853

The *Simulium nigritarse* complex

(Diptera Simuliidae)

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INTRODUCTION

Freeman and de Meillon (1953) in their revision of the Simuliidae of the Ethiopian Region did not recognize the existence of a « *Simulium nigritarse* » complex. In the appendix of this monograph they admitted the existence of only two, closely related species: *S. nigritarse* Coquillett, 1902 and *S. aureosimile* Pomeroy, 1920. Two other related species (*S. brachium* Gibbins, 1936 and *S. simplex* Gibbins, 1936), however distinct by several morphological characters, were not retained as valid and were synonymized with *S. aureosimile*.

The reappraisal of some morphological characters, especially the structure and the shape of the pupal gills and of the larvae (Crosskey, 1960 and 1969), has led to a new approach to the systematic of the Afrotropical Simuliidae.

During 1948-1949, the senior author collected in Rwanda 24 species of *Simulium* of which 8 were new (Fain, 1950a and b). Among this material there was a species close to *S. aureosimile* but was however distinct from it by the presence on the base of the pupal gills of a voluminous transparent vesicle. The pupae of that species were collected in a small mountain river (riv. Funda) in Rwanda. Recently, we have restudied more in detail the pupal gills of other *Simulium* species from Central Africa and we found that a basal vesicle is also present but less developed in all of them. We also found in contact

with this vesicle another organ consisting of a chitinous plate bearing 3 to 6 setae (pilous plate). The shape of these organs and the number of setae on the pilous plate provided new characters allowing us to separate more accurately some closely related species of Afrotropical Simuliidae (Dujardin & Fain, 1980). In addition to the species with this large basal vesicle, the senior author found several other species close to *S. aureosimile* but differing from it by several pupal characters.

In order to identify this material we asked Dr. R. Crosskey, British Museum, to allow us to examine the typical material of Pomeroy (*S. aureosimile*) and of Gibbins (*S. brachium* and *S. simplex*). Very kindly Dr. Crosskey has loaned us this material and he also provided additional material of the *nigritarse* group among which several new species already recognized by him.

The present paper is a revision of the *nigritarse* complex. This group comprizes at present 19 species, among which 12 are new and are described here for the first time.

It is to be noted that none of the species concerned here have yet been studied chromosomally but one may expect that the cytotaxonomic characters will confirm the morphotaxonomic conclusions.

Abbreviations of the Institutions where holotypes have been deposited: BMNH = British Museum, Natural History, London; MRAC = Musée Royal de l'Afrique Centrale, Tervuren; MNHN = Muséum national d'Histoire naturelle, Paris; USNM = U.S. Natural History Museum, Washington.

MATERIAL EXAMINED

1. Material of British Museum, Natural History:

Through the kindness of Dr. R. Crosskey, we are able to study the typical material described by Pomeroy and Gibbins and also many not identified specimens collected in various countries of the Afrotropical Region and conserved in the BMNH.

2. Material of the Muséum d'Histoire naturelle, Paris: type specimens of *Simulium elgonicum* Seguy.

3. Material collected by M. Lips in south-eastern Zaïre (see Hallot et al., 1965).

4. Material collected in eastern Zaïre, in Rwanda and Burundi by A.F. from 1948 to 1953, and by P. Elsen in 1980 (see Fain, 1949 and 1950).

5. Material collected in Cameroun by P. Elsen (see Fain & Elsen, 1973).

6. Material collected on Mount Kenya by J. Bafort (see Bafort et al., 1977).

REMARKS ABOUT THE TAXONOMIC POSITION OF THE *S. nigritarse* COMPLEX

Crosskey and Büttiker (1982) have discussed the taxonomic position of the species of the *S. nigritarse* complex. These species form a well defined subgroup (subgroup *S. nigritarse*) which belongs to the larger *S. ruficorne* group that occurs in the Palearctic, Afrotropical and Oriento-Australasian regions. A diagnosis of this group has been given by Crosskey (1969).

Crosskey and Büttiker, in the same paper, have removed the species of the subgroup *S. nigritarse* from the subgenus *Eusimulium* and placed them in the subgenus *Nevermannia* Enderlein, of which *S. ruficorne* Macquart is the type-species. We will follow here this procedure.

HABITS OF THE SPECIES OF THE *S. nigritarse* COMPLEX

Little is known concerning the habits of the adults of the members of this complex. In Cape Province a specimen attributed to *S. nigritarse* was caught feeding on man (Freeman & de Meillon, 1953, p. 215).

Females attributed to *S. aureosimile* were captured feeding on a fowl in Kenya (de Meillon, in Freeman & de Meillon, 1953, p. 216).

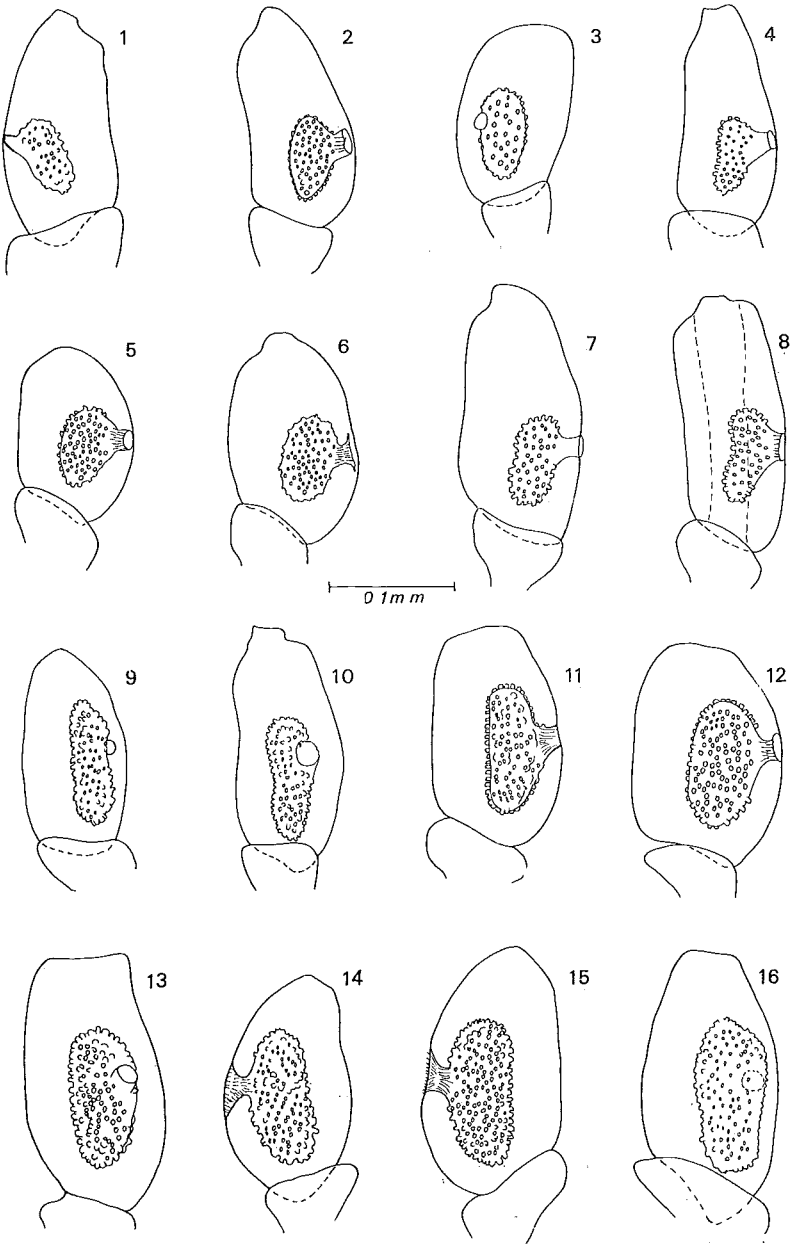
We have (present paper) caught feeding on wild birds eight females that are not separable from *S. flavinotatum*. These birds were shot down near the breeding places of this species.

DISTRIBUTION OF THE SPECIES OF THE *S. nigritarse* COMPLEX

The different species of the *S. nigritarse* complex are widely but unequally distributed in the Afrotropical region. They have never been found in the Western regions of Zaïre (e.g. Kinshasa, Mayumbe,

Kwango), in spite of extensive investigations. In South Africa this group is represented by two species, *S. nigritarse* and *S. brachium*. *S. nigritarse* extends in the eastern region of Africa until Kenya including Zimbabwe, Tanzania and the S.-E. of Zaïre. It is also known from Angola, Nigeria and Cameroun. It is generally found in lower areas at an altitude not exceeding 1500 m, at least if we consider our own observations, for the other records do not mention the altitude where the specimens were collected. The pupae of *S. brachium* are commonly found in East Africa (Tanzania, Kenya, Uganda) and eastern Zaïre, generally at altitudes varying from 1500 to 2000 m. It has also been found from Transvaal and South Africa (present paper).

It is in the mountain regions (altitude from 2000 to more than 4000 m) that speciation has been the most active and has led to the production of a series of very narrowly endemic species. This is the case for the following species: *S. sacculiferum*, known from two rivers in Rwanda and Burundi (2000 m); *S. bulbiferum* and *S. rubescens* from two rivers, in E. Kivu (Zaïre) and N.W. Rwanda (2500 and 3000 m); *S. duboisi* from one river in Rwanda (2500 m); *S. aspericorne* from two rivers on Mount Kenya (2350 to 4000 m); *S. flavinotatum* from a river in Rwanda (2300 m); *S. sirimonense* from Mount Kenya (2500 to 4000 m) and Mount Ruwenzori (in the Senecio forest) (4000 m); *S. raybouldi* from Mount Kilimandjaro, Tanzania (2400 m), and from another river of unknown altitude near Arusha, Tanzania; *S. alatum* from Mount Kenya (2140 to 3700 m); *S. baforti* from Mount Kenya (2140 to 3250 m); *S. simplex* from a river in Uganda (1800 m), a river in W. Kenya (2470 m) and a river in N.E. of Zaïre (2200 m); *S. aureosimile* from Cameroun (4 rivers at 1000 to 2300 m) and from the Mount Kenya (2140 to 3550 m); *S. antibrachium* from Mount Kenya (2140 to 4000 m) and W. Cameroun. The other species breeding mostly at lower altitudes have a wider distribution. This is the case for *S. nigritarse* and *S. brachium* mentioned above, and for *S. arabicum* which is found in Saudi Arabia (typical locality), Yemen, Ethiopia, Tanzania, Uganda, Kenya, Nigeria and Guinea. The known altitudes of the breeding places of *S. arabicum* are 850 m, 1350 m, 1650 m, 2000 m and 2800 m. The exact altitudes of the breeding places of two other species, *S. nyanzense* from Kenya and *S. candelabrum* from Tanzania, are unknown.



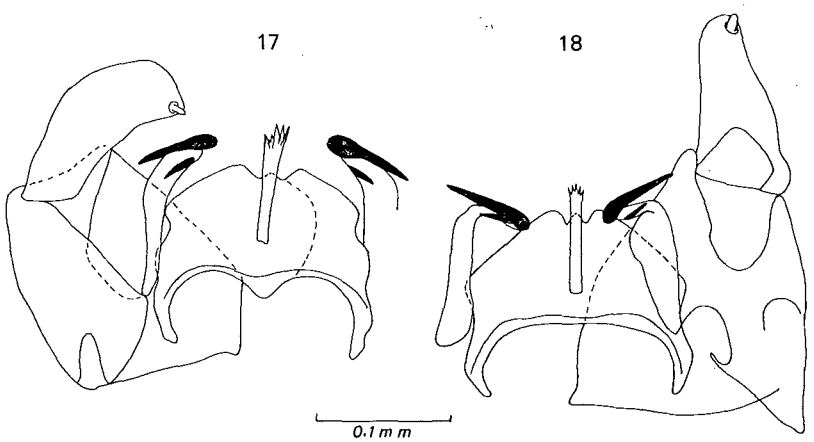
Figs. 1 - 16. — Third segment of palp, in females. - 1. *S. alatum;* - 2. *S. aureosimile* (Djem); - 3. *S. simplex;* - 4. *S. flavinotatum;* - 5. *S. nigritarse* (Nafyebo); - 6. *S. baforti;* - 7. *S. antibrachium* (Sirimon II); - 8. *S. antibrachium* (Marimba II); - 9. *S. brachium;* - 10. *S. raybouldi;* - 11. *S. bulbiferum;* - 12. *S. sacculiferum;* - 13. *S. rubescens;* - 14. *S. candelabrum;* - 15. *S. nyanzense;* - 16. *S. sirimonense* (Ruwenzori).

REMARKS ON SOME MORPHOLOGICAL CHARACTERS IN THE *nigritarse* COMPLEX

A. ADULTS.

1. *Size of third palpal segment in females* (figs. 1 - 16)

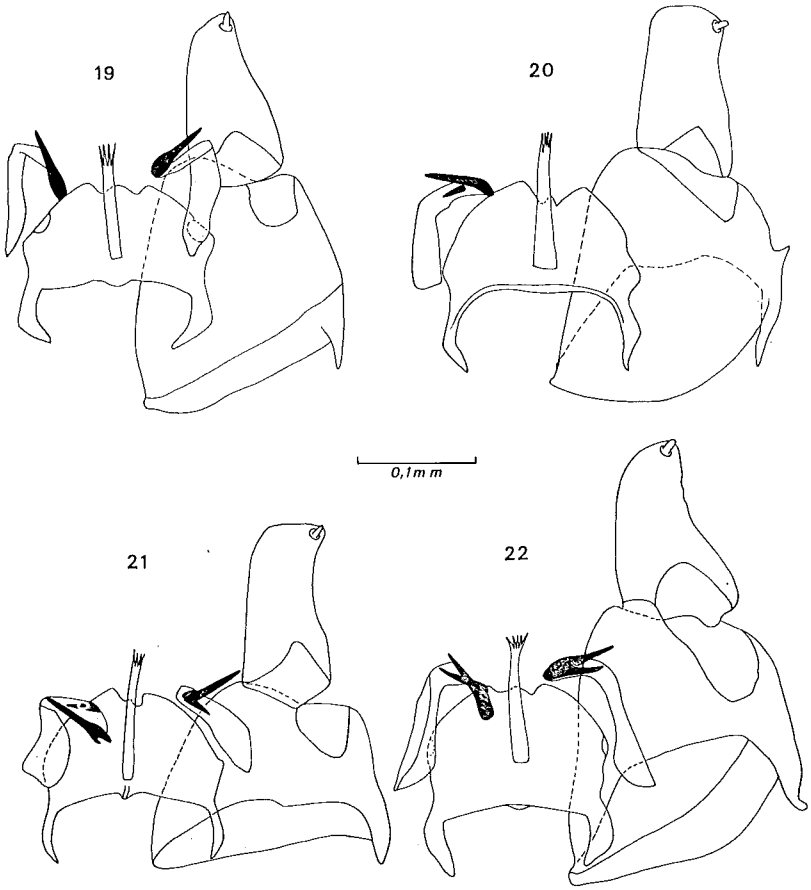
This segment is short and thick (about 1,5 to 1,7 times as long as wide) in *S. nigritarse* (specimen from riv. Nafyebo), *S. sacculiferum, S. bulbiferum, S. simplex, S. baforti.* In other species it is from 2 to 2,5 times as long as wide (*S. flavinotatum, S. aureosimile, S. antibrachium, S. sirimonense, S. raybouldi, S. arabicum*).



Figs. 17 - 18. — Male terminalia. - 17. *S. nigritarse* (Nafyebo); - 18. *S. aureosimile* (Djem).

2. *Shape of the sensory vesicle in the third palpal segment* (figs. 1-16)

In females this organ is broad or very broad (more than half the length of the segment) in *S. sacculiferum, S. rubescens, S. sirimonense, S. brachium, S. nyanzense, S. candelabrum* (figs. 9-16) and distinctly shorter than half of this length in *S. flavinotatum, S. simplex, S. nigritarse* (from riv. Nafyebo), *S. aureosimile, S. alatum, S. arabicum, S. antibrachium, S. baforti* (figs. 1-8). In males this organ is always small but its orifice may be much smaller than the vesicle (*sacculiferum, rubescens*) or nearly as large as half the diameter of the vesicle (*flavinotatum*).



Figs. 19 - 22. — Male terminalia. - 19. *S. sacculiferum;* - 20. *S. sirimonense;* - 21. *S. flavinotatum;* - 22. *S. rubescens.*

3. *Colour of mesonotum and of mesonotal scales.*

In some species the mesonotum has a reddish colour, either dark or pale and more or less pronounced according to the species. It is specially marked and pale in *S. rubescens,* but is also distinct but darker in *S. sacculiferum* and *S. flavinotatum.* In *S. nigritarse* the mesonotum is black. In several species (*sacculiferum, flavinotatum, rubescens,* etc.) the mesonotum is covered by golden scales, mixed posteriorly with coppery scales. In *S. nigritarse* the scales on mesonotum are narrow and mainly silvery.

4. *Scales on postnotum.*

A pair of tufts of pale scales is visible in the paramedian region of the postnotum of *S. nigritarse* and of *S. arabicum.* In all the other species the postnotum is bare.

5. *Legs III in males.*

The metatarsus and tibia III are dilated in all the males of the *nigritarse* complex.

6. *Mandibles and maxillae in females.*

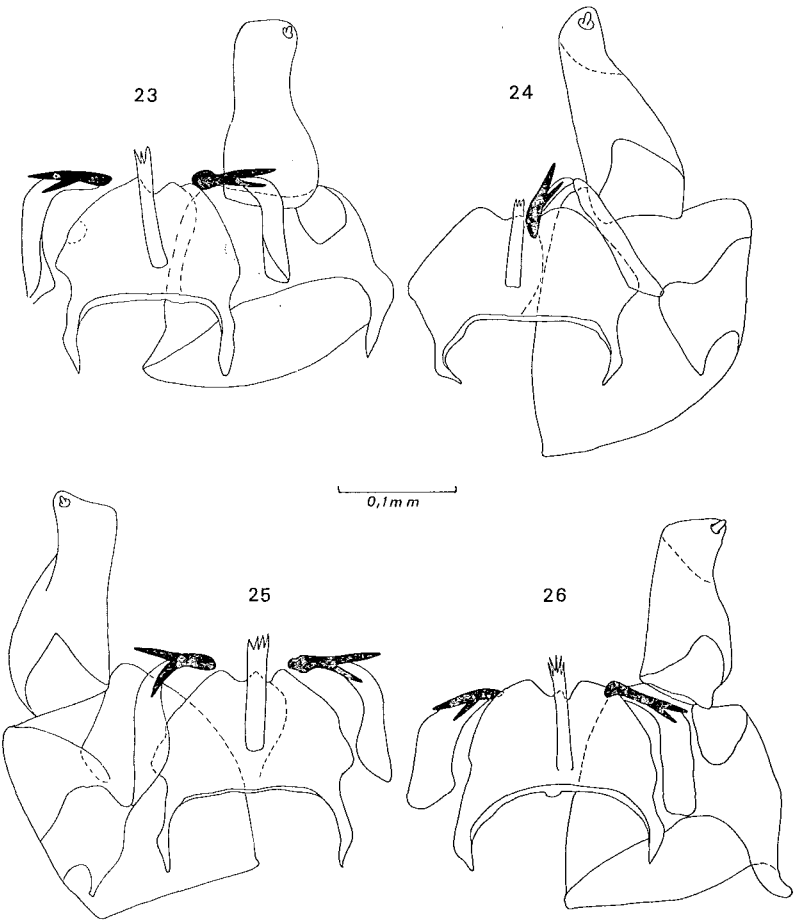
The mandibles carry generally more teeth (at internal side) than the maxillae (at external side), however in *S. aspericorne* the maxillae bear more teeth (17-6) than the mandibles (0-12 to 13).

7. *Wings.*

The subcosta bears more macrotrichia in females than in males. In the female of *S. sacculiferum* this vein is completely hairy (75 macrotrichia). In the females of the other species the apical part (20 % to 40 %) is bare. In the male of *sacculiferum* the three basal quarters are hairy (31-35 macrotrichia), in that of *S. rubescens* the subcosta bears only 2 to 3 hairs near the base, the rest being bare. In the female of *S. sacculiferum* the anal vein is longer and arrives closer to the margin of the wing than in the other species.

8. *Claws in female.*

In all the species the claws bear a large basal tooth.



Figs. 23 - 26. — Male terminalia. - 23. *S. raybouldi* (holotype); - 24. *S. alatum;* - 25. *S. antibrachium* (Ontulili); - 26. *S. nyanzense.*

9. *Abdomen.*

The hairs on the first abdominal segment may be very long and yellow (male of *S. simplex*) or shorter and either pale or very dark. In some species especially in females the median area of most of the tergites or of only the posterior tergites, is covered by numerous and narrow coppery scales. Coppery scales may also be present in the postero-lateral areas of abdomen.

