

## BITING MIDGES OF THE GENUS *CULICOIDES* FROM NEW GUINEA (Diptera: Ceratopogonidae)<sup>1</sup>

By Masaaki Tokunaga

LABORATORY OF ENTOMOLOGY, KYOTO PREFECTURAL UNIVERSITY,  
KYOTO, JAPAN

A preliminary study of New Guinea Ceratopogonidae was made in 1959 (Tokunaga, *Pac. Ins.* 1: 177-313). Later, intensive collecting was done with light traps. Numerous biting midges were sent by Dr. J. J. H. Szent-Ivany, Department of Agriculture, Stock and Fisheries, Port Moresby, New Guinea and Mr. L. Smee, Lowlands Agricultural Experiment Station, Keravat, New Britain. In the previous paper 30 species of the genus *Culicoides* were listed, with descriptions of 25 species. This paper corrects and supplements the previous list with new materials, including 392 slide-specimens and presents 26 additional species of the genus *Culicoides*, including 16 new species. Thus there are at least 56 New Guinea species of the genus, excluding 2 unexamined species (*Culicoides xanthoceras* Kieffer and Macfie's *C.* sp. near *mollis* Edwards).

Almost all species were mounted in Gater's solution. Morphological terms used in this paper are adopted from my papers on Japanese *Culicoides* (1937, *Tenthredo* 1) and on Micronesian Ceratopogonidae (1959, *Ins. Micron.* 12) and other modern taxonomic studies of the family by Wirth (1952, *Univ. Calif. Pub. Ent.* 9), Wirth & Hubert (1959, *Pac. Ins.* 1), Wirth & Blanton (1959, *U. S. Nat. Mus., Proc.* 109) and Arnaud (1956, *Microent.* 21).

Most of the material, including types, is deposited in Bishop Museum. Paratypes and duplicates, when available, will be deposited in the School of Public Health of the University of Sydney, Australia, the U. S. National Museum, Washington, the Department of Public Health, Port Moresby, New Guinea and my collection.

Abbreviations used in this paper are as follows: AR is antennal ratio showing combined length of distal 5 segments X-XIV to that of basal preceding 8 segments II-IX taken together. PR is maxillary palpal ratio showing length of palpal segment III to width of broadest part of segment. RL is relative length measured by an ocular micrometer under magnification of 150 (1 unit of which is 0.013 mm) in case of wings, wing veins, proboscis, head-capsules and leg segments and under magnification of 600 (1 unit of which is 0.003 mm) in case of antennae, maxillary palpi, spermathecae and ♂ hypopygia. RL-8A is relative length of 8 distal antennal segments VII-XIV (Arabic numeral prefixed before A shows number of distal antennal segments). RL-L is relative length of leg segments, except for coxa

1. Contribution from the Laboratory of Entomology, Kyoto Prefectural University, No. 73. Supported in part by a USPHS research grant (E-1723) to Bishop Museum from the National Institute of Allergy and Infectious Diseases, Nat. Institutes of Health.

and trochanter. RL-P is relative length of 5 segments of maxillary palpus. RL-V is relative length of wing veins R, M, stem of fMCu, R<sub>1</sub> and Rs. TR is tarsal ratio showing relative length of tarsal segment I to II. W is width of broadest part measured perpendicular to long axis. Roman numerals show ordinal number of segments of antennae, palpi, tarsi, etc. and, in the case of wing, first and second radial cell and first to third costal pale or dark spot or band.

I am indebted to Dr. J. L. Gressitt of Bishop Museum for financial and other help which made this study possible. I am also much indebted to Dr. W. W. Wirth of the U. S. National Museum who sent me many slide-specimens of Oriental *Culicoides* for comparison with New Guinea species. My deepest thanks must be extended to Dr. D. J. Lee of the School of Public Health of the University of Sydney for his kind advice on specific differences between *C. immaculatus* and *leei*, *guttifer* and *mackayensis*, and on systematic positions of *lineatus* Kieffer (not *Culicoides*, but certainly *Dasyhelea*) and *australiensis* Kieffer (not *Culicoides*, but *Forcipomyia*) and for loan of some important paratypes of Australian *Culicoides*. I also thank Dr. W. Peters, formerly of the Department of Public Health, Port Moresby; Mr. J. H. Ardley and Dr. J. J. H. Szent-Ivany of the Department of Agriculture, Stock and Fisheries, Port Moresby and Mr. L. Smees of the Lowlands Agricultural Experimental Station, Keravat, New Britain.

#### KEY TO NEW GUINEA SPECIES OF CULICOIDES

1. Wing without any pattern ..... 2  
Wing with pattern, although sometimes very faint ..... 4
- 2 (1). Scutellum entirely yellow; wing with radial cell II very small, far shorter than cell I; in ♀, antenna with short basal flagellar segments round to short-oval, segment X longer than VIII-IX, wing with macrotrichia spread only on apical part; in ♂, hypopygium with paramere serrate on apical part, aedeagus with spine-like shoulder processes ..... **1. smeei**  
Scutellum entirely dark brown to brown; wing with radial cell II elongate, as long as cell I; in ♀, antenna with short basal flagellar segments oval, segment X shorter than VIII-IX, wing with macrotrichia spread over nearly all of surface..... 3
- 3 (2). Fore and mid legs with knees broadly yellow; scutellum with 3-4 bristles; in ♀, wing without macrotrichia on basal radial cell, antenna with sensory tufts on segments II, IV, VI, VIII and X-XIII ..... **2. leei**  
Fore and mid legs without distinctly paler knees; scutellum with 6 bristles; in ♀, wing with macrotrichia on basal radial cell, antenna with sensory tufts on segments II-IX.....**3. immaculatus**
- 4 (1). Wing with radial cell II entirely or almost entirely dark ..... 5  
Wing with costal pale spot II enveloping at least apical 1/3 of radial cell II.. 27
- 5 (4). Wing without pale spots in cells M<sub>1</sub>, M<sub>2</sub>, and M<sub>4</sub>.....**4. melanesiae**  
Wing with pale spots in cells M<sub>1</sub>, M<sub>2</sub>, and M<sub>4</sub>..... 6
- 6 (5). Wing with oval pale spot straddling sub-basal part of vein M<sub>1</sub> ..... **5. rabauli**  
Wing without pale spot straddling sub-basal part of vein M<sub>1</sub>..... 7
- 7 (6). Wing cell R<sub>5</sub> with isolated pale spot under septum between radial cells..... 8  
Wing cell R<sub>5</sub> without isolated pale spot under septum between radial cells..... 9

- 8 (7). Wing with costal pale spot II distinctly oblique ..... **6. guttifer**  
 Wing with costal pale spot II sideward V-shaped ..... **7. mackayensis**
- 9 (7). Wing cell  $M_1$  with single pale spot at middle ..... 10  
 Wing cell  $M_1$  with double pale spots, when basal spot faint another spot located on apical 1/2 of cell  $M_1$  ..... 11
- 10 (9). Wing with costal pale spot II constricted or divided into 2 spots; eyes poorly pubescent ..... **8. yoshimurai**  
 Wing with costal pale spot II simple; eyes distinctly pubescent..... **9. hyalinus**
- 11 (9). Wing cell  $M_4$  with basal corner pale ..... **10. hollandiensis**  
 Wing cell  $M_4$  with basal corner infuscate ..... 12
- 12 (11). Wing with costal pale spot II constricted or divided into 2-3 small spots ..... 13  
 Wing with costal pale spot II simple, large..... 21
- 13 (12). Wing cell  $R_5$  with distinct oval pale spot lying adjacent to sub-basal part of vein  $M_1$  ..... 14  
 Wing cell  $R_5$  without pale spot lying adjacent to sub-basal part of vein  $M_1$ ..... 15
- 14 (13). Wing cell  $R_5$  with single pale spot on apical 1/2 beyond costal pale spot II, 3 branches of vein M ending in small apical pale spots..... **11. ardleyi**  
 Wing cell  $R_5$  with double pale spots on apical 1/2 beyond costal pale spot II, 3 branches of vein M not ending in pale spots..... **12. multinotatae**
- 15 (13). Costal dark band I of wing containing isolated round pale spot which straddles midportion of vein M; tarsal segments IV of all legs flattened and bell-shaped ..... **13. circumbasalis**  
 Costal dark band I of wing without isolated round pale spot on middle part ..... 16
- 16 (15). Costal pale spot III of wing semicircular around dark spot ..... **14. semicircum**  
 Costal pale spot III of wing not semicircular ..... 17
- 17 (16). Costal pale spot III of wing distinctly separated from wing margin by infuscate marginal zone ..... 18  
 Costal pale spot III of wing broadly abutting on wing margin..... 19
- 18 (17). Apical pale spots of wing cells  $M_1$  and  $M_2$  separated from wing margin, apical pale spot of cell  $R_5$  displaced towards apex..... **15. parviscriptus**  
 Apical pale spots of wing cells  $M_1$  and  $M_2$  abutting on wing margin, apical pale spot of cell  $R_5$  located at middle between costal pale spot II and apex of cell  $R_5$  ..... **16. marmoratus**
- 19 (17). Wing without pale spot just above fMCu, apical pale spot of cell  $R_5$  large and oval..... **17. ornatus**  
 Wing with small pale spot just above fMCu, apical pale spot of cell  $R_5$  elongate and oblique ..... 20
- 20 (19). Apical pale spot of cell  $M_1$  abutting on wing margin ..... **18. papuae**  
 Apical pale spot of cell  $M_1$  far separated from wing margin..... **19. schultzei**
- 21 (12). Scutum entirely very pale, with only faint and ill-defined brownish clouds; in ♀, functional spermatheca single; in ♂, paramere of hypopygium with round tubercle and apical serration..... **20. neopalpalis**  
 Scutum entirely dark brown or brown or with distinct pattern or spots ..... 22
- 22 (21). Maxillary palpus with surface sensillae on segment III, without common sen-

- sory pore; tarsal segments IV of all legs cordiform ..... **21. submagnesianus**  
 Maxillary palpus with common sensory pore on segment III, without surface  
 sensillae..... 23
- 23 (22). Scutum entirely or almost uniformly dark brown or brown, without distinct  
 yellow or pale marking..... 24  
 Scutum with distinct yellow spots or marking.....25
- 24 (23). Costal pale spot II enveloping apex of marginal wing vein of radial cell II;  
 in ♀, wing with macrotrichia very sparsely spread only along apical margin  
 ..... **22. robertsi**  
 Radial cell II of wing entirely dark including marginal veins; in ♀, wing  
 with macrotrichia spread over almost all of surface..... **23. palpalis**
- 25 (23). Scutum with many yellow spots; in ♀, functional spermatheca single .....  
 ..... **24. pallidimaculosus**  
 Scutum broadly yellow on caudal 1/2 and dark or dark brown on anterior  
 1/2 ..... 26
- 26 (25). Scutellum entirely yellow; in ♀, functional spermathecae 3 and subequal.....  
 ..... **25. flaviscriptus**  
 Scutellum largely yellow, but with central dark or brown spot; in ♀, func-  
 tional spermatheca single ..... **26. petersi**
- 27 (4). Wing without pale spots arranged on apical part of cell R<sub>5</sub> and those of cells  
 M<sub>1</sub>, M<sub>2</sub>, and M<sub>4</sub> ..... **27. tripallidus**  
 Wing with more than 3 pale spots, sometimes very faint ..... 28
- 28 (27). Wing cell M<sub>4</sub> with 2 separate pale spots..... 29  
 Wing cell M<sub>4</sub> with single pale spot ..... 31
- 29 (28). Wing without pale spot straddling sub-basal part of vein M<sub>1</sub>..... **28. novaguineanus**  
 Wing with pale spot straddling sub-basal part of vein M<sub>1</sub>..... 30
- 30 (29). Wing cell R<sub>5</sub> with 3 distinct apical pale spots beyond costal pale spot II; in  
 ♀, wing with macrotrichia spread over almost all of surface, 3 spermathecae  
 hemispherical..... **29. marksii**  
 Wing cell R<sub>5</sub> with single distinct pale spot beyond costal pale spot II; in ♀,  
 wing with macrotrichia spread sparsely on apical 1/3, 3 spermathecae some-  
 what flattened ..... **30. pseudostigmatus**
- 31 (28). Pale spot of wing cell M<sub>4</sub> curved along vein M<sub>3+4</sub> around dark central spot  
 ..... **31. bougainvillae**  
 Pale spot of wing cell M<sub>4</sub> simple ..... 32
- 32 (31). Wing with oval pale spot straddling sub-basal part of vein M<sub>1</sub> under costal  
 pale spot II..... **32. magnimaculatus**  
 Wing without oval pale spot straddling sub-basal part of vein M<sub>1</sub> ..... 33
- 33 (32). Wing with elongate-oval pale spot lying adjacent to basal part of vein M<sub>1</sub> ...  
 ..... **33. magnipictus**  
 Wing without elongate-oval pale spot lying adjacent to basal part of vein M<sub>1</sub>...34
- 34 (33). Maxillary palpus with surface sensillae on segment III and without common  
 sensory pore..... 35  
 Maxillary palpus with common sensory pore on segment III and without sur-  
 face sensillae..... 42
- 35 (34). Wing with apical pale spot of cell R<sub>5</sub> located far before apex of cell R<sub>5</sub>..... 36

