Considerations on the genus *Xiphinema* Cobb, 1913 (Nematoda : Longidoridae) and a "lattice" for the identification of species

Michel LUC * and Antoine DALMASSO
Laboratoire de Nématologie, ORSTOM,
Dakar (Sénégal)
and Station de Recherche sur les Nématodes,
INRA, Antibes (France)

ABSTRACT

In the first part of this paper the authors discuss the validity of groups and more particularly of the subgenera of Xiphinema *created by Cohn and Sher (1972). After a detailed examination of the characters used by Cohn and Sher to characterize their subgenera, the authors reject them mainly because of the five used the only two reliable characters (shape of the tail and structure of anterior female genital branch) were proven to have independant evolutions and thus divisions based on the greater importance of one than the other appear as arbitrary.*

The second part deals with an up-to-date list of valid species and of species inquirendae *of the genus* Xiphinema. *These lists are followed by detailed explanations concerning those species of which the status was modified from the list of Cohn and Sher, used for reference, or to other recent papers. Thus,* X. ifacolum, X. loosi, X. denoudeni, X. macrostylum, X. vulgare, X. yapoense, X. longidoroides *are considered as valid species, whereas* X. truncatum *is considered as a* species inquirenda, X. sandellum *as a* species incertae sedis *and* X. amarantum *as a junior synonym of* X. sahelense. *Thus, with the addition of twenty-two species published since the list of Cohn and Sher the genus* Xiphinema *comprises at the present time 74 valid species.*

In the last part, the characters of these 74 species are assembled in a "lattice" permitting a more easy and rational determination than keys or tables. This "lattice" is based on a "code" for which twelve characters (of which nine are concerning the females) were choosen and each divided into five or less categories (in one case seven).

The numerical values of an unknown population of Xiphinema *following the code permits its determination by successive comparison with values of known species. Due to the restricted number of characters and categories used, some pairs of species have the same numerical values ; for each of these eight cases, supplementary data are given permitting the differentiation, or notes are presented on a possible synonymization.*

RÉSUMÉ

Dans la première partie de cet article, les auteurs discutent la validité des groupes et plus particulièrement des sous-genres créés par Cohn et Sher (1972) à l'intérieur du genre Xiphinema. *A la suite d'un examen détaillé des caractères utilisés par Cohn et Sher pour définir ces sous-genres, les auteurs n'admettent pas la validité de ceux-ci. La raison principale en est que, sur les cinq caractères utilisés, les deux seuls qui ont une valeur certaine (forme de la queue et structure de la branche génitale antérieure femelle) font montre d'évolutions totalement indépendantes ; de ce fait, des divisions fondées sur la prévalence d'un caractère sur l'autre apparaissent arbitraires.*

La seconde partie contient une liste mise à jour des espèces valides et des species inquirendae *du genre. Cette liste est suivie d'explications concernant les espèces dont la position systématique a varié par rapport à la liste de Cohn et Sher prise comme référence, ou à d'autres publications plus récentes. Ainsi* X. ifacolum, X. denoudeni, X. macrostylum, X. vulgare, X. yapoense, X. longidoroides *sont considérés comme des espèces valides, tandis que* X. truncatum *est placé parmi les* species inquirendae, X. sandellum *classé comme* species incertae sedis *et* X. amarantum *comme synonyme junior de* X. sahelense. *Avec l'addition de vingt-deux espèces décrites depuis la publication de Cohn et Sher, le genre* Xiphinema *comprend 74 espèces valides.*

Dans la dernière partie de l'article, les caractères de ces 74 espèces sont assemblés dans une « grille»

---

* *Adresse actuelle :* Muséum National d'Histoire Naturelle, Laboratoire de Zoologie (Vers), 43, rue Cuvier, Paris (5^e^).

permettant une détermination plus aisée que les clés ou les tableaux. Cette « grille » est fondée sur un code pour lequel douze caractères, dont neuf se rapportent aux femelles, ont été choisis et divisés chacun en au plus cinq catégories (exceptionnellement sept dans un seul cas).

Les valeurs numériques d'une population inconnue de Xiphinema, *valeurs établies à l'aide du code, permettent sa détermination par comparaison successive avec les valeurs homologues des espèces décrites. Par suite du nombre limité de caractères et de catégories utilisés quelques couples d'espèces ont les mêmes valeurs numériques ; pour chacun de ces huit cas sont fournies des données supplémentaires permettant la séparation des deux espèces en cause ou sont notés les rapprochements qui permettraient d'envisager une synonymisation.*

A great part of the data contained in the present paper, and namely the "lattice" itself, appeared in recent publications of the authors (Luc, 1975a ; Luc & Dalmasso, 1975). Nevertheless, they estimate it would be more useful to reassemble these data in a more up-to-date and more detailed publication. In addition considerations on the groupings of species proposed by various authors, as "groups" or subgenera are included.

Obviously, the increasing number of publications on *Xiphinema*, dealing with description of new species or with complementary data on known species, brings the risk that the numerical data, on which the "lattice" is based, will become rapidly obsolete.

Thus, the authors consider this paper as a step in the development of the concept of specific relationships within the genus *Xiphinema* drawing attention to the adaptability of the system for specific determination.

1. GROUPS AND SUBGENERA IN *XIPHINEMA*

During the last ten years a relatively large number of taxonomic papers has been published on genus *Xiphinema*. Most of them, in the conventional way, are concerned with descriptions of new species occuring primarily in those regions where few or no nematological surveys have been made before. These areas are mainly in the tropics which seem to be the favourite habitat of *Xiphinema* judging by the number and the diversity of forms encountered. Some of these papers contain keys or tables to aid specific determination (Mc Leod & Khair, 1971 ; Loof & Maas, 1972 ; Southey, 1973a ; Tarjan, 1973 ; Lamberti & Tarjan, 1974). Esser (1973) gave a "diagnostic species compendium" based on numerical data (spear length, V, a, b, and c) and on tail shape.

Howewer, some authors have tried to go further and to present an analysis of specific criteria, assembling species having some phenotypic affinities. Thus, Dalmasso (1969) in a publication dealing mainly with European species wrote : « On constate assez fréquemment parmi les espèces [de *Xiphinema*] décrites des similitudes prononcées qui permettent de les rapprocher au sein de groupes, sortes de super-espèces ou sous-genres » (transl. : "Rather frequently among the [*Xiphinema*] species pronounced similarities are observed, that permit them to be assembled in groups, kinds of super-species or subgenera"). In this paper it was specified that the characters on which these groups have to be based are essentially those connected with the general morphology of the animals : habitus, evolution of the structure of the tail during development, profile of the "collum" (outline of cephalic and œsophageal parts).

Cohn and Sher (1972) expressed a similar opinion : "It may be advantageous at this stage to arrange the large number of existing species into categories based on gross morphological differences" ; but they went further and proposed to divide the genus *Xiphinema* in to eight subgenera : *Radiphinema*, *Krugiphinema*, *Xiphinema*, *Elongiphinema*, *Halliphinema*, *Basiphinema*, *Rotundiphinema* and *Diversiphinema*.

Southey (1973a) maintained these divisions but gave them a practical value only and not any phylogenic or taxonomic signification.

In the diagnosis of the eight subgenera, their authors use five characters, given in the following order : type of female reproductive system (monodelphic, pseudomonodelphic or didelphic) ; vulva position (V) ; presence or absence of a Z organ ; body length ; tail shape and ratio of tail length divided by body diameter at the level of the anus (c').

These five characters are those, with one exception (length of the spear), that Luc and Tarjan (1963) considered as essential for the characterization of species of *Xiphinema*.

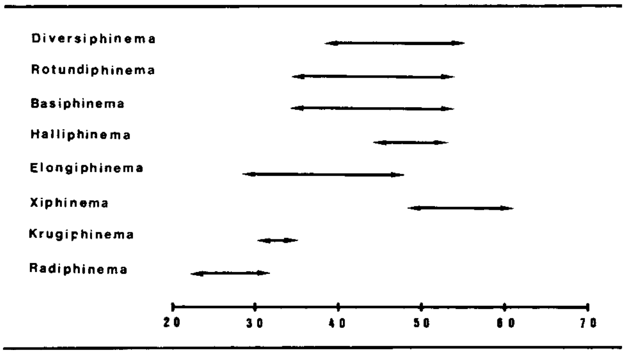
Each of these five characters are now examined with regard to their accuracy in firmly separating the eight subgenera :

— *Type of female reproductive system.* This character is used alone to separate the first two cited subgenera : *Radiphinema* comprises all and only the "monodelphic" species i.e. the species in which the females show no trace of an anterior genital branch ; whereas *Krugiphinema* comprises all and only the "pseudomonodelphic" species, i.e. the species in which the females have no anterior ovary but remnants of the anterior uterus and, in some cases, of the oviduct. These characters of the anterior branch are clear, but the species assembled differ greatly in tail shape, especially if we consider newly described species that could be placed in these two subgenera. Thus they appear as artificial groupings. On the other hand Southey (1973b) criticized the terms based on the suffix "delphic" as applied to the whole (didelphic, monodelphic, etc.) and consequently rejected the term "pseudomonodelphic". We agree with his conclusions and prefer now to use the term "genital tract" for the whole genital apparatus, "genital branch" for each of the anterior and posterior portions and longer, but more precise expressions to define the reduced anterior branch occuring in some species of *Xiphinema.*

— *Vulva position (coefficient V).* The values of this coefficient overlap considerably between the different subgenera (Table I) and only three groups can be recognised, *viz :*

TABLE I

Extreme values of the coefficient V



1) *Radiphinema* and *Krugiphinema*, where the low value of V (< 35) is correlated with the absence or the reduction of the anterior genital branch ;

2) *Xiphinema*, with a rather high V value (> 48) ; and

3) other subgenera with highly variable V value.

— *Presence or absence of a Z organ :* LUC (1973) differentiated the "Z organ" from the "Z pseudo-organ", but these two structures, in some cases difficult to distinguish from each other, can be grouped under the term of "Z" differentiation", the equivalent of the term "Z organ" as used by C. & S.[1] and other authors.

The presence of a Z differentiation is said by C. & S. to occur in some species of the two subgenera ***Basiphinema*** and ***Rotundiphinema*** and absent in others. But we can add the subgenus ***Halliphinema*** since the presence of a Z organ was demonstrated (LUC, 1973) in ***X. hallei*** and also the subgenus ***Diversiphinema*** since ***X. diversicaudatum*** has a well developed Z pseudo-organ (Fig. 2c). Concerning this species, C. & S. claimed that : "Presence of a Z organ was reported in some populations of *X. diversicaudatum* from Kent, England (FLEGG, 1966) ; however, since these were not from the type locality their taxonomic position is uncertain". In fact the Z pseudo-organ was constantly observed in numerous populations of *X. diversicaudatum* (and namely those associated with arabis mosaic virus) from various origins. To accept the argument of C. & S. implies a revision of all records of *X. diversicaudatum* ; that constitutes a very disputable situation, because this species then should be considered as *species inquirenda.* Moreover, if we admit that the species where a Z pseudo-organ was observed is not the true *X. diversicaudatum* but a very close and unnamed species, it would belong nevertheless to the subgenus *Diversiphinema.*

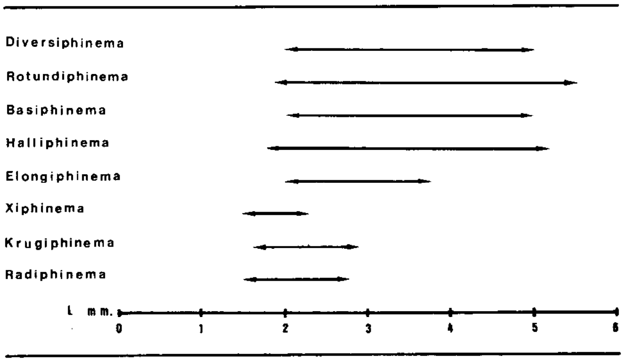
In fact the use of the Z differentiation has no significance for separating the subgenera. This differentiation occurs sporadically in species which are very different on the basis of all other characters, whereas very closely related species may show Z differentiation or not. The only points that can be made relative to the Z differentiation (LUC, 1973) are that it has never been observed in species with a reduced or no anterior genital branch, and that it is more frequent in species having numerous males. It constitutes a very good character which allows the differentiation of some species but cannot be used to assemble species in groups having any taxonomic or phylogenetic signification.

— *Body length* (coefficient L). As is true for the V value, the body length of the females show considerable overlapping between the different subgenera (Table II). At most this character permits the separation of the eight subgenera into two groups : the first composed of three subgenera (*Radiphihema*, *Krugiphinema* and *Xiphinema*) with relatively short species (L < 2.9 mm), the second by the five other subgenera in which the body length varies greatly between similar limits (from about 2 to 5-5.5 mm), except perhaps the subgenus *Elongiphinema* in which species are no longer than 4 mm. Thus, for the same reasons as those given for coefficient V, body length appears as an inappropriate character for the definition of the proposed subgenera.

— *Tail shape and the ratio-tail length divided by anal diameter* (coefficient c'). The great variety of tail shapes among the different species of *Xiphinema*, from

TABLE II

Extreme values of the coefficient L



---

[1] The publication of COHN and SHER (1972) will be hereafter referred to as« C. & S.».

long attenuated tails (c′ > 10) to the almost perfectly hemispherical ones (c′ ≃ 0.6), has naturally led to the use of this easily observable character for the differentiation of species and for the definition of groups.

Although the distinction between different created categories is difficult in some cases, the tailshape and c′ coefficient are very good characters and the groups thus formed have at least a practical usefulness. C. & S. used this character almost exclusively to separate the five subgenera in which the species show two complete female genital branches.

