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A SUPPLEMENTARY GUIDE FOR RAPID IDENTIFICATION OF THE LARVÆ OF ANOPHELES MINIMUS FLAVIROSTRIS (LUDLOW) AND ANOPHELES MANGYANUS (BANKS)¹

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FOUR PLATES

King (1932), in his descriptive notes on the three Philippine *Anopheles* of the *funestus-minimus* subgroup, described the larvæ of *Anopheles minimus flavirostris* (Ludlow) and *Anopheles mangyanus* (Banks) as follows:

Anopheles minimus var. flavirostris.—Clypeal hairs simple and unfrayed, outer and posterior occasionally forked; the posterior hairs as a rule do not extend beyond the base of the inner (with the head in a horizontal position); inner submedian prothoracic hairs usually with more than 21 branches; leaflets of thoracic palmate tapered to a short point, without a filament; tergal plate of segment 1 narrow, oblong; plate of second segment deeply concave with the small median plate or a portion of the main plate detached; tergal plates on segments 3 to 7 usually convex posteriorly and narrowed toward ends; anterior tergal hairs (hair 0) usually arise well away from the plate; antepalmate hairs (hair 2) of segments 2, 3, and 7 branched from the basal third; dorsal surface of larva with heavy subdermal pigmentation.

Anopheles mangyanus.—Clypeal hairs similar to the above except that the outer and posterior are longer, the latter extending to or nearly to the edge of the clypeus; inner anterior prothoracic hairs usually with from 18 to 23 branches; leaflets of thoracic palmate hairs with a fine

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filament; tergal plates of segments 1 and 2 similar to var. *flavirostris*, those of segments 4 to 7 with broader ends; small submedian plates usually chitinized; anterior tergal hairs usually arise from the tergal plate, sometimes near the edge either just on or just off the plate; antepalmate hairs of segments 2 and 3 usually branched from the middle third; antepalmate hair of segment 7 simple, or occasionally forked apically, larvæ pigmented with abundant spots of opaque white that are collected into submedian streaks on the thorax.

Keys to larvæ of A. minimus flavirostris and A. mangyanus.—In 1934 Russell and Baisas made a key to the Philippine species of the genus *Anopheles*. The two species in question may be identified, thus:

- | | |
|--|---|
| 1. Inner clypeal hairs widely separated | 11 |
| 11. Inner and outer clypeal hairs simple | 12 |
| 12. Palmate 1 developed | 13 |
| 13. Tergal plates large | 14 |
| 14. Leaflets of thoracic palmate hairs extended into long slender filaments; antepalmate VII simple or forked apically | <i>mangyanus</i> |
| Leaflets of thoracic palmate hair not extended into long slender filaments; antepalmate VII branched basally | <i>minimus</i> var. <i>flavirostris</i> |

Russell, Rozeboom, and Stone (1934) adopted a key based on that by Russell and Baisas (1934), to wit:

- | | |
|--|-----------------------------|
| 1. Inner clypeal hairs widely separated | 12 |
| 12. Clypeal hairs simple | 13 |
| 13. Abdominal segment 1 with developed palmate hairs | 14 |
| 14. Abdominal tergal plates large | 15 |
| 15. Thoracic palmate leaflets produced into long slender filaments; abdominal segment 7 with antepalmate hairs (No. 2) single or forked apically | <i>mangyanus</i> |
| Thoracic palmate leaflets not produced into long slender filaments; abdominal segment 7 with antepalmate hairs (No. 2) branched basally | <i>minimus flavirostris</i> |

In 1946, Baisas published a key to the larvæ of Philippine *Anopheles* based on natural groupings. It may be mentioned that this is now generally used in the identification of *Anopheles* larvæ in the Philippines.

