

## A REVISION OF THE TSETSE-FLIES (GLOSSINA), BASED ON A STUDY OF THE MALE GENITAL ARMATURE.

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The examination of the armature of the males of all the hitherto described species of the genus *Glossina*, with the exception of *G. maculata*, Newstead,\* has not only revealed some very striking morphological characters, but has led to the discovery of three new species† and the re-establishment of Bigot's *G. grossa*.‡ One of these new species, *G. submorsitans*, Newstead, has hitherto been overlooked through its striking similarity to *G. morsitans*. Morphologically these two species are separable chiefly by the small but important organs herein described as the median lobes; these characters will be best understood by reference to the accompanying figures (figs. 15ml, 16ml), in which the difference is as well marked as that between the holoptic and dichoptic heads found in certain groups of Diptera. *G. palpalis*, R. D., and *G. tachinoides*, Westw., are also very closely allied in the general form of the armature of the males, but they are easily separable by the minute differential characters of the inferior claspers (figs. 9ic, 11ic).

The scheme of classification here adopted for the members of this small, but very highly specialised genus, is, I believe, contrary to nearly every precedent, in so far as it begins with the lower and rises to the higher or more complex forms. It is based entirely upon the taxonomic characters of the armature of the males, which afford a natural and reliable guide for discriminating the superficially similar species, and indicate very clearly the alliances and distinctions which exist among these insects. That the species fall into three very striking and distinct groups may be easily gathered from a study of the illustrations accompanying this memoir, each group being distinguished by very trenchant characters. These are:—

### Group I.—The Fusca Group.

This division includes the four largest species of the genus: *G. fusca*, Walk., *G. nigrofusca*, Newst., and *G. tabaniformis*, Westw., which have a western distribution; *G. longipennis*, Corti, and *G. brevivalpis*, Newst., occurring chiefly on the eastern side of the continent. In all of these species the superior claspers are quite free, there being no membrane stretching between them; the distal extremities of these appendages have either a single large and bluntly-pointed tooth-like extension, or they are bluntly bidentate; the harpes in all cases being markedly different in structure.

\* The only example known is unfortunately a female.

† Ann. Trop. Med. and Parasit., vol. iv., pp. 369–375 (1910).

‡ [After a careful re-examination of the types, Mr. E. E. Austen agrees with Mr. Newstead in regarding *G. grossa*, Big., as distinct from *G. fusca*, Walk., but he considers it conspecific with the earlier *G. tabaniformis*, Westw., which name will stand. Mr. Austen is further of opinion that the species provisionally referred to *G. grossa* by Mr. Newstead is not the same as Bigot's insect, and must therefore be known as *G. nigrofusca*, Newst., the name tentatively suggested for it by Mr. Newstead (*l.c.* p. 370).—ED.]

**Group II.—The Palpalis Group.**

To this division belong the following species:—*G. palpalis*, R.D., *G. caliginea*, Aust., *G. tachinoïdes*, Westw., *G. fuscipes*, Newst., and *G. pallicerca*, Big. In all of these the superior claspers of the males are connected by a thin and finely spinose membrane which is deeply divided medially, but in all cases the distal extremities of the claspers are quite free and widely separated. In *G. palpalis* and *G. tachinoïdes* the claspers are identical in structure, though generally those of the latter are relatively smaller; in both species, also, the distal portion is produced into a single more or less falciform or tooth-like process. The claspers in *G. pallicerca* are suddenly truncated\* at the distal extremity, the inner half of which is furnished with minute spines; furthermore, they are much broader basally than in the other species which are included in this group.

**Group III.—The Morsitans Group.**

This group comprises *G. morsitans*, Westw., *G. submorsitans*, Newst., *G. pallidipes*, Aust., and *G. longipalpis*, Wied. In these the superior claspers are completely united by a spinose membrane and they are also fused medially. That they are of a very remarkable form may be gathered by a glance at the illustrations (figs. 14, 15, 16 and 17), their shape somewhat resembling the scapula of a mammal in miniature, and they are altogether much more highly complicated structures than those in either of the preceding groups.

Thus we see, in these three groups, forms which are so widely different as to lead one to assume, without taking the other external features into consideration, that they represent three distinct genera. Certain it is that these insects afford an interesting illustration of the fact that a high degree of differentiation in one set of morphological characters is not incompatible with the retention of others apparently of a more ancestral type.

**General characters of the Male Armature.†**

The sexual organs of the males of all the species of the genus *Glossina*, as has been shown, are strikingly characteristic in form. Externally the hypopygium (fig. 1) is broadly oval in shape and is highly convex, "its longer axis lying in the antero-posterior direction, with a vulviform median groove (the anus) running from the anterior margin to beyond the middle."‡ This hypopygium is articulated to the eighth abdominal segment; and when closed (fig. 1) the armature is completely hidden; the superior claspers (fig. 1sc) then lie in a horizontal position with the apices pointing towards the distal portion of the abdomen. If

\* The distal margin may eventually be found to possess a tooth-like process similar to that in other members of this group, but there is no trace of these in the example before me; further details cannot be given until more material comes to hand.

† Wesché (Trans. Linn. Soc. Lond. 2nd ser. Zool. IX., 1906, pp. 339–386, pl. 23–30) has dealt with the armature of four species of *Glossina*, but unfortunately I find myself unable to agree with many of his statements and conclusions. There is also an earlier paper by the same author (Journ. Quek. Micr. Club, 1905, p. 236) dealing exclusively with the genitalia of *Glossina palpalis*.

‡ Austen. Monograph of the Tsetse flies, p. 65.

macerated in caustic potash for a few minutes this organ, which is really a modified segment of the abdomen, can be turned backwards, as shown in fig. 2, so

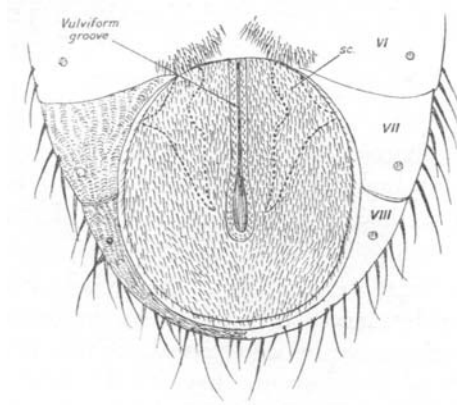


Fig. 1.—Hypopygium of male *Glossina*, as seen when closed ; the dotted lines indicate the position of the superior claspers beneath it.

that its ventral surface together with its various and complicated structures are displayed. These appendages are :

1. *Superior Claspers* (*sc* in all the figures). The position of these organs when the hypopygium is closed has already been described and it is indicated by the dotted lines in fig. 1. *sc*. These organs can be erected to an angle of varying degrees ; but in life they are never extended backwards so as to lie in a horizontal position or in the same plane as that of the abdomen, and considerable pressure is necessary to bring them into this position (see dotted lines in fig. 2).

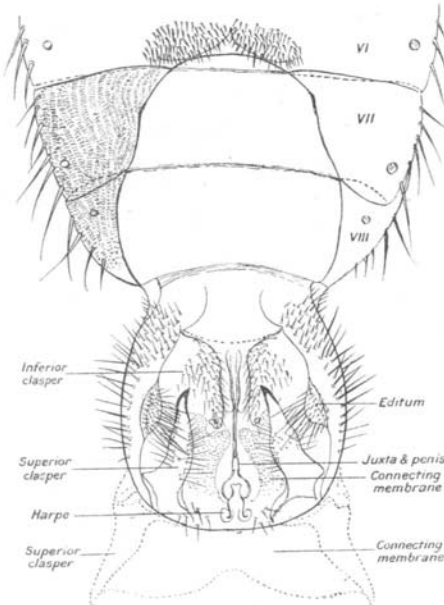


Fig. 2.—Hypopygium of male *Glossina* extended backwards so as to display the genital armature.

Their chief function is apparently to grip the abdomen of the female, and in several examples of *G. morsitans* and *G. submorsitans*, the distal margins present a distinctly chipped or worn appearance; whether this is produced by the act of coition or otherwise is uncertain. These organs are furnished with numerous slender bristles some of which are of great length, more especially so in *G. longipalpis*.

2. *Editum* (*e* in all the figures). This is a flange-like extension of the body-wall and is invariably furnished with a number of bristles, some of which are of great length and may extend to the middle area of the superior claspers (see fig. 14, p. 29).

3. *Inferior claspers* (*ic* in all the figures). These are very important organs, as they afford, in many instances, very striking morphological differences, by which closely allied species may be determined. They are very large in the *fusca* group; and in the *palpalis* group they are deeply folded at their bases, and the distal extremities are curiously modified. In the *morsitans* group they are not very clearly defined and their true structure has not yet been adequately determined, owing to the complicated folds which they present; for this reason also they are not shown in the illustrations. The function of these organs is at present unknown; but it should be a comparatively easy matter to find out in specimens preserved in coitu.

4. *Harpes* (*h* in all the figures). These organs are bilateral, and are most highly developed in the *fusca* group, more especially so in *G. fusca*. In the remaining groups these appendages are more or less rudimentary and very similar in form.

5. *Juxta* or *penis sheath* (*j* in all the figures). In all of the species included in groups II and III this is more or less tubular in form, with the distal portion strongly dilated and more or less deeply divided.

6. The *penis* (*p*) which lies in the middle of the sheath is a slender tube-like organ dilated distally, the extremity, in some instances (*G. longipalpis*, etc.) bearing four or five minute perforations. The *vesica* (*v* in all the figures) is a thin membranous extension of the juxta, supported, apparently, by the harpes. In *G. fusca*, *G. nigrofusca* and *G. brevipalpis*, it forms a complete tube presenting many irregular longitudinal folds and in some cases (*G. nigrofusca*) regular transverse ones also. In the species included in groups II and III it is quite rudimentary and in some species it resembles the harpes both in form and size, so far at least as one can judge by viewing it in optical section.

7. *Median process* (*mp* in all the figures). This organ has been found only in the *fusca* group. It lies in the position in which one would expect to find the anus; but it appears to be a non-tubular process and it is so highly chitinised in *G. brevipalpis* as to resist the action of stains. It lies in the middle line between the inferior claspers, and is slightly dilated distally and deeply grooved medially along its upper edge.

8. *Connecting membrane* (*cm* in all the figures). This is present in the *palpalis* and *morsitans* groups, but is absent in the *fusca* group. It is in all cases finely spinose and, when at rest (fig. 2), lies folded on either side of the median line.

