

A NEW SPECIES OF *Aedes* (*Ochlerotatus*) FROM TREE HOLES IN
SOUTHERN ARIZONA AND A DISCUSSION OF THE *VARIPALPUS*
COMPLEX (DIPTERA: CULICIDAE)¹

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In August 1955 the junior author collected a small number of biting females and reared three females and one male of what appeared to be the common western tree-hole mosquito, *Aedes varipalpus* (Coquillett, 1902), in the Santa Rita Mountains, Santa Cruz County, Arizona. Examination of this material by the senior author revealed that this form represents an undescribed species so remarkably similar to *varipalpus* in general facies that it had been reported as the latter species by Dyar (1922:86) from the Santa Catalina Mts. in Arizona. Apparently the same species was found by Ross (1943:86) in Baja California, Mexico. The discovery of this mosquito throws some light on the relationships of *Aedes varipalpus* and suggests that other forms exist in this complex. We are presenting at this time a detailed description of the new species together with a discussion of the complex, in order to call attention to the involved problem, with the full realization that its solution cannot be accomplished without much additional material. The descriptive terminology used is that of Belkin (1953a) except for corrections in the nomenclature of the larval and pupal chaetotaxy (Belkin, 1953b).

We are indebted to Dr. Alan Stone and the U. S. National Museum (USNM) and to Dr. E. S. Ross and the California Academy of Sciences (CAS) for the loan of specimens on which the above-mentioned literature records are based. For additional material we wish to thank Dr. R. M. Bohart, University of California, Davis (UCD), and Dr. G. D. Butler, Jr., University of Arizona, Tucson (Univ. Ariz.). Finally we are grateful to Mr. Charles L. Hogue for the drawings of thoracic scale patterns.

Aedes (*Ochlerotatus*) *monticola*

Belkin & McDonald, n. sp.

Aedes varipalpus, Dyar, H. G., 1922. U. S. Nat. Mus., Proc. 62: 86 (In part).
Aedes varipalpus, Ross, E. S., 1943. Pan-Pacific Ent. 19: 86.

DIAGNOSIS

FEMALE.—General facies as in *A. "varipalpus"*, Auct.² (as described by Carpenter and La Casse, 1955:257), from which it can immedi-

ately be distinguished by the presence of a large postcoxal tuft of white scales, the absence of a basal white ring on the fourth hind tarsal segment, the presence of several lower mesepimeral hairs and more extensive white scaling on the pleura. *Wing* about 2.75–4.0 mm. *Proboscis* dark-scaled, usually a few white scales at base ventrally. *Palpus* about 0.25 of proboscis; dark; apex and two bands white. *Vertex* with median white stripe, submedian dark spots, lateral white patches and ventrolateral dark areas; vertical and occipital erect scales numerous and extensive, white on median stripe, dark on submedian. *Antenna* with dark integument; torus and first flagellar segment each with a median patch of white scales. *Scutum* with dark integument; a broad median stripe of golden scales extending to middle; a pair of patches of golden scales on fossa and anterior supraalar area; anterior and lateral margins with patches and more or less continuous lines of pure white scales; a single median posterior acrostichal and a pair of dorso-central patches of pure white scales; prescutellar space bordered with white scales; yellowish scales in curved line mesad from scutal angle and straight line caudad from dorsocentral patches; remainder with bronzy scales with purplish reflections. *Scutellum* with large patches of pure white, broad, curved scales. *Pleuron* with large patches of pure white, decumbent, semi-erect or erect scales; *ppn* in addition with a few dark scales; no hypostigial scale patch; large scale tuft on postcoxal area; *lme* with scale patch extending to lower eighth; metameron with small scale patch; bristles and hairs light and numerous, on *ppn* predominantly dark; several light *lme* hairs. *Paratergite* white-scaled. *Wing* dark-scaled except for small patch of white scales at base of C; scales linear on dorsum of R_2+3 , R_2 and R_3 , narrow on R_s , M and 1A, broad elsewhere on dorsum; a small patch of dark scales at base of 1A ventrally. *Haltere* light-scaled. *Legs* generally bronzy black with purplish reflections and with pure white areas as below: conspicuous white knee spots; femora speckled with white anteriorly and extensively white posteriorly, with basal and apical white rings; tibiae with broad basal ring and small apical patch of white scales; fore and mid tarsus with broad basal and apical white rings on segment 1, and a broad apical white ring or dorsal patch (fore tarsus) on segment 2; hind tarsus with broad basal and apical

¹Accepted for publication May 2, 1956.

²See "Addendum", p. 191. This species should be called *A. sierrensis* (Ludlow, 1905).

white rings on segment 1, broad apical white rings on 2 and 3, segment 4 usually entirely dark, segment 5 entirely white. *Abdomen* largely bronzy black with purplish reflections on tergites and with posteriorly curved basal bands and connected lateral basal patches of pure white scales; a few apical white scales, more numerous on caudal segments and forming complete apical bands at least on segments 6 and 7; tergite 1 white in middle and laterally; laterotergite white-scaled; sternites predominantly white-scaled on basal segments, and dark-scaled on distal; segment 8 completely retractile.

MALE.—Distinguished from the very similar *A. "varipalpus"*, Auct. by the same characters as the female. Coloration in general as in the female. *Proboscis* with a white-scaled ventral streak to middle and a submedian white ring. *Palpus* slightly longer than proboscis; segment 1 with broad and segment 3 with narrow apical white bands; segment 2 entirely dark; segment 4 with basal white ring and a few apical white scales; segment 5 with broad basal white ring. *Antenna* with penultimate segment about as long as 6 preceding segments, apical about 0.77 of penultimate. *Abdomen* with basal tergal white bands straight and extending all the way to sides; no apical light scales on tergites.

MALE GENITALIA.—Conspicuously different from *A. "varipalpus"*, Auct. (as figured and described in Carpenter & La Casse, 1956:258). Sidepiece without apical lobe; basal lobe small but distinct, bearing one long differentiated apically curved seta and several smaller bristles; no short median bristles as in "*varipalpus*." Clasper about 0.5 sidepiece, swollen before middle, strongly curved on apex; spine about 0.3 clasper length, slender. Claspette stem length 8.0 median width, slightly and uniformly curved; filament about 1.1 stem, cylindrical at base, expanded and flattened beyond middle, apex attenuated and sharply curved.

PUPA.—Generally as in *A. "varipalpus"* from California but readily distinguished by uniform light bright yellowish pigmentation, less distinct integumentary sculpturing, much broader paddle, shorter cercus and details of chaetotaxy. Trumpet uniformly bright yellowish brown; index 5.0; tracheoid distinct. Paddle index 1.4; external margin rather uniformly curved; mesal part wider than outer. Hairs strongly pigmented, mostly single or with a few branches. Abdominal hair 2 on segments III–VII usually external to or in line with hair 1, at least not conspicuously mesal; hair 5 far removed from caudal border on segments IV–VI, strongest hair on these segments; hair 3 strongest hair on segments II and III; hair 7 strongest hair on segment VII; hair 1 single, weak and inconspicuous on segments III–VII. Cercus broad, prominent, with convex external margin.

LARVA.—Very similar to *A. "varipalpus"*, Auct. (as described and figured in Carpenter and La Casse, 1955:258–9), from which it can be distinguished by the shorter and broader antenna, shorter siphon, the absence of hair 11 on abdominal segment 1, fewer branches in hairs 1–II–VII, and other details of chaetotaxy. *Antenna* smooth; about 0.4 of head capsule; index about 7.0; hair 1–A at about 0.64 from base, length about 0.5 of antenna. *Head hairs*: 4(7; 5–10), 5(1; occasionally barbed), 6(1; 1–3), 7(4; 3–7). *Prothoracic hairs*: 1(2, 3), 2(1), 3(2), 4(2; 1–2), 5(2; 2–3), 6(1), 7(3, 2, 4). *Abdominal hairs*: 11–1 absent, 6–I–III(2; rarely 3), 6–IV, V(2), 6–VI(1, 2), 1–I(3–6), 1–II–VII(2, 3; 2–4). *Comb scales* (10–20) in a single, partial double or triple irregular row; individual scale in middle of caudal row narrow, elongate, more or less parallel-sided to apex, with lateral and apical fringes. *Siphon*: index about 3.0 or less; strong concavity on basal ventral surface; pigmentation very dark, sculpturing indistinct; pecten teeth (9–16) evenly spaced in basal 0.3, individual tooth with subbasal spines; hair 1(3) in basal 0.4, not distinctly barbed. *Anal segment*: saddle brown, extending only about halfway around segment; hair 1(2; 1–4; branches uneven, longest about 3.2 saddle length), 2(3; 2–3; about 3.6–5.2 saddle length), 3(1; about 6.0 saddle length), 4a–d on grid, 4a(1), 4b(1; 1–2), 4c(2, 1), 4d(2–4), 4e(2; 2–3), 4f(1; 1–3); anal gills subequal, about 3.5 saddle length.

