millefolii*. It is not clear how Chizhov and Subbotin extended its description to thirteen other species.

While the introduction of biological considerations in diagnoses of nematode species should be encouraged, biology alone does not differentiate a genus, when there are no morphological differences. Also the use of biological characters should be subject to the same prudence as any other character. Generic criteria must be shown to be reasonably constant and their presence be verified in all species grouped into a new genus.

Mesoanguina millefolii is here retransferred to *Subanguina* because of the arrangement of oocytes in one row.

Mesoanguina is proposed as a new synonym of this genus. All species placed in *Mesoanguina* by Chizhov and Subbotin (1985) are transferred back to *Anguina* or *Subanguina*, according to their taxonomic position in Brzeski (1981).

***Cynipanguina* Maggenti, Hart & Paxman, 1974**

DIAGNOSIS

Anguinidae. Median bulb with valve; isthmus separated from the glandular bulb by a constriction; intestine overlapping the end of the glandular bulb that forms a stem-like extension. Oocytes in one/two rows; columned uterus with four long rows of cells (about 14 cells per row). Testes without flexures, caudal alae leptoderan. Mature females swollen. Above ground parasites of higher plants. The adults are the cryptobiotic stage instead of one of the larval stages as in the other Anguinids.

TYPE AND ONLY SPECIES

C. danthoniae Maggenti, Hart & Paxman, 1974

The synonymy of *Cynipanguina* and *Anguina* proposed by Brzeski (1981) is here rejected because the stem-like esophageal extension of *C. danthoniae* is not an artifact. It was seen in living specimens, and in both younger and older females as well as in males. Also the genital system is closer to that of *Subanguina*.

***Anguina* Scopoli, 1777**

- = *Anguillulina* (*Anguina*) Scopoli, 1777
- = *Anguillulina* Gervais & Van Beneden, 1869
- = *Paranguina* Kir'yanova, 1955
- = *Nothanguina* Whitehead, 1959 (n. syn.)

DIAGNOSIS

Anguinidae. Procorpus generally separated from the median bulb by a constriction. Median bulb with or without valves; isthmus generally separated from the glandular bulb by a constriction; esophageal glands enlarged, generally overlapping intestine. Oocytes in many rows; columned uterus a long multinucleate tube. Testes usually with flexures; gubernaculum rarely absent; caudal alae long but not reaching tail tip. Mature females swollen. Form galls on above ground parts of higher plants, generally grasses.

TYPE SPECIES

A. tritici (Steinbuch, 1799) Chitwood 1935

OTHER SPECIES

See list in Brzeski (1981) with the following addition :
A. cecidoplastes (Goodey, 1934) Filip'ev, 1936
= *Nothanguina cecidoplastes* (Goodey, 1934) Whitehead, 1959

Anguillulina and *Anguina* had the same type species. Chitwood (1935) commented on the status of *Anguina* and recognized its seniority over *Anguillulina*. *Anguina* was accepted in the Official List of Works Approved as Available for Zoological Nomenclature, First Instalment, 1958, opinion 329, and *Anguillulina* was considered a junior objective synonym of *Anguina* in the Official Index of Rejected and Invalid Generic Names in Zoology, First Instalment, 1958, opinion 341, name 235.

Brzeski (1981) proposed to consider *Paranguina* as a synonym of *Anguina* because his examination of specimens of the type species of *Paranguina* revealed that the additional esophageal gland described by Kir'yanova was a fixation artifact. His conclusions are accepted here.

Nothanguina was differentiated from *Anguina* by the lack of a valve in the poorly developed median bulb and by lack of a gubernaculum. Both characters are not accepted as valid generic characters, and *Nothanguina* is here proposed as a new junior synonym of *Anguina*.

***Sychnotylenchus* Rühm, 1956**

(Name not available in Rühm, 1950; Rühm, 1955)

= *Neoditylenchus* Meyl, 1961 (n. syn.)

