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NEW SPECIES AND RECORDS OF THE AEDES KOCHI GROUP FROM EASTERN AUSTRALIA (DIPTERA : CULICIDAE)

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(With two Text-figures.)

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SYNOPSIS

The total of species of the *Aedes kochi* group known from Australia is raised from three to six. Both sexes, larva, and pupa of *A. josephinae* sp.n. from northern Queensland and of *A. dobrotworskyi* sp.n. from southern Victoria are described. *A. wallacei* Edwards is recorded for the first time from Australia. Additional distribution records and descriptive and biological notes are given for *A. kochi* (Dönitz), *A. alocasicola* Marks, and *A. gaehnicola* Marks.

Three species of Group A (*kochi* group) of the subgenus *Finlaya* have previously been recorded from Australia, *Aedes kochi* (Dönitz), *A. alocasicola* Marks and *A. gaehnicola* Marks. Three more species are now added to the list, *A. wallacei* Edwards and *A. josephinae* sp.n. from northern Queensland, and *A. dobrotworskyi* sp.n. from southern Victoria. Both sexes, larvae, and pupae of the new species are described below, and additional descriptive and biological notes and distribution records given for the other four species, which received detailed treatment in Marks (1947).

Species of the *kochi* group are characterized by profusely spotted wings, and spotted and banded femora and tibiae; they occur in the Australian region and eastern part of the Oriental region. The group has been extensively studied in recent years and Bohart (1957), in the most recent summary of it, lists 21 species. Laird (1957) has added one and the two new species described here bring the total to 24. Knight and Marks (1952) divided the group into three subgroups. On the basis of additional information, Bohart (1957) reconstituted subgroups I and II and his classification is followed here. Subgroup I—*kochi*, with a ventral apical scale tuft on the femora, comprises Papuan-Australian species and includes the six species of the Australian mainland; Subgroup II comprises the Oriental species; and Subgroup III includes only the New Guinea species, *A. gani* Bonne-Wepster. Subgroup I can be further subdivided into species with a bent specialized seta near the base of the male coxite (including *A. kochi* and *A. wallacei*) and species without this seta (including the remaining four Australian species).

The *kochi* group is apparently confined to the tropics except in eastern Australia where the ranges of *A. kochi* and *A. gaehnicola* extend to southern Queensland, and of *A. alocasicola* to central New South Wales, while *A. dobrotworskyi* sp.n. is known only from southern Victoria, which has a cool temperate climate.
In the descriptions the nomenclature of larval setae follows Belkin (1950) and of pupal setae, Belkin (1952, 1953).

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Aedes (Finlaya) josephinae sp.n.

Distinctive Characters: Adults differ from all Australian species except A. wallacei in having hind tarsal segments II and III with less than basal half dark; and from A. wallacei in lacking a distinct apical pale patch on mid tarsal segment III and in having the sector pale area on R, not more than 0·65 length of preceding dark spot.

Male terminalia: Coxite lacking a specialized seta at base and with a large scale tuft at mid-length; style not expanded.

Larva: Seta 3 (osc) of anal segment bifid (single in all other described larvae of kochi group); also distinguished from all Australian species except A. kochi on head setae 4 (d) and 6 (B) bifid, and from A. kochi on fewer lateral teeth of mentum (9-11 in A. kochi), and seta 3 of segment VIII single, as well as on form of comb and saddle spines.

Pupa: Distinguished from A. wallacei by having seta 1 on segment II 3 or 4 branched (single in A. wallacei) and from the other Australian species by the absence of seta 8 on segment VII.

Holotype Male: Wing length 2·8 mm.; pale scaling predominantly creamy.

Head: Clothed with flat scales with some narrow at nape, vertex, and along eye margin, creamy and white with large submedian and lateral dark patches; upright forked scales mixed dark and pale. Torus dark with flat creamy scales mesially; some dark scales on first flagellar segment of antenna; verticillate hairs brown, lying in a vertical plane. Palp 1·2 times length of proboscis, dark scaled with two broad and two narrower pale bands on shaft; segments IV and V with basal pale bands extending to apex of preceding segment; apex of V pale; long hairs at apex of shaft, along IV in inner and outer rows, and at apex of V. Proboscis 1·2 times length of fore femur, with a dorsal pale patch at mid-length extending as a short streak in both directions to cover 0·25 of proboscis; a small pale patch dorsally at apex; labella dark.

Thorax: Integument darkish brown. Scutum clothed with narrow curved dark scales with a broad creamy border on the anterior half, curving in behind scutal angle for a short distance; a few bronzy scales among the dark on anterior half, and creamy patches above the wing root and round the prescutellar bare area (all narrow). Scutellum with flat creamy scales and large black patch at apex of mid lobe. Ppn with broad creamy scales; apn with broad creamy and white scales, more or less continuous with a band of broad white scales across subspiracular area, upper stp and msp; white patches on propleuron, lower stp, and paratergite. On upper stp there are 2 bristles above the scale patch which divides round a patch of 6-9 bristles; 8 postspiracular bristles.
Legs: Fore and mid coxae with white and dark patches, hind with dark only; trochanters mainly dark. Femora with 7–9 pale bands or patches; with pale knee spots and with tufts of outstanding dark scales ventrally at apex. Tibiae with 8–12 pale bands or patches. Fore tarsal segment I with narrow white basal, sub-basal, median and apical patches, II with apical patch, and 1 or 2 pale scales preapically, III and IV dark, V white. Mid tarsal segment I with 6 bands or patches, II with pale patch on apical fourth, III and IV dark, V white. Hind tarsal segment I with white basal band, small median patch, and wide apical band, with or without scattered golden scales between them; II with basal fifth dark, III with basal sixth to fourth dark, on both a narrow ring of golden scales between the dark and white; IV dark, V white. Claws of fore and mid legs unequal, the anterior long with a strong pointed lateral basal tooth, and a strong blunt tooth at about mid-length; posterior shorter with a strong pointed tooth at about 0.3 its length; hind claws equal with slender pointed lateral basal tooth.