### Methods of preparing the male genitalia for microscopical examination.

The specimens used in the preparation of this memoir were all in a perfectly dry condition so that it was necessary to macerate them in order to be able to turn the hypopygium back and display the various structures. The best method is as follows :—

1. Either break off the abdomen close up to the thorax or clip it off with a pair of scissors midway in the region of the third or fourth segment. It is best, however, to leave as much of the abdomen attached as possible so as to facilitate the final mounting of the preparation. The armature can also be dissected out with a fine scalpel, but the result is not nearly so satisfactory ; though this method may be adopted in the case of rare and valuable specimens.

2. Place the abdomen in a test tube and partly fill it with 10 per cent. caustic potash (K O H). Write with a *pencil* on a slip of paper the full data and place it in the upper portion of the tube, away from the liquid. Place the tube in a water-bath and boil over a bunsen for fifteen minutes.

3. Remove from the potash and wash in clean water for five minutes. Then take a No. 1 sable brush and roll it *towards* the hypopygium until the latter is as fully distended as possible ; repeat the process until all the dirty fluids (dissolved body-fats, etc.) have been expelled.

4. Immerse for five minutes in 50 per cent. alcohol ; and for an equal time also in absolute alcohol, taking care that the claspers are kept well distended.

5. Immerse in clove oil for ten minutes, again displaying the claspers with the brush. If the preparation has not cleared thoroughly it is a good plan to heat the oil, which will remedy the defect immediately.

6. Place the abdomen on a glass slide and with the larger species put two small broken fragments of a cover-glass, one over the other on either side of it in order to relieve the pressure of the cover-glass. With the smaller species (*morsitans*, etc.) this method is not needed.

Staining with Carbol Fuchsin brings out certain details very clearly ; but unless the student has had previous experience in this method it is not advisable to adopt it.

All the members of the *fusca* group must be mounted so that the armature may be studied in profile ; though a dorso-ventral position is necessary for the determination of the width between the superior claspers. Members of the groups II and III must be mounted in a dorso-ventral position, otherwise the superior and also the inferior claspers will not show properly ; care must also be taken to place all of these with the *venter uppermost*. The Canada balsam should not be too thin and both the slide and cover-glass should be warmed over a bunsen or spirit lamp.

The species belonging to groups I and III can be mounted with comparative ease ; but those belonging to group II are somewhat difficult owing to the tendency of the superior claspers to fold back over the hypopygium, but with care they can be fully distended, and this is absolutely necessary, otherwise the surrounding organs will not be properly displayed. In all cases where it is necessary to mount the examples in profile the abdomen must be placed upon its

side and the armature extended by the pressure of the brush in the same way as when a dorso-ventral mount is required, as if the abdomen is flattened dorso-ventrally in the first instance, it is a most difficult matter to flatten it in the opposite direction subsequently.

*Caution.*—Do not use a brush of any kind to manipulate the preparation while it is in the potash—the hairs will shrivel in this re-agent.

### Synopsis of the Species of Glossina.

*Group I* (Fusca Group). Large species, length exclusive of proboscis 10 $\frac{3}{4}$ –12 mm.

A. Thorax with the usual longitudinal markings more or less distinct.

Palpi relatively long and thin. Thorax russet brown, markings distinct, areas enclosed by the curved lines becoming gradually paler outwardly. Third segment of antennae clothed with very short pubescence. Harpes of male with a strongly serrated margin; median process not extending beyond the inferior claspers.

1. *fusca*, Walk., p. 15.

Palpi as in 1. Thorax smoky brown, pale markings sharply and clearly defined. Third or terminal segment of antennae clothed with very long pubescence, and with apex strongly recurved. Harpes of male not serrated; median process projecting moderately beyond the inferior claspers.

2. *nigrofusca*, Newst., p. 17.

Palpi relatively short and stout. Thoracic markings not very clearly defined. Third segment of antennae with very short pubescence. Median process in the armature of the male more than twice the length of the inferior claspers; harpes not serrated.

3. *brevipalpis*, Newst., p. 19.

B. Thoracic markings reduced to spots.

Thorax with four (sometimes six) dark brown oval spots, the four larger ones arranged in a parallelogram. Harpes of male clothed with large squamose spines.

4. *longipennis*, Corti, p. 21.

*Group II* (Palpalis Group). Hind tarsi all dark. Length 7–9 $\frac{1}{2}$  mm.

Thorax, legs and abdomen spotted.

5. *maculata*, Newst., p. 22.

Abdomen very dark brown or blackish brown, with a small median pale triangular area on second segment, extending distally as a very narrow stripe. Inferior claspers of male with a long broad stem to the foot-like terminal process; superior claspers straight, rapidly narrowing distally and terminating in a conical point.

6. *palpalis*, R. D., p. 22.

Similar to *G. palpalis*, "but browner and somewhat larger . . . pale area on second segment broad and more or less quadrate or irregular in outline . . . dorsum of seventh abdominal segment . . . often cream-buff."\* Superior claspers of male with a terminal tooth-like extension one-third the length of the clasper.

7. *caliginea*, Aust. p. 23.

\* Austen, Bull. Ent. Res., I., p. 294 (1910).

Small and slenderly built. Abdomen pale, with distinct transverse blackish bands; median pale stripe very distinct. Legs with the exception of the hind tarsi and the tips of the front and middle ones, pale yellowish. Inferior claspers of male with a very short stem to the foot-like terminal process; superior claspers as in 6. 8. *tachinoides*, Westw., p. 25.

Small and stoutly built. Abdomen as in 6, but with the usual transverse dark bands more evident. Thorax dusky grey with four greyish-black, triangular, blotches. Legs almost uniformly infuscated. Superior claspers of male curved and terminating in a claw-like point.

9. *fuscipes*, Newst., p. 26.

Abdomen almost unicolorous, but darkening gradually towards the margins and posteriorly. Superior claspers of male straight and gradually narrowed, truncate and spinose at the apex. 10. *pallicerca*, Big., p. 27.

*Group III.* (Morsitans Group). Tips of hind tarsi only dark or black (A); or with the tips of all the tarsi dark or black (B). Length  $7\frac{3}{4}$ –10 mm.

A. Both sexes with the front and middle tarsi yellow. Third segment of antennae long and narrow, apex pointed. Superior claspers in male very similar to those of 12, with a large flange-like projection internally, the breadth of which is greater than the width of the stem of the clasper at the point of its origin.

11. *pallidipes*, Aust., p. 30.

B. Tips of all the tarsi dark or black.

Abdomen often with a large dusky red-brown area; transverse bands on third segment may be either widely separated and faintly indicated medially, or strongly pronounced and narrowly separated. Superior claspers in male terminating in a large tooth-like process on outer angles, the internal flange-like projection much narrower than stem of clasper, and not produced distally into a median lobe.

12. *longipalpis*, Wied., p. 29.

Abdomen with the median stripe usually much wider on the third segment than on the fifth. Median lobes of the superior claspers in male converging distally; outer angle of claspers without any tooth-like process.

13. *morsitans*, Westw., p. 32.

Abdomen with the transverse bands sharply defined medially, median stripe usually of uniform width on the third fourth and fifth segment. Median lobes of the superior claspers parallel; outer angle of claspers without any tooth-like process.

14. *submorsitans*, Newst., p. 33.

### **Glossina fusca**, Walker.

*Genital armature of the male* (figs. 3 and 4). Superior claspers (*sc*) very widely separated (dorso-ventral view, fig. 4); suddenly rounded apically on the outer lateral margin, the inner lateral margin produced and forming a stout tooth-like projection. When mounted so that an oblique lateral view is obtained the tips sometimes appear to be bluntly bidentate (fig. 3); but the true form of these appendages is that which is shown in fig. 4. Each clasper is clothed dorsally with fine pubescent hairs, and also with a number of very long bristles. The editum, or lappet-like extension of the body wall, is broad and bears a

number of long bristles. The inferior claspers (*ic*) are large; the distal margin is concave, the proximal margin deeply emarginate, hairs long and numerous; the harpes (*h*) have the larger process *strongly serrated along the upper edge* and

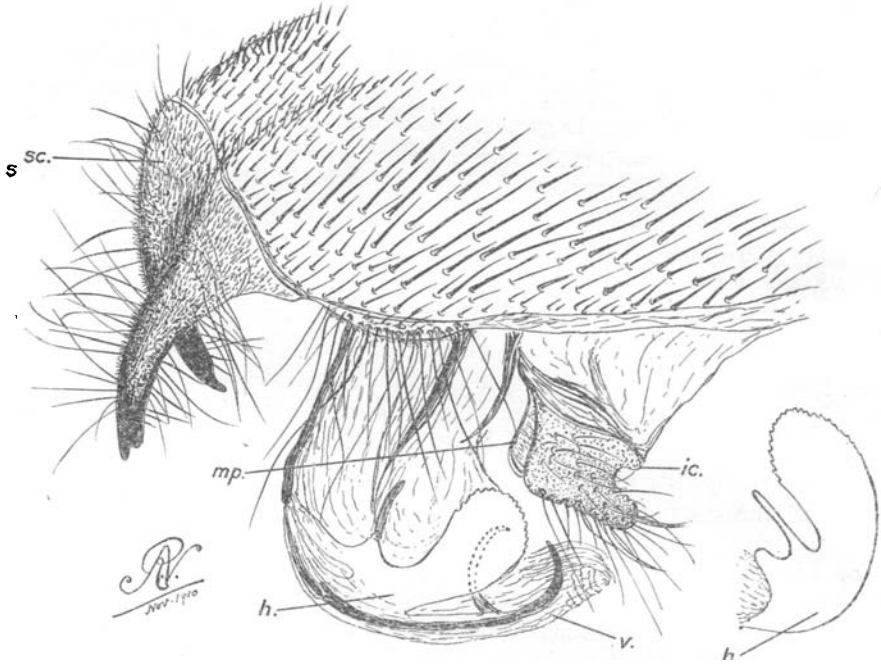


Fig. 3.—Male armature of *Glossina fusca*, Walk. ; lateral view.

posteriorly to this is a long narrow process; immediately in front of the serrated organ are two additional narrow falciform sclerites, each with the tips curving inwards so that a calliper-like process is formed. Vesica (*v*) somewhat cylindrical,