The three species under Group Myzomyia (inner anterior clypeal hairs widely separated, tergal plates large) may be differentiated as follows:

- | | |
|---|-----------------|
| 1. Inner clypeal hairs with fine lateral branches; tergal plate II convex at the posterior border | <i>filipina</i> |
| Inner clypeal hairs simple; tergal plate II concave at posterior border | 2 |

2. Antepalmate VII simple or branched apically; leaflets of thoracic palmate extended into long points..... *mangyanus*
 Antepalmate VII branched near the base; leaflets of thoracic palmate taper into short blunt points..... *minimus* var. *flavirostris*

Bohart (1945) in his A Synopsis of the Philippine Mosquitoes, describes the larvæ of the above species as follows:

Anopheles (myzomyia) mangyanus (Banks).—The larva is characterized by its simple clypeal hairs, the short and stoutly branched prothoracic hair 1, the slender but well developed palmate hair on abdominal tergite I and the rat-tailed apices of the leaflets on the palmate hair of tergite IV. It is very close to *minimus flavirostris* which differs in the somewhat thicker apices of the leaflets on the thoracic palmate hair and in having antepalmate hair 2 of abdominal tergite VII single or apically forked.

Anopheles (myzomyia) minimus flavirostris (Ludlow).—The larva of this species closely resembles that of *mangyanus* but differs from it in having the apices of the thoracic palmate hair not drawn out into filaments and in having the antepalmate hair 2 of abdominal tergite VII branched basally.

It will be noted that of the three recognized Philippine species of the Group Myzomyia, *Anopheles filipinæ* Manalang is easily identified by the convex posterior border of the second tergal plate (large). But considerable difficulty has been encountered, especially by a novice, in the identification of *A. mangyanus* and *A. minimus flavirostris* (both with concave posterior border of tergal plate II). The thoracic palmate (Plate 1-A) and antepalmate VII (Plate 1-B) are not easy to locate, especially as in most cases the specimens are examined alive. Moreover, the character of the thoracic palmate leaflets can be appreciated best only when the high power objective (X 450) is used. This involves a considerable loss of time and may lead to erroneous identification especially when one has to examine hundreds of larvæ. When the thoracic palmate and the antepalmate VII are used as landmarks, even an experienced worker may have to take some time to arrive at a correct identification.

Oftentimes the aforementioned anatomical parts are detached or mutilated, in which case the examiner encounters considerable difficulty. The keys published by Russell and Baisas, Russell *et al*, and Baisas, mentioned previously, cannot afford any relief.

When confronted by this predicament, few resourceful examiners may resort to King's description of tergal plates III to VII, which are "usually convex posteriorly" in *A. minimus flavirostris*, or have "broader ends" in *A. mangyanus*. Russell and Baisas (1934) also described tergal plates IV to VII as rounded

or blunt at the edges in *A. mangyanus*, tapering towards the edges in *A. minimus flavirostris*. However, these and other authors, for some reason or other, made no mention of the specific importance of the tergal plate or plates, since they invariably point to the thoracic palmate and antepalmate VII in their keys to larvæ of Philippine anophelines.

TAXONOMIC IMPORTANCE OF TERGAL PLATE VII

It has been observed that the seventh tergal plate, not to mention the other tergal plates, has a constant and definite shape, and that the shape of the tergal plate in *A. mangyanus* differs from that in *A. minimus flavirostris*. The posterior border of the seventh tergal plate in *A. mangyanus* is more or less a straight line (Plate 2-C), while in *A. minimus flavirostris*, it is convex or curved posteriorly (Plate 2-B).

This observation was subjected to an extensive and rigorous test, in the laboratory and in the field, in the hope of finding a variation or exception. Hundreds of specimens were examined and invariably the identification made according to the character of thoracic palmate leaflets and antepalmate VII corresponded with the identification made according to the character of the posterior border of the seventh tergal plate.

Carrying the test further, fifty *A. mangyanus* larvæ and also fifty *A. minimus flavirostris* larvæ were collected at different places and at different times and were individually bred out. Without exception, the imago identification was the same as the corresponding larval identification.

SUMMARY AND CONCLUSIONS

It will be seen that by the tergal plates alone, the three species under Group *Myzomyia* could be definitely and rapidly identified. The advantage of the seventh tergal plate over the thoracic palmate and antepalmate VII cannot be overemphasized. The first is easily located, cannot be detached, and the character of the posterior border can easily be appreciated even if live larvæ are examined as early as the second instar. On the other hand the thoracic palmate and antepalmate VII are easily detached or mutilated, and not easily located, and their characters are not easily evaluated especially when the specimen is examined alive.