10. *Terminalia in male and female* (figs. 17 - 36)

The ventral plate in male is relatively wider in *S. alatum, S. sirimonense, S. sacculiferum* and *S. aureosimile* than in *S. raybouldi, S. rubescens* and *nyanzense*. In *S. aureosimile, S. nigritarse, S. raybouldi, S. bulbiferum, S. rubescens, S. flavinotatum, S. aspericorne, S. alatum, S. nyanzense* and *S. sirimonense* there are two pairs of strong unequal parameral hooks, while in *S. arabicum, S. duboisi* and *S. sacculiferum* there is only one pair. The style is distinctly shorter than the coxite in *S. aureosimile, S. rubescens, S. sirimonense, S. sacculiferum, S. arabicum* and as long or longer than the coxite in *S. flavinotatum, S. bulbiferum, S. alatum, S. antibrachium* and *S. nyanzense*. The female cercus may be either distinctly triangular or rounded posteriorly (figs. 27-36).

B. Pupa and Cocoon.

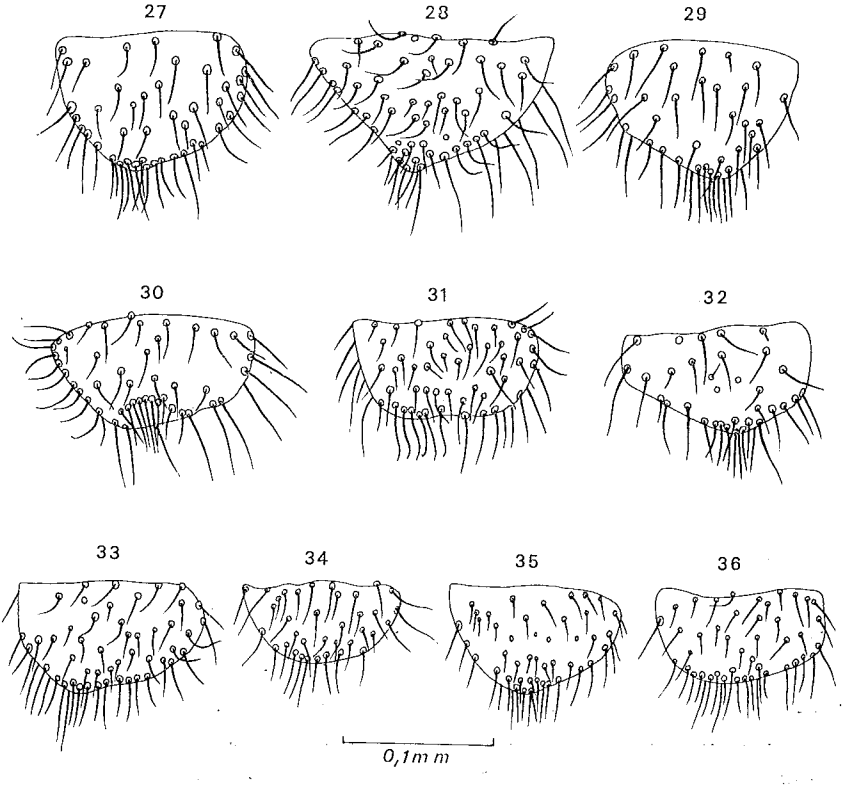
1. *Shape and colour of the basal trunk of the pupal gills.*

In *S. flavinotatum* the basal trunk is strongly sclerotized and bright orange in colour. In all the other species the basal trunk has no distinct colour, except in *S. rubescens* in which it may show a pale yellow colour. The basal trunk may be either very short and about as wide as long (*S. simplex, S. flavinotatum*), slightly longer than wide (most of the species) or much longer than wide (*S. raybouldi, S. alatum, S. baforti, S. nyanzense, S. rubescens*). In *S. flavinotatum* the basal trunk is slightly compressed laterally and enlarged dorso-ventrally; in *S. simplex* on the contrary the basal trunk is flattened dorso-ventrally and it appears wider in dorsal view than in lateral view (figs. 72-76).

2. *Shape and size of the basal vesicle of the pupal gills* (figs. 53 - 76)

The basal vesicle is a thin chitinous pouch situated at the anterior part of the base of the pupal gills (see Dujardin and Fain, 1980). The size of the basal vesicle may vary strongly according to the species.

It seems that there is some relationship between the size of the vesicle and the altitude of the breading places. The largest vesicle is observed in *S. bulbiferum* which bread in rivers at 2500 to 3000 m altitude, the smallest in *S. nigritarse* which occurs generally at low altitudes. One may distinguish three main types of vesicle :



Figs. 27 - 36. — Cerci of females. - 27. *S. antibrachium;* - 28. *S. rubescens;* - 29. *S. alatum;* - 30. *S. sacculiferum;* - 31. *S. aureosimile* (Djem); - 32. *S. bulbiferum;* - 33. *S. nigritarse* (Nafyebo); - 34. *S. baforti;* - 35. *S. candelabrum;* - 36. *S. nyanzense.*

Type 1 : Basal vesicle very large and surrounding the anterior and the lateral surfaces of the basal trunk. The external part of the vesicle is expanded in a voluminous ovoid whitish pouch longer than the basal trunk (e.g. *S. sacculiferum* and *S. bulbiferum*) (figs. 59-60).

Type 2: Basal vesicle well-developed but much less expanded and not longer than the basal trunk. This type is found in *S. raybouldi, S. rubescens, S. aureosimile, S. simplex, S. nyanzense, S. brachium,* etc.

Type 3: Basal vesicle small, distinctly shorter than the basal trunk (e.g. *S. nigritarse*).

3. *Structure of the pilous plate* (figs. 81 - 96)

In most of the species the pilous plate bears six short stiff setae gradually tapering towards the apex. In two species (*S. sacculiferum* and *S. bulbiferum*) these setae are very long and drumstick-like. In *S. nigritarse* (specimen from S.E. of Zaïre) and *S. raybouldi* all the setae are short and divided in either two, three or more branches (figs. 84-85). In *S. duboisi* at least 4 hairs are forked, the 2 others were broken in the only specimen examined. In *S. sirimonense* one hair is bifid.

4. *Mode of emergence of the filaments from basal trunk.*

The four filaments arise from the basal trunk in different ways. One may distinguish three main types:

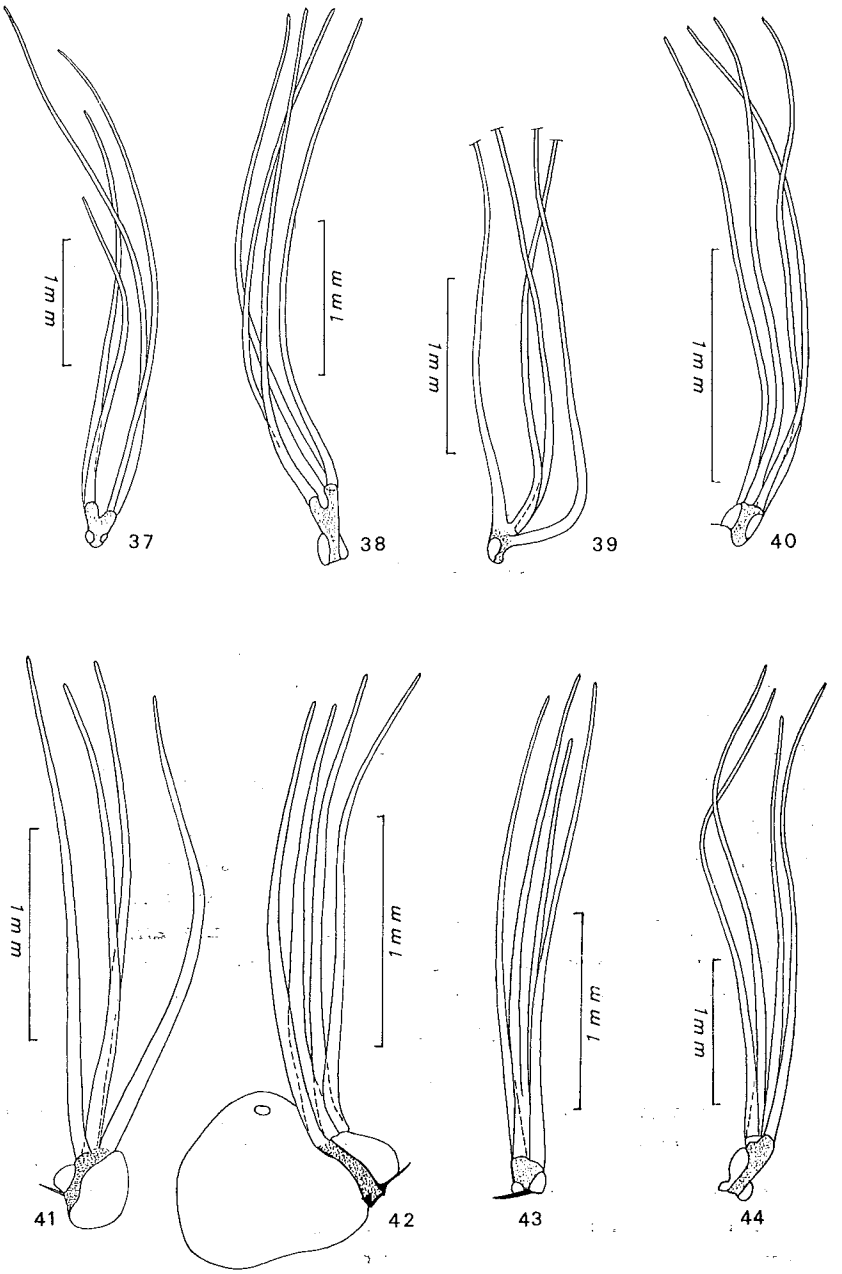
Type 1: The four filaments arise directly from the basal trunk, without definite pairing. This is the case for most of the species.

Type 2: Two filaments arise directly from the basal trunk, and two from a definite secondary trunk (*S. arabicum, S. antibrachium, S. candelabrum, S. sirimonense* and *S. nigritarse* from S.E. Zaïre).

Type 3: The four filaments arise in two definite pairs, each on either a short or a long common stalk, these stalks being generally unequal. This type is found in *S. nigritarse, S. aureosimile* and *S. aspericorne.* These two secondary trunks may vary in absolute or relative length in the same population (see description of *S. nigritarse*)

5. *Shape and length of the filaments* (figs. 37 - 52)

In *S. nigritarse* the 4 filaments are distinctly unequal in length and one is always much shorter than the others; in all the other species they are equal or subequal except in *S. alatum* and in *S. candelabrum* where one filament is distinctly longer than the three others. The configuration of the filaments is an important character in the separation of the species. In *S. arabicum* the filaments are spreading and



Figs. 37 - 44. — Pupal gills. - 37. *S. nigritarse* (Cape Province); - 38. *S. aureosimile* (Baliben); - 39. *S. brachium* (Nkokonjeru); - 40. *S. simplex;* - 41. *S. sacculiferum;* - 42. *S. bulbiferum;* - 43. *S. flavinotatum;* - 44. *S. rubescens.*

the uppermost filament and sometimes also the second and even the third are more or less suddenly bent or angled downwards at short distance from its base.

In *S. brachium* the uppermost filament describes a regular curve dorsally without angulation. In *S. antibrachium* it is the lowermost filament that is strongly curved ventrally, the uppermost being only slightly curved dorsally. In *S. duboisi* the four filaments are very thick and straight and they are spreading in different directions. In *S. candelabrum* the uppermost and lowermost filaments are opposite in direction, another is directed outwards and the fourth is directed forwards. In other species the filaments are very slightly spreading or remain parallel and lie close together (e.g. *S. simplex, S. flavinotatum, S. nyanzense, S. baforti, S. rubescens*).

6. *Structure of the filament walls* (figs. 77 - 80)

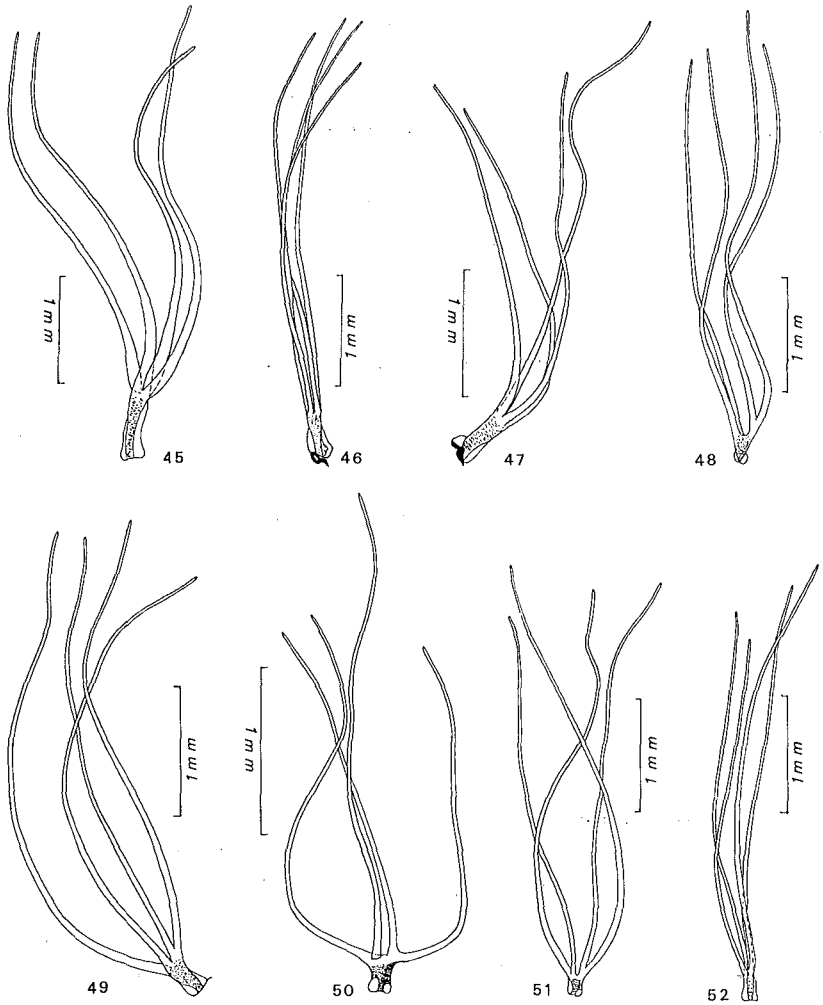
One can distinguish four main different types of filaments :

Type 1: Presence of a strongly raised reticulum. This reticulum is formed of a mixture of either short or very short piliform structures disposed along obliquely directed lines forming a raised network. This type of structure is found in *S. aureosimile, S. rubescens, S. bulbiferum, S. duboisi* and *S. aspericorne.* In the last two species the filaments are strongly sclerotized and very dark (fig. 77).

Type 2: Resembling type 1 but the piliform structures are not so strongly raised, they are equal in length, and disposed mainly along transverse lines. This type is encountered in *S. simplex* and *S. flavinotatum* (fig. 78). In *S. raybouldi, S. antibrachium* and *S. perforatum* the structure is somewhat intermediate between types 1 and 2 and there are poorly distinct irregular transverse or oblique lines, forming occasionally a slightly raised reticulum.

Type 3: With very short raised piliform structures not forming distinct transverse lines nor a network (fig. 79). This type is found in all the other species except in *S. sacculiferum.*

Type 4: The walls of the filaments are devoid of raised piliform structures but they bear very small irregular rounded structures. This type is found in *S. sacculiferum* (fig. 80).



Figs. 45 - 52. — Pupal gills. - 45. *S. raybouldi;* - 46. *S. nyanzense;* - 47. *S. alatum;* - 48. *S. perforatum:* - 49. *S. antibrachium;* - 50. *S. candelabrum;* - 51. *S. sirimonense;* - 52. *S. baforti.*

7. *Disc-like tubercles and pointed projections on the pupal head and thorax.*

We have examined three dorsal areas of the pupa: the thorax along the median longitudinal suture, the thorax around the bases of the gills and the head. This head area corresponds to the dorsal surface of the larva and it bears a pattern recalling that of the larva, but in negative.

In *S. duboisi* and *S. aspericorne* these areas are covered by very numerous pointed or spine-like projections mixed at some places with a few disc-like tubercles. In *duboisi* the spine-like projections are relatively very long especially in the area close to the pilous plate.

In *S. aureosimile* these area are densely covered by disc-like tubercles. Pointed projections exist in some specimens but they are confined to a small area close to the pilous plate. These spine-like projections are missing in all the other species.

In *S. bulbiferum* and *S. arabicum* there are numerous disc-like tubercles in the three areas.

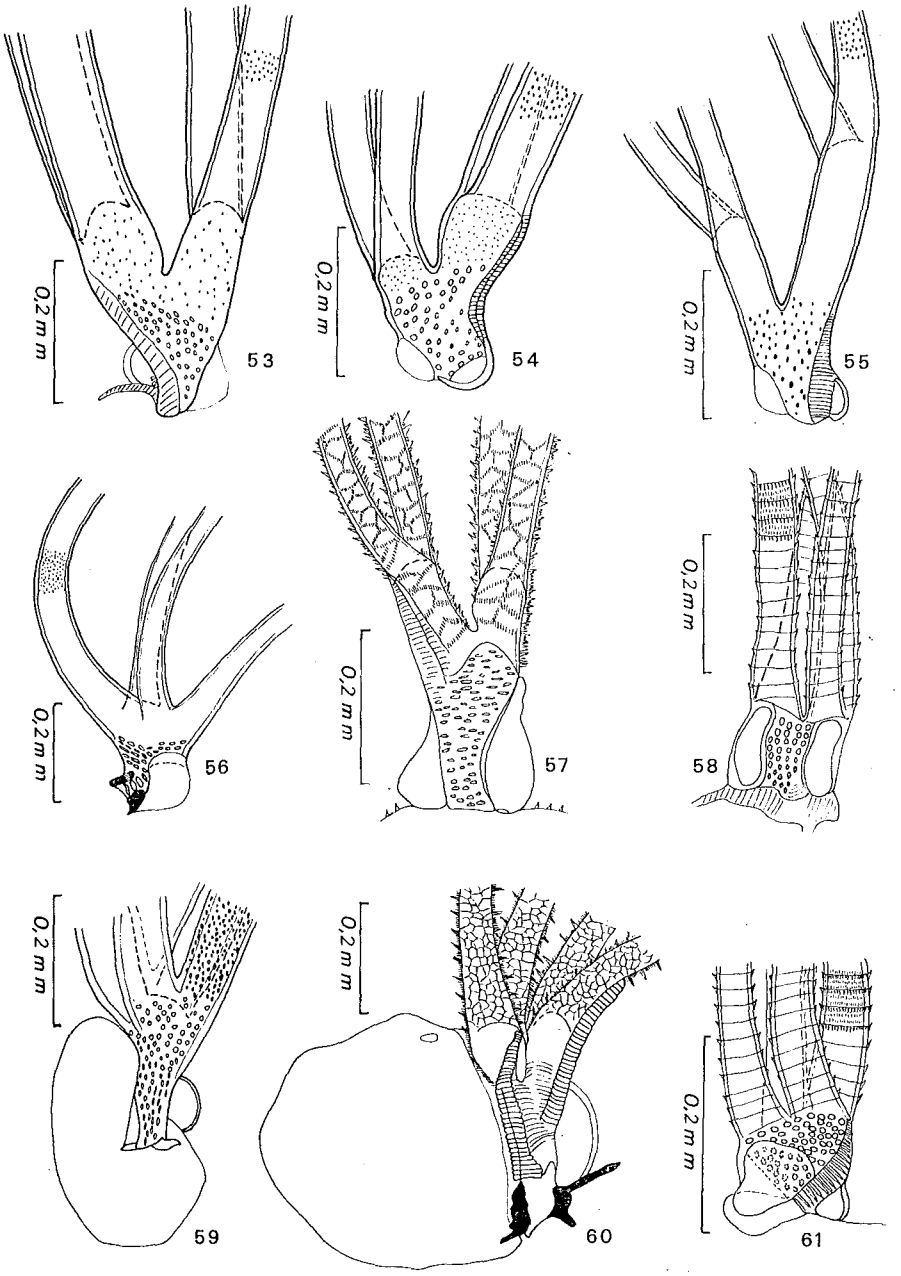
In *S. simplex* these areas are densely covered with disc-like tubercles except around the gills where they exist only on the posterior part of this area.

In *S. perforatum* the disc-like tubercles are well developed on the three areas.

In *S. antibrachium* the disc-like tubercles are very numerous in the three areas in the specimens from Cameroun but they are less abundant around the gills in the specimens from Mount Kenya.

In *S. nigritarse* (from Nafyebo) numerous disc-like tubercles are present on these three areas, but they are distinctly less numerous than in *S. aureosimile*.

In *S. sirimonense* the shape and the number of tubercles vary strongly according to the origin of the specimens. In the specimens from Mount Kenya the tubercles are replaced by flat grains that give a more or less shagreen aspect to the cuticle. Their number varies according to the specimen but generally they are poorly developed in the three areas. In all the specimens from Mount Ruwenzori raised disc-like tubercles are very abundant in the three areas.