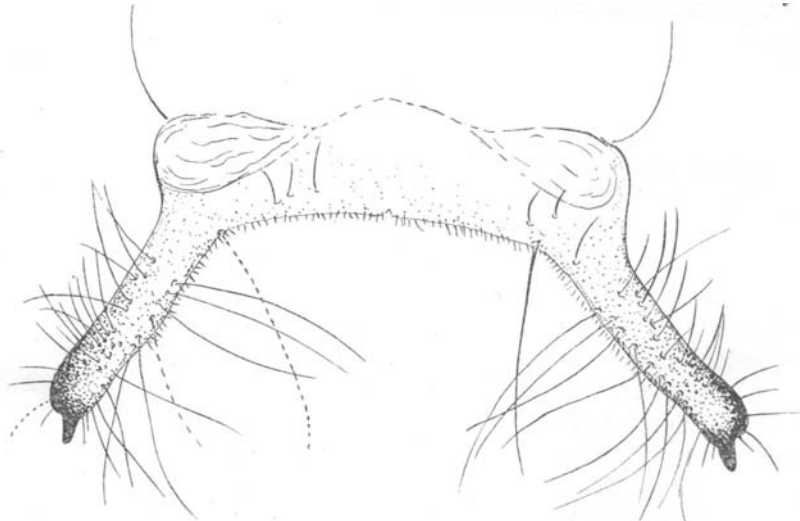


Fig. 4.—Superior claspers of *Glossina fusca*, Walk. ♂ ; ventral view.



and distinctly membranous in character. Juxta, or penis sheath, membranous, but supported by sclerites on both distal and proximal sides. Median process (*mp*) short and not extending beyond the inferior claspers; upper edge broader than the support, with a deep median depression.

The armature of *G. fusca* may be readily distinguished from those of its allies by the curiously serrated edge of the broad spatuliform portion of the harpes, by the shape of the inferior claspers, and the great width between the superior claspers.

**Glossina nigrofusca**, Newstead.\*

♂ *Glossina grossa*, Newstead ( *nec* Bigot), Ann. Trop. Med. and Parasit., IV, p. 373 (1910).

*Glossina nigrofusca*, Newstead, l.c., p. 370.

This species is distinguishable from *Glossina fusca* by its generally darker colour, the darker hind tarsi in the male, the narrow lines on the thorax and the strongly pubescent character of the antennae; also in the male armature, by the form of the superior claspers (fig. 5), the large group of squamiform spines (*s*) over the harpes (*h*), and the broad dark sclerite arising from its anterior portion at the base of the vesica (*v*).

Whether the dark colour and the strikingly clear and narrow thoracic markings are constant remains to be seen; the strongly pubescent antennae, however, with their recurved apices, may be taken as fixed characters. The structural characters of the genital armature are markedly distinct from those of the other members of the *fusca* group.

Length, 11–12 mm.; length of wing, 11–11.50 mm.

Thorax very dark brown to blackish brown, with very narrow pale longitudinal stripes, scarcely broader than the pale transverse suture. Abdomen blackish brown, with the second (largest) segment markedly paler. Legs dusky; hind tarsi either all dark, or with the last two segments black, the rest also rather dark but gradually paling proximally; hind and middle femora with a broad infuscated band.

MALE.—*Head* dusky brown to dusky buff; posterior surface dusky grey, sometimes darker towards the upper margins; facial pit grey to ochreous grey; frontal margins shimmering creamy white or yellow white. Antennae with the terminal segment *strongly recurved, and clothed with long pubescent hairs*, the longest hairs on the dorsal edge being equal to about three-fourths the width of the segment. Palpi long and relatively thin, brown with the tips slightly darker. Bulb of proboscis pale, with the proximal portion faintly infuscated. *Thorax* very dark brown to blackish brown, with very narrow pale longitudinal stripes, the submedian ones being generally sharply and clearly defined and scarcely broader than the pale transverse suture; pleurae dark brown. *Abdomen* blackish brown, with the second segment ochreous brown; there is no median stripe on the remaining segments, but a trace of ochreous brown is faintly visible on the third, fourth and fifth; lateral margins of all the segments narrowly paler than the rest; venter dusky ochreous: sides of the third, fourth and fifth segments and also the hypopygium infuscated; stigmata white.

\* See foot-note on p. 9.

*Legs* yellowish brown or buff; femora broadly and distinctly infuscated, especially the middle and hind pair. Middle and hind tibiae also with a very broad infuscated blotch; anterior tarsi with the tip of the fourth segment black, last segment dark at tip but not black; middle tarsi similar; hind tarsi all dark, but the distal half of the third segment and the whole of the two succeeding ones black; hairs on ventral surface bright golden brown.

**FEMALE.** Differing from the male in having the legs decidedly paler; the hind tarsi with the last two segments black, the second and third with the tips only black. The thoracic and abdominal markings and also the form and strongly pubescent character of the long terminal segment of the antennae are specifically the same as in the male.

Described from four examples, three males and one female. One male was taken at Kasongo, Congo Free State, 6. II. 04 (*Drs. Dutton and Todd*); another at Sunyani, Ashanti, 5. III. 10, and the third at Atroni, W. Ashanti, 16. VIII. 10 (*Dr. A. Kinghorn*); the only female I have yet seen was taken at Odumase, W. Ashanti, 27. IV. 10 (*Dr. A. Kinghorn*).

*Genital Armature of the male* (fig. 5). Superior claspers (*sc*), free and strongly bidentate; bristles long and slender; proximal half of the dorsal surface clothed with finely-pubescent hairs. The editum or extension of the

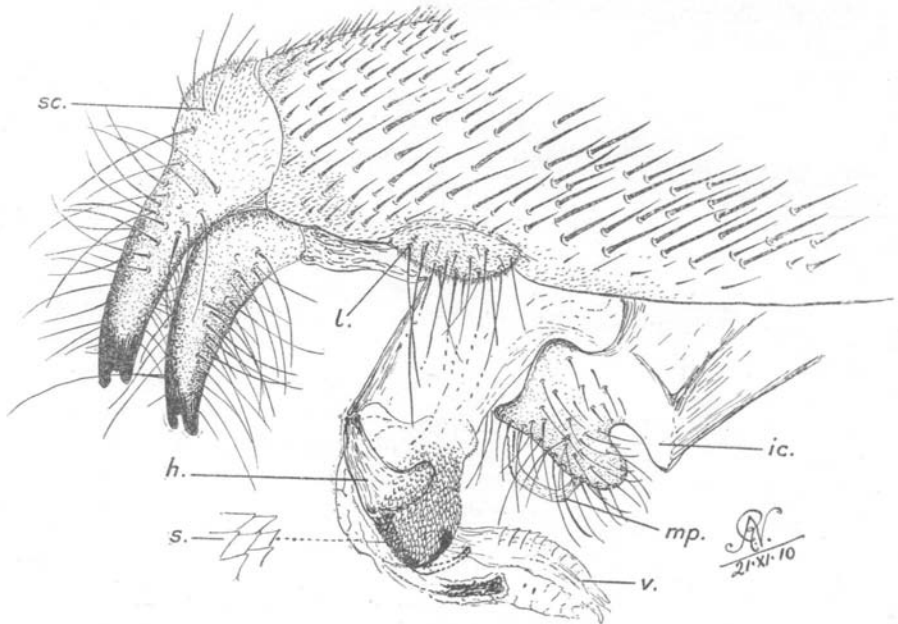


Fig. 5. Male armature of *Glossina nigrofusca*, Newst.; lateral view.

body-wall (*l*) with relatively few bristles, the longest reaching to the base of the harpes; some of the bristles are broken or entirely wanting, and it is highly probable that some of these may prove to be longer than those shown in the illustration. Inferior claspers (*ic*), clothed with numerous long hairs; distal margin presenting an ogee curve, the base being strongly and broadly produced, the distal angle narrowly produced and narrowly rounded; proximal margin with a very deep and somewhat elliptical emargination. Median process (*mp*)

relatively short, with a broad band-like upper surface. Harpes (*h*) protected by a thin membrane which is clothed with small squamiform spines; as far as one can ascertain by an examination of the armature in optical section, these spines are not attached to the harpes, as they are seen to extend beyond them on the thin mantle-like wall which completely envelopes the penis sheath; the terminal process of the harpes lies concealed beneath the squamose spines in one instance; in another specimen it projects beyond them as shown by dotted lines in fig. 5; it is somewhat falciform in shape, and formed of black chitin. Vesica (*v*) with a broad and apparently detached sclerite on the ventral surface; upper or proximal surface with several distinct transverse folds, presenting at the edge a distinctly serrated appearance.

### *Glossina brevipalpis*, Newstead.

*G. brevipalpis*, Newst., Ann. Trop. Med. and Parasit., IV., p. 372 (1910).

This tsetse-fly is easily recognised from the two western representatives of the *fusca* group (*G. fusca* and *G. nigrofusca*) by its shorter and stouter palpi, its more robust form, and the generally paler colour and somewhat indefinite thoracic markings; and again in the morphological characters of the male armature (figs. 6, 7), by the great length of the median process (*mp*), the presence of the long bilateral row or band of squamose spines (*s*), and in the form of the harpes.

Length, 10–12 mm.; length of wing, 11–11½ mm.

Thorax pale to dark brown, with greyish-brown longitudinal stripes and markings, often more or less obscure. Abdomen dark brown to smoky brown; second segment rarely much paler than the others. Legs ochreous brown; tips of middle and hind tarsi black; anterior tarsi generally without dark tips. Palpi relatively short and stout.

MALE. *Head* with the front uniformly pale ochreous brown, frontal margins brighter; eyes slightly converging. Antennae pale ochreous with the anterior half infuscated; arista infuscated at the base. Palpi relatively short and stout. *Thorax* dark brown, with the markings dusky grey-brown; these vary in intensity but are usually more or less indefinite. *Abdomen* dark brown; second segment scarcely paler than the others; margins and posterior angles sometimes narrowly paler. *Legs* pale ochreous brown; last two segments of middle and hind tarsi dark, blackish; last two segments of front tarsi either with or without brownish tips; front femora infuscated dorsally and slightly also internally; hind tibiae with a more or less distinct infuscated band; venter, in examples which have not partaken of a meal of blood, pale ochreous brown, margins of the third to the sixth segments infuscated; stigmata dusky ochreous.

FEMALE. Colour and pattern closely resembling that of the male, but with the hind and lateral margins of the abdomen sometimes more strongly pronounced.