A comparative illustration of the landmarks used in the identification of the larvæ of *A. minimus flavirostris* and *A. mang-*

yanus, both those adopted in keys to larvæ and those described in this papers, are shown in Plate 3 and Plate 4.

The following key to the larvæ under Group Myzomyia, that is, the larvæ with large tergal plates, may be adopted especially where rapid identification is desired.

1. Tergal plate II with convex posterior border *filipinæ*
Tergal plate II with concave posterior border..... 2
2. Tergal plate VII with convex posterior border.
minimus flavirostris
Tergal plate VII with more or less straight posterior border.
mangyanus

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ILLUSTRATIONS

PLATE 1

- FIG. 1. Thoracic palmate of *A. mangyanus* and *A. minimus flavirostris*, compared. Character of leaflets can best be appreciated by using high power magnification (X 450).
2. Antepalmate VII of *A. mangyanus* and of *A. minimus flavirostris*, compared. Its relation to other structures, indicated.

PLATE 2

- FIG. 1. Tergal plates of *A. filipinæ*. Second tergal plate with convex posterior border.
2. Tergal plates of *A. minimus flavirostris*. Second tergal plate with concave posterior border. Seventh tergal plate with convex posterior border.
3. Tergal plates of *A. mangyanus*. Second tergal plate with concave posterior border. Seventh tergal plate with more or less straight posterior border.

PLATE 3

- FIG. 1. Landmarks (second tergal plate, thoracic palmate, and antepalmate VII) used in the identification of *A. minimus flavirostris* according to keys of various authors.
2. Landmarks (second and seventh tergal plates) used in the identification of *A. minimus flavirostris* as described in this paper.

PLATE 4

- FIG. 1. Landmarks (second tergal plate, thoracic palmate, and antepalmate VII) used in the identification of *A. mangyanus* according to keys of various authors.
2. Landmarks (second and seventh tergal plates) used in the identification of *A. mangyanus* as described in this paper.