Wings: C with basal, large humeral, sector, subcostal, and apical pale areas; the sector pale area is 0.4 length of preceding dark spot and the subcostal pale area 0.2–0.5 length of preceding dark spot. Sc with sector and apical pale areas. R₁ with large basal and humeral, small sector and accessory sector pale areas, subcostal and accessory subcostal divided by one dark scale, and apical pale area. Pale areas at apices of remaining veins and at forks and cross veins. There are also pale scales (one or numerous) preapically on R₂, R₃, R₄₊₅, M₃₊₄, Cu₁, and An and large pale areas at bases of Cu₁ and An. Cell R₂ 2.5 times length of its stem; cell M₁ 0.9 length of its stem, its base well proximal to that of cell R₂; r-m oblique, 3 times its own length distal to base of M₃₊₄. Halteres with dark scaled knob with a few pale scales at its base.

Abdomen: Tergite I with median patch of dark scales, golden scales lateral to it, and white scaled lateral margin. Tergites II–VII golden scaled mesially with a sub-basal median black patch, which reaches apex on IV and is on apical half only on V and VI; there may be some dark scales proximal to the patch; dark scales laterally on tergites with some white scales on lateral margin; true tergite VIII dark with pale lateral margin. Sternites mainly dark scaled with outstanding scales at apex of VI and VII, less obvious on V; VIII dark with pale lateral border.

Terminalia (Fig. 1a; general description from holotype and 4 paratypes): Coxite about 3 times as long as broad, densely clothed with black scales sternally as well as laterally and to a lesser extent tergally, and with a membranous area along its inner aspect. Sternal to this area, at mid-length of coxite, is a tuft of about 16 broad pointed scales, the longest almost half length of coxite; just tergal to the scale tuft is a dense patch of about 30 fine straight setae; at some distance beyond the scale tuft is a single long, stout, usually striated seta. Tergally, at the base of the coxite, there is no specialized seta, but a patch of about 40–50 setae which extend in 2 or 3 rows to the level of the scale tuft; 2 or 3 in the proximal row are longer and the most lateral may be stouter; most of the setae are slender with slightly curved tips, about 10 of the more mesial and distal have slightly flattened tips; on distal half of coxite are several rows of numerous, scattered, moderately long, mesially directed setae. Style about half length of coxite, straight,
widening slightly from base and narrowing on distal fourth, with one small preapical seta; appendage about 0·6 length of style, slender, slightly curved with blunt tip. Harpago one-fourth length of coxite; appendage slender, twice length of harpago, widening gradually into a membranous expansion and tapering to a narrow curved tip. Paraproct with single tooth. Phallosome simple, slightly wider and rounded distally. Lobe of tergite IX with 2–4 curved setae; sternite IX strongly convex mesially with 2 setae.

**Paratype Males:** Among 6 paratype males the following differences from the holotype were observed. Wing length 2·1–2·6 mm.

**Head:** Palp 1·1 times length of proboscis; shaft with 3–5 bands or patches; pale scales extending over basal half of segment IV; proboscis with complete median band, and with streak covering about half its length, reaching almost to base.

**Thorax:** Golden scaling of scutum reduced with none above wing root, or more extensive, curving in behind seutal angle and continuing back in a line lateral to the dorsocentral bristles which links with the golden patch round prescutellar bare area (which may include some flat scales); scutellum with a few dark scales at apex of lateral lobe; 4–6 postspiracular bristles; 4–7 bristles in upper stp scale patch with 1 or 2 above it; some white scales on prealar knob.

**Legs:** Fore tarsal segment I with 4–6 bands or patches; mid tarsal segment I with 5 bands or patches, II with patch on apical fifth and a couple of pale scales at mid-length; basal 0·2–0·3 of hind tarsal segments II and III dark.

**Wings:** Ratios of pale areas on C to preceding dark spots—sector, 0·2–0·35; subcostal, 0·3–0·5. Subcostal and accessory subcostal pale area on R₁ may be fused; cell R₂ 2·3–2·4 times length of its stem; cell M₁ 1·0–1·1 times length of its stem; r-m 2·5 times its own length distal to base of M₃+₄.

**Abdomen:** Tergites I–VI with a complete median longitudinal dark stripe, and the pale area lateral to it incompletely subdivided at mid-length on III and IV.

**Females:** Among the allotype and 7 paratype females the following differences from the males occur. Wing length 2·5–3·0 mm. (2·7 in allotype).

**Head:** Torus light yellowish-brown, darker mesially; verticillate hairs short, dark; palp 0·2–0·25 length of proboscis, with a few pale scales at apex (all dark in one specimen); proboscis with median pale band 0·15–0·3 its length.

**Thorax:** 5–9 postspiracular bristles and 3–7 bristles in upper stp scale patch, which may not be obviously divided by them.

**Legs:** Mid tarsal segment II with apical patch 0·25–0·4 its length; III rarely with one white scale at apex; hind tarsal segment I with 4–7 patches, only the basal and apical forming complete rings; basal 0·2–0·35 II and III dark; claws equal, those of fore and mid legs with a strong pointed tooth, hind claws apparently as in male.
Wings: A small accessory subcostal pale area on C in one specimen; ratios of pale areas on C to preceding dark spots—sector, 0·2–0·65 (exceeding 0·5 in only one specimen); subcostal, 0·3–0·7. Small pale areas basally on Cu and preapically on M₁; cell R₂ 1·9–2·8 times length of its stem; cell M₁ 1·1–1·9 times length of its stem; r-m 2–3 times its own length distal to base of M₃₊₄.

Abdomen: Tergites mainly dark scaled; I with a few pale at apex, or entirely pale; II–VII with median basal and paired preapical patches (sometimes fused on VII); basal patch may be large and bilobed on II or absent from III and IV, or may be sub-basal on V and VI; apical pale border on VI and VII, or VI extensively pale as in male; tergites I–VII have a lateral border of white scales, curved a short distance dorsally just before apex but not recurved; tergite VIII all dark mesially or with 2 or 3 pale scales, and with some pale scales laterally. Sternites dark scaled mesially with lateral white patches, very small on IV and V; VI and VII sometimes with some pale scales mesially towards base. Sternite VIII dark scaled with some pale scales at apex. Cerci pale scaled.