*Type* ♀ Songwe River, N. Nyasa 7. I. 09 (*Dr. J. B. Davey*). Co-type males from near Kaporo, N. Nyasa, 5. VIII. 09 (*Dr. J. B. Davey*).

*Genital armature of the male* (figs. 6 and 7). Superior claspers (*sc*) free and strongly and bluntly bidentate; they are also narrowly separated when fully extended (fig. 7); bristles on the inner surface much longer than those on the outer

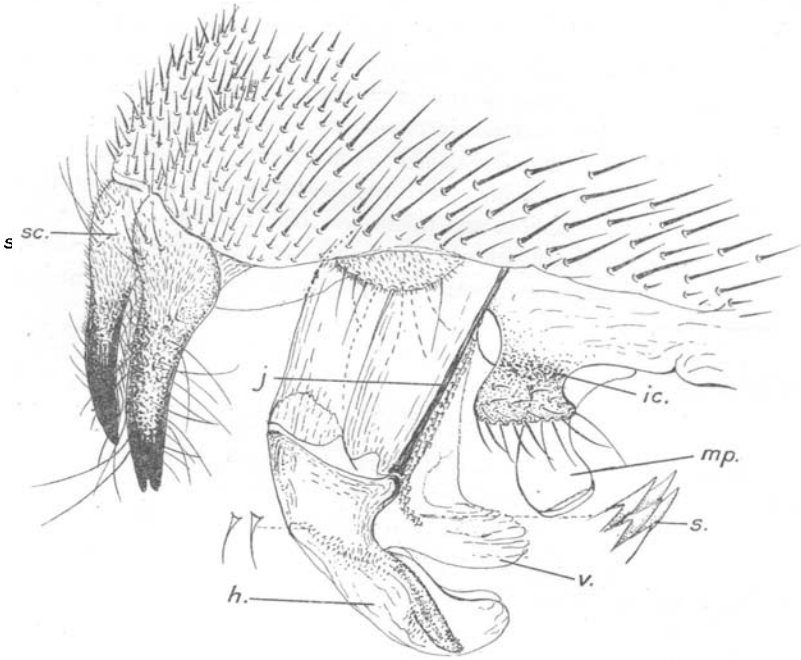


Fig. 6. Male armature of *Glossina brevipalpis*, Newstead ; lateral view

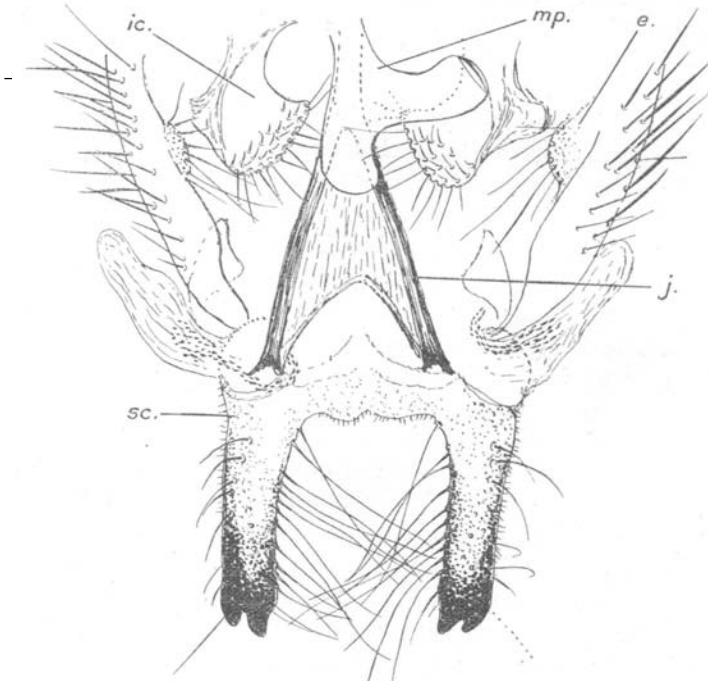


Fig. 7. Male armature of *Glossina brevipalpis*, Newstead ; ventral view.

lateral margin. Editum or extension of the body wall (*e*) with very few bristles. Inferior claspers (*ic*) relatively small and narrowed basally on both sides; bristles at the sides short. Median process (*mp*) a little more than twice the length of the inferior claspers, gradually dilated towards the apex and of a clear horn-yellow colour; it is so highly chitinised as to resist the action of stains, and stands out in marked contrast to the surrounding organs; it is also so large that it can be seen with the aid of a pocket lens only. Harpes (*h*) with the tips of the larger process broadly dilated; there is also a long narrow and slightly curved sclerite overlapping the broader process; these appendages are partly covered by the thin membrane which protects and envelopes the penis-sheath; extending obliquely across the harpes is a band of minute spines which are strongly dilated proximally. On the proximal surface of the juxta is a bilateral row of squamose spines (*s*). The juxta in dorso-ventral view (fig. 7, *j*) presents a distinctly elongated, triangular outline; but in profile (fig. 6) only one of the lateral sclerites (*j*) forming the juxta is visible in the same focal plane as the harpe.

**Glossina longipennis, Corti.**

*Genital armature of the male* (fig. 8). Superior claspers (*sc*) free, as in the other members of the *fusca* group; relatively short and stout, apices rather

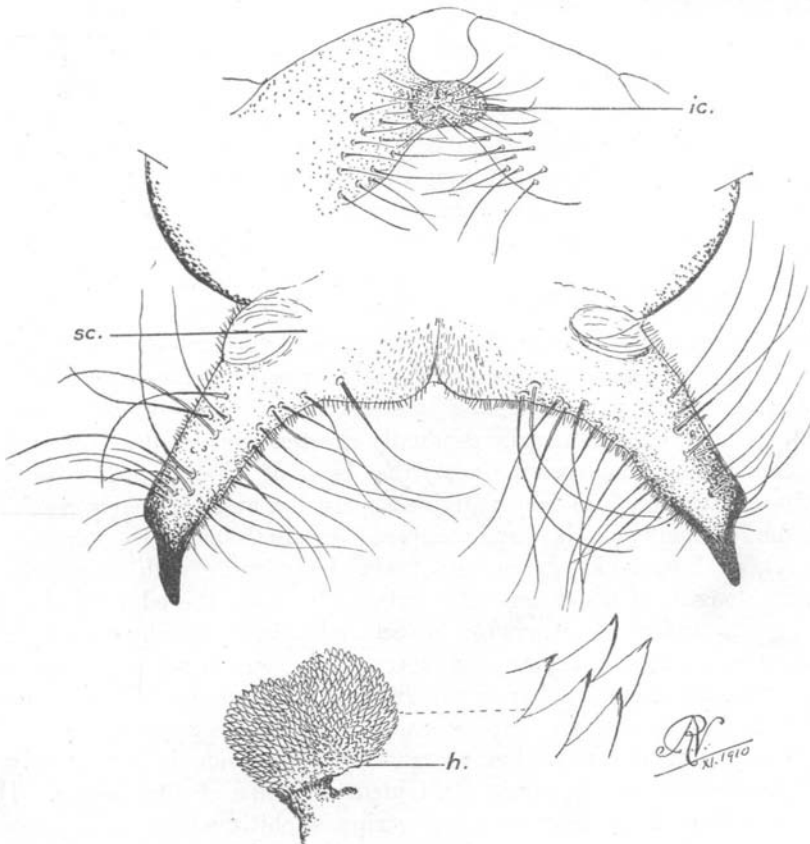


Fig. 8. Male armature of *Glossina longipennis*, Corti; ventral view.

gradually attenuated and falciform; bristles very long on both sides, and the pubescence extending to the dark chitinous portion near the apex. Inferior claspers (*ic*) relatively very small, and narrowly rounded apically; they are also placed much nearer the articulation of the hypopygium, and as seen in the dorso-ventral position (fig. 8, *ic*) the tips overlap so that a dark ovoid area is presented; bristles long and slender, extending considerably into the broadly dilated or proximal portion. Harpes (*h*) with the larger process broadly bilobed and completely covered with large squamose spines.

Unfortunately the only two preparations in our possession are mounted so as to give a dorso-ventral view, and in this position it is impossible to give further details of the other morphological characters. Be this as it may, the species is markedly distinct from the other tsetse-flies belonging to this group, and, apart from the spotted character of the thorax, the males of *Glossina longipennis* may be easily distinguished by the curious squamiform harpes, and the position of the relatively small and overlapping inferior claspers. So soon as fresh material comes to hand further details will be given, together with drawings of the armature in profile, so that they may be compared with those of the other members of the *fusca* group.

### ***Glossina maculata*, Newstead.**

The type and only known example of this insect is unfortunately a female; otherwise I would sacrifice it so that its specific identity could be more definitely established. It is nearly related to *Glossina palpalis*, but in its colour and pattern is so markedly distinct as to be recognised from the latter without any difficulty. It has been suggested that the characteristic dusky spots are due to secretion from other flies which were enclosed in the same packet. This interpretation I cannot accept, as the spots are not due to any such foreign matter.

### ***Glossina palpalis*, Rob.-Desv.**

*Genital armature of the male* (fig. 9). Superior claspers (*sc*) widely separated and connected by a membrane (*cm*); distal extremity suddenly attenuated and tooth-like; there are numerous long bristles on both sides of each clasper, but those on the inner lateral margin gradually shorten towards the apex; there is usually one rather long bristle near the base of the tooth-like projection. Connecting membrane (*cm*) deeply divided centrally, and not nearly reaching the tips of the claspers; it is partly covered on both sides by minute spines. Editum (*e*), or lappet-like extension of the body wall, with relatively short bristles, the longest of which extends midway between the edge of the editum and the juxta. Inferior claspers (*ic*) broad and spinose basally; apices greatly extended, the extension taking the form of a long leg-like process with a suddenly dilated extremity, shaped somewhat like a human foot, and furnished with a few minute spines along its lateral margin; these appendages are deeply folded basally (not shown in figure), and on either side is a relatively large beak-like extension, often apparently a folded extension of the clasper. Harpes (*h*) represented by minute narrow curved strips of chitin which curve upwards so that the ends in some instances almost touch the lobe-like extensions of the

juxta. Vesica (*v*) minute and rudimentary. Juxta or penis sheath (*j*), relatively narrow, the upper surface represented by two strips of chitin, which curve outwards distally, their apices being distinctly lobe-like; basally these strips meet and form a single tube. On either side of the juxta is a short tubular process, and attached to the lower or distal opening of this is a folded membrane which is thickly studded with minute spines.

