

ON CERTAIN DISTINGUISHING CHARACTERS OBSERVED IN *ANOPHELES FUNESTUS* GILES

BY

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In his 'Provisional List and Reference Catalogue of the Anophelini,' Christophers (1924), restricted the definition of *A. funestus* Giles, to include only the African form of the group, the Oriental *A. minimus*, *A. aconitus* and *A. listoni* being regarded as distinct species. With regard to the last-named species, however, it was stated that the question still arises 'whether this is a variety only of *A. funestus* or a distinct species.' In their synoptic table of the Indian Anophelinae, Christophers, Sinton and Covell (1927) still regard the three oriental forms as distinct species. The identity of some of these Oriental species has, however, recently been called in question by Manalang (1930) who, referring back to a paper by Strickland (1924), published before the appearance of Christophers' Memoir referred to above, gives his reasons for regarding the form of *A. minimus* found in the Philippines as synonymous with *A. funestus* Giles. A new variety of *A. aconitus* from the Philippines, is described in the same paper.

In the paper referred to, Manalang calls attention to certain larval characters which he finds useful in distinguishing the Philippine *minimus* ('*funestus*') from another Philippine form of the group, the newly described *A. aconitus* var. *filipinae* Manalang. A comparison between Manalang's description of the larvae of Philippine '*funestus*' and those of a series of bred *funestus* from the type locality, Freetown, Sierra Leone, has led to the discovery of a well-marked difference which may perhaps be of value in further establishing the distinctness of *A. funestus* from *A. minimus* and possibly also from *A. listoni* and *A. aconitus*. In addition to this, a character common to the males of African *funestus* has also been investigated and shows what appears to be a constant difference from *A. minimus*, *A. listoni* and *A. aconitus*. The larval material on which the following observations

are based, comprises a few larvae from which I bred out adults of *funestus* in Freetown, in 1925, four larvae collected in Freetown by Professor Blacklock and the writer in the same year, and four larvae collected near Stanleyville, Belgian Congo, and kindly presented by Dr. J. Schwetz; some of this latter series were bred out, giving rise to *funestus* adults. Oriental larvae examined were a series of *A. minimus* var. *varuna* identified by Dr. M. O. T. Iyengar, and one *A. listoni* and two *aconitus* larvae from Ceylon, identified by Mr. H. F. Carter; the larvae were presented by these entomologists to Professor Patton, to whom I am indebted for permission to examine them.