Concerning the characters "tail rounded or with slight median protuberance" *versus* "tail short with distinct peg" used by C. & S. to separate the subgenera *Rotundiphinema* and *Diversiphinema* respectively, we must note that some species classed in the latter subgenus *(X. diversicaudatum, X. index, X. vuittenezi)* may have in some cases a rounded tail with no trace of a mucro (compare Fig. 6-A and 6-G).

A character to be considered with reference to round tails is the presence or the absence of a "blind terminal canal". This structure is seen (SOUTHEY & LUC, 1973) as a clear zone of the cuticle more or less free of the fine radial striations that surround the rest of the tail ; this canal extends posteriorly through all except the outermost cuticle layer (see *X. loosi*, Fig. 6-H).

The structure of the tail-tip is often an important diagnostical character both in species with round-shaped tails and others ; in some species it is the best character, permitting a rapid differentiation of closely related species e.g. *X. pini* (Fig. 6-I), *X. attorodorum* (Fig. 4-E) and *X. ifacolum* (Fig. 5-G).

To summarize our comments on the characters used by C. & S. in the definition of their subgenera, we consider that only two of them have a sufficiently accurate value for this purpose :

— the more or less pronounced regression of the anterior female genital branch, and

— the tail shape.

The definition of subgenera, and not of groups, implies that a phylogenic value is given to these taxa and that more than one character is used in definition ; otherwise, nearly all genera of nematodes could be divided into two or more subgenera.

The two characters retained certainly have a phylogenic value ; this is evident for the regression of the anterior branch of the female genital tract for which a line can be traced from the lightest one (ovary strongly reduced and probably non functionnal, oviduct and uterus sligthly reduced in *X. orbum*) to the more pronounced (no trace of anterior branch, in *X. radicicola*), with all the intermediate stages. It appears logical to conclude that the more primitive structure is that with two complete branches.

With reference to tail length and shape, as previously observed all intermediate types exist between long filiform tails as in *X. filicaudatum* or *X. spinuterus* (Fig. 4-A) and short hemispherical ones, as in *X. hygrophilum* (Fig. 6-K) or *X. yapoense* (Fig. 6-J). It is suggested that forms with long attenuated tail are the most primitive. This hypothesis is based on the fact that in all the species in which larval development was studied, with the exception of *X. simillimum* (LOOF & YASSIN, 1970), a regression of the coefficient c′ was observed, meaning that larval stages have always a proportionally more elongated tail than the adult stage. This is very clear in some species with hemispherical adult tails, such as *X. costaricense*, *X. hygrophilum*, *X. pyrenaicum* and *X. turcicum*.

It is howewer important to note that species with similarly shaped female tails may develop from larvae whose tails shapes differ greatly, as illustrated by the last three cited species. For that reason it is desirable in the future to describe, wherever possible, tails of each stage.

If these two characters are accepted as being of evolutionary signification it must be concluded that the evolution of each has been independant. This concept is illustrated in Table III, in which the Y-axis represents the value of c′ and the X-axis the more or less pronounced regression of the anterior branch, following four categories :

— A : anterior ovary strongly reduced and apparently nonfunctional, anterior oviduct and uterus more or less reduced : *X. hygrophilum* (*27*) [1]. Fig. 1-A), *X. orbum*, (*51*).

— B : no anterior ovary but rest of anterior branch showing differentiation (uterus, sphincter, oviduct) and long : *X. filicaudatum* (*24*), *X. krugi* (*35*, Fig. 1-D), *X. longicaudatum* (*36*, Fig. 1-B), *X. surinamense* (*65*).

— C : no anterior ovary, rest of anterior branch undifferenciate but rather long (> 1.5 vulvar diameter) : *X. denoudeni* (*17*, Fig. 1-G), *X. simillimum* (*63*).

— D : rest of anterior branch non-existent or short (< 1.5 diameter) : *X. australiae* (*4*), *X. brasiliense* (*9*), *X. chambersi* (*12*), *X. costaricense* (*14*). Fig. 1-E, F), *X. ensiculiferum* (*23*), *X. loosi* (*38*, Fig. 1-I), *X. monohysterum* (*46*), *X. orthotenum* (*52*), *X. radicicola* (*57*, Fig. 1-H).

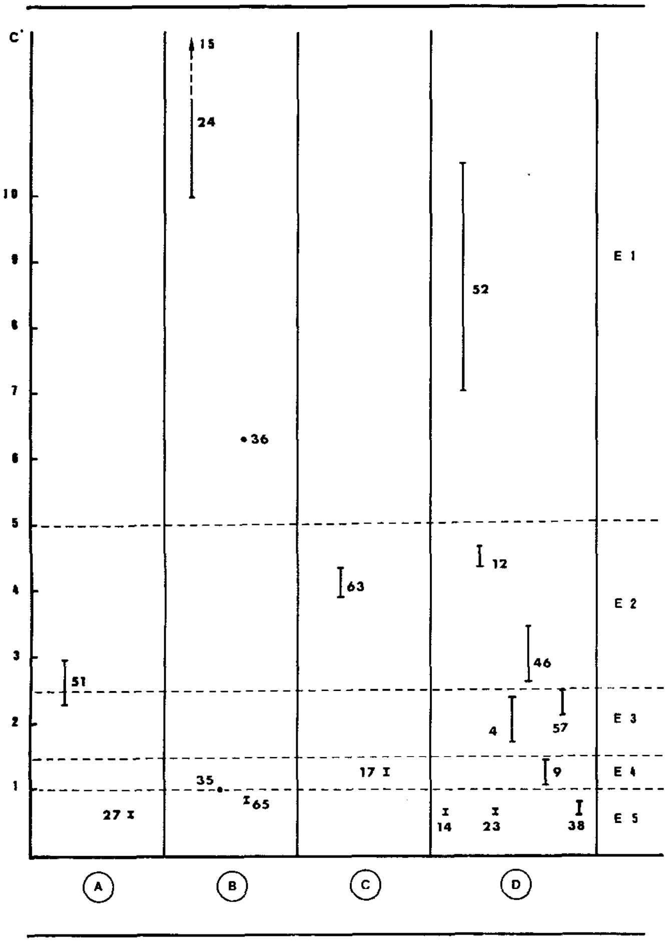
Table III shows clearly that the regression of the anterior genital branch and the shortening of the tail are two characters that have evolved independantly. A supplementary proof of this independancy can be given if we considered the fact that the long-tailed species are very frequent in the tropical or subtropical areas whereas they are exceptional in temperate regions ; this could suggest that, tropical areas being the place of diversification, the rare species adapted to colder climates would be the most evolved ones. But in regard to the regression of the anterior genital branch, all the species showing such a phenomenon are present only in tropical or subtropical areas.

---

[1] Italic number following the name of species is the ordre number of the list of species (p. 308) ; under these number are quoted the species in Table 3.

TABLE III

Regression of the anterior genital branch and coefficient c′ (explanation in text)



Thus, C. & S. are led to use independantly these two characters : they separate two subgenera only on the basis of the structure of the anterior genital branch (*Radiphinema* with no anterior branch and *Krugiphinema* with a reduced one) without regarding the tail shape and length and on an other hand the five other subgenera are divided essentially by use of the tail shape and length.

C. & S. give a slightly greater importance to the structure of the female genital tract on the general morphology, whereas the opinion of DALMASSO (1969) is the reverse. Consequently groups have a different composition depending upon the line that was chosen.

In cases where the characteristics of the female genital tract are of minor importance, the two opinions are converging. Thus, the "group 2" of DALMASSO (1969), or "*X. americanum* group" of various authors, corresponds to the subgenus *Xiphinema* of C. & S., or "group 5" of Southey (1973a) : type species : *X. americanum* ; other species : *X. brevicolle*, *X. mediterraneum*, *X. opistohysterum*, *X. rivesi*.

The agreement seems rather good between the "group 3" of Dalmasso and the subgenus *Elongiphinema* of C. & S., or "group 3" of Southey : types species : *X. elongatum* ; other species : *X. attorodorum*, *X. insigne*, *X. italiae*, *X. orbum*.

Nevertheless, the place of *X. orbum* is debatable because of its spiral habitus, not observed in other species and the previously mentioned reduction of the anterior genital branch.

The position of *X. coxi* in the subgenus *Basiphinema* appears doubtful if we consider the European populations of this species, which are nearer to *X. diversicaudatum*; this species is placed in an other subgenus by C. & S.

So, in the theses of C. & S. groups were formed having phylogenic relationships and not artificially formed in order to make the specific determination easier ; but this fact implies a hierarchization of the different characters used and, to be correct, this hierarchization must avoid separating species which show evident affinities by other characters.

Now the subdivisions established by C. & S., as they impose as the main character the structure of the female genital tractus, put into three different subgenera such species as *X. hygrophilum* (under the name of *X. ensiculiferum*), *X. krugi* and *X. ensiculiferum* (under the name of *X. ensiculiferoides*) which constitute one of the most remarkable evolutionnary lines within the genus *Xiphinema* (SOUTHEY, 1973b) to which we can add the recently described species *X. loosi*, *X. surinamense* and *X. costaricense*.

The same can be said regarding *X. chambersi* (and now *X. simillimum* too) and *X. zulu* which were placed in two different subgenera because the former species lacks an anterior branch of the female genital tract. In fact *X. zulu* is different too by its spiral habitus *versus* the straight one or slightly posteriorly curved of the species having only one complete female genital branch.

Another homogenous series was separated into two parts by C. & S., i.e. the "group 1" of Dalmasso that contains namely *X. diversicaudatum*, *X. index*, *X. pyrenaicum* and *X. turcicum*.

From all the arguments developed it does not seem possible to the present authors to accept taxonomical entities so open to criticism in their definition as the subgenera of *Xiphinema* proposed by C. & S. In general it appears premature to us to make groupings with a phylogenic value within the genus *Xiphinema*. Such subdivisions, if created in order to make the specific identification easier, could be retained for this purpose, as "groups", this term suggesting no special phylogenic affinity between the species of the same "group". SOUTHEY (1973a) did so and to this concept had inclined one of the authors (LUC, 1973).

But in fact these "groups", as well as the "keys", can be replaced by a "lattice", or polytomous key, herein.

2. THE SPECIES OF THE GENUS *XIPHINEMA*

Before the introduction of the "lattice", the valid species of the genus *Xiphinema* and the *species inquirendae* must be listed. As a basis, we selected the list of C. & S., not as complete as that of Southey (1973a) but containing the main junior synonyms and the *species inquirendae.*

A) Valid species (only synonyms since the list of Baker (1962) are given) :

1 — *X. americanum* Cobb, 1913 : type species
2 — *X. arcum* Khan, 1964
3 — *X. attorodorum* Luc, 1961
4 — *X. australiae* McLeod & Khair, 1971
5 — *X. bakeri* Williams, 1961
6 — *X. basilgoodeyi* Coomans, 1964
7 — *X. basiri* Siddiqi, 1959
8 — *X. bergeri* Luc, 1973
9 — *X. brasiliense* Lordello, 1951
= *X. itanhaense* Carvalho, 1962
10 — *X. brevicolle* Lordello & da Costa, 1961
11 — *X. cavenessi* Luc, 1973
12 — *X. chambersi* Thorne, 1939
13 — *X. clavatum* Heyns, 1965
14 — *X. costaricense* Lamberti & Tarjan, 1974
15 — *X. coxi* Tarjan, 1964
16 — *X. cubense* Razjivin *in* Razjivin, O'Relly & Millan, 1973
17 — *X. denoudeni* Loof & Maas, 1972
18 — *X. dimorphicaudatum* Heyns, 1966
19 — *X. diversicaudatum* (Micoletzki, 1922 & 1927) Thorne, 1939
= *X. paraelongatum* Altherr, 1958
20 — *X. douceti*, Luc, 1973
21 — *X. ebriense* Luc, 1958
22 — *X. elongatum* Schuurmann-Stekhoven & Teunissen, 1938
= *X. pratense* Loos, 1949
= *X. campinense* Lordello, 1951
23 — *X. ensiculiferum* (Cobb, 1893) Thorne, 1937
= *X. ensiculiferoides* Cohn & Sher, 1972
24 — *X. filicaudatum* Loof & Maas, 1972
25 — *X. flagellicaudatum* Luc, 1961
26 — *X. hallei* Luc, 1958
27 — *X. hygrophilum* Southey & Luc, 1973
28 — *X. ifacolum* Luc, 1961
29 — *X. imambaksi* Loof & Maas, 1972
30 — *X. imitator* Heyns, 1965
31 — *X. index* Thorne & Allen, 1950
32 — *X. ingens* Luc & Dalmasso, 1963
33 — *X. insigne* Loos, 1949
= *X. indicum* Siddiqi, 1959
34 — *X. italiae* Meyl, 1953
= *X. arenarium* Luc & Dalmasso, 1963
= *X. bulgariense* Stoyanov, 1964
= *X. conurum* Siddiqi, 1964
35 — *X. krugi* Lordello, 1955
36 — *X. longicaudatum* Luc, 1961
37 — *X. longidoroides* Luc, 1961
38 — *X. loosi* Southey & Luc, 1973
39 — *X. macrostylum* Esser, 1966
40 — *X. malagasi* Luc, 1973
41 — *X. mammillatum* Schuurmans-Stekhoven & Teunissen, 1938
42 — *X. manubriatum* Luc, 1975
43 — *X. marsupilami* Luc, 1973
44 — *X. mediterraneum* Martelli & Lamberti, 1967
45 — *X. meridianum* Heyns, 1971
46 — *X. monohysterum* Brown, 1968
47 — *X. neoamericanum* Saxena, Chhabra & Joshi, 1973
48 — *X. neovuittenezi* Dalmasso, 1969
49 — *X. nigeriense* Luc, 1961
50 — *X. opistohysterum* Siddiqi, 1961
51 — *X. orbum* Siddiqi, 1964
52 — *X. orthothenum* Cohn & Sher, 1972
53 — *X. parvistilus* Heyns, 1971
54 — *X. paulistanum* Carvalho, 1965
55 — *X. pini* Heyns, 1965
56 — *X. pyrenaicum* Dalmasso, 1969
57 — *X. radicicola* Goodey, 1936
58 — *X. rivesi* Dalmasso, 1969
59 — *X. rotundatum* Schuurmans-Stekhoven & Teunissen, 1938
60 — *X. sahelense* Dalmasso, 1969
= *X. amarantum* Macara, 1970
61 — *X. seredouense* Luc, 1975
62 — *X. setariae* Luc, 1958
63 — *X. simillimum* Loof & Yassin, 1971
64 — *X. spinuterus* Luc, 1973
65 — *X. surinamense* Loof & Maas, 1972
66 — *X. tarjani* Luc, 1975
67 — *X. tropicale* Zullini, 1973
68 — *X. turcicum* Luc & Dalmasso, 1963
69 — *X. vanderlindei* Heyns, 1962
70 — *X. variabile* Heyns, 1966
71 — *X. vuittenezi* Luc, Lima, Weischer & Flegg, 1964
72 — *X. vulgare* Tarjan, 1964
73 — *X. yapoense*, Luc, 1958
74 — *X. zulu* Heyns, 1965