DIAGNOSIS

Anguinidae. Labial framework six sectoried with the six sectors equal or lateral sectors narrower than subdorsal and sub-ventral ones. Esophagus with procorpus generally wide and separated from median bulb by a constriction, rarely thin and without a constriction. Median bulb with valve, well-defined, fusiform to spherical. Esophageal glands short, pyriform to elongate, wide. Position of excretory pore variable from anterior to median bulb to opposite posterior end of glands. Female tail small, cylindroid to broadly rounded end. Oocytes in one/two rows. Columned uterus four rows of more than four cells (seven to fourteen cells), PUS present.

Male with peloderan caudal alae. Spicules long, sometimes longer than tail.

TYPE SPECIES

S. intricati Rühm, 1955

OTHER SPECIES

S. abieticolus (Rühm, 1956) n. comb.
= *Ditylenchus abieticolus* Rühm, 1956

- S. abietis* Rühm, 1955
S. autographi (Rühm, 1956) n. comb.
 = *D. autographi* Rühm, 1956
S. corniculatus (Massey, 1974) n. comb.
 = *Neoditylenchus corniculatus* Massey, 1974
S. dendroctoni (Massey, 1974) n. comb.
 = *N. dendroctoni* Massey, 1974
S. dendrophilus (Marcinowski, 1909) n. comb.
 = *Tylenchus dendrophilus* Marcinowski, 1909
S. eremus (Rühm, 1956) n. comb.
 = *D. eremus* Rühm, 1955
S. gallicus (Steiner, 1935) n. comb.
 = *Anguillulina gallica* Steiner, 1935
S. glandarius (Massey, 1974) n. comb.
 = *N. glandarius* Massey, 1974
S. glischrus (Rühm, 1956) n. comb.
 = *D. glischrus* Rühm, 1956
S. major (Fuchs, 1915) n. comb.
 = *T. major* Fuchs, 1915
S. mutici Massey, 1974
S. ortus (Fuchs, 1938) n. comb.
 = *A. orta* Fuchs, 1938
S. ovarius (Massey, 1974) n. comb.
 = *N. ovarius* Massey, 1974
S. panurgus (Rühm, 1956) n. comb.
 = *D. panurgus* Rühm, 1956
S. petithi (Fuchs, 1938) n. comb.
 = *A. petithi* Fuchs, 1938
S. phloeosini Massey, 1969
S. pinophilus (Thorne, 1935) n. comb.
 = *A. pinophila* Thorne, 1935
S. pityokteinophilus (Rühm, 1956) n. comb.
 = *D. pityokteinophilus* Rühm, 1956
S. puniwopus (Massey, 1969) n. comb.
 = *N. puniwopus* Massey, 1969
S. rarus (Meyl, 1954) n. comb.
 = *D. rarus* Meyl, 1954
S. scolyti Massey, 1969
S. striatus (Fuchs, 1938) n. comb.
 = *Anguillonema striatum* Fuchs, 1938
S. ulmi Rühm, 1955
S. yasinskii (Massey, 1969) n. comb.
 = *N. yasinskii* Massey, 1969

COMMENTS

Neoditylenchus has been differentiated from *Sychnotylenchus* by several authors (Rühm, 1956; Meyl, 1961; Goodey, 1963; Massey, 1974; Kakuliya & Devdariani, 1975). The differentiating criteria are discussed below.

1. Relative size of lip sectors

The lip sectors are described only in *N. panurgus*, *S. intricati*, *S. phleosini*, *S. scolyti*. In all cases, the illustrations show the labial framework, not the lip sectors. We are unable to locate any SEM photograph of the lip sectors.

Because the actual external shape of the lip sectors is unknown and because the differences in labial frame-

works are small and documented only in a few species, it is not considered that the lip shape can be used for the moment to differentiate genera.