- Wing with apical pale spot of cell R<sub>5</sub> occupying apical part of cell R<sub>5</sub> ..... 37
- 36 (35). Scutum with 2 yellowish oval median spots between foveae before level of scutal sutures; in ♀, wing with macrotrichia on cell M<sub>4</sub> and anal cell, 2 radial cells present..... **34. jimmiensis**  
 Scutum uniformly dark brown or brown, without yellowish median spots; in ♀, wing without macrotrichia on cell M<sub>4</sub> and anal cell, radial cell not divided and single ..... **35. gentilis**
- 37 (35). Tarsal segments IV of legs distinctly cordiform ..... **36. near magnesianus**  
 Tarsal segments IV of legs normally subcylindrical..... 38
- 38 (37). Wing with costal pale spot II confluent with basal pale spot of cell M<sub>1</sub> beyond vein M<sub>1</sub> ..... **37. maculiscutellaris**  
 Wing with costal pale spot II not extending to vein M<sub>1</sub>..... 39
- 39 (38). Wing with radial cell II normal, not much longer than I; in ♀, wing with macrotrichia spread on cell M<sub>4</sub> and anal cell, 2 spermathecae large and functional ..... **38. longiradialis**  
 Wing with radial cell II very large, about 2× as long as I; in ♀, wing without macrotrichia spread on cell M<sub>4</sub> and anal cell, 3 spermathecae well developed ..... 40
- 40 (39). Spermatheca with short sclerotized part of duct; style of ♂ hypopygium strongly inflated on basal part, suddenly narrowed and sharply pointed... **39. flavescens**  
 Spermatheca without sclerotized part of duct; style of ♂ hypopygium gradually tapered and not sharply pointed ..... 41
- 41 (40). Scutellum dark or dark brown; in ♀, mandible with 10–16 teeth; in ♂, median caudal lobe of aedeagus slender and round at tip..... **40. barnetti**  
 Scutellum yellow to pale brown; in ♀, mandible with 6–8 teeth; in ♂, median caudal lobe of aedeagus broad and truncate at tip ..... **41. palpifer**
- 42 (34). Apical pale spot of wing cell R<sub>5</sub> situated far before apical corner of cell R<sub>5</sub>... 43  
 Apical pale spot of wing cell R<sub>5</sub> broadly extending almost to apical corner of cell R<sub>5</sub> ..... 45
- 43 (42). Basal pale spot of wing cell M<sub>1</sub> approximating or united with preapical pale spot of cell M<sub>2</sub>..... **42. amamiensis**  
 Wing cell M<sub>2</sub> without distinct preapical pale spot ..... 44
- 44 (43). Apical pale spot of wing cell R<sub>5</sub> abutting upon anterior wing margin, scutellum with single bristle ..... **43. unisetiferus**  
 Apical pale spot of wing cell R<sub>5</sub> more or less separated from wing margin, scutellum with 3–4 bristles ..... **44. buckleyi**
- 45 (42). Wing with 3 costal dark bands attenuated and quite separated from each other ..... 46  
 Wing with 3 costal dark bands normal or rather broad and at least II and III confluent with each other under costal pale spot II along vein M<sub>1</sub> ..... 49
- 46 (45). Wing with 1–2 costal dark spots forming complete bands extending towards anal margin across wing; in ♀, wing with macrotrichia spread over almost entire surface ..... 47  
 Wing with dark spots strongly constricted or segregated into several small dark spots; in ♀, wing with macrotrichia spread only on apical part ..... 48
- 47 (46). Wing with costal dark spot I extending beneath forming 2 transverse bands,

- veins  $M_1$  and  $M_2$  ending in small apical dark spots..... 45. **quaterifasciatus**  
 Wing with costal dark spot I extending beneath forming single transverse band,  
 veins  $M_1$  and  $M_2$  not ending in dark spots..... 46. **tritenuifasciatus**
- 48 (46). Scutum with caudal 1/2 entirely yellow ..... 47. **dikhros**  
 Scutum with caudal 1/2 entirely dark brown..... 48. **fragmentum**
- 49 (45). Eyes conspicuously pubescent ..... 49. **crassus**  
 Eyes quite bare..... 50
- 50 (49). Scutellum entirely yellow or with dark or yellow spots ..... 51  
 Scutellum entirely dark brown or brown, without yellow spots..... 54
- 51 (50). Scutellum with color spots..... 50. **monothecalis**  
 Scutellum entirely yellow..... 52
- 52 (51). Wing with costal dark band I broadly extending beneath, occupying major  
 basal area of wing between arculus and level of cross-vein r-m.....  
 ..... 51. near **longiradialis**  
 Wing with costal dark band I narrowly extending beneath, not broadened in  
 anal cell ..... 53
- 53 (52). Wing with median fuscous spot of anal cell band-like across anal cell; in ♀,  
 scutellum with 3 bristles, spermathecae round and each with tapered scler-  
 otized part of duct ..... 52. **flavidorsalis**  
 Wing with median fuscous spot of anal cell small, not reaching anal margin;  
 in ♀, scutellum with 4 bristles, spermathecae oval and each with slender  
 sclerotized part of duct..... 53. **novairelandi**
- 54 (50). Legs with tarsal segments IV flattened, bell-shaped; in ♀, wing with macro-  
 trichia spread over almost all of surface..... 54. **papuensis**  
 Legs with tarsal segments IV normal, subcylindrical; in ♀, wing with macro-  
 trichia spread only on apical marginal area ..... 55
- 55 (54). Wing pattern distinct, clearly defined; in ♀, proboscis long, being longer  
 than 2/3 of head-capsule, maxillary palpus slender, with segment III much  
 longer than 2× width ..... 55. **orientalis**  
 Wing pattern of apical and posterior areas ill-defined; in ♀, proboscis short,  
 being only a little longer than 1/2 of head-capsule, maxillary palpus rather  
 stout, with segment III at most 2× as long as wide ..... 56. **pungens**

The above key contains the species which I actually investigated; consequently the unexamined *xanthoceras* Kieffer and Macfie's sp. near *mollis* Edwards are omitted.

1. **Culicoidea smeei** Tokunaga, 1961, *Akitu* 9: 73.

Small, brown and yellow; wings quite unadorned, thorax mainly brown, but scutellum paler or yellowish, legs almost uniformly pale, abdomen almost entirely whitish. General appearance similar to that of *immaculatus*.

*Female*: Body 1.39 (1.17–1.56) mm long. Wing 0.96 (0.86–0.99) × 0.42 (0.37–0.44) mm. Head dark to brown, with eyes bare and contiguous, mouthparts pale brown, proboscis shorter than 1/2 (0.45) of head-capsule; palp rather stout, PR about 2.15, segment III with sensory pore just beyond middle shallow. Antenna entirely brown, with short basal flagellar segments round to short-oval, with sensillae very long, about 2× as long as verticils, AR 1.66 (1.55–1.82), sensory tufts present on II, IX, XI and XIII. Scutellum with

4 bristles and 2 small median setae.

Legs mainly yellow or pale ochreous, with knees narrowly brown or dark brown, bands basad and apicad of knees faintly paler or yellowish white, bases of femora and apices of mid and hind tibiae also faintly paler, midportions of fore and mid femora, similar parts of mid and hind tibiae, apical 2/3 of fore tibia and apical 3/4 of hind femur slightly more brownish or fuscous; hind tibial comb with apical bristles 4, tarsal segments IV of legs slightly cordiform; TR and RL-L 2.85 (2.67-3.08) and 21.3 : 19.9 : 10.3 : 3.8 : 2.6 : 1.9 : 2.6 in fore, 3.74 (3.67-3.86) and 27.2 : 25.4 : 15.2 : 4 : 3.3 : 2 : 2.8 in mid, 2.43 (2.29-2.53) and 24.8 : 24.5 : 11 : 4.4 : 2.9 : 1.9 : 2.8 in hind leg. Wing short-oval, without pattern, macrotrichia sparsely spread only on apical 1/4, cell  $M_4$  with or without trichia, costa ending at basal 0.66 of wing length (46.4 : 70.8), RL-V 22.2 : 20 : 31.8 : 11.4 : 16.8, radial cell II small, oval or subtriangular, about 1/2 as long as I (3.6 : 6.8), fMCu under middle of radial cell I. Halter white, Abdomen generally whitish, with caudal segments brown, tergites large, but pale, hemisternites much paler, cerci pale; spermathecae brown, 2 large, short-oval or subspherical, unequal, 2.5+12×10.1 units and 2.3+10.9×9.1 units, 1 vestigial, tubular, long, 8.9×0.6 unit.

*Male*: Body 1.33 (1.21-1.5) mm long. Wing 0.88 (0.85-0.92) × 0.33 (0.31-0.34) mm. General color paler than in ♀, main specific characters as in ♀, with usual sexual differences. PR about 1.7, RL-P 5 : 7.7 : 11.7 : 5.7 : 8.7. Antenna with scape dark, segments II-XI and plumose hairs pale ochreous or yellow, XII-XIV pale brown, XI without plumose and other setae; sensory tufts present on II, XI and XIII, rarely on XII; combined lengths of II-XI and XII-XIV 91.3 : 67.2. Thorax mainly dark brown, scutellum yellow, scutum with ill-defined pale ochreous clouds covering scutal sutures and along mesal sides of foreveae, sternum paler, scutellum with 3-4 bristles and 2 small setae.

Legs almost entirely whitish, being much paler than in ♀, knees brownish; claws cleft at apices; TR and RL-L 2.66 (2.64-2.68) and 21.7 : 20.3 : 10.5 : 3.8 : 3 : 1.9 : 2.7 in fore, 3.74 (3.56-4.0) and 27.2 : 25.5 : 15.5 : 4.3 : 3.4 : 2 : 2.6 in mid, 2.16 (2.06-2.26) and 23.7 : 23.7 : 10.5 : 4.8 : 3 : 2 : 2.7 in hind leg. Wing elongate-oval, with macrotrichia scantily spread along apical margin between tips of  $R_s$  and  $M_2$ , costa ending at basal 0.6 of wing length (40.3 : 67.3), RL-V 22.3 : 20.3 : 33.3 : 8.3 : 11.5, radial cell II small, about 1/2 as long as I (2.7 : 5). Abdomen whitish or faintly infuscate; hypopygium brown, tergite elongate, with anal points subtriangular, widely separated, caudal margin slightly convex; sternite with caudal margin shallowly concave in V-shape; coxite stout, tapered, with 2 basal roots unequal, short; style small, much shorter than coxite (21.3 : 28.7), basal 1/2 thickened, apical 1/2 slender and slightly arcuate; aedeagus large, basal arch broad, round, almost 1/2 of total length, caudal median lobe elongate-triangular or tape-like, ending before caudal margin of tergite, paired spine-like large processes arising from shoulder parts, strongly pointed and hardly as long as caudal median lobe, basal membrane smooth; paramere strongly curved at middle, with apical 1/2 broad and serrate with 6-9 slender and sharp teeth on one side, blunt tubercle on middle part.

**DISTRIBUTION**: New Britain.

**SPECIMENS EXAMINED**: 24 ♀♀, 3 ♂♂. Keravat, New Britain, 13-17. VI and 10-26. VIII. 1960, Smee.

## 2. *Culicoides leei* Tokunaga, 1961, Akitu 9: 72.

*Culicoides immaculatus* Lee & Reye, Tokunaga, 1959, Pac. Ins. 1: 206.

Medium-sized, brown and yellow, related to *immaculatus*. General color and structure as in my 1959 report. Main specific characters as follows:

*Female*: Body 1.43–1.46 mm long. Wing 0.98–1.0×0.43–0.46 mm. Head dark brown to brown, with eyes bare and narrowly separated, proboscis about 0.58–0.6 as long as head-capsule. Palp slender, dark brown or brown, segment III slightly inflated on midportion, with sensory pore just beyond middle large, PR about 2.67, RL–P 7: 16: 20: 8.5: 8.5. Antenna with scape brown to ochreous, segments II–VI or II–VII pale ochreous, but with apical parts brown, segments VII–XIV or VIII–XIV brown, segments II–IX short-oval to elongate-oval, AR 1.04, RL–8A 10.5: 10.8: 10.8: 15.5: 15: 17.8: 19: 24.3; sensory tufts present on II, IV, VI, VIII, and X–XIII or II–IV, VI, VIII and X–XIII. Thorax mostly brown, but scutum with yellow median stripes along mesal sides of foveae broad and sub-confluent on middle part of scutum, ill-defined pale lateral clouds anterior and posterior to scutal sutures, pleural sclerites brown, membranes yellow, sternum pale or yellow, scutellum with 3–4 strong bristles and 6–7 small setae.