Larvae (Fig. 1 b–f): Length 6–8 mm.; head, siphon and saddle light brown; thorax and abdomen with stellate setae.

Head: Almost as long as broad. Antenna 0·25–0·28 length of head, 5 times as long as broad, straight, smooth; seta 1 arising at 0·7, single, simple; terminal and subterminal setae arising close together, seta 2 moderately long, setae 3–6 short. Head seta 1 3 or 4 branched; setae 4, 6, and 7 arising in a line curved towards anterior margin of head, their bases about equal distances apart; seta 5 arising behind 7 and slightly mesial to 6; seta 4 bifid (rarely single or tridid), simple; seta 5 single, simple; seta 6 bifid (rarely single), simple; seta 7 3–6 branched, frayed, stellate; seta 8 single or bifid; seta 9 2–4 branched; seta 10 single; seta 11 6–10 branched, stout, frayed, stellate; seta 12 single or bifid; seta 13 single; seta 14 3–7 branched, long, frayed; seta 15 3–6 branched, small, fine. Mentum with large median tooth and 7 or 8 large lateral teeth.

Thorax: Prothorax—seta 0 7–12 branched, stellate; setae 1–3 arising close together, without sclerotised bases, 1 6–13 branched, stellate; 2 long, single; 3 13–21 branched, stellate; setae 9–13 arising from a rounded sclerotised base; seta 9 10–16 branched, stellate; seta 10 7–11 branched, stellate; seta 11 single to tridid, short, fine; seta 12 long, single. Mesothorax—setae 9–12 arising from prominent base bearing a short spine; seta 9 long, 5–8 branched; seta 10 long, single (rarely bifid); seta 11 shorter, 2–5 branched, stellate; seta 12 long, single. Metathorax—form of setae 9–11 and their base similar to those of mesothorax; seta 9 6–9 branched; seta 10 single; seta 11 2–4 branched; seta 12 of medium length, single.

Abdomen: Seta 6 on segments I–VI and seta 7 on I and II long, frayed. Seta 6 on segment I 3–5 branched; on II 3 or 4 branched; on III–VI usually bifid, rarely tridid on III, IV, or VI; seta 7 on segments I and II single or bifid. Segment VIII—seta 1 5–10 branched, frayed, stellate; setae 2–4 single, 2 and 3 frayed, 4 simple; seta 5 4–8 branched, frayed, stellate. Lateral comb a triangular patch of about 65–80 teeth arranged in 3 or 4 rows; in the distal row there are 8–12 stout spines.
approximately 60–65 μ in length, each with 2–4 strong curved lateral
denticles at about 0·3 from base; the tip of the spine is broad and
flattened and in most tapers to a fine point; the remaining comb teeth
are apically rounded fringed scales, those of second row being 0·7 length
and remainder about 0·3 length of distal teeth.

Siphon finely pilose, acus present, index 2·9–3·6; pecten
commencing at 0·1–0·2 and extending to 0·4–0·5 length of siphon, of
5–9 pointed spines, finely fringed along proximal edge; seta 1 single or
bifid, frayed, arising at 0·47–0·56 length of siphon; seta 2 short, single;
seta 6, 8 long (about equal to diameter of tip of siphon), single.

Anal segment—saddle covering dorsal 0·6 of segment, finely pilose,
with 2–5 spines on its distal margin above seta 1 and 2–5 below it, as
well as some smaller spicules; the spines are pointed and simple; seta
1 long, bifid, frayed; seta 2 3 or 4 branched; seta 3 bifid (single on one
side in one specimen); seta 4 (ventral brush) of 10 or 11 tufts, 1–3
branched, rarely 4 branched; the most proximal tuft may be vestigial;
no grid. Anal papillae subequal, the upper 1·1–1·4 times length of
lower and 2·1–2·8 times length of saddle.

Description based on 4 larval skins, individually associated with
holotype, allotype, a paratype male, and a morphotype pupa, and on
20 morphotype larvae.

PUPAE (Fig. 1 g,h): There is no distinct colour pattern; the
ecephalothorax behind the trumpets, the metanotum, and abdominal
segments I–III are slightly darkened; the longer setae are often frayed.

Cephalothorax: Trumpet evenly pigmented, about 3 times as long
as greatest width, with oblique opening, ratio of meatus to whole
1:1·4–1·6; apical notch shallow. Seta 1 strongly developed, bifid; seta
2 bifid; seta 3 bifid (rarely single); seta 4 5–13 branched; seta 5 2–6
branched (9 branched in one specimen); seta 6 1–3 branched; seta
7 2–5 branched; seta 8 2–4 branched; seta 9 1–4 branched; seta 10 2–7
branched; seta 11 single; seta 12 2–6 branched.

Abdomen: Seta 2 on segments I–VII single (rarely bifid at tip);
seta 7 on segments I–V and seta 11 on segments III–VII single.
Segment I—seta 1 strongly developed with many frayed branches; seta
3 single or bifid; seta 4 1–5 branched; seta 5 4–11 branched; seta 6 1–4
branched (usually single); seta 10 2–4 branched. Segment II—seta
1 3 or 4 branched; seta 3 1–4 branched; seta 4 2–5 branched; seta 5 2–6
branched; seta 6 1–3 branched; seta 7 arises well anterior to seta 6;
seta 10 1–4 branched. Segment III—seta 1 2–5 branched; seta 3 single
or bifid; setae 4, 5 2–5 branched; setae 6, 8 1–3 branched; seta 10 3–7
branched; seta 12 2–4 branched. Segment IV—seta 1 2–5 branched;
seta 3 1–5 branched; seta 4 2–4 branched; setae 5, 6, 8 1–3 branched;
seta 10 2–6 branched; seta 12 single or bifid. Segment V—seta 1 2–4
branched; seta 3 1–5 branched; seta 4 2–8 branched; seta 5 bifid; seta
6 single or bifid; seta 8 1–3 branched; seta 10 2–5 branched; seta 12 single
or bifid. Segment VI—seta 1 2–4 branched; seta 3 1–3 branched; seta
4 2–5 branched; seta 5 bifid; seta 6 single or bifid; seta 7 in 10 specimens is short, stout, single, reaching only about half the distance from its base to the distal margin of the segment; in 3 specimens (including pelts of holotype and allotype), on one side at least, it is long, 2 or 3 branched, and reaches beyond the distal margin of the segment; seta 8 1–4 branched; seta 10 2–4 branched; seta 12 1–4 branched. Segment VII—setae 1, 4, 6 1–3 branched; seta 3 single or bifid; seta 5 1–4 branched; seta 7 long, single or bifid; seta 10 single or bifid; seta 12 1–3 branched. Segment VIII—seta 5 1–3 branched; seta 7 6–12 branched, about half length of paddles. Paddles ovoid with finely denticulate margin; breadth index 1.4–1.9; midrib well developed; seta 1 single.

