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NEW ANOPHELINE MOSQUITOES *Yong & Colless*
FROM NORTH BORNEO

by
Donald H. Colless

ANOPHELES FILE

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New Anopheline Mosquitoes from North Borneo.

by DONALD H. COLLESS, B.Sc. Agr.*

Recent collections of mosquitoes from relatively inaccessible areas of North Borneo have brought to light three new forms of Anopheline mosquito. The first, although clearly a good species, is obviously related to *A. watsoni*; the second is a large and handsome species with no immediately obvious affinities, but perhaps most closely related to *A. watsoni* also; the third is an undescribed sub-species of the widespread *A. gigas*. Formal descriptions are given below.

A. stokesi, n. sp.

Types: Holotype female, allotype male, with corresponding larval and pupal skins, to be placed in the British Museum (Natural History).

Type locality: Tambunan, North Borneo.

Adult female (3 specimens seen)

A rather small dark mosquito, with conspicuous white markings.

Head. Labium (fig. 1c) dark, length 1.6-1.8 mm. Palps (fig. 1c) a little shorter than proboscis, with 4 pale bands at the apices of segments 2, 3, 4, and 5; apical and pre-apical pale bands and sub-apical dark band all of approximately the same width (about $\frac{1}{2}$ apical segment). Clypeus and tori without scales, but antennal segment 3. with a small internal tuft of pale scales.

Thorax. Integument mainly dark. Mesonotum with a silvery bloom, the characteristic *Neomyzomyia* "eyespot" pattern poorly developed. Pronotal lobes with rather sparse tufts of dark scales. Anterior promontory with usual central tuft of fine pale scales, extending back a short distance on to the mesonotum; lateral tufts of broader scales, pale above and dark below. A patch of very fine pale scales present laterally in front of the wing roots. *Setae*: Propleural 2-3, spiracular 1 or 2, upper sternopleural 4-6, lower sternopleural 4-5, pre-alar 4-8, sub-alar 4-6.

Legs. Coxae without scales; fore trochanters with lateral scaling, dark basally, pale apically. Femora, tibiae, and fore

*Now, Faculty of Medicine, University of Malaya.

and hind tarsal segments 1, with pale speckling; occasionally fore tarsal segment 2 with 1 pale spot. Hind femora and all tibiae with very narrow pale apical bands. Fore tarsal segs. 1 to 3 with rather narrow pale apical bands, segs. 4 and 5 similar or not obviously banded. Mid-tarsal segs. 1 to 3 with ill-defined pale apical bands. Hind-tarsi (fig. 1d): seg. 1 with a narrow pale apical band, other segs. rather variable—in 2 specimens out of 3, seg. 2 with a broad apical pale band (about $\frac{1}{3}$ the segment), segs. 3-5 pale, although on one leg of one specimen, seg. 4 with a central dark patch on the outer surface; in the remaining specimen, seg. 2 with a narrow pale band and seg. 3 dark on basal half of outer surface, its under surface almost entirely pale. Fore femur 1.7—2.0 mm., av. 1.8 mm.

Wing. (fig. 1a). Length 3.1-3.4, av. 3.2 mm. Costa with prehumeral pale spot very small (1/3) or absent (2/3); accessory sector pale spot well developed. Vein 1 with presector dark spot undivided and as long as the corresponding costal spot; middle dark spot with 1 pale interruption (the accessory sector) which is much longer than the basal portion of the dark spot; pre-apical dark spot with one pale interruption, in one wing of one specimen extending on to costa as a few pale scales. Cross-vein 1-2 apparently absent, vein 2 forking directly from vein 1. Vein 3 with dark apical and basal spots, central area variable, from mainly pale to mainly dark. Vein 4 almost entirely dark, with small pale spots at fork and cross-vein junctions. Fringe pale from a little before vein 1 to past 2.1 and from before 2.2 to past 3; also at apices of 4.1, 4.2, and 5.1.