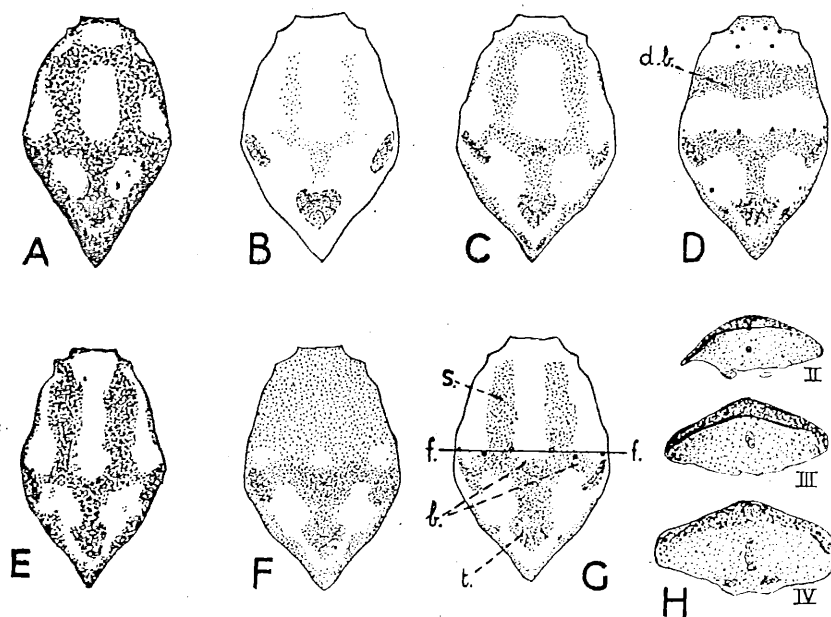


FIG. 1. A to E.—Fronto-clypeus of fourth stage larva, to show pattern; A.—*Anopheles aconitus* var. *flipinae*; B, C, F and G.—*A. minimus* var. *varuna*; D.—*A. funestus*; E.—*A. minimus* ('*funestus*'), Philippine form; H.—Tergal plates of second to fourth abdominal segments of larva of *A. funestus* (a-typical). A and E copied from photographs in Manalang (1930), other figs. original. The markings in D should be darker than shewn.

The larval character described by Manalang, which I find to be distinct in African *funestus* larvae, is the fronto-clypeal pattern. The great value of this character in separating larvae of *A. sergenti* from those of *superpictus* was pointed out by Buxton (1923).

The differences observed in this character are described with reference to the diagram (fig. 1, G), which represents the pattern seen

in some specimens of *A. minimus* var. *varuna* Iyengar. The transverse line, *f.f.*, drawn across the front at the level of the mid frontal bristles, divides the pattern into a proximal portion which, as Buxton has pointed out, is chiefly a broad transverse 'butterfly-shaped band.' This band is lettered *b.* in the diagram. In many specimens it is connected with the basal triangular patch *t.* Beyond the level of the line *f.f.*, the pattern consists of two longitudinal stripes *s.*, which are usually continuous with the transverse band *b.* Fig. 1, B, C, F and G, illustrate some variations seen in eight fourth stage larvae of *A. minimus* var. *varuna* examined. In none of the specimens examined was the pattern dark, and in several it was very light. The pattern shown in fig. 1, G, was seen in three out of the eight larvae studied. In three others there was a reduction in the dark areas, the main centres of chitinisation being more or less isolated from each other, as in fig. 1, B; it is possible, however, that these were recently moulted fourth stage larvae. Fig. 1, C, illustrates the condition seen in one of the larvae, the main difference from that shown in fig. 1, G, being that the two longitudinal stripes are connected across anteriorly to form an 'O' shaped pattern in front. It is interesting to note that this pattern agrees in this respect with that of Manalang's *aconitus* var. *filipinae*, while that illustrated in fig. 1, G, resembles that of the Philippine *minimus* ('*funestus*'). Figs. 1, A. and E, are copied from Manalang's photographs. In one larva of *minimus* var. *varuna*, in which the imaginal buds appeared to be in an advanced state of development, practically the whole of the anterior half of the fronto-clypeus was chitinised, as shown in fig. 1, F. Thus it is seen that a considerable amount of variation exists in *A. minimus* var. *varuna* with regard to this character.

In the larva of *listoni* and two *aconitus* larvae I have examined, the pattern could not be made out very clearly on the anterior quarter, but in both cases it was evident that longitudinal marks continuous with the proximal transverse band were present, the general plan being that shown in figs. 1, C. and G, but in all three the chitinisation was much heavier than in the var. *varuna* larvae, and the markings appeared rather more extensive than in fig. 1, G.

In all our African larvae of *A. funestus* in which this character can be clearly seen, the pattern is quite different from that seen in

any of the above described variations of *minimus* var. *varuna*, and from that of the larvae of *listoni* and *aconitus* I have seen, and also from those illustrated by Manalang for the Philippine forms of the group. A typical pattern is that illustrated in fig. 1, D, which was drawn from a larva collected in Freetown, West Africa. It will be seen that the proximal part of the pattern shows little difference from that of the Oriental forms; it may show slight differences, as shown in the illustration on page 12 of my memoir (1927). On the distal half, however, the difference is striking. Instead of two longitudinal stripes there is a broad transverse band, *d.b.*, extending across the whole width of the front and separated from the proximal band by a space about equal to the width of the distal dark band. The occurrence of this separate transverse dark band across the distal third of the fronto-clypeus is a constant feature in the seven larvae, including specimens from Sierra Leone and Stanleyville, in which the pattern can be clearly made out.