Described from 9 pupal skins (4 individually associated with holotype, allotype, and 2 paratypes; 5 unassociated morphotypes), 3 whole morphotype pupae, and 4 incomplete topotypical skins.

Biology: Larvae were collected from leaf axils of Hanguana malayana (a swamp plant with a general resemblance to a crinum) growing along the margins of a swampy creek at Skull Creek, northern Queensland. In one sample in which larvae of A. josephinae were numerous they were associated with a few larvae of Tripteroideos bimaculipes (Theobald). Adults were not taken here but in rain forest, biting at about 5.00 p.m. Pupal period occupied from three to five days in the laboratory in Brisbane in October, and also when kept in a constant temperature room at 25°C.

Types: Holotype male (P. 1314), allotype female (P. 1316), each with associated larval and pupal skins, reared from axils of Hanguana malayana, Skull Creek (10°56'S., 142°22'E.), Cape York Peninsula, Queensland (15.v.1953, E. N. Marks); 5 male (2 on slides) and 3 female paratypes, same data as holotype; 1 male (P. 1258 with associated larval and pupal skins) and 1 female paratype, same locality (13.vii.1952, M. J. Mackerras and E. N. Marks); 3 females, 1 mile E. of Cowal Creek, biting in rain-forest (13.vii.1952, M. J. Mackerras and E. N. Marks). Morphotypes: 19 larvae, 3 whole pupae (one with associated larval skin) and 5 pupal skins, same data as holotype; 1 larva, same site, 13.vii.1952. The Cowal Creek site is about 3 miles N.W. of the type locality, which is where the overland telegraph line crosses Skull Creek.

Holotype, allotype, 2 male and 2 female paratypes, 10 larval and 3 pupal morphotypes in University of Queensland collection. One male, and one female paratype, two morphotype larvae and one morphotype pupal skin in each of the following collections—Queensland Museum; C.S.I.R.O. Division of Entomology, Canberra; School of Public Health and Tropical Medicine, Sydney; British Museum (Natural History). One female paratype, two morphotype larvae, and one morphotype pupa with male terminalia mount in U.S. National Museum, Washington.

This species is named after Dr. M. J. Mackerras, whose collaboration and companionship the writer has enjoyed on several field investigations in northern Queensland.

Discussion: A. josephinae shows resemblance to several other species of subgroup I of the kochi group, but there is no strong indication of a very close relationship to any particular species. On
general scale pattern of the adults it is nearest to *A. wallacei*, but on male terminalia is quite distinct from *A. wallacei* and perhaps nearest to *A. knighti* Stone and Bohart from Solomon Is. (Larva and pupa of *A. knighti* are undescribed.) The form of the comb spine most nearly resembles that of *A. solomonis* Stone and Bohart, also from Solomon Is., which differs on terminalia. Pupae of the following species all have seta 8 present dorsally on segment VII—*A. alocasicola*, *A. gahn nicola*, *A. kochi*, *A. bougainvillensis* Marks, *A. samoanus* (Grinberg), *A. dobrotworskyi* sp.n. (not shown in Marks’ (1947) figures of the first four species); in *A. solomonis* it is very small or absent, and in *A. josephinae* it is apparently always absent; it is absent also from Penn’s (1949) figure of *A. wallacei*.

**Aedes (Finlaya) dobrotworskyi** sp.n.

**Distinctive Characteristics:** Adults differ from *A. wallacei* and *A. josephinae* in having hind tarsal segments II and III with basal 0·5–0·6 dark; and from *A. kochi* in lacking an accessory subcostal pale area on C. They closely resemble *A. alocasicola* and *A. gahn nicola*, being rather intermediate between these in the extent of pale scaling on scutum and abdomen, and it may not be possible to distinguish some females. *A. alocasicola* usually has scutal scales almost entirely white and golden, some creamy scales among the white on tibiae (all white in *A. dobrotworskyi* and *A. gahn nicola*), and 4 or 5 white bands or patches on fore and mid tarsal segment I (2 or 3 in *A. dobrotworskyi*). *A. gahn nicola* has similar white patches on scutum to *A. dobrotworskyi*, but usually has only a few bronzy scales linking them rather than the fairly extensive golden scales in *A. dobrotworskyi*; it also usually has a basal pale area on Cu (rarely present in *dobrotworskyi*) and usually lacks the median basal patch on several tergites.

**Male terminalia:** *A. dobrotworskyi* is distinguished by lack of a specialized seta at base of coxite, and by the style and scale patch. It is intermediate between *A. gahn nicola* and *A. alocasicola* both in number of scales in the scale patch (1–3 in *A. gahn nicola*, 4–6 in *A. dobrotworskyi*, 7–10 in *A. alocasicola*) and in the extent to which the style is expanded.

**Larva:** The combination of head setae 4 (d), 5–10 branched, and 6 (B), 3 or 4 branched distinguish it from *A. kochi* and *A. josephinae*. The stout pointed comb spines with 4–8 short lateral denticles on basal third distinguish it from *A. alocasicola* and *A. gahn nicola*, whose comb spines lack denticles, but have a fine lateral fringe near base, and from *A. wallacei*, whose comb spines are slender with 2 or 3 lateral denticles.