DESCRIPTION

FEMALE.—Wing: 2.75–4.0 mm. Abdomen: 1.9–3.0 mm. Proboscis (labium and labella): 1.75–2.4 mm. Front femur: 1.3–2.0 mm. Specimens examined: 22.

Head: Integument black throughout (dark brown in old specimens); eyes rather widely separated on the frons. Vertex (occiput in terminology of Carpenter and La Casse, 1955) with a median patch of rather broad, apically pointed, curved, pure white, decumbent scales, arranged on edge and appearing linear from above, continued as a dense patch on frons below; a narrow orbital line of short, broad, flat, pure white scales, expanding into a patch of similar but larger decumbent scales laterad, no orbital line of scales below this patch; a pair of submedian dark areas with sparse scaling, anteriorly scales are narrow, curved, decumbent, rather dense and bronzy black with purplish iridescence, posteriorly scales are pure white, linear, decumbent and rather numerous on occiput where they join the median white patch and longer, broader, curved, semi-erect and scattered toward middle of vertex; postgena with a patch of short, broad, flat bronzy black scales below lateral white patch of vertex, followed by similar pure white scales below; erect forked scales of vertex numerous and rather short, white on median patch, black

on submedian dark areas, rather uniformly distributed from occiput to orbital bristles except for anteromedian triangular area from which they are absent; 2 or 3 pairs of light orbital bristles on white median patch of vertex, median pair developed as frontals; 4 dark orbital bristles near anterior border of each submedian dark area of vertex, bristles far removed from orbital border; 5 dark orbital bristles on each postgenal area with at least 1 additional bristle below. Clypeus bare. Palpus about 0.25 of proboscis; all segments without scales on ventral surface; palpifer completely without scales; segment 1 immovably joined to palpifer, with dark scales and usually at least a few white ones on apex; segments 2 and 3 united, dark-scaled at base and with a large apical white band; segment 4 (long segment) dark-scaled at base and white on apical third, a few scattered white scales also present before apex; segment 5 minute, not visible except in slide preparations, hidden by white scales of 4; dark scales bronzy black with purplish reflections, white scales pure white; bristles short, dark. Labium uniformly and smoothly covered with small bronzy black scales with purplish iridescence, usually at least a few pure white or whitish scales ventrally near basal bristles, often a conspicuous patch of such scales, occasionally a few white or whitish scales elsewhere on ventral surface; labella with dark integument and a few small dark scales at base dorsally. Antenna slightly shorter than proboscis; integument black or dark brown throughout except for lighter membranes; torus (pedicel) with conspicuous patch of small pure white, broad scales on mesal surface, particularly toward dorsal apex; mesal surface of first flagellar segment with a conspicuous patch of similar scales; about 6 long bristles in each flagellar whorl; last three flagellar segments subequal to each other and to more basal segments.

Thorax: Scutal integument uniformly black or dark brown except for lighter postalar margin and scutal angle; a striking but rather variable scale pattern, usually as in Figure 1a; scales of three general colors; dark scales bronzy black with purplish iridescence, occupying most of the dark areas in the figure except for bare prescutellar space but most conspicuous on anterior part of fossa, posterior dorsocentral and prescutellar line where they are rather short, broadened, curved and decumbent, and in the supraalar area where they are long, linear, straight and appressed; light scales pure white or golden, with some intermediate yellowish ones; white scales generally broad, apically pointed, curved and decumbent but more linear, straighter, appressed ones also present; anterior promontory and humeral angles with conspicuous patches of broad white scales in line respectively with acrostichal and dorsocentral bristles; from humeral patches a more or less continuous curved lateral line of white scales

to scutal angle where a patch of white scales is formed; a conspicuous patch of narrow white scales just laterad of dorsocentral line at level of paratergite, this patch (dorsocentral) more or less connected to scutal angle patch by whitish or yellowish scales; a patch of white scales on

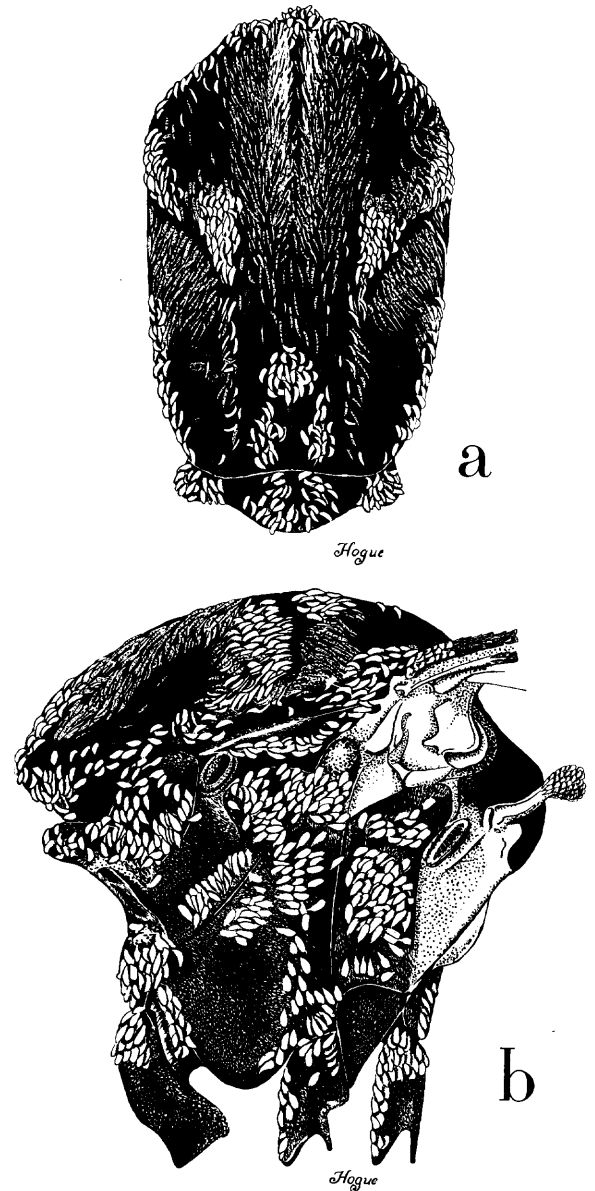


FIG. 1. Thoracic scale ornamentation of adult female of *Aedes monticola*, n. sp.: bristles not shown. a, Dorsal aspect of mesothorax. b, Left lateral aspect of entire thorax.

antealar space, scales largely outstanding, some linear, others broadened and curved, a few broad white scales extending into supraalar area; a conspicuous median patch of broad white scales at caudal end of acrostichal line in front of

prescutellar space; lateral borders of prescutellar bare space, mesad of prescutellar lines, with broad curved white scales, these mesoprescutellar lines often not extending all the way cephalad; a narrow interrupted line of broad whitish or yellowish scales laterad of posterior dorsocentrals and prescutellars, more or less connected to dorsocentral patch and often abbreviated caudally; golden scales generally narrower and straighter than white ones, forming a large conspicuous anterior median stripe between dorsocentral bristles from cephalic margin of scutum to slightly beyond its middle, usually a number of white or whitish scales on anterior portion of this stripe extending from anterior acrostichal white scale patch; a small patch of golden scales in posterior part of fossa; a conspicuous and characteristic patch of golden scales between dorsocentrals and supraalars at level of paratergite; acrostichal bristles well developed, light on anterior promontory and for a short distance caudad where white scales predominate, remainder dark; dorsocentrals larger than acrostichals, light on humeral angles, remainder dark, merging caudad with dark prescutellars; a more or less regular row of strong dark presuturals extending laterocaudad from humerals; usually 2 to 4 dark transverse bristles between presuturals and dorsocentrals near caudal end of fossa; supraalars dark, strongly developed. Scutellum dark brown; lobes with conspicuous patches of broad, pointed, curved decumbent pure white scales; each lobe with about 6 long dark bristles and 4 or more smaller lighter bristles. Postnotum dark brown. Pleural integument brown to dark brown, lighter around anterior spiracle, under wing base, entire metapleuron and membranous areas; vestiture of pure white scales as in Figure 1b, scales predominantly decumbent, semi-erect or erect and at least slightly curved, giving a shaggy appearance to pleuron, all scales broad, some rounded apically, others pointed; in addition some dark scales similar to those on scutum present on upper part of *ppn* in the white-scaled patch and cephalad; *apn* with 9 or 10 dark bristles on upper part and with 1 or more dark bristles and up to 20 light hairs and bristles on lower part; *ppn* with about 6 dark bristles in a more or less regular row, caudad or ventrad of which usually 4 or more light bristles, 1 or 2 light or dark bristles some distance cephalad on disc of *ppn*; *ppl* (propleuron, proepisternum) with 20 or more light bristles and hairs; *pst* (prosternum) with a pair of large lateral white-scaled patches, continuous with patches of *ppl*, some of the scales appear to arise in membrane anterior to fore coxa, others from lateral margin of *pst*, which also bears 4 or more light hairs; *pcx* (postcoxal area, membrane caudad of fore coxa) with a very conspicuous tuft of elongate white scales; *plr* (paratergite) with semi-erect and erect scales along outer border and below; *psp* (postspiracular