Figs. 53 - 61. — Bases of pupal gills. - 53-55. *S. nigritarse:* 53. from Cape Province, 54. from Nafyebo, 55. from riv. Séré, Cameroun; - 56. *S. brachium;* - 57. *S. aureosimile* (Djem); - 58. *S. simplex;* - 59. *S. sacculiferum;* - 60. *S. bulbiferum;* - 61. *S. flavinotatum.*

In *S. brachium* (from Nkokonjeru) disc-like tubercles are few in numbers in the three areas.

In *S. rubescens* all the tubercles are flat they are rather numerous along the suture anteriorly and on the head and rare around the gills.

In *S. flavinotatum* rare tubercles are present along the suture, the other areas have no tubercles.

In *S. sacculiferum* tubercles are absent on the head and rare and flat in the other areas.

In *S. baforti* and *S. nyanzense* there are a very few tubercles on head and along the suture and no tubercles around the gills.

In *S. alatum* and *S. candelabrum* these tubercles are very rare or absent on the three areas.

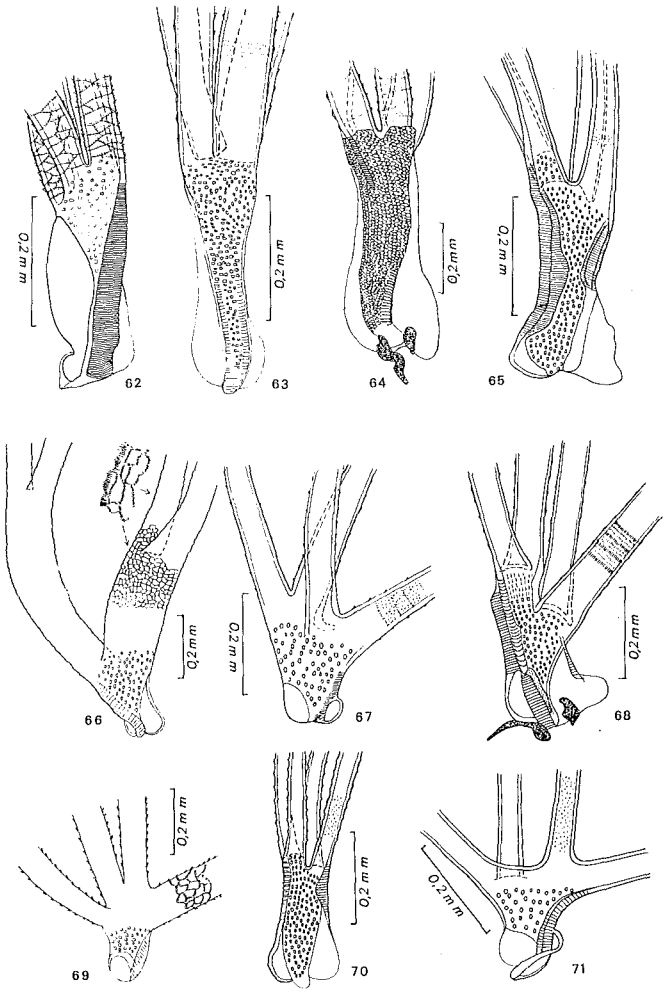
In *S. raybouldi* we have not observed tubercles on these areas.

It appears that there is some relation between the density of the disc-like tubercles or the spine-like projections on the pupal head and thorax and the structure of the pupal gills. It is in the species where the filaments are the most soulptured (*S. duboisi, S. aspericorne, S. aureosimile* and *S. bulbiferum*) that these tubercles or projections are the most developed. The only exceptions are *S. flavinotatum* and *S. rubescens* whose filaments bear a strong structure while the cuticle of thorax and head of the pupa bears only a few number of tubercles.

8. *Onchotaxy of the pupal abdomen* (figs. 97 - 111)

In *S. simplex* the following structures are present at each side. *Dorsum:* segments 3 and 4 with a row of 4 small recurved hooks; segments 5 to 9 with a row of smaller backwardly directed spines (4 to 6 on segments 5 and 6; 4 to 5 on segment 7; 5 to 6 on segment 8 and 2 to 3 much smaller spines on segment 9). *Ventrally:* segment 4, 6 and 7 with 1 thin simple and 1 bifid hook, segment 5 with 2 bifid hooks. In addition the venter bears combs formed of microspinules : one comb on segments 5, 6, 7 and 8 and 2 combs on segment 4 (figs. 97-98).

In *S. raybouldi, S. sirimonense, S. aureosimile, S. nigritarse* (from Kaduna, Nigeria), *S. candelabrum, S. sacculiferum, S. alatum* and *S. aspericorne* there are no spines on segment 5.



Figs. 62 - 71. — Bases of pupal gills. - 62. *S. rubescens;* - 63. *S. nyanzense,* - 64. *S. raybouldi;* - 65. *S. alatum;* - 66. *S. aspericorne;* - 67. *S. sirimonense* (Mt. Kenya); - 68. *S. antibrachium;* - 69. *S. duboisi;* - 70. *S. baforti;* - 71. *S. candelabrum.*

In *S. brachium* (1 pupa) the segment 5 bears at one side a very small trifid spine.

In *S. baforti, S. nigritarse* (specimens from Zaïre, South-Africa, Kenya and Cameroun), *S. antibrachium* and *S. flavinotatum* these spines are present on segment 5 but they are smaller than those of segment 6 and much smaller than in *S. simplex.*

In *S. candelabrum* the segment 6 bears only small spines, much smaller than those of segment 7.

The shape, size and number of these dorsal spines vary in the different species.

In *S. sirimonense* the cuticle of the anterior segments is thick and bears very small and very numerous rounded or oval slightly raised structures.

9. *Shape and structure of the cocoon* (figs. 112 - 127)

The cocoon in the species of the *nigritarse* complex is always slipper-like, however in some species (e.g. *S. sacculiferum, S. sirimonense*) the antero-ventral parts of the cocoon are strongly developed and are either contiguous or fused in the midline.

The texture of the cocoon is variable. Three different types may be distinguished :

a) Cocoon finely woven without perforations or fenestrations and not reinforced laterally by thick threads (e.g. *S. nigritarse, S. aureosimile, S. raybouldi, S. antibrachium, S. candelabrum, S. flavinotatum, S. sacculiferum, S. duboisi, S. nyanzense, S. rubescens* and *S. arabicum*). In some of these species either the lateral or the median parts or both are reinforced by very thin poorly distinct threads (figs. 117 - 127).

b) Cocoon finely woven and without perforations or fenestrations but distinctly reinforced by a few thick transverse threads (*S. alatum*) or by very numerous threads irregular in thickness and in orientation (*S. simplex*) (figs. 115-116).

c) Cocoon loosely woven, basket-like, with small and numerous perforations (*S. brachium, S. bulbiferum, S. aspericorne*) (figs. 112-113) or with large irregular perforations or fenestrations (*S. sirimonense*) (fig. 114) and *S. perforatum.*

A slightly thickened anterior rim is present in the cocoons of all the species, however in *S. rubescens, S. brachium* and *S. sirimonense* this rim is poorly developed or absent. A median projection of the anterior border is well developed in *S. raybouldi, S. aspericorne* and *S. alatum,* poorly developed in *S. nyanzense* and absent in the other species.

C. LARVA.

The following characters have been studied :

1. *Size of the body:*

The length varies from 5 to 10 mm in mature larvae (table I).

2. *Pigmentation of dorsal surface of the head:*

There are typically six pigmented areas in the middle area of the dorsal surface of the head : two median and 4 paramedian. The size and shape of these areas varies slightly from species to species. In some species there is a third median pigmented area in the posterior part of the head. There are no negative spots.

3. *Hypostomium* (table I):

The size and the degree of projection of the median tooth vary in the different species. The distance between the corner teeth and from the corner tooth to the first hypostomial seta as well as the number of hypostomial setae vary in the different species.

4. *Antennae* (table II):

The relative lengths of the three segments (the short apical segment is included in the third segment) as well as the ratio of « length: width » of the basal segment may be used in the study of the species.

5. *Mandible*

Shape and size of the apical teeth and the comb teeth and of the mandibular serrations.

6. *Respiratory histoblast.*

This is a good character for recognizing the species. The shape and the structure of this organ are basically the same as for the pupal gills. The aspect of the basal trunk, the basal vesicle and the pilous plate and the structure of the filaments provide important characters in the systematic of the group.

RELATIVE IMPORTANCE OF THE MORPHOLOGICAL CHARACTERS IN THE SEPARATION OF THE SPECIES OF THE *nigritarse* COMPLEX

It appears from our study that the most reliable characters for separating the members of the *S. nigritarse* complex are the characters of the pupa and of the cocoon, especially the following ones : relative length and colour of the basal trunk of the gills, size and shape of the basal vesicle, length and shape of the pilous plate hairs, mode of emergence of the filaments, their direction, their length and their texture, onchotaxy of the pupal abdomen, degree of extension and shape of tubercles on pupal head and thorax, shape and texture of the cocoon.

The characters of the adults are much less useful. The most reliable are the colour of the scales on thorax and abdomen, the presence or absence of tufts of hairs on the postnotum, in the female the relative size of the sensory vesicle of the palp, the shape (rounded or triangular posteriorly) of the cercus, in male the shape of the posterior leg (dilation of metatarsus and tibia), the size of the style, coxite and ventral plate, the number of parameral hooks.

The larval characters are also useful but less than the pupal characters, especially the shape and the structure of the respiratory histoblast and of its accessories (pupal vesicle, pilous plate), the structure of the mandible, the relative lengths of the antennal segments.

KEY TO THE SPECIES OF THE *nigritarse* COMPLEX

— Pupal gills and cocoons —

1. Walls of filaments with a strongly raised reticulum (type 1) visible even at low magnification 2

   Filaments without such a strongly raised reticulum. An incomplete and slightly raised reticulum is however present in *S. antibrachium, S. raybouldi* and *S. perforatum* 6

2. Filaments with thick walls strongly sclerotized and dark brown or blackish. Dorsal surface of pupal thorax and head covered with spine-like projections 3

   Filaments with walls not abnormally thick or sclerotized, paler. Dorsal surface of pupal thorax and head mainly or exclusively covered with disc-like tubercles 4

3. The four filaments are very thick and relatively short. They arise directly from the base and are strongly divergent. Total length of pupal gills 2 mm. Cocoon finely woven without antero-median process ..... *S. duboisi*

   The four filaments are thinner and longer. They arise from 2 basal rather thick stems 300 and 500 μ long respectively. Total length of pupal gills 3 mm. Cocoon loosely woven with an antero-median process ..... *S. aspericorne*

4. The four filaments arise directly from the base and lie closely together 5

   The four filaments arise from 2 generally unequal secondary stems. Cocoon finely woven without fenestrations, there is no median process ..... *S. aureosimile*

5. Basal vesicle very voluminous and longer than the basal trunk. Hairs of pilous plate very long and inflated apically. Cocoon with fenestrations laterally ..... *S. bulbiferum*

   Basal vesicle small and shorter than the basal trunk. Hairs of pilous plate shorter not inflated apically. Cocoon finely woven without fenestrations ..... *S. rubescens*

6. Filament walls with very short raised piliform structures disposed either on transverse lines (type 2) or on transverse and oblique lines forming occasionally an incomplete and slightly raised reticulum (intermediate between types 1 and 2) 7

Filaments walls with very short slightly raised structures not forming a distinct pattern 11

7. Walls of filaments with a pattern of raised transverse lines (type 2). The four filaments arise directly from the base and remain parallel. Cocoon with a rim but lacking a median process. Basal trunk very short 8

Walls of filaments with transverse and oblique lines forming occasionally an incomplete slightly raised reticulum (intermediate between types 1 and 2) 9

8. Basal trunk bright orange, compressed laterally and enlarged dorso-ventrally, bearing small rounded and raised tubercles. Basal vesicle smaller. Cocoon finely woven not reinforced by thick threads ..... *S. flavinotatum*

Basal trunk brownish, flattened dorso-ventrally and enlarged laterally bearing more numerous not raised rounded structures. Basal vesicle larger. Cocoon strongly reinforced with numerous and irregular either thick or thin threads ..... *S. simplex*

9. Base of pupal gills about 600 μ long. Cocoon with a broad antero-median process. Pilous plate with all the hairs branched ..... *S. raybouldi*

Base of pupal gills less than 200 μ long. Cocoon without antero-median process. All the hairs of pilous plate simple 10

10. Cocoon loosely woven with fenestrations in lateral and anterior parts. The uppermost filament describes a distinct slightly angulate dorsal curve ..... *S. perforatum*

Cocoon finely woven without fenestrations. The lowermost filament describes a wide ventral curve ..... *S. antibrachium*

11. Walls of filaments with very short irregularly rounded structures (type 4). The four filaments arise directly from the base. Basal vesicle strongly developed, sacciform, longer than the basal trunk. Hairs of pilous plate very long and drumstick-like. Cocoon finely woven ..... *S. sacculiferum*

Walls of filaments with very short piliform structures (type 3). The four filaments arise either directly from the base or from secondary trunks. Basal vesicle less developed, not sacciform. Hairs of pilous plate much shorter and not inflated apically 12

12. Base of pupal gills from 270 to 400 μ long and more than 2,7 times as long as its width in the middle of the trunk 13

    Base of pupal gills not longer than 200 μ and not more than twice as long as wide 15

13. Cocoon very wide, transparent, with a short rounded antero-median process and reinforced laterally by thick obvious transverse threads ..... *S. alatum*

    Cocoon narrower, not reinforced by thick transverse threads, with the anterior margin either slightly produced or not 14

14. Basal trunk more than three times as long (380-400 μ) as wide (120 μ). Anterior margin of the cocoon slightly produced .... *S. nyanzense*

    Basal trunk about 2,7 times as long (270 μ) as wide (100 μ). Anterior margin of the cocoon not produced ..... *S. baforti*

15. The four filaments arise from two secondary stems and they are strongly unequal : one is relatively very short, one is distinctly longer than the others, and two are unequal and intermediate in length. All the hairs of the pilous plate are bifid or trifid. Cocoon finely woven ..... *S. nigritarse*

    The four filaments arise either directly from the base or two arise from a short stem and the others directly from the base. The four filaments are subequal in length. Hairs of pilous plate simple, except in *S. sirimonense* where one hair is bifid . 16

16. The two dorsal filaments arise from a common stem distinctly diverging from the others. The uppermost filament describes an angulated curve. Cocoon finely woven .... *S. arabicum*

    The four filaments arise directly from the base, they are spreading away at their base but the uppermost filament is never angulate 17

17. Only the uppermost filament describes a wide regular curve. Cocoon loosely woven with fenestrations ..... *S. brachium*

    Either the uppermost and the lowermost filaments describe a regular curve 18

18. Uppermost and lowermost filaments almost opposite in direction. Cocoon finely woven ..... *S. candelabrum*

    Uppermost and lowermost filaments much less divergent. Cocoon very loosely woven with large fenestrations *S. sirimonense*

TABLE I.

Characters of mature larvae (with gill-spots)

(* = Larvae without gill-spots)

Species and origin	Length in mm	Distance between corner teeth of mentum (in μ)	Distance from corner tooth to first hypostomial seta	Number of long hypostomial setae
S. nigritarse (near Embu)	—	67	48-50	3 to 4
»	5 to 5,2	69	55	4 to 5
»	—	66	54-57	5
S. nigritarse (Kaduna)	6,5 to 7	75	63	4 to 5
»	—	75	65	4
S. brachium (Nkokonjeru)	7,2 to 8	63	69	5
S. simplex (Bumboi)	7,2 to 9	60	60	4
S. duboisi (Ngaboge)	6,5	78	69	4
S. nyanzense (Nyanza)	6,5	63	54-60	3 to 5
»	6,5 to 7	72	60	4

S. aureosimile (Mambilla)	7,5	75	69-73	5 to 6
* *S. aureosimile* (Djem)	—	70	69-75	5 to 6
S. antibrachium (Ontulili)	—	75	72	3 to 4
S. sacculiferum (Funda)	10	76	66	5 to 7
»	—	80	63	5
S. aureosimile (Mt. Kenya)	—	—	—	—
S. baforti (Marimba)	—	66	63	4
* *S. alatum* (Ontulili)	—	78	93	4 to 5
S. raybouldi (Ngaremtoni)	7,5 to 8,5	80	66	4 to 5
S. aspericorne (Ontulili)	—	75	90-100	4 to 5

TABLE II.

Length of larval antennae in mature larvae (with gill-spots) (in μ)

(* = larvae without gill-spots)

Species and origin	Basal segment: length × max. width (and ratio)	Intermediate segment	Third segment (apical segment included)	Ratios of segments
S. nigritarse (near Embu)	180 × 36 (5,0)	190	145	6,0 - 6,3 - 4,8
»	170 × 30 (5,7)	195	144	5,7 - 6,5 - 4,8
»	178 × 30 (5,9)	200	150	5,9 - 6,7 - 5,0
S. nigritarse (Kaduna)	215 × 30 (7,2)	246	154	7,2 - 8,2 - 5,1
»	216 × 29 (7,4)	—	—	7,2
S. brachium (Nkokonjeru)	210 × 36 (5,8)	240	130	7,0 - 8,0 - 4,3
»	210 × 34 (6,2)	240	135	7,0 - 8,0 - 4,5
S. simplex (Bumboi)	220 × 30 (7,3)	240	150	7,3 - 8,0 - 5,0
S. duboisi (Ngaboge)	235 × 35 (6,7)	240	—	7,8 - 8,0
S. nyanzense (Nyanza)	252 × 33 (7,6)	246	168	8,4 - 8,2 - 5,6
»	250 × 28 (8,9)	250	171	8,3 - 8,3 - 5,7

S. aureosimile (Mambilla)	250 × 36	(6,9)	285	148	8,3 - 9,5 - 4,9
* *S. aureosimile* (Djem)	255 × 36	(7,1)	300	149	8,5 - 10 - 5,0
S. antibrachium (Ontulili)	255 × 36	(7,1)	275	150	8,5 - 9,2 - 5,0
S. sacculiferum (Funda)	255 × 36	(7,1)	315	132	8,5 - 10,5 - 4,4
»	255 × 42	(6,1)	295	140	8,5 - 9,8 - 4,7
S. aureosimile (Mt. Kenya)	270 × 36	(7,5)	305	165	9,0 - 10,2 - 5,5
S. baforti (Marimba)	285 × 36	(7,9)	295	180	9,5 - 9,8 - 6
* *S. alatum* (Ontulili)	285 × 39	(7,3)	315	178	9,5 - 10,5 - 5,9
S. raybouldi (Ngaremtoni)	285 × 36	(7,9)	330	158	9,5 - 11 - 5,3
S. aspericorne (Ontulili)	285 × 38	(7,5)	339	165	9,5 - 11,3 - 5,5

1. **Simulium (Nevermannia) nigritarse** Coquillett, 1902

Simulium nigritarsis Coquillett, 1902 : 27; de Meillon, 1934 : 261; 1935 : 351; 1942 : 6; Gibbins, 1938 : 30 (in part); Meeser, 1942 : 33; Freeman & de Meillon, 1954 : 215 (in part); Crosskey, 1969 : 127.

Cnetha caffrarica Enderlein, 1935 : 359; 1936 : 117.

Simulium aureosimile (nec Pomeroy) Crosskey, 1960 :49; Dujardin & al., 1980 : 375 (in part).

Simulium (*Eusimulium*) *nigritarse*, Crosskey, 1969 : 117; 1980 : 206.

Simulium (*Eusimulium*) *aureosimile* form *brachium* (nec Gibbins) Fain & Elsen, 1973 : 525.

There has been some confusion about the gender of the name « *nigritarsis* ». The earlier authors have left the term *nigritarsis* invariable, following the first opinion of Coquillett the author of the species. Crosskey (1980), in his list of Afrotropical Simuliidae used the neuter form *nigritarse* in accordance with the genus name *Simulium*. As in the name *nigritarsis* the substantive *tarsus* is not on the nominative form, one can consider that it had been used by Coquillett as an adjective and therefore it should have the same gender as the genus. We think therefore that *nigritarse* is more appropriate than *nigritarsis*.

This species has been described from Cape Province, South Africa. Freeman & de Meillon (1935, appendix) recorded it from Natal, Transvaal, Mozambique and S. Rhodesia (Salisbury and Vumba Mountains). They surmised that all the northerly records apply to *aureosimile*.

