

**Keys to adult
and immature Macronematinae
(Insecta : Trichoptera)
from the Ivory Coast (West Africa)
with notes on their taxonomy
and distribution⁽¹⁾**

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SUMMARY

This is the second and final part of a study dealing with keys, taxonomy, and distribution of Hydropsychidae in the Ivory Coast. As in the first part, which considered Hydropsychinae, keys which include numerous illustrations are presented here, describing females, males, larvae and, less comprehensively, pupae of the Macronematinae. Leptonema bihoumi n. sp. and Protomacronema barnardi n. sp. are described.

It seems that the Macronematinae are more sensitive to exposure to seasonal droughts in the streams as well as to the regular insecticide treatments of the Onchocerciasis Control Programme than the Hydropsychinae. The minimum number of Hydropsychidae species in the Ivory Coast amounts to 31. Of these we assigned larvae to adults in 16 spp., 11 of them for the first time. The distribution patterns of these species are based on samples from 112 localities. The following areas of occurrence can be distinguished: savannah, which can probably be divided into a western « rainy » part and an eastern « dry » part, lowland forest, and mountainous areas, separated from one another by transition zones.

KEY WORDS : Africa — Running Water — Caddis Flies — Species Discrimination — Areas of Occurrence — Pesticides.

RÉSUMÉ

CLÉS ÉLABORÉES POUR LES MACRONEMATINAE (INSECTES : TRICHOPTÈRE) DE CÔTE D'IVOIRE (AFRIQUE OCCIDENTALE) ACCOMPAGNÉES DE NOTES SUR LEUR SYSTÉMATIQUE ET DISTRIBUTION

Cet article est la seconde partie d'une étude de la systématique et de la distribution des Hydropsychidae en Côte d'Ivoire. Comme dans la première partie, qui traitait des Hydropsychinae, des clés abondamment illustrées ont été élaborées pour les mâles, les femelles, les larves et parfois les nymphes. Leptonema bihoumi n. sp. et Protomacronema barnardi n. sp. sont décrites.

(1) Parts of the field and laboratory studies were carried out during a period in which B. STATZNER acted as a consultant for the World Health Organization in the Onchocerciasis Control Programme.

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Il semble que les Macronematinae soient plus sensibles que les Hydropsychinae aux assèchements saisonniers des cours d'eau ainsi qu'aux traitements insecticides hebdomadaires du Programme de Lutte contre l'Onchocercose.

Sur les 31 espèces d'Hydropsychidae récoltées en Côte d'Ivoire, 16 larves ont été avec certitude associées aux adultes, 11 d'entre elles pour la première fois. Des cartes de distribution, établies à partir d'échantillons récoltés sur 112 localités, permettent de mettre en évidence plusieurs régions : savane (où l'on peut probablement distinguer une partie occidentale humide et une partie orientale sèche), forêt de plaine, régions montagneuses ainsi que des zones de transition.

MOTS-CLÉS : Afrique — Eaux courantes — Trichoptère — Identification spécifique — Aire de distribution — Pesticides.

1. INTRODUCTION

In this paper, the second one on Hydropsychidae from the Ivory Coast, the Macronematinae are considered. The first one, concerning the subfamily Hydropsychinae (STATZNER, 1984) introduces the general and the specific reasons which make keys and distribution data of these groups so urgently necessary. The essentials are: 1) the general lack of keys needed by ecologists for the specific identification of African caddis flies, especially for the immature stages; 2) the use of various insecticides against the larvae of the *Simulium damnosum* complex, the vector of human onchocerciasis (river blindness) in West Africa. This programme risks the eradication of non-target species.

The latter will hardly be documented by the operational methods used to monitor the environment in the Onchocerciasis Control Programme (O.C.P.), since larvae of non-targets are frequently regarded at the family level, as are e.g. the Hydropsychidae. Now we know that this family is represented by more than 30 species in the Ivory Coast, and the disappearance of a large part of these species due to insecticide treatment can be obscured by the presence of less sensitive species, if the "Hydropsychidae" are not differentiated below the family level. It is evident, that the Macronematinae became much rarer in the Ivory Coast as the area treated by O.C.P. was extended there. Situations like those shown in Fig. 1, photographed at an untreated rapid of the Maraoue River in 1977 by B. STATZNER are completely unknown to F. M. GIBON, who came to the Ivory Coast later, when most of the country had already been treated.

Hence the two keys on the Hydropsychidae yet known from the Ivory Coast will certainly increase the quality of the monitoring programme of the environmental effects of O.C.P. activities. Since Macronematinae as well as Hydropsychinae predate on larvae of the *Simulium damnosum* complex (SERVICE & ELOUARD, 1980; ELOUARD, 1983) it is essential to know whether species of these groups

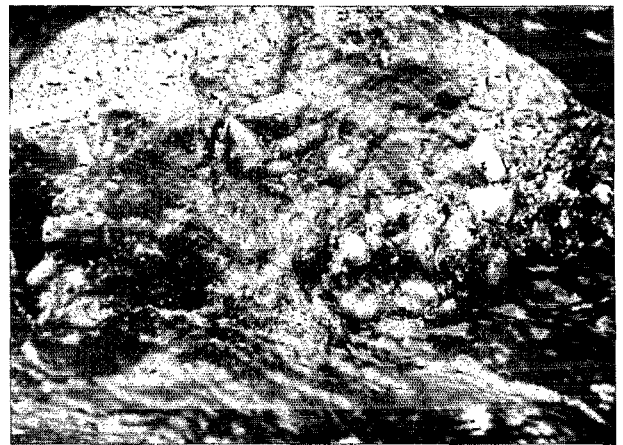


FIG. 1. — Larval retreats of *Macrostemum alienum* on a stone from a rapid of the Maraoue River (Entomokro) before the start of insecticide spraying of the Onchocerciasis Control Programme

Repaires de larves de Macrostemum alienum sur une pierre du rapide du fleuve Maraoue (Entomokro) avant le début des pulvérisations d'insecticides du Programme de Lutte contre l'Onchocercose

are eradicated and how this changes the predator pressure on the vector. Furthermore the keys enable the evaluation of the species reservoir in streams not so far treated in the operation. These keys also enable the study of probable reinvasions of these species after the end of the programme, or the consequences of replacing the current insecticide applied in the operational area with one which has different toxic effects on these groups.

2. METHODS AND THE STUDY AREA

The description and discussion of the methods used and the area studied presented by STATZNER (1984) are also valid for this paper. Thus only minor additions will follow. F. M. GIBON resampled several

of the locations mentioned in Fig. 1 of STATZNER's previous key (1984), mainly by light trapping. For this purpose he used a portable UV-lamp (12 V, Deyrolle) for the last period of his studies. A few new collection sites were established by F. M. GIBON at various tributaries of the N'Zi River and at the Feredougouba north of Touba, a tributary of the Sassandra River.

3. DESCRIPTION OF THE NEW SPECIES

This chapter is not essential for the reader who is only interested in the following keys. It gives brief additional descriptions of the new species, which will be characterized more comprehensively in the keys, and discusses their systematic position.

Leptonema bihoumi n. sp.

HOLOTYPE

1 male, 10/8/1982, waterfalls at Man (Zoologische Staatssammlung München).

PARATYPES

2 males, 1 female (Zoologische Staatssammlung München); 2 males (British Museum Nat. Hist. London); 2 males (author's collections); all paratypes from the same locality and the same date as the holotype.

Dorsal side of head and of first antennal segment dark brown; dorsal side of thorax brown; palps, antennae, ventral side of thorax, and legs yellowish; forewing membrane uniformly brown, venation as in Fig. 6 (male). Male genitalia (Fig. 6): 10th segment on each side with one chitinized inferior lobe curved upwards and two superior ones, both similar in shape, covered with small setae; aedeagus arched, apex curved upwards. Female genitalia as in Fig. 6.

The aedeagus of *L. bihoumi* resembles that of *L. occidentale* ULMER 1907, *L. natalense* MOSELY 1933, and *L. guineense* GIBBS 1973. These species can be easily differentiated by the structure of the 10th abdominal segment. In the other known species of this genus from Africa the shape of the aedeagus is more complicated than in *L. bihoumi*. The female was assigned to the male by means of sex independent characters.

Protomacronema barnardi n. sp.

HOLOTYPE

1 male, 16/6/1982, Niouniourou River at Zakpaberi (Zoologische Staatssammlung München).

PARATYPES

1 female, 18/1/1978, Sassandra River (Zoologische

Staatssammlung München); 1 male, 18/1/1978, Sassandra River (British Museum Nat. Hist. London); several specimens (males, females, pupae, larvae) (author's collections).

Head, thorax, legs, and antennae orange-brown; forewing light brown, with a pale area around the anastomosis; venation as in Fig. 13 (male). Male genitalia (Fig. 13): No U-shaped incision in the margin of the 8th tergite; inner structure of the tip of the aedeagus characterized by the two inferior spines, which do not protrude. Female genitalia and larva as in Fig. 13.

The male of this species can be distinguished from *P. africana* (Ulmer) (see KIMMINS, 1962) by the absence of the incision in the 8th tergite and by the larger tip of the aedeagus. From *P. pubescens* Ulmer, which has the same general appearance, the male can be discriminated mainly by the tip of the aedeagus. This is a minor characteristic but constant in the material we have seen from the Ivory Coast.

Corresponding to the difference in the tip of the aedeagus, the females differ in the shape of the vaginal sclerite (which is assumed to be the point of contact during copulation between the two structures). The larvae of the two species are easily distinguished from each other. *Macronema furcata* (JACQUEMART & STATZNER, 1981) is a *Protomacronema*. The aedeagus of this wrongly classified species shows a greater similarity to *P. pubescens* than to *P. barnardi*. Until larvae of this species become known, it is therefore provisionally assigned to *P. pubescens*.

4. KEYS

Keys to females and males as well as to larvae are given below. Several drawings on pupae will be added, where available, although pupae can be identified with the help of imaginal and larval characters (cf. STATZNER, 1984). Terminology is based on the literature referred to in STATZNER (1984). Most of the terms and abbreviations used will be explained in the figure in which a morphological structure is first illustrated. The abbreviations are also summed up in the appendix. The keys to the genera of adults and larvae are based on MARLIER (1962), GIBBS (1973), BARNARD (1980) and SCOTT (1983). However, they are modified and abbreviated according to the material we have studied. These generic keys as well as the specific keys are so constructed that only the characters best suited for species discrimination as well as fast identification are considered.

The adults of some genera can be easily differentiated when wing characters are regarded. In spite of the usefulness of the wings for the iden-

tification, we have added details of the genitalia and of some other structures too. The larval keys are based on characters of the final (= fifth) instar (in contrast to SCOTT (1983) material from our ecological studies gives no indication of a sixth larval instar in *Aethaloptera* or in *Macrostemum*). However, in most cases, with a bit of experience, larvae II to IV can be identified with the following illustrations. In some groups some characters can also be utilized for species discrimination of larvae I (STATZNER, 1981).

ADULTS

Since most of our adult keys are based on sex independent characters, females and males are treated together.