area) with 10 or more light hairs, semi-erect curved scales among hairs, a separate patch of flat scales above; *ssp* (subspiracular area) with long patch of appressed scales; *pra* (prealar area) with about 20 light hairs and 1 or 2 linear erect scales on knob, a patch of appressed scales below knob; *stp* (sternopleuron) with bristles and hairs all light, a more or less regular longitudinal row of about 6 bristles at upper end of scale patch followed ventrally by numerous scattered light hairs on caudal third or fourth of sclerite down to lower margin, scales in this area erect, at middle just below transverse row of bristles scales are semi-erect and reach anterior border of sclerite, this patch is continued ventrocephalad parallel to anterior margin but not reaching it, scales in this area decumbent; *ume* (upper mesepimeral area) with 30 or more light hairs and small patch of erect scales below hairs; *lme* (lower mesepimeral area) with a very extensive patch of scales continued at least to lower eighth of sclerite, cephalo-dorsal part of patch ruffled and usually with 4 or 5 small light *lme* hairs, caudal part of patch with scales decumbent; *mtm* (metameron, meteu-sternum) with small flat patch of scales; all other sclerites and membranes without scales, bristles or hairs. Haltere yellowish at base and stem, white-scaled on upper part of stem and knob.

Wing: Venation normal; distance between crossveins slightly more than length of *m-cu*. Scales all dark, except for small patch of white scales at extreme base of C and occasional light scales at base of R; scales linear on dorsal surface of $R_2 + 3$, R_2 and R_3 , narrow on R_4 (except at base) and 1A (except at base), broad on dorsal surface of other veins; a small but conspicuous patch of dark scales on base of 1A on ventral surface; bristles on stem vein (base of R) very short, barely projecting beyond scales. Fringe rather light on posterior border, whitish near base; border scales of fringe and alula dark.

Legs: Coxae and trochanters with brown or dark brown integument, membranes lighter. Fore coxa with decumbent pure white scales covering anteromesal and anterior surfaces except for a variable number of dark scales near middle, scaled area bounded laterally by an irregular row of dark bristles from middle of anterior margin of coxa down along anterior margin of articular membrane of trochanter to mesal surface; numerous scattered light bristles and hairs basad of dark bristles and on scale patch mesad; outer surface largely bare, white scales in small tuft at base continuous with anteromesal scales, a small white, decumbent scale patch on apical third (free portion of coxa) preceding a row of short bristles and a few dark and white narrow scales along posterior margin of trochanterial membrane to prosteroapical margin of coxa. Mid coxa with white scaling on anteromesal surface as on fore coxa except that it extends on to outer surface so that the more regular, dark and light boundary

bristles are about one-third from anterior margin; dark scales absent; light bristles and hairs restricted to base; outer surface with only the basal tuft of white scales; posterior margin bare except for a few elongate dark scales and very small bristles. Hind coxa with a dense patch of white decumbent scales at base on outer surface, extending slightly to anterior surface and prolonged ventrally as an irregular streak along anterior margin to apex, near middle of streak a triangular projection of streak to anterior surface; a few short dark bristles on apex of anterior margin; a large bare space on outer surface caudad of scale streak followed by dark and light boundary bristles which are near posterior margin; posterior surface with a few light hairs, mostly in basal half, and a few light scales at base. Trochanters with mixed white and dark, small, appressed scales except for bare external (dorsal) articular surface. Femora all with narrow basal and apical rings; all largely dark-scaled on dorsal margin (fore femur speckled with white); anterior surface of fore femur largely dark-scaled, a narrow, irregular white streak from base to near apex along ventral margin; mid and hind femora dark-scaled on anterior surface and ventral margin but speckled with white scales which are more numerous proximad; posterior surface of fore femur largely white-scaled, speckled with dark scales which are more numerous distad; mid and hind femora with posterior surfaces largely white-scaled in basal half, dark-scaled distad but with some white scales, more on mid femur; dark scales bronzy black with purplish reflections, white scales pure white; bristles largely white. Tibiae dark-scaled except for broad basal ring and small apical patch of white scales; scale and bristle coloration as on femora. Fore tarsus with broad basal and apical white rings on segment 1, a broader white apical dorsal patch on segment 2, remainder dark-scaled; mid tarsus similar to fore tarsus except that on segment 2 dorsal patch is now an incomplete or complete ring and segment 5 is somewhat lighter; hind tarsus with very broad basal and apical white rings on segment 1 (white scaling occupying almost half of segment), segments 2 and 3 with broad apical rings (white scaling occupying about one-third of segments), segment 4 entirely dark-scaled or rarely with a few white scales dorsally near base or apex, segment 5 entirely white-scaled, remainder dark-scaled; scale and bristle coloration as on femora. Fore claws subequal, slightly curved, with slender tooth in basal third; mid claws subequal, somewhat larger, more curved, with slender tooth in basal third; hind claws subequal, simple.

Abdomen. Tergite 1 sparsely scaled, central area with variable number of white scales in the middle and dark scales on the sides, lateral areas with scattered white scales, laterotergite with dense patch of white scales; tergites 2-6 densely

covered with bronzy black scales with purplish reflections, pure white scales forming rather narrow, curved basal bands which are narrowed laterad and joined to large lateral white-scaled, square or rectangular, basal patches, a few apical white scales on 2, becoming more numerous on caudal segments and forming a complete band on at least tergite 6, sometimes also 5; tergite 7 without distinct dorsal basal band but with lateral basal patches and a broad apical white band; tergite 8 completely retractile. Sternite 2 white-scaled; sternites 3 and 4 largely white-scaled and with apicolateral dark patches, 3 sometimes completely white; 5 and 6 with more extensive subapical dark patches, on 6 these form a continuous subapical dark band followed by narrow apical light band; 7 white in the middle, dark laterad; extent of dark and light scaling extremely variable. Abdominal bristles numerous, small, all light.

MALE (173-104, *Holotype*).—Wing (exclusive of fringe): 3.1 mm. Proboscis: 2.2 mm. Front Femur: 1.7 mm.

Generally very similar to female. A white-scaled streak covering entire ventral basal 0.48 of proboscis and extending dorsad to form a white ring at 0.33 to 0.48 of proboscis. Palpus slightly longer than proboscis; scaling bronzy black with purplish reflections and pure white; segments 1-3 unscaled ventrally, 4 and 5 completely scaled; segment 1 with broad dorsal apical white band; segment 2 entirely dark; segment 3 not articulated with 2, widened apically and curved up, a few short hairs subapically, a narrow dorsal apical white band; segments 4 and 5 broadened, turned down, with a small number of long dark bristles; segment 4 with basal white ring and scattered white scales apically; segment 5 with broad basal white ring. Antenna slightly shorter than proboscis; basal flagellar segments short and wide; penultimate very slender, about as long as 6 preceding segments, with dense whorl of bristles near base and sparse short hairs beyond; apical slender, about 0.77 of penultimate, with whorl of 6 bristles near base and with numerous short hairs beyond; flagellar whorls with 30 or more long bristles projecting mostly dorsad and ventrad, longest bristles about 0.5 of flagellar length. Fore and mid claws enlarged, unequal, slender, moderately curved, all with slender sub-basal tooth; hind claws subequal, simple. Abdominal tergite 1 without white scales in center; segments 2-5 with basal white bands straight, basal lateral white spots absent but bands a little wider at these points; no apical light scales or bands; other segments not seen. Abdominal sternite 2 as in female; 3 and 4 white-scaled and with apical lateral dark patches; 5 with basal lateral white patches, remainder dark-scaled other segments not seen.