2. Position of the excretory pore

The position of the excretory pore varies in *Neoditylenchus* from the level of the posterior end of the glands to that of the base of the median bulb; it varies in *Sychnotylenchus* from the base of the median bulb to the posterior third of the procorpus. The ranges of positions in the two genera overlap slightly; the pore is more anterior in *N. petithi* than in *S. phloeosini*.

Because the position of the excretory pore varies continuously from species to species with no definite gap between the two nominal genera — with, in fact, a slight overlap — it is difficult to accept this character as a generic criterion.

3. Esophagus

The species traditionally placed in *Neoditylenchus* (excretory pore in a more posterior location) and in *Sychnotylenchus* (excretory pore more anterior) exhibit a wide variability in the shapes of the different parts of the esophagus.

Procorpus : In both genera, the procorpus is generally wide and separated from the median bulb by a constriction. It is thinner and lacks a constriction in *N. striatus*, *N. petithi*, and *S. ulmi*.

Median bulb : The median bulb varies from a strong spherical structure to a weak fusiform swelling. Both shapes occur in either genera : *N. ovarius*, *S. ulmi*, etc., have strong spherical bulbs; *N. eremus*, *S. scolyti*, etc., have fusiform bulbs.

Isthmus : The isthmus is generally thin. It is wider in *N. panurgus* and a few other *Neoditylenchus*. However, many *Neoditylenchus* have a thin or a very thin isthmus : *N. corniculatus*, *N. abieticolus*, etc.

Esophageal glands : The glands are generally long and enlarged in *Neoditylenchus*, except in some species like *N. striatus* with shorter glands. They are short and squat, pyriform, in *Sychnotylenchus*, except *S. scolyti* with longer glands.

The taxonomic value of the shape of esophageal glands can be questioned in view of the wide range of variation that exists in the related genus *Ditylenchus*.

4. Relative size of spicules and male tail

In the two genera under consideration, the species with the most anterior position of the excretory pore have very long spicules, equal to, or longer than the tail, while the species with more posterior excretory pore have comparatively shorter spicules.

The division between the two groups of species does not quite fit the traditional division between *Sychnotylenchus* and *Neoditylenchus*. All *Sychnotylenchus* and the

Neoditylenchus spp. with excretory pore at level or anterior to nerve ring have longer spicules. The rest of the *Neoditylenchus* have shorter ones. However, there are exceptions to this rule : *N. pityokteinoophilus*, *N. striatus*, etc.

In conclusion, some species in the two genera under discussion have the excretory pore more anterior, esophageal glands short and squat, spicules as long as tail, and possibly lateral sectors of the labial framework narrower than the other sectors. Other species have the excretory pore more posterior, esophageal glands longer and wider, spicules shorter, and all sectors of labial framework equal. Many species do not fit this dichotomy and present characters of both groups. There is no difference in the biology of these species: they are all associates of bark beetles.

Neoditylenchus is proposed as a new junior synonym of *Sychnotylenchus*

Chitinotylenchus Micoletzky, 1922

The nomenclatural status of this genus has been recently reviewed by Fortuner (1982). Because many characteristics relevant for generic differentiation are not known for *C. paragracilis*, type species of the genus, *Chitinotylenchus* is considered a *genus inquirendum* or *incertae sedis* in Anguininae.

Hypothetical evolution of the anguinids

Some species in the *Ditylenchus* (*D. ausafi*, *D. emus*, *D. equalis*, *D. microdens*, *D. nortoni*, and *D. valveus*) are very close to Tylenchidae (esophagus not evolved, male tail with short bursa). This may indicate a common origin of the two families Tylenchidae and Anguinidae. The basic differences between these two groups is the structure of the genital system. In Anguinidae, sperm cells have a greatly enlarged cytoplasm. The evolutionary value of this modification is not known. The increase in sperm cell size is related with a modification of the female spermatheca. In Anguinidae, this organ is a long tubular structure, much larger than the corresponding small rounded pouch of the tylenchids.