Legs mainly yellow, knees yellow, femora and tibiae broadly brown, in fore leg femoral base narrowly and knee broadly yellow, in mid leg femoral basal 2/5, knee broadly and tibial end narrowly yellow, in hind leg femoral base narrowly and both ends of tibia yellow, fore and hind tarsal segments I pale brown; claws simple, hind tibial comb with apical bristles 5; TR and RL–L 2.29–2.37 and 23: 22.3: 11.4: 4.9: 3.4: 2.7: 3.1 in fore, 2.8–2.82 and 28: 27.5: 14.7: 5.2: 3.9: 2.7: 3.2 in mid, 2.24–2.27 and 27: 26.2: 13.4: 5.9: 4.9: 3.2: 3.4 in hind leg. Wing elongate-oval, without pattern, with macrotrichia spread over almost all of surface; venation: costa ending above tip of  $M_{3+4}$  and at basal 0.67 of wing length (51: 76), RL–V 24.5: 21.5: 32: 14: 21.5, 2 radial cells subequal in length. Halter with knob brown or dark brown, stem yellow. Abdomen largely whitish, with tergite brown, hemisternites pale brown, cerci white; spermathecae dark brown, 2 large, pyriform, subequal, 3.5+19×15.5 units and 3.5+18×15 units, 1 vestigial, tubular, 6×1 units.

*Male*: Body length 1.12 (1.05–1.26) mm. Wing 0.82 (0.81–0.85) mm by 0.31 (0.3–0.33) mm. Color generally somewhat paler than in ♀, main structures as in ♀. Head with eyes barely separated. RL–P 4.5: 9: 12.1: 5.6: 7.3. Antenna pale brown, with plumose hairs reduced and absent on segments X–XI, in some ♂♂ IX and X more or less fused together, sensory tufts present on II and X–XIII, rarely II and XI–XIII or II, X–XI and XIII; combined lengths of II–XI and XII–XIV about 85.8: 70.8, RL–8A 7: 7.3: 7.5: 5.8: 7.3: 23.5: 22.8: 23.3. Thorax paler than in ♀, infuscate on scutellum, postscutellum, propleura and pleural sclerites under wing bases; scutellum with 3 bristles and 1–2 small setae.

Legs entirely pale ochreous or slightly fuscous; hind tibial comb with apical bristles 5, claws of legs cleft at tips; TR and RL–L 2.26 (2.11–2.38) and 20: 20.1: 10.1: 4.6: 3.1: 2.6: 3 in fore, 2.72 (2.67–2.82) and 25: 25.1: 12.6: 4.7: 3.4: 2.6: 3 in mid, 2.15 (2.05–2.33) and 23.1: 23.3: 10.8: 5: 3.3: 2.6: 3.1 in hind. Wing elongate-oval, with macrotrichia sparse on apical 1/2 of cells  $R_5$  and  $M_1$ , along wing margin of cells  $M_2$  and  $M_4$ ; costa ending at basal 0.64 of wing length (40.5: 63.3), RL–V 20.8: 19.3: 29.3: 9: 14, rarely apical part of  $R_1$  atrophied, radial cell II subtriangular, nearly as long as I (4.5:



5). Halter with knob pale brown. Abdomen with tergites complete, pale brown, sternites reduced, membranes whitish, caudal segments brown. Hypopygium brown, tergite elongate, with anal points broadly triangular, widely separated, caudal margin with minute cleft; sternite deeply concave in U-shape; coxite long, tapered, hardly reaching to base of anal point, with 2 basal roots unequal, caudal one small and other slender; style tapered, slightly arcuate, about  $5/6$  as long as coxite (25.5 : 30.8); aedeagus with basal arch triangular, about  $1/2$  of total length, hood-like membranous swelling on basal arch, median caudal lobe spear-like, forked into 2 sharply pointed tips, basal membrane spiculous on basal  $1/2$ ; paramere large, with basal part elongate, apical  $3/5$  tape-like, but apical  $1/5$  curved laterad, suddenly tapered and twisted on preapical part.

DISTRIBUTION: New Guinea, New Britain.

SPECIMENS EXAMINED: 1 ♀, Bubia near Lae, New Guinea, 5. II. 1959, Ardley; 1 ♀, Keravat, New Britain, 22–26. VIII. 1960, Smee; 4 ♂♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters.

So similar to *immaculatus* I misidentified it in 1959. In comparison with a ♀ of *immaculatus* from Thursday I. of Arafura Sea, which was determined and sent by Lee, the following differences may be pointed out. In *immaculatus*, (1) body length 1.69 mm, wing  $1.03 \times 0.43$  mm; (2) general color more brownish, without yellowish markings; (3) proboscis longer, about 0.8 as long as head-capsule (18 : 23); (3) palp with PR about 2.55, RL-P 9 : 19 : 28 : 12 : ?; clypeus more setigerous with 10–12 marginal setae; (4) antenna almost entirely brown, with segments II–IX short-oval, RL–8A 8.2 : 8.2 : 8.2 : 13.5 : 13.2 : 15 : 16 : 22.5 (W=6.8 to 5.5); AR 0.99–1.03; sensory tufts present on segments II–IX; (5) thorax almost entirely brown, caudoscuteal area of scutum and scutellum slightly yellowish; scutellum with 6 large bristles and 14 small setae; (6) legs extensively brown, paler than thorax, trochanters and femoral bases pale, last tarsal segments whitish, knees not obviously paler; hind tibial comb with spical bristles 4; TR 2.74 in fore, 2.72 in mid, 2.32 in hind; (7) wing short-oval, with macrotrichia more densely spread over all of surface, space between veins M and stem of fMCu hairy, basal radial cell with about 10 macrotrichia, no bare areas along vein  $M_1$ , 2 radial cells infusate, not paler on apical parts of Costa and Rs; (8) spermathecae yellowish brown, elongate-oval, equal,  $1.5 + 13.5 \times 9$  units and  $1.5 + 13.5 \times 10$  units, 1 vestigial tubular,  $5 \times 1.3$  units; (9) cerci brown; (10) halter white, slightly fuscous on base of knob. In *leei*, these characters are shown in the descriptions.

3. *Culicoides immaculatus* Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77: 375 (not Tokunaga's *immaculatus* of 1959).

Medium-sized, brown; wings densely hairy and without pattern. Main specific characters as shown in the comparison with *leei*. Measurements of leg segments and wing veins as follows: RL–L 28.5 : 28.2 : 15.2 : 5.2 : 3.8 : 2.5 : 3.9 in fore, 34.5 : 35 : 18 : 6 : 4 : 3 : 4 in mid, 33 : 32 : 16.5 : 7.2 : 5 : 3 : 4 in hind leg. Wing with costa ending at basal 0.65 of wing length (51 : 79), RL–V 23 : 21 : 33 : 13 : 20.5, radial cell II elongate, narrow, nearly as long as I (6 : 7), fMCu under midportion of radial cell I, Cu<sub>1</sub> ending at level of tip of R<sub>1</sub>. Abdomen whitish, with tergites pale brown, not reduced, hemisternites sub-square, paler, pleural membranes faintly infusate.

DISTRIBUTION: Australia, Thursday Island.

SPECIMEN EXAMINED: 1 ♀, Lee's collection.

4. *Culicoides melanesiae* Macfie, 1939, Linn. Soc. N. S. Wales, Proc. 54: 368. Figs. 1, 19.

Small; ♀ dark brown or brown, ♂ paler than ♀. General structure and coloration similar to those of Macfie's description and it is probably this species. In these specimens, however, palp provided with distinct sensory pore on segment III as the most distinctive difference from the specimen examined by Macfie. Female with thorax mainly brown, but scutum with several pairs of ochreous spots, scutellum mainly pale ochreous, with median and lateral small fuscous clouds; legs dark with rather distinct paler bands basad and apicad of knees; wing fuscous, with small pale spots just beyond arculus, on cross-vein r-m and just beyond costal end, macrotrichia densely spread over almost all of surface. Male with thorax mainly brown, scutum without pale or yellowish spots, but with irregular markings faint and slightly fuscous, scutellum as in ♀; legs almost entirely pale brown, but fore leg with white bands basad and apicad of knee; wing with pattern as in ♀, but macrotrichia spread only on apical 1/2 of cells  $R_5$  and  $M_1$  and on marginal area of cell  $M_2$ ; hypopygium with anal points long and widely separated, coxite with basal roots approximated and slender, paramere swollen on midportion, filiform and curved on apical part.

*Female*: Body 1.49 (1.26–1.63) mm long. Wing 1.0 (0.92–1.08) × 0.46 (0.43–0.49) mm.

Head dark brown including mouthparts, with eyes bare, narrowly separated, proboscis about 1/2 as long as head-capsule (11.8 : 23). Palp dark brown, stout, segment III short-oval, with deep and distinct sensory pore on preapical part; PR 1.84, RL-P 6 : 15.8 : 17.5 : 6.8 : 8.4. Antenna with scape dark, other segments dark brown, segments III–IX short-oval to elongate-oval and each with short neck part; AR 1.15 (1.09–1.22), RL-8A 11 : 11 : 11.5 : 18.1 : 17.9 : 19.4 : 19 : 25; sensory tufts present on II and VII–XIV. Thorax mainly brown, scutum with ochreous ill-defined spots: 3 pairs of middle spots between foveae, 1 small lateral anterior to and 1 large posterior to scutal sutures, scutellum pale ochreous, with small fuscous clouds at middle and on sides, scutellar trichia: 2 lateral and 1 or 2 median bristles and 9–12 scattered minute setae.

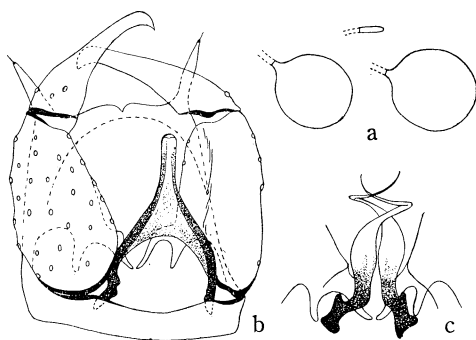


Fig. 1. *Culicoides melanesiae*. a, spermatothecae; b, ♂ hypopygium; c, parameres.

Legs mainly dark, but coxae, trochanters, femoral bases and tarsi paler, fore knee, mid and hind femoral ends dark, fore leg with paler bands basad and apicad of knee, mid with similar bands basad of knee and on basal part of tibia, hind with similar bands on both ends; claws simple, hind tibial comb with apical bristles 4; TR and RL-L 2.61 (2.42–2.78) and 24.4 : 24.4 : 12.5 : 4.9 : 3.4 : 2.5 : 2.4 in fore, 3.12 (2.95–3.26) and 30.5 : 30 : 15.5 : 5 : 3.6 : 2.8 : 2.9 in mid, 1.99 (1.9–2.12) and 29.3 : 27.9 : 13 : 6.5 : 3.9 : 2.9 : 3 in hind leg. Wing (fig. 19) short-oval, almost entirely hairy and fuscous, with only 3 small pale spots just beyond arculus, covering r-m and just beyond costal end respectively, middle

spot small, oval or subsquare covering only r-m and base of radial cell I, separated from costal margin, apical spot small as in figure and not covering apices of costa and Rs but rarely slightly larger and covering apices of these veins; costa ending at basal 0.7 of wing length (53.3 : 76.8), RL-V 22.8 : 21.8 : 33.3 : 12.3 : 21.8, radial cell II elongate, as long as I (8.3 : 8); macrotrichia densely spread over all of surface but basal radial cell without trichia. Halter entirely white. Abdomen with tergites and hemisternites brown, dorsal and ventral membranes pale, pleural membranes entirely pale or slightly fuscous; cerci fuscous, spermathecae (fig. 1a) brown, 2 subspherical or short-oval, subequal,  $1.1+18 \times 15.3$  units and  $1.3+16.5 \times 14.3$  units, each with minute chitinized part of duct, 1 vestigial, tubular,  $5.1 \times 1.3$  units.

*Male*: Body 1.17 mm long. Wing  $0.73-0.76 \times 0.29-0.32$  mm. Color generally brown, paler than in ♀, scutum without distinct paler spot, but with irregular fuscous clouds, scutellum as in ♀ or without central fuscous cloud; legs almost entirely pale brown, fore leg with knee dark, bands basad and apicad of knee white, other legs with knees pale brown and without distinct bands; wings with pattern similar to those of ♀, but pale spots slightly larger; abdomen pale, hypopygium fuscous brown. Head with eyes barely separated. Palp stout, PR 1.75, RL-P 4 : 8 : 10.5 : 5.5 : 7.5, sensory pore distinct. Antenna with scape dark brown, other segments and plumose hairs brown, combined lengths of II-XI and XII-XIV 77 : 72.8, RL-8A 6.5 : 6.3 : 6 : 5 : 6 : 26 : 21 : 23.5, sensory tufts on II and XIII-XIV or II and XIII. Scutellum with single median, 2 lateral bristles and 3-5 minute setae.

Legs with TR and RL-L 2.44-2.85 and 20.3 : 19.8 : 10.2 : 3.8 : 2.8 : 2.5 : 2.9 in fore, 3.0-3.13 and 25 : 23.8 : 12.5 : 4 : 3 : 2.5 : 2.8 in mid, 1.9-2.0 and 23 : 22 : 10 : 5.1 : 3.2 : 2.5 : 2.9 in hind. Wing with 3 pale spots slightly larger than in ♀, but basal 2 spots more or less separated from costa and apical spot semicircular and usually covering extreme tip of radial cell II, macrotrichia sparsely spread on apical 1/2 of cells R<sub>5</sub> and M<sub>1</sub> on marginal area of cell M<sub>2</sub> and few along anal margin of cell M<sub>4</sub>, venation: costa ending at basal 0.64 of wing length (36.5 : 57), RL-V 18.5 : 17 : 26.5 : 7 : 11.5, radial cell II elongate-subtriangular, fully as long as I (4.5 : 4). Abdomen pale, but caudal segments and hypopygium fuscous. Hypopygium (fig. 1b) with tergite subsquare, broad, bearing long anal points, about 0.4 as long as style (9.5 : 22.5), widely separated, as wide as  $1.5 \times$  length of anal points, caudal margin with small median cleft; sternite with caudal margin slightly arcuate; coxite conical, with 2 basal roots approximated at bases, slender; style stout, much shorter than coxite (22.5 : 26.5), almost straight; aedeagus as long as style, tapered, with median lobe slender, basal arch about 2/5 of total length, basal membrane bare; paramere (fig. 1c) with basal part dark, midportion swollen, tapered on apical 2/5 and strongly curved, ending in filiform apical part.