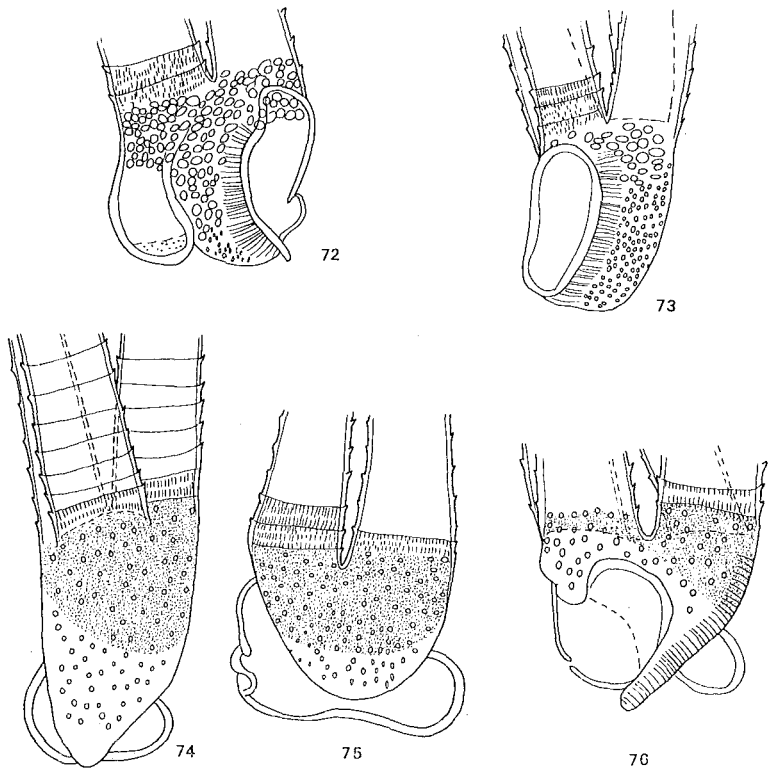
According to Freeman & de Meillon, the main differences between these two species are the constant presence in *nigritarse* of two patches of silvery scales on the postnotum, the silvery aspect of the scales of thorax and abdomen (brassy in *aureosimile*) and the unequal lengths of the pupal filaments. In the males of both species there are either one or two unequal parameral hooks.

MATERIAL EXAMINED.

A. *Collection of BMNH.*

We have examined one paratype female and other non-typical material from various countries of the Afrotropical Region.

Paratype female: Antennae blackish, except basal segments reddish. Mesonotum blackish except a large rounded median area which is paler and bears a poorly distinct dark longitudinal line; shoulders reddish; the scales are silvery and mixed with a few coppery scales. Scutellum brown-red. Postnotum dark with 2 patches of silvery scales. Wing 2,8 mm long. Basal tuft of hairs pale. Subcosta with the two basal thirds hairy. Legs with basal parts yellowish. Hind leg with 60 % of basal part of femur yellowish. Abdomen in very poor condition.



Figs. 72 - 76. — Bases of pupal gills. - 72-73: *S. simplex* (Bumboi) in dorsal (72) and latero-external (73) views. - 74-76: *S. flavinotatum* in dorsal (74), dorso-external (75) and latero-external view (76).

Other non-typical material not separable from *S. nigritarse:*

1. Two pinned specimens (male and female) with their pupae and cocoons, from Cape Province, 22.VIII.1952. *Female:* Wing 3,1 to 3,2 mm long with subcosta hairy on its basal two thirds. Mesonotum

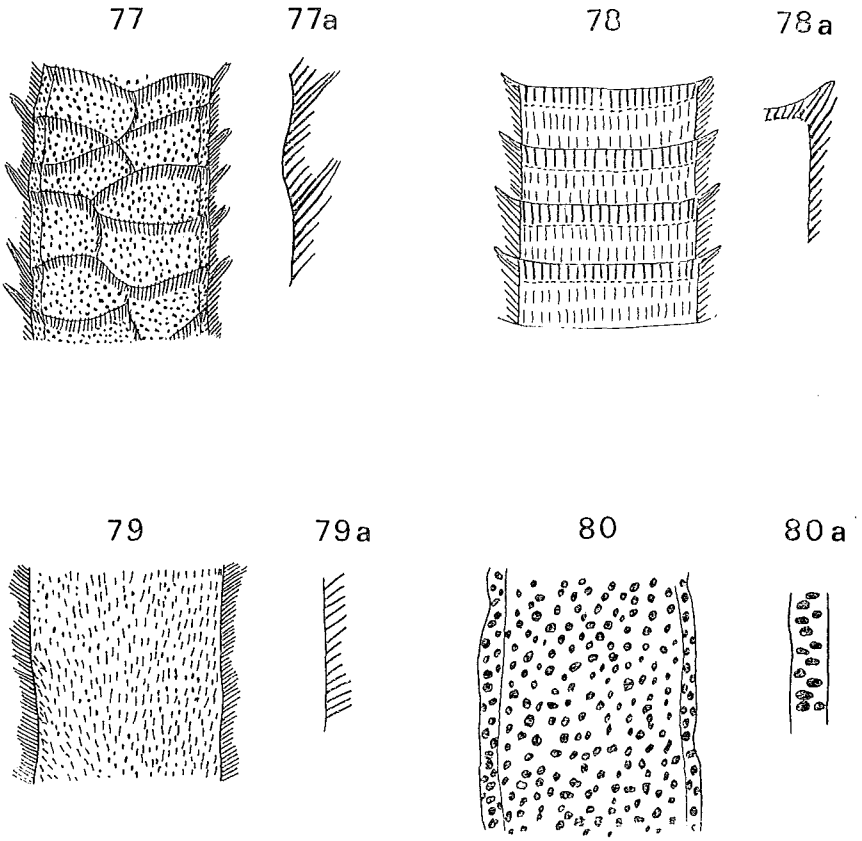
blackish with a paler irregular median area; scales silvery with a few coppery scales posteriorly. Scutellum brown with pale yellow hairs. Postnotum blackish with 2 tufts of silvery scales. Legs as in the paratype. Wing: Subcosta hairy on basal 90 %. Abdomen: First segment with long pale brassy hairs. Other segments with pale brassy or silvery scales and no coppery scales. *Male:* Wing 2,8 mm long with basal tuft of hair dark. Mesonotum velvet-black with silvery scales ,mixed with coppery scales posteriorly. Postnotum as in female. Legs darker than in female. Hind metatarsi swollen but less than tibiae, the latter black in its 60 % apical, the rest yellow. Abdomen: First segment with long pale yellow hairs; other segments with pale brassy or silvery scales without coppery scales. *Pupae* (mounted on slides): Pupal gills with 4 filaments, 3,5 mm long, arising from 2 short unequal and thick stems. The 4 filaments are unequal, one being relatively very short. Basal trunk very short. Basal vesicle small. Walls of filaments without a raised pattern (type 3). Abdomen of pupa with small spines on dorsal surface of segment 5 (fig. 103). *Cocoon* (fig. 123): 3,2 mm long in midline, maximum width 2,5 mm, finely woven, reinforced laterally by a few very thin threads, without fenestrations, with a well formed rim but no median projection.

2. Three pinned females: one from Somerset East, Cape Province (E. Turner, Oct. 1930); one from Pretoria (G.A. Bedford); one from Johannesburg (Hasselbarth, 15.3.1964). These specimens resemble the other mentioned above, but the postnotal hairs are missing in the female from Johannesburg. It is possible that this specimen belongs in fact to *S. brachium* (see below).

3. Pupal filaments from Cape Province, South Africa, Jan.1934 (de Meillon): Pupal gills 4 mm long with a very short base. The 4 filaments arise from 2 short secondary trunks; they are very unequal, the shortest is 2,9 mm, the longest is 3,8 mm long (fig. 37 and 53). Texture of type 3. All the hairs of the pilous plate are forked.

4. Natal, Weenen. Numerous pinned specimens but no pupae. All bear the postnotal scales. In a dissected female (Weenen, XII.1923, Thomasset) the sensory vesicle is very slightly shorter than the length of the 3rd segment of the palp, the mandibles bear 2 to 3 vestigial outer teeth and 15 normal inner teeth, the maxillae 10 to 13 and 5 to 6 teeth.

5. Zimbabwe, Riv. Ruwa, near Salisbury, 1962 : Pinned adults and pupae in alcohol (A.D. Hawinton); also from S. Zimbabwe (C.V. Meeser). In the females from riv. Ruwa the mesonotal scales are mostly golden, while in that collected by Meeser they are pale silvery except in posterior half where coppery scales are also present.



Figs. 77 - 80. — Texture of filaments. - 77. type 1; - 78. type 2; - 79. type 3; - 80. type 4. - Margins of the same, enlarged: 77a to 80a.

6. Tanzania, Kibena Dam, Spillway, Njombe, 14.VI.1968 : 3 females and 1 male (pinned), slides with pupae, numerous pupae and larvae in alcohol (Raybould). In these specimens the mesonotum is densely clothed with silvery scales and coppery scales, the latter forming in the posterior half of mesonotum 2 long paramedian and 2 shorter more lateral bands of coppery scales. Wing of female with subcosta

hairy in their 80 % basal. Pupal filaments from 4,3 to 6,4 mm in length (base included), similar to those from Cape Province. Pilous plate with short branched hairs as for the specimens from riv. Nafyebo, Zaïre. Cocoon as for the specimens from South Africa.

7. Kenya, from a stream 17 Km N.-E. of Embe, 28.VII.1979 and from Nanyuki, Central Province, 25.VII.1979 : Pupae and larvae in alcohol (R.W. Crosskey). Not separable from Sth. African material except for the larvae (see Table I). Other pupal gills from Nairobi, with secondary stems slightly longer than for S. African specimens.

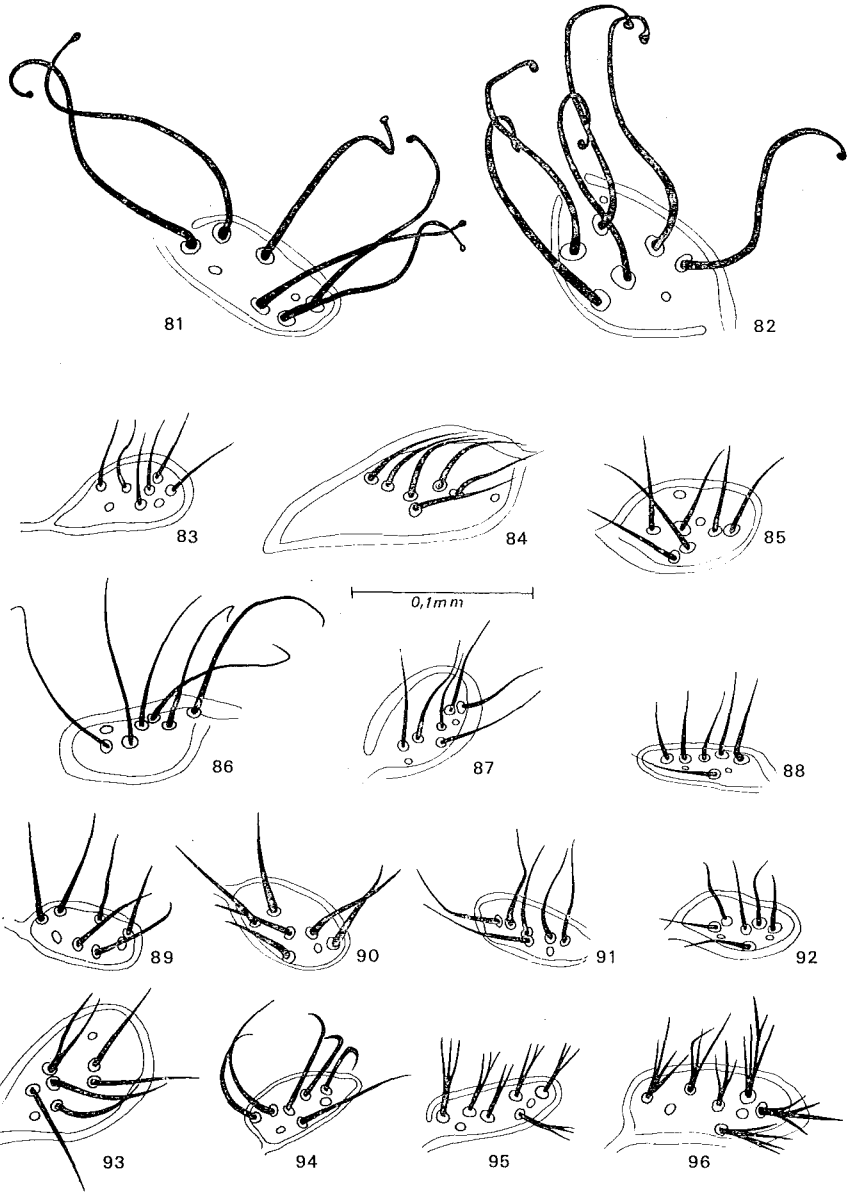
8. Nigeria, Kaduna State : Pupal gills on 6 slides, numerous pupae and larvae in alcohol (R.W. Crosskey). These specimens were labelled « *S. aureosimile* ». Texture of filaments and general aspect as for specimens from Sth. Africa; they differ however by the shape of the secondary stems which are longer and narrower but this character is variable in the series of slides that we have examined. In one specimen these stems measure 210 μ and 150 μ respectively, while in the two others these lengths are 230 and 150 μ and 270 and 240 μ. In all the specimens the longest filament is much longer than the shortest, the two others are subequal and intermediate in length, between the other. Total length of pupal gills 3,5 to 4 mm. There are no spines on dorsal surface of 5th segment of pupal abdomen.

9. Angola : Two females from Bruco, 1972. Postnotal scales present. Most of mesonotal scales are lost.

10. Lubumbashi, S.E. Zaïre: One pinned female: Mesonotum with bands of coppery scales as in the specimens from Djombe, Tanzania. Halters orange. We have not observed the postnotal scales.

B. *Collection of the authors.*

1. S.E. of Zaïre, river Nafyebo: Numerous pupae and a few larvae. Pupal gills as in Sth. African specimens (fig. 54). Length of the filaments 3 to 4 mm (including the short base). The 4 filaments arise from 2 short secondary stems. These stems vary strongly in length and proportion as shown by the measurements of seven specimens : 150 and 75 μ; 135 and 75 μ; 85 and 45 μ; 118 and 45 μ; 120 and 45 μ; 120 and 45 μ and 120 and 15 μ; the ratios vary from 2 : 1 to 8 : 1. In these specimens the pilous plate bears relatively short branched hairs (fig. 95).



Figs. 81 - 96. — Pilous plates. - 81. *S. sacculiferum;* - 82. *S. bulbiferum;* - 83. *S. baforti;* - 84. *S. nyanzense;* - 85. *S. simplex;* - 86. *S. rubescens;* - 87. *S. antibrachium;* - 88. *S. candelabrum;* - 89. *S. flavinotatum;* - 90. *S. aspericorne;* - 91. *S. alatum;* - 92. *S. brachium;* - 93. *S. sirimonense;* - 94. *S. aureosimile* (Djem); - 95. *S. nigritarse* (Nafyebo); - 96. *S. raybouldi.*

In a dissected male the ventral plate is relatively wide and only slightly narrowed posteriorly and there are 2 pairs of unequal parameral hooks (fig. 17). Wing with a few macrotrichia in basal part of subcosta. In a female the sensory vesicle of the third segment of the palp is slightly shorter than half the length of the segment (fig. 5). Wing with subcosta hairy on its basal half.

2. S.E. Zaïre, river Kalule : Several pupae, not separable from those from riv. Nafyebo.

3. Cameroun, river Dadourou (fig. 102): several pupae with typical pupal gills. The two secondary stems are either equal (135 μ), subequal or slightly unequal (180 μ and 130 μ) subequal. In specimens from river Sere (Cameroun) these stems are much longer (240 μ and 135 μ respectively) and more unequal.

4. Mount Kenya, river Nanyuki II: pupae of *S. nigritarse* (fig. 101).

Pupal abdomen in S. nigritarse : In specimens from river Nafyebo, Zaïre, from river Dadourou in Cameroun and from riv. Nanyuki II on Mt. Kenya, the dorsal surface of the 5th segment bears at each side several small spines (figs. 100-103). On segment 9 there are generally some very small spines. In specimens from Kaduna (Nigeria) only the spines on 9th segment are present. Segments 6 to 8 with spines as in the other species.

Larva.

We have seen mature specimens from Kaduna (Nigeria). These larvae have been described by Crosskey (1960) under the name « *aureosimile* ». We have also seen larvae from other localities (see Tables I-II).

REMARK :

It appears from our study that there is a rather great variability in the specimens attributed to *S. nigritarse*. These variations are observed mainly in the shape of the pupal gills (length of secondary stems), the onchotaxy of the pupal abdomen, the characters of the larvae (see Table I) and the colour of the mesonotal scales in the adults (either brassy or silvery with or without longitudinal bands of coppery scales). We think therefore that the species « *nigritarse* » could be in fact composed of several very closely related though distinct species.

2. **Simulium (Nevermannia) aureosimile** Pomeroy, 1920

Simulium aureosimile Pomeroy, 1920 : 78; de Meillon, 1930, 197; Freeman & de Meillon, 1953 : 216 (appendix) (in part).

Simulium (Eusimulium) aureosimile, Crosskey, 1969 : 63; Fain & Elsen, 1973 : 525; Bafort & al., 1977 : 594 (in part); Dujardin et al., 1980 : 375 (in part).

This species has been described from a single female and a single male bred from pupae and several adults of both sexes dissected from pupae, in Cameroun. We give here a summary of the original description and figures :

Male : Thorax covered with red-golden scales. Pleural membrane brown, bare. Legs : with upper parts mainly yellowish. All tarsi black. Tibiae III with basal two-thirds yellow, apex black. Genitalia : In the drawing the ventral plate is tapering posteriorly and there is only one large spine at each side of the parameres. Style shorter than coxite. *Female :* Thorax dull black sparsely covered with light golden scales. Pleura as in male. Abdomen dull brown. Legs with upper parts mostly yellowish. Tarsi black. Tibiae III with basal third yellow, the remainder black. Claws with a large basal tooth. *Pupa :* Pupal gills with 4 filaments. According to the original description and figures the two first filaments arise directly from the basal trunk; the two others emerge from a short stem arising from the base. The walls of the filaments present a raised reticulum (type 1). The cocoon has not been described or figured. *Typical locality :* Balibo or Baliben, Cameroun, 10.I.1916. Pupae were found in a slow-moving stream, altitude 1000 m. Not found biting.

MATERIAL EXAMINED.

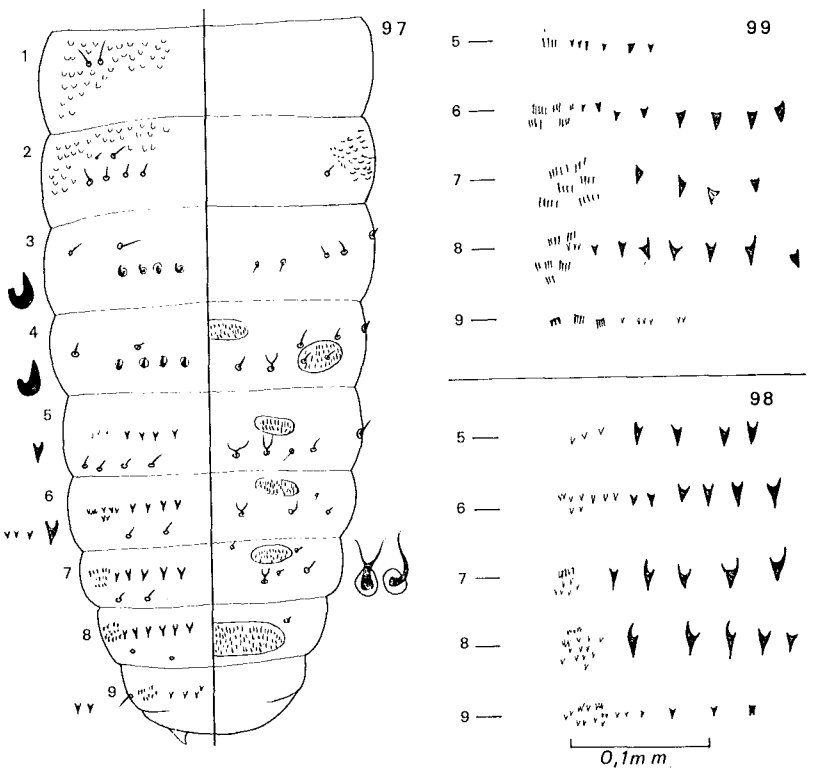
A. Collection of BMNH.

Paratypes examined : One slide containing a female enclosed in the pupa and one pinned female in poor condition. The structure of the pupal gills with a strongly raised reticulum agrees with the original figure. Basal trunk about 200 μ long, with a basal vesicle almost as long as this trunk, the gills are present only at one side. The four filaments arise from two short but distinct secondary stems, as shown in the only intact pupal gill separated from the pupa and present in the same slide (fig. 38).