MALE GENITALIA (173-104, *Holotype*).—As in Figure 2a. Ninth tergite displaced in

mount, interlobar space apparently less than width of one lobe; lobe broader than long, bearing 7 or 8 spines. Proctiger with tenth sternite strongly sclerotized and heavily pigmented on hooked apical portion, 3 small setae laterally; tenth tergite unsclerotized. Sidepiece (basistyle) about 4.0 as long as width at middle, uniformly spiculate including mesal membrane; mesal two-thirds of dorsal surface with short slender hairs at base, hairs longer and heavier toward apex, mesal dorsal margin bare except for a few short slender hairs on apical 0.25; outer third of dorsal surface, external and ventral surfaces with usual strong bristles and scales, mesal ventral margin with moderately heavy, long bristles from base to apex. Apical lobe completely absent. Basal lobe moderately prominent, separated by distal and basal membranes; dorsal surface with one long, strong differentiated seta with strongly curved apex, projecting mesad and followed ventrally by one or more strong attenuated bristles; remainder of apex with numerous short, weak hairs, more numerous and prominent on ventral surface. Clasper (dististyle) including claw slightly more than 0.5 of sidepiece; swollen before middle, apex strongly curved; spiculate on mesal and dorsal surfaces except at base, one to three small setae near apex; spine (claw) slightly less than third of clasper body, deeply inserted on apex, very slender, nearly straight and uniform in width, apex slightly attenuated, apical membrane very small. Claspette stem very slightly and uniformly curved, gradually and slightly narrowed apically, length about 8.0 median width; dorsal mesal surface very sparsely short-spiculate, ventral mesal more extensively long-spiculate, 4 to 6 short setae on ventral mesal margin near base; filament about 1.1 stem, cylindrical at base, strongly expanded and flattened beyond middle, gradually attenuated and then sharply recurved at apex. Mesosome simple; length about 2.0 basal width in dorsal aspect; poorly sclerotized except at base, dorsally and laterally; apex broad, smooth, simple, slightly truncate. Other structures not clear in mount.

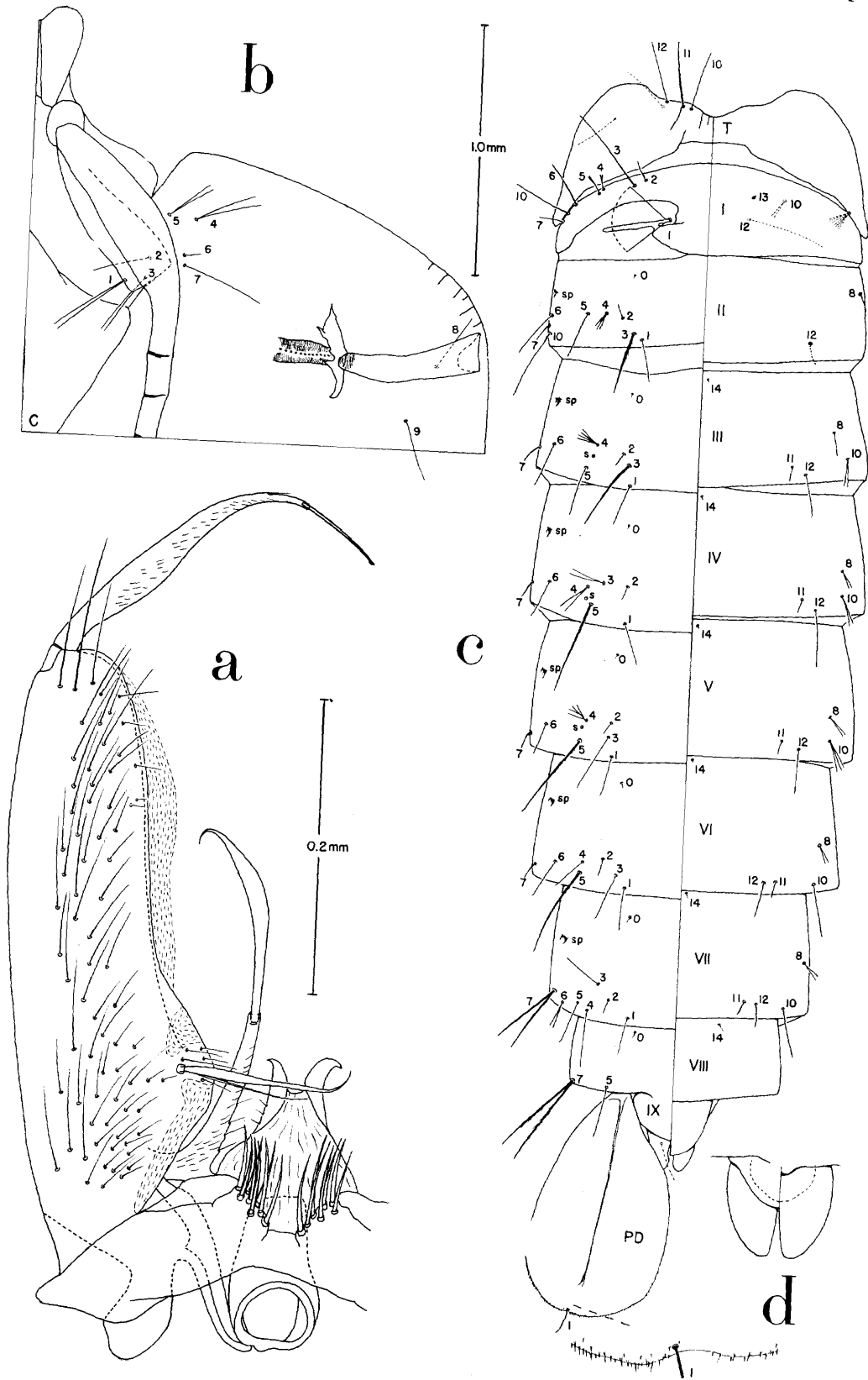
PUPA.—Abdomen: 3.4(♂)—4.0(♀) mm. Trumpet: 0.55(♂)—0.65(♀) mm. Paddle: 0.92(♂)—1.0(♀) mm. Specimens examined: 2♂, 3♀.

Cephalothorax (Figure 2b, c): Uniformly light yellowish except for narrow blackish middorsal area on caudal part of mesonotum; metanotum darkened except laterally. Trumpet uniformly bright yellowish brown except for blackish tracheoid; length about 5.0 median width; gradually widened from tracheoid to apex; inner wall distinctly separated except in pinna; tracheoid extending to about 0.15–0.20; reticulate with regular imbrications, without conspicuous spicules; pinna about 0.25. All hairs darkly pigmented but small and inconspicuous, simple; relative position, length, and degree of develop-

ment as figured. Hairs: 1(2, 1; 1–3), 2(1; 1–2), 3(2, 1), 4(2; 1–2), 5(2; 2–5), 6(1, 2), 7(1, 2; 1–3), 8(1; 1–2), 9(1; duplicated in one specimen), 10(1; 1–2), 11(1), 12(1; 1–2). Two additional dorsal hairs, one near 12, the other laterally, occasionally present; a stellate tuft present in one specimen at base of haltere case (possibly homolog of 13T of larva); a small branched hair present in one specimen underneath mesothoracic wing case.

Abdomen (Figure 2c): Uniformly light bright yellowish brown except for blackish anterior median dorsal portion of segment 1 and darkened intersegmental areas (including middle of anterior border of tergites and sternites 2–7); integumentary reticulation and spiculation inconspicuous. Hairs darkly pigmented, strongly contrasting with integument; relative position, length and degree of development as figured; hair 1 weak, generally single, except on segments I and II; hair 2 on segments III–VII external to hair 1 except on III, where it is usually in line with 1; hairs simple and generally unbranched except as noted, when branched usually some distance from base. Segment I: hair 1 (dendritic tuft; usually 32–34d; one 62–68), 2(1, 2), 4(2; 1–2), 5(2–4; 2–7), 6(1, 2; 1–5), 10(1, 2; 1–3); three additional hairs occasionally present on sternite, a mesal peg, a long hair at level of 1, and a shorter (sometimes branched) hair laterad of level of 1, probably homologs of 13, 12 and 10 respectively of the larva. Segment II: hair 0(1; 1–2), 1(1, 2), 3(1; 1–2), 4(3, 4; 3–5), 5(1; 1–3), 6(1; 1–2), 8(1; 1–2); hair 12 occasionally present. Segment III: hair 0(1; 1–2), 4(2–4), 5(1; 1–2), 6(1; 1–2), 8(1, 2; 1–3), 10(2, 3; 2–4), 14(1–2); dorsal sensillum variable in position. Segment IV: hair 3(2), 4(2, 3; 1–3), 6(1; 1–2), 8(2, 1), 10(2; 1–3); dorsal sensillum variable in position. Segment V: hair 4(4, 3; 3–6), 8(2; 1–2), 10(3, 2; 1–4), 14(1; 1–2); dorsal sensillum variable in position. Segment VI: hair 2(1; 1–2), 6(1; 1–2), 8(2, 1). Segment VII: hair 2(1; 1–2), 4(1; 1–3), 6(1, 2), 7(1; 1–2), 8(1–3), 14(1; 1–2). Segment VIII: hair 7(2, 3), 14(1; 1–2). Segment IX: extending to about 0.22 of paddle; hair 1 absent. Paddle as figured: uniformly pigmented a light bright yellowish brown except for darker brown midrib and base of external buttress, basal pigment bar present or absent; length about 1.4 median width; midrib strongly sclerotized, evanescent apically; external buttress indistinct; external margin serrations starting at about 0.5, more prominent