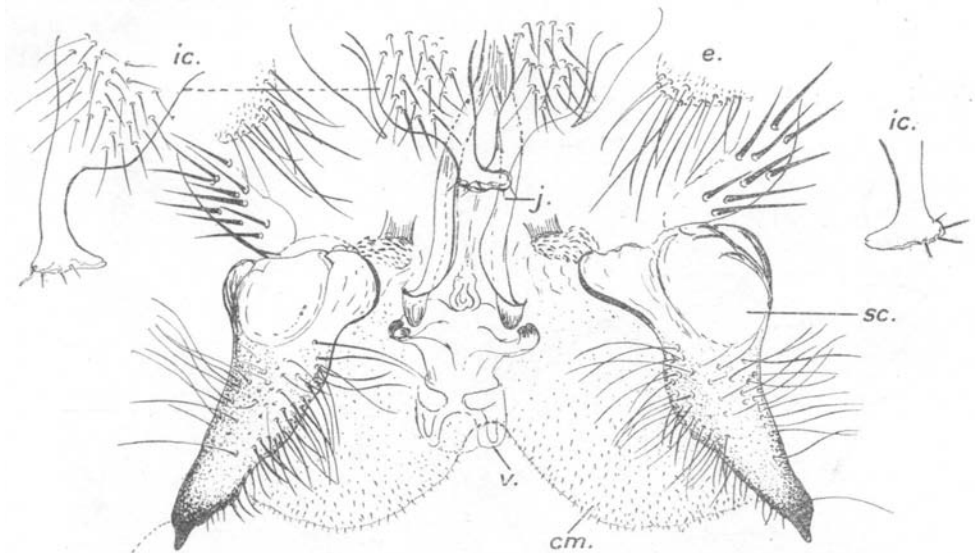


Fig. 9. Male armature of *Glossina palpalis*, R. D.; ventral view.

The most marked character of the armature of this tsetse-fly is the curious form of the inferior claspers, and this is the only structure in which it differs specifically from the armature of the male of *G. tachinoides*.

***Glossina palpalis* var. *wellmani*.** Austen.

A large series of preparations of this variety has been examined microscopically, with the result that the genital armature has been found to be quite identical with that in typical examples of *G. palpalis*. This form is distinguished from normal *G. palpalis* by its smaller size and slightly different thoracic markings. These differences, however, are not sub-specific, but merely varietal in character, for the var. *wellmani* occurs in company with the typical form in various localities, and in a good series every intergrade can be found.

***Glossina caliginea*,** Austen.

*Genital armature of the male* (fig. 10).—Superior claspers (*sc*) curving inwards and calliper-like; tooth at distal extremity very long and falciform, the length nearly equal to one-third the length of the clasper, strongly curved ventrally as well as laterally, so much so that its actual length is difficult to determine when viewed dorso-ventrally as shown in the illustration; remaining portion of clasper very broad and flattened dorso-ventrally; inner lateral bristles long but shortening

gradually as they approach the base of the falciform tooth, from which there arises a single bristle of much greater length than the rest; median group of bristles very long. Connecting membrane divided medially as in the other members of this group. Inferior claspers (*ic*) gradually attenuated, distally forming a leg-like extension terminating in a foot-like process bearing three or four slender and relatively long hairs; basal portion densely clothed with long bristles. Editum (*e*) rather large; bristles not reaching beyond the middle of the inferior clasper. Harpes and penis-sheath similar to those in *G. palpalis*; vesica with two inwardly curved sclerites, the apices of which meet in the middle line; distal portion membranous.

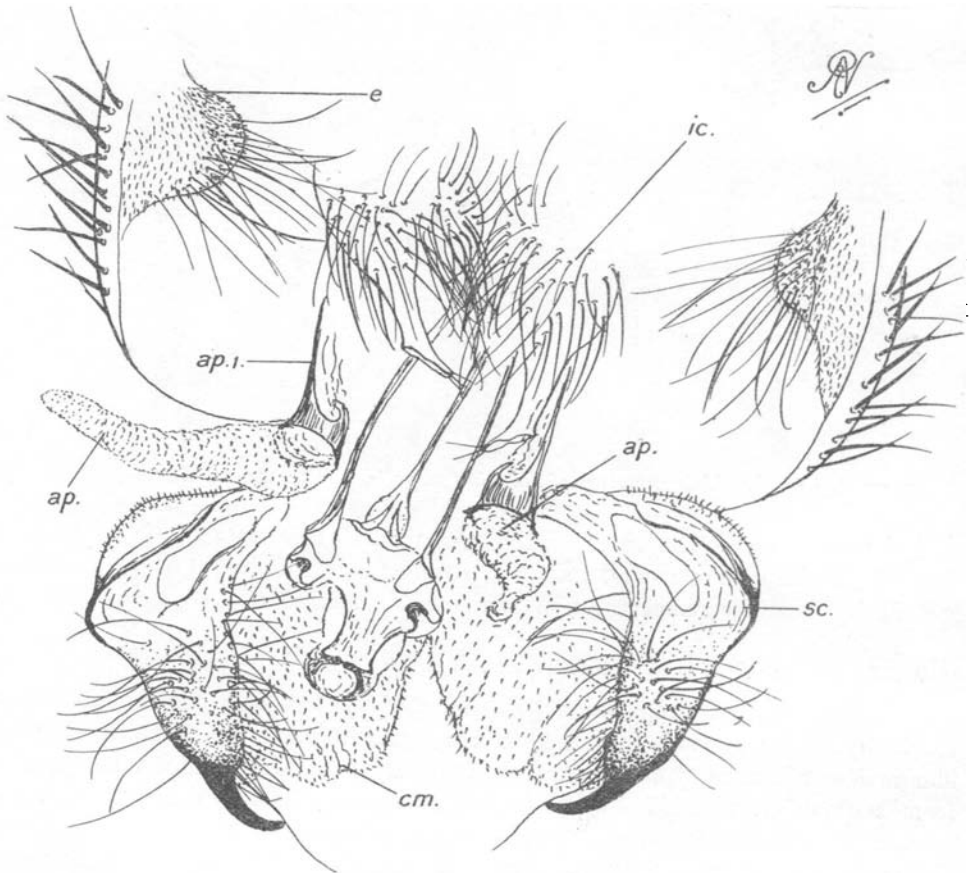


Fig. 10.—Male armature of *Glossina caliginea*, Austen.

Lying immediately in advance of the apex of the inferior claspers is a short chitinous cylindrical tube (*ap* 1), the outer wall of which is extended backwards or proximally, forming a long band-like sclerite which is apparently connected with the inferior clasper; attached to the circular orifice of the short tube is a very long, narrow, membranous sac or vermiform appendix (*ap*) bearing upon its exterior surface a number of minute spines arranged more or less in transverse rows. This organ has been observed in other species of *Glossina*; in no other



instance however has it been found fully extended, but in all cases it was seen lying in a folded and contorted position similar to that which is shown in fig. 10 on the right side of the illustration (*ap*).

Though closely related to *G. palpalis*, the armature of the male may be easily determined by the great length of the falciform or claw-like extensions of the superior claspers; the inferior claspers are also much more gradually attenuated and the toe or apex of the foot-like process is furnished with three or four small hairs. There are also other minute differences such as the form of the vesica and the juxta, but the most marked morphological character is the great length of the tooth-like extension of the superior clasper which gives this structure a very distinct and marked character.

**Glossina tachinoides**, Westwood.

*Genital armature of the male* (fig. 11).—Superior claspers (*sc*) united by a membrane; in shape they are identical with those in *Glossina palpalis*, but are

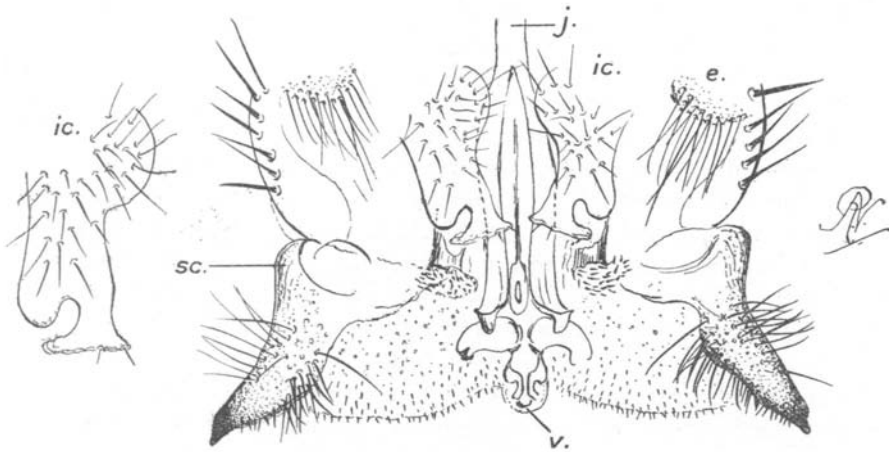


Fig. 11.—Male armature of *Glossina tachinoides*, Westw. ; ventral view.

relatively smaller. Connecting membrane (*cm*) spinose on both surfaces, and deeply divided centrally. Inferior claspers (*ic*) with the inner lateral margin proximally produced and broadly rounded; beyond this prominence the process is broad and parallel-sided; the outer lateral margin at the distal extremity is suddenly rounded and deeply emarginate; the inner lateral portion being extended into a foot-like process on the edge of which are two or three minute hairs. The editum (*e*), the harpes (*h*) and the vesica (*v*) are all specifically identical with the corresponding organs in *G. palpalis*; and although these organs respectively may appear to differ slightly in the illustrations, the differences are simply due to the orientation in the mounted preparations.

It may be readily seen on comparing the figure of *G. tachinoides* with that of *G. palpalis* that the morphological characters of the species are almost identical; the only salient characteristic being the curious form of the inferior claspers in *G. tachinoides*, which will at once serve to distinguish the male of this tsetse from the male of *G. palpalis*.

**Glossina fuscipes**, Newstead.

*G. fuscipes*, Newst., Ann. Trop. Med. and Parasit., IV, p. 375 (1910).