Other non-typical material not separable from *S. aureosimile* :

1. Nigeria, a river on Mambilla Plateau road to Gembu XI-XII.1968 (J.C. Deeming) : one adult female and larvae.

Female : Wing 3 mm long; mesonotum black with brassy to golden scales. Postnotum dark brown, bare. Scutellum and 1st abdominal



Figs. 97 - 99. — Onchotaxy of pupal abdomen. - 97. abdomen (dorsally at left, ventrally at right) of *S. simplex;* - 98. segments 5 to 9, dorsally in the same; - 99. segments 5 to 9, dorsally in *S. antibrachium.*

segment with yellow hairs; other abdominal segments covered with brassy to golden scales; 80 % of the base of subcosta is hairy. Other material (2 females in poor condition) from Mambilla Plateau collected by H.R. Kamartan.

2. Cameroun : 1 female (R.H.L. Disney).

B. *Collection of the authors.*

We have seen pupae with pupal gills and cocoons identical in structure to those of *S. aureosimile*, from the following rivers : Riv. Djem and Tchabal Mbabo (2300 m) (Cameroun) (Fain & Elsen, 1973), Riv. Sirimon II (2500 m) and VIII (3550 m) of Mt. Kenya and Riv. Marimba (2140 m) on the foot-hills of Mt. Kenya (Bafort et al., 1977).

In all these pupae the basal trunk is divided in 2 short and unequal stems, each again divided in 2 filaments. All these filaments are equal or subequal. In specimens from riv. Djem the basal trunk is 210 μ long and bears a large basal vesicle almost as long as the basal trunk (fig. 57). Pilous plate bearing 6 non-divided hairs 60 μ long (fig. 94) Length of pupal gills (base included) about 4 mm. Cocoon well woven not reinforced laterally and not fenestrated, there is a rim but no antero-median projection (fig. 122). We describe here some characters of the adults dissected from their pupae (riv. Djem):

Female : Head : third segment of palp containing a sensory vesicle shorter than half the length of the segment (fig. 2). Mandible with 0 and 17 teeth, maxillae with 13 and 5 teeth. Wing : the two basal thirds of the subcosta are hairy. Cercus rounded posteriorly (fig. 31). *Male :* Terminalia : Ventral plate wide at its base, strongly narrowed posteriorly. There are 2 pairs of very unequal parameral hooks, the internal being very large. Style shorter than the coxite (fig. 18). The larva of *S. aureosimile* is still unknown. Crosskey (1960) has described larvae that he identified, following Freeman and de Meillon, 1953, as *S. aureosimile* (from Kaduna, Nigeria) but it appears now (Crosskey in litt.) that these specimens belong in fact to another species, probably *nigritarse*. The present work confirms that these specimens belong to *nigritarse*. *Pupal onchotaxy* (specimens from riv. Djem) (fig. 110): Dorsal backwardly directed spines are present on segments 6, 7 and 8, and absent on segments 5 and 9. *Larvae* of 5th stage (from riv. Djem) (figs. 124-128 and Tables I-II). Hypostomium with 5 to 6 long hairs. Median tooth of mentum prominent. Pigmented spots of head, mandible and antenna see figs. 128-132 and Tables I-II.

REMARK :

S. aureosimile differs from *S. nigritarse* by the following characters : In the adults : dorsal scales not silvery but brassy or golden ; there are no scales on the postnotum; third segment of palp in female

more elongate. *Pupa:* filaments equal or subequal with a raised reticulum, a longer basal trunk and a larger basal vesicle; the hairs of the pilous plate are not branched and there are no spines on the 5th segment of the pupal abdomen.

3. **Simulium (Nevermannia) brachium** Gibbins, 1936

Simulium brachium Gibbins, 1936 : 230.
Simulium (*Eusimulium*) *brachium*, Crosskey, 1969 : 122; 1980 : 206.

We summarize here the description of Gibbins :

Female : length 3 mm; wing 3,5 mm. Antenna dark brown except the basal segments light brown. The sensory vesicle of 3rd segment of palps is longer than half the length of this segment. Mesonotum dull black with a few golden scales medially and longer and more numerous scales laterally. Scutellum black covered with long golden scales. Abdomen dark brown uniformly covered with goldes scales; first tergite with lateral fringe of pale yellow hairs. Legs bright yellow except the tarsi and outer apical half of tibiae and femora dark brown. *Male* (*holotype*) : Length 3 mm; wing 3 mm. Mesonotum velvet-black densely covered with dull brassy scales. Scutellum dark brown, with brassy scales and a marginal tuft of long black hairs on either side. Abdomen dark velvet-brown, covered with brassy scales. Terminalia: ventral plate wide, tapering posteriorly. Parameres with one large hook on each side. Legs uniformy dark brown : metarsus III inflated. *Pupa:* Head and thorax with disc-like tubercles : trichomes simple. Pupal gills : The 4 equal or subequal filaments are almost as long as the pupa and they arise directly from the very short common base. They are slightly spreading basally and the most dorsal filament describes a regular curve. The walls of the filaments bear very minute pigmented nodules. Cocoon dark-brown, 5 mm long, coarsely moven. Larva 6 mm long. Front without markings. There are about 30 bristles on feeding brushes. *Typical locality :* Bumboi, Riv. Naboinga, Mt. Nkokonjeru, Bugishu Dist., Uganda, alt. 1800 m, 28.III.1932.

MATERIAL EXAMINED :

A. *Collection of BMNH.*

Typical material: We have examined the holotype male and 32 paratypes of both sexes (all pinned specimens), three slides with pupal gills and mouth parts of adults, and pupae in alcohol.

Holotype male : Length of wing 3 mm, of thorax 1,2 mm. Mesonotum velvet-black with numerous coppery scales. Median region of abdomen also with numerous coppery scales. Scutellum and first segment of abdomen with long dark hairs. *Female:* Mandibles with 0-18 to 19 teeth, maxillae with 15-6 teeth. Sensory vesicle of third palpal segment is slightly longer than half of the length of the segment (fig. 9). Mesonotum blackish with numerous coppery scales in the median area. First abdominal segment with long greyish hairs. *Pupa :* Structure of the filament wall of type 3.

The filaments are distinctly spreading away especially the uppermost filament which describes a large and regular dorsal curve with no angulation. Basal trunk of filaments very short. Two filaments arise from a common very short stem, the two others emerge directly from the base (fig. 56). Total length of filaments including the base : about 3 mm; all these filaments are broken at their apices. Basal vesicle small. Pupal plate with 6 simple short hairs (fig. 92). Pupal onchotaxy (in a specimen from Kenya) : Backwardly directed spines as in *S .simplex* but the dorsal spines on segment 5 are particularly small and they are present only at one side and the segment 9 does not carry true dorsal spines but only very minute combs. The spines on segments 7 and 8 are relatively long and narrow (fig. 111). *Cocoon :* Loosely woven, with obvious threads and numerous, rather small fenestrations; there is a poorly developed anterior rim but no median projection. Length in midline 3,5 to 4 mm (fig. 113). *Larva :* Length 7,2 to 8 mm. Other characteristics see Tables I-II.

Other non-typical material not separable from *S. brachium :*

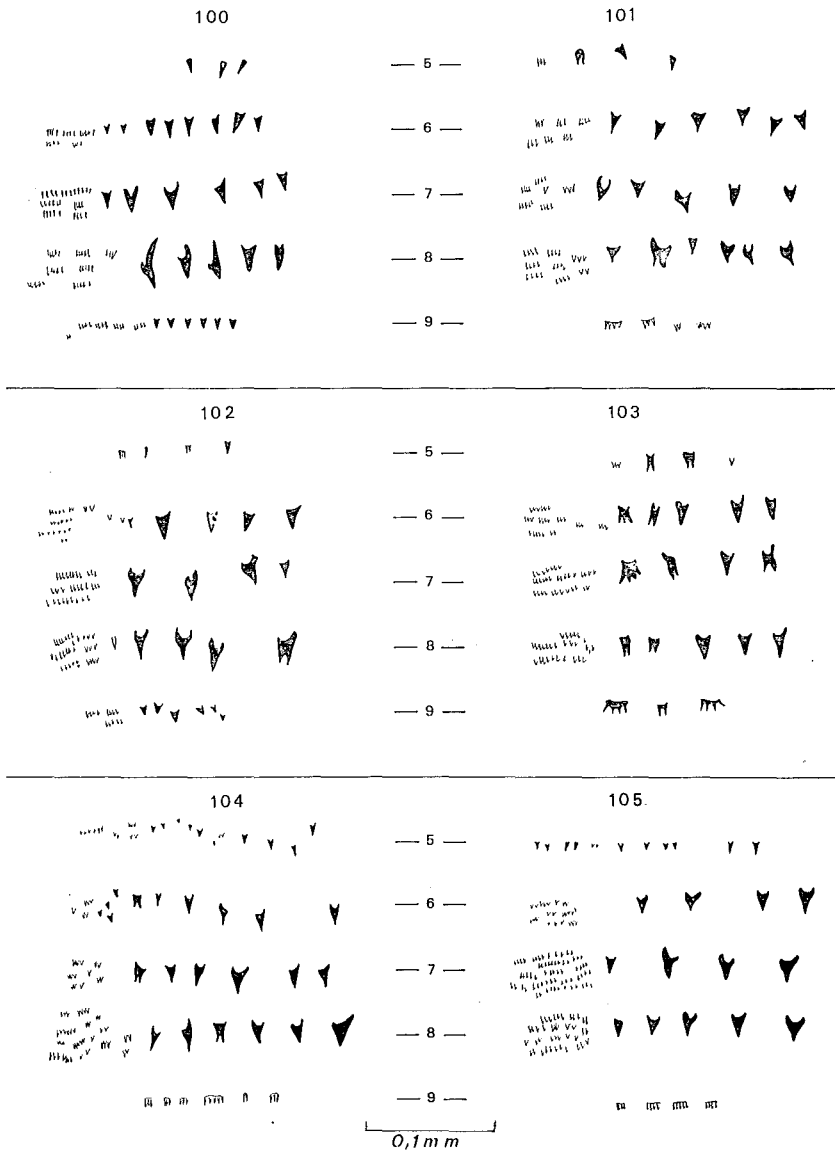
1. Uganda, Mt. Elgon, at Nabongo near Sipi, 18.IV.1964 and at Bufambo, 1964: numerous pupae and larvae in alcohol (Coll. R.W. Crosskey). Specimens not separable from the types.

2. Kenya, from 3 places : riv. Cheptaborabora (Nyanza region), Jan. 1961 (R.B. Highton); Nyanza region, IV-V.1960 (J.P. McMahon); riv. Nanyuki, Mt. Kenya : larvae and pupae in alcohol.

3. Tanzania, riv. Ngaremtoni, near Arusha, 2.V.1966: pupae and larvae in alcohol.

4. Transvaal, at Brits, Magaliesberg, X.1979 (Paterson): pupal gills and cocoon.

5. South Africa, Table Mt., Platteklip stream, Cape Town, XII.1934 (K.H. Barnard): pupal gills.



Figs. 100 - 105. — Segments 5 to 9 of pupal abdomen, dorsally. - 100-103. *S. nigritarse:* from Nafyebo (100), from Mt. Kenya (101), from Dadourou (102) and from Cape Province (103). 104. *S. baforti;* - 105. *S. flavinotatum.*

B. *Collection of the authors.*

From Zaïre, riv. Aü, Ituri, 1949 (A. Fain); and riv. Lutomba, Kivu: pupae (A. Fain).

REMARK:

S. brachium is distinguished from *S. nigritarse* and *S. aureosimile* mainly by the shape of the pupal gills, with the uppermost filament strongly recurved, and the structure of the cocoon, very loosely woven with fenestrations. The filament walls do not bear a raised reticulum as in *aureosimile* and filaments arise directly from the basal trunk (unlike in *nigritarse*). In addition the dorsal surface of segments 6 to 8 of the pupal abdomen bears backwardly spines relatively much narrower than in these species. In the adults the sensory vesicle of the female palp is relatively longer than in these species, and there are no postnotal scales (present in *nigritarse*).

4. **Simulium (Nevermannia) simplex** Gibbins, 1936

Simulium simplex Gibbins, 1936 : 232.
Simulium (Eusimulium) simplex, Crosskey, 1969: 129; 1980 : 206.
Simulium elgonicum Seguy, 1938 : 323.

We summarize here the description of Gibbins.

Female : Length 3 mm; wing 3 mm. Third segment of palps with a sensory vesicle shorter than half the length of the segment. Mesonotum dull black, uniformly covered with golden scales. Scutellum with golden scales and with long golden marginal hairs. Abdomen dark brown covered with brassy scales. Legs as in *brachium* but darker. *Male :* Length of body and wing as in female. Mesonotum velvet-black covered with pale yellow scales which are rather sparse in the median area. Scutellum dark brown with lateral marginal tufts of long pale yellow hairs. Abdomen dark brown covered with golden scales; first tergite with a lateral fringe of very long pale yellow hairs. Terminalia as in *brachium* but the median process of the ventral plate is relatively longer. Legs dark brown except for basal third of hind tibia. *Pupa* as in *brachium* but the 4 filaments emerge from a very short indistinct base and they do not spread but remain narrowly parallel; the outer walls of the filaments show a fine striated appearence. *Cocoon :* 4 mm long and unlike that of *brachium,* but as in *S. hirsutum* (which is loosely woven). *Larva* as in *brachium* but longer (8 mm) and with the mentum bearing a row of 7 short spines (for 8 in *brachium*). *Locality* and *habitat* as for *brachium.*

MATERIAL EXAMINED.

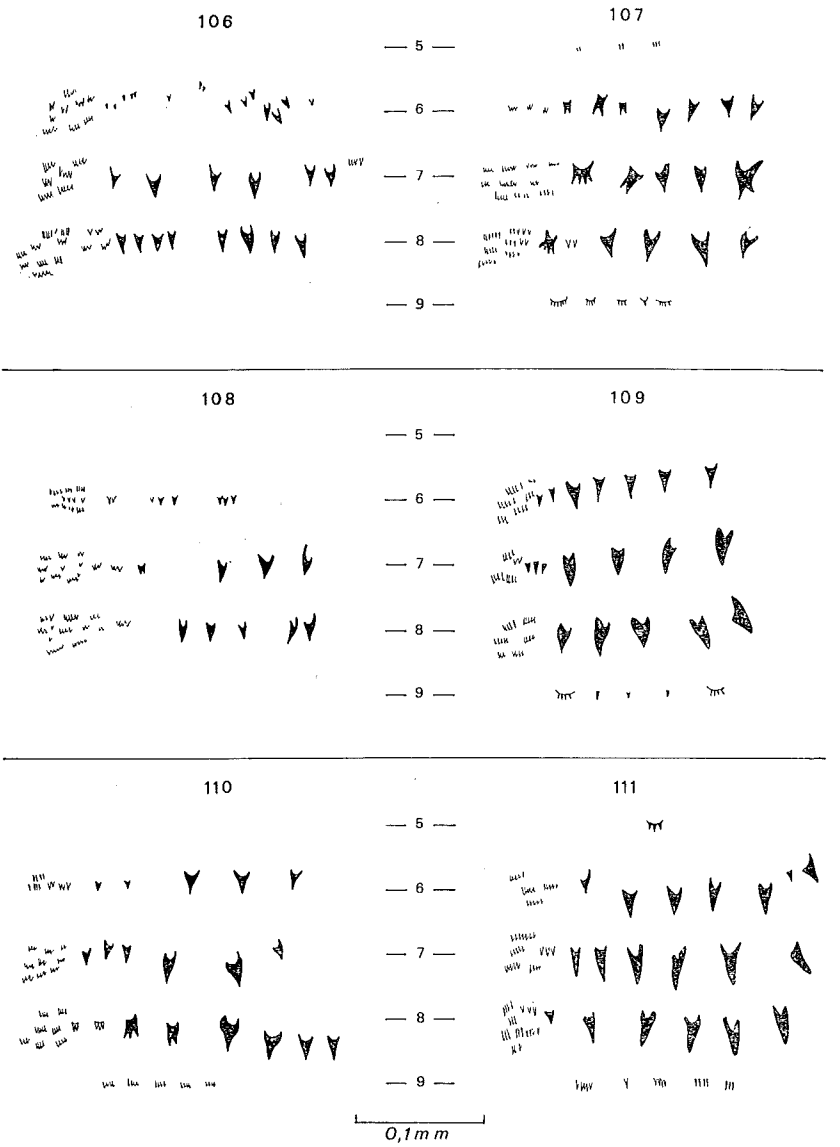
We have examined the typical material of this species. It consist of 12 slides (2 with pupal gills, 1 with a pupa, 3 with parts of females or of males, 7 with larvae) and 8 pinned paratypes (3 males and 5 females).

The slide material is very poor and not useful in the study of the species.

The *holotype male* is pinned : Length of wing 3,2 mm, of thorax 1,2 mm. Mesonotum velvet-black with light brassy or silvery scales mixed with a few coppery scales. Scutellum with pale yellow hairs. First segment of abdomen with long pale yellowish hairs. Posterior part of abdomen is lacking. Legs III are lacking. In a paratype the metatarsus and tibiae III are dilated and blackish except the basal 40 % of tibia which is yellowish.

Female: Length of wing 3,2 mm. Subcosta almost entirely pilose. Mesonotum dark brown with brassy to golden scales mixed posteriorly with coppery scales. First abdominal segment with long yellow hairs. Rest of abdomen with golden scales; coppery scales not observed. *Pupa:* The filaments agree with the description. The walls bear a structure consisting of very small raised piliform formations disposed in parallel transverse lines (type 2). Total length about 3,2 mm, but all the filaments, except one, are broken at apex. Basal trunk very short, flattened dorso-ventrally and narrowed laterally (figs. 40, 58, 72, 73). Basal vesicle slightly shorter than the basal trunk and only slightly expanded externally. Pilous plate with 6 stiff hairs 40-50 μ long (fig. 85). Onchotaxy of pupal abdomen see general remarks and figs. 97-98. *Cocoon:* Loosely woven, without fenestrations but reinforced with numerous either thick and thin threads. There is a rim but no median projection (fig. 115). *Larva:* We have examined 6 paratypes. They have been mounted in Canada balsam which is an unsuitable medium for such material. We succeeded in remounting one of them in a Berlese medium. The characteristics are given in Tables I and II.

We have also one pupa collected by A. Fain (1951) in a river on Mt. Korovi, Ituri, Zaïre (2200 m).



Figs. 106 - 111. — Segments 5 to 9 of pupal abdomen, dorsally. - 106. *S. sacculiferum;* - 107. *S. nyanzense;* - 108. *S. candelabrum;* - 109. *S. sirimonense;* - 110. *S. aureosimile* (Djem); - 111. *S. brachium.*

— Status of *Simulium elgonicum* Seguy, 1938 —

S. elgonicum Seguy, 1938 is a synonym of *S. simplex*. We have examined the typical series of this species consisting of 7 pinned adults (4 males and 3 females) and 9 slides of dissected adults. There are no pupae nor cocoons. This examination has convinced us that these two species are not separable from each other. As Seguy did not designate a holotype we can consider that all these specimens are syntypes. Therefore we select one of the male specimens as a *lectotype*. This specimen was already labelled « Type ». In this specimen the wing is 3,2 mm long, the thorax 1,2 mm long, the body about 3,5 mm. Mesonotum velvet-black with rare silvery or pale brassy scales mixed with a few coppery scales. Scutellum with long pale yellow hairs. Postnotum bare. First segment of abdomen with long pale yellow hairs. Base of legs yellowish. Tarsi blackish. Hind legs with metatarsus and tibiae dilated. Hind tibia with basal 40 % yellow, the rest is black. These characters correspond closely with the types of *S. simplex*. A second male of the typical series also correspond closely with this description, in two other males, the legs are paler and the hind tibiae are yellow in their basal 50 to 60 %. In these specimens the wings are 3 to 3,2 mm long. The typical series was collected from Elgon Saw Mill, East Side of Mount Elgon, Kenya (alt. 2470 m).

REMARK:

S. simplex is characterized by the shape of the pupal gills, with a very short basal trunk flattened dorso-ventrally, by the structure of the filament walls with raised piliform formations oriented transversely (type 2), by the presence of relatively large spines of the fifth segment of the pupal abdomen, and by the aspect of the cocoon which is reinforced by numerous threads.

5. **Simulium (Nevermannia) duboisi** Fain, 1950

Simulium duboisi Fain, 1950a : 104.
Simulium nigritarsis duboisi Freeman & de Meillon, 1953 : 103.
Simulium (Eusimulium) duboisi, Crosskey, 1969 : 117 ; 1980 : 206.

This species is well characterized by the aspect of the pupal gills which are strongly sclerotized and very dark, their walls bear a raised reticulum strongly pigmented. The basal trunk is very short and the 4 filaments are subequal, relatively short (2 mm) and very thick; they

arise separately from the basal trunk and are strongly divergent. Most or (?) all of the hairs of the pilous plate are branched. Cocoon finely woven without median process (fig. 125). *Larva :* see Tables I-II.

Typical locality: Riv. Ngaboge (2500 m), Rwanda. An holotype was not designated in the original description. We designate here a lectotype female (with its pupal skin and cocoon) among the syntypes. It is deposited in the MRAC.

6. **Simulium (Nevermannia) aspericorne** Fain, Bafort & Siberstein, 1976 - stat. nov.