Abdomen. Integument very dark, apparently devoid of scales.

Adult male (1 specimen seen).

Generally similar to female but wing (fig. 1b.) much paler, with reduction of the dark areas. Costa with minute prehumeral pale spot, and a pale interruption in the pre-apical dark spot; apical dark spot about $\frac{1}{2}$ length of pre-apical dark spot. Vein 1 with basal portion of middle dark spot obliterated by the large accessory sector pale spot. Vein 5.2 almost entirely pale. Terminalia: a very poor preparation, but apparently similar to *A. watsoni*.

Pupa. (3 specimens seen)

Characteristic features: Hair C, seg. 2, with 8-15 branches rising close together at the end of a short stem; hairs B and C on segs. 4 to 7 (fig. 3b) as long as the following segment, with strong stems and numerous branches. Lateral spines (fig. 3b) on segs. 2 and 3 very small and blunt, that on seg. 4 markedly longer, (about 4 or 5 times seg. 3), those on segs. 5 to 7 of increasing

length, with prominent side-spicules. Paddle (fig. 3a) with toothed margin greatly reduced, extending posteriorly less than half way to paddle hair; terminal and accessory paddle hairs 2-3 branched (3 branched in 2/3).

Larva. (3 specimens seen)

A small, black, very active larva.

Head. Clypeal hairs (fig. 1c): ic. long, very stout basally but tapering sharply at about $\frac{1}{3}$ its length to a long fine tip, the basal $\frac{1}{3}$ with 5-9 conspicuous side-branches: oc. $\frac{1}{2}$ - $\frac{2}{3}$ length of ic., placed well back, with strong stout stem, single or bifid, and 9-17 branches; pc. $\frac{2}{3}$ - $\frac{3}{4}$ length of oc., placed well forward between ic. and oc. and projecting past anterior margin of the head, with stout tapering stem and 12-18 branches. The bases of ic., oc., and pc. on each side form an approximately isosceles triangle. Frontal hairs reduced, sub-equal in length, inner pair reaching about to base of oc. Sutural hair long, stout, simple; trans-sutural similar or bifid at the tip. Antennal hair placed $\frac{1}{3}$ - $\frac{1}{2}$ distance along shaft on outer dorsal surface, rather long; terminal antennal hair very long, bifid near base.

Thorax. Shoulder hairs (fig. 1f.): inner with stout flattened stem and 17-21 branches, basal boss prominent; central similar but longer with 15-18 branches; basal bosses separate. Prothoracic hair 13 (fig. 1j.) with 7-11 long radiating branches, its base covered by a pigmented chitinous plaque. Metathoracic palmate hair weakly developed, with 5-10 long, clear, lanceolate leaflets. Pleural hairs: prothoracic group with one rather short with 3-4 spiky branches, metathoracic group with one short bifid hair, remainder all simple.

Abdomen. Palmate hairs: seg. 1 rudimentary with 7-10 narrow flattened or lanceolate branches; seg. 2 (fig. 1g.) fully developed with 19-24 pigmented leaflets with fine, sharply differentiated, filaments, these about $\frac{1}{3}$ as long as the blade; segs. 3-6, (fig. 1h) similar, seg. 7, with 12-17 weakly differentiated leaflets. Lateral hair on seg. 4 simple or bifid, on seg. 4 bifid. Pecten (fig. 1k) with long teeth, all of about the same length.

Habitat.

This is an extremely rare species and has been found on only one occasion. Its larvae were taken from rainwater collected in a split bamboo pole lying in the jungle, near Tambunan, at an altitude of about 2,000 feet. Larvae of *A. leucosphyrus balabacensis* were present in the same water.

Notes.