DISTRIBUTION: New Guinea, New Britain.

SPECIMENS EXAMINED: 3 ♀ ♀, Keravat, New Britain, 13-17. VI. 1960, Smee; 1 ♂, Maprik, Sepik Distr., New Guinea, II. 1959, Peters; 7 ♀ ♀, 1 ♂, Bubia, near Lae, New Guinea, 2. II-18. III. 1959, Ardley.

There is little doubt that this species is *melanesiae*, reported by Macfie from Rabaul, New Britain. In type of *melanesiae*, however, segment III of maxillary palpus is devoid of sensory pore as a distinct difference from these specimens, but Macfie described the species from a single specimen which is said to be badly mounted and cannot be examin-

ed satisfactorily on this point.

5. **Culicoides rabauli** Macfie, 1939, Linn. Soc. N. S. Wales, Proc. 64: 367. Fig. 20.

Medium-sized, dark brown; thorax dark brown, legs almost entirely dark, but with faint trace of narrow paler bands, wing with distinct pattern, many small pale spots, spot of cell  $M_4$  characteristic in shape, elongate and smaller spots straddling basal part of  $M_1$  and middle of  $M_2$  respectively, apical pale spots of cells  $R_5$ ,  $M_1$  and  $M_2$  more or less separated from wing margin, macrotrichia densely spread over almost all of surface and on basal radial cell. Male unknown.

*Female*: Body length 1.77 mm. Wing 1.39–1.4×0.6 mm. Head dark brown, with eyes bare and separated, proboscis about 0.7 as long as head-capsule (23 : 34). Palp slender, III with sensory pore on apical part large; PR about 2.1 (30 : 14), RL–P 10 : 30 : 30 : 10 : 10. Antenna with scape dark, other segments brown, short basal flagellar segments discoidal, round to short-oval successively towards apical, sensory tufts on II, IV, VI–VIII and X–XIV or II, IV, VI, and VIII–XIV; AR 1.73, RL–8A 9 : 9 : 9 : 24 : 25 : 28 : 28 : 37 (W=8.5 : 9). Thorax entirely dark, scutellum with 3 median large bristles, 2 lateral large bristles each accompanying small seta, 12 minute scattered setae.

Legs almost entirely dark, but tarsi pale brown, fore leg with pale brown narrow bands basad and apicad of knee, mid with similar band apicad of knee, hind with pale brown bands on both ends of tibia and white distinct band on sub-basal part of tibia; claws simple, hind tibial comb with apical bristles 4; TR and RL–L 2.31 and 35 : 34 : 17 : 7.5 : 5 : 3.5 : 4 in fore, 3.07 and 45 : 44 : 25 : 8 : 5 : 3.5 : 4 in mid, 2.36 and 42 : 39 : 20 : 9 : 5.5 : 3.5 : 4 in hind leg. Wing (fig. 20) broadened basally, with many distinct pale spots, costal pale spot I large oval, II small, not covering radial cell II, III separated from costal margin and far before apex of cell  $R_5$ , oblong pale spot straddling basal part of vein  $M_1$ , small pale spot also straddling midportion of vein  $M_2$ , pale spot of cell  $M_4$  large, arch-like, with central dark spot, pale spot just above fMCu small; macrotrichia densely spread over all of surface, basal radial cell also with several trichia; venation: costa ending at basal 0.65 of wing length (70 : 107), RL–V 32 : 29 : 45 : 15 : 25, 2 radial cells subequal in length. Halter white. Abdomen with tergites and hemisternites large, brown, pleural membranes fuscous; cerci brown, spermathecae brown, 2 functional round, equal, 16×15 units, without sclerotized part of duct, 1 vestigial tubular, 7×1 units.

DISTRIBUTION: New Britain, New Guinea.

SPECIMEN EXAMINED: 1♀, Bubia, near Lae, New Guinea, 11. III. 1959, Ardley.

Highly specific in wing pattern, differing from other New Guinea species of *Culicoides*. According to original description, the type specimen differs slightly from this specimen in following points: scutellum is provided with 4 large bristles instead of 5, pale spot straddling midportion of vein  $M_2$  is larger, being as large as similar spot straddling basal part of vein  $M_1$ , and hind TR is about 2.2, being a little smaller than 2.36.

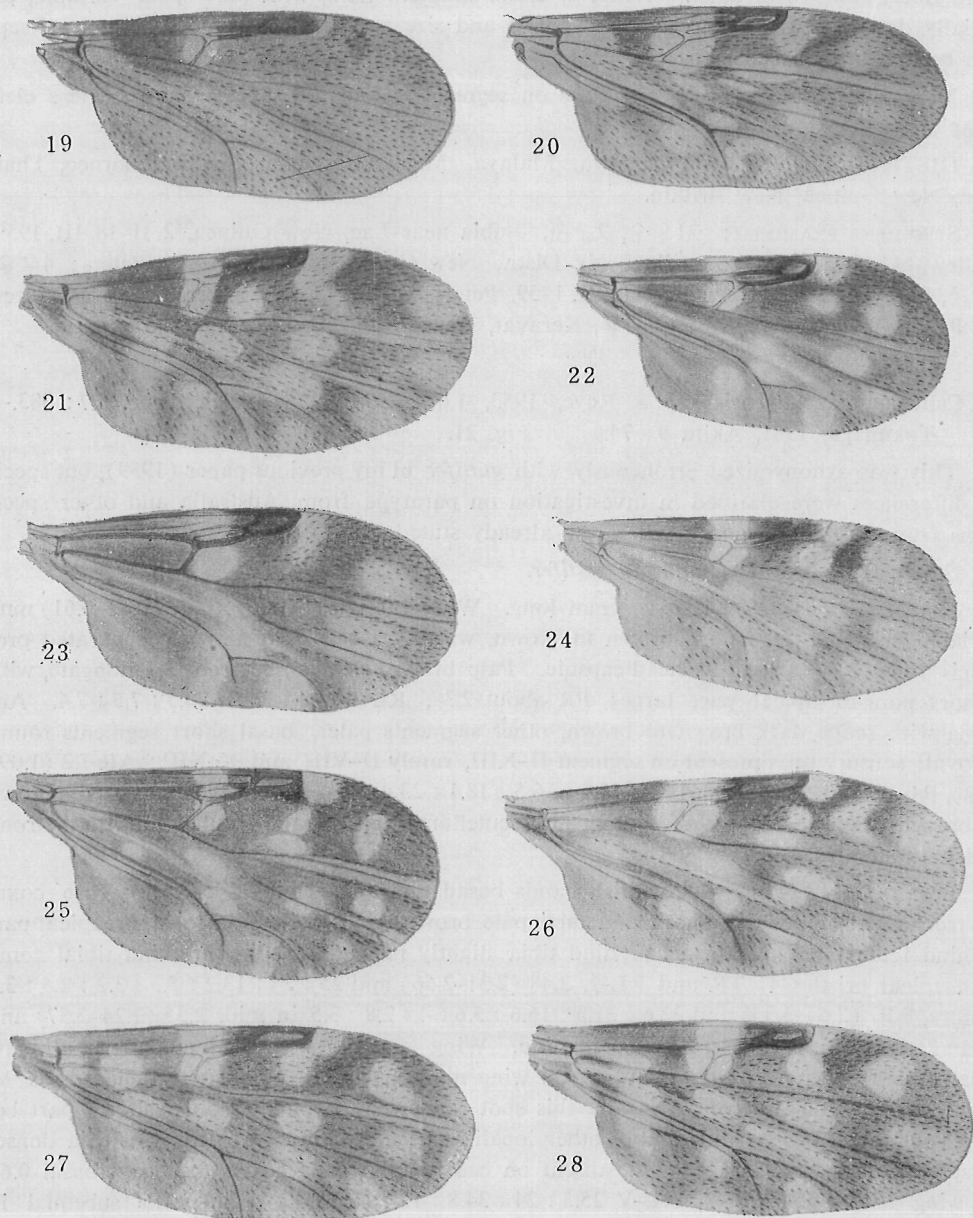
6. **Culicoides guttifer** de Meijere, 1907, Tijdschr. Ent. 52: 209.—Edwards, 1922, Bull. Ent. Res. 13: 163.—Tokunaga & Murachi, 1959, Ins. Micron. 12: 327.—Tokunaga, 1959, Pac. Ins. 1: 216; 1961, Akitu 9: 74.

*Culicoides guttifer* var. *histrion* Johannsen, 1946, Bishop Mus. Bull. 189: 190.

*Culicoides leucostictus* Kieffer, 1911, Ind. Mus., Rec. 4: 340.

*Culicoides micropunctatus* Tokunaga, 1951, Saikyo Univ., Agr. Sci. Rept. 1: 105.

This is the representative species of *guttifer*-group of *Culicoides* and its specific char-



Figs. 19–28. Wings of *Culicoides* species: 19, *melanesiae* ♀; 20, *rabauli* ♀; 21, *mackayensis* ♀; 22, *yoshimurai* ♀; 23, *hyalinus* ♀; 24, *hollandiensis* ♀; 25, *ardleyi* ♀; 26, *multinotata* ♀; 27, *circumbasalis* ♀; 28, *marmoratus* ♀.

acters have been reported in detail. This is to supplement earlier reports.

*Female*: Proboscis about 0.56 as long as head-capsule (15.2 : 27). Antenna with sensory tufts on segments II-V and X-XIII, rarely II-V, VII and X-XIII or II-III and X-XIII. Hind tibial comb with apical bristles 4, claws simple. Wing with pale spots variable, especially double nature of costal pale spot II and size and shape of pale spot beneath septum between radial cells variable.

*Male*: Antenna with sensory tufts on segment II and XII-XIII. Claws of legs cleft at apices.

**DISTRIBUTION**: Java, Sumatra, Malaya, Mariana Is., Caroline Is., Borneo, Thailand, New Guinea, New Britain.

**SPECIMENS EXAMINED**: 21 ♀♀, 2 ♂♂, Bubia near Lae, New Guinea, 2.II-18.III. 1959, Ardley; 11 ♀♀, 1 ♂, Maprik, Sepik Distr., New Guinea, I and II. 1959, Peters; 4 ♀♀, 2 ♂♂, Bainyik, Sepik, New Guinea, III. 1959, Peters; 3 ♀♀, Goldie River, near Port Moresby, Papua, 22.IX. 1959, Ardley; 1 ♀, Keravat, New Britain, Smee.

7. **Culicoides mackayensis** Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77: 383.—Tokunaga, 1961, Akitu 9: 74. Fig. 21.

This was synonymized erroneously with *guttifer* in my previous paper (1959), but specific differences were clarified in investigation on paratype from Australia and other specimens from N. Borneo and Thailand as already stated (1961).

Small, dark brown; similar to *guttifer*.

*Female*: Body 1.48 (1.12-1.7) mm long. Wing 1.09 (0.91-1.35) × 0.48 (0.42-0.61) mm, variable in size. Head dark brown to brown, with eyes bare and narrowly separated proboscis about 2/3 as long as head-capsule. Palp brown, slender; segment III elongate, with sensory pore on apical part large; PR about 2.38, RL-P 6.8 : 17.8 : 20.5 : 7.5 : 7.4. Antenna with scape dark brown to brown, other segments paler, basal short segments round to oval; sensory tufts present on segment II-XIII, rarely II-VIII and X-XIII; AR 1.2 (1.09-1.32), RL-8A 8.3 : 8.4 : 8.9 : 14.9 : 15.2 : 16.5 : 18.1 : 23.4 (W=6.1-6.5). Thorax dark brown or brown, caudoscuteal area of scutum and scutellum slightly paler, scutellum with 4 strong and 6-10 small setae.

Legs mainly brown, with whitish bands basad and apicad of dark knees, fore coxa, all trochanters, bases of femora and tarsi pale brown, hind basitarsus brown, preapical part of hind femur and apical part of hind tibia slightly paler; claws simple, hind tibial comb with apical bristles 4; TR and RL-L 2.48 (2.31-2.56) and 25 : 24 : 13.2 : 5.3 : 3.2 : 2.5 : 3.4 in fore, 2.97 (2.64-3.35) and 32.6 : 31.3 : 16.6 : 5.6 : 4 : 2.8 : 3.5 in mid, 2.35 (2.24-2.57) and 30.4 : 28.8 : 15.2 : 6.4 : 4.4 : 2.9 : 3.6 in hind. Wing (fig. 21) with distinct pattern, all marginal pale spots more or less abutting on wing margin, costal pale spot II sideways V-shaped, in a paratype from Australia this spot somewhat expanded on posterior part before vein M<sub>1</sub> differing from that of other localities as shown in figure; macrotrichia densely spread over all of surface but absent on basal radial cell; costa ending at basal 0.65 of wing length (54.3 : 84), RL-V 25.3 : 24 : 34.8 : 12.3 : 20.5, 2 radial cells subequal in length (6.3 : 7). Halter pale, but knob of Australian specimen dark brown. Abdomen pale, but caudal segments dark or brown, anterior tergites brown or pale brown, each reduced to 3 plates, hemisternites much paler, pleural membranes faintly infuscate, cerci

brown or pale brown; spermatheca single, large,  $25 \times 14$  units, subrhombic in lateral aspects, brown and gradually paler towards bottom.