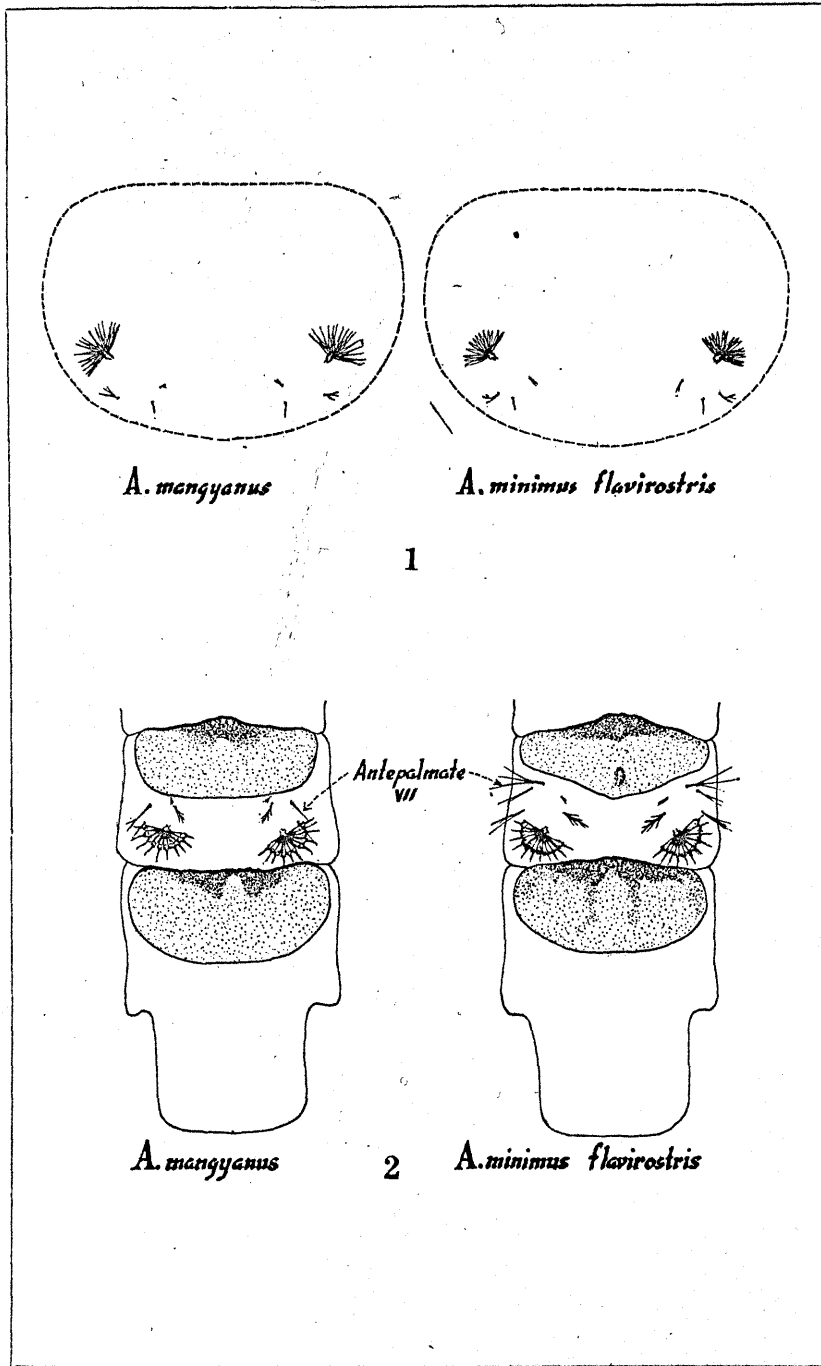


PLATE 1.