B) Species inquirendae :

X. brevicaudatum Schuurmans-Stekhoven, 1951
X. cylindricaudatum Schuurmans-Stekhoven & Teunissen, 1938
X. digiticaudatum Schuurmans-Stekhoven, 1951
X. dolichodorum (De Man, 1907 *nom. nov.*) Thorne & Swanger, 1936
X. effilatum Schuurmans-Stekhoven, 1951
X. grande Steiner, 1914
X. lineum (Grube, 1849) Thorne, 1939
X. obtusum Thorne, 1939
X. pachtaicum (Tulganov, 1939) Kirjanova, 1951
= *Longidorus pachtaicus* Tulganov, 1938
X. parasetariae Luc, 1958
X. truncatum Thorne, 1939, new designation

C) Species incertae sedis :

X. sandellum Heyns, 1966, new designation

D) Notes on the changes :

1) Twenty-two valid species are added to the list of C. & S. that were overlooked or described since its publication : *X. bergeri*, *X. cavenessi*, *X. costaricense*, *X. cubense*, *X. denoudeni*, *X. douceti*, *X. filicaudatum*, *X. hygrophilum*, *X. imambaksi*, *X. loosi*, *X. manubriatum*, *X. marsupilami*, *X. meridianum*, *X. neoame-*

***ricanum*, *X. parvistilus*, *X. seredouense*, *X. spinuterus*, *X. surinamense*, *X. tarjani*, *X. tropicale* and *X. variabile*.**

The status of several other taxa are changed ; reasons for which are given below.

2) *X. ensiculiferoides*, described in the article of C. & S., was placed as a junior synonym of *X. ensiculiferum* by SOUTHEY and LUC (1973).

3) *X. amarantum* Macara, 1970 is listed as a valid species by SOUTHEY (1973a), but the author himself stated, in an infra-paginal note of a subsequent publication (MACARA, 1972), that it must be considered as a junior synonym of *X. sahelense* Dalmasso, 1969.

4) *X. ifacolum.* C. & S. considered *X. basiri* Siddiqi, 1959 and *X. ifacolum* Luc, 1961 as identical and the later a junior synonym of the former on the basis of several characters (shape of the head and of the tail, length of the body and of the spear, values of coefficients L, a, b, c, V). They also added that since the two species were described under *Citrus* spp. they are conspecific but this seems a rather poor argument because not less than thirteen species of *Xiphinema* were described or recorded on various species of *Citrus*.

In fact, some of their arguments appear valid ; however at least two details of structure permit easy differentiation of these two species :

— The structure of the female genital tract : in females of *X. basiri*, as stated and drawn by LOOF and YASSIN (1972) and as we have observed on paratypes specimens (Fig. 2E), the "Z organ" is in fact a weakly developed "Z pseudo-organ" : the cells of the uterus wall do not show any differentiation at this level ; however the lumen of the uterus is enlarged and contains some (three or four) opaque globules. This Z differentiation is the poorest we observed and in some cases it could be so weak that we are not surprised that TARJAN (1973) considers it as non-existent.

— To the contrary, in females of *X. ifacolum* a highly differentiated true "Z organ" exists (fig. 2A) ; it is barrel-shaped with a wall made by circular muscles, with a wide lumen bordered by a sclerotized membrane and containing four irregular "teeth" attached to the inner wall. It is one of the best differentiated "Z organ" we observed. In addition other differences exist in structure of other parts of the genital tractus.

— The tail shape is rather different in the two species. In *X. ifacolum* (Fig. 5G) it is short regular conical, slightly curved ventrally. In *X. basiri* (Fig. 5J) it is short conical but digitated ; the two species are on this point differently coded on the lattice. Moreover the inner structure of the tail-tip is very different. In *X. ifacolum* this structure is so peculiar that it constitutes the best character to recognize the species quickly : the inner surface of the cuticle of the tail tip forms a thin and regular "blind canal", surrounded apically by a thin muff. This structure of the tail-tip is constant in the species based upon examination if several populations. In *X. basiri* the structure of the tail-tip is the most common one : a large, conical "blind canal" without any muff apically ; this point was well illustrated by LOOF and YASSIN (1972).

So, on the basis of the structure of genital apparatus and of the inner structure of the tail, we consider *X. basiri* and *X. ifacolum* as distinct and valid species.

5) *Xiphinema krugi*, *X. denoudeni* and *X. loosi.* C. & S. considered *X. ensiculiferum* apud Loos (1949) and apud J. R. WILLIAMS (1959) as pertaining to the species *X. krugi*. SOUTHEY and LUC (1973), after examination of LOOS's types, described them as a new species, *X. loosi*, and tentatively referred WILLIAMS's specimens to the same species. More recently LAMBERTI and TARJAN (1974) synonymized *X. loosi* and *X. denoudeni* with *X. krugi*.

Actually, the identity and the relationships of these three species are difficult to establish, mainly due to the fact that the syntypes of *X. krugi* are not available and that the types of *X. loosi* are few in number ; however one of the authors (M. L.) is presently working on several populations pertaining to these species and hopes to clarify this question in a near future.

At the moment, on the basis of data from published literature, it seems more convenient to consider *X. krugi*, *X. denoudeni* and *X. loosi* as different and valid species.

6) *X. macrostylum* was recently reinstated as a valid species by SOUTHEY and LUC (1973).

7) *X. setariae* and *X. vulgare.* C. & S. consider *X. vulgare* as a junior synonym of *X. setariae* on the basis of similar general morphology and structure and of the similarity of different measurable characters and coefficients (body and spear length, coefficients a, b, c, c′ and V). TARJAN (1974) rejects this synonymy and emphasizes the differences existing in the tail shape and structure not noted by C. & S.

Reexamination of types of the two species convinced us that the arguments given by TARJAN (1974) are sufficient to separate the two species.

The two species can be easily differentiated on the basis of the length and structure of the tail. In *X. setariae* (Fig. 5H) the tail length is 55-65 μm, but only 46-53 μm in *X. vulgare* (Fig. 5E) ; moreover the hyaline part at the extremity of the tail is longer in *X. setariae* (23-29 μm) than in *X. vulgare* (13-20 μm). It is the best character to separate the two species.

However these two species are very close and it is possible that in the future intermediate populations will be found, and at that time their taxonomic positions should be revised. But, for the moment, it seems preferable to consider the two species *X. setariae* and *X. vulgare* as valid and distinct.

8) *Xiphinema truncatum* Thorne, 1939. C. & S. considered this species as a junior synonym of *X. elongatum*. It seems difficult to accept this opinion for the following reasons :

— C. & S. observed only the male holotype of *X. truncatum*, the four syntype females being apparently lost. In fact, it is quite impossible to characterize a *Xiphinema* species on males only : the characters used for that purpose are those of the female (Luc & Tarjan, 1963). In addition the tail-shape, one of the best characters, can be rather different in males and females of the same species. Moreover, the tail-tip of the holotype male is broken.

— The photograph given by C. & S. of the anterior part of the holotype male (Fig. 10 : phot. A) although not clear, shows a weak depression separating the lip region, similar to the depression observed in females of true *X. elongatum* (Fig. 10 : phot. B and C). It does not agree with Thorne's drawing that showed, as stated in text a "uniform tapering of the neck to the continuous truncate head". C. & S. explain this difference by stating that "the uniform tapering of the neck, described and illustrated by Thorne, was probably an artefact on a specimen under pressure". It seems surprising that Thorne did not recognize such a flattening of the females, so great as to cause the complete disappearence of a labial constriction. Therefore, it is not certain that the male holotype of *X. truncatum* is conspecific with the syntype females.

— The V value given by Thorne (1939) does not fit with that one of *X. elongatum* : for *X. truncatum* this value is 33, for *X. elongatum* the mean value is 37-40. C. & S. explain this difference by the fact that "the specimen measured with a vulva position of 33% was exceptional or, more likely, the result of an error in measurement or print". This hypothesis appears much too speculative.

Syntype females of *X. truncatum* being lost, male holotype differing on an important point from the diagnosis of the species, and the description, measurements and drawings given by Thorne bein insufficient to characterize the species, we propose that *X. truncatum* Thorne, 1939 be considered a *species inquirenda.*

9) *X. yapoense* Luc, 1958 is considered by C. & S. as a *species inquirenda* for the main reasons that the species was described from only one female and never found again ; the type was not obtained for consultation and many species with hemispherical tails have been subsequently described making the differentiation of *X. yapoense* from these species rather difficult.

X. yapoense is one of the species from a peculiar biotope, a virgin or very old established rain forest of the Ivory Coast. Two other species *(X. hallei* and *X. longidoroides)* are in the same situation : they were never found in any other place. Moreover, *X. yapoense* is very rare ; despite sieving many kilograms of soil from the above locality, only two other females could be obtained. A redescription of this species is in preparation by one of the authors (M. L.).

Without waiting for the publication of its redescription we can state that the species is indeed a valid one. In fact, it is clearly differentiated in the lattice below from the seven other species with rounded tail and two complete female genital branches. The closest species appears to be *X. clavatum* from which *X. yapoense* differs by the smaller V value (39-43 against 49-54) and the shape of the tail. (Compare Fig. 6J and 6L.)

10) *Xiphinema sandellum* Heyns, 1966 and *X. longidoroides* Luc, 1961. Although listed by C. & S. as valid species, these two species are not included in their classification in subgenera because they "have characters intermediate to *Xiphinema* and *Longidorus*". Below the position of each of these species is examined.

X. sandellum was described from three males and three females ; the genital tractus of the females was said to be "poorly preserved" and so "details of the structure of the gonads cannot be discerned". Thus, an important anatomical structure could not be observed with sufficient accuracy.

In fact it was difficult to attribute this species to *Xiphinema* or to *Longidorus* on the basis of original description and drawings. Due to the kindness of Dr. J. Heyns, one of us (M. L.) was able to examine paratypes of this species, and the detailed study of it confirms the peculiar intermediate characters of this species :

— The aperture of the amphids is not slit like character of *Longidorus*).

— The basal flanges of the spear are very weakly developed and the junction between odontostyle and odontophore is of the *Longidorus* type (Dalmasso, 1969).

— The guiding apparatus is apparently tubular, as in *Xiphinema*, but its position, rather anterior for this genus, is more similar to that observed in some species of *Longidorus*, such as *L. siddiqi* Aboul-Eid, 1970, for example :

— The expanded lips are more common in *Longidorus* than in *Xiphinema.*

— The shape of the tail more closely ressembles *Longidorus* than *Xiphinema.*

— The high value of both coefficients a and V (respectively 73-83 and 53-54), although individually not infrequent in *Xiphinema*, are, when associated, more reminiscent of *Longidorus.*

So *X. sandellum* appears closer to *Longidorus* than to *Xiphinema* and this opinion is supported by the fact that in the diagnosis, the author does not differentiate it from other species of *Xiphinema* but from *Longidorus brevicaudatus* (renamed now *L. siddiqii*) and from *Paralongidorus xiphinemoides* Heyns, 1965. Cytological studies would be very useful in clarifying the position of the species (see Dalmasso, 1970).

This species may represent a new genus intermediate between Xiphineminae and Longidorinae, but it seems more prudent, before a redescription based on numerous and well preserved specimens, to consider *X. sandellum* as *species incertae sedis.* Note that Loof and Maas (1972) consider *X. sandellum* as *species inquirenda* but we consider it too well established for this position.

X. longidoroides. Close reexamination of types of this species confirms that without doubt it belongs to the genus *Xiphinema.* The single character which makes *X. longidoroides* peculiar is the rather weak development of the spear's flanges ; but these flanges do exist. All the other characters used to separate *Xiphinema* and *Longidorus*, namely the type of amphidial aperture, the type and position of the spear's guiding apparatus, are those of *Xiphinema.*

Perhaps this species represents a weakly differentiated link between *Xiphinema* and the group *X. sandellum* → *Paralongidorus xiphinemoides* → *Paralongidorus* → *Longidorus* but at the present time we must consider it as a true *Xiphinema.*

3. THE LATTICE

The following lattice has been developed from one given by STEGARESCU (1966), in accordance to the principle of polytomous determination. It has some advantages over keys because it presents all of the characters of each species without any hierarchization. Thus it permits an easier diagnosis as there is no need to examine the different characters in a preestablished order, inevitably arbitrary and too restrictive. This "lattice" facilitates species determination even if the material to be examined is not perfect ; this is not always possible with keys. It also facilitates the establishment of the diagnosis of new species because it is easy to note for each character concerned which species are closest to the new one.