- 1 Maxillary and labial palps reduced, so that they have no filamentous character (Fig. 4)..... 2
 1+ Maxillary and labial palps filamentous (Fig. 6, 14).... 3
 2 Vein R4+5 on forewing simple (Fig. 2)... *Polymorphanisus*
 2+ Vein R4+5 forming a triangle on the forewing (Fig. 2)..
 *Aethaloptera*
 3 Discoidal cell present on forewing (Fig. 6)..... 4
 3+ Discoidal cell absent on forewing..... 5
 4 On hindwing, furca V longer than furca II, second segment of maxillary palps longer than third (Fig. 6).... *Leptonema*
 4+ On hindwing, furca V not distinctly longer than furca II (Fig. 8), second segment of maxillary palps shorter than third (Fig. 9)..... *Macrostemum*
 5 Terminal segment of maxillary and labial palps relatively thin, as long or longer than the underlying segments together (Fig. 13)..... *Protomacronema*
 5+ Terminal segment of maxillary and labial palps relatively thick, shorter than the underlying segments together (Fig. 14)..... *Amphipsyche*

LARVAE

- 1 Dorsal area of head without an U- or horseshoe-shaped ridge (carina); no sclerites between frontoclypeus and abrum 2
 1+ Dorsal area of head bordered by a carina; anteclypeus with two or four sclerites..... 4
 2 Head and thorax elongated and distinctly narrower than abdomen; thoracic sternites with a long process pointing backwards, lying in the mesothorax; maxillary palps long, protruding beyond the mandibles; gill branches on the mesosternum ending in tufts; no stridulatory ridges (Fig. 3).....
 *Polymorphanisus*
 2+ Head oval, head and thorax not distinctly narrower than abdomen; thoracic sternites without a long process; maxillary palps short, not protruding beyond the mandibles..... 3
 3 Gill branches on mesosternum form a very long filament ending in two or several short filaments, which arise from the terminal part of the long filament; no stridulatory ridges; foretrochantin elongated; width and length of submentum about equal; abdomen lacking dense cover of striated setae (Fig. 4)..... *Aethaloptera*
 3+ Gill branches on mesosternum ending in a denser tuft of filaments, which arise from the whole length of the main filament; stridulatory ridges present; foretrochantin stout;

- submentum wider than long; abdomen densely covered with striated setae (Fig. 7)..... *Leptonema*
 4 Anterior edge of tibia and tarsus of the foreleg with a very dense tuft of extremely fine and long setae (insertion of the single setae hardly visible); anteclypeus with two sclerites; gills on mesosternum ending in tufts (Fig. 11, 12)..
Macrostemum
 4+ Anterior edge of tibia and tarsus of foreleg without dense tufts of setae; anteclypeus with four sclerites..... 5
 5 Gills on mesosternum form a long filament, ending in one or two short filaments; carina runs along the posterior edge of frontoclypeus (Fig. 13)..... *Protomacronema*
 5+ Gills on mesosternum ending in tufts; carina posteriorly without a bulge (Fig. 15)..... *Amphipsyche*

4.1. *Polymorphanisus* Walker

ADULTS (Fig. 2)

Since BARNARD's key (1980) was always a useful tool for identifying material we examined, we use it here in an abbreviated form.

- 1 In the forewing M2 is a direct continuation of M1+2... 2
 1+ In the forewing M1 is a direct continuation of M1+2... 3
 2 Thorax with spot(s) of variable shape on the mesoscutellum; antennae yellow..... *P. elisabethae* Navas
 2+ Thorax without spot(s) on the mesoscutellum; proximal part of antennae dark..... *P. hargreavesi* Barnard
 3 Forewing with two dark spots..... *P. similis* Ulmer
 3+ Forewing without spots..... *P. angustipennis* Ulmer

LARVAE (Fig. 3)

- 1 Head dorsally without a distinct dark colouration; anterior margin of foretrochantin with longer and shorter setae.....
 *Polymorphanisus* sp. I
 1+ Head dorsally with a distinct dark colouration; anterior margin of foretrochantin only with short setae, some of them stout..... *Polymorphanisus* sp. II

4.2. *Aethaloptera* Brauer

ADULTS (Fig. 2, 4)

All adults in our material were *A. dispar* Brauer. The larval material, however, indicated that a second *Aethaloptera* species exists in the Ivory Coast, which was much rarer than *A. dispar*. A second African species noted by BARNARD (1980) is *A. maxima* Ulmer, which has been found up to now only in the south and the east of the continent. *A. dispar* has a sessile fork R 4 in the hind wing, while this fork is stalked in *A. maxima*. We assume that the tip of the aedeagus and what is assumed to be its interlocking structure, the vaginal sclerite, are valuable characters for species discrimination within this group. Hence if an adult examined deviates from the characters given for *A. dispar* here, one must consult the revision of *Aethaloptera* (BARNARD, 1980). Since our unassigned larva differs from the description of *A. maxima* (SCOTT, 1983), more than the two known species can be expected in the continent.

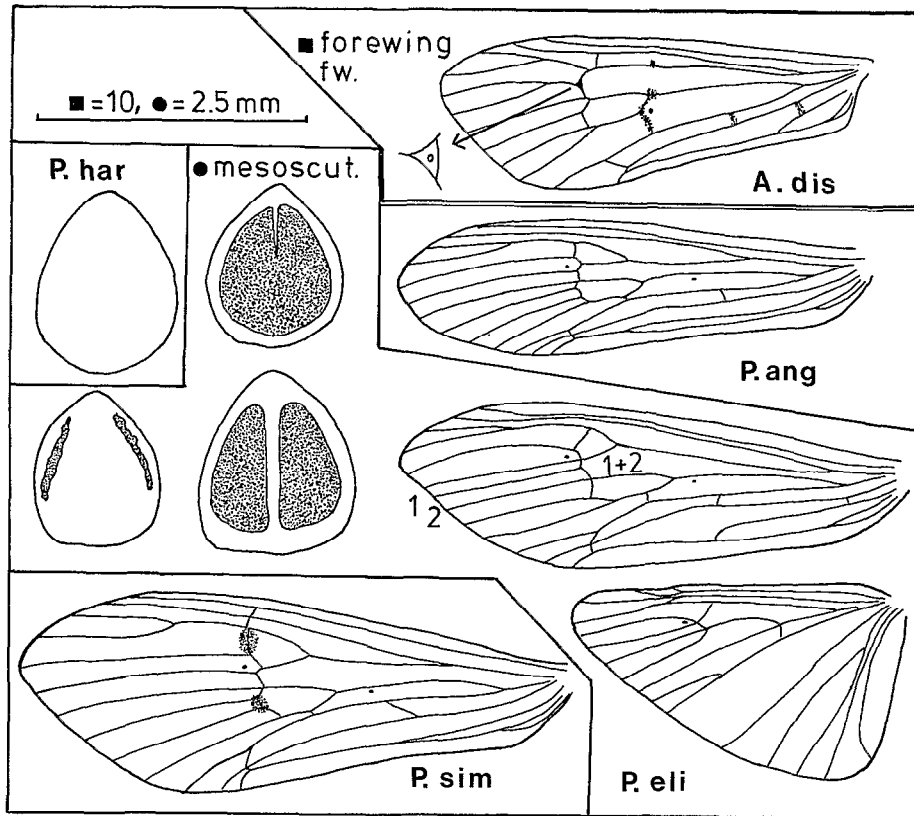


FIG. 2. — Imaginal characters of *Polymorphanisus elisabethae* (including the variability of the spots on the mesoscutellum), *P. angustipennis*, *P. hargreavesi*, *P. similis*, and *Aethaloptera dispar*
 Caractères imaginaires de *Polymorphanisus elisabethae* (y compris la variabilité des tâches sur le scutellum du mesothorax), de *P. angustipennis*, *P. hargreavesi*, *P. similis* et *Aethaloptera dispar*

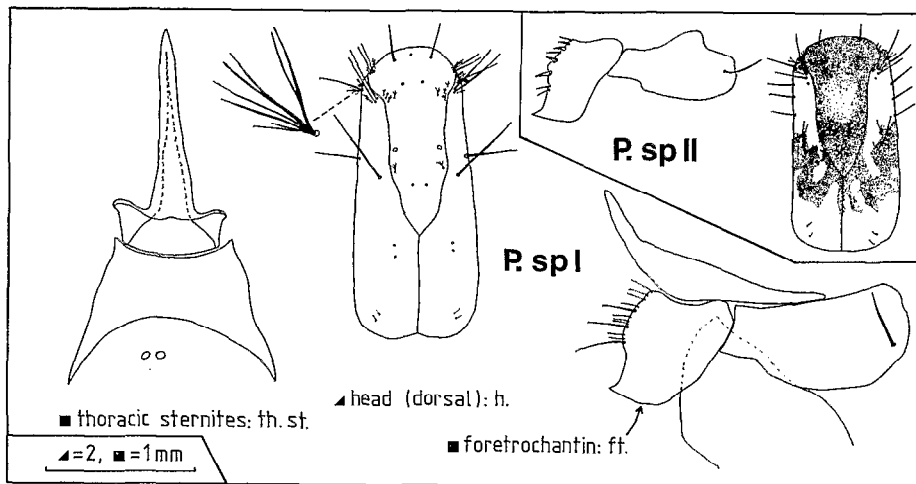


FIG. 3. — Larval characters of *Polymorphanisus sp. I* and *II*
 Caractères des larves de *Polymorphanisus sp. I* et *II*

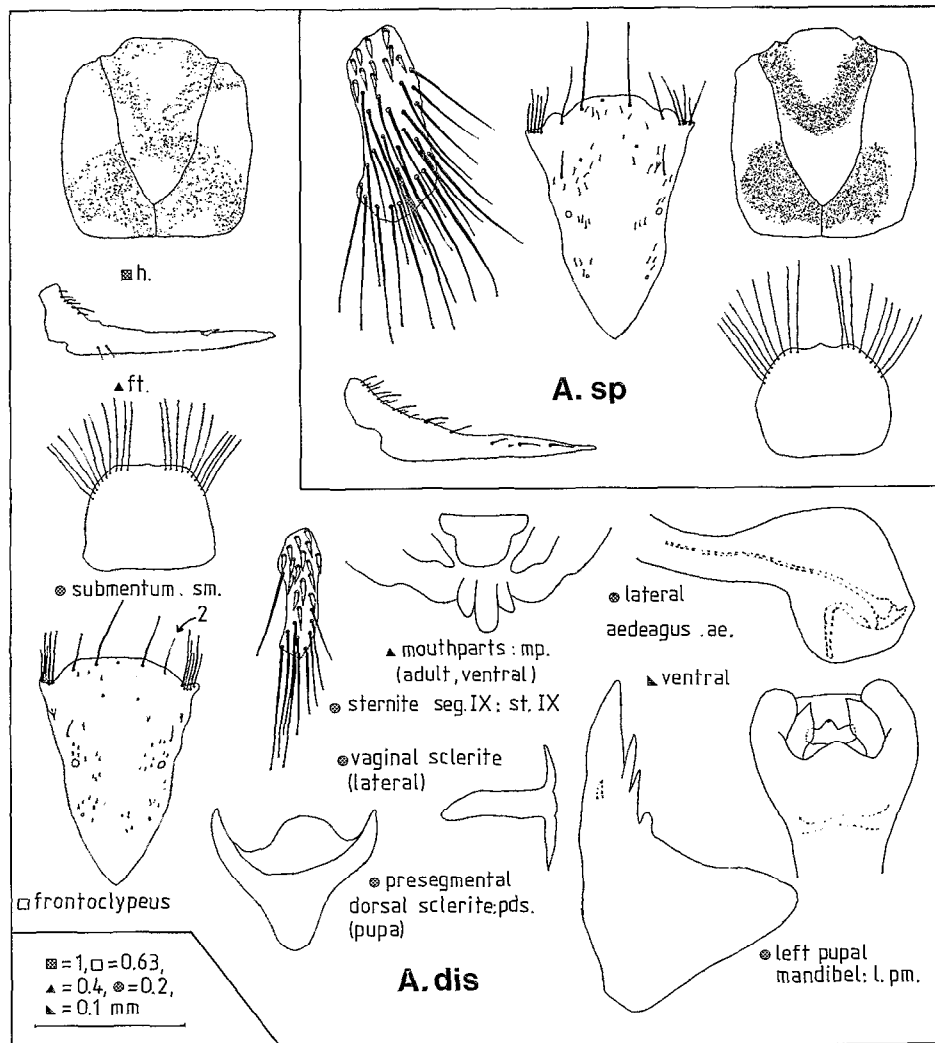


FIG. 4. — Characters of imagines and immatures of *Aethaloptera dispar* and *Aethaloptera* sp.
 Caractères des *Aethaloptera dispar* et *Aethaloptera* sp. imaginaux et immatures

LARVAE (Fig. 4)

1 Anterior margin of frontoclypeus round in front of seta 2; gill branches on mesosternum ending in two filaments; submentum narrowed only at its most posterior part; foretrochantin with a stout spine at the beginning of its distal third; area coloured darker on the frontoclypeus nearly always connected by dark bands to the dark areas on the lateral sclerites; area with light spines nearly always larger than that with long dark setae on the sternite of abdominal segment IX..... *A. dispar* Brauer
 1+ Anterior margin of the frontoclypeus with an incision in front of seta 2; gill branches on mesosternum ending in several filaments; submentum narrowed already at the beginning of its posterior third; foretrochantin with several fine setae around the beginning of its distal third; area

coloured darker on the frontoclypeus isolated, not connected by dark bands to the dark areas on the lateral sclerites; area with light spines smaller than that with long dark setae on the sternite of abdominal segment IX..... *Aethaloptera* sp.