This species is obviously closely related to *A. watsoni*; I have no specimens available for direct comparison but from the des-

cription and figures in Gater (1935), the adults must be well-nigh inseparable. Possibly there are wing differences—vein 4 in *stookesi* has small separate pale spots over the cross-vein junctions, while *watsoni* apparently has not; also, vein 2.1 in *watsoni* is figured with one long dark spot, while in *stookesi* this is broken into 2 small spots. The larval differences however are at once obvious and dramatic—the exaggerated branching of the clypeal hairs, particularly *pc.*, separates *stookesi* immediately from all other *Neomyzomyia* species. Prothoracic hair 13 is also quite unusual, in that it rises from beneath a small dark chitinous plaque. All the same, most other features of the larva, and particularly the placing of the clypeal hairs, bear out the relationship with *A. watsoni*, and one is tempted to regard *stookesi* as a subspecies with exaggerated development of certain characters. However I have seen typical *watsoni* larvae from Brunei state and there is no obvious geographical barrier between the areas of distribution. For this reason, and by morphological analogy with other species, it seems that *stookesi* is in fact a good species.

A. saungi, n. sp.

Types. Holotype female, allotype male, with larval and pupal skins of allotype and two morphotype larvae, in the British Museum (Natural History). Male paratype and morphotype larva in the collection of Institute for Medical Research, Kuala Lumpur.

Type locality: Saung-Saung, Sunsuran Trace, North Borneo.

Adult female. (2 specimens seen)

A large, rather pale mosquito, with conspicuous white markings.

Head. Labium (fig. 2c) dark, length 2.2-2.4 mm. Palps (fig. 2c) rather thin, a little shorter than proboscis, 2.0-2.1 mm. in length; pale apical bands present on segs. 2-5, those on 2 and 3 narrow, those on 4 and 5 somewhat broader and of approximately the same width as the pre-apical dark band; seg. 3 with central patch of pale scales on the dorsal surface. Clypeus dark with a central area of pale frosting. Tori mid-brown. Seg. 3 of antenna with a patch of pale scales.

Thorax. Integument brown with usual *Neomyzomyia* pattern of dark eyespots and silvery frosting. Anterior promontory with a central tuft of fine pale scales, and lateral tufts of broader scales, pale above and dark below; a few broad pale scales extend back along the antero-lateral margins of the fossae. Setae: propleural 2-4, spiracular 6-8 forming a quite prominent tuft, upper sternopleural 6-7, lower sternopleural 5-7 pre-alar 7-8, sub-alar 9-11.

Legs. Coxae without scales, but fore trochanters scaled on external surface, pale apically, dark basally. Femora, tibiae, and tarsal segs. 1 of all legs with conspicuous spots and splashes of yellowish-white. Hind femora and tibiae and fore tibiae with narrow pale apical bands; tibiae of all legs narrowly pale at base. Fore tarsi with rather narrow, ill-defined, pale bands at the apices of all segments. Mid tarsi similar, with narrower bands. Hind tarsi (fig. 2d): seg. 1 with narrow pale apical band; seg. 2 with broad pale apical band and splashes of white on central third; seg. 3 white with a narrow basal dark patch or band; seg. 4 dark with pale bands at base and apex; seg. 5 narrowly pale at apex. Fore femur 2.3-2.5 mm. in length.

Wing. (fig. 2b). Length 4.2-4.4 mm. Costa with a prominent prehumeral pale spot, and an accessory sector pale spot in 2 out of 3 specimens; pre-apical and apical dark spots very long, the pale spot separating them being about the same length as the subcostal spot. Vein 1 with presector dark spot entire, middle and pre-apical dark spots each with one pale interruption. Cross-vein 1-2 apparently absent, vein 2 forking from vein 1. Stem of vein 4 almost entirely dark, with one pale spot at cross-vein 4-5. Vein 6 with 3 dark spots of increasing length from base. Fringe pale from a little before vein 1 to past vein 2.1, and from before 2.2 to past 3; also at apices of veins 4.1, 4.2, 5.1, and 5.2.

Abdomen. Integument dark and devoid of scaling.