In order to afford the most simple and useful possible instrument of determination, only twelve characters were chosen, of which the last three can be considered as accessory ones. Each character was divided into five categories at most (with the exception of character D concerning the shape of the tail where seven categories were created) in order to avoid too many frequent and important overlappings. But such restricted subdivisions have a disadvantage in that a few different species may have the same numerical values. In such infrequent cases notes are given below the lattice where complementary differential characters are indicated [1].

This lattice should be considered as a working instrument, certainly improvable, and comments and suggestions of nematologists having used it would be greatly appreciated.

A) CODE OF THE LATTICE
(without any other indication,
characters refer to the females)

A — Type of female genital tractus :

— No anterior branch or anterior branch reduced to unorganized structure shorter than 2 vulval diameter (Fig. 1-E, F, G, H, I) 1
— No anterior ovary but rest of anterior branch showing differentiation (uterus, sphincter and, in some cases, oviduct) and more than 2.5 vulval diameter long. (Fig. 1-B, D) 2
— Anterior ovary present but reduced and not functional ; rest of anterior branch normal or reduced but differentiated (Fig. 1-A).................. 3
— Two branches having approximatively the same development 4
— Posterior branch reduced 5

B — Type of uterine differentiation, if present :

— Z organ present (Fig. 2-A, B) 1
— Z pseudo-organ present (Fig. 2-C, D, E, F, G & Fig. 3-A, B) 2
— Differentiation other than a Z organ or a Z pseudo-organ (« spines») (Fig. 3-B, C).................. 3
— No differentiation in the uterus 4

C — Position of vulva (coefficient V) :

— $V < 30$ 1
— $30 < V \leqslant 40$ 2
— $40 < V \leqslant 50$ 3
— $V > 50$ 4

D — Shape of the tail :

— Tail long attenuated and pointed ($c' > 7,5$) (Fig. 4-A) 1
— Tail long conical ($2.5 < c' \leqslant 7.5$) (Fig. 4-B, C, D, E, F) 2
— Tail regularly short conical ($c' \leqslant 2.5$) (Fig. 5-A, B, C, D) 3
— Tail short conical-digitate ($c' \leqslant 2.5$) (Fig. 5 I, J) .. 4
— Tail conical-rounded to hemispherical with a terminal peg, mucro or bulging[1] (Fig. 6-A, B, C, D).. 5
— Tail more or less regularly hemispherical[2] (Fig. 6-F, G, J, K).................................. 6
— Tail rounded spatulate (Fig. 6-L) 7

---

[1] These species are noted * in the lattice.

[1] Some species having normally a tail of the hemispherical type with a mucro, peg or bulge can have occasionally a « pegless» tail. Concerning these species, the normal figure 5 is followed by (6).

[2] For each species having a hemispherical tail, whenever possible, the presence (a) or the absence (b) of a « blind terminal canal» in the cuticle of the tail-tip is noted.

E — Ratio tail-length divided by anal diameter (coefficient c′) :

— $c' > 5$	1
— $2.5 < c' \leqslant 5$	2
— $1.5 < c' \leqslant 2.5$	3
— $1 < c' \leqslant 1.5$	4
— $c' \leqslant 1$	5

F — Body length :

— $L \leqslant 1.5$ mm	1
— $1.5 < L \leqslant 2.5$	2
— $2.5 < L \leqslant 3.5$ mm	3
— $3.5 < L \leqslant 4.5$ mm	4
— $L > 4.5$ mm	5

G — Spear length :

— Spear $\leqslant 150\ \mu m$	1
— 150 m < spear $\leqslant 200\ \mu m$	2
— $200\ \mu m$ < spear $\leqslant 250\ \mu m$	3
— Spear > 250 m	4

H — Outline of the fore-part of body :

— Without any constriction ; outline progressively attenuated (Fig. 7-A)	1
— Without any constriction but outline not progressively attenuated (Fig. 7-C)	2
— With weak constriction and outline not progressively attenuated (Fig. 7-D)	3
— With conspicuous constriction (Fig. 7-E)	4

I — Habitus :

— *Body straight or nearly so* (Fig. 8-A)	1
— Body weakly curved (Fig. 8-C, D)	2
— Body hook-shaped or in C or J-shape (Fig. 8-E)	3
— Body spiral-shaped (Fig. 8-F, G)	4

J — Tail-shape of the fourth larval stage :

— Same divisions as for adult : see D.

K — Tail-shape of the first larval stage :

— Same divisions as for adult : see D.

L — Presence or absence of males :

— Males unknown or exceptional	1
— Males rather frequent	2

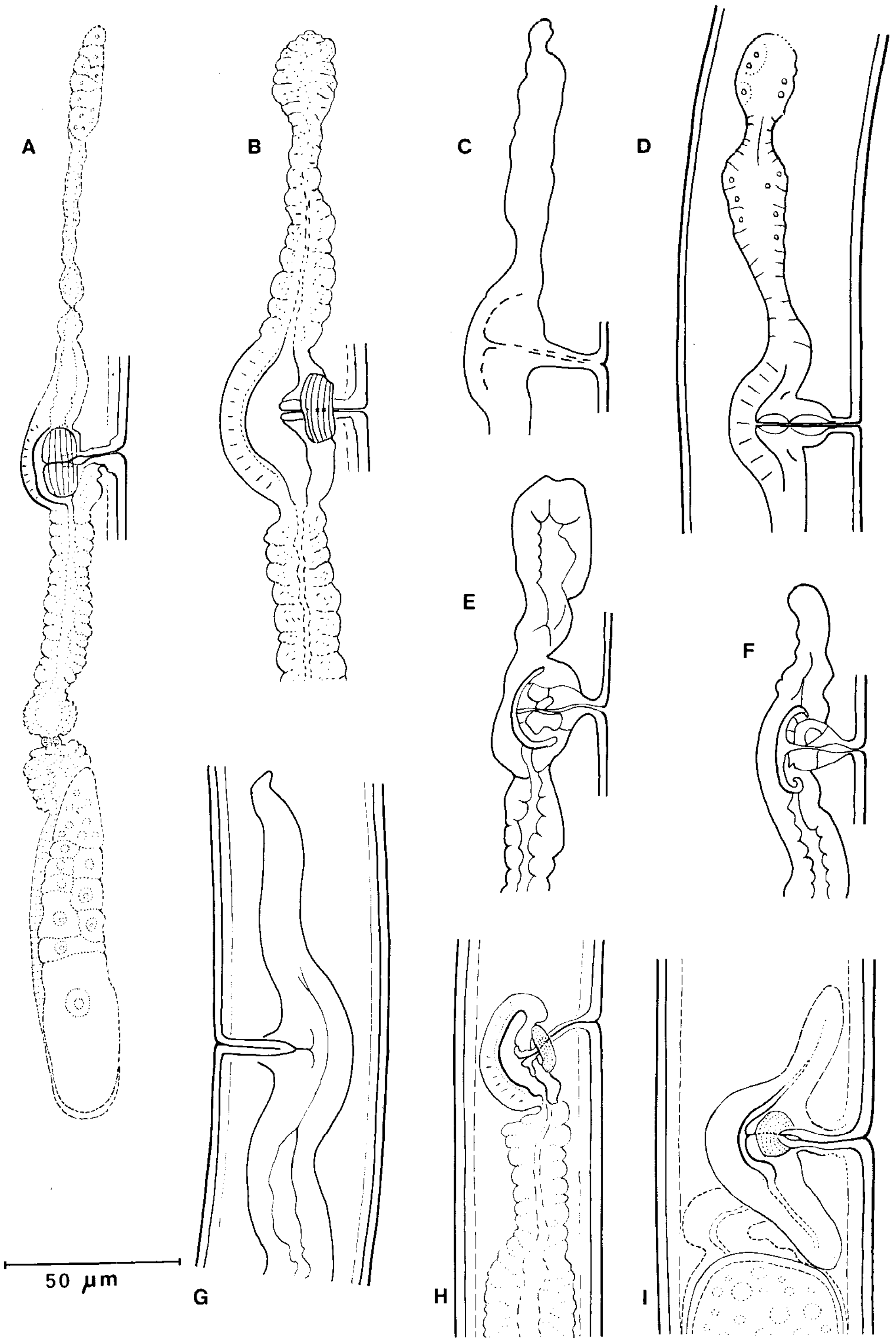


Fig. 1. — Anterior genital branch of the female (code A)

A : *X. hygrophilum* (code A3 ; paratype ; from Southey & Luc, 1973). B : *X. longicaudatum* (code A2 ; pop. *Coffea* sp., Ivory Coast ; orig.). C : *X. krugi* (?) (pop. Florida ; from Tarjan, 1974). D : *X. krugi* (code A2 ; pop. type ; from Lordello, 1955). E, F : *X. costaricense* (code A1 ; pop. type ; from Lamberti & Tarjan, 1974). G : *X. denoudeni* (code A1 ; pop. type ; from Loof & Maas, 1972). H : *X. radicicola* (code A1 ; pop. forest, Ivory Coast ; orig.). I : *X. loosi* (code A1 ; paratype ; from Southey & Luc, 1973)

B) « LATTICE » FOR THE IDENTIFICATION OF *XIPHINEMA* SPECIES

(explanations in the text)

	A	B	C	D	E	F	G	H	I	J	K	L
orthotenum	1	4	1	1	1	2	2 3	1	1			1
chambersi	1	4	1	2	2	2 3	2	2	2 3			1
monohysterum	1	4	1 2	2	2	2 3	2	4	2			1
radicicola *	1	4	1 2	4	3	2 3	2 3	2	3			1
australia *	1	4	1 2	4	3	3	2 3	3	2 3	4	2	1
brasiliense	1	4	1 2	5	4	2	3	3	3	4		1
loosi	1	4	1 2	5 6 a	5	2	2	3	2			1
ensiculiferum *	1	4	1 2	6 b	5	2	3 4	2	2			1
denoudeni	1	4	2	5 6	4	2	2 3	4	3			1
costaricense *	1	4	2	6 b	5	2	3	2	2	6	2	1
simillimum	1-2[1]	4	1 2	2	2	2	2	2 3	3			1
longicaudatum	2	4	2	1 2	1	3	3	1	3			1
krugi	2	4	2	3	5	2	2 3	1 2	2	3 4		1
filicaudatum	2	4	2 3	1	1	4	4	1	1 2	1	1	1-2[4]
surinamense	2	4	2 3	6 b	5	2 3 4	3 4	1	2	6		2
orbum	3	4	1 2	2 3	2 3	3	1	2 3	4	2 3	3	1
hygrophilum	3	4	2 3	6 b	5	1 2	3 4	1	2	6	1 2	1
tropicale	4	1	2	6	5	2 3	2	2				1
imambaksi	4	1	2 3	5	3 4	3	2 3	2	3			1
ebriense	4	1	3	4	4	2	2	1	3			2
hallei	4	1	3 4	2	1	3 4	2 3	3	3			2
ifacolum	4	1	3 4	3	3	3 4	2	2 3	3 4			1
rotundatum	4	1	3 4	3 6	4 5	2 3	2 3	1	3			1
manubriatum	4	1	4	5	3 4	1 2	2 3	2	2			1
imitator	4	2	3 4	5 6 a	4 5	2 3	1 2	2	3	3 4		1
pini	4	2	3 4	5 6 a	5	3 4	2	2	4	3 4	3	2
zulu	4	2[3]	3	2	2	3	2	1	4	2	2	2
malagasi	4	2 + 3	3 4	2	2	3	2	3 4	3			1
diversicaudatum	4	2	2 3	5 (6)	4	4 5	3	1 2	3	5	3	1
marsupilami	4	2	3	1	1	4	4	2 3	1 2			2
coxi	4	2	3	4	3 4	3 4	2 3	2 3	3	4	3	1
meridianum	4	2	3 4	2 4	3 4	3 4	2	4	3	3		1
parvistilus	4	2	3 4	4	3 4	2 3	1	3 4	3	4		1
basiri	4	2	3 4	4	3 4	3	2	2 3	3 4	3		1
ingens	4	2	3 4	5 6 a	5	5	3 4	2	3			2