4.3. *Leptonema* Guérin-Meneville

ADULTS (Fig. 6)

1 Tip of aedeagus complicated, with several processes.....
 *L. latipenne* Marlier (female, not present in our material, presumably different to those females illustrated here)
 1+ Tip of aedeagus without spines; females as illustrated in Fig. 6..... 2
 2 Forewing uniformly dark brown; second segment of

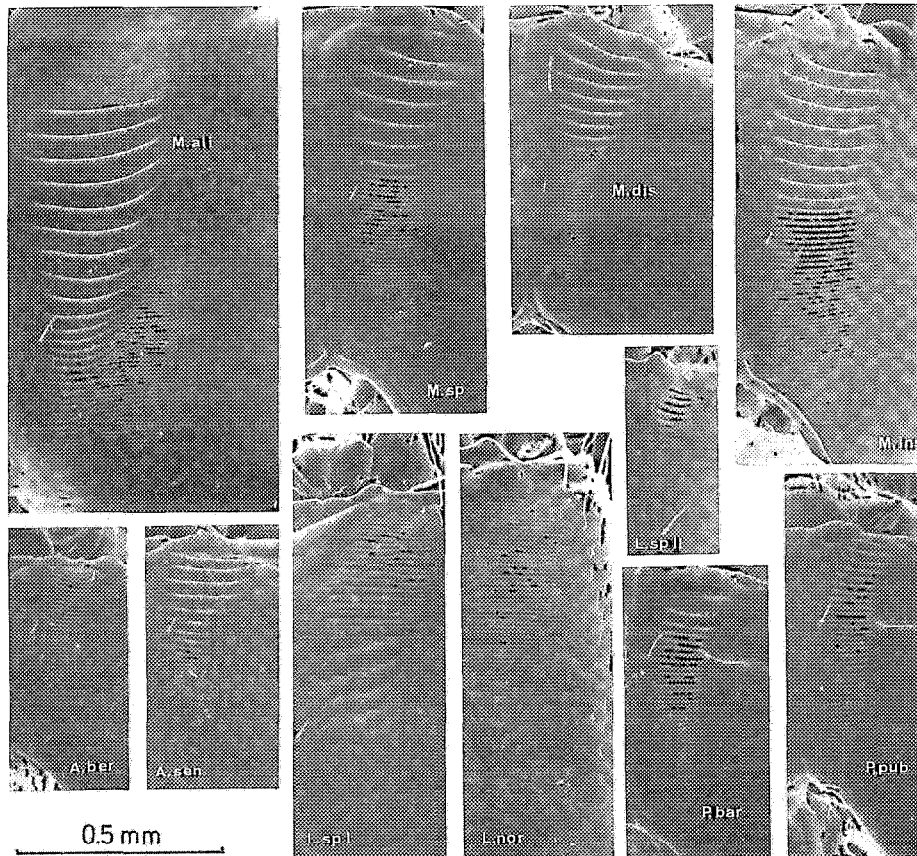


FIG. 5. — Stridulatory ridges (ventral side of head) of larvae of *Leptonema normale*, *Leptonema sp. I* and *II*, *Macrostemum alienum*, *M. distinctum*, *M. inscriptum*, *Macrostemum sp.*, *Protomacronema barnardi*, *P. pubescens*, *Amphipsyche berneri*, and *A. senegalensis*

Appareil stridulatoire (face ventrale de la tête) des larves de Leptonema normale, Leptonema sp. I et II, Macrostemum alienum, M. distinctum, M. inscriptum, Macrostemum sp., Protomacronema barnardi, P. pubescens, Amphipsyche berneri et A. senegalensis

maxillary palp longer than the fourth one; male genitalia as in Fig. 6; median fingershaped appendix of female abdominal segment X tapered only in its distal third; gap between female abdominal sternites VIII narrower than in the following species. *L. bihoumi* n. sp.
 2+ Forewing uniformly light-yellow brown; second segment of maxillary palp about as long as the fourth one; male genitalia as in Fig. 6; median fingershaped appendix of female abdominal segment X tapered over its whole length; gap between female abdominal sternites VIII not as narrow as in the previous species. *L. normale* Banks

LARVAE (Fig. 5, 7)

1 Abdominal setae with a large distal end; forecoxa as in Fig. 7. *L. normale* Banks
 1+ Abdominal setae distally not much larger than proximally 2
 2 Anterior margin of forecoxa with a protruding corner only distally, the remaining part nearly straight, setae on the anterior margin of the forecoxa not as stout as in the following

species; stridulatory ridges covering a larger area than in the following species. *Leptonema sp. I*
 (The forecoxa of this larva resembles that of *Leptonema sp.* (GIBBS, 1973), *L. natalense* (MARLIER, 1961) and *L. occidentale* (JACQUEMART & STATZNER, 1981). Hence we assume that the general form of the forecoxa is probably group-specific.)
 2+ Anterior margin of forecoxa with several protrusions, setae on the anterior margin of the forecoxa stout; stridulatory ridges restricted to a relatively small area. *Leptonema sp. II*

4.4. *Macrostemum* Kolenati

All African *Macronema* species were recently transferred into the genus *Macrostemum* (FLINT & BUENO-SORIA, 1982).

ADULTS (Fig. 8-10)

Adults can be most easily distinguished by means of the general pattern of the wing colouration. Only

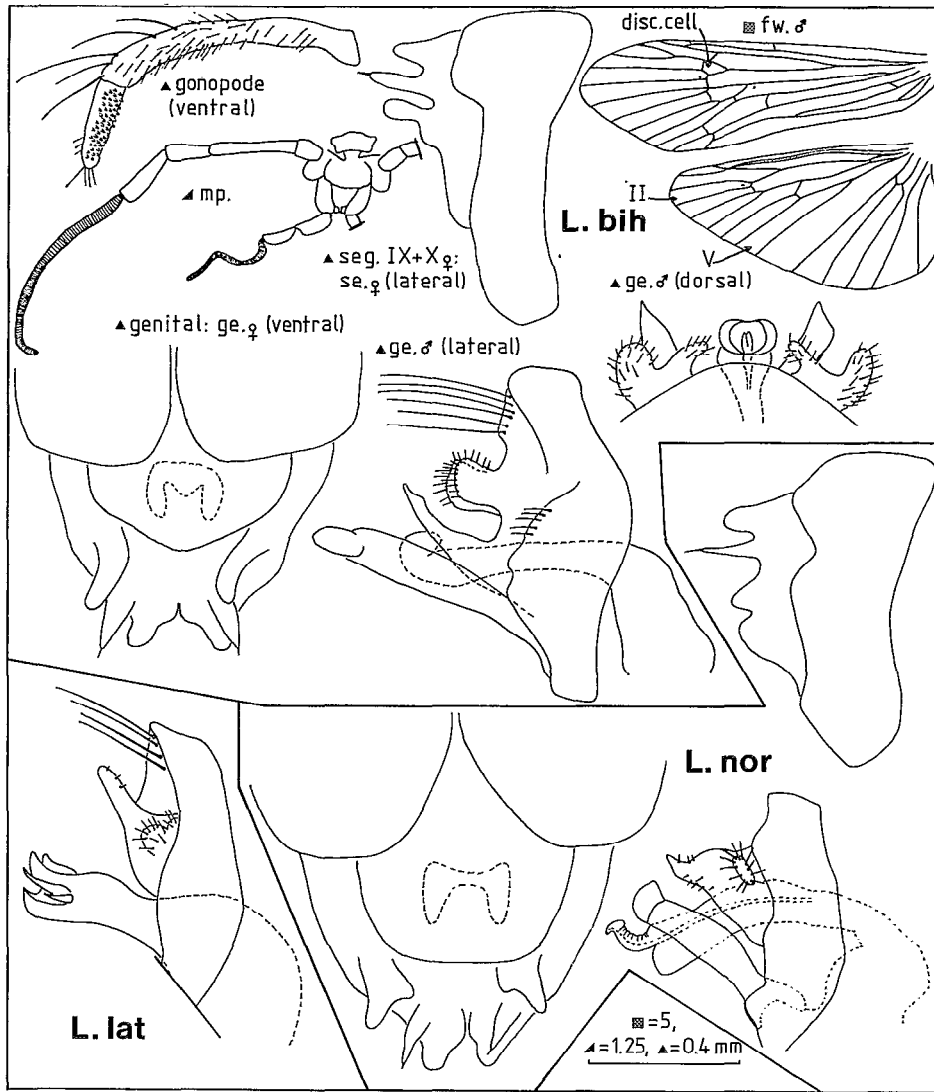


FIG. 6. — Imaginal characters of *Leptonema bihumi*, *L. latipenne*, and *L. normale*
 Caractères imaginaux de *Leptonema bihumi*, *L. latipenne* et *L. normale*

in very few cases did we find adults with an atypical wing colouration. These wings are also illustrated (Fig. 8). Nevertheless determinations should be confirmed using the other characters given in the key. The morphology of the tip of the aedeagus is an especially stable and distinct characteristic for species discrimination. Some confusion exists in the *capense* group of this genus, where a lot of varieties were described, most of them have been treated as full species at times (see Scott, 1983, for more information). The examination of our material, particularly the structure of the aedeagus, convinced

us, that the three forms of this group represented in the Ivory Coast have to be treated as valid species, viz. *M. capense*, *M. inscriptum*, and *M. pulcherrimum*.

1 Forewing marbled in its proximal half; eyes relatively small compared with the setal areas on the head (dorsal view); lateral process on abdominal sternum V forms a lobe; tip of the aedeagus in the lateral view relatively simple; male and female genitalia as in Fig. 9; very large species *M. alienum* (Ulmer)
 1+ Forewing in its proximal half not marbled; eyes relatively large compared to the setal areas on the head; lateral process

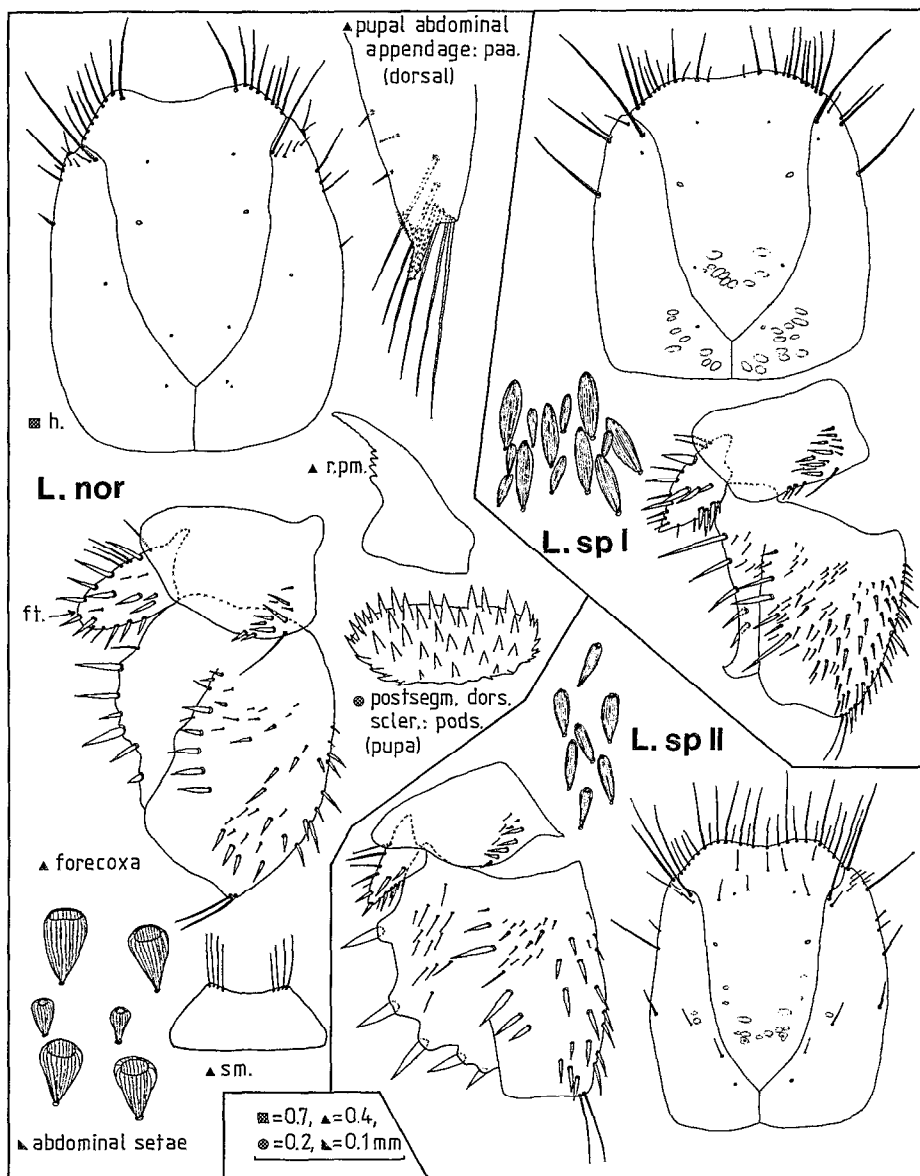


FIG. 7. — Characters of immatures of *Leptonema normale*, *Leptonema sp. I* and *II*
Caractères des Leptonema normale, Leptonema sp. I et II immatures