**DISTRIBUTION:** Australia, New Ireland North Borneo, Thailand.

**SPECIMENS EXAMINED:** 1 ♀, Kavieng, New Ireland, 4. VI. 1959, Peters; 1 ♀, Wirth's coll., N. Borneo; 1 ♀, Wirth's coll., Thailand; 1 ♀ (Paratype), Lee's coll., Australia.

Numerical values of above description are mean, minimum and maximum of measurements of 4 ♀♀ from different localities.

**8. *Culicoides yoshimurai* Tokunaga, 1941, Annot. Zool. Jap. 20: 114.—Tokunaga & Mura-chi, 1959, Ins. Micron. 12 (3): 330. Fig. 22.**

Minute, dark brown; eyes slightly pubescent on middle, scutum variable in adornment: in darker specimens almost entirely dark or dark brown, in paler specimens bearing ill-defined paler spots on lateral sides and much paler large median spots between foveae, legs with knees broadly pale or yellowish, but hind femur usually not distinctly paler at end, wing short-oval, with distinct paler spots, cell  $M_1$  with only 1 pale spot at midportion, apical pale spot of cell  $R_5$  far separated from wing margin, costal pale spot II divided or constricted. Male hypopygium: paramere strongly undulate, with spine-like or finger-like process at mid and apical part flattened and serrated. Main additional specific characters of ♀ observed on New Guinea specimens as follows:

*Female:* Wing  $0.75-0.81 \times 0.36-0.38$  mm. Head with eyes slightly pubescent on mid part of frontal aspect, proboscis short, shorter than  $1/2$  of head-capsule (7.7: 17.3). Palp stout, segment III short-oval, with sensory pore on preapical part rather deep, PR 1.7. Antenna with AR 1.31 (1.18–1.44), sensory tufts present on segments II and VII–IX. Thorax dark or brown extensively, sometimes with paler ill-defined clouds on scutum, scutellum with median accessory small setae 0–2 in addition to 3 bristles.

Legs with claws simple, hind tibial comb with apical bristles 4; TR 3.02 (2.75–3.3) in fore, 3.69 (3.46–3.87) in mid, 2.55 (2.46–2.67) in hind leg. Wing (fig. 22) short-oval, with distinct pale spots, which are variable in size and shape: in specimens with smaller spots, costal pale spot II distinctly separated into 2 spots and median spot of cell  $M_1$  round as in figure, when with larger spots, costal pale spot II constricted or subconfluent and spot of cell  $M_1$  elongate oval, but apical spot of cell  $R_5$  not abutting on wing margin as shown in original report; macrotrichia spread on apical  $1/4$  of wing; venation: 2 radial cells almost completely dark, apical part of  $R_1$  (basal part of radial cell II) usually atrophied almost completely but sometimes remaining as dark stripe, costa ending at basal 0.64 of wing length (37.8: 59.5), RL–V 17: 15.5: 26.3: 10: 14.5, apical part of  $R_s$  (part of radial cell II) about  $1/2$  as long as radial cell I (3.8: 6.5). Halter with knob dark, stem yellow. Abdomen with 2 spermathecae well developed, brown, short-oval, equal,  $4.7+12.5 \times 8.7$  units, each with distinct chitinized part of duct.

**DISTRIBUTION:** Micronesia, New Guinea, New Britain, New Ireland.

**SPECIMENS EXAMINED:** 3 ♀♀, Bubia near Lae, New Guinea, 12. II–8. III. 1959, Ardley; 1 ♀, Kavieng, New Ireland, 3. IV. 1959, Peters; 1 ♀, Keravat, New Britain, 13–17. IV. 1960, Smee.

Specimens from Micronesia have a wing pattern similar to those from New Guinea, but differ in almost always paler spots larger and costal pale spot II not divided into 2

spots; antennal ratio usually somewhat larger, varying from 1.36 to 1.57, but tarsal ratio of hind leg falls within range between 2.5 and 2.7 as in New Guinea specimens; the sclerotized part of duct of functional spermatheca is slightly shorter but length of this part variable in both specimens to some extent.

**9. *Culicoides hyalinus* Tokunaga, n. sp. Figs. 23.**

Small, dark; eyes pubescent, pale ochreous spots on scutum, yellowish white bands on legs, single colorless hyaline spermatheca and only a few pale spots on wings. Male unknown.

*Female*: Body length 1.13 mm. Wing  $0.96 \times 0.46$  mm. Head brown; eyes distinctly pubescent, narrowly separated, proboscis about  $1/2$  as long as head-capsule. Palp brown, stout, segment III short-oval, with sensory pore on apical  $1/2$  large and shallow, PR about 1.3, RL-P 5 : 10 : 16 : 5.6 : 6.5. Antenna with scape dark brown, other segments entirely brown, segments III-IX equally short-oval, sensory tufts present on II and IV-IX; AR 1.15, RL-8A 8 : 8 : 8 : 13.5 : 14 : 14.5 : 16 : 22. Thorax mainly brown, scutum with many pale ochreous spots: 2 small pairs before scutal sutures, large ill-defined pair behind scutal sutures, oblong large median pair on anterior  $1/2$ , similar pair on caudoscuteal area; scutellum with 2 lateral, single medial bristles and 2 small median setae.

Legs mainly brown, femoral bases and tarsal segments paler, knees of fore and hind legs dark, fore leg with pale yellow bands basad and apicad of knee, mid leg with knee pale yellow, hind leg with pale yellow band beyond knee and pale brown on apical part of tibia; claws simple, hind tibial comb with apical bristles 4; TR and RL-L 3.3 and 22 : 20 : 11 : 3.7 : 2.5 : 2 : 2.5 in fore, 3.3 and 25 : 25 : 15 : 4.5 : 3.3 : 2 : 2.5 in mid, 2.35 and 26 : 26 : 12.7 : 5.2 : 3.5 : 2.2 : 2.5 in hind leg. Wing (fig. 23) short-oval, mainly dark, with only a few pale spots, costal pale spot I subconfluent with spots behind it forming transverse band, but r-m not enveloped in this pale spot and Rs dark, costal pale spot II small, apical pale spot of cell  $R_5$  widely separated from wing margin, cell  $M_1$  with only 1 spot separated from apical margin; macrotrichia spread on apical  $1/2$  of wing, sparsely on cell  $M_4$ , arranged in a line close to anal margin of anal cell; venation: costa short, ending slightly beyond middle of wing (48 : 74), RL-V 22 : 21 : 35 : 12 : 19, radial cell II subtriangular, slightly shorter than 1 (6 : 8). Abdomen with tergites and hemisternites small, pale, pleural membranes fuscous, cerci pale yellow, spermatheca single, colorless, hyaline, round,  $1+13 \times 13$  units, with minute chitinized part of duct, other 2 invisible.

DISTRIBUTION: NE New Guinea.

Holotype ♀ (BISHOP 3233), Maprik, 150 m, Sepik Distr., New Guinea, II. 1959, Peters.

Wing pattern of *hyalinus* similar to that of Japanese *kibunensis* Tokunaga but eyes pubescent, AR much smaller being only 1.15, hind TR larger than 2.0 being 2.35, wing has more distinct paler spot, cell  $M_1$  has single elongate pale spot on middle, apical  $1/2$  of vein  $M_2$  pale-margined just before apex, macrotrichia spread only on apical  $1/3$  of wing, differing from *kibunensis*. In addition, single hyaline functional spermatheca is one of most distinctive specific characters.

**10. *Culicoides hollandiensis* Tokunaga, 1959, Pac. Ins. 1 : 226. Figs. 2, 24.**

Small, brown and yellow; thoracic tergites with distinct yellow spots, legs with con-



spicuous yellow or white bands, wings with well defined pattern, costal pale spot II gourd-shape or divided into 2 small pale spots, cell  $M_4$  with pale spot at basal corner which is sometimes united with apical spot under vein  $M_{3+4}$ , small pale spot present just above fMCu, macrotrichia densely spread over almost all of surface in ♀, sparsely spread on apical 1/3 of wing in ♂. Male hypopygium with cylindrical anal points, basal membrane of aedeagus pubescent, parameres inflated on sub-basal parts, tapered and sharply pointed apically. Chief specific characters as stated in original description.

*Female*: Wing 1.0 (0.96–1.04) × 0.45 (0.42–0.47) mm. Head with proboscis longer than 1/2 of head-capsule (0.65). Palp slender, PR 2.33, RL–P 7.2 : 19.9 : 2.0 : 8 : 8.4. Antenna with sensory tufts on segment II–XIII, II–IV and VI–XIII, II–IV, VI and VIII–XIII, II and IV–XIII, II and V–XIII, or II, III–VIII and X–XIII; AR 0.9 (0.83–0.95), RL–8A 9.7 : 9.7 : 9.5 : 13.3 : 13.1 : 13.8 : 14.9 : 19.9. Thorax brown, scutum with many yellow distinct spots, usually with small yellow spot on caudal corner of either lateral side, darker on anterior marginal area, scutellum mainly yellow, with median and lateral small brown clouds.

Legs usually with distinct yellow or white bands basad and apicad of dark knees, femora and tibiae mainly brown (in type specimens paler); claws simple, hind tibial comb with apical bristles 4; TR and RL–L 2.5 (2.32–2.63) and 23.7 : 21.8 : 11.7 : 4.5 : 3 : 2.5 : 3 in fore, 3.2 (2.92–3.52) and 29.3 : 27.7 : 15.3 : 5 : 3.2 : 2.5 : 2.9 in mid, 2.03 (1.88–2.12) and 27.1 : 26.3 : 12.3 : 6.2 : 3.8 : 2.8 : 3 in hind. Wing (fig. 24) with pattern distinct, well defined, costal pale spot II just covering apical apex of radial cell II, incompletely or completely constricted into 2 spots, costal pale spot III large, slightly constricted, elongate to some extent along vein  $M_1$ , always separated from wing margin, two pale spots of cell  $M_4$  sometimes united under vein  $M_{3+4}$ , rarely basal pale spot reduced or very faint and very rarely absent; venation: costa ending at basal 0.67 of wing length, RL–V 24.5 : 22.7 : 34.3 : 12.7 : 19.8, radial cell II wide, as long as I (7.5 : 6.8); macrotrichia densely spread on apical 1/2 beyond level of r-m and on anal cell. Halter white. Abdomen with tergites small, transverse; spermathecae brown, 2 subequal, 2.1 + 14.2 × 11.7 units and 1.4 + 13.3 × 11.2 units, 1 vestigial 4.3 × 1.5 units. Other characters as in original description.

*Male*: Body 1.13–1.53 mm long. Wing 0.96–1.0 × 0.34–0.36 mm. General color and structure as in ♀. RL–P 5.5 : 13 : 14 : 8.5 : 9, PR 2.33. Antenna with sensory tufts on segments II and XIII; combined lengths of II–XI and XII–XIV 110–116 : 76–77, RL–8A 9 : 9 : 9 : 9.5 : 25 : 23 : 23 : 8. Legs with claws bifid at extreme apices; fore TR 2.36–2.49, middle 2.95–3.02, hind 1.88–1.94. Wing with pattern as in original drawing but in a ♂ basal corner of cell  $M_4$  faintly paler and both sides of veins  $M_2$  as pale as those of vein  $M_1$ ; venation: costa ending at basal 0.6–0.63, RL–V 26.5 : 24.5 : 35.5 : 10 : 14.5, radial cell II small, as long as or shorter than I. Abdomen pale brown, almost whitish; hypopygium (fig. 2a) with anal points prominent, cylindrical or conical, separated by distance equal to length, differing from type; coxite with basal roots small; paramere (fig. 2b) slender

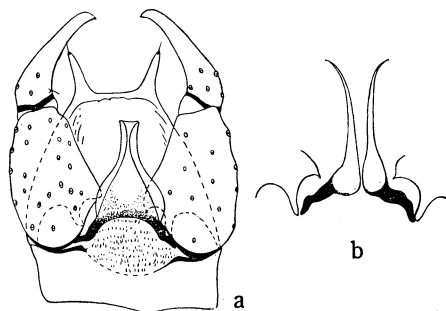


Fig. 2. *Culicoides hollandiendensis*, ♂. a, hypopygium; b, parameres.

and sharply pointed but inflated on sub-basal portion. Other structures as in original description.

**DISTRIBUTION:** NE New Guinea.

**SPECIMENS EXAMINED:** 6 ♀♀, Maprik, Sepik Distr., New Guinea, II-7.III.1959, Peters; 2 ♀♀, 1 ♂, Bubia, near Lae, New Guinea, 8.III. and 26-27.IV.1959, Ardley.