Adult male. (7 specimens seen)

Generally similar to female but paler. Speckling of legs extends to tarsal segs. 3 of fore and mid legs of some specimens. In many specimens, basal dark band of seg. 3 of hind tarsi is absent or reduced to a small patch on the external surface, and seg. 4 has a basal as well as apical pale band. Wing (fig. 2a) with considerable reduction of dark spots. Costa with long pale area, from humeral dark spot almost to base; subcostal and pre-apical pale spots almost as long as pre-apical dark spot and longer than apical dark spot; pre-apical dark spot with 1 or 2 pale interruptions. Vein 4 with much pale scaling, in some specimens completely pale proximal to cross-vein 4-5.

Terminalia: phallosome with about 18-20 blade-like leaflets (fig. 2c), the longest about .045 mm. in length, some of the largest with serrations along one edge. Harpago (fig. 2f) with rather broad club; also one terminal seta and one small internal seta, the latter about $\frac{1}{8}$ the length of the former, which is slightly shorter than the club.

Pupa (6 specimens seen)

Characteristic features: Hair C, seg. 2, strongly developed with numerous (about 40-50) dendritic branches and prominent stem. Hairs B and C (fig. 3d) of all segments shorter than tergite of segment following. Lateral spines (fig. 3d) of segs. 1-4 very small, that on 4 barely longer than that on 3; those on segs. 5-7 long and prominent, of about the same length, and some with side-spicules. Paddle (fig. 3c) with teeth of lateral margin extending some $\frac{2}{3}$ distance to paddle hairs. Terminal paddle hair rather short, markedly stout and pigmented.

Larva. (10 specimens seen)

A very large larva, about 8 mm. in length; in many live specimens, the thorax has a characteristic white dorsum, resembling that of *A. kochi*.

Head. Clypeal hairs (fig. 2g): ic. long, simple, stout basally, with a few fine side-hairs in most specimens; oc. simple, $\frac{1}{3}$ - $\frac{1}{2}$ the length of ic., placed a little posterior to ic.; pc. long and prominent, reaching forward well past anterior margin of the head, rather stout basally, placed a little external to ic., simple or 2-3 branched at tip. Frontal hairs normal. Sutural hair long, simple or bifid at tip; trans-sutural long, 3-7 branched. Terminal antennal hair usually bifid, sometimes with 3 or 4 branches on one side.

Thorax. Shoulder hairs (fig. 2h): inner with stout flattened stem and 15-21 branches; central about $1\frac{1}{2}$ times length of inner, with 10-16 branches; outer usually simple, but bifid in one specimen; inner and central with prominent basal bosses, well separated; inner boss with a rounded, dorso-anterior projection. Prothoracic hair 13, 4-7 branched. Metathoracic palmate hair with 2-9 (av. 6) long, attenuated leaflets. Pleural hairs all simple with exception of a short 2-3 branched hair in the metathoracic group.

Abdomen. Palmate hairs: seg. 1, not developed; seg. 2, (fig. 2k) with a differentiated stem and flattened branches; segs 3-6, (fig. 2j) fully developed, with well differentiated filaments about $\frac{1}{2}$ the length of the blade; seg. 7, smaller, weakly differentiated. Lateral hairs on segs. 4-6 usually 3-branched, rarely 2 or 4-branched on one side only. Hair 9 (fig. 2j) of segs. 1-6 with obvious stem and side-branches. Pectew (fig. 2m) showing marked differentiation of long and short teeth.

Habitat.

This is apparently a rather common species at higher altitudes in the Crocker Range of North Borneo. Larvae were found in large numbers in muddy pools along jungle tracks and in neigh-

bouring seepages, but only above 3,500 feet. *A. gigas* was also present in the same pools. *A. saungi* appears to occupy the ecological niche filled by *A. leucosphyrus balabacensis* at lower levels.

Notes.