on sternum V filamentous; tip of the aedeagus much more complicated than in the previous species; not as large as *M. alienum*..... 2
 2 Forewing dark, with light areas between the veins near the margin of the tip of the wing; the dorsally protruding tip of the aedeagus (see arrow in Fig. 9) without spines on its surface; male and female genitalia as in Fig. 9. *M. distinctum* (Ulmer) 2+
 2+ Forewing lacks light areas on a dark background between the veins near the margin of the tip of the wing; dorsally protruding tip of the aedeagus with spines on its surface. . . 3

3 Forewing with two dark bands; posterior setal areas on the head reduced; male and female genitalia as in Fig. 9.....
 *M. pulcherrimum* (Walker)
 3+ Forewing (nearly always!) with dark band(s) and a darker area (see Fig. 8 for variability of this character); posterior setal areas on the head not reduced..... 4
 4 Light field in the dark area of the distal half of the forewing relatively small, forewing in few cases completely dark; lateral process on sternum V long and thin; male genitalia as in Fig. 10 (no females in the material)... *M. capense* (Walker)

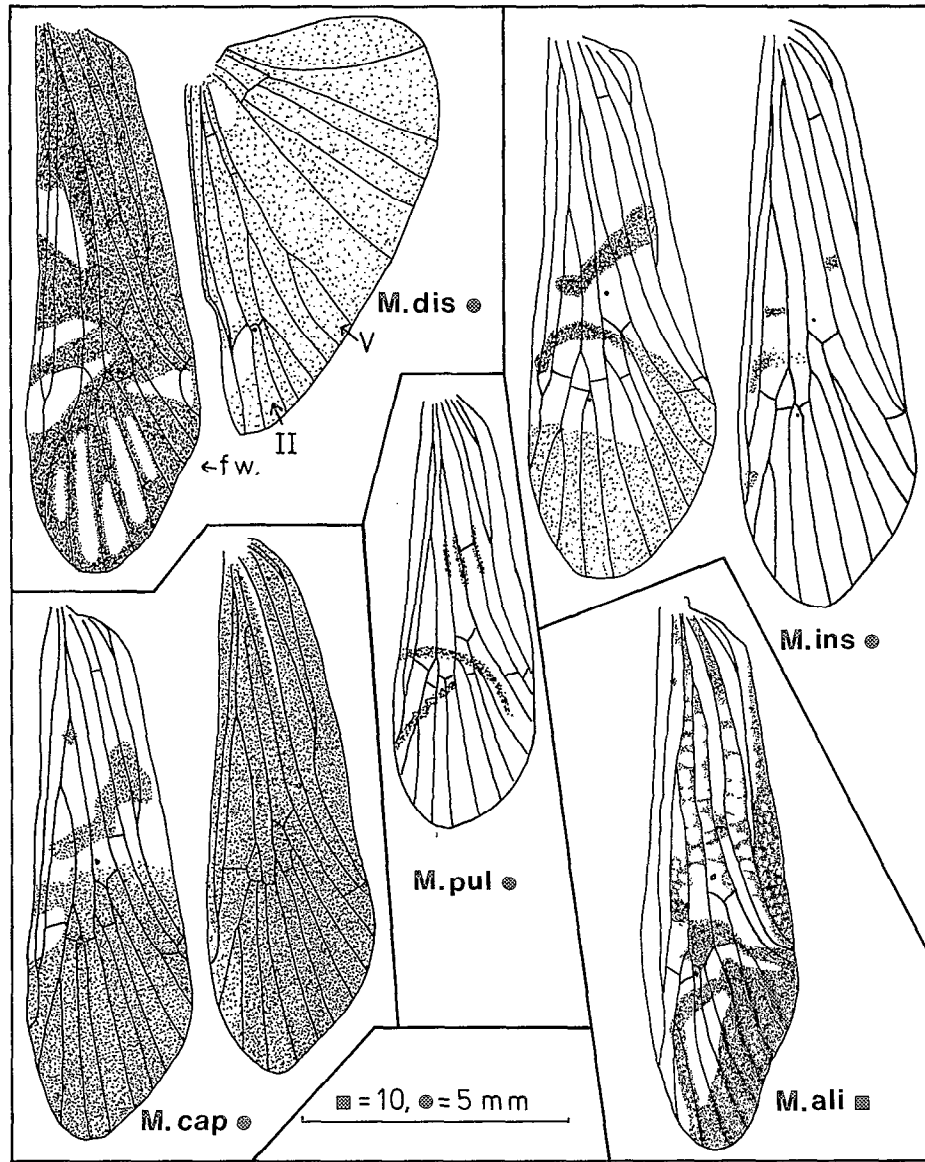


FIG. 8. — Forewing of *Macrostemum distinctum* (also hindwing), *M. capense* (the darker wing is a rare variation in our material), *M. pulcherrimum*, *M. inscriptum* (the paler wing is a rare variation in our material), and *M. alienum*

Aile antérieure de Macrostemum distinctum (également aile postérieure), de M. capense (l'aile plus foncée est une variante rare), de M. pulcherrimum, M. inscriptum (l'aile plus claire est une variante rare) et de M. alienum

4+ Light field in the dark area in the distal half of forewing relatively large, forewing in few cases nearly light; lateral process on sternum V short and stout; male and female genitalia as in Fig. 10..... *M. inscriptum* (Walker)

LARVAE (Fig. 5, 11, 12)

1 Posterior edge of head protruding upwards (lateral view); width of the anterior edge of the submentum greater than the length of the submentum; anterior margin of the thoracic

sternite with a median fissure; stridulatory ridges as in Fig. 5..... *M. distinctum* (Ulmer)
 1+ Posterior edge of head round; width of the anterior edge of the submentum smaller than the length of the submentum 2
 2 Stridulatory ridges very fine and closely spaced anteriorly, coarser and wider apart in the middle and again finer posteriorly (Fig. 5)..... *M. alienum* (Ulmer)
 2+ Stridulatory ridges very coarse at the anterior edge of

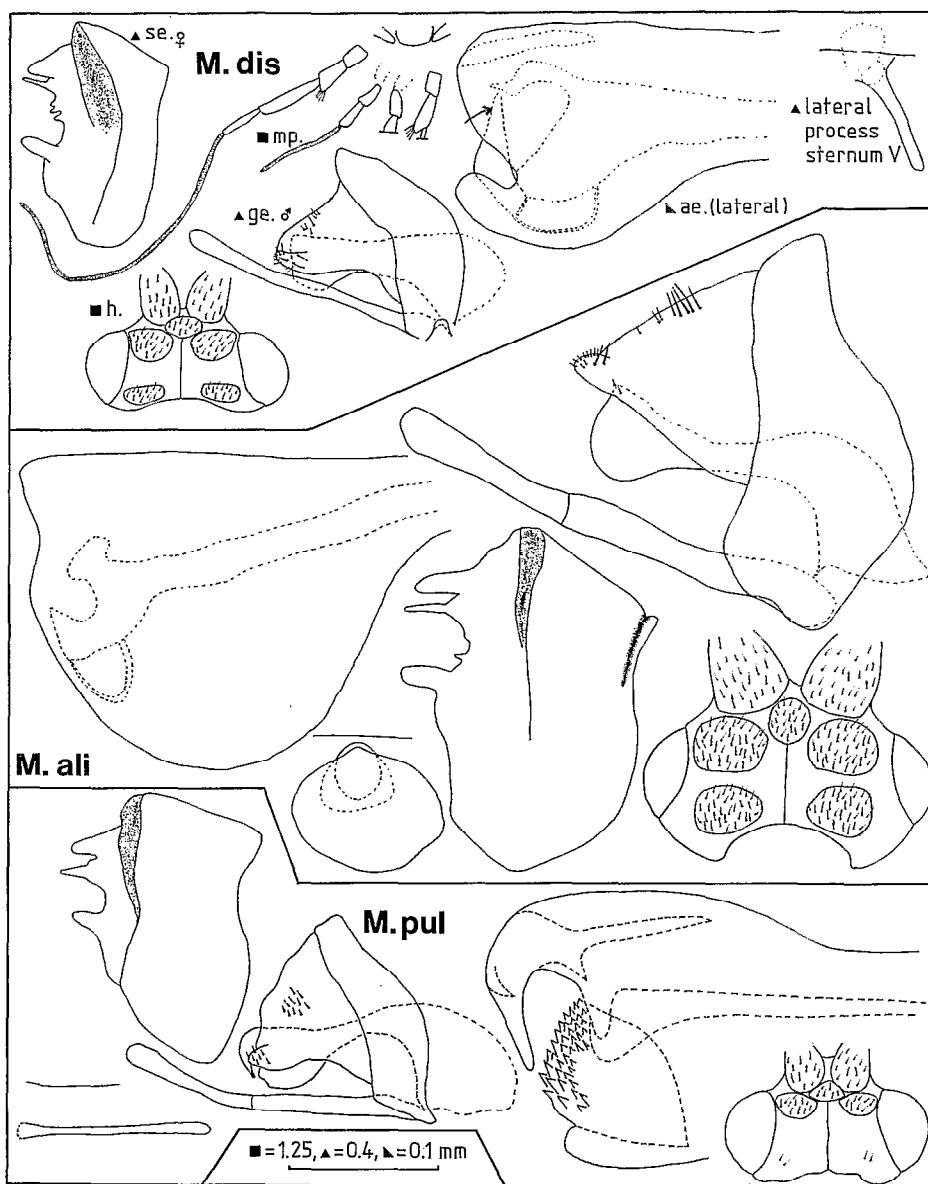


FIG. 9. — Imaginal characters of *Macrostemum distinctum*, *M. alienum*, and *M. pulcherrimum*
 Caractères imaginaires de *Macrostemum distinctum*, de *M. alienum* et de *M. pulcherrimum*

the head, becoming progressively finer and closer 3
 3 Anterior margin of submentum with a convex protrusion; light spines on anterior part of the abdominal sternite IX relatively long; stridulatory ridges as in Fig. 5. *M. inscriptum* (Walker)
 3+ Anterior margin of submentum concave; light spines on the anterior part of the abdominal sternite IX relatively stout, not as long as in the previous species; stridulatory ridges as in Fig. 5; one seta (arrow in Fig. 11) on the dorsal margin of the foretrochantin relatively thick *Macrostemum* sp.