FIG. 2. Male and pupa of *Aedes monticola*, n. sp. *a*, Dorsal (morphologically) aspect of male genitalia, large lateral setae and scales of sidepiece not shown. *b*, Ventral aspect of left anterior portion of cephalothorax. *c*, Dorsal (left) and ventral (right) aspect of metanotum and abdomen of female pupa, with enlarged detail of apex of paddle. *d*, Same aspect of apex of abdomen of male pupa.



apically, arranged in two or three incomplete dorsal rows on apex, teeth slender, sharply pointed; internal margin with similar serrations; apex of paddle emerginate in area of hair 1, usually few or no serrations in this notch mesad of hair 1; hair 1(1, 2; 1-4). Female genital lobe (Figure 2c) extending to slightly less than 0.3 of paddle, without integumentary spiculation; anal segment not separated from genital lobe; cercal sclerites prominent, broad, with convex external margin, extending slightly beyond apex of genital lobe (in one specimen each cercus with a long simple hair). Male genital lobe (Figure 2d) extending to slightly less than 0.5 of paddle, without integumentary spiculations, apex of side-piece broadly rounded; anal segment almost as long as segment IX, about 0.55 as wide as latter at base.

LARVA.—Head: 0.8–0.95 mm. Siphon: 0.8–0.95 mm. Anal saddle: about 0.28 mm. Specimens examined: 5.

Head (Figure 3b): Width about 1.1 of length; integument light yellowish brown, darkened anteriorly and posteriorly; ocular areas lighter; sculpturing indistinct. Labrum very short, anterior margin very slightly convex. Mental plate small, with 14 to 20 teeth. Maxillary sutures conspicuous, strongly divergent, continued dorsolaterad beyond posterior tentorial pits. Hairs of head capsule strongly pigmented, conspicuous; relative position, length and degree of development as figured. Hair 0 (not seen), 1 (1; occasionally split on apex, quite heavy), 2 (absent), 3 (1; slender), 4(7; 5–10), 5(1; occasionally barbed), 6(1; 1–3), 7(4; 3–7), 8(1; 1–2), 9(2; 1–2), 10(2; 1–2), 11(5–13), 12(1), 13(2, 3; 1–4), 14(1), 15(2–5). Antenna about 0.4 of head, slightly curved and gradually and slightly narrowed to apex, length about 7.0 or less median width; uniformly light yellowish brown; shaft smooth, spicules not developed. Antennal hairs with same pigmentation as shaft except for transparent apex of 5-A; all unbranched; 1-A at about 0.64 from base, length about 0.5 of antenna; basal sense organ very inconspicuous, in basal membrane.

Thorax (Figure 3b): All hairs very strongly pigmented; tubercles brown, present only at base of hairs 9–12-P, 5-M, 6–7-M, 8-M, 9–12-M, 7-T, 9–12-T; apices of long hairs attenuated; long hairs with short barbs largely near base; relative position, length and degree of development as figured. Prothorax: hair 0(7, 6; 5–8), 1(2, 3), 2(1), 3(2), 4(2; 1–2), 5(2; 2–3), 6(1), 7(2–4), 8(5, 6; 5–7), 9(1, 2), 10(1), 11(2, 3; 1–3), 12(1), 14(2; 2–3). Mesothorax: hair 1(2), 2(1; 1–2), 3(1), 4(1, 2), 5(1; 1–2), 6(3; 3–5), 7(1), 8(7, 6; 5–7), 9(4–6), 10(1), 11(1, 2), 12(1), 13(5–11), 14(3–7). Metathorax: hair 1(3–4; 2–4), 2(1), 3(3, 2), 4(3, 4; 2–4), 5(1; 1–2), 6(1), 7(6–8; 6–9), 8(4–8), 9(4; 4–6), 10(1), 11(1), 12(1), 14(4–6; 4–7).

Abdomen (Figure 3b, c): Hairs strongly pigmented; tubercles absent except 2–3-X; long hairs without barbs except a few on those of caudal segments; relative position, length and degree of development as figured. Hair 11–I absent. Segment I: hair 1(3–6), 2(2), 3(1–2), 4(3–5), 5(2–3; 2–4), 6(2), 7(1), 8(2; 1–2), 10(2), 12(1), 13(2). Segment II: hair 0(1), 1(2–4), 2(1), 3(3–5), 4(1), 5(2, 3; 1–3), 6(2; 2–3), 7(2, 1), 8(2; 1–2); 9–12(1), 13(2–4; 2–5). Segment III: hair 0(1), 1(2; 2–3), 2(1), 3(2; 1–3), 4(1), 5(2, 3; 1–3), 6(2; 2–3), 7(2–3), 8(1; 1–2), 9, 10(1), 11(1, 2), 12(1), 13(2), 14(1), dorsal sensillum present. Segment IV: hair 0(1), 1(2, 3; 2–4), 2(1; 1–2), 3(2, 1; 1–3), 4(1), 5(2, 3), 6(2), 7(3, 2), 8–10(1), 11(1, 2), 12(1), 13(2, 3), 14(1), dorsal sensillum present. Segment V: hair 0(1), 1(2; 2–4), 2(1), 3(2; 2–3), 4(1), 5(2; 2–3), 6(2), 7(2; 2–3), 8(1; 1–2), 9–12(1), 13(2; 2–3), 14(1), dorsal sensillum present. Segment VI: hair 0(1), 1(3, 2), 2–4(1), 5(2; 2–3), 6(1, 2), 7(1), 8(2, 1; 1–3), 9, 10(1), 11(1; 1–2), 12(1), 13(7–9; 5–10), 14(1). Segment VII (Figure 3d): hair 0(1), 1(2–3), 2(1; 1–2), 3(1, 2), 4(1), 5(2), 6(4, 3; 3–5), 7(1), 8(4–6), 9(1, 2; 1–3), 10–12(1), 13(2; 1–3), 14(1). Segment VIII (Figure 3d): comb scales (10–20) in a single, partial double or triple irregular row; those of caudal narrow, elongate, more or less parallel-sided to apex, with lateral and apical fringes; more proximal ones pointed apically and with fringe reduced; hair 0(1), 1(3; 2–3), 2(1), 3(3; 2–5), 4(1), 5(4; 3–5), 14(1). Siphon: as in Figure 3d; length (on dorsal surface) about 3.0 or less median width; characteristic concavity on basal ventral surface and slight submedian swelling; pigmentation uniformly deep blackish brown, sculpturing indistinct; acus strongly developed; pecten extending to about 0.3 of ventral length; teeth (9–16) very dark except for light acute apex, with 2 or more subbasal spines; valves as figured, more lightly and less uniformly pigmented than siphon; hair 1(3), 2–7(1), 8(1–3), 9(1), others not studied. Segment X (Fig. 3d): saddle extending only about halfway around segment, brown except for darker dorsal surface, sculpturing indistinct except apically; gills subequal, broad, sausage-shaped, apically rounded, length about 4.3 median width and about 3.5 saddle length; hair 1(2; 1–4; branches uneven, longest about 3.2 saddle length), 2(3; 2–3; about 3.6–5.2 saddle length), 3(1; about 6.0 saddle length), 4a(1; about 5.3 saddle length), 4b(1; 1–2; about 6.0 saddle length), 4c(2, 1; about 3.7 saddle length), 4d(2–4; about 1.5 saddle length), 4e(2; 2–3; about 0.9 saddle length), 4f(1; 1–3; about 0.5 saddle length); 4d and f basad of grid; no sclerotization laterad of grid.