	A	B	C	D	E	F	G	H	I	J	K	L
turcicum	4	2	3 4	6 b	5	4 5	3 4	1 2	3	6	2	1
variabile	4	2	4	2 3	2 3	2 3	1	4	3 4	3		2
spinuterus	4	3	3	1	1	3	3	2 3	1 2			2
bergeri *	4	4	1 2	2	1 2	2 3	1 2	2	2			1
bakeri	4	4	1 2	4	3 4	4	3	4	3			1
insigne *	4	4	2	2	2	2	1 2	3 4	2	2	2	1
arcum	(?) 3 - 4^{2}	4	2	6 b(?)	4 5	2 3	2	2	2			1
attorodorum *	4	4	2 3	2	2	2 3	2	3	2			1
elongatum	4	4	2 3	3	3	2	1 2	3	3			1
vulgare *	4	4	2 3	3 4	3	2 3	2	3 4	3	3	3	1
setariae *	4	4	2 3	3 4	3	2 3	2 3	3 4	3			1
mammillatum	4	4	2 3	5	5	2 3	2 3	1 2	3			1
index *	4	4	2 3	5 (6)	4 5	3	2 3	1 2	3	5	3	1
macrostylum	4	4	2 3	6 b	5	2	4	1 2	2			1
flagellicaudatum	4	4	3	1	1	3	2 3	3	1 3	1	1	1
sahelense	4	4	3	4	3 4	4 5	2 3	2 3	2	3	3	2
paulistanum	4	4	3	4	4	2	2	1				2
neovuittenezi	4	4	3	5 (6)	4 5	3	2 3	2 3	2 3	3 4	2	2
yapoense	4	4	3	6 (b)	5	3	3	2 3	2 3			1
cavenessi	4	4	3 4	1 2	1	2 3	1 2	1	1 2			1
dimorphicaudatum	4	4	3 4	1 2	1 2	4 5	1 2	3	3	2	2	2
douceti *	4	4	3 4	2	1	2 3	2	1 2	3			1
vanderlindei	4	4	3 4	2	1	3 4	1	4	1 2			2
nigeriense *	4	4	3 4	2	1 2	2	2	1 2	2 3			1
italiae	4	4	3 4	2 3	2 3	2 3 4	1 2	4	2	2	2	1
neoamericanum	4	4	3 4	3	4 5	2	1	1	3 4			1
americanum	4	4	3 4	3	3 4	2	1 2	3 4	4	3	3	1
seredouense	4	4	3 4	5	3 4	3 4	3	1	4			1
tarjani	4	4	3 4	5	4	2	2	2	2 3	4		1
basilgoodeyi	4	4	3 4	5	4 5	3	1 2	2	3	5	2	1
vuittenezi	4	4	3 4	5 (6)	4 5	3 4	3 4	2 3	3	5	2	1
pyrenaicum	4	4	3 4	5 6	5	3 4 5	3	1 2	3	5 6	2	1
clavatum	4	4	3 4	7b	4 5	3	2 3	2	2 3	5 7		2
opistohysterum *	4	4	4	3	3	2	1	4	4			1
longidoroides	4	4	4	3	3	3 4	2 3	1	3			1
mediterraneum *	4	4	4	3	3 4	2	1 2	4	4	3	3	1
rivesi	4	4	4	3	4	2	1 2	2	4	3	3	1
brevicolle	4	4	4	3	5	2	2	2 3	3 4	3	3	1
cubense	5	4^{5}	3	6	4	3 4	2 3	1				1

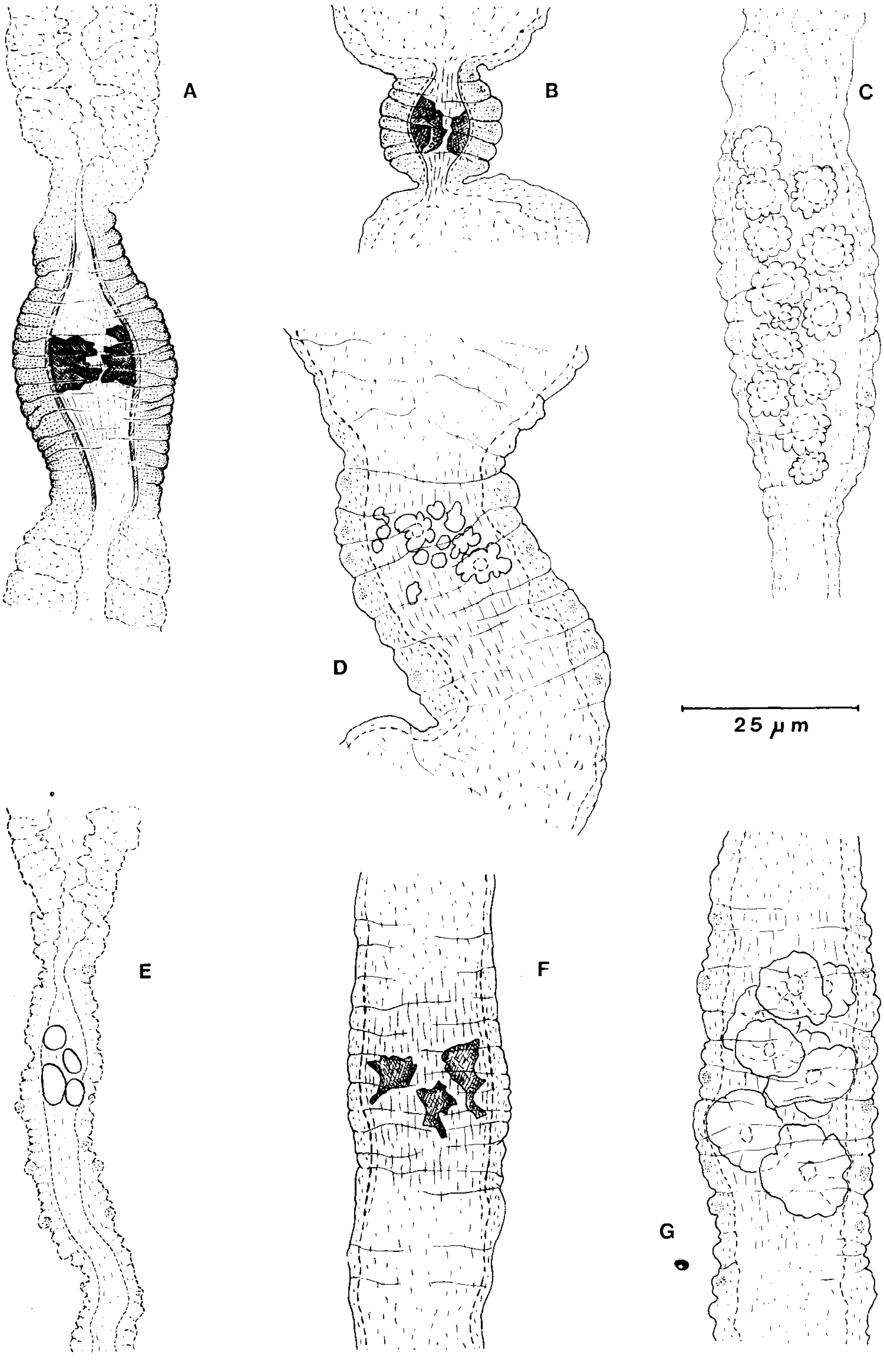


Fig. 2. — Z differentiation (code B)

A : *X. ifacolum* (true Z organ ; code B1 ; pop. Ivory Coast ; orig.). B : *X. ebriense* (true Z organ ; code B1 ; topotype ; orig.). C : *X. diversicaudatum* (Z pseudo-organ ; code B2 ; pop. France ; orig.). D : *X. turcicum* (Z pseudo-organ ; code B2 ; pop. Algeria ; orig.). E : *X. basiri* (Z pseudo-organ ; code B2 ; paratype ; orig.). F : *X. pini* (Z pseudo-organ ; code B2 ; paratype ; orig.). G : *X. ingens* (Z pseudo-organ ; code B2 ; paratype ; orig.)

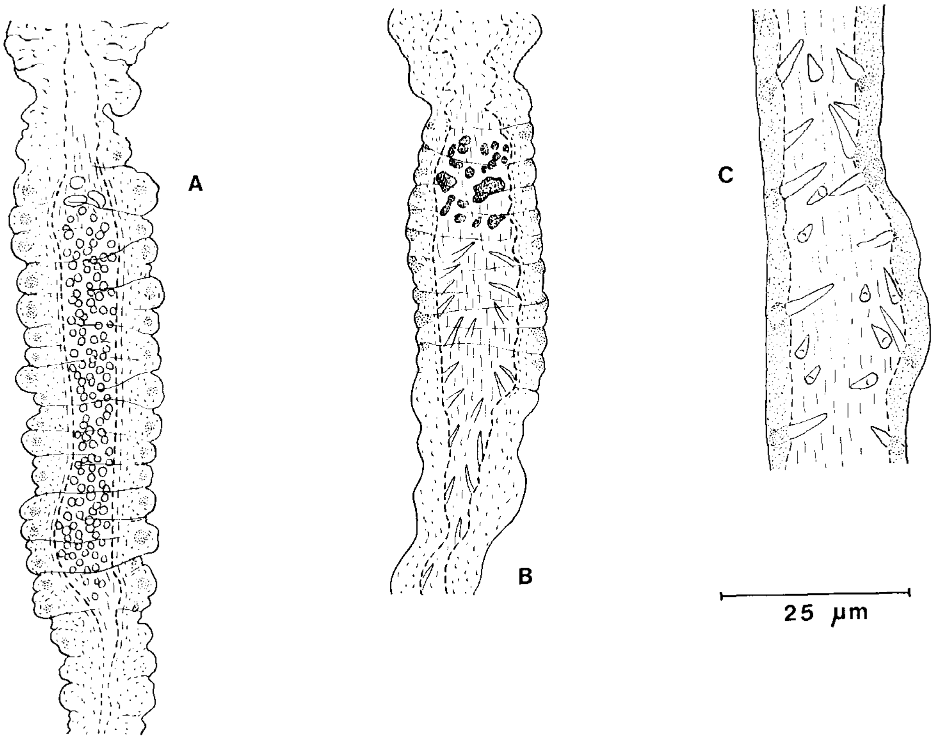


Fig. 3. — Z differentiation (code B)

A : *X. marsupilami* (Z pseudo-organ ; code B2 ; paratype ; from Luc, 1973). B : *X. malagasi* (Z pseudo-organ and« spines» ; code B2+3 ; paratype ; from Luc, 1973). C : *X. spinuterus* (« spines» ; code B3 ; paratype ; from Luc, 1973)

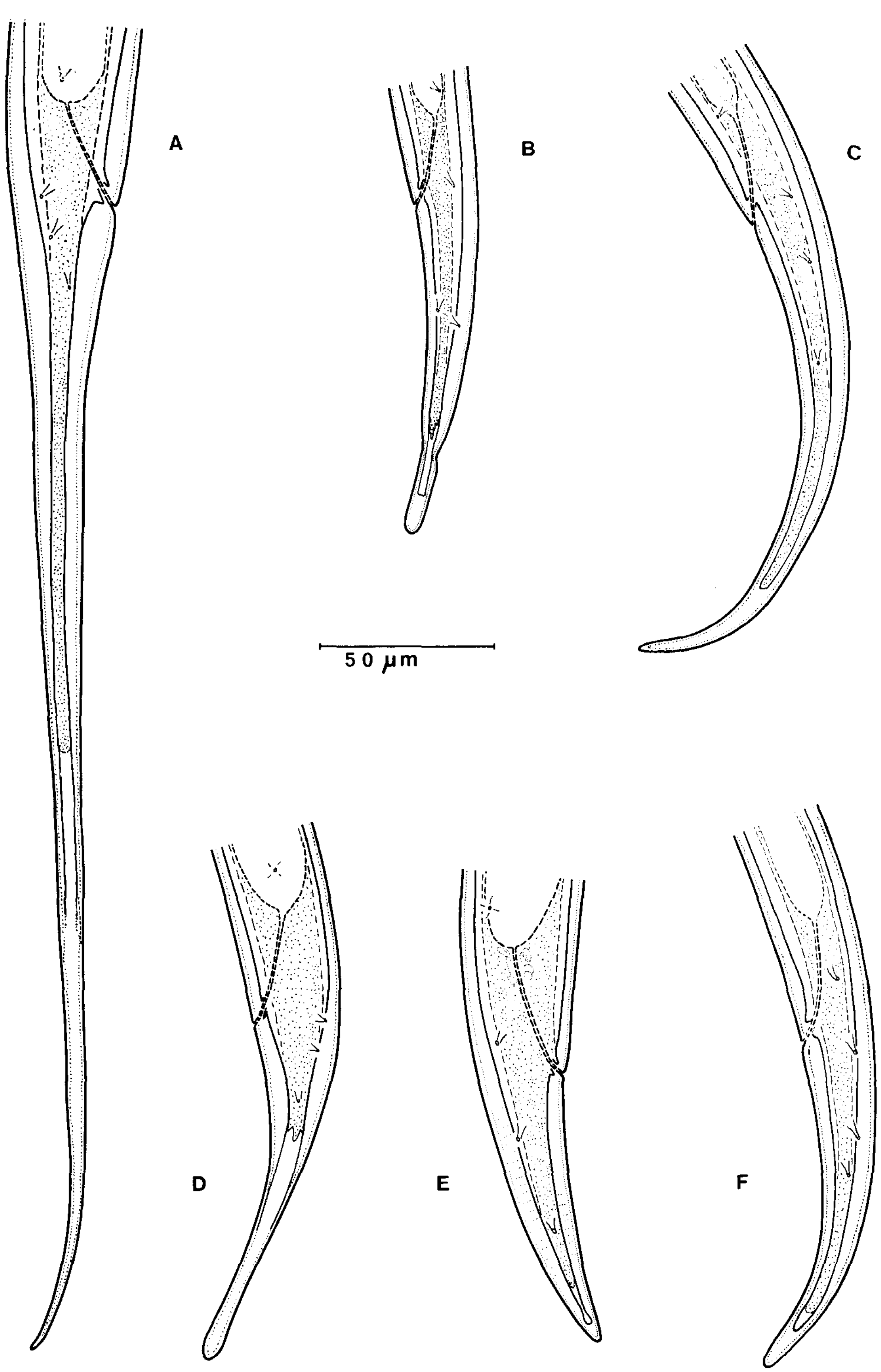


Fig. 4. — Shape of the female tail (code D)

A : *X. spinuterus* (code D1 ; paratype ; from Luc, 1973). B : *X. bergeri* (code D2 ; paratype ; from Luc, 1973). C : *X. douceti* (code D2 . paratype ; from Luc, 1973). D : *X. nigeriense* (code : D2 ; paratype ; from Luc, 1961). E : *X. attorodum* (code D2 ; paratype ; orig.); F : *X. insigne* (code D2 ; paratype ; orig.)