4.5. **Protomacronema** Ulmer

ADULTS (Fig. 13)

Since we did not find any sex independent character for species discrimination, females could be assigned to males only via the larval exuviae of female and male pupae.

1 Females 2
 1+ Males 3

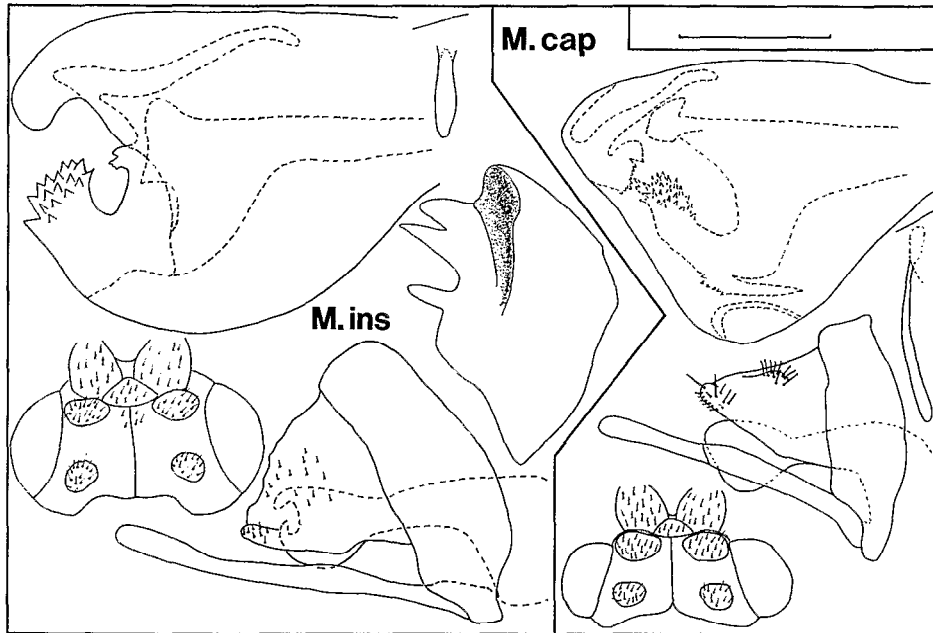


FIG. 10. — Imaginal characters of *Macrostemum inscriptum* and *M. capense* (see Fig. 9 for further explanations)
 Caractères imaginaires de *Macrostemum inscriptum* et de *M. capense* (voir Fig. 9 pour des explications complémentaires)

- 2 Gap between abdominal sternites VIII relatively narrow; proximal part of vaginal sclerite as in Fig. 13 (the strongly sclerotized parts of that sclerite illustrated here are visible only in mazerated specimens!)..... *P. pubescens* Ulmer
- 2+ Gap between abdominal sternites wider than in the previous species; proximal part of vaginal sclerite as in Fig. 13..... *P. barnardi* n. sp.
- 3 Tip of aedeagus with a sclerotized protrusion (see arrow in Fig. 13); tergum of abdominal segment IX distinctly curved in lateral view, area cranial of the dorsolateral suture larger than in the following species (see arrow in Fig. 13; this character is visible only after preparation or mazeration of the specimen studied)..... *P. pubescens* Ulmer
- 3+ Tip of aedeagus without a sclerotized protrusion; tergum of abdominal segment IX almost straight, area cranial of the dorsolateral suture smaller than in the previous species..... *P. barnardi* n. sp.

LARVAE (Fig. 5, 13)

The colouration of the dorsal side of the head is very variable in this genus. The patterns illustrated here are those we found most frequently in our material. The general shape of the tergites of the abdominal segment IX shows less variation than that found in the head colouration. Since larval thoracic sternites and the pupal mandibles and postsegmental dorsal plate look alike in both species, they are only illustrated for one of them.

- 1 Secondary setae on the head very long; tergite on abdominal segment IX usually almost oval; stridulatory ridges slightly closer at the beginning (see Fig. 5); frequently with one distinct white patch in the centre of the frontoclypeus..... *P. pubescens* Ulmer
- 1+ Secondary setae on head short; tergite on abdominal segment IX usually more rectangular in its general shape; stridulatory ridges slightly further apart at the beginning; frequently with light patches in front of the white patch in the center of the frontoclypeus..... *P. barnardi* n. sp.

4.6. *Amphispyche* Mc Lachlan

ADULTS (Fig. 14)

Our only female specimens of *A. senegalensis* were almost mature pupae. Therefore the strongly sclerotized part of the vaginal sclerite may be more complex in an adult than illustrated here.

- 1 Maxillary palp with 4 segments; third antennal segment distally distinctly narrower than proximally; aedeagus with two large sclerotized protrusions, at their tip pointing towards the median of the aedeagus (dorsal view!); gap between female sternites VIII narrowing at its cranial end; smaller than the following species..... *A. berneri* Kimmins
- 1+ Maxillary palp usually with five segments, sometimes the two last segments not completely divided by a suture (see detail in Fig. 14); third antennal segment distally almost as

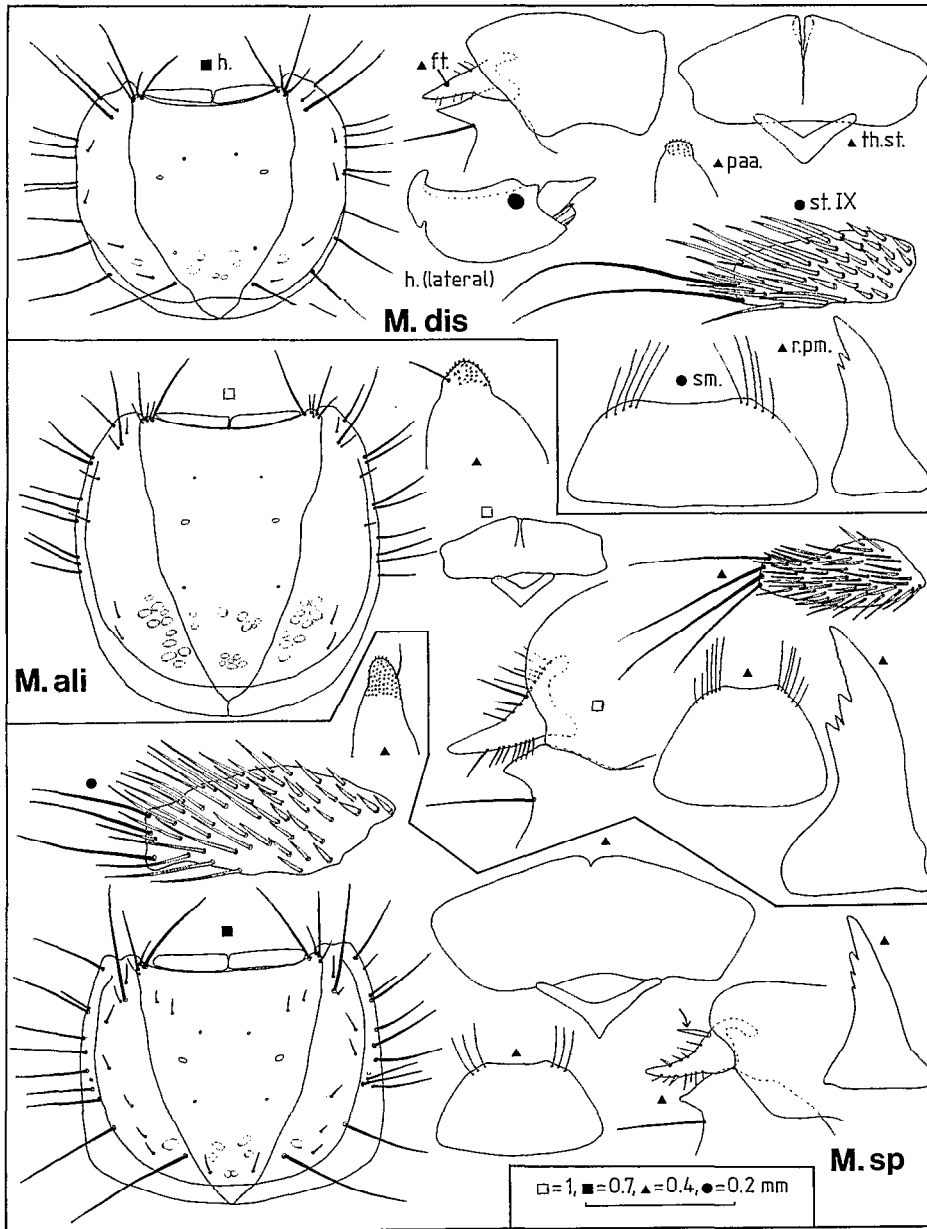


FIG. 11. — Characters of immatures of *Macrostemum distinctum*, *M. alienum*, and *Macrostemum sp.*
 Caractères de *Macrostemum distinctum*, de *M. alienum* et de *Macrostemum sp.* immatures

large as proximally; aedeagus without large sclerotized protrusions; gap between the female sternites VIII widening at its cranial end; larger than the previous species.....
 *A. senegalensis* (Brauer)

LARVAE (Fig. 5, 15)

As in *Protomacronema*, the colouration of the

dorsal side of the head as well as the general shape of the tergites and sternites of abdominal segment IX is to some extent variable.

1 Stridulatory ridges closer together in the anterior section; dorso-posterior part of the head in lateral view rounded; thoracic sternite anteriorly with a wide incision; margin of submentum without humps; only one of the two thick setae

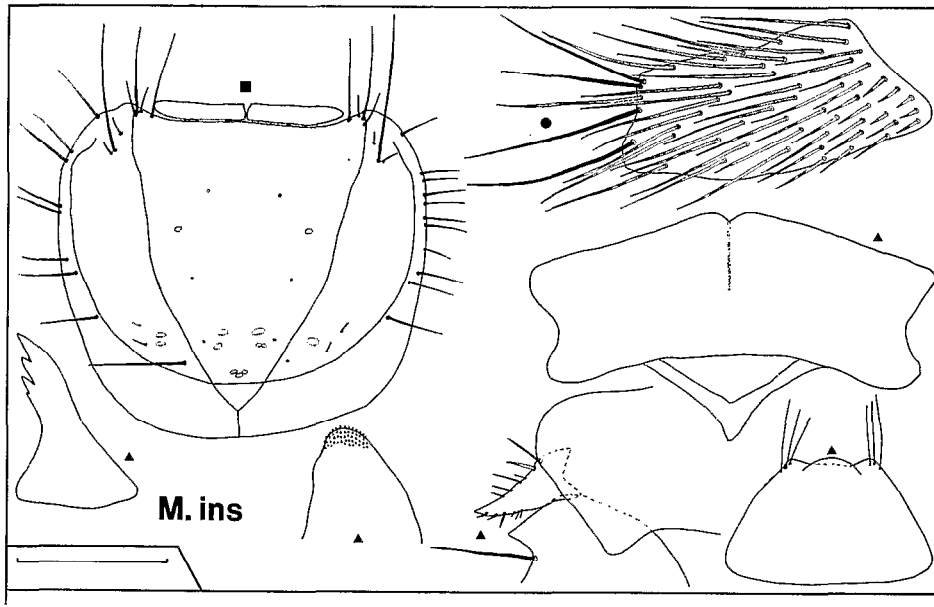


FIG. 12. — Characters of immatures of *Macrostemum inscriptum* (see Fig. 11 for further details)
 Caractères de *Macrostemum inscriptum* immatures (voir Fig. 11 pour de plus amples informations)

inserted at a corner of the tergite of abdominal segment IX; sternite of abdominal segment IX approximately as wide as long; frontoclypeus usually with two light patches and a larger white area between them. *A. berneri* Kimmins
 1+ Stridularory ridges wider apart in the anterior part; dorso-posterior part of the head in lateral view angular; anterior margin of thoracic sternite without a distinct, wide incision; margin of submentum with two humps (see arrow in Fig. 15); both thick setae on tergite of abdominal segment XI inserted near a corner of the sclerite; abdominal sternite IX longer than wide; frontoclypeus usually without a light area between the two lateral light patches.
 *A. senegalensis* (Brauer)

5. DISTRIBUTION OF MACRONEMATINAE IN THE IVORY COAST

The distribution pattern already reported for the Hydropsychinae (STATZNER, 1984) is, with some modifications, also valid for the Macronematinae. Generally Macronematinae were distinctly rarer than Hydropsychinae in streams where flow stopped for a relatively long period in the dry season. Some species occurred locally in zones where they were not normally found. The classification of these should be regarded with some reservations.