This tsetse-fly may be readily distinguished from *G. palpalis*, by its much smaller size, by the uniformly infuscated or dusky legs, and the dusky grey thorax. In size it resembles *G. tachinoides*, Westw., but it is a relatively stouter built insect; and altogether it is most like a dwarfed specimen of *G. palpalis* with infuscated legs and dusky thorax. The genital armature resembles those of *G. palpalis* and *G. tachinoides* in its general form; but the superior and inferior claspers are quite distinct from those of either of these insects.

Length,  $7\frac{1}{2}$  mm.; length of wing, 8 mm.

MALE.—*Head* with the frontal stripe yellowish brown, margins dusky white; ocellar triangle buff, enclosing a very dark brown spot. Antennae grey; arista dark brown ventrally. Palpi smoky brown with a paler narrow median line. Proboscis with the bulb dark piceous. *Thorax* with a median dark grey rectangular area extending from the front to the scutellum, the sides of which are perfectly straight and parallel; on either side of the grey area are two greyish black and somewhat triangular blotches, evidently remnants of those found in other species of *Glossina*; scutellum dark grey with a very faint pale grey median line, margins buff; sides of the lateral thoracic depressions dark brown or almost black; pleurae dark grey. *Abdomen* resembling that of *G. palpalis*, but the transverse banding somewhat pronounced; lateral margins with pale angular areas. *Legs* strongly and almost uniformly infuscated (dark or smoky grey); femora with the basal and inferior portions ochreous buff; hind tarsi all dark brown or almost black. *Wings* with the anterior transverse vein strongly and suddenly incrassate at its junction with the third longitudinal vein.

*Genital armature of the male* (fig. 12). Superior claspers (*sc*) sub-cheliform; suddenly curved inwards distally, at a point about two-thirds of the distance from the base, so suddenly on the outer margin as to present an almost angular or elbowed appearance; distal extremity furnished with a strongly curved tooth or claw-like process, the constriction being on the inner lateral margin; proximally they are rather broad and have a distinct beak-shaped base, the apex of which points inwards; bristles relatively short, those on the inner lateral margin more spinose in character and attached to transparent chitin. Inferior claspers (*ic*) very broad with a large and almost circular emargination on the outer lateral margin, distally; stem of the foot-like extension slightly curved inwards, the terminal portion relatively narrow and bluntly pointed. Chitinous walls of the vesica (*v*) with a few squamose spines; it is possible that these form the rudimentary harpes. Connecting membrane as in other members of this group. The juxta, vesica and some other organs became displaced in the process of mounting the armature, so that they lie in an asymmetrical position and present a somewhat peculiar aspect as may be gathered from the illustration.

The only example which we possess of this small tsetse-fly was taken by Dr. J. O. Shircore, and was forwarded with a letter dated from Nimule, Nile Province, Uganda. Fortunately it proved to be a male otherwise it might have been passed over as a small dusky form of *Glossina palpalis*.

In a more recent communication Dr. Shircore states :—" I think it must be different from *G. palpalis*. I have seen so many specimens of *G. palpalis* and this fly side by side ; and especially round Nimule, they are constantly found in certain places with the larger *G. palpalis*. The difference in size in fresh specimens is very noticeable. The *G. tachinoides*\* is found chiefly along the course

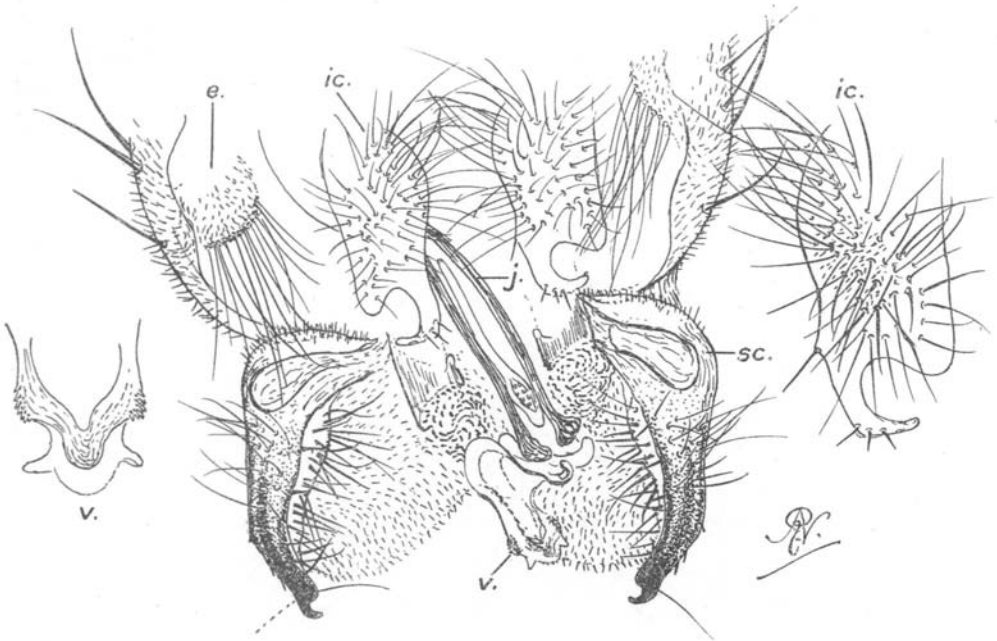


Fig. 12.—Male armature of *Glossina fuscipes*, Newstead ; ventral view.

of very rocky streams, whereas the large one occurs along streams of quite a different character. Dr. Wiggins to whom I showed the fly inclines to my view that it is certainly different from the ordinary *G. palpalis* ; as also does Dr. Mackie, of the Sleeping Sickness Commission, who was out here with Sir David Bruce."

### ***Glossina pallicera*, Bigot.**

*Genital armature of the male* (fig. 13). Superior claspers (*sc*) united by a membrane ; base of clasper four times broader at the base than at the distal extremity, with the inner basal portion extended inwardly so that it comes very near to the juxta ; outer basal portion broadly rounded and with a broad curved and somewhat attenuated process, the tip of which rests upon the inner basal process ; this portion of the clasper is clothed with fine pubescent hairs ; margins gradually tapering distally ; apex suddenly truncate, the inner half bearing a few short spines ; bristles on the inner lateral margin gradually shortening distally, those on the outer lateral margin few in number, some of which are

\* Dr. Shircore apparently has an idea that the species in question is *G. tachinoides*.—R.N

slightly longer than the longest on the opposite side of the clasper. The connecting membrane (*cm*) deeply divided and spinose on both sides. Harpes somewhat S-shaped, the distal portion being much broader and flatter than the proximal. Juxta (*j*) very similar to that in *G. palpalis* and *G. tachinoides*. Inferior claspers (*ic*) with a number of bristles on the broad basal portion, their apices somewhat falciform, being curved outwards and apparently bluntly pointed; but their true morphological character cannot be exactly ascertained as the terminal portion presents an oblique view in the only specimen examined; they are however specifically distinct from the corresponding organs in the other known species of tsetse-flies. Editum (*e*) with the longest bristles reaching almost to the proximal portion of the superior claspers.

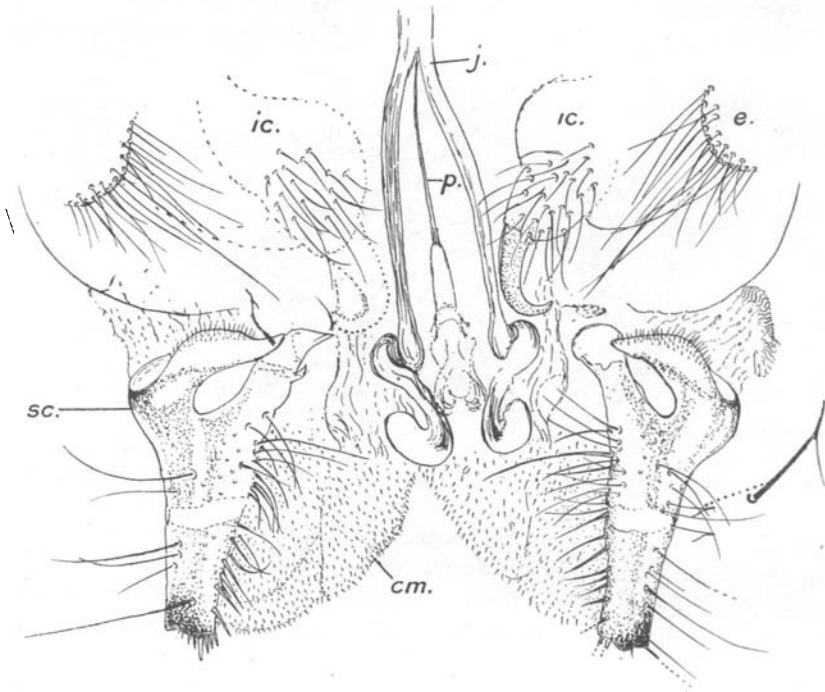


Fig. 13.—Male armature of *Glossina pallicera*, Bigot; ventral view.

I have been able to examine but a single example of the male armature of this insect, so that it is just possible that other characters may in future be discovered. One cannot be at all certain for instance as to whether the outer half of the distal extremity of the claspers will invariably present the suddenly truncate or broken appearance as exists in the specimen described; it is obvious, however, that the inner half of the apical margin is perfect and intact, as the presence of the spines amply testifies.

The distinctive morphological features are: the great width of the claspers proximally and the presence of the short spines on the distal margin; the curious and somewhat falciform shape of the inferior claspers and the striking form of the harpes.

It may be interesting to add that there are some curiously malformed bristles present upon the right clasper (see fig. 13); these give off a fine lateral hair towards the apex the tip of which points backwards, so that a reversed bifurcation is produced. This striking malformation is not peculiar to this tsetse-fly as similar instances have been observed in *Glossina submorsitans* and also in other species of the genus.