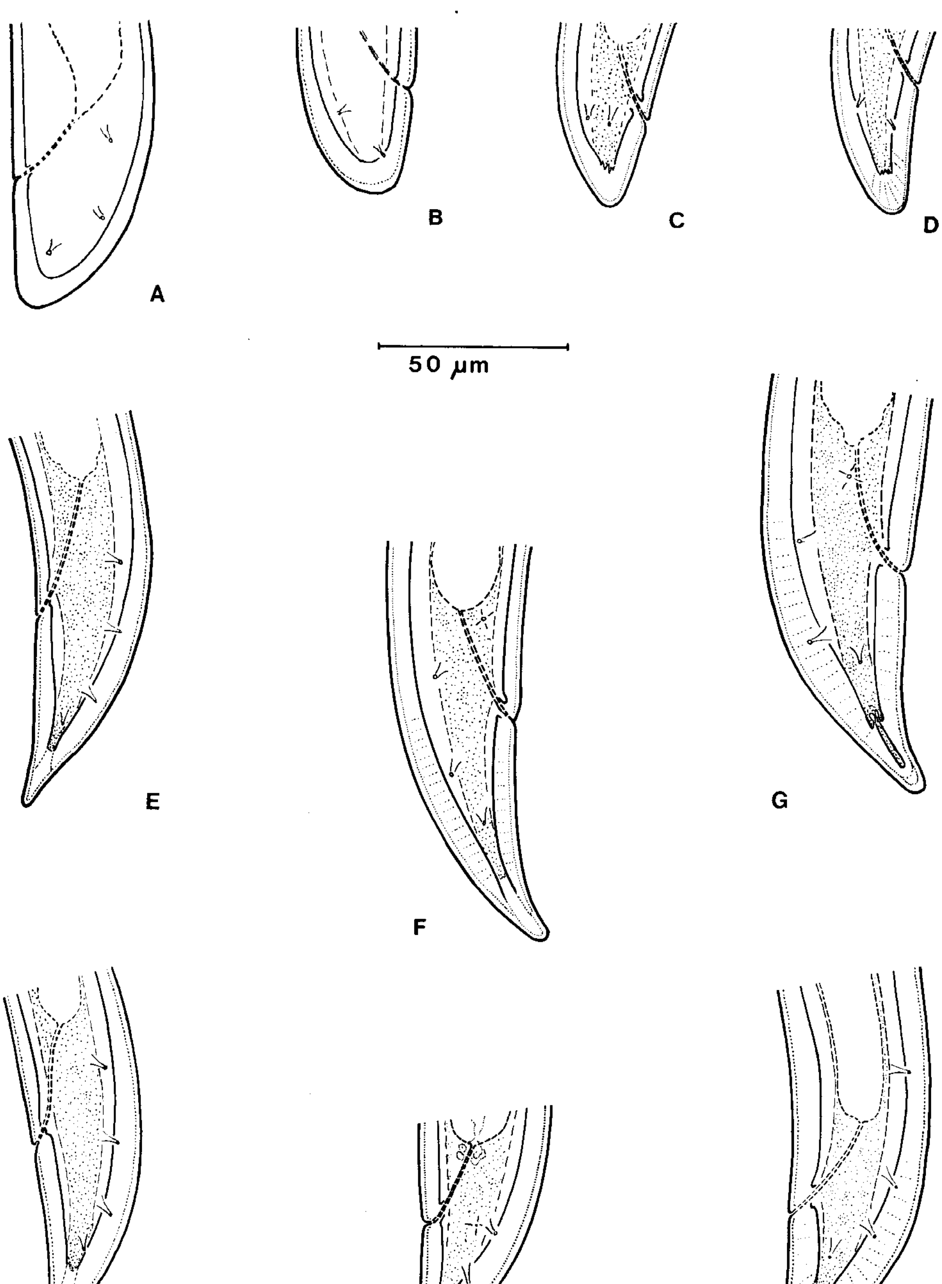


Fig. 5. — Shape of the female tail (code D)

A : *X. krugi* (code D3 ; type ; from Lordello, 1955). B : *X. krugi* (?) (code D3 ; pop. Florida ; from Tarjan, 1974). C : *X. brevicolle* (code D3 ; pop. *Citrus*, Ivory Coast ; orig.). D : *X. rivesi* (code D3 ; paratype ; orig.). E : *X. vulgare* (code D3/4 ; paratype ; orig.). F : *X. longidoroides* (code D3 ; paratype ; orig.). G : *X. ifacolum* (code D3 ; paratype ; orig.). H : *X. setariae* (code D3/4 ; paratype orig.). I : *X. ebriense* (code D4 ; topotype ; orig.). J : *X. basiri* (code D4 ; paratype ; orig.)

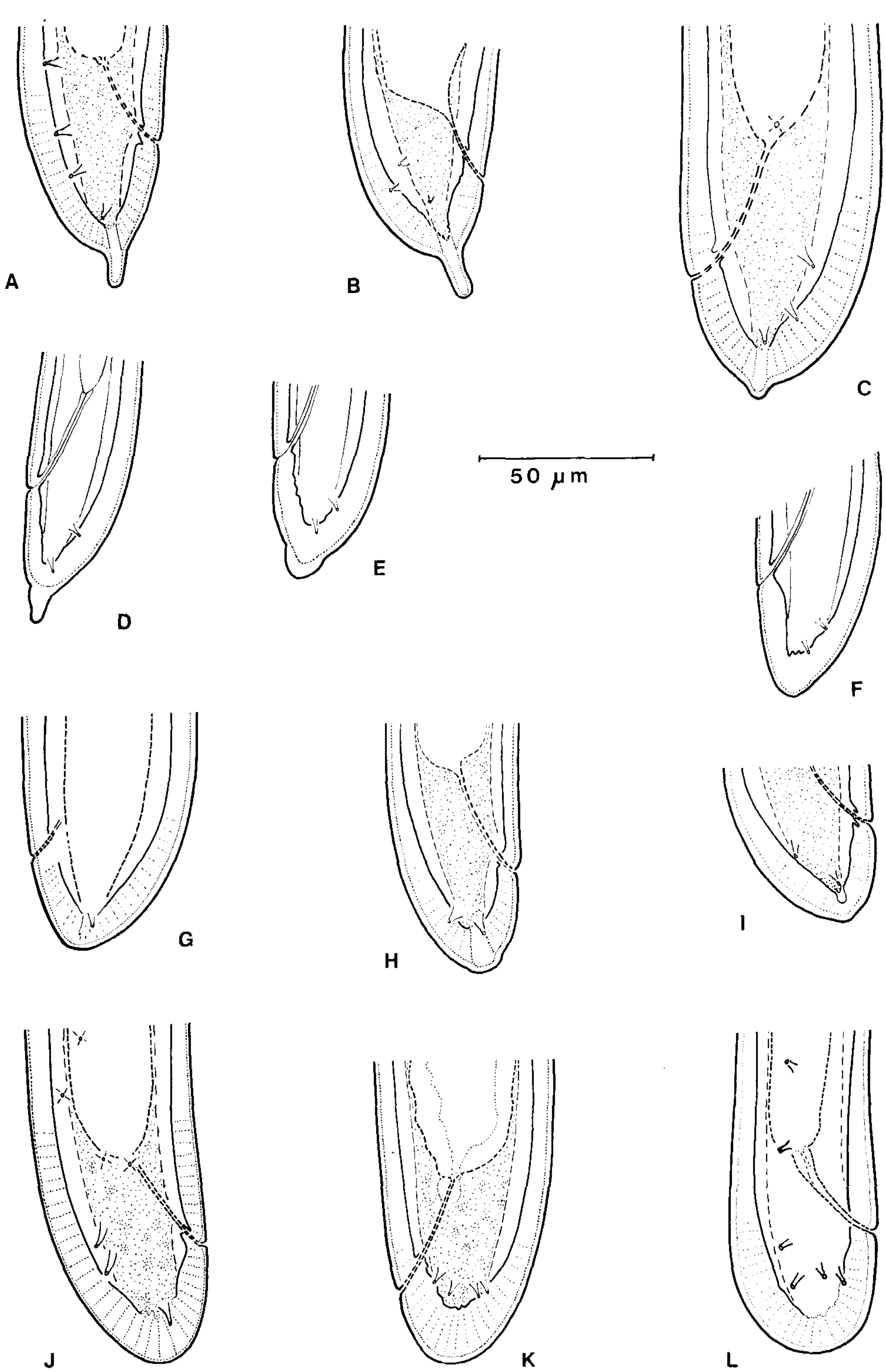


Fig. 6. — Shape of the female tail (code D)
A : *X. index* (code D5 ; pop. fig-tree, France ; orig.). B : *X. brasiliense* (code D5 ; syntype ; from Tarjan's orig. drawing). C : *X. mammillatum* (code D5 ; lectotype ; from Luc & Tarjan, 1963). D, E, F : *X. denoudeni* (respectively code D5, D5/6, D6 ; from Loof & Maas, 1972). G : *X. index* (code D6 ; pop. vine, France ; from Dalmasso's orig. drawing). H : *X. loosi* (code D 5/6 a ; type ; from Southey & Luc, 1973). I : *X. pini* (code D 5/6 a ; paratype ; orig.). J : *X. yapoense* (code D6 b ; holotype ; orig.). K : *X. hygrophilum* (code D6 b ; type ; from Southey & Luc, 1973). L : *X. clavatum* (code D7 b ; type ; from Heyns, 1965)

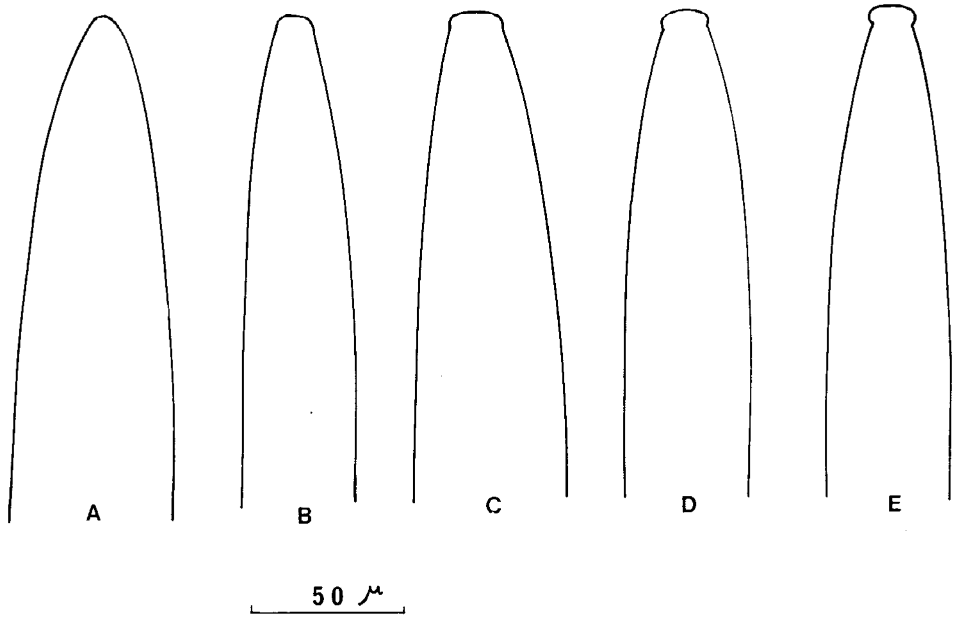


Fig. 7. — Outline of the fore part of the body (code H)

A : *X. hygrophilum* (code H1). B : *X. pyrenaicum* (code H1/2). C : *X. pini* (code H2). D : *X. loosi* (code H3). E : *X. monohysterum* (code H4)

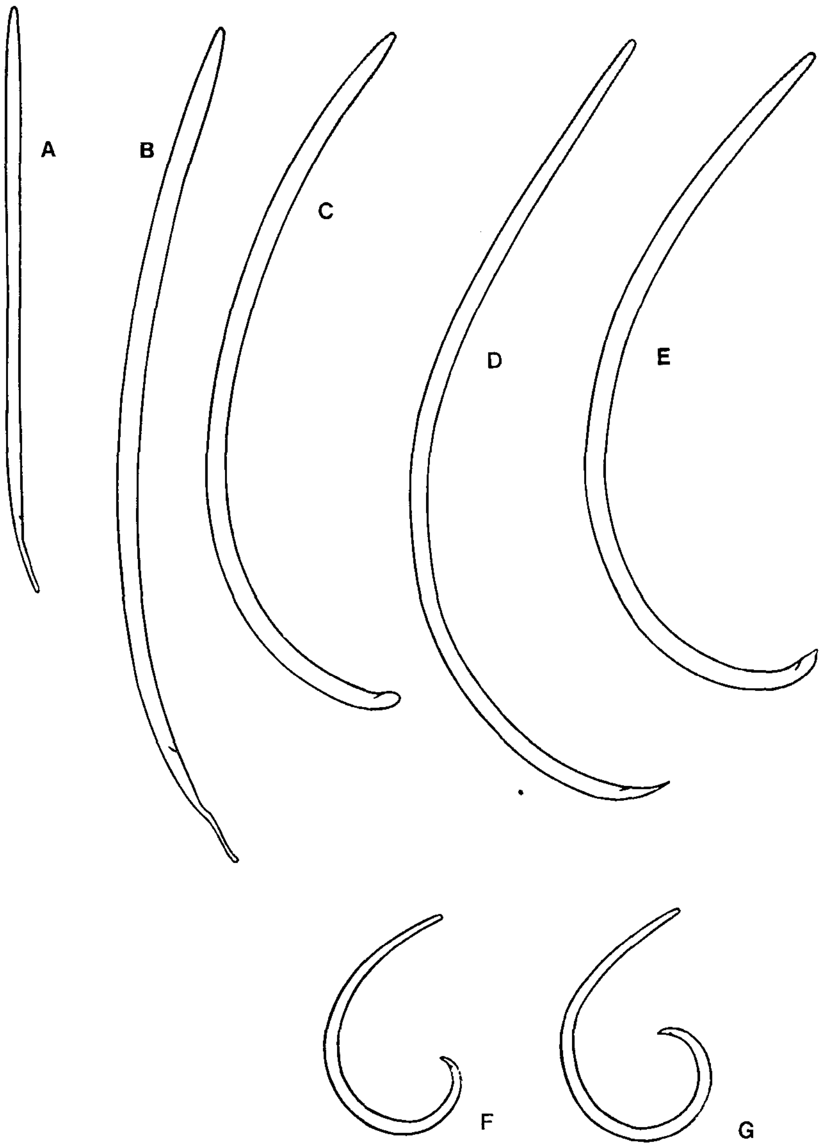


Fig. 8. — « Habitus» of the adult female (code I)