**Pupa:** Distinguished from *A. josephinae* and *A. wallacei* by the presence of seta 8 on segment VII, from *A. kochi* by having seta 7 on segment VIII 3–5 branched, from *A. alocasicola* by lack of a distinct pigmentation pattern, and from *A. gahn nicola* by uniform pigmentation of the trumpets.

**Holotype Male:** Wing length 2·9 mm.

**Head:** Clothed with flat scales with some narrow in midline at vertex and nape, and along eye margin; white and creamy scaled with large submedian and small lateral dark patches; upright forked scales
dark. Torus dark with flat pale scales mesially, some flat dark scales on first flagellar segment; verticillate hairs of antenna dark, lying in a vertical plane. Palp 1.1 times length of proboscis, dark scaled with 3 white bands on shaft; a basal white patch on segment IV; a basal white band and apical patch on V; some long hairs at apex of shaft, in outer and inner rows along IV and at apex of V. Proboscis slightly longer than fore femur, dark scaled with an indistinct median dorsal pale streak about 0.2 its length and small pale dorsal patch at apex; labella dark.

Thorax: Integument dark, posterior half of scutum and scutellum lighter brown. Scutum clothed with narrow curved scales, mainly golden; a large patch of dark scales on fossa, smaller patches in front of wing root, and in centre of scutum; small patches of white scales on anterolateral and scutal angles, submesially behind scutal angle, above wing root and round prescutellar bare area (where most of the scales are broad); bristles long, dark, about 8 acrostichal, 6 dorsocentral, and 7 prescutellar. Scutellum with flat creamy scales on all lobes, some white at base of mid lobe; 4 long bristles to mid lobe and 3 to lateral lobes. Ppn with broad white scales and some dark along upper margin; broad white scales form a more or less continuous band across apn, subspiracular area, upper stp, and upper half of msp, and also occur on propleuron, lower stp, paratergite, and both below and on prealar knob; 3 or 4 postspiracular bristles; one bristle arising in upper stp scale patch, and on one side, one above the patch.

Legs: Coxae with black and white scales. Femora black scaled with 5-7 pale (mainly white) bands or patches and pale knesspot and with a tuft of outstanding dark scales ventrally at apex. Tibiae with 6-9 white bands or patches; tarsal segment I with basal, median, and apical white bands; fore tarsal segment II with basal 0.8 dark, III and IV dark, V white; mid tarsal segment II with basal 0.7 dark, III-V as on fore leg; hind tarsus with basal 0.6 I and III dark, IV dark, V white. Claws as in A. josephinae.

Wings: Pale areas small; C with basal, humeral (on one wing), sector, subcostal and apical pale areas; Sc with sector and apical; R1 with humeral, sector, accessory sector, subcostal and apical; small pale areas at apices of remaining veins, at forks, crossveins, and base of An. Cell R2 2 times length of its stem; cell M1 equal in length to its stem, their bases level; r-m 3 times its own length distal to base of M3+4. Halteres pale, knob black scaled with a few pale scales at its base.

Abdomen: Tergite I dark scaled with a few pale scales at base mesially and white scales on lateral margin. Tergites II-VII dark scaled, with basal median and large paired preapical submedian creamy patches (all on II and the preapical on III and IV incompletely separated), and with preapical lateral white patches extending towards base on some segments. Sternites dark scaled, with basal lateral white patches and creamy and white scales mesially; V-VII with outstanding dark scales apically; tergite and sternite VIII creamy and white scaled, with dark scales mesially at apex.

Terminalia (Fig. 2a; described from holotype and 3 paratypes): Coxite dark scaled, 3 times as long as broad, with a membranous area along its inner aspect. Sternal to this area, at 0.6 length of coxite.
is a row of 4–6 rather slender pointed scales, of which the distal one may be 0·3 length of coxite, or all may be short with 2 strong setae arising in line with and distal to them; just tergal to the scale tuft is a dense patch of fine straight setae; just tergal to the membranous area there are numerous short fine setae on proximal half of coxite (no specialized seta), and about 16–20 longer mesially directed setae in 2 or 3 rows on distal half with some fine setae at apex; there is a row of 4 or 5 moderately long setae tergally and several long setae laterally and at apex. Style about half length of coxite, moderately expanded on basal two-thirds, narrowing apically with 1 or 2 short preapical setae; appendage terminal, slender, curved, with rounded tip, 0·5 length of style. Harpago 0·3 length of coxite, slender, with a short preapical seta; appendage 1·2 times length of harpago, slender, with slight membranous expansion and tapering to a fine curved tip. Paraproct with a single tooth. Phallosome simple, with expanded and flattened apex. Lobe of tergite IX with 1–3 setae; sternite IX with almost straight distal margin, slightly concave in mid-line, and with 2 setae.

**Paratype Males:** Among 3 male paratypes the following differences occur. Wing length 2·3–3·0 mm.; submedian dark patches on head small, a few upright forked scales pale; dorsal streak on proboscis extending over middle third; scutum with white median patch on anterior margin, and with small dark patches on fossae or with more extensive dark scales replacing the golden, which mainly occur adjacent to the white patches; white scales only on mid lobe of scutellum; ppn with some creamy scales near upper margin; no basal white patch on fore tarsal segment I; R$_1$ with prehumeral and M and Cu with basal pale areas; cell R$_2$ 2·5, and cell M, 1·2 times length of their stems; base of cell M, proximal to that of cell R$_5$; haltere with a few pale scales at apex of knob; tergite I creamy scaled, II–V with the dorsal patches fused into large median rectangular pale patches reaching nearly to apex.

**Females:** The allotype and 25 paratype females show the following differences from males. Wing length 2·5–3·3 mm.

Head: Torus light brown; verticillate hairs of antenna short, dark; palp 0·20–0·25 length of proboscis, with large white patch at apex and occasionally a small white patch at mid-length; proboscis a little shorter than fore femur, with median white band 0·2–0·3 its length, and small apical white band.