There are species, which are:

(a) distributed over the whole Ivory Coast: *Macrostemum inscriptum* (Fig. 19);

(b) distributed over almost the whole non-moun-

tainous Ivory Coast: *Aethaloptera dispar* (Fig. 17), *Macrostemum alienum* (Fig. 19), *Protomacronema pubescens* (Fig. 20), *Protomacronema barnardi* (Fig. 20);

(c) more or less restricted to the savannah region and the transition zone between savannah and forest: *Amphipsyche senegalensis* (locally in the forest region; Fig. 21), *Polymorphanius angustipennis* (Fig. 16), *Polymorphanius sp. I* (Fig. 16), *Aethaloptera sp.* (rare species, known only from the N'Zi River, from which regular samples of Hydropsychidae were taken for an extended period at five places (STATZNER, 1982); thus it can be assumed that it is more widely distributed than is reported in Fig. 17);

(d) found in the forest region: *Macrostemum pulcherrimum* (Fig. 19), *Leptonema normale* (Fig. 18; most frequently in the mountainous area);

(e) more or less restricted to the non-mountainous forest region: *Leptonema latipenne* (Fig. 18), *Leptonema sp. II* (Fig. 18), *Macrostemum sp.* (Fig. 19; locally in the savannah, occurring in smaller streams); several forest species were more or less frequently found in the transition zone and occurred locally in the savannah: *Amphipsyche berneri* (Fig. 21), *Macrostemum distinctum* (Fig. 19), *Polymorphanius hargreavesi* (Fig. 16), *Polymorphanius elisabelhae* (Fig. 16);

(f) restricted to the mountainous area around

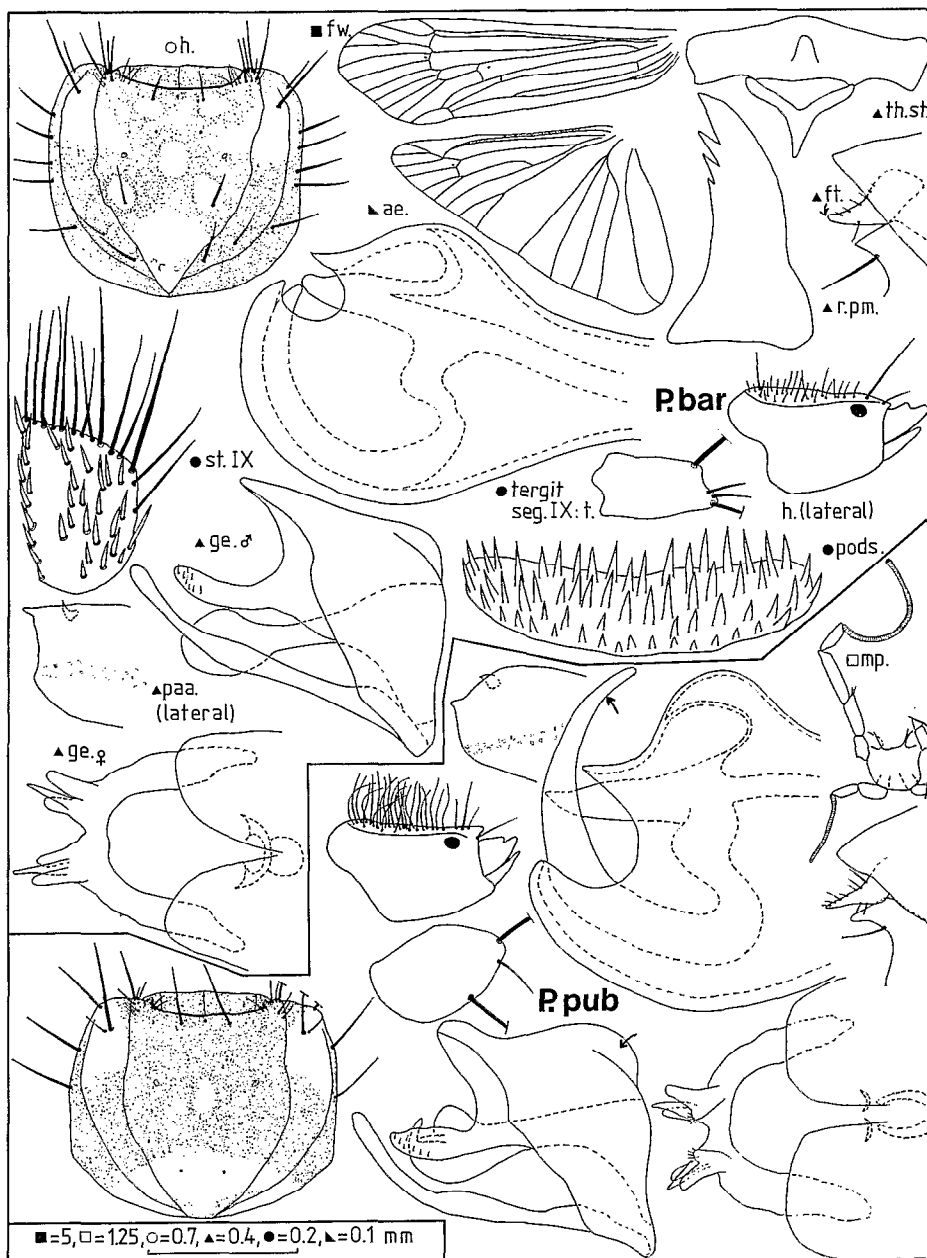


FIG. 13. — Characters of imagines and immatures of *Protomacronema barnardi* and *P. pubescens*
 Caractères de *Protomacronema barnardi* et *P. pubescens* imaginaux et immatures

Man: *Macrostemum capense* (Fig. 19), *Leptonema bihoumi* (Fig. 18), *Leptonema sp. I* (Fig. 18), *Polymorphanius similis* (Fig. 16);

Polymorphanius sp. II (Fig. 16) was not classified due to insufficient material. In contrast to the

Hydropsychinae, there was no Macronematinae species restricted to the savannah or the transition zone between savannah and forest. The causes of these distribution patterns are discussed in detail by STATZNER (1984). The essentials of that discussion

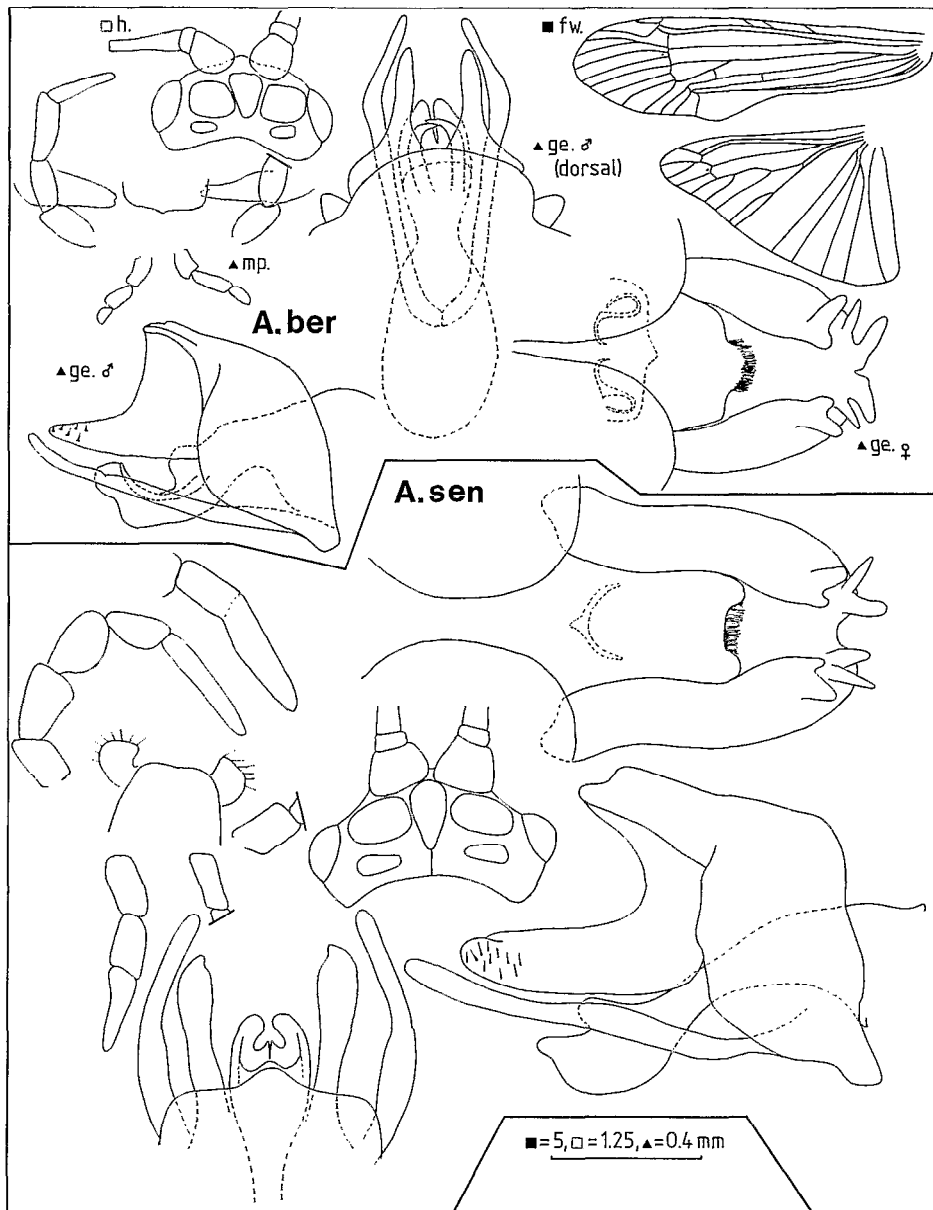


FIG. 14. — Imaginal characters of *Amphipsyche berneri* and *A. senegalensis*
Caractères imaginaux de Amphipsyche berneri et de A. senegalensis

will be briefly outlined in the next chapter, where conclusions will be drawn about Macronematinae as well as Hydropsychinae.