A : *X. orthotenum* (code I1). B : *X. filicaudatum* (code I1/2). C : *X. surinamense* (code I2). D : *X. italiae* (code I2). E : *X. index* (code I3). F, G : *X. mediterraneum* (code I4)

C) NOTES ON THE LATTICE

(1) *X. simillimum :* in regard to the genital tractus, the structure of anterior branch may be in question ; if the original drawing (3B) shows clearly a reduced and unorganized branch it is said in the original description (LOOF & YASSIN, 1971) : " anterior gonad very short, undifferentiated, except in the only egg-bearing specimen where it is rather long (110 µm) and somewhat differentiated".

(2) *X. arcum :* in the original description (KHAN, 1964) it is stated : "anterior branch of reproductive system comparatively less developed than the posterior one" ; the original illustration 2A shows clearly a reduced anterior branch (length calculated on drawing : 240 µm, against 370 µm for the posterior one) and a very small anterior ovary (50 × 12 µm against 128 × 30 µm for the posterior one). Thus this species could appear as an intermediate between the hemispherical tailed species with two genital branches approximatively equal and *X. hygrophilum* in which the reduction of each part of the anterior branch is much more pronounced.

(3) *X. zulu :* the original description (HEYNS, 1965) does not give details on an eventual Z differentiation in the uterus, but figure 31 shows, at the place where this differentiation normally occurs, a different type of uterine wall and small bodies in the lumen, differing from spermatozoa also present in the spermatheca. This structure ressembles a pseudo-organ Z of the *X. marsupilami* type, but less differentiated.

(4) *X. filicaudatum :* LOOF and MAAS (1972) have found two populations of this species : one with rather abundant males (7 for 28 females), the other with no males in regard to 28 females too.

(5) *X. cubense :* This species was described (RAZJIVIN *in* RAZJIVIN, O'RELLY & MILLAN, 1973) under the name of *X. cubensis* but the latin suffix *-nema* being neuter, the species name must be written *cubense.* In the original description it is stated that a Z organ is present. But from examination of the description of the genital tractus and from the original drawing IB, it is clear that the author described as a Z organ the sphincter (more or less developped but present in each species) that constitutes the limit between uterus and oviduct. Anyway the species is unique in the genus by having the *posterior* genital branch reduced : the different parts are present but notably shorter that the corresponding ones of the anterior branch. The ovary, extremely short and thin, is not in a reflexed position as usual. Apart from this last point this type of reduction is rather close to the one depicted for the genital anterior branch of *X. hygrophilum.*

D) HOW TO USE THIS LATTICE

1) The characteristics corresponding to each letter of the code are observed, measured or calculated ; each of them is allocated the corresponding figure.

2) These figures are put on a strip of transparent paper, so that each corresponds to the column of each letter, for example :

A	B	C	D	E	F	G	H	I	J	K	L
4	2	2/3	5	4	4/5	3	1/2	3	5	3	3

3) This strip of paper is moved down from the top of the lattice until a horizontal line is found in which the figures correspond exactly to the figures put on the transparent strip, in this example *X. diversicaudatum.* Nevertheless it is necessary to continue to the last line, in case of double correspondence. In this case, see notes following the lattice where supplementary differential characters are given.

4) For each column, only one identical figure is needed ; in the example chosen, for character C (V value) the figures corresponding are 2/3, because an overlapping on two divisions (V = 40-46). For this character all the species coded C2 or C3, and not only those coded C2/3, are in correspondence. On other hand species coded C1/2 or C 3/4 are to be discarded except in case of perfect identity of figures for all other letters.

5) If no identity for the all letters is observed in any horizontal line, the specimens being identified are theorically new, but it is more prudent to test, by gradual approach, the other species appearing close of them.

E) DIFFERENTIATION OF SOME SPECIES

As stated before, some pairs of species cannot be differentiated on the lattice because they have the same values for the main characters used. So for each of these cases we give below supplementary details permitting a practical differentiation of the species involved or we note that a synonymization could be taken in consideration.

1) *X. radicicola* and *X. australiae*

In fact, as stated by C. & S. and as examination of types of the two species and of various other populations (of which the measurements where taken in consideration in the lattice) has shown, these two species are very closely related and it could seem valuable to synonymize them. A publication dealing on these species is in preparation by one of us (M. L.).

2) *X. ensiculiferum* and *X. costaricense.*

As emphasized by the authors of the last species (LAMBERTI & TARJAN, 1974) these two species are very close. They can nevertheless easily be differentiated by the position of the vulva (V = 30.3 — 32.5 for *X. ensiculiferum* and 36.6 — 37.5 for *X. costaricense*). This difference is correlated with the weaker development of the vestigial anterior branch in *X. ensiculiferum*, another character to be taken into consideration.

3) *X. insigne* and *X. bergeri ; X. insigne* and *X. attorodorum.*

X. insigne is not well differentiated on the lattice from *X. attorodorum* although these two species are clearly separated from each other by the use of character "V" (position of vulva).

Independantly of other characters, the best way to distinguish *X. insigne* from the two other species is to examine the structure of the tail-tip :

— In *X. insigne* (Fig. 4F) the tail tip is regularly conical rounded at the extremity and the inner surface of the cuticle is regular.

— In *X. attorodorum* (Fig. 4E) the tail tip is also regularly conical, rounded at the tip, but the inner surface of the cuticle forms a fine canal with a slight vesicle at its end ; this structure is very characteristic of the species.

— In *X. bergeri* (Fig. 4B) the tail tip is clavate and the inner cuticular canal stops half-way to the inflated terminal part of the tail tip. This structure is characteristic of the species.

4) *X. setariae* and *X. vulgare*

For differentiation between these two species see p. 309.

5) *X. mammillatum* and *X. index*

The tail shape and namely the development and the position of the terminal mucro permit easy separation of these two species, in *X. mammillatum* (Fig. 6C), the peg is most frequently short and, above all, situated strictly in the long axis of the body ; in *X. index* (Fig. 6A), the peg is more often rather long and well differentiated and in any case situated clearly on the ventral part of the tail. Moreover *X. mammillatum* is a very rare tropical species, never found again since its description, in 1938, from Zaïre ; *X. index* is, on the contrary, a rather common species of temperate areas, namely in Europe and USA.

6) *X. nigeriense* and *X. douceti*

These two species are close to each other but their differentiation is easy on the basis of morphology of the tail : in *X. nigeriense* (Fig. 4D), the tail is only slightly ventrally curved, not regularly conical-elongated ; the tail-tip is rounded and the more often slightly clavate ; the hyaline terminal portion is very large (58-64% of tail-length). In *X. douceti* (Fig. 4C), the tail is strongly ventrally arcuate, regularly conical-elongated ; the tail-tip is more or less pointed but never clavate and the hyaline terminal position shorter (18-29% of tail-length).

7) *X. opistohysterum* and *X. mediterraneum*

In the diagnosis of the latter species, LAMBERTI and MARTELLI (1971) wrote : "the differentiation between *X. mediterraneum* and *X. opistohysterum* seems... difficult owing the strikingly similar overall appearence of the two species". They give nevertheless differential characters :

	X. opistohysterum	*X. mediterraneum*
length of the odontostyle	67 µm	87 µm
distance from the base of the stylet guide to the fore-part	60 µm	78 µm
coefficient "c"	54	62

These figures apply to the mean values and overlaps may exist. Moreover, these authors stated that the shape of the tail is slightly different in the two species : the tip of the tail is, in *X. mediterraneum* slightly "indented" on the both ventral and dorsal sides, whereas in *X. opistohysterum* this "indentation" does not exist or is present only on the ventral side.

In fact, these differences are very weakly established and it will not be surprising if, in the future, the study of numerous populations leads to the discovery of linking specimens which will question the validity of separating these two species.

AKNOWLEDGEMENTS

The authors from which material or informations were received are aknowledged in the text. Special thanks are due to Prof. A. C. TARJAN and Prof. F. LAMBERTI for communication of articles previous to their publication and to Dr. D. P. TAYLOR and Dr. C. E. TAYLOR who kindly revised the English of the present paper.

Manuscrit reçu au S.C.D. de l'ORSTOM le 29 juillet 1975.

BIBLIOGRAPHY

ABOUL-EID (H. Z.) – 1970 – Systematic notes on *Longidorus* and *Paralongidorus*. *Nematologica* **16**, 159-179.

ALTHERR (E.) – 1958 – Nématodes du bassin inférieur de la Weser et des dunes d'Heligoland. Espèces nouvelles ou incomplètement décrites. *Mém. Soc. vaud. Sci. nat.* **74**, 12, 45-63.

BAKER (A. D.) – 1962 – *Check list of the nematode Superfamilies Dorylaimoidea, Rhabditoidea, Tylenchoidea and Aphelenchoidea.* Leiden, E. J. Brill, XI + 261 p.

BROWN (R. H.) – 1968 – *Xiphinema monohysterum* n. sp. (*Nematoda* : Dorylaimoidae) from Southern New South Wales. *Nematologica* (1967) **13**, 633-637.

CARVALHO (J. C.) – 1962 – *Xiphinema itanhaense* n. sp. (Nematoda : Dorylaimoidea). *Arq. Inst. Biol., São Paulo* **29**, 223-225.

CARVALHO (J. C.) – 1965 – *Xiphinema paulistanum* una nova espécie de Nematoide. *Arq. Inst. Biol., São Paulo* **32**, 77-79.

COBB (N. A.) – 1893 – Nematodes mostly Australian and Fijian. *MacLeay Mem. Vol., Linn. Soc. N.S.W.* 252-308.

COBB (N. A.) – 1913 – New nematode genera found inhabiting fresh water and non-brackish soils. *J. Wash. Acad. Sci.* **3**, 432-444.

COHN (E.), SHER (S. A.) – 1972 – A contribution to the taxonomy of the genus *Xiphinema* Cobb, 1913. *J. Nematol.* **4**, 36-65.

COOMANS (A.) – 1964 – *Xiphinema basilgoodeyi* n. sp. with observations on its larval stages (Nematoda : Dorylaimina). *Nematologica* **10**, 581-593.

DALMASSO (A.) – 1969 – Etude anatomique et taxonomique des genres *Xiphinema, Longidorus* et *Paralongidorus.* (Nematoda : Dorylaimidae). *Mém. Mus. natl. Hist. nat. Paris, Sér. A. Zool.* **61**, 33-82.

DALMASSO (A.) – 1970 – La gamétogenèse des genres *Xiphinema* et *Longidorus* (Nematoda : Dorylaimida). *C.R. Acad. Sci. Paris* **270**, 824-827.

ESSER (R. P.) – 1966 – *Xiphinema macrostylum* n. sp. (Nematoda : Longidoridae). *Proc. helm. Soc. Wash.* **33**, 162-165.

ESSER (R. P.) – 1973 – A Diagnostic Species Compendium of the Genus *Xiphinema* Cobb, 1913. *Soil & Crop Sci. Soc. Florida* **33**, 88-92.

FLEGG (J. J. M.) – 1966 – The Z-organ in *Xiphinema diversicaudatum. Nematologica* **12**, 174.

GOODEY (T.) – 1936 – A new dorylaimid nematode, *Xiphinema radicicola* n. sp. *J. Helminthol.* **14**, 69-72.

HEYNS (J.) – 1962 – A report on South African nematodes of the families Longidoridae, Belondiridae and Alaimidae (Nematoda : Dorylaimoidea), with descriptions of three new species. *Nematologica* **8**, 15-20.

HEYNS (J.) – 1965 – Four new species of the genus *Xiphinema* (Nematoda : Dorylaimoidea) from South Africa. *Nematologica* **11**, 87-99.

HEYNS (J.) – 1965 – New species of the genera *Paralongidorus* and *Longidorus* (Nematoda : Dorylaimoidea) from South Africa. *S. Afr. J. agric. Sci.* **8**, 863-874.

HEYNS (J.) – 1966 – Studies on south african *Xiphinema* species, with descriptions of two new species displaying sexual dimorphism of the tail. *Nematologica* **12**, 369-384.

HEYNS (J.) – 1966 – Further studies on south african *Longidoridae* (Nematoda). *S. Afr. J. agric. Sci.* **9**, 927-944.