Above ♂ specimen distinctly different from type only in development of anal points the hypopygium. Similar individual difference rarely found in other species of genus.

**11. *Culicoides ardleyi* Tokunaga, n. sp. Fig. 25.**

Small, dark brown; many yellow spots on scutum, distinct white bands on legs, many pale small spots on wings, costal pale spot II divided into 3 small spots, tips of 3 median veins ending in pale spots, cell  $M_1$  with small pale spot straddling vein  $M_2$ , abdominal tergites II-V highly reduced to small sclerites. Male unknown.

*Female:* Body 1.07-1.3 mm long. Wing  $0.85-0.9 \times 0.39-0.43$  mm. Head dark brown, with eyes bare and contiguous, proboscis  $1/2$  as long as head-capsule. Palp dark brown, slender, segment III with sensory pore on preapical part small, PR about 2.0, RL-P 5 : 13 : 13.5 : 6.8 : 7. Antenna with scape dark, other segments brown, short basal segments equally short-oval, AR 1.01-1.05, RL-8A 9 : 9 : 9 : 13 : 12.8 : 13.8 : 14.5 : 22.5, sensory tufts present on II and VI-IX or VII-IX. Thorax mainly dark brown, scutum with caudoscuteal area brown, scutal yellow spots: 2 small pairs before scutal sutures, 2 small or 1 large pairs behind scutal sutures, 1 large oblong median pair on anterior  $1/2$ , similar median pair on caudoscuteal area; scutellum with 2 yellow subconfluent spots, 2 lateral and single median bristles and 2-3 median small setae.

Legs largely brown or dark brown, with knees dark, tarsal segments II-V white, distinct white bands present basad and apicad of fore and middle knees, on sub-basal and apical part of hind tibia; claws simple, hind tibial comb with apical bristles 4; TR and RL-L 2.7-3.07 and 21.3 : 20 : 10.5 : 3.5 : 2.8 : 2.2 : 2.8 in fore, 3.5-3.6 and 26.3 : 24 : 13.5 : 3.8 : 3 : 2.2 : 2.9 in mid, 2.6-2.62 and 24.8 : 23 : 10.5 : 4.2 : 3 : 2.3 : 3 in hind leg. Wing (fig. 25) short-oval, with many small distinct pale spots on dark ground color, costal pale spot II band-like reaching  $M_1$  and constricted into 2 or 3 small spots, costal pale spot III far separated from wing margin, apical spots of cell  $M_1$  and  $M_2$  also separated from wing margin, 3 branches of media ending in small pale spots; veins passing through costal pale spot I not completely pale; macrotrichia spread on apical area beyond level of costal end, anal cell and cell  $M_4$  with sparse trichia closely along anal margin, in a paratype cell  $M_4$  with additional trichia and a line of trichia present along furrow above vein  $M_{3+4}$  beyond fMCu; venation: costa ending at apical  $2/5$  (43.5 : 67.5), RL-V 20.8 : 19.8 : 32 : 10.5 : 16.5, radial cell II almost as long as I (5.5 : 6.5). Abdomen whitish, tergites I-V pale brown, III-V very small, other caudal tergites brown and larger, sternites almost completely reduced, pleural membranes with fuscous clouds arranged segmentally; cerci white, spermathecae 2 brown, subequal, round,  $0.5+9.5 \times 9$  units and  $0.5+8.2 \times 8$  units, each with minute chitinized part of duct, 1 minute brown, tubular,  $1.8 \times 0.8$  units.

**DISTRIBUTION:** NE New Guinea, Solomon Is.

Holotype ♀ (BISHOP 3234), Bubia, near Lae, New Guinea, 28. I. 1959, Ardley. Para-

type: ♀, Kieta, Bougainville I, Solomon Is., 26. V. 1959, Peters.

Superficially resembles *poikilonotus* Macfie and *crescentis* Wirth, both from C. America, in general facies and wing markings, but distinguished by scantily spread macrotrichia of wings, displaced costal pale spot I which envelops only basal 1/2 or cross-vein r-m and the development of the antennal sensory tufts. Besides these differences, in the first allied species, basal pale spot of wing cell  $M_1$  does not straddle vein  $M_2$ , PR is smaller, 1.4–1.8, AR is larger, 1.18–1.32, and antennal sensory tufts are present on segments II and X–XIV; in the second allied species, pale spot lying adjacent to vein  $M_1$  is displaced on midportion of vein  $M_1$ , pale spot of cell  $M_4$  extends to basal corner along vein  $M_{3+4}$ , AR is much larger, 1.48, and antennal sensory tufts are present on II and X–XIV.

12. *Culicoides multinotatae* Tokunaga, n. sp. Fig. 26.

Medium-sized, dark brown or brown; many yellow spots on scutum, legs with distinct white bands, wings with many small pale spots on dark ground-color as in *C. papuae*, but arrangement of pale spots of wing highly specific: costal pale spot II divided into 3 small spots including elongate spot lying adjacent to vein  $M_1$ , additional pale spot present between costal pale spots II and III, vein  $M_1$  with pale spot straddling its midportion. Male unknown.

*Female*: Body 1.3 mm long. Wing  $1.07 \times 0.47$  mm. Head dark brown, with eyes bare, narrowly separated, proboscis about 1/2 as long as head-capsule. Palp brown, stout, segment III oval, with sensory pore on apical 1/2 large and shallow, PR 2.0; RL–P 6 : 11 : 18 : 7.5 : 13. Antenna with scape dark brown, other segments brown, III–IX round to short-oval, X–XIII bottle-like, each with slender neck-part, sensory tufts present on II and VI–IX; AR about 1.51, RL–8A 9.5 : 9.5 : 10 : 20 : 20 : 23.5 : 22.5 : 29. Thorax mainly brown, but dark on anterior margin of scutum, scutal yellow spots: small pair on humeral pits, 2 small pairs before scutal sutures, larger pair behind scutal sutures, median oblong pair on anterior 1/2, small pair on anterior part of caudoscuteal area, obscure small pair on posterior parts of foveae; scutellum yellow on lateral parts, postscutellum pale brown on median part; scutellum with 2 lateral and 2 median bristles, several median small hairs.

Legs mainly brown, with knees dark, tarsal segments II–III pale, IV–V white, femoral bases pale brown, fore and mid legs with distinct white bands basad and apicad of knees, hind femur with preapical part pale brown, hind tibia white on sub-basal and apical part; claws simple, hind tibial comb with apical bristles 4. TR and RL–L 3.37 and 27.5 : 25.5 : 14.3 : 4.5 : 3 : 2 : 3 in fore, 3.61 and 34 : 32.5 : 19 : 5 : 4 : 2.5 : 3.5 in mid, 2.41 and 31 : 29 : 15 : 6.2 : 4 : 2 : 3.5 in hind leg. Wing (fig. 26) dark, with many pale spots, costal pale spot I large, costal pale spot II constricted into 3 small spots, costal dark area III containing characteristic additional pale spot, costal pale spot III round and just before apical corner of cell  $R_5$ , pale spot of cell  $M_4$  subconstricted, other pale spots small as in figure; venation: costa ending at apical 2/3 of wing length, RL–V 26 : 24 : 38 : 12 : 22, radial cell II about  $2 \times$  as long as I (11 : 6); macrotrichia thickly spread on apical 1/2, sparsely on anal cell. Halter with stem yellow, knob dark brown. Abdomen with tergites and sternites pale brown, pleural membranes fuscous; cerci white; spermathecae 2 pale brown, subspherical, subequal,  $1+13 \times 12$  units and  $1+12 \times 11$  units, each with minute chitinized part of ducts.

DISTRIBUTION: New Ireland.

Holotype ♀ (BISHOP 3235), Kavieng, New Ireland, 4. VI. 1959, Peters.

Highly specific in arrangement of pale spots of wings: cell  $R_5$  with 6 isolated spots, vein  $M_1$  with a pale spot straddling middle, an elongate pale spot lying adjacent to vein  $M_1$  under radial cell II. By these characters the new species may be distinguished easily from allied species.

13. *Culicoides circumbasalis* Tokunaga, 1959, Pac. Ins. 1: 232. Fig. 27.

Medium-sized, dark brown; scutum dark and marked with many brown spots, legs with distinct white bands basad or apicad of dark knee-parts, tarsal segments IV flattened and bell-shaped, claws stout, each with single sharp tooth at base besides basal hair-like structure, wing with many pale spots, basal costal dark band broad and comprising single round pale spot, costal pale spot II more or less distinctly constricted, apical pale spots of cells  $R_5$  and  $M_1$  far separated from apices of these cells, apical margin of wing pale, macrotrichia densely spread over almost all of surface, but basal radial cell without trichia, size and shape of pale spots of wing variable. Male unknown. The original description is supplemented with additional observations on 8 ♀♀ from New Ireland.

*Female*: Body 1.23 (1.07–1.37) mm long. Wing 1.07 (1.03–1.13) × 0.47 (0.43–0.48) mm. Head dark brown, with proboscis as long as 0.63 of head-capsule (13.8 : 22). Palp with PR 2.0, RL–P 6.2 : 16.8 : 19.2 : 6.8 : 7.4. Antenna with scape dark brown, basal short flagellar segments yellow, but apical parts of all segments brown, round to short-oval, X–XIV brown; AR 1.02 (0.95–1.12), RL–8A 9.3 : 9.3 : 9.2 : 14 : 14.3 : 15.2 : 15.8 : 22.8; sensory tufts present on II–XIII. Thorax mostly dark brown, scutum with 5–7 pairs of brown spots, some of which are faint and ill-defined, scutellum with 4–10 small setae and 4 large bristles.

Legs with yellowish or white distinct bands on preapical part of fore femur and sub-basal parts of tibiae, knees dark brown or black; claws stout, each with basal sharp tooth and curved long hair, hind tibial comb with apical bristles 4, rarely 3, tarsal segments IV flattened, bell-shaped; TR and RL–L 2.57 (2.5–2.76) and 25.3 : 23.8 : 11.9 : 4.8 : 3 : 2.3 : 3.3 in fore, 3.12 (3.04–3.35) and 32.2 : 30.4 : 17.3 : 5.3 : 3.4 : 2.6 : 3.5 in mid, 3.3 (3.19–3.45) and 29.6 : 28 : 14 : 6 : 4 : 2.5 : 3.5 in hind leg. Wing (fig. 27) with pattern distinct, with many pale spots, shape and size of pale spots variable (original drawing of wing shows it with larger pale spots), usually preapical pale spot more or less separated from wing margin, costal dark band I always broad and containing circular pale spot, Fig. 27 showing the wing with smaller pale spots; venation: costa ending at basal 0.65 of wing length (54 : 82.6), RL–V 25.6 : 24 : 35 : 13 : 20.6, radial cell II elongate, longer than I (8.2 : 7.4); macrotrichia densely spread over all of surface, but basal radial cell without trichia. Abdomen with cerci dark brown; spermathecae brown, 2 functional short-oval, unequal, 4 + 20.3 × 17 units and 5 + 18 × 14.7 units, each with distinct chitinized part of duct tapered, 1 vestigial tubular, 5.3 × 1.3 units. Other characters as in original description.

DISTRIBUTION: New Guinea, New Ireland.

SPECIMENS EXAMINED: 8 ♀♀, Kavieng, New Ireland, 4. IV. 1959, Peters.

14. *Culicoides semicircum* Tokunaga, 1959, Pac. Ins. 1: 208. Fig. 3.

Medium-sized, brown and yellow; wing with characteristic semicircular apical spot of cell  $R_5$ . Male hypopygium with tergite long, basal roots of coxite unequal, paramere with apical serration and median tubercle. Main specific characters as in original description of ♀.

*Female*: Wing 0.95 (0.88–0.91) × 0.41 (0.4–0.43) mm. Head with proboscis short, about 0.4 as long as head-capsule. Palp with PR about 1.57, RL-P 4.2 : 8.5 : 12.2 : 5 : 5.7. Antenna with AR 1.57 (1.38–1.79), RL-8A 7.8 : 8 : 9 : 17.5 : 17.3 : 19 : 20.2 : 27, sensory tufts present on II, IX, XI and XIII. Scutellum with 2–4 minute setae besides 3 bristles. Legs with claws simple, hind tibial comb with apical bristles 4, TR 2.91 (2.8–3.0) in fore, 4.35 (4.14–4.61) in mid, 2.83 (2.62–3.07) in hind. Wing with pattern as in original drawing, often costal pale spot II not distinctly constricted, and sometimes semicircular, costa ending at basal 0.64 of wing length. Abdomen with single functional spermatheca about 3.5+15.5 × 12.5 units, 2 vestigial tubular, equal, 6.7 × 1 units and 7 × 1.1 units. Other characters as in original description.

*Male*: Body length 1.0–1.2 mm. Wing 0.73 × 0.3 mm. Color and structures usually as in ♀ with usual sexual differences. Eyes slightly separated, almost bare, but with dot-like structures among facets. Palp pale brown, short, somewhat moniliform, segment III short-oval, with sensory pore on apical part large, shallow; PR 1.07, RL-P 4 : 4.5 : 7 : 4 : 5.5. Antenna with scape brown, other parts pale; sensory tufts present on II, XI and XIII; combined lengths of II–XI and XII–XIV 57.3 : 71.5, RL-8A 7 : 6.8 : 6.5 : 6 : 7.8 : 20 : 17 : 21; XI without plumose hairs and united with X. Thorax as in ♀, but scutum with 3 lateral pale spots behind humeral pit larger and confluent, scutellum with 2 accessory minute setae.