Thorax: Scutum with white patches as in male, linked by a variable amount of golden scaling, but with at least a golden patch behind scutal angle, and in front of prescutellar bare area; the median and lateral white patches on anterior border may be confluent; there is usually a pair of diagonal golden lines running from the anterolateral white patches to mid-length of scutum, terminating between the acrostichal and dorsocestral bristles, but linked by a short horizontal line; lateral lobe of scutellum sometimes with a few dark scales at apex; 1–4 postspiracular bristles.

Legs: Basal 0·7–0·8 fore tarsal segment II and 0·5–0·7 mid tarsal II dark; rarely some pale scales at apex of mid tarsal III; hind
tarsus rarely with a white patch between the basal and median bands on I, basal 0·5–0·6 II and III dark. Claws equal; fore and mid toothed, hind simple.

Wing: C usually only with basal, sector, subcostal, and apical pale areas, rarely a small humeral; R₄ usually without prehumeral pale area; base of Cu₁ usually dark (2 paratypes have a small basal pale area on both wings, and 5 have it on one wing only); base of An sometimes dark; cell R₂ 2·0–3·1 and cell M₁ 1·1–1·5 times length of their stems; r-m 2–3 times its own length distal to base of M₃₊.

Abdomen: Tergite I with variable amount of dark and pale scaling mesially, frequently all dark; II–VII usually with the dorsal pale patches well separated; the basal median patch may be very small and may be absent on VI; II–VII with a line of white scales extending from base along lateral border, curving dorsally preapically and sometimes recuring forwards on V–VII, or VI and VII with preapical lateral patches only; VIII with a large basal white patch. Outstanding scales may not be obvious at apex of sternite V; sternite VIII with variable amount of dark and pale scaling; some pale scales on cerci.

An additional 21 females from various localities, not used for the paratype series because of damage or discoloration, fell within the above range of variation, except that wing length of one was 2·3 mm, and one specimen lacked a white spot at the base of cell R₂ on one wing.

Larvae (Fig. 2 b–f): Length 5·2–6·7 mm.; head, siphon, and saddle light brown; thorax and abdomen with stellate setae.

Head: About as long as broad. Antenna 0·26–0·31 length of head, 5 times as long as broad, straight, smooth; seta 1 arising at 0·7–0·8, bifid, simple; terminal and subterminal setae arising close together; seta 2 moderately long; setae 3–6 short. Head seta 1 3 or 4 branched; setae 4, 6, 7 arising in a line curved towards anterior margin of head, their bases about equal distances apart; seta 5 arising behind 7 and in line with 6; seta 4 5–10 branched, simple or frayed; seta 5 single, simple or frayed; seta 6 3 or 4 branched, frayed; seta 7 10–15 branched, frayed, stellate; seta 8 bifid; seta 9 2–4 branched; seta 10 single; seta 11 18–30 branched, strong, stellate; seta 12 bifid; seta 13 single or bifid; seta 14 14–22 branched, stellate; seta 15 2–5 branched. Mentum with median tooth and 9 or 10 pointed lateral teeth.

Thorax: Prothorax—seta 0 9–15 branched; setae 1–3 arising close together; 1 13–20 branched, stellate; 2 long, single; 3 17–24 branched, stellate; setae 9–13 arising from a rounded base; seta 9 12 or 13 branched, stellate; seta 10 shorter, 9–11 branched, stellate; seta 11 bifid, short, fine; seta 12 long, single. Mesothorax—setae 9–12 arising from a prominent base bearing a short spine; seta 9 long, 5–8 branched; setae 10, 12 long, single; seta 11 shorter, 5–11 branched, stellate. Metathorax—form of setae 9–11 and their base similar to those of mesothorax; seta 9 5–7 branched; seta 10 single; seta 11 5–7 branched; seta 12 medium length, single.

Abdomen: Seta 6 on segments I–VI and seta 7 on segments I and II long, frayed. Seta 6 on segment I 3–5 branched, on II 2–5 branched, on III bifid or trifid, on IV and V bifid, on VI bifid or trifid; seta 7 on segment I single, on segment II single or bifid. Segment VIII—seta 1
16–22 branched, frayed, stellate; setae 2, 4 single, simple; seta 3 2–5 branched, frayed; seta 5 17–24 branched, frayed, stellate. Lateral comb a triangular patch of about 60–75 teeth arranged in 4 rows. In the distal row there are 14–18 stout spines, about 75–90 μ in length, each with 4–8 fine sharp lateral denticles on basal third; the remaining comb teeth are pointed fringed scales, those of the second row are 0·7 length and the remainder 0·3 length of the distal teeth.

Siphon pilose; acus present; index 2·9–3·3; pecten extending to 0·37–0·51 length of siphon, of 7–9 broad spines with a fine fringe and sometimes a denticle on proximal edge. Seta 1 2–4 branched, frayed, arising at 0·47–0·53 length of siphon; seta 2 short, single; setae 6, 8 long (about equal to diameter of tip of siphon), single.

Anal segment—saddle covering 0·6–0·7 of segment, finely pilose, with 7 or 8 long slender spines on its distal margin above seta 1 and 3–6 below it; these spines are pointed and usually fringed on basal half; seta 1 long, 4–8 branched; seta 2 2–4 branched; seta 3 single; seta 4 (ventral brush) of 10 tufts, 2–4 branched; no grid. Anal papillae unequal, the upper 1·3–1·9 times length of lower, and 1·0–1·5 times length of saddle.

Description based on 2 larval skins, one associated with the allotype and one with a paratype, 5 morphotype larvae, and two incomplete topotypical larvae.

_PUPAE_ (Fig. 2 g, h): There is no distinct colour pattern; the cephalothorax behind the trumpets, the metanotum, and abdominal segments I–IV are slightly darkened.

_Cephalothorax:_ Trumpet evenly pigmented, 3 times as long as greatest width, with oblique opening; ratio of meatus to whole 1:1·25; apical notch shallow. Seta 1 strongly developed, bifid; setae 2, 3 single or bifid; seta 4 2–5 branched; seta 5 single or bifid; seta 6 single; seta 7 bifid; seta 8 single or bifid; seta 9 bifid; seta 10 2 or 3 branched; seta 11 single; seta 12 3–6 branched.