TYPES

Holotype ♂ (UCLA 173–104) with associated larval and pupal exuviae and genitalia slide,

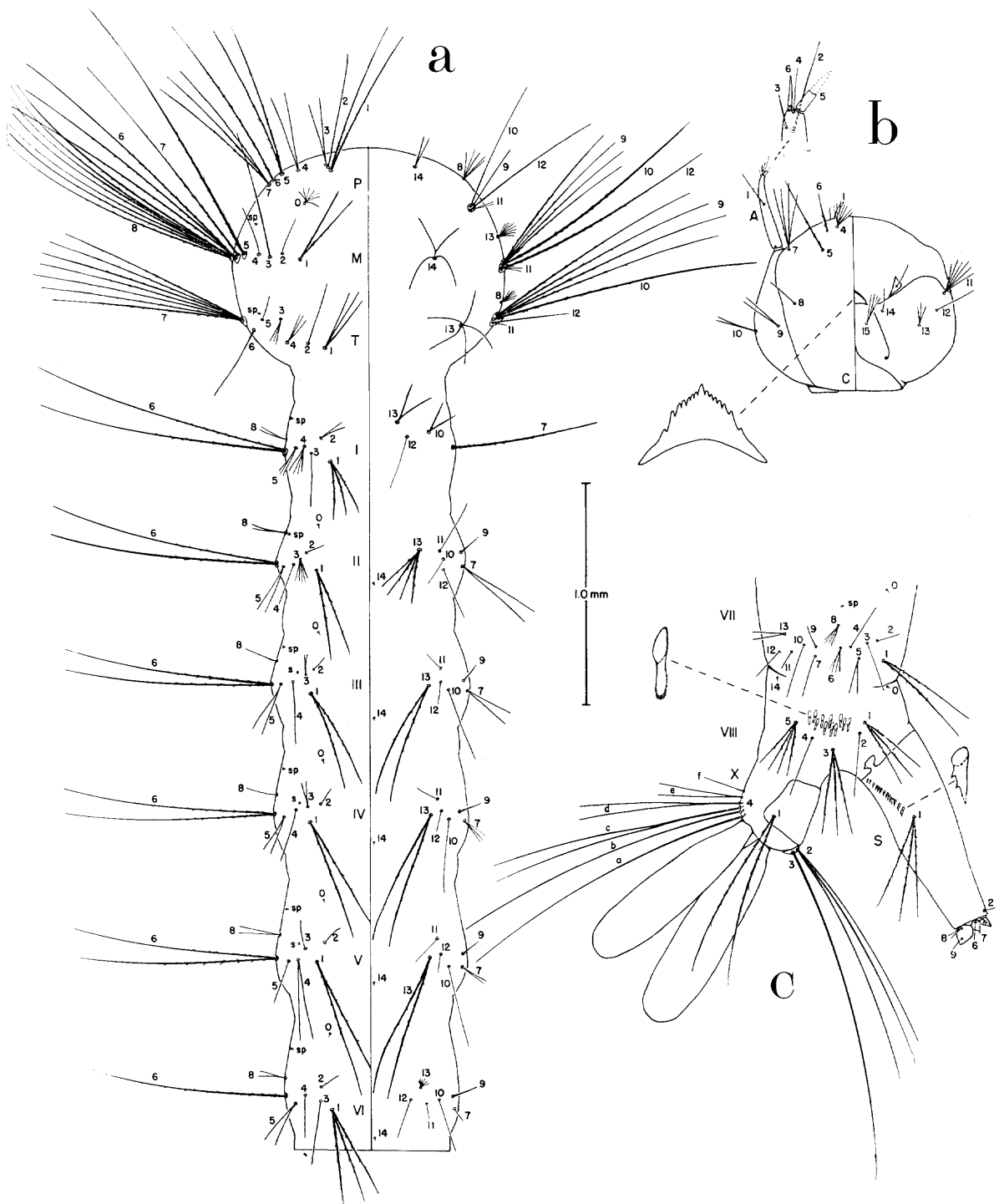


FIG. 3. Fourth instar larva of *Aedes monticola*, n. sp. *a*, Dorsal (left) and ventral (right) aspect of thorax and proximal abdominal segments. *b*, Same aspect of

head, with enlarged details of apex of left antenna and of mental plate. *c*, Left lateral aspect of terminal and proximal abdominal segments.

Madera Canyon, Santa Cruz County, Arizona, elevation ca. 5,000 feet, Aug. 18, 1955, reared from larva collected in rot hole in dead, fallen sycamore trunk (W. A. McDonald) [USNM No. 63244].

Allotype ♀ (UCLA 173-105) with associated pupal exuviae, same data as holotype [USNM].

Paratypes: 2 ♀ (UCLA 173-102, 103) with associated larval and pupal exuviae, 1 whole larva (UCLA 173-101), 1 pupal skin (173-1), same data as holotype; 1 whole larva (UCLA 173-205), same locality, collector and date as holotype but from rot hole in living oak; 14 ♀ (UCLA 170-3), same locality and collector as holotype but collected biting or resting, Aug. 17, 1955 [BMNH, CAS, UCLA]; 1 ♀, Sabino Basin, Santa Catalina Mts., Pima County, Arizona, Aug. 24 (1918) (C. H. T. Townsend) [USNM]; 1 ♀, White House Canyon (Madera Canyon), Santa Rita Mts., Arizona, May 31, 1946 (R. M. Bohart) [UCD]; 1 ♀, Mt. Graham, Pinaleno Mts., Graham Co., Arizona, elev. 7000 feet, July 4, 1940 (S. L. Green) [Univ. Ariz.]; 1 ♀, Santa Rita Mts., Arizona, Oct. 20, 1940 (R. A. Flock) [Univ. Ariz.]; 1 ♀, Chiricahua Mts., Cochise Co., Arizona, June 17, 1937 (R. S. Beal) [Univ. Ariz.].

DISTRIBUTION

ARIZONA. *Graham Co.*: Mt. Graham, Pinaleno Mts. *Cochise Co.*: Chiricahua Mts. *Pima Co.*: Sabino Basin, Santa Catalina Mts. *Santa Cruz Co.*: Santa Rita Mts. (For data see section on Types.)

MEXICO. *Baja California*: La Laguna, Sierra Laguna (Cape Region), elev. 6,200 feet, 2 ♀ biting in pine oak forest (E. S. Ross and G. E. Bohart) [CAS].

VARIATION

The females from Madera Canyon are quite uniform in size and conspicuously larger than the average *A. "varipalpus"*. However, the other females from Arizona exhibit a variation in size comparable to that found in "*varipalpus*." In the Arizona females the mesonotal ornamentation is extremely variable both as regards the coloration and the shape of scales; even the more or less characteristic supraalar golden patch may be practically entirely replaced by dark scales. On the other hand, the broad anterior median golden stripe is quite constant in our small series. The extent of the white scaling as well as the shape of the scales is also quite variable on the pleura and on the head as is also the white speckling of the femora and the white scaling of the abdomen. In its diagnostic characters of the presence of the postcoxal scale patch and the absence of a white ring at the base of hind tarsal segment 4, *monticola* shows absolute separation from "*varipalpus*", Auct.

The two females from Baja California may represent a distinct subspecies of *monticola* but the recognition of a separate taxon must await

much additional material of all stages. These females possess the postcoxal scale patch and lack the white ring at the base of hind tarsal segment 4 as in the typical *monticola* but in other characters of ornamentation they are intermediate between them and "*varipalpus*", Auct. In particular, the anterior median mesonotal golden patch is broken into three lines separated by dark scales and there are fewer and smaller white scales at the anterior end, the supraalar golden patch is apparently lacking, the pleural scaling is not as extensive and there are apparently no lower mesepimeral bristles.

The small number of larvae and pupae, five of each stage, is hardly adequate to evaluate the variability of these stages. However, the diagnostic characters appear to be quite constant. In the pupa there is a remarkably large number of anomalous retentions of larval hairs: four different hairs on the cephalothorax, three on abdominal segment I, one on segment II, and one on the cercus.

BIONOMICS

The immature stages of *monticola* have been collected only twice in the same general locality in Madera Canyon in the Santa Rita Mts., Arizona, at an elevation of about 5,000 feet (McDonald, 1956a). In both cases *A. muelleri* Dyar, 1920 was associated with *monticola*. One collection came from a rot hole in a dead prone sycamore trunk (*monticola* predominating) and the other from a rot hole in a living oak (*muelleri* predominating).

Females of *monticola* bite man readily. Several females were captured while attempting to feed during the late afternoon of August 17, 1955 in the immediate vicinity of the sycamore log mentioned above. Two of these were successfully blooded on the forehead and cheek of the junior author, but died later in the laboratory without producing eggs. Others were found on the inner sides of the rot hole in the sycamore trunk and among the foliage of the still-living stump of the same tree. A single female was attracted to a Coleman lantern set on a white sheet draped over a nearby log during the night of August 19, 1955 (air temperature 21.5°C.; moon two days old). No males were collected in the field.

Ross (1943:86) reported females of *monticola* (as *varipalpus*) biting in a pine-oak forest at an elevation of 6,200 feet on Oct. 14, 1941 at La Laguna, Sierra Laguna (Cape Region), Baja California, Mexico. This locality is "characterized by its Upper Sonoran biota isolated by several hundred miles of desert from comparable environments in the San Pedro Martir Mountains of the north."