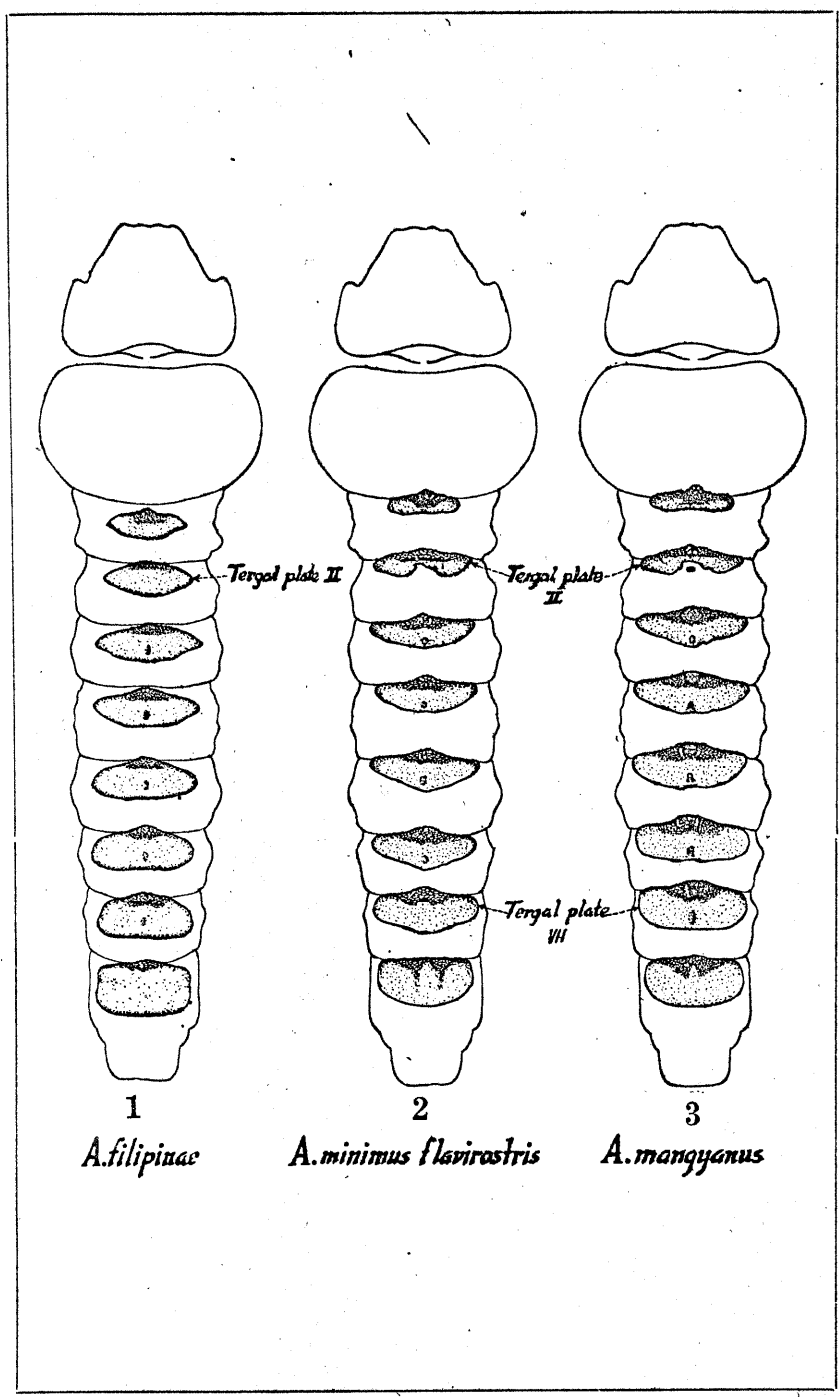


PLATE 2.