This species is easily recognised in both the larval and adult stages by its large size. Also, the tarsal banding of the adult, and the long pc.'s and 3-branched lateral hairs of the larva are highly characteristic. Larvae may be easily identified by the latter character, using only a 20x hand lens. The wing pattern, and to some extent, the tarsal banding, show some resemblance to *A. stookesi*, and hence to *A. watsoni*; the larval characters however agree more closely with *leucosphyrus* group.

It is not improbable that *A. saungi* occurs outside Borneo. Its local abundance and distinctive morphology indicate the probability that it is by no means a "young" species; moreover, Nainggolan (1939) records "*A. leucosphyrus*" from Sumatra, breeding with *A. gigas* at altitudes up to 5,500 feet, which is well above the altitude range of *leucosphyrus* in Borneo. This suggests that the species in question may have been *A. saungi*, misidentified as *leucosphyrus*, as was the initial experience of the present author.

A. gigas crockeri, n. subsp.

Types: Holotype female with corresponding larval and pupal skins and one morphotype larva, to be placed in the British Museum (Natural History).

Type locality: Saung-Saung, Sunsuran Trace, North Borneo.

Adult female (1 specimen seen)

Possesses the usual characters of the species with the following special characteristics:—

1. *Palp* with three pale bands, apex dark or faintly golden.
2. *Wing* (fig 3e): Rather closely resembles *A.g. sumatrana*. Vein 2.1 with only one long dark spot; vein 2.2 with 2 dark spots but *pale* at apex. Vein 4.1 with 2 dark spots but the distal one is only sub-apical, not apical as in most forms. Vein 5.1 with dark apical spot, pale at base. Wing fringe pale from before apex of vein 1 almost to vein 2.2, and at apices of 4.1, 4.2, and 5.1, and between 5.2 and 6 (On one wing of specimen the spots at 4.2 and 5.1 are barely indicated)

Pupa (1 specimen seen)

Similar to *A.g. formosus*, as illustrated by Baisas (1936), but differing as follows:—

1. Hair B of segs. 4-7 markedly longer and stronger than the corresponding hairs C.
2. Lateral margin of paddle with usual teeth, but followed by only one or two short hairs; remainder of margin devoid of hairs.
3. Paddle hair very short, stout, and dark.

Larva. (7 specimens seen)

A very large, dark, rather slim larva, about 10 mm. in length.

Head. Clypeal hairs (fig. 3f): ic. long, over $\frac{1}{2}$ the length of head, simple, without side hairs; oc. long, about $\frac{3}{4}$ ic., 1-3 branched, usually bifurcating near base; pc. $\frac{1}{2}$ - $\frac{2}{3}$ oc., markedly stout, simple or bifid near tip. Sutural hair 5-8 branched; transsutural hair 5-9 branched. Antennal hair placed more or less dorsally, about $\frac{1}{4}$ the distance along shaft, 3-7 branched; terminal antennal hair 3-4 branched.

Thorax. Shoulder hairs (fig. 3g): inner small with 4-6 branches; central 2-3 times length of inner, with 6-8 branches and fairly prominent boss. Prothoracic hair 13 with 7-10 long branches. Mesothoracic hair 1 fairly strong, with prominent boss and 13-20 branches. Metathoracic palmate hair represented by an ordinary hair with 4 or 5 branches. Propleural group with a short, 2-6 branched hair.

Abdomen. Palmate hairs quite undeveloped on segs. 1 and 2; on segs. 3-7 fully developed (fig. 3h) but without differentiated filaments, margins serrate, the teeth tending to extend almost to base of blade. Lateral hairs on segs. 4 and 5 simple. Pecten showing clear differentiation of long and short teeth but fairly wide variation within each group.

Habitat.

This species has been found on only one occasion, breeding with *A. saungi* in muddy pools on jungle tracks at altitudes above 3,500 feet. It is probably fairly abundant locally.

Notes.