No data are available for the other collections from Arizona except for dates and the fact that all were made in mountain areas. Undoubtedly

the females were collected while attempting to feed.

DISCUSSION

Despite its considerable economic importance, the western tree-hole mosquito has never been the object of an intensive taxonomic study. Coquillett (1902:292-3) described *Culex varipalpus* from a single female collected by H. S. Barber at Williams, Arizona. Apparently no additional topotypic material has ever been obtained. In 1904 Coquillett identified males, females and larvae reported by Dyar (1904:40-41) from British Columbia as this species. Ludlow (1905:231-2) described *Taeniorhynchus sierrensis* from several males and females sent from Three Rivers (Tulare County), California and subsequently (Ludlow, 1906:132) synonymized it with *varipalpus*. Since that time the common tree-hole *Aedes* of Western North America has been identified as "*varipalpus*" and has now been reported in literature from British Columbia, Washington, Oregon, California, Nevada, Arizona and Baja California (Carpenter and La Casse, 1955:258; Ross, 1943:86).

With the discovery of *monticola*, it becomes evident that the "*varipalpus*" of authors is actually a complex of two or more sibling species and possibly several subspecies. Following the study of the material from Southern Arizona and its comparison with material from California, it appeared that we might be dealing with two species, one restricted to the Pacific Slope and characterized in the adults by the absence of a postcoxal scale patch and the presence of a white ring at the base of the fourth hind tarsal segment, and the other restricted to the mountains in the interior and characterized by the presence of the scale patch and the absence of the white ring. However, the situation is much more complex. First, the specimens from Baja California possess both diagnostic features of the Southern Arizona form, although they differ in other details. Second, and much more significant, the holotype female of *varipalpus* examined for us by Dr. Stone, lacks both the postcoxal scale patch and the white ring. We have come to the conclusion that *monticola* is a distinct species characterized by the presence of the postcoxal scale patch and that it is represented in Baja California by probably a distinct subspecies. We suspect that the Pacific Slope populations, including the Nevada record from Glenbrook (adjacent to Lake Tahoe), constitute a species distinct from the true *varipalpus* from Central Arizona mountains, and further that they may break up into two or more subspecies, as we find Southern California males exhibiting constant differences from all other California populations we have seen. Solution of this problem must await study of topotypic males, larvae, pupae and additional females, and a comparison of material from the

entire range of "*varipalpus*." It appears to us that this complex is prone to speciation and that additional distinct populations exist in unsuspected areas in Western North America. Dr. D. W. Jenkins (1956, *in lit.*) informs us that he has reared a large number of adults of "*varipalpus*" from larvae collected in cottonwood tree-holes near Hamilton, Montana. This material has not been studied as yet. Should our surmises prove correct, the name *sierrensis* may have to be resurrected for at least some of the populations of the Pacific Slope. For the present, we are using "*varipalpus*" for all the populations of the complex other than *monticola* and the true *varipalpus* from Williams, Ariz.

As indicated in the diagnosis, *monticola* is extremely similar to "*varipalpus*", Auct. (as described and figured in Carpenter & La Casse, 1955:257-9) in most characters of the adults, larvae and pupae and is distinguished from it in these stages by relatively few characters. Since the two forms are tree-hole breeders and are allopatric, it might be considered that they are merely subspecifically distinct. The striking difference in the male genitalia as well as the constancy of the differential characters, particularly the presence of the postcoxal scale patch of the adults, the shape of the pupal paddle, and the absence of hair 11 on abdominal segment I of the larva, lead us to the interpretation that *monticola* is a distinct species. We consider that the similarities with "*varipalpus*" are genetic despite the unexpected male genitalic differences and are not due to convergence developed concomitant to the utilization of similar breeding habitats.

No attempt has been made by American workers in the past to determine the affinities of *Aedes varipalpus*. It has stood as an anomalous element in the mosquito fauna of North America since its description and has been shuffled back and forth among the various subgenera of *Aedes*. Following Edwards (1932:154), *varipalpus* has been placed in *Finlaya*, chiefly on the basis of breeding habitat and some male characters. Knight and Marks (1952:517) removed it from *Finlaya* because of differences in female genitalia but did not assign it to any other subgenus. A search for Old World forms related to *monticola* reveals that the *varipalpus* complex has many similarities, as indicated by Martini (1930:319), with the *Aedes pulchritarsis* complex which occurs in Europe, the Mediterranean area, South Russia and extends into Central Asia, India (Barraud, 1934:150-2) and even into northern Thailand (Thurman, 1956:222). All members of the two complexes, so far as is known, are tree-hole breeders and have a similar type of ornamentation. The male genitalia of *monticola* appear to be very close to those of *A. pulchritarsis* (Rondani, 1872) as figured by Martini (1930:318, fig. 358) and its larva shows some similarities

with that of *A. stegomyia* Stackelberg & Montchadsky, 1926 (Montchadsky, 1926:153, fig. 2). We are convinced that the *varipalpus* complex is the New World offshoot of the *pulchritarsis* complex. On the basis of the simplicity of the male genitalia we may speculate even further that *monticola* represents the relict remnants of the parental stock of the *varipalpus* complex from which the more specialized modern "*varipalpus*" has evolved but, at present, we cannot even guess the relation of the true *varipalpus* to the other forms.

Edwards (1932:141) placed *pulchritarsis* in group E (*dorsalis*) of *Ochlerotatus*, apparently chiefly on the basis of superficial similarity in tarsal ornamentation. We believe that *pulchritarsis*, *varipalpus* and related forms should be recognized as a separate group with a tentative characterization as given by Edwards (1932:141) for the second of the two subgroups he recognized. This *pulchritarsis-varipalpus* group appears to be an ancient one, with a number of isolated relict populations scattered in the Old as well as the New World. Its typical members are tree-hole breeders but it is probable that *A. mariae* (Ed. & Et. Sergent, 1903), which breeds in rock holes, also belongs in the group. There are a number of superficial similarities between this group and some *Finlaya*. It appears to us that these similarities are due to convergence but it is quite possible that the group is close to the stem from which *Finlaya* originated. For the present, we prefer to retain the group in *Ochlerotatus*, pending a much needed revision of this complex subgenus and its various derivatives.

In addition to the *varipalpus* complex, two species of tree-hole breeding *Aedes* have been reported from Western North America, namely *A. muelleri* Dyar, 1920 and *A. purpureipes* Aitken, 1941 (McDonald, 1956a, b). The affinities of both species have been obscure. We find that the male genitalia of these two species are very similar to those of *monticola* (apical lobe undeveloped; basal lobe small or indistinct and with a single differentiated seta) and further that their larvae and pupae share a number of characters with *monticola* (particularly position of hairs 1 and 2 on abdominal segments IV and V of the pupa and absence of hair 11 on segment I of the larva) and differ in these respects from other North American *Aedes*. Although it is quite possible that some of the similarities may be due to convergence, they are so numerous that we believe they are indicative of rather close relationship. *Aedes muelleri* departs from the *varipalpus* complex chiefly in ornamentation of the adults (different mesonotal pattern, entirely dark tarsi) and in the absence of teeth on the fore and mid claws of the female (but not of the male). We would place *muelleri* as an aberrant member of the *pulchritarsis-varipalpus* group despite the toothless claws, for although this character has

not been reported, to our knowledge, in any North American *Ochlerotatus*, it is known in some races of Palaerctic species assigned to this subgenus. On the other hand *purpureipes*, although it has many similarities with this group, is strikingly different in some characters of the larva (spiculose integument, ventral brush, anal gills, etc. . . .) and particularly in the absence of postspiracular bristles in the adults, which also have an entirely different type of ornamentation. It appears to us that this species is probably a derivative of the *pulchritarsis-varipalpus* group. However, its distinctive characters are so unique, at present, among New World *Aedes* that we prefer to leave it in the monotypic subgenus *Kompia*.

We have made no attempt to identify the *pulchritarsis-varipalpus* group in the mosquito fauna of Central and South America but it would seem likely that it is represented in these regions, particularly in montane areas, and that at least some of the tree-hole breeding *Ochlerotatus* reported from the Neotropical region belong to it. Before any changes are made in the subgeneric assignment of this group and its derivatives it will be necessary to examine carefully all such forms.

ADDITIONS TO EXISTING KEYS

To facilitate the recognition of *Aedes monticola* and other known tree-hole breeding *Aedes* of Western North America we present the following modifications and additions to the keys of Carpenter and La Casse (1955), using their terminology and style.