Simulium duboisi aspericorne Fain, Bafort & Silberstein, 1976 : 173; 1977 : 484; Crosskey, 1980 : 206.

This species was first described as a subspecies of *S. duboisi.* We elevate it here to the species level. This species differs from *S. duboisi* by several characters.

Pupal gills : the 4 filaments are narrower and longer (2,4 and 2,5 mm), they arise from 2 relatively thick main stems 300 and 500 μ long respectively and are only slightly divergent. Total length of the pupal gills about 3 mm. Cocoon 5,5 to 6 mm long, loosely woven (finely woven in *duboisi*), and with a median process (without process in *duboisi*). There are 6 simple hairs on the pilous plate (fig. 90). Male with a ventral plate shorter and wider than in *duboisi* and with 2 pairs of parameral hooks (for one pair in *duboisi*). In female the mandibles present less teeth (12 to 13 teeth at one side) than the maxillae (17 + 6 teeth).

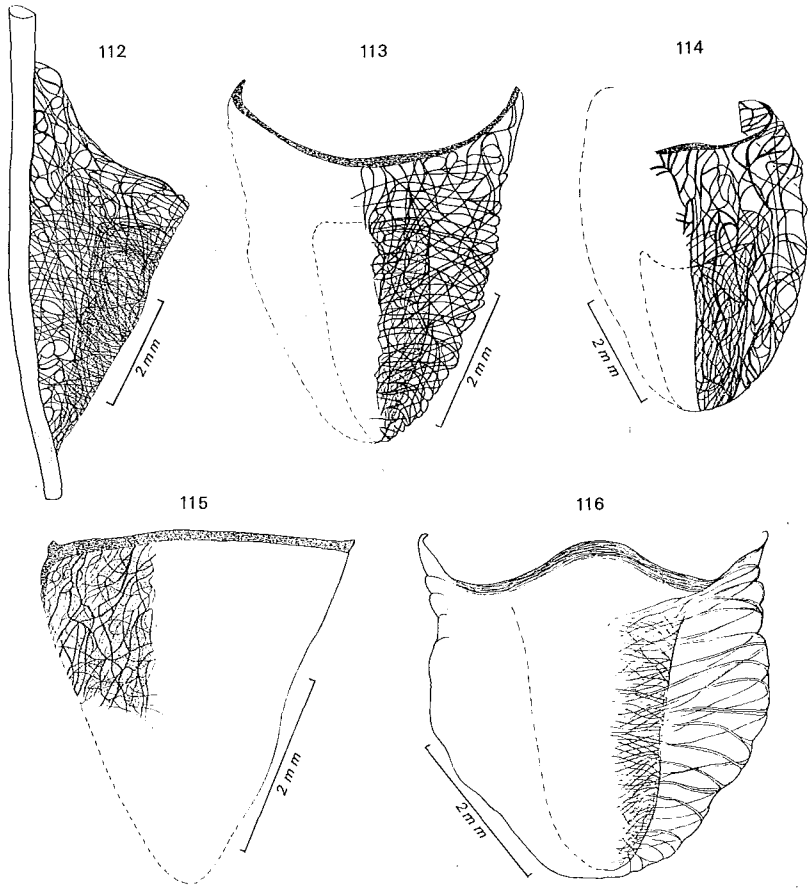
Typical locality : Riv. Ontulili (alt. 3230 to 4000 m) and Riv. Naro Moru (2350 and 3150 m) both on Mt. Kenya. The lectotype that we designate is a male dissected from its pupa and mounted with the pupal gills and the cocoon on a slide (Riv. Naro Moru); it is deposited in MRAC.

7. **Simulium (Nevermannia) sacculiferum** spec. nov.

Simulium aureosimile (nec Pomeroy) Dujardin et al., 1980: 375 (in part).

Female : Lengths in the holotype : Body 3,3 mm; thorax 1,5 mm; wing 3,4 mm; ratio wing : thorax = 2,26 : 1. Width of thorax 1,05 mm. *Head :* Face and frons with golden scales. Antennae black-reddish,

with basal segments paler. Mandible with 0 and 20 teeth, the 3 or 4 basal very small and slightly separated from the other teeth. Maxillae with 12 to 15 and 6 to 8 teeth. *Palp:* 3rd segment 1,5 times as long as wide; sensory vesicle slightly longer than half the length of third



Figs. 112 - 116. — Cocoons loosely woven or reinforced by thick threads. - 112. *S. bulbiferum;* - 113. *S. brachium;* - 114. *S. sirimonense;* - 115. *S. simplex;* - 116. *S. alatum.*

segment (fig. 12). Mesonotum black with slight reddish reflections, covered with golden scales mixed with a few smaller coppery scales. Scutellum pale-brown, with yellowish hairs. Postnotum bare, slightly more reddish and paler than mesonotum. Katepisternum and pleural membrane bare. Halters whitish with a brown stalk. *Legs:* Femora I

yellowish with golden scales except apex dark with blackish scales On femora II and III the dark area and the blackish hairs occupy a larger area. All tibiae yellowish except apices black, tibiae II and III with apical half or third black. Tarsi black with coppery scales especially on leg III. Claws toothed as in the other species of the complex. *Wings:* Subcosta completely hairy with 75 macrotrichia. Anal 1 vein arriving close to the border of the wing. Base of costa and radius with a dark-coppery tuft of hairs. *Abdomen:* Basal segment with pale hairs, long laterally, shorter in the middle. Rest of abdomen clothed laterally with brassy to golden scales and bearing in the middle a wide longitudinal band formed of small coppery scales. Cercus slightly triangular posteriorly (fig. 30).

Male: Lengths of body 3,8 mm, of thorax 1,5 mm, of wing 3,5 mm, of antenna 0,5 mm. Width of thorax 1,05 mm, of wing 1 mm. *Head:* Antennae blackish. *Thorax:* Mesonotum velvety dark-reddish, with golden scales mixed with very rare coppery scales. Scutellum dark brown with yellowish hairs. Postnotum, pleural membrane and katepisternum as in female. Legs very dark, covered with black hairs except femur I partly yellowish. Tibiae with basal third or half pale. Coppery scales are present on all the legs but specially on femora II and III, on tibiae III and on tarsi. Metatarsus III dilated. *Wing:* The apical quarter of subcosta bare, the rest with 31-35 macrotrichia, basal tufts of hairs coppery. *Abdomen:* Basal segment with long pale hairs. Other tergites clothed with long silvery hairs. A few coppery scales are present on the apical segments laterally. Sternites pale with a wide longitudinal median dark band. *Terminalia:* Ventral plate relatively very wide, tapering posteriorly; there is only one pair of large parameral hooks (fig. 19).

Pupa: Head and thorax: With a few rounded disc-like tubercles. Abdominal hooks and spine combs as usual. Pilous plate with 6 very long (180 μ) drumstick-like setae (fig. 81). *Pupal gills:* Basal trunk relatively short, bearing a voluminous basal vesicle longer (340-350 μ) than the basal trunk (170 μ). This vesicle is strongly produced at ventral and external sides of the trunk (figs. 41 and 59). The four equally long filaments arise directly from the base, they do not spread out and they remain parallel. Texture of the filaments without raised formations but bearing small dots not forming a reticulum. Total length of the gills 3 mm (including base). *Pupal onchotaxy:* Segments 5 and 9 without dorsal spines (fig. 106 and Tables I-II).

Cocoon (fig. 126): A simple well-woven pocket without fenestrations, with a weak rim, not produced medianly, and fairly well produced antero-laterally with a tendency to form a collar. Length in midline 4 mm, maximum width 3,2, mm.

Larva (figs. 133-137, Tables I-II). Length 10 mm (alcohol specimens), with classical body shape. *Head:* Eye spots well developed. Positive spots are present near the postgenal cleft. Postgenal cleft small, more or less rectangular. Hypostomium: apical teeth with the median tooth not prominent, behind the external intermediate teeth. There are 4 to 6 lateral serrations and 5 to 7 long hypostomial setae. Mandible of classical shape, with 3 long apical teeth, of which the posterior is much stronger than the first comb teeth, with 3 comb teeth, of which the third (posterior) is as long or longer than the 2nd; the 2 posterior serrations unequal, the anterior is the largest and with anterior border strongly convex (fig. 136). Antennae (see Table I). There are about 30 cephalic fans. *Thorax:* Respiratory histoblast: Basal vesicle and pilous plate as in the pupa.

Locality:

1. Holotype female hatched from a mature pupa, from Riv. Funda (1900 m), Rwanda. From the same river and date: 5 females and 6 males, all paratypes hatched from pupae; 6 specimens (3 males and 3 females, paratype) dissected from their pupae; 10 mature larvae (Coll. A. Fain, VI.1950).

2. Several pupae from a small river (2000 m) near Bururi, Burundi; 24.IX.1980 (Coll. P. Elsen). Holotype and 2 paratypes female; 3 paratypes scale with pupae in MRAC. Paratypes in BMNH (1 female, 1 male hatched from pupae, 8 pupae).

REMARK:

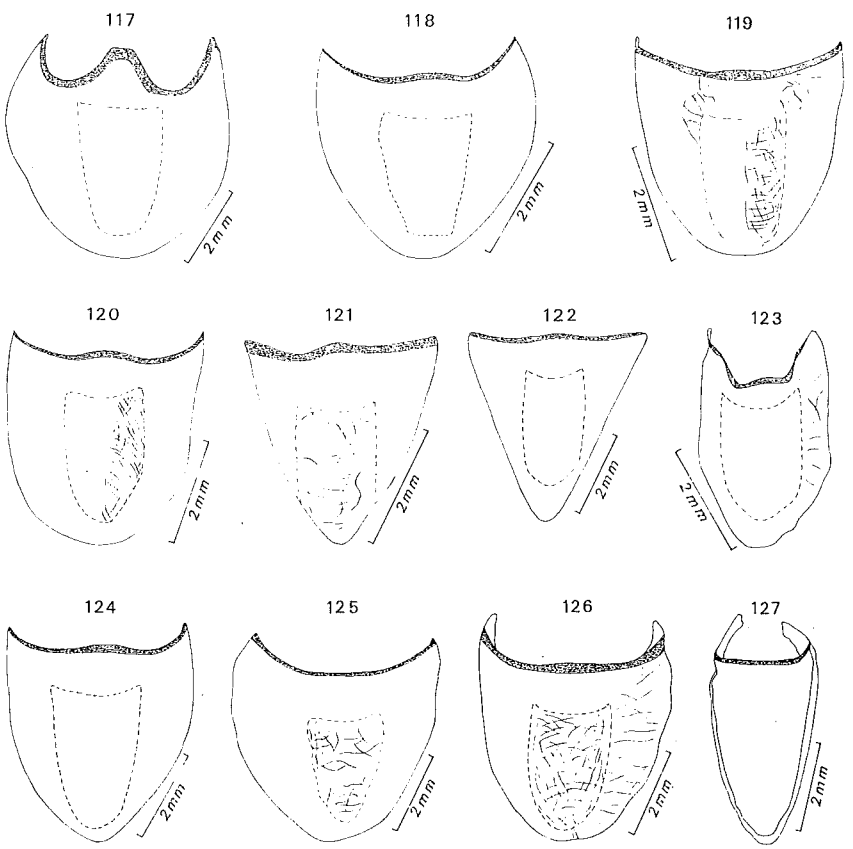
This species is well characterized by the structure of the pupal gills, especially the very large development of the basal vesicle, forming a voluminous external pouch, and the aspect of the pilous plate bearing very long and drumstick-like hairs.

8. **Simulium (Nevermannia) bulbiferum** spec. nov.

This species is known from an incomplete male hatched from the pupa, two males dissected from their pupae, 5 males still enclosed in their pupae, and 2 females. The pupa resembles that of *S. saccu-*

liferum by the great development of the basal vesicle but is however distinguished from the latter by the more voluminous size and the different shape of this vesicle, by the structure of the walls of the gill filaments bearing a raised reticulum as in *S. aureosimile* and by the texture of the cocoon loosely woven and with fenestrations in its lateral parts.

Male : The holotype is a pinned male whose head and wings are lost. The thorax is 1,5 mm long. Mesonotum dark reddish as in *sacculiferum* but with coppery scales more numerous. Postnotum reddish-brown, bare. Pleural membrane and katepisternum bare. Legs as in



Figs. 117 - 127. — Cocoons finely woven and not reinforced by thick obvious threads. - 117. *S. raybouldi;* - 118. *S. candelabrum;* - 119. *S. baforti;* - 120. *S. nyanzense;* - 121. *S. flavinotatum;* - 122. *S. aureosimile* (Djem); - 123. *S. nigritarse* (Cape Province); - 124. *S. antibrachium;* - 125. *S. duboisi;* - 126. *S. sacculiferum;* - 127. *S. rubescens.*

sacculiferum. First segment of abdomen with long pale hairs, other segments with golden scales laterally and small coppery scales in the median area; in posterior segments the coppery scales are also present laterally.

Dissected paratypes : third segment of palps less pigmented than in *sacculiferum* with sensory vesicle similar as in that species. *Legs :* third tibia yellowish except apical half black. Legs III dilated as in *sacculiferum*. Wings : Apical half of subcosta bare, the rest with only 15-20 macrotrichia. *Terminalia :* There are two strong and unequal parameral hooks at each side. Style as long as coxite.

Female : Represented by one specimen partly emerging from its pupae and one specimen dissected from the pupa and mounted on a slide. In the first specimen the thorax is 1,5 mm long. Frons and face with golden scales. Mesonotum reddish-brown densely covered with golden scales mixed posteriorly with coppery scales. Scutellum with long yellow hairs. Postnotum reddish-brown, bare. First segment of abdomen with long golden hairs. Halters pale yellowish with brownish stalks.

In the dissected specimen the mandible shows 0 and 17 to 19 teeth, the three basal teeth being smaller and distinctly separated from the others by a slight depression. Maxillae with 15 and 7-8 teeth. Third segment of palps with a large sensory vesicle longer than half the length of the segment (fig. 11). *Wings :* Subcosta with about 40-50 macrotrichia occupying the eighty or ninety basal parts of the vein. *Terminalia :* cercus with triangular posterior border (fig. 32).

Pupa : Pupal gills 2,5 to 3 mm long, including the basal trunk; the latter is 300 μ long and bears a voluminous basal vesicle. The external lobe of this vesicle is ovoid and 600-700 μ long (longitudinal diameter) (figs. 42 and 60). In most of the specimens there is a small hole on the top of this vesicle. Pilous plate as in *sacculiferum* (fig. 82). The filaments arise directly from the basal trunk and are not spreading. Texture of filaments as in *S. aureosimile* (fig. 77).

Cocoon (fig. 112): Slipper-like but with a tendency to form a collar antero-ventrally. There is a rim but no median projection. It is rather well woven in its median part but loosely woven and with large fenestrations laterally. Length in midline 4 to 4,5 mm, laterally 5 to 5,5mm; maximum width 3,5-4 mm. The cocoons that are fixed on a flat support reach a width of 3,5-4 mm. When the support is a very thin leaf the cocoon becomes cylindro-conical and is only 2 mm wide.

Larva : unknown.

Locality :

Holotype male with pupal skin and cocoon from a small river (2500 m) in a forest at 40 km S.-E. of Kisenyi, Rwanda. August 1947. Paratypes : 2 mature males dissected from their pupae, 2 females of which one dissected from the pupa, the other partly emerged from the pupa; 6 mature pupae, all from riv. Kumbi (3000 m), Kivu, September 1948 (Coll. A. Fain). Holotype and 2 paratypes male, 1 female pupa and cocoons in MRAC. Paratypes in BMNH (3 pupae).

9. **Simulium (Nevermannia) flavinotatum** spec. nov.

Simulium aureosimile (nec Pomeroy) Dujardin & al., 1980 : 373 (in part).

Female : Lengths in holotype : body 3,1 mm; thorax 1,4 mm; wing 3,5 mm; antenna 0,50 mm. General characters as in *S. sacculiferum*. It differs from it by following characters :

1) Mesonotum velvety black. Coppery scales much more developed, they cover most of the mesonotum; on the abdomen they form a wide median band beginning on segment II and extending to the posterior extremity; they are also very abundant on legs III. Base of wings with 2 tufts of coppery scales. Scutellum brownish-black. Postnotum bare, of same colour as mesonotum. Abdomen blackish except the three last abdominal tergites which are pale pink.

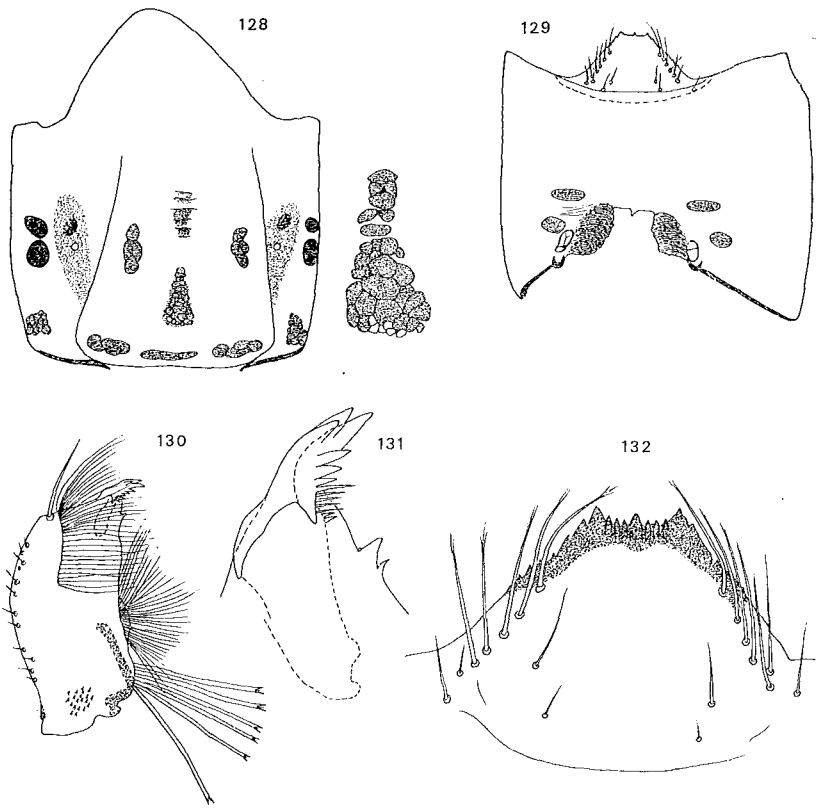
2) Wings : The spinules on the costa are disposed on two rows (on three rows in *S. sacculiferum*). The three quarters of the base of the subcosta are heary and bear 34 macrotrichia. The ratio of lengths of wing to thorax is 3,94 (for 3,14 in *S. sacculiferum*).

3) Mandible with 0-20 teeth. Maxillae with 14-6 teeth. The 3rd segment of the palps is more than twice as long as wide. The length of the sensory vesicle is 38 % of that of the segment (fig. 4).

Male : Length of body 3 mm, of thorax 1,4 mm, of wing 3,4 mm, of antenna 0,45 mm. General characters as in *S. sacculiferum* except for the followings :

1) Third segment of palps only slightly pigmented, containing a very small sensory vesicle. The opening of this vesicle is about as large as the vesicle.

2) Mesonotum with a dark-reddish tomentosity, bearing mainly golden scales and also coppery scales slightly more numerous than in the male of *S. sacculiferum*. Pleura dark blue-greyish. Halters brownish, with blackish stalks. *Wings :* subcosta with a few macrotrichia in its basal half.



Figs. 128 - 132. — Larva of 5th stage of *S. aureosimile* (Djem). - 128. dorsal head spots; - 129. ventral view of head; - 130-131. Mandible; - 132. Hypostomium.

3) Abdomen darker, blackish; sternites darker, blackish with a thin lateral pale line. Coppery scales are more developed on tergites than in *S. sacculiferum*.

4) Terminalia: Ventral plate distinctly tapering posteriorly. Style longer than coxite (fig. 21). There are 2 pairs of strong parameral hooks rather widely separated from each other.

Pupa : Head and thorax as in *S. sacculiferum*. Pilous plate with 6 simple equal setae, 54 μ long (fig. 89). Pupal gills 3 mm long, including basal trunk. Basal trunk as long as its maximum width (140-150 μ), strongly sclerotized, triangular distinctly compressed laterally and enlarged dorso-ventrally; it has a bright orange colour. The basal vesicle is small (126 μ long and 135 μ wide). The 4 filaments are subequal in length and they arise directly from the base; they bear short raised piliform structures disposed along transverse lines (fig. 43, 61, 74-76). Onchotaxy of pupal abdomen resembling that of *S. simplex* but the spines of 5th segment are smaller and there are no true spines on segment 9 (fig. 10).

Cocoon (fig. 121): As for *S. sacculiferum* but slightly smaller, its length in midline is 3,5 to 3,8 mm, its maximum width 2 to 2,4 mm.

Larva : Unknown.