_Abdomen:_ Seta 2 on segments I–VII and seta 7 on I–VI are single. Segment I—seta 1 strongly developed with many frayed branches; seta 3 single; seta 4 single or bifid; seta 5 2–4 branched; seta 6 single; seta 10 single or bifid. Segment II—seta 1 single to trifid; seta 3 single; setae 4, 5 single or bifid; seta 6 single; seta 7 arises level with or slightly posterior to seta 6; seta 10 2–4 branched; there is a small single seta, possibly seta 11, ventrally in one specimen. Segment III—seta 1 single to trifid; seta 3 single; seta 4 single to trifid; seta 5 single or bifid; seta 6 single; setae 8, 10 single or bifid; seta 11 single; seta 12 bifid. Segment IV—setae 1 and 4 single or bifid; setae 3, 5 bifid; seta 6 single; seta 8 single or bifid; setae 10, 12 bifid; seta 11 single. Segment V—setae 1, 4 single; seta 3 single to trifid; seta 5 bifid; seta 6 single or bifid; seta 8 2 or 3 branched; seta 10 2–4 branched; seta 11 single; seta 12 single or bifid. Segment VI—seta 1 single; seta 3 single or bifid; seta 4 1–4 branched, further divided near tip; seta 5 single to trifid, its tip frayed or divided; seta 6 single; setae 8, 10 single or bifid; setae 11, 12 single. Segment VII—seta 1 single to trifid; setae 3–5 single; seta 6 single or bifid; seta 7 bifid, long, stout, frayed; seta 8 dorsal, arising well forward, single or bifid; setae 10, 12 single; seta 11 single or bifid. Segment VIII—seta 5 single or bifid; seta 7 3–5
Text-fig. 2.
branched, plumose, slightly more than half length of paddles. Paddles ovoid with finely denticulate margin; breadth index 1.7–1.9; buttress and midrib moderately developed; seta 1 single.

Described from two pupal skins associated with the allotype and one paratype, and one morphotype pupa.

**Biology:** Mr. Dobrotworsky has furnished the following information—lures were collected from leaf bases of sword grass (*Gahnia* sp.); females are day-biting and usually prefer to bite the face in the same way as *Tripteroides* do; at Noojee adults were taken along a river in swamy bush with large patches of sword grass. Mr. Douglas took adults biting man, 4–7 p.m. in scrub at Tidal River, and 4 p.m. at Kalinna.

**Types:** Holotype male (P.1686), allotype female, 1 male and 2 female paratypes (allotype, P. 1684, and one paratype female, P.1685, each with associated larval (damaged) and pupal skins) reared from axils of sword grass, Barham Valley, Apollo Bay, Otway, Victoria (5.xii.1956, N. V. Dobrotworsky). Paratypes: 2 males and 23 females from the following localities in Victoria—3 females, Tarago River, Drouin West (1.iv.1953, A Neboiss); 5 females, Noojee, 15 m. N. of Drouin (14.xi.1957, N. V. Dobrotworsky); 1 male, 7 females, Tidal River, Wilson’s Promontory (2.iii.1953, G. W. Douglas); 1 male, Kalinna, East Gippsland (4.iii.1953, N. V. Dobrotworsky); 6 females, Kalinna (5.iii.1953, G. W. Douglas); 2 females, Cabbage Tree Creek, near Orbost (22.ii.1956, N. V. Dobrotworsky). Morphotypes: 5 larvae and 1 pupa, same date as holotype.

Holotype, allotype, 1 male and 8 female paratypes, 2 morphotype larvae, 1 morphotype pupa in University of Queensland; 1 male and 8 female paratypes, 2 morphotype larvae in National Museum of Victoria; 1 male, 3 female paratypes, 1 morphotype larva in C.S.I.R.O., Division of Entomology, Canberra; 2 female paratypes in School of Public Health and Tropical Medicine, Sydney, British Museum (Natural History), and U.S. National Museum, Washington.

This species is named after Mr. N. V. Dobrotworsky, in appreciation of his researches on Australian mosquitoes and his generous co-operation with the writer in this and other studies.

**Distribution:** This species has been found only in southern Victoria, from Apollo Bay, about 95 m. S.W. to Cabbage Tree Creek, 200 m. E. of Melbourne. In addition to the localities listed above, specimens have been examined from Christmas Hills, about 30 m. N.E. of Melbourne (27.ii.1952, D. L. McIntosh). The record from Tidal River, 39°17’S. 146°20’E. is the highest latitude at which any member of the *kochi* group has been taken.

**Discussion:** *A. dobrotworskyi* is closely related to *A. gahnicola* and *A. alocasicola*, differing to a greater degree from other members of the *kochi* group. Following on the discussion in Marks (1947) on relationships within the group suggested by the form of the distal lateral comb teeth, the presence of distinct basal denticles on the comb.
teeth of *A. dobrotworskyi* might indicate that it is nearer to the ancestral stock of the group than *A. gahnicola* and *A. alocasicoala*, which have only a basal fringe on the comb teeth. These two species could have developed in a northward migration after isolation of the parent form in the south of the continent. Laird (1957) suggested that the development of pointed spines in the distal row of comb teeth of species of the *kochi* group and the development of lateral denticles on these teeth are both specializations from a more generalized type of comb tooth, the fringed scale. He pointed out that *A. freycinetae* Laird from Fiji and *A. lutus* Ludlow (illustrated as *A. flavipennis* (Giles) in Marks (1947) ) from Philippine Is. have the distal comb teeth apically fringed, and without lateral denticles, in accord with the general tendency for the more primitive representatives of animal groups to be found towards the periphery of the zone of dispersal. *A. dobrotworskyi* does not accord with this tendency, if Laird is correct, and it has more specialized comb teeth than its nearest relatives.