- ADULT FEMALES—p. 139
- 24(23). Palpi entirely dark; scutellum with narrow yellowish scales. . . . **atropalpus** (Coq.), p. 253
Palpi with white bands; scutellum with broad white scales. 24a
- 24a(24). Postcoxal scale tuft present. **monticola** Belk. & McD.
Postcoxal scale tuft absent. 24b
- 24b(24a). Fourth hind tarsal segment dark at base.
. **varipalpus** (Coq.)
Fourth hind tarsal segment with a distinct basal white ring. "**varipalpus**", Auct., p. 257
Note: Females of *purpureipes* and *muelleri* run satisfactorily in the existing keys to couplets 26 and 54 respectively.
- MALE TERMINALIA—p. 141
- 9(8). Basal lobe of basistyle with one or more strong differentiated setae. 9a
Basal lobe of basistyle without strong differentiated setae but with numerous slender hairs. 10
- 9a(9). Basal lobe of basistyle with a dense clump of long strong apically curved setae.
. "**varipalpus**", Auct., p. 257
Basal lobe of basistyle with only one strong seta differentiated. 9b
- 9b(9a). Differentiated seta of basal lobe nearly straight, not sharply curved nor hooked on apex; basal lobe hardly differentiated but with extensive area covered with numerous short, weak hairs.
. **purpureipes** Aitken, p. 220

- Differentiated seta of basal lobe sharply curved or hooked on apex; basal lobe moderately prominent and with a smaller area covered with few hairs of different sizes.....9c
- 9c(9b). Differentiated seta of basal lobe strongly attenuated and sharply curved on apex; claspette filament sharply attenuated and abruptly curved on apex; lobes of ninth tergite each with seven or more strong setae.....*monticola* Belk. & McD.
- Differentiated seta of basal lobe not strongly attenuated but abruptly hooked on apex; claspette filament gradually attenuated and without abrupt curvature on apex; lobes of ninth tergite each with two to four strong setae.....*muelleri* Dyar
- Note: Male terminalia of *varipalpus* (Coq.) undescribed.

LARVAE (FOURTH INSTAR)—p. 146

- 40(39). Integument of thorax and abdomen strongly spiculate.....*purpureipes* Aitken, p. 220
- Integument of thorax and abdomen smooth.....40a
- 40a(40). Long hairs of ventral brush of anal segment multiple, usually with four branches; anal gills markedly unequal, ventral pair smaller, dorsal pair rarely more than twice as long as the saddle of the anal segment.....41
- Long hairs of ventral brush usually single or double; anal gills subequal, at least two and one-half times as long as the saddle.....41a
- 41a(40a). Individual comb scale elongated into an unfringed spine; most caudal hair of ventral brush (4a) a short multiple tuft.....*muelleri* Dyar
- Individual comb scale broadly rounded and fringed on apex; most caudal hair of ventral brush long and single.....41b
- 41b(41a). Hair 11 of first abdominal segment present....."varipalpus", Auct., p. 258
- Hair 11 of first abdominal segment absent.....*monticola* Belk. & McD.
- Note: Larva of *varipalpus* (Coq.) undescribed.

ADDENDUM

In August 1956 we were fortunate in obtaining all stages and in making individual rearings of 20 males and 22 females of *A. varipalpus* from the type locality of Williams, Arizona. Although this material has not been studied in detail as yet and will be fully described at a later date, we should like to indicate at this time the outstanding characteristics of *varipalpus* so that the necessary corrections can be made in the text and keys of this paper. As we surmised, *varipalpus* Coq. is a species distinct from both *monticola* and the "varipalpus" of the Pacific Slope, which now should be called *Aedes (O.) sierrensis* (Ludlow, 1905). In most respects *varipalpus* is closer to *monticola* than to *sierrensis*. The male genitalia of the first two species are similar and conspicuously different from those of *sierrensis* in the presence of only one differentiated bristle instead of a clump of many stout bristles on the basal lobe of the sidepiece. *A. varipalpus* differs from *monticola*, however, in the presence of numerous long slender bristles, instead of 1 or

2, ventrad of the differentiated bristle of the basal lobe and in addition has a differently shaped claspette filament. Adults of both sexes of *varipalpus* can be told from the other two known species by the presence of several light bristles among the scales of the subspiracular patch, a very unusual character not reported previously for any mosquito to our knowledge. The coloration of the fourth hind tarsal segment of *varipalpus* is variable, some specimens showing a very narrow basal pale ring, others a slight dorsal pale patch but never a broad basal pale ring as in *sierrensis*. The larva of *varipalpus* is similar to that of *monticola* in lacking hair 11-I but differs from it in details of chaetotaxy, shape of siphon and length of anal gills. The pupal stage has not been studied as yet.

It is of interest to note that we also found *varipalpus* in the Hualpai Mts., an isolated range near Kingman, Ariz., some 100 airline miles west of Williams. In both areas *varipalpus* larvae were scarce and were associated with those of *Aedes muelleri*, the latter species being dominant at Williams.

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AN EXPLORATORY INVESTIGATION OF THE EFFECT IN VIVO AND IN VITRO OF COCKROACH TISSUES ON THE VIABILITY OF NEWCASTLE DISEASE VIRUS¹

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Some microorganisms which are pathogenic to higher animals exhibit pathogenicity to insects also, whereas a number of non-pathogenic organisms are quite virulent for insects. However, as a group, insects in general have a relatively high natural immunity to most organisms which are pathogenic to higher animals. Moreover, the rate of immunization is extremely rapid for insects, usually being accomplished within 24 hours after injection of the antigen. For these reasons the prospects of employing insects in virus studies appear to offer great promise. Although considerable research has been conducted on the polyhedral diseases which affect many insects, and on the rickettsial and viral diseases of which insects are the known or suspected vectors, there has been very little investigation of the effects of insects on the viability of foreign viruses.

As early as 1922, Macfie observed that cockroaches could ingest pathogenic bacteria and subsequently excrete these in a viable condition, thus suggesting the possibility of the role of roaches as disease carriers. Wedberg and Clarke (1947) devised a method for the quantitative measurement of the possible role of insects in the transmission of diseases through infected excreta. This appears to have given impetus to research along such lines; for shortly after, it was shown (Mackerras and Mackerras, 1948; Mackerras and Pope, 1948; Olson and Rueger, 1950) that the cockroach was able to excrete viable *Salmonella* for a period of at least 5 days following ingestion of the infectious agent.

Syverton and Fischer (1950) demonstrated that the cockroach is capable of harboring intracorporeally for at least 7 days the virus of spontaneous mouse encephalomyelitis and that during this period it excreted daily dosages sufficient to kill test mice. Hurlbut (1950) injected poliomyelitis virus into the haemocoel of the American roach and found that the virus remained viable for at least 15 days. Fischer and Syverton (1951) showed that roaches fed a single dose of

Coxsackie virus were capable of excreting daily over a period of as many as 15 days sufficient virus to kill test mice.

It is possible that the passage of certain viruses through insects will alter the properties of the virus, and if so, such technique would have important widespread application. On the one hand insects may prove to be satisfactory culture media for virus, or they may have an inhibitory effect on the growth of certain disease agents. In view of the dearth of information concerning this it appears extremely worthwhile to make preliminary studies. Newcastle was selected as the agent because of its ease of handling, and facile characterization. The American cockroach (*Periplaneta americana* L.) was chosen as the subject for reasons of availability, size, and available information on physiology and biochemistry of the species.

MATERIALS AND METHODS

Virus Strain Used. The virus employed in these tests was the California strain of Newcastle, No. NC 194-5-6-7, and unless otherwise specified was obtained January 7, 1952. This culture was filtered through a Berkefeld January 12, 1952.

Inoculation of Chicken Embryos. Unless otherwise stated all inoculations were made into the allantoic cavity of 9- to 10 day-old developing chicken embryos (white leghorn) according to the procedure described by Beaudette *et al.* (1952). Two-tenths cc. of inoculum was employed in each instance.

Injection of Roaches with Virus. Both sexes of the adult (6 to 7 months old) American cockroach were employed in these studies. Each insect received 0.05 cc. of the virus preparation by means of a micro-injection apparatus which has been previously described. To facilitate handling, the insects were anesthetized with CO₂ prior to injection. The treated insects were then placed in containers which were specially designed for the facile collection of feces (described further on).

Feeding Virus to Roaches. Individuals of both sexes were fed 0.03 or 0.05 cc. of the virus preparation using the same micro-injection apparatus employed in the injection studies. In this case, however, the insects were not anesthetized, but were held in a relatively quiescent position while feeding.

Collection of Feces. To facilitate the collection

¹Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey, Department of Entomology. Accepted for publication April 19, 1956.

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