HEYNS (J.) – 1971 – Three *Xiphinema* species from the Western Cape Province (Nematoda : Longidoridae). *Phytophylactica* **3**, 107-114.

KHAN (E.) – 1964 – *Longidorus afzali* n. sp. and *Xiphinema arcum* n. sp. (Nematoda : Longidoridae) from India. *Nematologica* **10**, 313-318.

KIRJANOVA (E. S.) – 1951 – [Soil nematodes of cotton fields and virgin land on the Golonaya steppe in Uzbekistan]. *Trudi Zool. Inst. Akad. Nauk. SSSR* **9**, 625-657.

LAMBERTI (F.), MARTELLI (G. P.) – 1971 – Notes on *Xiphinema mediterraneum* (Nematoda : Longidoridae). *Nematologica* **17**, 75-81.

LAMBERTI (F.), TARJAN (A. C.) – 1974 – *Xiphinema costaricense* n. sp. (Longidoridae, Nematoda), a new species of dagger nematode from Costa Rica. *Nematol. medit.* **2**, 1-11.

LOOF (P. A. A.), MAAS (P. W. Th.) – 1972 – The genus *Xiphinema* (Dorylaimida) in Surinam. *Nematologica* **18**, 92-119.

LOOF (P. A. A.), YASSIN (A. M.) – 1971 – Three new plant-parasitic nematodes from Sudan, with notes on *Xiphinema basiri* Siddiqi, 1959. *Nematologica* **16** (1970), 537-546.

LOOS (C. A.) – 1949 – Notes on free-living and plant-parasitic nematodes from Ceylon. Nos 5 & 6. *J. zool. Soc. India* **1**, 23-29, 30-36.

LORDELLO (L. G. E.) – 1951 – *Xiphinema brasiliense* nova especie de nematoide do Brasil, parasita de *Solanum tuberosum* L. *Bragantia* **11**, 87-90.

LORDELLO (L. G. E.) – 1951 – *Xiphinema campinense,* nova especie (Nematoda, Dorylaimidae). *Bragantia* **11**, 313-316.

LORDELLO (L. G. E.) – 1955 – *Xiphinema krugi* n. sp. (Nematoda, Dorylaimidae) from Brazil with a key to the species of *Xiphinema. Proc. helm. Soc. Wash.* **22**, 16-21.

LORDELLO (L. G. E.), DA COSTA (C. P.) – 1961 – A new nematode parasite of Coffee roots in Brazil. *Rev. bras. Biol.* **21**, 363-366.

LUC (M.) – 1958 – *Xiphinema* de l'ouest africain : description de cinq nouvelles espèces (Nematoda : Dorylaimidae). *Nematologica* **3**, 57-72.

LUC (M.) – 1961 – *Xiphinema* de l'ouest africain (Nematoda : Dorylaimoidea). Deuxième note. *Nematologica* **6**, 107-122.

Luc (M.) – 1973 – Redescription de *Xiphinema hallei* Luc, 1958 et description de six nouvelles espèces de *Xiphinema* Cobb, 1913 (Nematoda : Dorylaimoidea). *Cah. ORSTOM, sér. Biol.* **21**, 45-65.

Luc (M.) – 1975a – Taxonomy of *Xiphinema* Cobb, 1913. *In : Nematode Vectors of Plant Virus* ; édit. : Lamberti F., Taylor C. E. & Seinhorst J. W. ; Plenum Publ. Cy, New York ; p. 39-52.

Luc (M.) – 1975b – Trois nouvelles espèces de *Xiphinema* à queue arrondie-mucronée (Nematoda : Longidoridae). *Cah. ORSTOM, sér. Biol.*, vol. X, n° 3, 293-302.

Luc (M.), Dalmasso (A.) – 1963 – Trois nouveaux *Xiphinema* associés à la vigne (Nematoda : Dorylaimidae). *Nematologica* **9**, 531-541.

Luc (M.), Dalmasso (A.) – 1975 – "Lattice" for the identification of species of *Xiphinema* Cobb, 1913. *In : Nematode Vectors of Plant Virus* ; édit. : Lamberti F., Taylor C. E. & Seinhorst J. W. ; Plenum Publ. Cy, New York, p. 53-70.

Luc (M.), Lima (M. B.), Weischer (B.), Flegg (J. J. M.) – 1964 – *Xiphinema vuittenezi* n. sp. (Nematoda : Dorylaimidae). *Nematologica* **10**, 151-163, 649.

Luc (M.), Tarjan (A. C.) – 1963 – Note systématique sur le genre *Xiphinema* Cobb, 1913 (Nematoda : Dorylaimidae). *Nematologica*, **9**, 111-115.

Macara (A. M.) – 1970 – *Xiphinema amarantum* sp. nov. (Nematoda : Dorylaimidae). *Rev. iber. Parasitol.* **30**, 649-658.

Macara (A. M.) – 1972 – Nematodes and associated fungi found in forest nurseries. *Act. III^{e} Congr. Un. fitopat. mediter., Oeiras, Portugal, 22-28 Oct.*, 321-326.

Martelli (G. P.), Lamberti (F.) – 1967 – Le specie di *Xiphinema* Cobb, 1913 trovate in Italia e commenti sulla presenza di *Xiphinema americanum* Cobb. (Nematoda : Dorylaimoidea). *Phytopath. medit.* **6**, 65-85.

Mc Leod (R. W.), Khair (G. T.) – 1971 – *Xiphinema australiae* n. sp., its host range, observations on *X. radicola* Goodey, 1936 and *X. monohysterum*, Brown, 1968 and a key to monodelphic *Xiphinema* spp. (Nematoda : Longidoridae). *Nematologica* **17**, 58-68.

Meyl (A. H.) – 1953 – Beitrage zur Kenntnis der Nematodenfauna vulkanisch erhitzer Biotope. I. Mitt., Die Terrikolen Nematoden im Bereich von Fumarolen auf der Insel Ischia. *Z. Morph. Okol. Tiere* **42**, 67-116.

Razjivin (A. A.), O'Relly (J. P.), Millan (J.-P. Perez) – 1973 – Nuevas especies de Nematodos (Nematoda : Dorylaimidae y Hoplolaimidae) parasitos de la cana de azucar an Cuba. *Poeyana* **108**, 1-12.

Saxena (P. K.), Chhabra (H. K.), Joshii (R.) – 1973 – *Xiphinema neoamericanum* sp. n. (Nematoda : Longidoridae). *Zool. Anz.* **191**, 130-132.

Schuurmans-Stekhoven (J. H.) – 1951 – Nématodes saprozoaires et libres du Congo Belge. *Mém. Inst. Sci. nat. Belgique* **2**, 3-79.

Schuurmans-Stekhoven (J. H.), Teunissen (R. J. H.) – 1938 – Nématodes libres terrestres. *Expl. Parc. Natl. Albert* ; *Mission G. E. De Witte*; *Inst. Parcs Natl. Congo Belge, Bruxelles* **22**, 229 pp.

Siddiqi (M. R.) – 1959 – Studies on *Xiphinema* spp. (Nematoda : Dorylaimoidea) from Aligarh (North India), with comments on the genus *Longidorus* Micoletzky, 1922. *Proc. helm. Soc. Wash.* **26**, 151-163.

Siddiqi (M. R.) – 1961 – On *Xiphinema opisthohysterum* n. sp., and *X. pratense* Loos, 1949, two dorylaimid nematodes attacking fruit trees in India. *Z. Parasitenk.* **20**, 457-465.

Siddiqi (M. R.) – 1964 – Three new species of *Dorylaimoides* Thorne & Swanger, 1936, with a description of *Xiphinema orbum* n. sp. (Nematoda : Dorylaimoidea). *Nematologica* **9**, (1963), 626-634.

Siddiqi (M. R.) – 1964 – *Xiphinema conurum* n. sp. and *Paralongidorus microlaimus* n. sp. with a key to the species of *Paralongidorus* (Nematoda : Longidoridae). *Proc. helm. Soc. Wash.* **31**, 133-137.

Southey (J. F.) – 1973a – Identification of *Xiphinema* species. *In : "The Longidoridae"*, Manual Worksh. Nemat. Group Assoc. appl. Biologists, 37-58.

Southey (J. F.) – 1973b – Terminology of the female reproductive organs in nematodes with special reference to *Xiphinema* species. *Nematologica* **19**, 405.

Southey (J. F.), Luc (M.) – 1973 – Redescription of *Xiphinema ensiculiferum* (Cobb, 1893) Thorne, 1937 and description of *Xiphinema loosi* n. sp. and *Xiphinema hygrophilum* n. sp. (Nematoda : Dorylaimoidea). *Nematologica* **19**, 293-307.

Stegarescu (O.) – 1966 – [Application of the polytomous principles to determination of nematodes of the genus *Xiphinema* Cobb]. *In : "Politomičeskij princip opredelenija životnyh i rastenij"*, 55-58.

Steiner (G.) – 1914 – Freilebende Nematoden aus der Schweiz. *Arch. Hydrobiol. (Plankt.)* **9**, 259-276, 420-438.

Stoyanov (D.) – 1964 – [A contribution to the nematode fauna of the grapevine]. *Rast. Zasht.* **12**, 16-24.

Tarjan (A. C.) – 1964 – Two new american dagger nematodes (*Xiphinema :* Dorylaimidae) associated with Citrus, with comments on the variability of *X. bakeri* Williams, 1961. *Proc. helm. Soc. Wash.* **31**, 65-76.

Tarjan (A. C.) – 1974 – The dagger nematodes (*Xiphinema*, Cobb) of Florida. *Soil Crop Sci. Soc. Florida Proc.* **33**, 92-95.

Thorne (G.) – 1937 – Notes on free-living and plant-parasitic nematodes. III. *Proc. helm. Soc. Wash.* **4**, 16-18.

THORNE (G.) – 1939 – A monograph of the nematodes of the super-family Dorylaimoidea. *Capita Zool.* **8**, 1-261.

THORNE (G.), ALLEN (N. W.) – 1950 – *Paratylenchus hamatus* n. sp. and *Xiphinema index* n. sp., two new nematodes associated with fig roots, with a note on *Paratylenchus anceps* Cobb. *Proc. helm. Soc. Wash.* **17**, 27-35.

THORNE (G.), SWANGER (H. H.) – 1936 – A monograph of the nematode genera *Dorylaimus* Dujardin, *Aporcelaimus* n. g., *Dorylaimoides* n. g. and *Pungentus* n. g. *Cap. Zool.* **6**, 1-223.

TULGANOV (A. T.) – 1938 – [The fauna of nematodes of cotton and surrounding soil in Katta-Kurgan district of the Uzbek SSSR.] *Trudi Uzbeksk. Gos. Univ.* **12**, 1-25.

WILLIAMS (J. R.) – 1959 – Studies on the nematode soil fauna of sugar cane fields in Mauritius. 3. Dorylaimidae (Dorylaimoidea, Enoplida). *Occ. Pap. Mauritius Sug. Ind. Res. Inst.* **3**, 1-28.

WILLIAMS (T. D.) – 1961 – *Xiphinema bakeri* n. sp. (Nematoda : Longidorinae) from the Fraser River Valley, British Columbia, Canada. *Canad. J. Zool.* **39**, 407-412.

ZULLINI (A.) – 1973 – Some soil and freshwater nematodes from Chiapas (Mexico). *Quad. Accad. naz. Lincei* **171**, 55-96.

NOTES ADDED ON PROOF

1) Since the submission of the manuscript the description of some new species has been recorded by the authors :

— *Xiphinema vitis* Heyns, 1974 (*Phytophylactica 6*, 249-260, 1974). This species is closely related to *X. italiae*. The code in the « lattice » is :

A4 - B4 - C3 - D3 - E3 - F3 - G2 - H2 - I3 - J2-3 - K? - L1.

— *Xiphinema neoamericanum* Khan & Ahmad, 1975 (*Nematol. mediterr.* **3**, 23-28, 1975). The name of this species is in fact preoccupied by *X. neoamericanum* Saxena, Chhabra & Joshii, 1973. The differential characters given by the authors appear too light to be sure that this species is different from *X. americanum* ; three characters are used : the total spear length is said to be longer but this measurement is given for the holotype only ; the basal guiding ring is said to be more posteriorly located, but the position of this structure is very variable, nearly always depending on the length and position of the spear itself ; the lip region is continuous and not slightly expanded as in *X. americanum*, but this character is too difficult to appreciate to constitute a differential point between species closely related by numerous other morphometric characters. Thus, the present authors consider this species as a non valid taxon and the specimens recorded as pertaining to *Xiphinema americanum sensu lato*.

— *Xiphinema saopaoloense*, Khan & Ahmad, 1975 *(ibid.)* is the name given to the specimens described by CARVALHO as *X. americanum* (*in : Rev. Inst. A. Lutz* **15**, 180-185, 1955). In fact the females described and figured by CARVALHO appear to be close or identical to *X. brevicolle*, as stated by HEYNS (*Phytophylactica* **6**, 157-164, 1974), opinion to which the present authors agree. In addition to give a new name on the basis of literature data only, without reexaminating the specimens themselves, may leads to error. Moreover no type is designated and it is not sure that CARVALHO's specimens have been retained. Thus, this species is considered as a non valid taxon.

2) Regarding the problem of a Z pseudo-organ in *Xiphinema diversicandatum* (cf. p. 305), PITCHER, SIDDIQI and BROWN (*C.I.H Descript. Pl. parasit. Nem., Set* 4, n° 60, 1-4, 1974) confirmed the presence of this structure in all the populations of the species they observed.