Legs with claws probably simple, TR and RL-L 2.72–2.92 and 18.5 : 15.8 : 8.8 : 3.1 : 2.2 : 1.7 : 2.3 in fore, 3.69–4.3 and 23 : 20.8 : 13.3 : 3.5 : 2.8 : 1.9 : 2.3 in mid, 2.38–2.46 and 20.3 : 18.5 : 9.3 : 3.6 : 2.7 : 1.9 : 2.4 in hind. Wing short-oval, with pattern paler and pale spots larger than in ♀; macrotrichia present only along apical margin between tips of veins  $R_5$  and  $M_1$ ; costa ending at basal 0.6 of wing length (32.8 : 55.8), RL-V 17 : 16 : 26.5 : 6 : 9.3, 2 radial cells small, equal in length, fMCu under septum of radial cells or just before it,  $Cu_1$  ending under costal tip. Halter fuscous. Abdomen pale, sclerites reduced, pleural membranes fuscous. Hypopygium (fig. 3a) brown; tergite elongate, tapered, truncate at caudal end, but anal points prominent, triangular; sternite with caudal margin slightly concave; coxite with 2 basal roots distinctly unequal, anterior with round tip, posterior with 2 pointed tips; style slender, slightly arcuate, a little shorter than coxite (21 : 26), with tip curved; aedeagus broad basally, with lateral sclerites strong, median lobe about 1/2 as long as total length; paramere (fig. 3b) strongly curved, with tubercle on midportion, apical 1/2 serrate on one side with 6–7 delicate teeth.

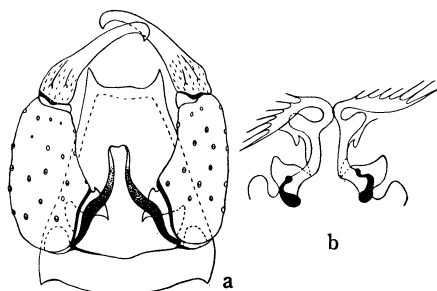


Fig. 3. *Culicoides semicircum*, ♂. a, hypopygium; b, parameres.

Hypopygium (fig. 3a) brown; tergite elongate, tapered, truncate at caudal end, but anal points prominent, triangular; sternite with caudal margin slightly concave; coxite with 2 basal roots distinctly unequal, anterior with round tip, posterior with 2 pointed tips; style slender, slightly arcuate, a little shorter than coxite (21 : 26), with tip curved; aedeagus broad basally, with lateral sclerites strong, median lobe about 1/2 as long as total length; paramere (fig. 3b) strongly curved, with tubercle on midportion, apical 1/2 serrate on one side with 6–7 delicate teeth.

DISTRIBUTION: E. New Guinea.

SPECIMENS EXAMINED: 3 ♀♀, 1 ♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 2 ♀♀, 1 ♂, ditto, II and 7. III. 1959, Peters; 3 ♀♀, 1 ♂, Bubia, near Lae, New Guinea, 18. III. 1959, Ardley; 3 ♀♀, 1 ♂, Bainyik, Sepik Distr., New Guinea, III. 1959, Peters; 1 ♀, Goldie River, near Port Moresby, Papua, 25. IX. 1959, Ardley.

**15. *Culicoides parviscriptus* Tokunaga, 1959, Pac. Ins. 1: 213.**

Medium-sized brown or dark brown species with highly characteristic wing pattern; wing infuscate broadly and with many small pale spots.

DISTRIBUTION: New Guinea, New Britain.

**16. *Culicoides marmoratus* (Skuse). Fig. 28.**

*Ceratopogon marmoratus* Skuse, 1889, Linn. Soc. N. S. Wales, Proc. 4: 304.

*Culicoides marmoratus*, Macfie, 1939, *ibid.* 64: 556.—Lee & Reye, 1953, *ibid.* 77: 382.

Small, dark brown; scutal spots brown, legs with femora pale brown, tibiae broadly brown on middle parts, white on sub-basal and apical parts, wings with obvious pattern and many pale spots, macrotrichia spread over almost all of surface.

*Female*: Body 1.41 (1.35–1.46) mm long. Wing 1.04 (0.99–1.12) × 0.46 (0.43–0.51) mm. Head entirely dark brown, eyes bare, separated by distance equal to width of single facet, proboscis short, 0.56 as long as head-capsule. Palp slender, dark brown, segment III elongate, fusiform, without sensory pore, surface sensillae on apical 1/2; PR 2.5, RL–P 7.5 : 17 : 19.5 : 7 : 8.8. Antenna with scape dark brown, II–VIII ochreous, IX–XIV brown, short basal flagellar segments round to short-oval; AR 1.25–1.3, RL-8A 8.3 : 8.3 : 7.3 : 14.5 : 15.5 : 15.8 : 17.5 : 25.2; sensory tufts present on II–XIII or II–VI, VIII and X–XIII, but rarely II, IV–VIII and X–XIII. Thorax extensively dark brown, scutum broadly brown on lateral parts, with 2 pairs of large oval brown median spots between foveae, scutellum brown, with 2 lateral, 2 median bristles and 9–15 small setae.

Legs with coxae and trochanters brown, knees dark, tarsi pale brown, femora pale brown, but white on basal parts, fore and mid femora with preapical white bands, tibiae broadly brown on mid parts, with sub-basal and apical white bands; claws simple, hind tibial comb with apical bristles 4, sometimes 5; TR and RL–L 2.22 (2.15–2.27) and 24.3 : 22.3 : 12 : 5.4 : 3.1 : 2.5 : 3 in fore, 3.05 (3.0–3.09) and 30.8 : 29.8 : 17.1 : 5.5 : 3.7 : 2.7 : ? in mid, 2.11 (1.96–2.21) and 28.5 : 27.5 : 14.3 : 6.8 : 4.5 : 2.7 : 3.5 in hind. Wing (fig. 28) with distinct pattern, many pale spots, costal pale spot II not enveloping radial cell II, constricted into 2 small spots as in figure or incompletely constricted forming gourd-shape, costal pale spot III variable in shape being subtriangular, semicircular or subsquare, well separated from tip of cell  $R_5$ , widely or very narrowly separated from anterior wing margin, 2 pale spots of cell  $M_1$  elongate, apical one abutting on wing margin or barely separated from it, cell  $M_2$  with elongate pale spot under basal 1/2 of vein  $M_2$  and above  $M_{3+4}$ , small oval spot under cross-vein r-m, no pale spot just above fMCu; macrotrichia densely spread over all of surface; costa ending at basal 0.65 of wing length, RL–V 25 : 22.7 : 33 : 12.7 : 18.7, radial cell II as long as I. Halter with knob dark, stem yellow. Abdomen mostly brown, pleural membranes dark, caudal segments and cerci dark brown; spermathecae dark brown, 2 functional short-oval, subequal, 1.7+16.3 × 13.3 units and 1.7+16.5 × 13.5 units, each with sclerotized part of duct very short, curved, 1 vestigial tubular, 5.7 × 1.2 units.

DISTRIBUTION: Australia, New Guinea.

SPECIMENS EXAMINED: 3 ♀♀, Port Moresby, Papua, I. 1960, Peters.

According to Lee & Reye, ♂ hypopygium has parameres somewhat similar to those of *palpalis* but entire length is less undulated and apical serration is strongly uneven. Palpal segment III is said by Macfie to have a small subapical pit, and drawing of Lee & Reye shows several irregular sensory pores on apical 1/2. Actually, segment III bears clavate sensillae each rising from an independent minute pore. AR and hind TR, measured by Lee & Reye, smaller than reported by Macfie and me, being 1.09–1.18 and 1.74–1.77 respectively.

17. *Culicoides ornatus* Taylor, 1911, Austral. Inst. Trop. Med., Rept. for 1911, 1913: 73.—  
Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77: 381. Fig. 29.

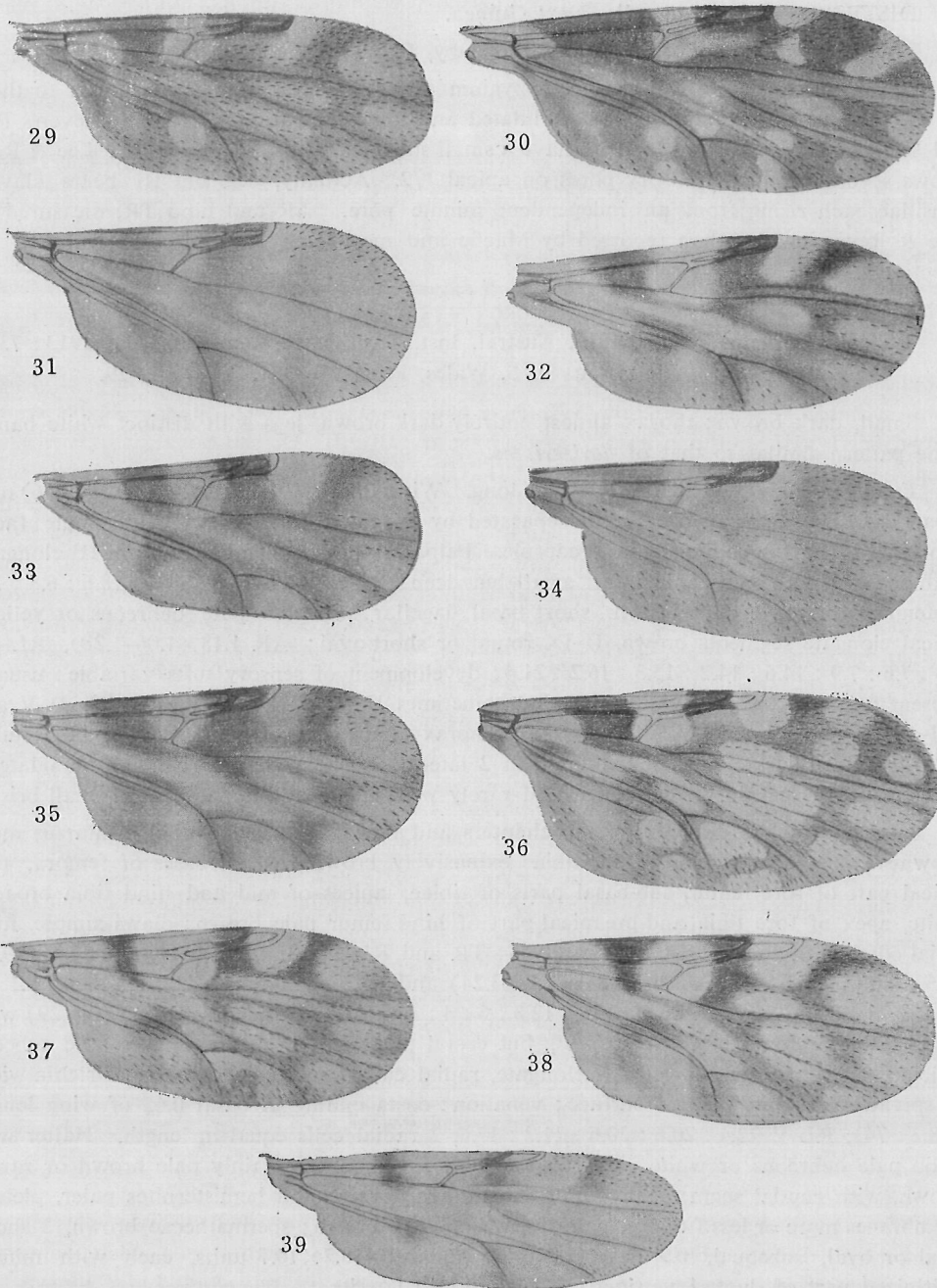
Small, dark brown; thorax almost entirely dark brown, legs with distinct white bands, wing pattern similar to that of *flaviscryptus*.

*Female*: Body 1.38 (1.17–1.48) mm long. Wing 0.96 (0.91–1.0) × 0.42 (0.39–0.46) mm. Head dark brown, with eyes bare, separated by distance equal to width of single facet, proboscis long, 0.78 as long as head-capsule. Palp dark brown, slender, segment III elongate, with sensory pore on preapical part small but deep; PR 2.3, RL-P 6: 15.4: 18.6: 6.8: 7.1. Antenna with scape dark brown, short basal flagellar segments pale ochreous or yellow, apical elongate segments brown, II–IX round or short-oval; AR 1.18 (1.06–1.28), RL-8A 7.6: 7.6: 7.9: 14.6: 14.2: 15.3: 16.2: 21.4; development of sensory tufts variable: usually present on II–V and always X–XIII, but sometimes II–III, II–IV, II–V, II–VIII, II–V and VII–IX, II and V, or II–V, VII and IX. Thorax almost entirely dark brown, but scutum with ill-defined dark clouds, scutellum with 2 lateral, 2 median large bristles, 2 or 3 lateral accessory, 2–6 accessory small setae and rarely with single additional central small bristle.