Larvae proved very difficult to rear at lower altitudes and only one adult was obtained, but its characters appear sufficiently clear-cut to warrant erection of a new subspecies. The pale apices of wing veins 2.1 and 4.1 and the distribution of the fringe spots appear to be characteristic of this form. Existing descriptions of the larvae of other subspecies are rather inadequate, but the form of the clypeal hairs is also probably diagnostic for this subspecies.

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(Illustrations on following three pages overleaf)

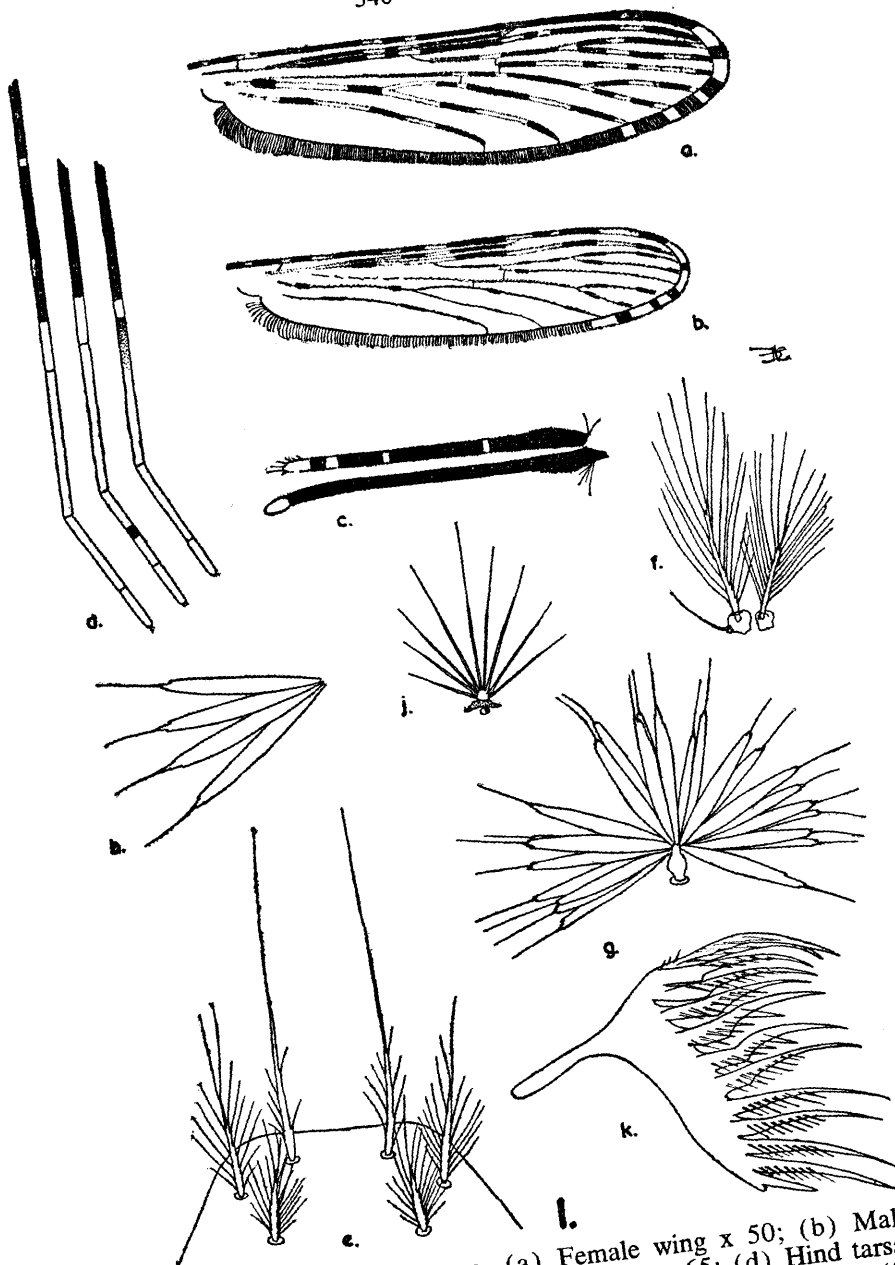