**Glossina longipalpis**, Wiedemann.

*Genital armature of the male* (figs. 14, 15A). Superior clasper (*sc*) completely united by a membrane and also fused medially; base narrower than the greatest width of the distal portion; general outline broadly spathuliform; stem in its narrowest portion about one third the width of the distal portion; distal margin, on the outer lateral portion, with a large tooth-like extension; the remaining

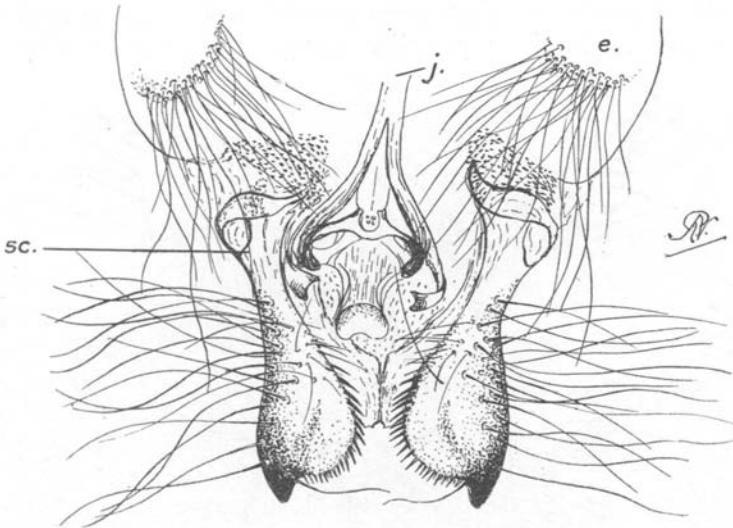


Fig. 14.—Male armature of *Glossina longipalpis*, Wied.; ventral view.

portion broadly rounded and furnished with a closely set series of stout spines, the smallest arising from near the base of the tooth-like projection; these gradually lengthen as they extend towards the base of the clasper; bristles on the outer lateral half unusually long, being equal to three-fourths the entire length of the clasper; there is also a single, but shorter bristle arising from the base of the tooth-like projection which curves outwards and inwards in the same way as has been observed in the corresponding bristles found in *G. morsitans* and *G. submorsitans*; each clasper has also a thin but strongly chitinised flange-like extension which meets the one on the opposite clasper with which it is apparently fused, though a faint straight suture is visible between them; this process extends to the widest portion of the claspers where it terminates suddenly and sometimes presents a small median emargination; but there are no lobe-like extensions as in *G. morsitans* and *G. submorsitans*. The dorsal surface of this

flange is furnished with several rather large spines. Editum (*e*) with a large number of very long bristles, the longest of which extends beyond the middle of the superior claspers. The inferior claspers are so contorted and folded that so far it has been impossible to interpret their true character; one can only say that they are provided dorsally with bristles of great length. In all probability they may be seen best when mounted in profile but at present we have no more material available for examination.

The remarkable and unique form of the claspers will, however, enable the student readily to distinguish the males of this tsetse-fly from any of the other known species. Fourteen examples have been examined.

### *Glossina pallidipes*, Austen.

*Genital armature of the male* (fig. 15). Superior claspers in their general form closely resembling those of *G. longipalpis*, but the stem is relatively broader and the broad distal portion is much more rounded and produced inwardly. The single hairs on the distal or posterior margin are generally very short and

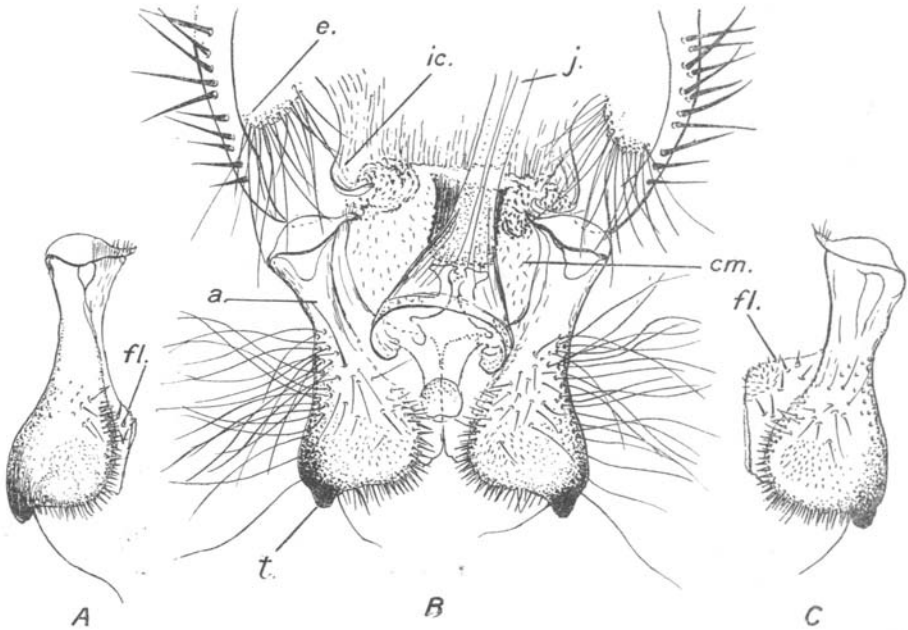


Fig. 15. Male armatures of *Glossina pallidipes*, Aust, and *G. longipalpis*, Wied.  
 A. Left superior clasper of *G. longipalpis*. B. Entire armature of *G. pallidipes*.  
 C. Right superior clasper of *G. pallidipes*.

slender, but the length varies somewhat and occasionally they are asymmetrical, but in no single instance have they been found sufficiently long to overlap or meet in the median line. Posterior lateral tooth (*t*) set in slightly from the outer lateral margin; each clasper has a thin but strongly chitinised flange-like extension which meets the one on the opposite side so that a fine straight median suture is formed; this flange-like extension (*C*, *fl*) commences near the centre of

the stem of the clasper and takes a course almost at right angles to the latter until it reaches the middle line, when it bends suddenly towards the distal margin of the claspers so that a large rectangular projection is formed, the breadth of which is greater than the width of the narrowest portion of the superior clasper ; bristles on the outer lateral portion similar to those in *G. longipalpis* but relatively shorter. Juxta (*j*) with a very narrow slit on the distal portion. Bristles of the editum (*e*) half the length of the superior claspers. Inferior claspers (*ic*) pointed, basal portions very broad and apparently meeting in the median line.

The morphological differences between this species and *G. longipalpis*, though they may appear at first very slight, are really well marked and pronounced, as may be gathered from the following table and the accompanying illustrations :—

*Comparative Table of the Morphological Characters of the Superior Claspers, &c., of G. pallidipes and G. longipalpis.*

	<i>G. longipalpis.</i>	<i>G. pallidipes.</i>
Heel or posterior lateral tooth.	Outer lateral margin taking same contour as the margin of the clasper.	Outer lateral margin generally curved inwards.
Single long hair on distal margin.	Long and capable of overlapping corresponding hair on opposite clasper.	Short and not capable of overlapping hair on opposite clasper.
Inner flange-like extension of superior clasper.	<i>Greatest breadth about one-fourth</i> the width of the narrowest portion of stem.	<i>Breadth greater than the width of the narrowest portion of the stem.</i>
Longest hairs of editum.	Equal in length to the superior clasper.	One-half the length of the superior clasper.

In the paper recently published by me in the *Annals of Tropical Medicine and Parasitology* (Vol. IV., p. 370) I called attention to the fact that I had examined a single example of what had been considered an authentic specimen of *G. pallidipes*, Austen, and that it proved to be morphologically identical with *G. longipalpis*, Wied. In the light of this discovery I felt that the only course open to me was to treat *G. pallidipes* as a colour variety of *G. longipalpis*. The specimen in question has, however, proved to be a variety of the latter with pale front and middle tarsi, so that this insect is evidently given to occasional variation in the colour of the tarsi, though at the present moment this would seem to be an isolated instance.

Thanks to the kindness of Mr. E. E. Austen, of the British Museum of Natural History, I have been able to examine the genitalia of seven males of his *G. pallidipes*,\* and it was by the examination of this material that

\* All labelled from "Machakos, B. E. Africa. Presented by Tsetse-Fly Committee of the Royal Society per Lt.-Col. Bruce."

the morphological differences were found to exist. I am delighted therefore to be able to refute the statement previously made by me (*l.c.*) and to express my indebtedness to Mr. Austen for so generously placing the specimens at my disposal.

### *Glossina morsitans*, Westwood.

*Genital armature of the male* (fig. 16). Superior claspers (*sc*) completely united dorsally by a thin membrane which is thickly studded with minute spines; form somewhat like the scapula of a mammal; each clasper is furnished on the inner lateral margin with a strip of pale chitin which *curves outwards and touches*

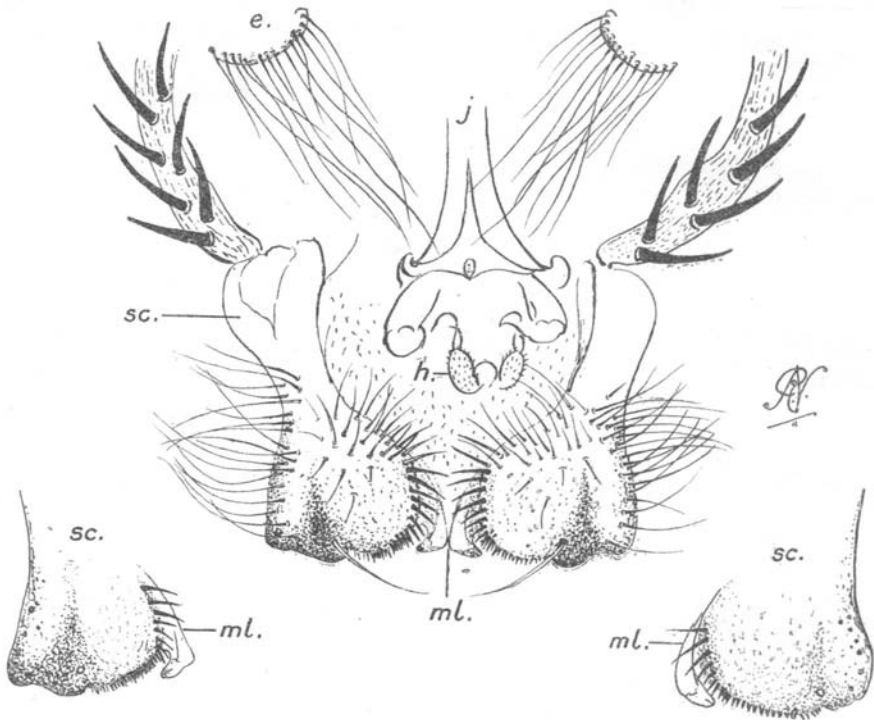


Fig. 16. Male armature of *Glossina morsitans*, Westw. ; ventral view.