Locality : The holotype is a female hatched from a pupa, from Riv. Muruhondo (2300 m.), Rwanda, August 1949. Paratypes from the same river and date: 2 females and 8 males (pinned specimens), 2 females and 4 males dissected and mounted on slides. Eight female paratypes have been collected on wild birds freshly killed, close to the Muruhondo river (August 1949) (All material collected by A. Fain). Holotype female and 6 paratypes male in MRAC. Paratypes in BMNH (1 male and 1 female hatched from pupae).

REMARK :

This species differs from *S. sacculiferum* by several characters mentioned above. It also differs from *S. simplex* mainly by the following characters : female with numerous coppery scales on mesonotum and abdominal tergites (with rare coppery scales on mesonotum and not on abdomen in *simplex*); posterior abdominal tergites pale pink (black in *simplex*); base of pupal gills orange in colour and compressed laterally (brown and flattened dorso-laterally in *simplex*); cocoon finely woven without thick threads (loosely woven and reinforced with thick threads in *simplex*); pupal abdomen with vestigial spines on 5th tergite (with well developed spines on this tergite in *simplex*).

10. **Simulium (Nevermannia) rubescens** spec. nov.

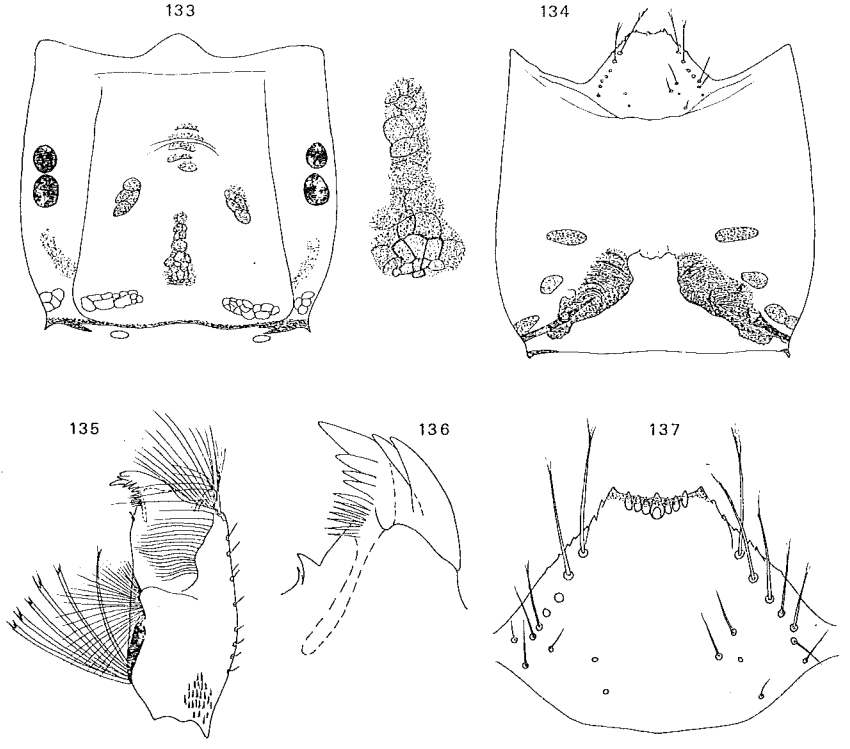
Simulium aureosimile (nec Pomeroy) Dujardin & al., 1980 : 373 (in part).

A large species characterized by the reddish colour of the thorax in both sexes, combined with the absence of hairs on postnotum, the closely-woven aspect of the cocoon without fenestrations and the structure of the filament walls with a raised reticulum as in *S. aureosimile*. The basal trunk of the pupal gills is elongate and conical and it bears a basal vesicle almost as long as the basal trunk. In the male the subcosta is bare except 2 or 3 macrotrichia near its base.

Female : Length of body 3,4 mm, of thorax 1,9 mm, of wing 4,25 mm. *Head:* Face and frons with golden scales. Antennae reddish-brown, with basal segments yellowish. Mandible with 0 and 21 to 24 teeth, maxillae with 17 and 4 teeth. Third segment of palp brownish, 1,9 times as long as wide, with a sensory vesicle whose length is slightly more than half the length of the segment (fig. 13); this vesicle opens in the middle of the segment. *Thorax :* Mesonotum pale reddish-brown with golden scales mixed with coppery scales in the posterior half. Scutellum pale brownish; postnotum bare, dark brown-red. Halters whitish with brownish stalks. *Legs* as in *S. sacculiferum* but femur I is not dark apically but bears black scales on its distal quarter. Leg III with metatarsus, tibia and femur dilated. *Wings :* Spinules of costa disposed along one row. Subcosta with 49 macrotrichia occupying the three basal quarters. *Abdomen :* First tergite with pale hairs, other segments with long golden hairs laterally and short coppery scales in a median band from 2nd segment to the end of the abdomen. Cercus triangular (fig. 28).

Male : Lengths of body 3,5 to 4 mm, of thorax 1,6 mm, of wing 4,3 to 4,8 mm, of antennae 0,5 mm. *Head :* Antennae darker than in the female. Third segment of palps moderately pigmented containing a relatively large ovoid sensory vesicle, whose length is 30 % of the length of the segment. *Thorax:* Mesonotum reddish, scutellum pale brown. Postnotum reddish, darker than mesonotum. Halters pale brown with darker stalks. Femur I not pigmented apically. Legs III with metatarsi, tibiae and femora dilated. *Wings :* Subcosta bare except 2 or 3 macrotrichia near its base. *Abdomen:* Tergites with long golden hairs and a few coppery scales on the posterior segments. Sternites blackish. *Terminalia:* Ventral plate relatively narrow and long. Parameres with two pairs of unequal hooks. Style shorter than coxite (fig. 22).

Pupa : Head and thorax with a few poorly sclerotized disc-like tubercles. Abdominal hooks and spines as usual. *Pupal gills:* Basal trunk about 300 μ long, narrowly triangular. Basal vesicle triangular, shorter than basal trunk, 266 μ long. Pilous plate 58 μ wide (maximum



Figs. 133 - 137. — Mature larva of *S. sacculiferum.* - 133. dorsal head spots; - 134. ventral view of head; - 135-136. mandible; - 137. hypostomium.

diameter), with 6 simple hairs 110 to 120 μ long (fig. 86). The 4 filaments are equal or subequal in length, they arise directly from the basal trunk and do not spread out. Total length of the gills 3,5 mm. Texture of filaments as in *S. aureosimile* (fig. 44, 62, 77).

Cocoon (fig. 127): A simple well-woven pocket without fenestrations, with a weak rim but without median process. Length in midline 4,5 mm, laterally 5 mm; width 2,5 to 3 mm.

Larva : Unknown.

Locality : Holotype and 1 paratype female and 3 paratypes male, all hatched from their pupae, 5 males and 2 females paratypes dissected from their pupae. All from riv. Muruhondo (2300 m), Rwanda, August 1949 (Coll. A. Fain). Also from riv. Kumbi (3000 m), Zaïre, 3 males and 1 female, hatched from pupae (paratypes). Holotype and 2 paratypes female, 1 paratype male, hatched from pupae; 3 males and 3 females dissected from pupae, all paratypes and deposited in MRAC. Paratypes in BMNH (2 females, 1 male, 3 pupae).

11. **Simulium (Nevermannia) raybouldi** spec. nov.

Dr. Crosskey kindly transmitted us the typical series of this species for inclusion in our revision. This species is named after Dr. J.N. Raybould who discovered it and sent the specimens to the BM.

This species is clearly distinct from all the other species of the « nigritarse » complex by the following characters : pupal gills with a very long and narrow basal trunk, pilous plate bearing 6 furcate hairs, cocoon with a large antero-median projection. The holotype is a pupa still enclosed in the cocoon and containing a mature male.

Male : Terminalia dissected from the pupa : Ventral plate of the *nigritarse* type, distinctly narrowed posteriorly. There are two pairs of strong unequal parameral hooks (fig. 23). On the paratypes male mounted on slides the hind legs are lacking. Wing 3,5 mm long, subcosta with 60 % from the base hairy.

Female (on slide): Sensory vesicle of the palps as long as half the length of the segment (fig. 10). Mandibles with 0 and 14 teeth, maxillae with 12 and 6 teeth. Subcosta with 80 % from the base hairy.

Pupa : Pupal gills with a very long (about 600-700 μ) and narrow base, the total length of the gills (including the base) is 4,3 mm. The filaments are subequal in length, their texture is faint and somewhat intermediate between types 1 and 2. The basal vesicle is approximately as long as the base (figs. 45, 64). Pilous plate with 6 branched hairs (with 2 to 5 branches) (fig. 96). Pupal abdomen (dorsum): Segment 5 with a very small spine at one side; segments 6 and 7 with 5 to 6 pairs of larger spines and a few very small ones; segment 8 with 6-7 pairs of larger spines; segment 9 with a few very small triangular spines and numerous small combs.

Cocoon : Thin and transparent, finely woven, without fenestrations and reinforcements, 5 mm long in midline, 5,2 wide, with a well-formed rim and a broad antero-median process (fig. 117).

Larva : 7,5 to 8,5 mm long. Hypostomium with the median tooth not proeminent. There are 4-5 long hypostomial setae (figs. 138-141). Other characters see Tables I and II.

Locality : Holotype pupa with a mature male, from Ngaremtoni stream, near Arusha, Tanzania, 2.V.1966. Paratypes from the same place : 5 pupae and 3 larvae in alcohol ; 14 slides containing 3 males, 3 females, pupae, cocoons and fragments of larvae. Paratypes from Mt. Kilimandjaro, Tanzania (2400 m), 5.VIII.1955 : 2 pupae in alcohol and pupal gills (1 slide). Holotype and paratypes in BMNH. Paratypes in MRAC : 1 male and 1 female dissected from their pupae and 3 pupae.

12. **Simulium (Nevermannia) sirimonense** spec. nov.

Simulium (*Eusimulium*) *aureosimile* (nec Pomeroy) Bafort, 1977 : 594 (in part).

This species is represented by 2 males and a female dissected from their pupae and by immature pupae.

The pupal gills are characteristic and differ from all those of the other species of the *nigritarse* complex by their configuration. The cocoon is very loosely woven with thick threads and large fenestrations. It differs from *S. brachium* by the different orientation of the filaments and by the structure of the cocoon with thicker threads and the presence of large fenestrations.

Male (Holotype) (dissected from the pupa) (specimen from Mt. Kenya) : *Terminalia :* Ventral plate relatively wide at base but tapering posteriorly. Parameres with 2 unequal hooks at each side (fig. 20). Style much shorter than coxite.

Female (dissected from the pupa) (specimen from Mt. Ruwenzori): Sensorial vesicle of palp voluminous, distinctly longer than half the length of the 3rd segment (fig. 16). Mandibles with 0 and 16-18 teeth, maxillae with 17 and 8 teeth. Cercus triangular.

Pupa : Pupal gills with a very short basal trunk. The 4 filaments arise from two very short stalks or directly from the base (figs. 51,

67). At their origin the uppermost and lowermost filaments are diverging at an angle of about 90°; at a short distance from the base they describe a regular curve and become parallel. Structure of the filaments of type 3. Basal vesicle small. Pilous plate with 5 simple and 1 branched hairs (fig. 89). Total length of pupal gills 4 mm. Pupal abdomen : segment 5 without dorsal spines (fig. 105).

Cocoon (fig. 114): Slipper-shaped, with antero-lateral parts strongly developed and sometimes fused in midline; very loosely woven, resembling a network with numerous obvious and thick threads and large fenestrations. There is a poorly developed rim and no distinct median process. Length in the midline 6 mm, maximum length including the antero-lateral processes 8 mm, maximum width 4 mm.

Larva : Unknown.

Locality :

1. The holotype is a male dissected from its pupa, from riv. Little Sirimon (3750 m), Mt. Kenya (mounted on 2 slides). Paratypes from riv. Sirimon II, V, and VII (2500 to 3550 m): 1 male dissected from pupa, 10 immature pupae, 4 cocoons; from riv. Ontulili III, V, and VIII (3500-4000 m), Mt. Kenya : 5 immature pupae.

2. Mt. Ruwenzori, from a river in Senecio forest (about 4000 m): 2 paratypes female dissected from their pupae (mounted on 3 slides), 3 paratypes larvae of 5th stage and 2 pupae on slides, three cocoons in alcohol. Holotype, 1 paratype male, 6 pupae with cocoons, all paratypes, in MRAC. Paratypes in BMNH : 1 female dissected from a pupa and 2 pupae (Ruwenzori); 4 pupae from Mt. Kenya.

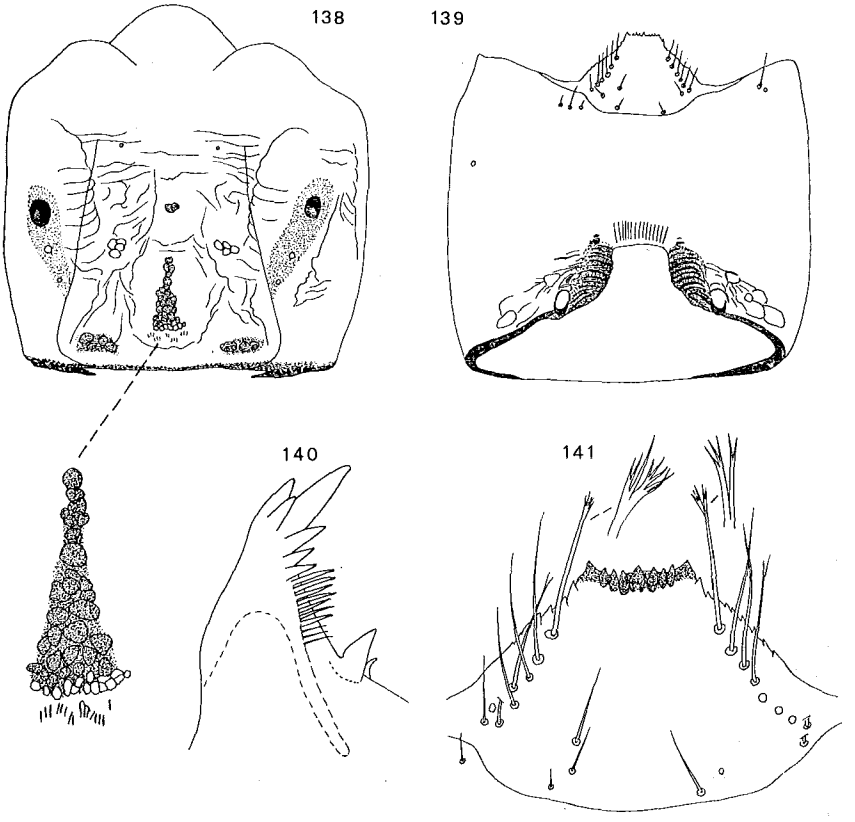
13. **Simulium (Nevermannia) alatum** spec. nov.

This species is represented by 2 males and 3 females dissected from their pupae and by immature pupae.

It is characterized mainly by the structure and the shape of the cocoon which is as wide or wider than long, finely woven, transparent and without fenestrations but reinforced laterally by 10 to 15 relatively thick transverse threads; its antero-median margin is distinctly produced. Pupal gills with a long basal trunk, texture of the walls of type 3.

Female: Sensory vesicle of 3th segment of palp much shorter than the segment (fig. 1). Teeth on mandibles 0-21, on maxillae 14-6. Cercus triangular (fig. 29).

Male: Terminalia: Ventral plate wide basally, attenuated posteriorly. There are 2 pairs of strong unequal parameral hooks. Style shorter than the coxite. Median sclerite short (fig. 24).



Figs. 138 - 141. — Mature larva of *S. raybouldi.* - 138. dorsal head spots; - 139. ventral view of head; - 140. mandible; - 141. hypostomium.

Pupa: Pupal gills with a long basal trunk (350 to 375 μ long). The 4 filaments arise directly from the base (figs. 47, 65). The longest is 4 to 4,5 mm long, the shortest 3 to 3,5 mm. They do not spread but remain parallel. Structure of filament wall of type 3. Basal vesicle short. Hairs of pilous plate simple 50 to 80 μ long (fig. 91). Onchotaxy of pupal abdomen : segment 5 without dorsal spines.

Cocoon (fig. 116): Slipper-like, as wide as or wider than long, finely woven, with very thin and transparent walls but reinforced laterally by 10-15 transverse relatively thick threads. There is a thick rim and a distinct antero-median rounded process. Length 4 to 4,3 mm, maximum width 4,6 to 5 mm.

Larva : Unknown.

Locality :

Only known from Mt. Kenya : The holotype is a pupa containing an immature male, from riv. Ontulili II, Mt. Kenya (3230 m) (Coll. J. Bafort, 1975). Paratypes (3 females, 1 larva and 12 immature pupae) from the same place and date.

Other paratypes from riv. Ontulili I (2500 m) (1 immature pupa and 1 male dissected from the pupa), Ontulili IV (3700 m) (2 males and 1 female dissected from the pupae) and riv. Marimba I (2140 m) (1 female dissected from the pupa). Holotype : pupa with cocoon ; 2 pupae with cocoons, 2 paratypes male, 2 paratypes female, larvae, all paratypes, in MRAC. Paratypes in BMNH : 4 pupae in their cocoon.

14. **Simulium (Nevermannia) baforti** spec. nov.

This species is named for Dr. J. Bafort, who collected an interesting collection of Simuliidae on the Mount Kenya, among which several new species.

This species belongs to a small group characterized by the relatively great length of the base of the pupal gills, the aspect of the cocoon, finely woven without fenestrations, the structure of the filament walls, without raised reticulum or lines. It differs from the three other species of this group (*S. raybouldi, S. alatum* and *S. nyanzense*) by the much shorter length of the basal trunk, the shape of the cocoon with anterior margin not produced and the much smaller size of the sensorial organ in the palp of the female.

Female (dissected from pupa): Sensorial vesicle of the palp shorter than half the length of segment 3 (fig. 6). Mandibles with 0-18 teeth, maxillae with 13-6 teeth. Cercus not triangular, with posterior border regularly rounded (fig. 34).

Male (dissected from pupa): *Terminalia :* Ventral plate with a wide base, but tapering posteriorly. There are 2 pairs of strong parameral hooks. Style wide apically, distinctly shorter than the coxite.

Pupa: Pupal gills with a rather long (235 to 250 μ long) and narrow basal trunk. The 4 filaments arise directly from the base (figs. 52, 70). Total length of pupal gills 3,2 to 3,5 mm. Basal vesicle shorter than the basal trunk. Pilous plate with simple hairs 40 to 50 μ long (fig. 83). *Onchotaxy of the abdomen:* There are several small spines on segment 5, dorsally (fig. 104).

Cocoon (fig. 119): Slipper-like, 3 mm long in midline, finely woven, without fenestrations and with indistinct fine threads antero-laterally. There is an anterior rim but no antero-median process.

Larva (figs. 142-145): In a mature larva the median tooth of the hypostomium is prominent. There are 3 long hypostomial hairs. Other characters see Tables I-II.

Locality:

All the specimens were collected on rivers of Mt. Kenya, by Dr. J. Bafort, in 1975. Holotype female from riv. Sirimon II, 2 paratypes (one male dissected from pupa and 1 immature pupa) from the same river. Paratypes from riv. Marimba (2140 m) (1 male dissected from pupa, 1 mature larva and 15 immature pupae) and from riv. Ontulili I and II (2500 to 3230 m) (2 immature pupae and a male dissected from pupa). Holotype female with pupa and cocoon, 5 pupae with cocoons, 1 mature larva, all paratypes in MRAC. Paratypes in BMNH: 3 pupae in their cocoons, 1 pupa without cocoon.

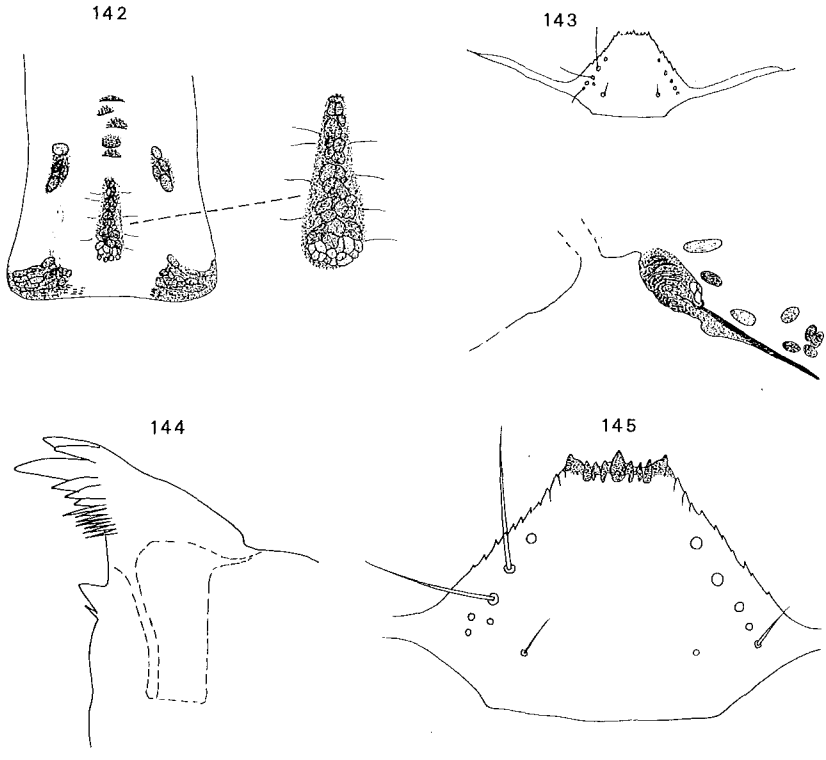
15. **Simulium (Nevermannia) nyanzense** spec. nov.