Figure 1. *A. stookesi*, n.sp. (a) Female wing x 50; (b) Male wing x 50; (c) Female palp and proboscis x 65; (d) Hind tarsal banding, with variations, x 50; (e) Clypeal hairs x 310; (f) Shoulder hairs x 105; (g) Palmate hair, abdominal seg. 2, x 310; (h) Leaflets from palmate hair, abdominal seg. 4, x 310; (i) Prothoracic hair 13 x 105; (k) Pecten x 310.

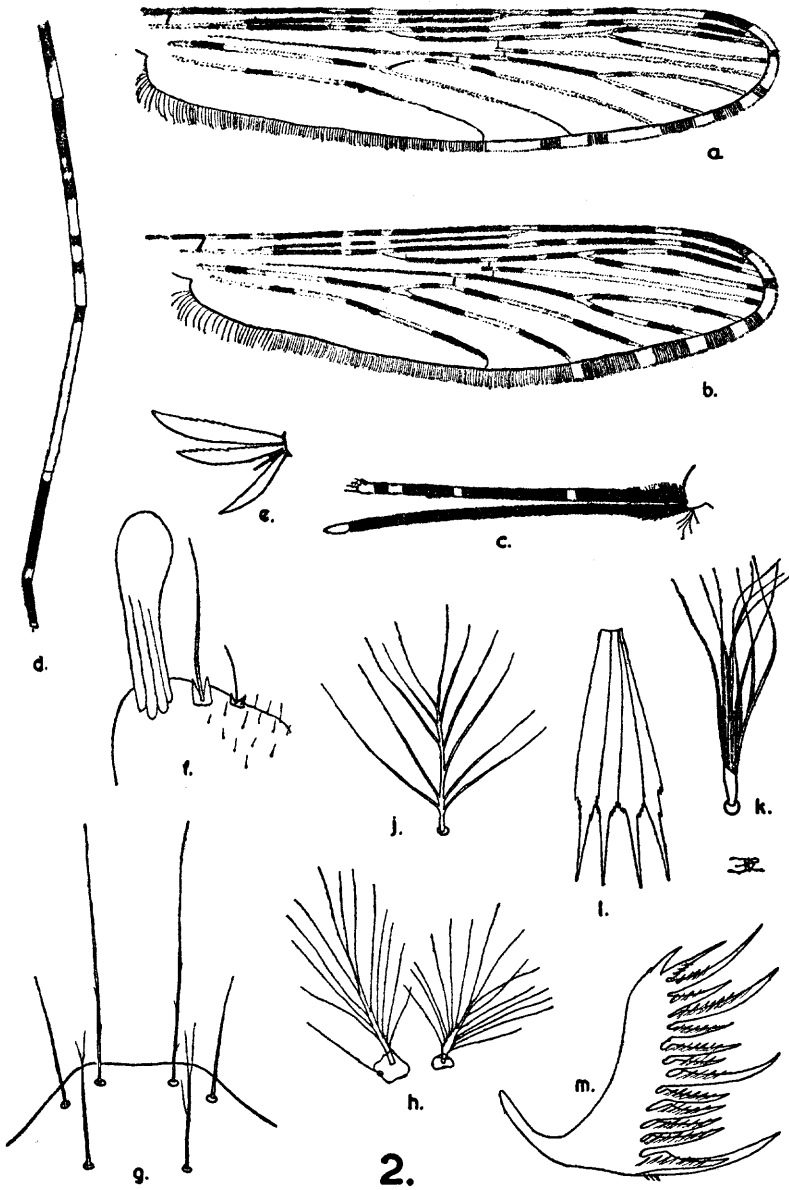
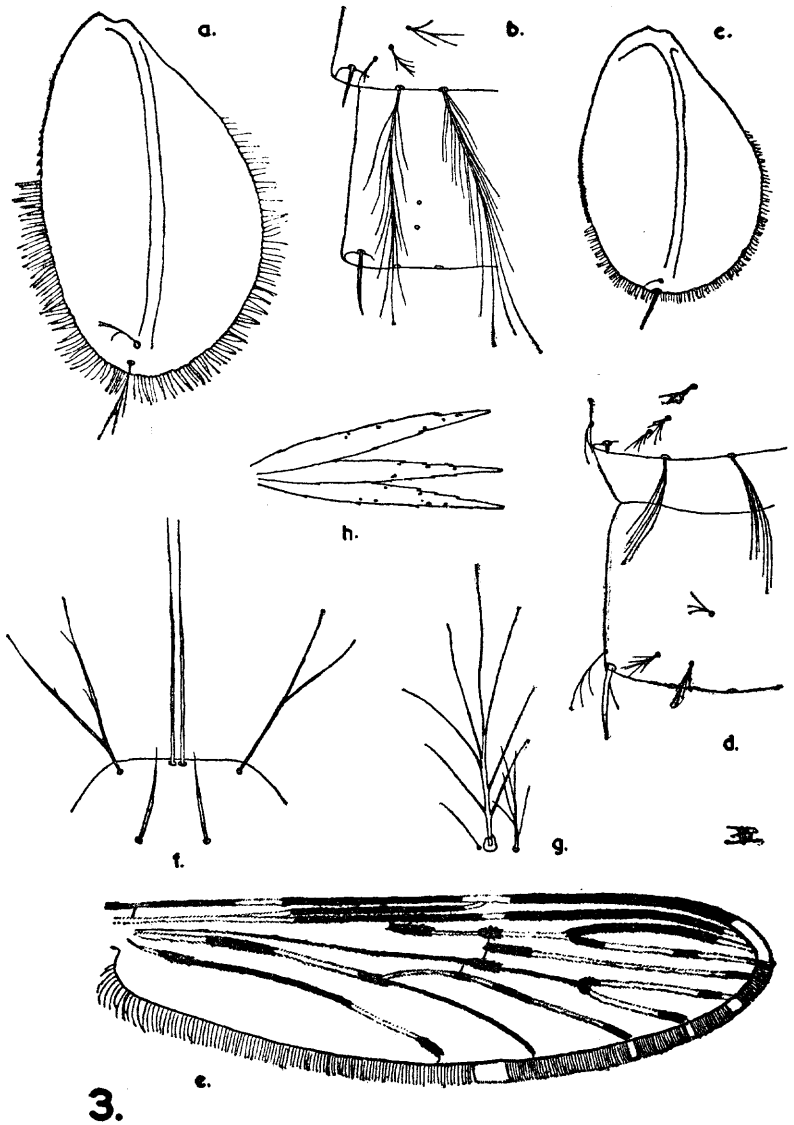


Figure 2. *A. saungi*, n.sp. (a) Male wing x 50; (b) Female wing x 50; (c) Female palp and proboscis x 50; (d) Hind tarsal segs. 2-5 x 50; (e) Leaflets from phallosome x 425; (f) Harpago x 400; (g) Clypeal hairs x 105; (h) Shoulder hairs x 105; (j) Hair 9, abdominal seg. 3, x 180; (k) Palmate hair, abdominal seg. 2, x 400; (l) Leaflets from palmate hair, abdominal seg. 4, x 400; (m) Pecten x 180.



3. (a), (b), *A. stookesi*, pupa; (c), (d), *A. saungi*, pupa; (e) to (h), *A. gigas crockeri*, n. subsp. (a) Paddle x 90; (b) abdominal segs. 4 and 5; x 90; (c) Paddle x 45; (d) Abdominal segs. 4 and 5 x 70; (e) Female wing x 50; (f) Clypeal hairs x 125; (g) Shoulder hairs x 105; (h) Leaflets from palmate hair, abdominal seg. 4 x 90.