*the process on the opposite side near the distal extremity only*; apices divergent, forming a recurved lobe-like extension (*ml*); inner lateral group of hairs usually relatively shorter than the corresponding group in *G. submorsitans*; these hairs gradually shorten distally and finally merge into strong black spines, the latter also gradually shortening distally and becoming quite minute on the posterior or distal margin. There is a single long hair which has its origin within the margin near the centre of the median process; in the figure this bristle is shown projecting beyond the clasper and is, in all probability, in its normal position, though in a number of examples it lies pointing towards the proximal portion of the claspers. Harpes (*h*) small, spinose, curved upwards and rounded at the tips; basal process also curved upwards and presenting no very definite form. Vesica, or median process, very small and broadly rounded. Juxta (*j*) broadly



dilated distally; lips reflexed; editum (*e*), or lappet-like extension of the body wall, with numerous long hairs. Apart from the form of the superior claspers there is no marked difference between the armature of this species and that of *G. submorsitans*.

Sixty-five examples have been examined.

***Glossina submorsitans*, Newstead.**

*G. submorsitans*, Newst., Ann. Trop. Med. and Parasit., IV, p. 371 (1910).

Nearly related to *Glossina morsitans*, Westw., in having the tips of all the tarsi dark. There are two well-marked varieties: a dark form and a light form. The former may be readily distinguished by its general dusky or dull vinous grey colour and generally smaller size; the pale form, however, very closely, resembles *G. morsitans* in the general colour of the abdomen; but in both forms the transverse black abdominal bands are:

- (a) much more clearly and sharply defined;
- (b) equally and more narrowly interrupted in the median line on the third, fourth, and fifth segments;
- (c) slightly rounded medially and suddenly tapering towards the lateral margins.

In *G. morsitans* the bands are:

- (a) not so sharply defined medially;
- (b) unequally interrupted in the middle line, the space between the two divisions of the band on the third being much greater than the space between those on the fifth segment; and the dark colour gradually shading off into the pale colour forming the median line;
- (c) broadly rounded medially and very gradually tapering towards the lateral margins.

The genital armatures of the males of these two species are easily separable by the form of the median lobes (figs. 16, 17, *ml*) and other characters (*see* p. 36).

Length, 7 to 8 millim; length of wing, 7 to 8 millim.

**DARK FORM.**—*Head.* Frontal stripe smoky brown or red brown to ochreous, ridges paler; cheeks clothed with greyish dust; jowls clothed with long white hairs; roof of buccal cavity with two more or less angular patches of brown. *Antennae* dusky ochreous grey to pale red-buff, sometimes infuscated at the tip; arista with the proximal ventral portion dark brown. *Palpi* greyish buff; usually cinereous above, apical portion infuscated, tips usually black. *Thorax* grey, often with a faint vinous tinge, the elongated brownish markings sometimes reduced to small and more or less elongated spots; scutellum normal; pleurae ochreous grey. *Abdomen* olivaceous grey (greenish grey), generally with a vinous tinge, paler at the margins; second (first visible) segment generally with a large infuscated blotch on each side, near the outer lateral margin of which is a clearly defined small blackish brown spot; in some instances the small spot is quite separated from the infuscated blotch, in others the small spot only is visible; segments 3 to 6 with clearly defined brownish black bands interrupted

in the middle by the olivaceous grey, or grey, ground colour, the latter forming a continuous median stripe; the dark bands occupy the basal two-thirds of each segment, they taper towards the lateral margin but their inner margins are almost straight. *Legs* varying from pale buff to dusky buff; front femora inside, the middle and hind pair on the outside, more or less infuscated; front and middle tarsi with the last two segments black at the tips; last two segments of hind tarsi entirely black. *Wings* normal; halteres pale yellowish, translucent.

*Types* ♂ ♀ (Coll. British Museum) Katagum River, between Katagum and Geidam, Northern Nigeria (Dr. F. W. McKay).

**PALE FORM.**—*Thorax* with markings similar to those in the dark form, but the pleurae generally paler. *Abdomen* greyish buff, with a pale vinous tinge; blackish bands very sharply and clearly defined and narrowly interrupted in the median line; those on the third, fourth and fifth segments being equally separated; the bands are also only very slightly rounded medially and rather suddenly so towards the lateral margins. *Legs* as in the dark forms.

Two co-type males and a female (Coll. Brit. Mus.) were captured by Dr. A. Kinghorn at Sabiya-Bofe, Northern Ashanti, 24.IV.10. Eight additional specimens were also captured by Dr. Kinghorn in various localities in Ashanti all of which have pale abdomens.

*Genital armature of male* (fig. 17).—Superior claspers (*sc*) very like those of *Glossina morsitans*; width of distal margin nearly three times that of the narrowest

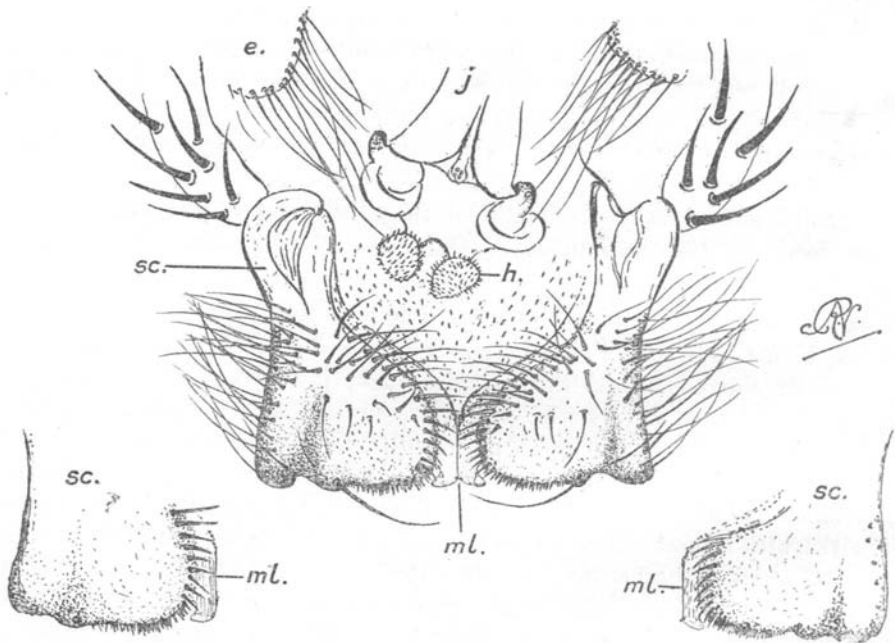


Fig. 17.—Male armature of *Glossina submorsitans*, Newst.; ventral view.

portion of the stem; each clasper is furnished, on the inner lateral margin, with a broad parallel-sided strip of pale chitin the tip or distal extremity of which is

somewhat triangular in shape, and turned outwards, forming, with the one on the opposite side, a median lobe-like projection (*ml*); on the outer margin of each of these appendages, near the base of the curved portion is a minute tubercular process; this curious little structure is evidently moveable as in many instances it is seen lying concealed in a cavity extending distally from its base; in some instances both are seen to lie in a recumbent position; in other examples either one or both may stand erect at right angles to the basal attachment. The heel or posterior lateral angle is normally somewhat strongly produced and narrowly rounded; but in two examples (shown separately in fig. 17) this process is more broadly rounded; and in one instance it does not extend distally as far as the sub-median process; the latter is never so prominent as it is in *G. morsitans*, and *immediately within its margin* is a long bristle which in the majority of specimens lies upon the surface of the clasper with its point towards the proximal or basal portion; but for the sake of clearness it has been figured as seen in some few instances; outer lateral margins concave and furnished with a series of very long slender bristles or hairs, becoming more numerous proximally and shortening gradually as they extend across the flat portion, finally merging into those which extend along the inner lateral margin. These are again succeeded by short black spines which project over the median processes; these black spines also gradually diminish in size and merge into the minute ones extending along the posterior or distal margin as far as the submedian process. The most marked feature of the claspers is their general angular outline and the somewhat straight-cut appearance of the posterior margin; these characters taken together with the form of the median pair of processes will serve at once to distinguish the genitalia of this insect from those of *G. morsitans*, and with a little practice the species may be separated unerringly by the aid of a lens having a magnification of 20 diameters only. Inferior claspers small and covered with minute hairs; these together with the juxta (*j*) and its appendages and also the harpes (*h*) are practically identical with the corresponding organs found in *G. morsitans*.

It may be well to note that this insect has a marked tendency to become 'greasy,' so that all trace of colour disappears. Dr. Macfie has also noticed the same tendency and says, in a letter, dated 7th October, 1910, Minna, Northern Nigeria, "When I was at Baro last September, on Sleeping Sickness duty, I noticed one day (September 11th, 1910) that there were two distinct forms of what I supposed to be *G. morsitans*—the one dark, the other pale. The difference was quite noticeable when the flies settled on the 'boys' coats, and I was able to catch specimens of each variety. Unfortunately all my own specimens were destroyed by ants, but one of the dark specimens which I had given to Dr. Ingram remained. I was ordered off to Bida before I could get any more specimens, but on my return to Baro on September 24th, Dr. Ingram pointed out to me that the tsetse I had given him was almost absolutely black. It certainly was not black when I gave it to him. Some other specimens he and Dr. Morrison had collected a week before had similarly turned black, and it was at first supposed that the naphthaline used as a preservative was responsible for the remarkable change. But as all the specimens of *G. morsitans* taken had been treated alike, and only some half dozen had darkened, this could not be considered

proved. Finally, a specimen of Dr. Morrison's, which had not been exposed to naphthaline at all, was found to be black."

In all, 93 examples have been examined.

*Comparative Table of the Morphological Characters of the Superior Claspers of G. morsitans and G. submorsitans.*

	<i>G. submorsitans.</i>	<i>G. morsitans.</i>
Median lobes ( <i>ml</i> in figs.).	With the outer (free) margins <i>straight</i> and <i>parallel</i> ; sub-apical tubercle distinct, when extended.	With the outer margins <i>curved</i> and <i>converging</i> distally; apex with a median line or division; subapical tubercle absent.
Heel or posterior angle.	Usually strongly produced distally.	Usually broadly rounded.
Submedian prominence.	Relatively small, rarely extending beyond the heel; bristle inserted near the margin.	Very prominent and usually projecting considerably beyond the heel; bristle inserted considerably within the margin.
Inner lateral margin	Narrowly rounded distally; and considerable produced.	Broadly rounded distally; and not markedly produced.
Upper lateral group of bristles.	Relatively long.	Relatively short.

December 20th, 1910.