This species belongs to the same group as *S. raybouldi, S. baforti* and *S. alatum*. In these species the basal trunk of the pupal gills is long (from 270 to 600 μ) and narrow and the structure of the filaments is of the type 3. *S. nyanzense* is the most close to *S. alatum* but it differs from it by the structure and the shape of the cocoon, the large size of the palpal sensorial vesicle and the rounded aspect of the cercus in the female.

Female (dissected from pupa): Sensorial vesicle of the palp relatively very large and distinctly longer than half the length of the third palpal segment (fig. 15). Mandibles with 0-18 teeth, maxillae with 12-6 teeth. Cercus rounded posteriorly (fig. 36).

Male (dissected from pupa): Terminalia: Ventral plate only slightly tapering posteriorly. There are 2 pairs of large unequal parameral hooks. Style only slightly shorter than the coxite (fig. 26).

Pupa: Basal trunk of pupal gills relatively very long (370-400 μ) and narrow (120 μ wide) (figs. 46, 63). The 4 filaments arise directly from the base. Structure of the filament walls of type 3. Total length of pupal gills 4 mm. Basal vesicle approximately as long as the basal trunk. Pilous plate with 6 piliform hairs (fig. 84). Onchotaxy of pupal abdomen (dorsally): Segment 5 without backwardly directed spines; the spines of segment 6 are distinctly smaller than those of segment 7 (fig. 107).



Figs. 142 - 145. — Mature larva of *S. baforti.* - 142. dorsal head spots; - 143. ventral view of head; - 144. mandible; - 145. hypostomium.

Cocoon (fig. 120): Slipper-like, 3,5 to 3,8 mm long in midline, finely woven and not reinforced laterally by additional threads. There is a well-formed rim and the anterior margin is slightly produced.

Larva (figs. 146-150 and Tables I-II): Length 6,5 to 7 mm. Median tooth of hypostomium not prominent. There are 3-5 long hypostomial setae.

Locality:

Holotype female dissected from a pupa, from Kenya, Nyanza region, May 1960 (Coll. J.P. McMahon). Paratypes (4 males and 2 females dissected from pupae, 7 immature pupae, 2 cocoons, 2 mature larvae) Numerous pupae and larvae in alcohol (not paratypes), all from the same locality. Holotype and paratypes in BMNH. Paratypes (1 female, 2 males and 2 pupae) in MRAC.

16. **Simulium (Nevermannia) antibrachium** spec. nov.

This species is close to *S. brachium* Gibbins. It differs from it mainly by the shape of the pupal gills and the structure of the cocoon. In *S. antibrachium* only the lowermost filament describes a wide curve and the cocoon is finely woven without fenestrations while in *S. brachium* only the uppermost filament is strongly curved and the cocoon is loosely woven with fenestrations.

Male (dissected from a pupa). *Terminalia:* Ventral plate wide anteriorly and strongly tapered posteriorly. There are 2 pairs of strong slightly unequal parameral hooks. Style about as long as coxite (fig. 25).

Female (dissected from a pupa): Third segment of palp very elongate with sensorial vesicle much shorter than half the length of the segment (fig. 7-8). Mandible with 24 teeth, maxillae with 13-8 teeth. Cercus slightly triangular (fig. 27).

Pupa: Basal trunk of pupal gills of medium length (200 to 220 μ long) and relatively thick (110-120 μ wide) (fig. 68). Two filaments arise from the basal trunk, the two other arise from a short secondary stem. Total length of pupal gills including the base 3 to 3,5 mm. The filaments are spreading at their origin and the lowermost filament describes a wide ventral curve, while the uppermost filament is slightly curved dorsally (fig. 49). Structure of the filament walls poorly marked, somewhat intermediate between types 1 and 2, with transverse and oblique raised lines, but less marked than in *S. simplex*. Basal vesicle shorter than the basal trunk and relatively well expanded externally (fig. 68). Pilous plate with simple hairs (60 μ long) (fig. 87). Onchotaxy of pupal abdomen: Segment 5 with a few very small dorsal spines. Spines of segments 6 to 8 medium-sized. Segment 9 with a few very small spines and numerous minute combs (fig. 99).

Cocoon (fig. 124): Slipper-like, 4 to 4,2 mm long in midline, finely woven, without obvious secondary threads and without fenestrations. A rim is present but there is no antero-median process.

Larva : Hypostomium with median tooth prominent. There are 4 or 5 long hypostomial setae. Teeth of mandibular comb subequal. Serration with a straight apical surface.

Locality :

1. Holotype and paratypes from streams of Mt. Kenya. The holotype is an immature pupa extracted from its cocoon. It was found in riv. Marimba I (Bafort, 1975). Paratypes from the same river (2 immature pupae); riv. Teleki I (1 pupa); riv. Sirimon II (2 males and 1 female dissected from their pupae); riv. Ontulili I and III (3 males dissected from pupae and 3 immatures pupae); riv. Ontulili VIII (2 larvae and 2 pupae); riv. Nanyuki II (1 male dissected from a pupa); riv. Naro Moru I (1 mature larva).

2. We attribute to *S. antibrachium* 2 females and 1 male dissected from pupae and 2 pupae, all paratypes mounted on slides and collected from Buea, W. Cameroun, 25.I.1969, by R.H. Disney (Coll. of BMNH). Holotype with cocoon in MRAC. Paratypes : 1 male and 1 female dissected from pupae, 2 pupae with cocoon, 1 mature larva, all in MRAC; 2 females, 1 male, pupae from Cameroun, 3 pupae from Mt. Kenya in BMNH.

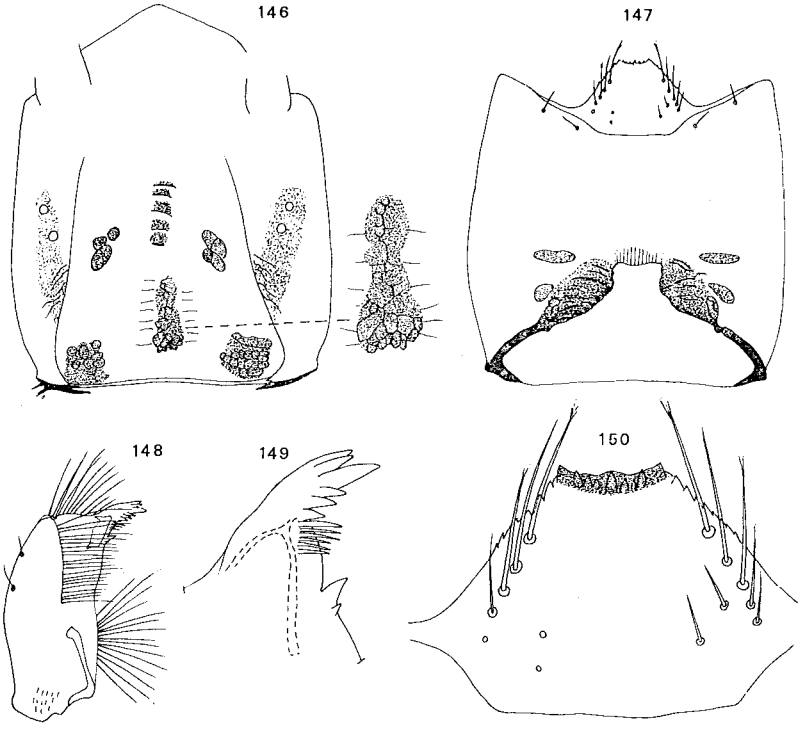
17. **Simulium (Nevermannia) candelabrum** spec. nov.

The pupal gills are very characteristic in this species and resemble a branched candlestick or candelabrum. The uppermost and lowermost filaments are strongly divergent at their origin and almost opposite in direction. They describe a wide curve and become parallel but remain widely separated from each other.

Male (dissected from a pupa): Immature specimen. *Terminalia :* Ventral plate slightly tapering posteriorly. There are 2 pairs of unequal parameral hooks. Style slightly shorter than the coxite.

Pupa : Basal trunk of pupal gills very short (160-190 μ long), thick apically. Two filaments arise directly from the base, the two others arise from a short and thick secondary stem. The filament walls bear very short not raised piliform structures. The filaments are strongly

spreading. The uppermost filament describes a wide dorsal rounded curve, the lowermost filament is almost opposite to the former and describes a similar curve but oriented ventrally. One of these filaments is distinctly longer than the three others (fig. 50). Total length of the pupal gills (= length of the longest filament plus the base) about 3,2 mm. Basal vesicle small. Pilous plate with short simple hairs (fig.



Figs. 146 - 150. — Mature larva of *S. nyanzense*. - 146. dorsal head spots; - 147. ventral view of head; - 148-149. mandible; - 150. hypostomium.

88). *Onchotaxy of pupal abdomen:* dorsal surface of segments 5 and 9 without spinelets, on segment 6 there are microspines disposed on small combs.

Cocoon (fig. 118): Slipper-like, 3 mm long in midline. A rim is present but no distinct antero-median process. The cocoon is finely woven without fenestrations but the lateral parts are reinforced by very thin threads.

Larva: Unknown.

Locality:

The holotype is a pupa still in its cocoon and containing an immature male, from Lukungwi stream, at Amani, Tanzania, 16.XII.1964. Paratypes: 1 immature male dissected from a pupa, 2 immature larvae and 15 pupae (5 in alcohol) from the same locality and date. Holotype and paratypes in BMNH. Paratypes in MRAC: 2 males and 1 female (dissected from their pupae) and 2 pupae.

18. **Simulium (Nevermannia) arabicum** Crosskey & Büttiker, 1982

Simulium (*Nevermannia*) *arabicum* Crosskey & Büttiker, 1982: 425 (figs. 30-65).

The adults of this species present two tufts of pale scales on the postnotum as in *S. nigritarse*. These two species however are clearly distinct from each other by the shape of the pupal gills and the larval characters. The four filaments are spreading away from each other at the base and the uppermost filament is suddenly bent or angled downwards at a short distance from its base; the upper pair of filaments arise from a short common stalk, the lower pair of filaments arise more or less directly from the gill base. Walls of filaments with no definite surface sculpture. The cocoon is a simple semi-transparent pocket; it is closely woven, without obvious threads or perforations; a rim is present but there is no median process. This species has a wide distribution and has been recorded at altitudes varying from 850 to 2800 m (see above).

Material examined:

We attribute to that species the following material collected by J. Bafort in two rivers of Mount Kenya: riv. Naro Moru I (2350 m) and riv. Nanyuki (1950 m) (Several pupae some containing immature males).

19. **Simulium (Nevermannia) perforatum** spec. nov.

The pupal gills of this species resemble those of *S. arabicum* with the uppermost filament curved and slightly angulate. This angulation is however less marked than in that species and is absent in some specimens. In addition this species differs from *S. arabicum* by the following characters:

1) Filament walls with a raised structure intermediate between types 1 and 2.

2) Cocoon loosely woven, with fenestrations anteriorly and laterally.

3) In the female the sensory vesicle is longer (115 μ) than half the length of the third segment; this segment is 200 μ long and 125 μ wide in a female from the river Nyarutovu.

4) Absence of tufts of hairs on postnotum in female.

Female : Mandibles with 12 -13 well formed teeth and 3 to 4 smaller ones; maxillae 13 to 15 and 6 teeth. *Wing:* subcosta hairy on 90 % from the base bearing approximately 70 setae. Palp with a large sensory vesicle. Cercus slightly triangular, as in the female of *S. nigritarse* from Lubumbashi (fig. 33).

Pupa : Basal trunk short (175 μ long), triangular. Two filaments arise from the base, the two others arise from a very short common trunk. Uppermost filament describing a curve more or less angulated (fig. 48). All the setae of the pilous plate are simple and 40-55 μ long. Filament walls between types 1 and 2, with a slightly raised structure, forming irregular transverse or obliquely directed lines, rarely connected to each other and not really reticulate. Total length of the gills 3,5 mm. The 5th segment of the pupal abdomen bears several very small spines dorsally.

Cocoon : Loosely woven, with fenestrations in lateral and anterior parts.

Larva (from riv. Nyarutovu): Distance between corner teeth of hypostomium 75 μ; distance from a corner tooth and the first hypostomial seta 50 μ. There are 5 to 7 long hypostomial setae. *Antenna :* basal segment 240 μ long, 37 μ wide, intermediate segment 280 μ, apical segment 135 μ.

Locality: The holotype is a female dissected from its pupa and mounted with its cocoon on a slide. This specimen had been collected in river Nyarutovu, 1500 m, near Musigati, Burundi (Coll. P. Elsen, 1979); Paratypes from the same river: 1 dissected male, 7 immature pupae, 2 mature larvae with gill-spots. Paratypes from river Madasamwa, Rwanda: 2 dissected females, 4 immature pupae, 1 mature larva, 1 female hatched from pupa. Paratypes (pupae) from river Lutomba, Zaïre (Coll. Fain, 1949). Holotype and 1 paratype female in MRAC. Paratypes (2 pupae) in BMNH.

It is to be noted that in the female specimens from Madasamwa the mandibules bear only 11-12 teeth, the maxillae 11-12 and 4-5 teeth. The subcosta is hairy on 80 % from the base and bear only 50 setae.

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LIST OF THE BREEDING PLACES OF THE SPECIES OF THE *nigritarse* COMPLEX

(N.-B.: Partial lists have been published by Fain, 1949, 1950 a & b, Hallot & al., 1965; Fain & Elsen, 1973, Bafort & al., 1977)

Agatare (riv.), Rwanda : 1°34'S - 29°42'E; 1750 m.
Amani, Tanzania.
Aü (riv.), Ituri, Zaïre : 1°32'N - 30°31'E; 1700 m.
Baliben or Balibo, Cameroun : 1000 m.
Brits, Magaliesberg, Transvaal.
Bruco, Angola.
Bumboi (riv.), Bugishu dist., Uganda (see Naboinga).
Buea, W. Cameroun.
Bugishu, Mt. Nkokonjeru, Distr. Mt. Elgon, Uganda; 1800 m.
Bufumbo, Mount Elgon, Uganda.
Cheptaborabora (riv.), Kenya.
Dadourou (riv.), Cameroun : 7°9'N - 12°20'E; 1300 m.
Dendezi (riv.), Rwanda : 2°30'S - 28°56'E; 1500 m.
Djem (riv.), Cameroun : 7°15'N - 12°8'E; 2300 m.
Elgon (Mount), Uganda.
Funda (riv.), Rwanda : 1°48'S - 29°20'E; 2000 m.
Kadune State, Nigeria.
Kalule (riv.), Zaïre: 11°42'S - 27°29'E; 1200-1300 m.

Kibena Dam, Tanzania.
Kumbi (riv.), Kivu, Zaïre : 1°40'S - 28°50'E ; 3000 m.
Lubumbashi, S.-E. Zaïre.
Lukungwi (riv.), Amani, Tanzania.
Lutomba (riv.), Kivu, Zaïre : 1°52'S - 28°58'E; 1500 m.
Madasamwa (riv.), Rwanda : 2°31'S - 29°28'9 ; 1850 m.
Marimba I and II (riv.), Mount Kenya ; 2140 m.
Matafwadi (riv.), Zaïre : 1°38'S - 27°28'E.
Muruhondo (riv.), Rwanda; 2°33'S - 29°21'E; 2300 m.
Naboinga (riv.), Mount Nkokonjeru, Uganda : 1800 m.
Nabongo (riv.), Mount Elgon, Uganda.
Nafyebo (riv.), Zaïre : 11°36'S - 27°25'E ; 1200-1300 m.
Nanyuki (riv.), Mount Kenya : alt. 1950 m (Coll. BMNH).
Nanyuki (riv.), Mount Kenya : 0°0' - 37°7'E ; 2296 m.
Naro Moru I, Mount Kenya :2350 m.
Naro Moru III, Mount Kenya : 2850 m.
Naro Moru IV, Mount Kenya : 3150 m.
Ngaboge (riv.), Rwanda : 2°32'S - 29°23'E; 2500 m.
Ngaremtoni (riv.), near Arusha, Tanzania.
Nkokonjeru (Mount), Uganda; 1800 m.
Nyabitare (riv.): see Agatare.
Nyarutovu (riv.), Rwanda : 1°38'S - 29°51'E ; 1700 m.
Nyarutovu (riv.), near Musigati, Burundi ; 3°5'S - 29°25'E ; 1500 m.
Ontulili I, Mount Kenya : 2500 m.
Ontulili II, Mount Kenya : 3230 m.
Ontulili VIII, Mount Kenya : 4000 m.
Platteklip stream, Cape Town, Sth. Africa.
Pretoria (Sth. Africa).
River on Mount Nkokonjeru Distr. Mt. Elgon, Uganda; 1800 m.
River on Mount Kilimandjaro, Tanzania.
River in Senecio forest, Mount Ruwenzori : 4000 m.
River near Bururi ; Burundi : 3°55'S - 29°30'E ; 2000 m.
River near Arusha, Tanzania.
River at 40 Km S.-E. of Kisenyi, Rwanda : 2500 m.
River in Nyanza region, Kenya.
River on Mount Korovi, Ituri, Zaïre : 1°50'N - 30°45'E; 2200 m.
River on Mount Ruwenzori.
Rushumba (riv.), Rwanda : 1°45'S - 30°E; 1500 m.
Ruwa (riv.), Zimbabwe.
Sere (riv.), Cameroun : 8°28'N - 13°24'E ; 380 m.

Sirimon II (riv.), Mount Kenya: 2500 m.
Sirimon III (riv.), Mount Kenya; 2700 m.
Sirimon IV (riv.), Mount Kenya; 3000 m.
Sirimon VIII (riv.), Mount Kenya; 3550 m.
Sirimon (little Sirimon) (riv.), Mount Kenya : 3750 m.
Somerset East, Cape Province, Sth. Africa.
Tchabal Mbabo (riv.), Cameroun : 7°17'N - 12°12'E; 2300 m.
Teleki I (riv.): Mount Kenya; 3500 m.
Thingithu (riv.), Mount Kenya : 1540 m.
Tshuru (riv.), Zaïre : 1°45'N - 30°35'E; 1750 m.

SUMMARY

The authors revise the species of the *Simulium nigritarse* complex, widely represented in the Afrotropical Region. The number of species recognized in this complex is now 19, of which 12 are new and are described here. In the separation of the species emphasis is given to the characters of the pupa (e.g. structure and configuration of the pupal gills, shape of the basal vesicle and of the pilous plate, and onchotaxy of the pupal abdomen), and of the cocoon (shape and structure).

ADDENDUM

Deposition of the types of Simulium species described by A. Fain from 1949 to 1980

The holotypes or lectotypes of the following species have been deposited in the MRAC : *S. berghei* Fain, 1949; *S. rodhaini* Fain, 1950; *S. duboisi* Fain, 1950; *S. aureliani* Fain, 1950; *S. ngabogei* Fain, 1950; *S. jadini* Fain, 1950; *S. akanyaruense* Fain, 1950; *S. ruandae* Fain, 1950; *S. vulcani* Fain, 1950; *S. vulcani fuscicorne* Fain, 1950; *S. adersi urundiense* Fain, 1950; *S. katangae* Fain, 1951; *S. ituriense* Fain, 1951; *S. gilleti* Fain, 1964; *S. evillense* Fain et al., 1966; *S. woodi ethiopiense* Fain & Oomen, 1968; *S. mayumbense* Fain & Elsen, 1973; *S. colasbelcouri tchabalense* Fain & Elsen, 1973; *S. akouense* Fain & Elsen, 1973; *S. ngouense* Fain & Elsen, 1973; *S. tondewandouense* Fain & Elsen, 1973; *S. kingundense* Fain & Elsen, 1974; *S. kwangoense* Fain & Elsen, 1974; *S. bayakorum* Fain & Elsen, 1974; *S. africanum trimicrospherae* Fain & al., 1976; *S. dentulosum trifurcatum* Fain & al., 1976; *S. duboisi aspericorne* Fain & al., 1976; *S. dentulosum altissimum* Fain & al., 1976; *S. dentulosum bambusicola* Fain & al., 1977; *S. buisseti* Fain & Elsen, 1980; *S. spinulicorne* Fain & Elsen, 1980; *S. johannae novemcornutum* Fain & Elsen, 1980.

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