Ditylenchus is a large complex genus, with species that show evolutionary tendencies in several directions.

A first group of species became specialized parasites of above-ground parts of higher plants (*D. dipsaci*, *D. destructor*, *D. angustus*, and others). These species

present a derived esophageal region (with elongation of glands that eventually overlap the intestine), derived genital system (with elongated ovary that may reach the esophagus and/or fold upon itself), longer relative length of bursa in relation to tail (bursa reaching to 2/3 or more of tail length). Evolution of each character seems to be independent from the other characters. For example, *D. cyperi* with bursa reaching almost to tail end has esophagus and ovary not derived.

These evolutionary tendencies in *Ditylenchus* points towards the more derived plant parasitic anguinids : *Subanguina*, *Cynipanguina*, and *Anguina*. Evolution in these genera proceeded by further modifications of the esophagus (enlarged procorpus and/or isthmus, increased size of glands). In *Cynipanguina* the end of the glands are enfolded within the anterior end of the intestine and becomes a characteristic " stem " not unlike the stem in pauroidontids. These modifications of the digestive system may be related to a better adaptation to plant parasitism evident in many species of these genera (leaf galls). At the same time, and perhaps correlated to the better food supply, modifications of the genital system produce more eggs (rearrangement of the ovary with multiple rows of oocytes) that are processed through a longer columned uterus (twelve or multi-celled).

The plant parasitic anguinids are well adapted to above-ground parasitism on higher plants. However, this ecological niche proved to be an evolutionary dead-end and the main stream of evolution towards phytoparasitism was due to occur within the soil ecosystem where it probably originated and developed in different nematode groups (belonolaimids, pratylenchids, hoplolaimids, and heteroderids).

Many species in *Ditylenchus*, as defined above, seem to follow a different evolutionary process. In this second group of species, the median bulb valve regresses and eventually disappear completely. The evolutionary significance (if any) of this regression is not known.

A third group of species evolved from hypothetical *Ditylenchus*-like ancestors when they became associated with bark beetles. For an unknown reason their tail length, both in male and female specimens, became greatly reduced until a different genus, *Sychnotylenchus*, was differentiated with short rounded female tails, and short male tail, completely enveloped by the bursa.

Generic identification

To help with the practical identification of the genera discussed in Anguinidae, a tabular key for the identification of the valid taxa is proposed in Table 1.

Table 1
Tabular key to the genera in Anguinidae

	<i>Procorpus</i>	<i>Isthmus</i>	<i>Glands</i>	<i>Oocytes in Ovary</i>	<i>Cells of Columella</i>	<i>Caudal alae</i>	<i>Remarks</i>
<i>Pseudhalenchus</i>	No constrict.	No constrict.	Overlap	1/2 rows	4 × 4	Leptoderan	Small sperms
<i>Ditylenchus</i>	No constrict.	No constrict.	+/- overlap	1/2 rows	4 × 4	Leptoderan	
<i>Halenchus</i>	No constrict.	No constrict.	overlap	1/2 rows		Leptoderan	Marine; wide excretory duct.
<i>Thada</i>	No constrict.	No constrict.	No overlap	1/2 rows	4 × 4	Leptoderan	DGO far from stylet
<i>Pterotylenchus</i>	No constrict.	No constrict.	Overlap	1/2 rows	4 × (8-9)	Leptoderan	Cuticular flaps present
<i>Subanguina</i>	+/- constrict.	+/- constrict.	+/- overlap	1/2 rows	4 × (8-12)	Leptoderan	
<i>Cynipanguina</i>	No constrict.	Constrict.	Stem	Several rows	4 × (12-14)	Leptoderan	
<i>Anguina</i>	+/- constrict.	Constrict.	+/- overlap	Several rows	Multi-celled	Leptoderan	
<i>Sychnotylenchus</i>	+/- constrict.	No constrict.	No overlap	1/2 rows	4 × (7-14)	Peloderan	Tail short cylindrical

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