6. CONCLUSIONS

The minimum number of Hydropsychidae species in the Ivory Coast is 31. Of these we were able to

relate larvae to adults in 16 species, 11 of these for the first time. About the same number has been assigned in Macronematinae and Hydropsychinae for Africa south of the Sahara up till now. The first conclusive assignment of larvae to adults was made in the genus *Protomacronema*. Further we were able to relate all females in our material to males. Apart from the genus *Hydropsyche*, our material contained

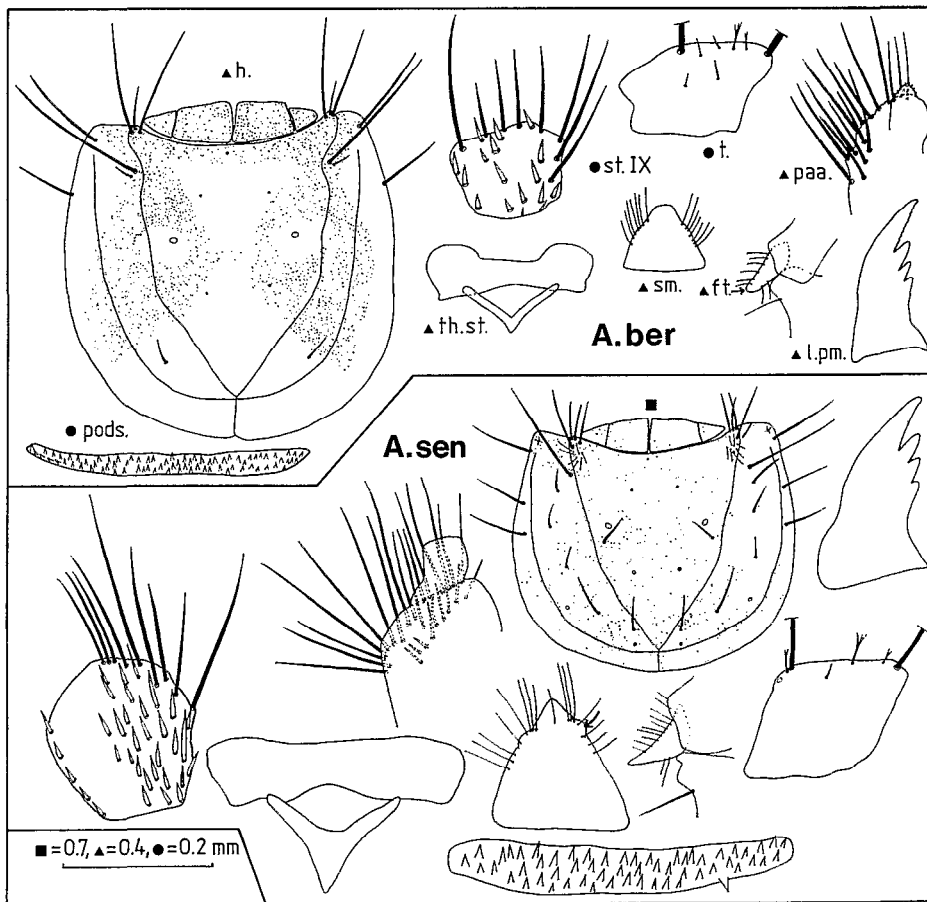


FIG. 15. — Characters of immatures of *Amphipsyche berneri* and *A. senegalensis*
Caractères de Amphipsyche berneri et de A. senegalensis immatures

more than one species in every genus. This enables the confirmation of characters useful for species discrimination of the larvae in the different genera which, we hope, will also be useful in African regions outside the Ivory Coast.

From the analyses of the larvae it became evident, that the systematic groups based on adult characters are sometimes merely reflected within the larvae. This was the case in the Hydropsychinae (STATZNER, 1984) and holds also true in the Macronematinae. Future work on these topics should, in our opinion, be focussed on the validation of the tribes Polymorphanisini/Macronematini and the genus *Macrostemum*.

The different geographical distribution areas established by us (Fig. 22), based on samples from 112 different localities, are expected to undergo changes on the microscale, when more comprehensive data become available. Relatively few samples were collected in the east of the country. Under present

conditions the boundaries between savannah (in large parts Sudan savannah) — transition zone (to some extent Guinea savannah) — forest cannot be as clearly defined as in Fig. 22 (MENAUT & CESAR, 1982). Deforestation is rapidly progressing in the zones C, D, and E, and it can be expected that species which we found to be common in the forest will disappear from the south of the country in the future (cf. MARLIER, 1981). Species now present there as well as in the savannah will probably remain.

In general, we note a steady increase of species numbers from the north to the south. Since nearly all northern species are to be found in the south too, this increase in species numbers is a result of additional species occurring in the south rather than the result of a species replacement. When travelling in a north-south direction southern species normally appeared for the first time in the transition zone between savannah and forest. This north-south