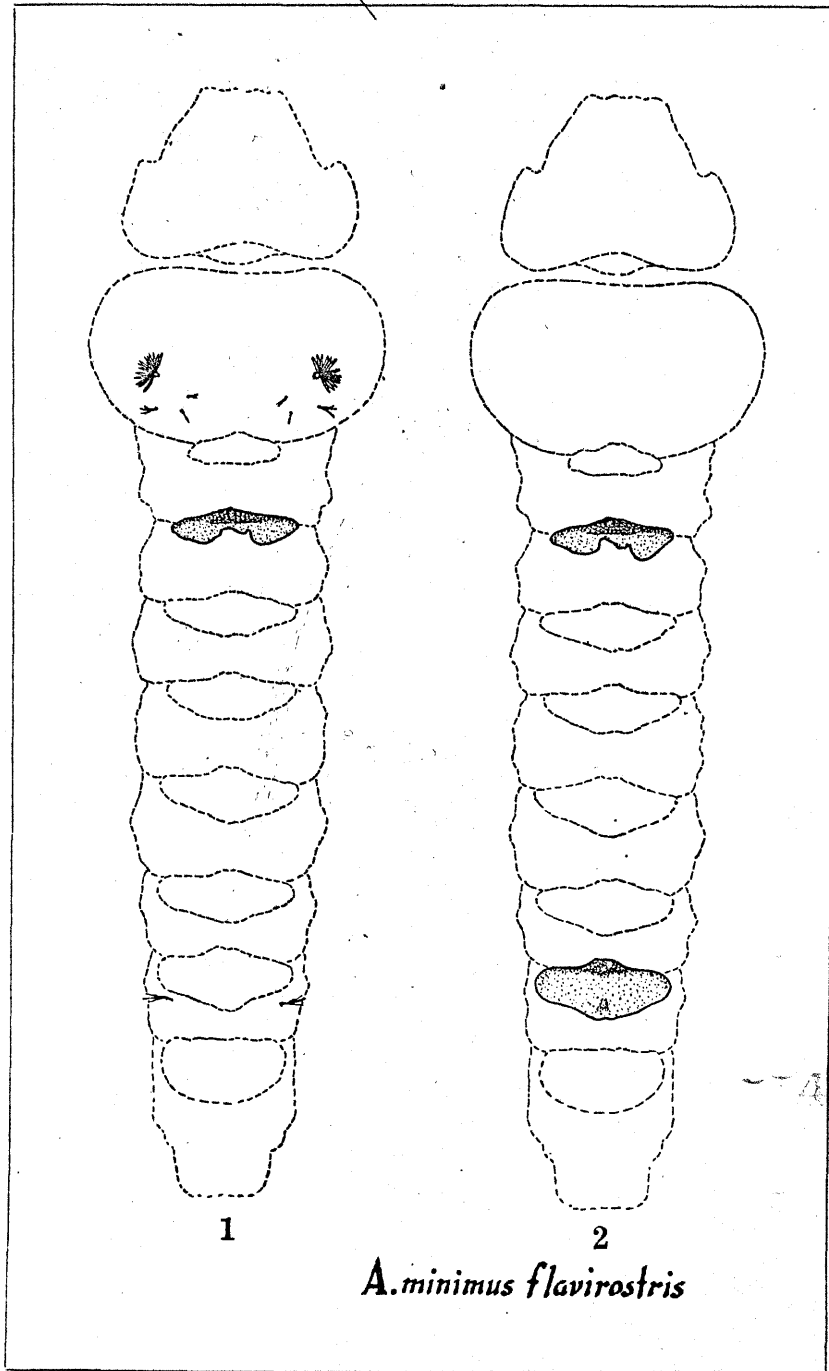
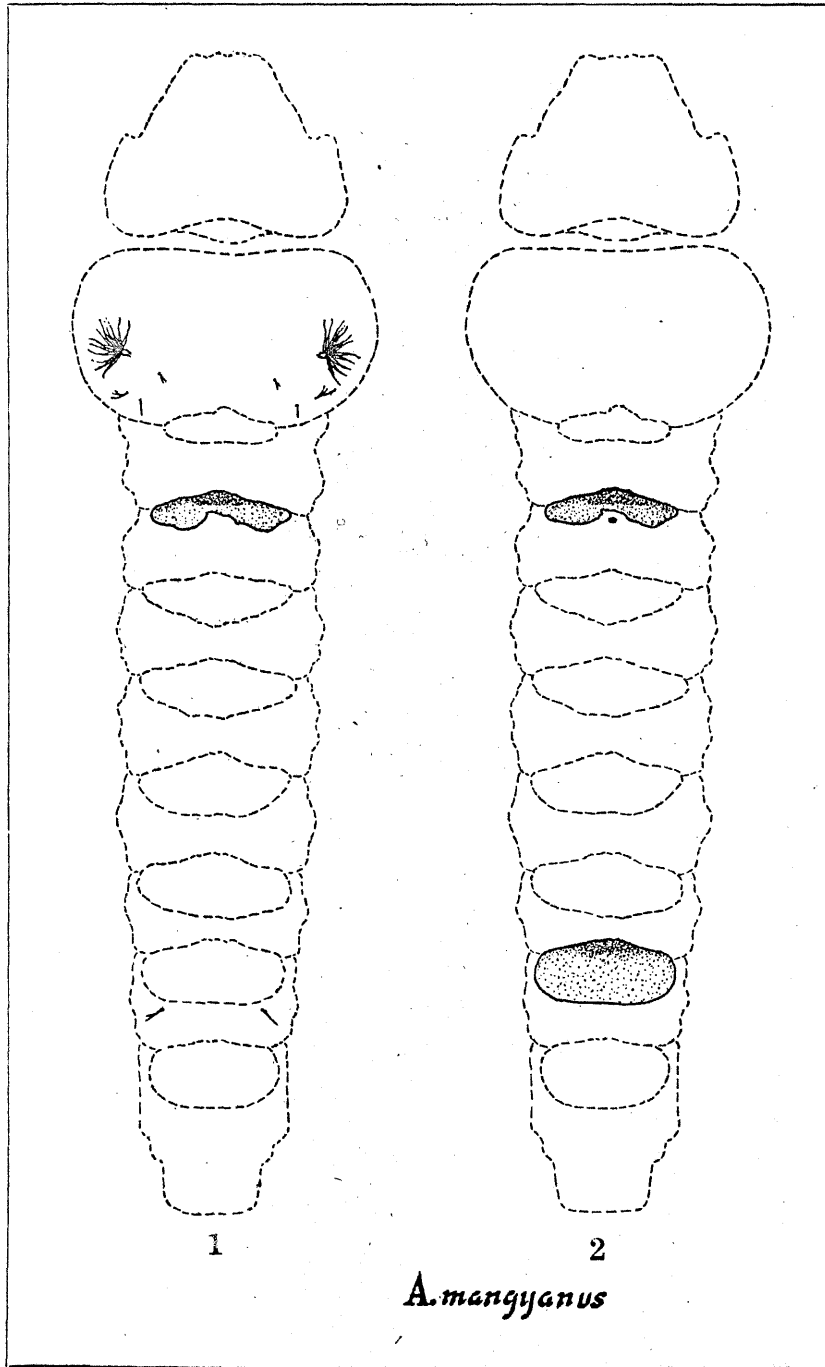


PLATE 3.



A. mangyanus