Manalang has also found that the presence or absence of chitinous 'islets' in the membranous part of the abdominal segments dorsally is a character which distinguishes the two Philippine forms. It is interesting, therefore, to note that in twelve African *funestus* larvae examined, 'islets' are usually absent, but one larval pelt shows the condition illustrated in fig. 1, H. In some other larvae, 'islets' were represented on most of the segments by thickenings of the tergal plate, as in the fourth segment of the larva illustrated.

Adult character. In their 'Synoptic Table for the Identification of the Anopheline Mosquitos of India,' Christophers, Sinton and Covell (1927), illustrate the male palps of *A. listoni* and *A. minimus*; *A. aconitus* is said to resemble *minimus* in this respect. In the illustrations given it is seen that in typical specimens the club shows a pale spot or band (*listoni*) or broad pale area (*minimus* and *aconitus*) at the base. From other descriptions seen and examination of the male palps of specimens of *minimus* and *listoni* in the collection of the Liverpool School of Tropical Medicine, including examples determined by Colonel Christophers, it seems certain that white scales in the form of a well-defined band or area or sometimes a small spot are practically always present at the base of the palps in these Oriental species. In one specimen from Hong Kong determined by me as *minimus*, there was only a very small pale spot in this position.

In specimens of *funestus* from Africa that I have examined, however, the base of the club of the male palp was invariably without any pale scales. The amount of white on the outer half of the club shows a great deal of variation. Sometimes it is reduced to one or two very small spots and in other exceptional cases the whole or almost the whole of the outer half of the club is pale scaled. Fig. 2, c, which was drawn from a specimen bred from a larva taken in Freetown, Sierra Leone, represents a typical condition met with in African *funestus*. In addition to specimens from Freetown and

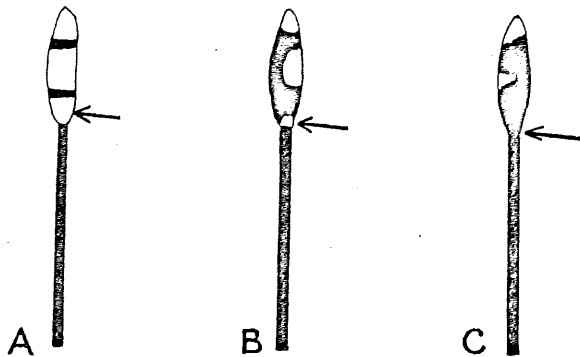


FIG. 2. Male palps, diagrammatic. A.—*A. minimus*; B.—*A. listoni*; C.—*A. funestus*. A and B after Christophers, Sinton and Covell (1927), C original.

elsewhere in Sierra Leone, I have examined the male palps in *funestus* from the Gold Coast, Nigeria, Belgian Congo, Kenya, Pemba, Nyasaland and Mauritius; two males of *funestus* var. *fuscivenosus* Leeson, kindly presented by Mr. Leeson, also showed the dark base of the palps. This character also seems to be a good distinction between *A. funestus* and small specimens of *A. transvaalensis*.

It has frequently been pointed out that characters formerly used to separate *funestus* from *minimus* and *listoni* are subject to a certain amount of variation. Even the width of the subapical pale band on the female palp of *A. minimus* is sometimes seen to approach a condition frequently seen in *funestus*. This is so in a specimen I have determined as *minimus* from Hong Kong, the subapical pale band being considerably less than the dark band. So far as the material I have examined goes, however, the characters described here appear to show definite discontinuity between *A. funestus*, as

restricted by Christophers (1924) on the one hand, and *A. listoni*, *A. minimus* and *A. aconitus*, on the other. The number of larvae examined is too small to form the basis of definite conclusions, but it is suggested that investigation of these characters in many more specimens of all these species may help to establish the distinctness of *funestus* from the Oriental species of the group.

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