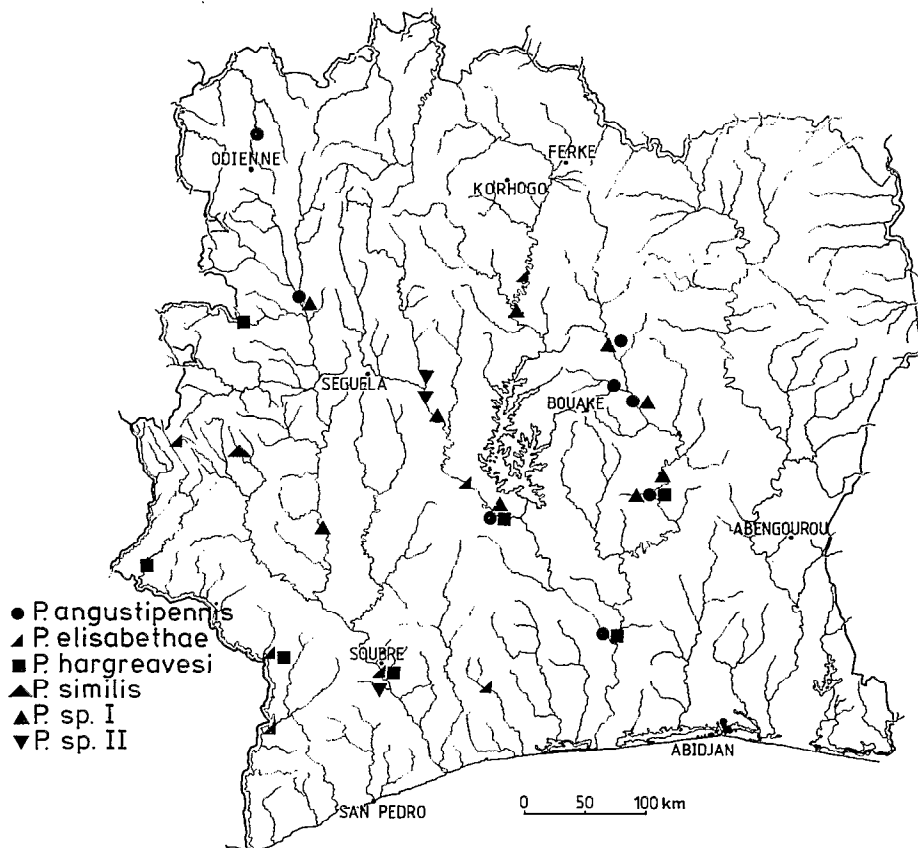


FIG. 16. — Distribution of *Polymorphanus*
Distribution de Polymorphanus

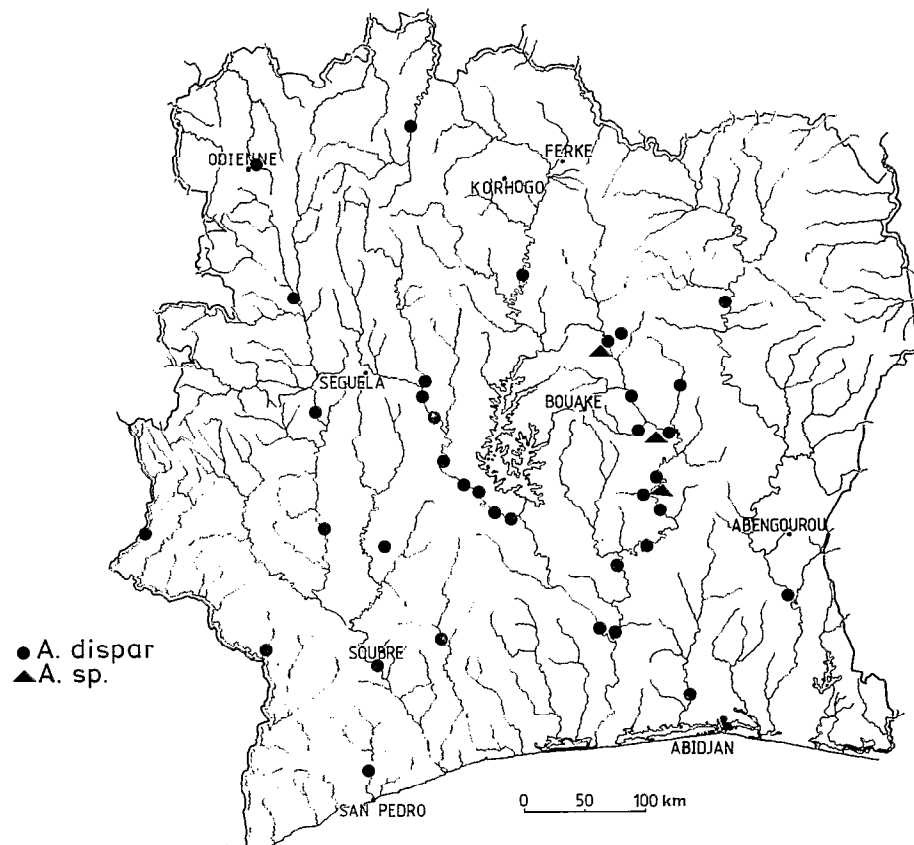


FIG. 17. — Distribution of *Aethaloptera*
Distribution de Aethaloptera

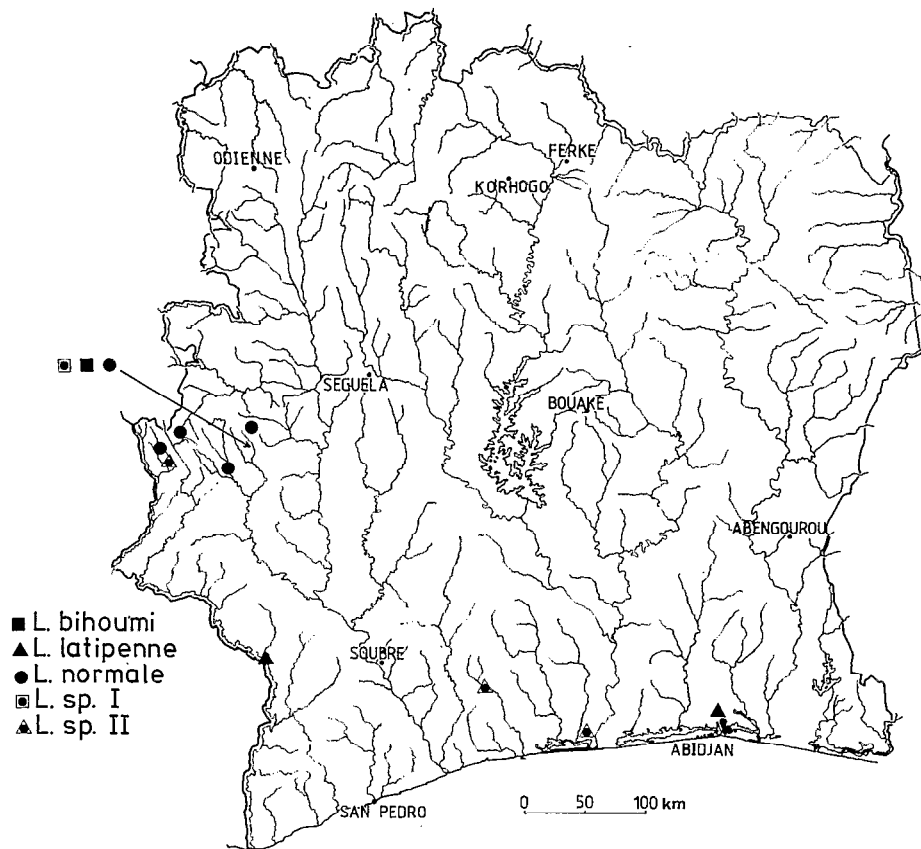


FIG. 18. — Distribution of *Leptonema*
Distribution de Leptonema

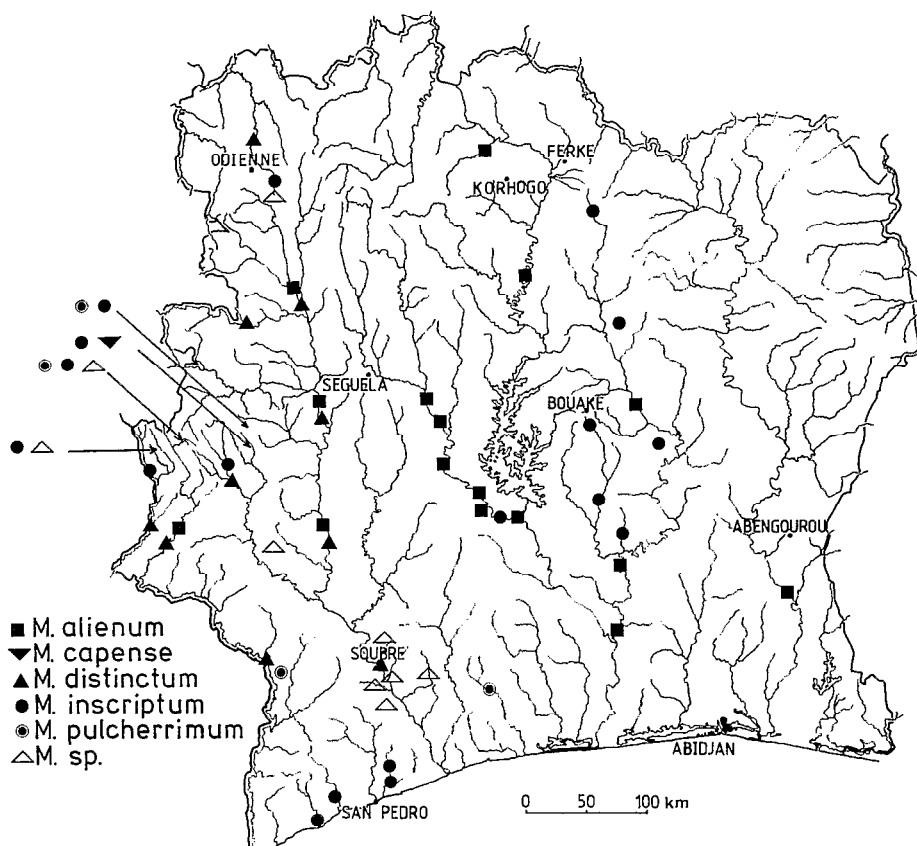


FIG. 19. — Distribution of *Macrostemum*
Distribution de Macrostemum

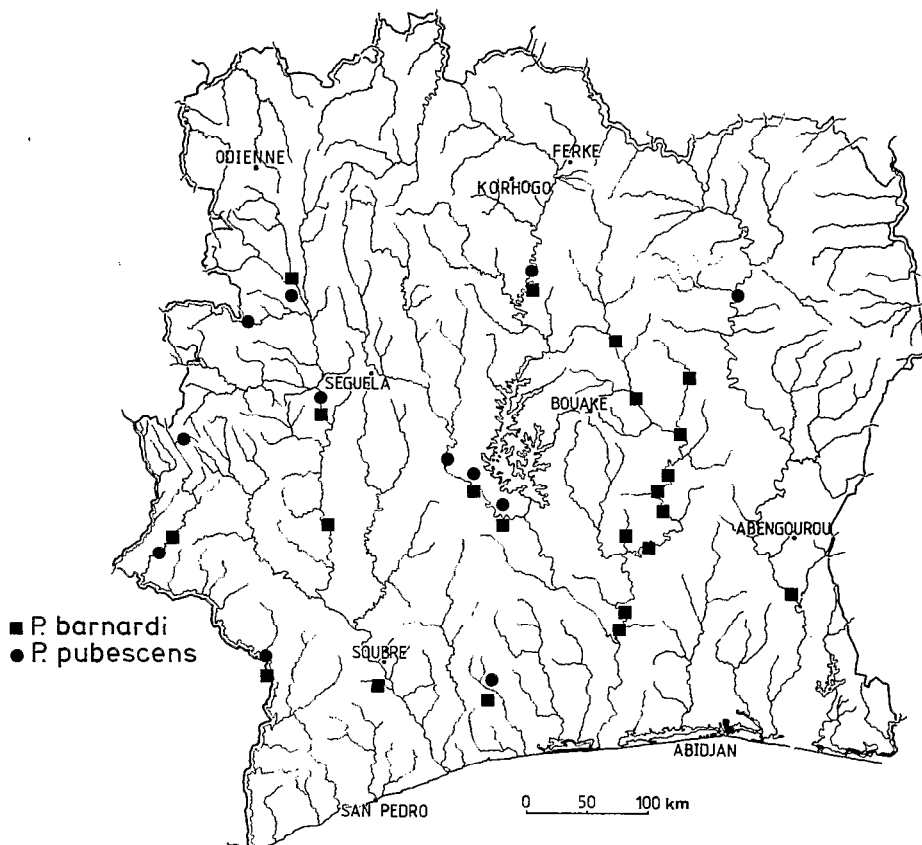


FIG. 20. — Distribution of *Protomacronema*
Distribution de Protomacronema

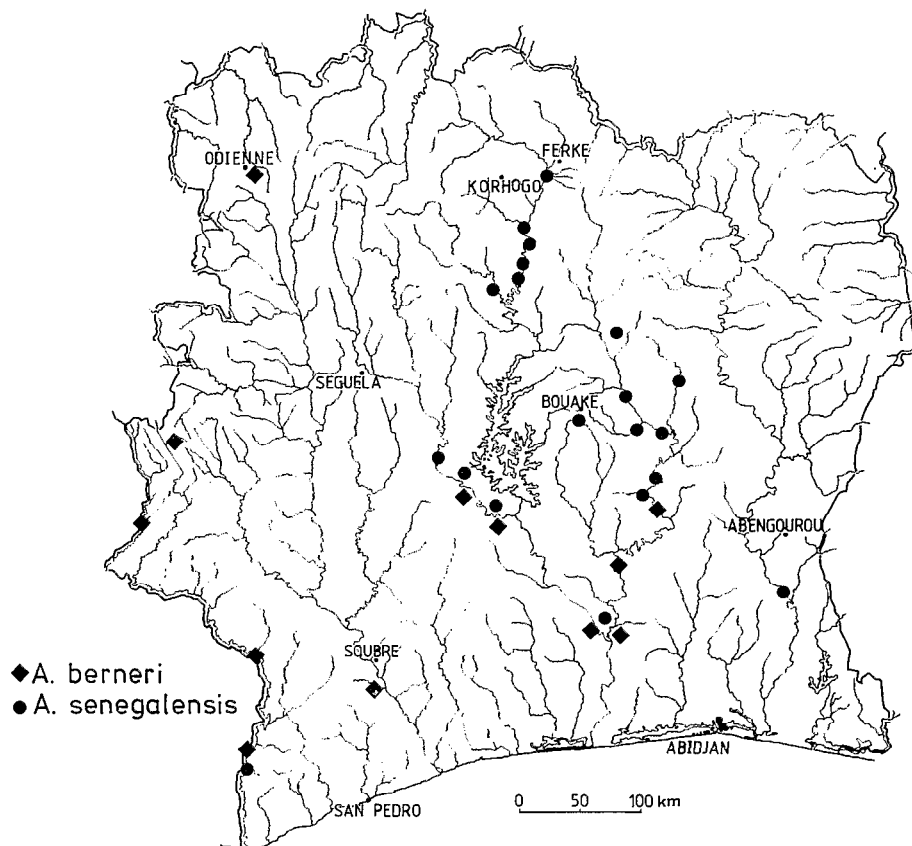


FIG. 21. — Distribution of *Amphipsyche*
Distribution de Amphipsyche

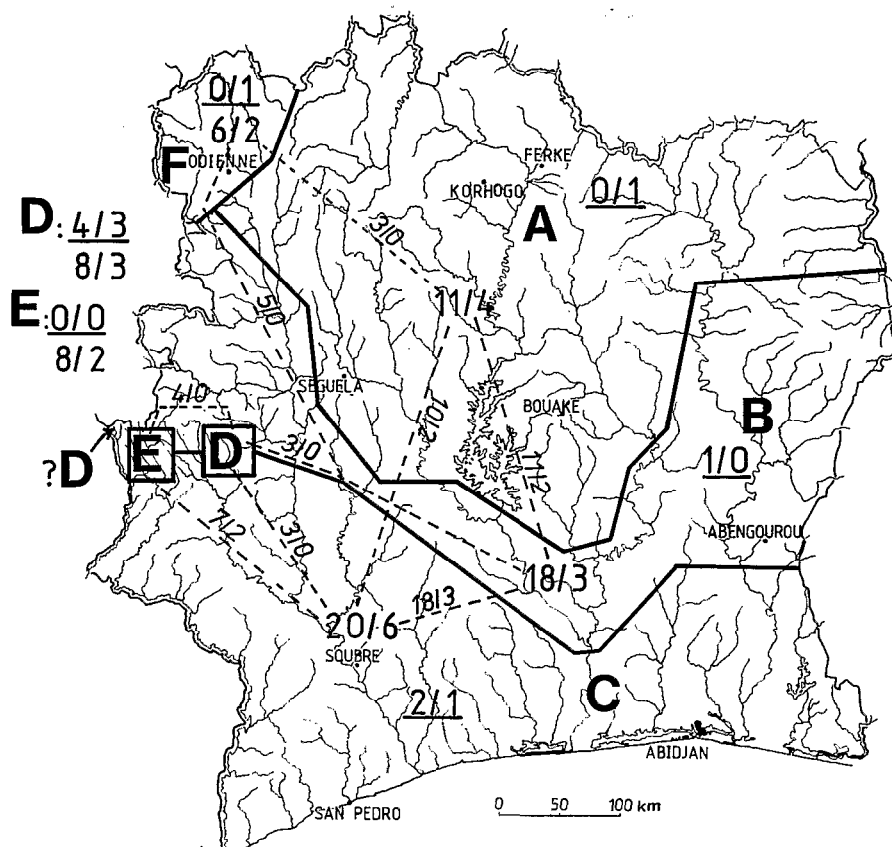


FIG. 22. — Summary of the distribution of all Hydropsychidae in the Ivory Coast. Numbers: total species/total unassigned larvae; if underlined: endemic to one of the areas. F: "wet" savannah; A: "dry" savannah; C: lowland forest; D: mountainous regions; B, E: zones of transitions. The limits between these areas are somewhat arbitrary due to continuing deforestation and shifts in distribution with the wet/dry-seasons. Numbers at broken lines between different areas indicated species number common to both areas

Récapitulation de la distribution de tous les Hydropsychidés en Côte d'Ivoire. Chiffres: espèces totales/larves totales non attribuées; si le chiffre est souligné: endémique dans une des zones. F: savane « humide »; A: savane « sèche »; C: forêt de plaine; D: régions montagneuses; B, E: zones de transition. Les limites entre ces zones sont un peu arbitraires en raison du défrichement continu et des changements de distribution en fonction des saisons sèches et humides. Les chiffres qui se trouvent sur les lignes discontinues délimitant les différentes zones indiquaient le nombre d'espèces commun aux deux zones

gradient in the distribution is expected to be caused mainly by the differences in the flow patterns between northern and southern streams (see Fig. 2 in STATZNER, 1984; ILLIS & LÉVÊQUE, 1982). Most northern streams are usually dry for a relatively long period. This period of drought gradually becomes shorter in a southerly direction and within the transition zone streams start to become permanent. Hence the ability of the species to survive periods without flow as a larva or an adult as well as the ability to recolonize such a stream after the resumption of flow by immigration of adults from other localities determines the northern distribution limit.

It is evident that the composition of species in the relatively rainy savannah in the west differs to some extent from that of the relatively dry savannah in the east. The region separated most clearly from all others is that of the mountainous region around Man. Although it could be not confirmed by samples, we assume that a similar fauna occurs on the Mt. Nimba (?D in Fig. 22). The area of low hills between these two mountainous areas is expected to be a transition zone between the mountains and the forest areas. From the mountainous areas *Leptonema normale* and *Cheumatopsyche lestoni* invade these hilly areas.

Except for a small area in the northeast (see Fig. 1 in STATZNER, 1984), our distribution maps are based on data obtained before the extension of the area treated by the OCP. In the meantime, the areas A, F, and B are treated with various insecticides according to the season. This led to a decrease in the abundance and occurrence of the Macronematinae.

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le 18 avril 1984*

APPENDIX

List of abbreviations used in the figures:

ae.	= aedeagus	pm.	= pupal mandible
ft.	= foretrochantin	Pods.	= postsegmental dorsal sclerite (pupa)
fw.	= forewing	r.	= right
gc.	= genitalia	se. ♀	= abdominal segment IX and X (female)
h.	= head (usually dorsal)	sm.	= submentum (larva)
l.	= left	st. IX	= sternite abdominal segment IX (larva)
mp.	= mouthparts (adult, ventral)	t.	= tergite abdominal segment IX (larva)
paa.	= pupal abdominal appendage	th. st.	= thoracic sternites (larva)
pds.	= presegmental dorsal sclerite (pupa)		

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