**Aedes (Finlaya) wallacei** Edwards

Descriptive Notes: Two females from Cape York Peninsula agree with females from New Guinea identified as *A. wallacei*, and differ from *A. josephinæ* in the following characters: Mid tarsal segment I with 5 or 6 dorsal pale patches, which run together making it entirely pale ventrally, (occurs in only some New Guinea specimens); II with patch on apical 0.5, or smaller apical patch with 1 or 2 patches proximal to it; III with a distinct white apical patch; ratio of pale areas on C to preceding dark spots—sector, 0.7–1.15; subcostal, 0.5 (0.8–1.1 and 0.55–0.65 respectively in 5 New Guinea females); tergites II–VII with pale apical border (not in some New Guinea specimens); tergite VIII with distinct basal median pale patch; sternites pale scaled mesially except at apex (only on VI and VII in one New Guinea specimen).

Biology: Specimens were taken biting in rain-forest, 2.15–3.00 p.m., and near an over-grown water course, 4.30–6.00 p.m.


**Aedes (Finlaya) alocasicoala** Marks

Descriptive Notes: Two males from Yarraman have wing length 3.4 mm. Males from Yarraman (no females were seen) and both sexes from Barrington Tops show variable, but more extensive, pale sealing on apical half of wing than previously described. Along the lower edge of R₁ the subcostal pale area may be rather indefinitely extended distally; there may be a few pale scales precapically or extensive mottling on R₂, R₃, R₄₊₅, M₁, and M₂, or R₄₊₅ may be almost entirely pale. Some of these specimens would run to *A. bougainvillensis* Marks in Marks’ (1947) key. In addition, among Barrington Tops specimens, fore tarsal segment I may lack a sub-basal pale patch; mid tarsal segment III may have pale scales at apex; and female may have pale apical border on tergites II–VII.
Biology: This species was seen breeding in axils of cunjevoi (Alocasia macrorrhiza), growing in rain-forest at all the localities listed below except Yarraman, where it was in a drier rain-forest dominated by hoop-pine (Araucaria cunninghamii) at a site kept moist by underground springs.

Distribution: Queensland—Tamborine Mt. (xi.1956), Kinnane’s Creek (2.xi.1952), Cunningham’s Gap (5.v.1947), Bolderty Park, 5 m. from Cooyar (20.iv.1957), Yarraman (20.iv.1957), E. N. Marks. New South Wales—Williams River Valley, Barrington Tops, about 25 m. N.W. of Dungog, 1250 ft. (29.iii.1948, B. McMillan). This is the first record outside south-east Queensland.

Aedes (Finlaya) gahnicola Marks

Descriptive Notes: A female from Beerwah has wing length 2.9 mm., and one from Mountain Creek has a couple of dark scales on lateral lobe of scutellum. Pale area occasionally absent from base of Cu and An. Sternites may have fairly extensive dark scaling including a median stripe, or be similar to A. dobrotworskyi.

A larva from Bribie I. has head seta 4 (d) 9 branched, 6 (B) 5 branched.

Biology: Specimens were observed breeding at base of leaf axils of Gahnia sieberiana at Beerwah, and Gahnia sp. at Bribie I.; biting on heath by day, Lake Cootharaba; at 10 a.m. in rain-forest, Mountain Creek; 3.30–5.50 p.m. in rain-forest, Noosa; 3 p.m. in semi-tropical forest, Sarina; just after dusk, in open eucalypt forest, Stony Creek.

Horsfall (1955,p.464) misquoted the records of Marks (1947) in stating that the larvae occur in coastal swamps among bases of swordgrass. They have in fact been found only in leaf axils of Gahnia and (once) Pandanus.

Distribution: Bribie I. (6.x.1948, 15.ix.1956), Beerwah (17.ix.1955), Mountain Creek, Buderim Mt. (23.xi.1952), Noosa (16.iii.1956), Lake Cootharaba (18.iv.1954), E. N. Marks. Kinross Park, Maleny (24.iv.1945, J. L. Wassell). These localities are all within the previously recorded range from Dunwich to Bundaberg. A. gahnicola is now recorded from central Queensland—Stony Creek, 30 m. S.W. of Sarina (10.xii.1954, E. N. Marks), and Sarina (3.vi.1956, I. C. Yeo).

Aedes (Finlaya) kochi (Dönitz)

Descriptive Notes: In two females from The Crater the pale scales of the scutum are pale golden; in two others reared from the same lot of larvae, they are the normal white.

Biology: A new plant record as a breeding site of A. kochi is Australian wild turmeric (Curcuma australasica). Larvae were collected from the bases of flower bracts of plants growing among and shaded by dense long grass on Moa I.; associated with them were larvae of Harpagomyia genurostris Leicester and Uranotaenia diagonalis Brug. On Darnley I., along a swampy shaded creek, a patch of cunjevoi (Alocasia macrorrhiza) adjoined a patch of taro (Colocasia antiquorum). In the cunjevoi leaf axils was a mixed population of A. kochi and Harpagomyia spp. larvae, A. kochi predominating; from one large taro
plant about five yards from the cunjevoi, over 100 *Harpagomyia* spp. larvae were collected, but no *A. kochi*. (*H. genurostris* and *H. leei* Wharton were reared from pooled samples from the cunjevoi and taro). Other records from leaf axils of plants are from cunjevoi at The Crater and on Murray I., from *Crinum* at Mackay, and from *Pandanus* at Palm I., Etty Bay, Coen, Lockhart River Mission (from both low-growing plants and trees), and Badu I.

*A. kochi* has been taken biting man in the bush along creeks or near swamps at most of the localities listed at various times from 3 p.m. to 9.45 p.m., but most commonly at dusk or after; at Townsville it was taken biting horses at night. On Murray I. a collection, between 6 and 7 p.m., of mosquitoes biting a native man, woman, and five children on the verandah of their house comprised 491 *A. kochi* and fifteen specimens of other species. On the following day only three females and two males of *A. kochi* were collected on sheets when this and neighbouring houses were sprayed with DDT. There were many potential breeding places for *A. kochi* in proximity to this village, and in such conditions it might be important as a vector of filariasis.


**References**


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