Legs with coxae dark brown, trochanters and tarsi pale brown, hind basitarsus more brownish, knees dark, femora and tibiae extensively brown, except bases of femora, preapical part of fore femur, sub-basal parts of tibiae, apices of mid and hind tibia broadly white, apex of fore tibia and preapical part of hind femur pale brown; claws simple, hind tibial comb with apical bristles 4, rarely 3; TR and RL-L 2.32 (2.22–2.44) and 22.4: 20.6: 10.9: 4.6: 3: 2.3: 2.8 in fore, 3.0 (2.75–3.24) and 29.5: 26.5: 4.3: 4.8: 3.5: 2.4: 3.1 in mid, 2.23 (2.04–2.36) and 26.4: 25.2: 12.8: 6: 4: 2.4: 3.1 in hind leg. Wing (fig. 29) with pattern similar to that of *flaviscryptus*, but costal pale spot II much smaller and subconstricted, basal pale spot of cell M<sub>2</sub> elongate, radial cell II more slender, macrotrichia widely spread over almost all of surface; venation: costa ending at basal 0.65 of wing length (48.2: 74), RL-V 22.4: 20.6: 30.6: 11.2: 17.8, 2 radial cells equal in length. Halter with knob pale ochreous or white, stem always white. Abdomen mainly pale brown or rarely brown, with caudal segments brown or dark brown, tergites and hemisternites paler, pleural membranes more or less fuscous, cerci brown or dark brown; spermathecae brown, 2 short-oval or oval, subequal, 0.9+14×11.2 units and 0.7+13.2×10.7 units, each with minute chitinized part of duct, 1 vestigial, tubular, 5.1×1.1 units.

DISTRIBUTION: Australia, New Guinea.

SPECIMENS EXAMINED: 12 ♀♀, Port Moresby, New Guinea, I. 1960, Peters.



Figs. 29-39. Wings of *Culicoides* species: 29, *ornatus* ♀; 30, *papuae* ♀; 31, *neopalpalis* ♀; 32, *submagnesianus* ♀; 33, *robertsi* ♀; 34, *palpalis* ♀; 35, *petersi* ♀; 36, *marksi* ♀; 37, *bougainvillae* ♀; 38, *magnipictus* ♀; 39, sp. near *magnesianus* ♂.



An Australian ♀ identified by Lee shows sensory tufts of antenna present on segments II, X–XIII or II, V and X–XIII?

**18. *Culicoides papuae* Tokunaga, n. sp. Fig. 30.**

Small or medium-sized, dark brown and yellow, closely resembling *schultzei* Enderlein and *reticulatus* Lutz. Thoracic tergites with many yellow spots; legs with knees dark, bands basad and apicad of knees white; wing dark, with pale spots small, costal pale spot II not covering radial cell II, completely divided, costal pale spot III oblique and basad of tip of cell R<sub>5</sub>, marginal pale spots not separated from wing margin. Male unknown.

*Female*: Body 1.2–1.3 mm long. Wing 1.11–1.12×0.47–0.51 mm. Head dark brown, mouth-parts brown, eyes bare, narrowly separated, proboscis about 2/3 as long as head-capsule. Palp stout, RL–P 6.3 : 15.3 : 19 : 7 : 7.8, PR about 2.0, segment III oval, sensory pore on apical 1/2 large, shallow. Antenna with scape dark brown, other segments entirely brown or II–VIII yellowish basally and brown apically, III–IX short-oval, X–XI or X–XII elongate, each with slender neck part, XII–XIII or XIII subcylindrical and slightly tapered; sensory tufts present on II and VI–IX; AR 1.32–1.55 (1.44), RL–8A 9.8 : 9.8 : 10.1 : 18.8 : 20 : 23.3 : 24 : 31.3. Thorax mainly dark brown, scutum with marginal part dark, median part between foveae brown, with 7 pairs of small yellow spots: 1 round humeral pit, 2 round before scutal sutures, 2 oval behind scutal sutures, 1 elongate-oval on anterior 1/2 of median part, 1 elongate on lateral sides of caudoscuteal area; scutellum yellow, with median brown spot; postscutellum dark brown, with pale brown median part; scutellum with 2 lateral, 2 median bristles and 4–9 minute medial setae.

Legs mainly dark brown, femoral bases paler, tarsal segments II–III pale brown, IV–V white, white bands basad and apicad of dark knees wide, distinct, hind tibia white on apical 1/3; claws simple, hind tibial comb with apical bristles 4; TR and RL–L 2.83–2.94 (2.89) and 25.5 : 23.2 : 13.2 : 4.3 : 3 : 2 : 2.8 in fore, 3.88–4.05 (3.94) and 33.2 : 30.3 : 18.5 : 4.8 : 3.5 : 2.5 : 3 in mid, 2.33–2.61 (2.5) and 31 : 29 : 14 : 5.7 : 3.4 : 2.3 : 3.1 in hind leg. Wing (fig. 30) mainly dark, with pale spots small, radial cell II entirely dark, area beneath R<sub>s</sub> indistinctly paler, costal pale spot II divided into 2 unequal or equal spots, apical pale spots of anal cell confluent in 1 paratype; macrotrichia spread on apical 1/2 and sparse along anal margin of anal cell; costa ending at apical 1/3 of wing length (57 : 85.3), RL–V 29 : 26.3 : 40.3 : 13 : 21, radial cell II slightly longer than I (8.3 : 6.8). Halter with stem white, knob pale brown. Abdomen brown, tergites complete, sternites obscure, cerci pale; spermathecae 2 brown, subequal, oval, 4.5+13.5×10.5 units and 4.5+13.5×9.5 units, each with distinct sclerotized part of duct, 1 brown, tubular, 6.5×1.3 units.

**DISTRIBUTION**: New Guinea, New Ireland.

Holotype ♀ (BISHOP 3236), Kavieng, New Ireland, 4. VI. 1959, Peters. Paratypes: 1 ♀ with holotype; 1 ♀, Bubia, near Lae, New Guinea, 18. III. 1959, Ardley.

Closely allied to *C. schultzei* Enderlein, but easily distinguished by pale spots of wing smaller, no distinct pale spots at apices of median veins, 2 radial cells much longer, antennal sensory tufts present on more flagellar segments. *C. reticulatus* Lutz, known from Brazil and Panama, has similar wing pattern, but pale cloud beneath R<sub>s</sub> forms 1 distinctly isolated spot, apical pale spots of cells M<sub>1</sub>, M<sub>2</sub> and M<sub>4</sub> are separated from wing margin and 3 branches of media end in apical pale spots, differing from the new species.

19. *Culicoides schultzei* Enderlein, 1908, Med. Nat. Gesellsch. Jena, Denkschr. 13: 459.—Okada, 1954, Japan. Jour. Appl. Zool. 19: 5.—Tokunaga, 1959, Pac. Ins. 1: 210.—Nagaty & Morsy, 1960, Egypt. Pub. Health Assoc., Jour. 35: 27. Fig. 4.

*C. oxystoma* Kieffer, 1910, Ind. Mus., Mem. 2: 193.—Edwards, 1922, Bull. Ent. Res. 13: 164.—Tokunaga, 1937, Tenthredo 1: 295, 298, 307.—Arnaud, 1956, Microent. 21: 120.

*C. oxystoma* var. No. 1 Tokunaga, 1950, Japan. Jour. Saint. Zool. 1: 64, 66.

*C. kiefferi* Patton, 1913, Ind. Jour. Med. Res. 1: 336.

*C. punctigerus* Tokunaga, 1951, Saikyo Univ., Agr. Sci. Rep. 1: 101.

Wing pattern variable especially in development of pale spots of cell  $R_5$ . Usually wing cell  $R_5$  bears on midportion 2 gourd-shaped oblique pale spots which are incompletely convergent before vein  $M_1$  forming subpentagonal costal dark spot III and an additional ill-defined pale cloud under the dark radial cells, as in wing of *C. oxystoma* from Taiwan and Japan (Tokunaga, 1937). In darker wing, the convergence is not strong, costal dark spot III being widely open before vein  $M_1$ , costal pale spot II is completely constricted or divided into 2 small spots, of which posterior round spot is reduced in various degrees, and ill-defined pale spot beneath dark radial cells disappears, as shown in wing of a New Guinea specimen (Tokunaga, 1959). In paler wing, 2 pale spots around costal dark spot

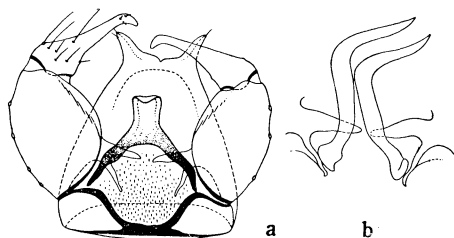


Fig. 4. *Culicoides schultzei*, ♂. a, hypopygium; b, parameres.

III become larger, almost touching each other before vein  $M_1$ , and pale spot beneath dark radial cells enlarged, taking a definite oval shape and almost uniting with costal pale spot I basally and with anterior part of costal pale spot II apically, as shown in the wing of Java specimen (Tokunaga, as *punctigerus*, 1951). Beside above variation, following modification observed in specimens from New Guinea: in ♂, apical pale spot around costal dark spot III unequally constricted, posterior part being small and consequently posterior part of dark spot being widely open, and in another case of modification (♀), apical pale spot enlarged and completely united with posterior separated pale spot of costal pale spot II, consequently costal dark spot III open between 2 pale spots of II.

The ♂ hypopygium of this species is well known and accurately shown by Arnaud (1956) and me (1937). In these typical cases, parameres slender, sharply pointed and sometimes sparsely pubescent at tips. While, in 2 ♂♂ of New Guinea, the general structure is similar to the typical species (fig. 4a), parameres alone are different, being stout, much shorter, less undulate and bare at tips (fig. 4b). The intermediate shape, however, may be found by further research.

Additional notes observed on New Guinea specimens are as follows:

*Female*: Proboscis about 1/2 as long as head-capsule; palp with PR about 2.23. AR 0.94–1.13; sensory tufts present on segments II and VII–IX. Hind tibial comb with apical bristles 4 and rarely 3; hind TR 2.1–2.18.

*Male*: Antenna with sensory tufts on segments II and IX–X.

**DISTRIBUTION**: India, Thailand, Burma, Malaya, Philippine, Formosa, Java, New

Guinea, N. China, Manchuria, Korea, SW & N. Africa.

SPECIMENS EXAMINED: 33 ♀♀, 51 ♂♂, Minj, W. Highlands, NE New Guinea, 8. V. 1959, Peters; 4 ♀♀, Bubia, near Lae, New Guinea, 5-8. III. 1959, Ardley.

20. *Culicoides neopalpalis* Tokunaga, n. sp. Figs. 5, 31.

Minute, pale; eyes distinctly pubescent, palps stout, short, ♂ antenna 12- or 13-segmented, thorax mainly pale yellow, scutum with pale brown clouds ill-defined, legs mainly pale brown with white bands basad and apicad of knees broad, wing pattern similar to that of *robertsi* but much paler as in *palpalis*, radial cell II almost entirely dark, apical end of vein Rs paler, spots generally small, apical pale spots obscure, macrotrichia sparsely spread around apical margin in ♀. Spermathecae unequal; ♂ hypopygium similar to that of *semicircum*.

*Female*: Body length 1.07 (0.91-1.24) mm. Wing 0.88 (0.83-0.96) × 0.39 (0.36-0.42) mm. Head brown, with eyes distinctly pubescent, broadly contiguous, proboscis short, only about 1/3 of head-capsule. Palp pale brown, stout, segment III short-oval, with sensory pore on preapical part large; RL-P 4.7 : 6.8 : 11.2 : 4.6 : 5.1. Antenna with scape brown, other segments paler, basal short flagellar segments round to short-oval; sensory tufts present on II, IX, XI, and XIII, and rarely also on X; AR 1.83(1.7-2.2), RL-8A 6.7 : 6.6 : 8.3 : 16.8 : 17.1 : 19 : 20.3 : 25.8. Thorax mainly pale ochreous, scutellum pale fuscous along anterior marginal part, on central part of caudoscuteal area and along foveae, post-scutellum entirely pale fuscous, scutellum with 2 lateral, 1 (rarely 2) central bristles and 0-2 median small setae.

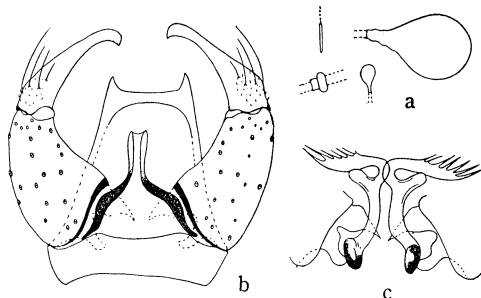


Fig. 5. *Culicoides neopalpalis*. a, spermathecae; b, ♂ hypopygium; c, parameres.

Legs with coxae and trochanters pale brown, tarsi pale brown on basal segments, paler on apical segments, femora largely brown, but with bases paler, apical 1/3 or 1/4 white, knees dark on fore and hind legs, pale brown on mid leg, tibiae largely brown, but with sub-basal parts widely white and apical part of hind tibia narrowly white; claws simple, hind tibial comb with apical bristles 4 (rarely 5); TR and RL-L 2.99 (2.85-3.18) and 19.7 : 19.3 : 10.4 : 3.1 : 2.3 : 1.9 : 2.1 in fore, 3.99 (3.36-4.16) and 25 : 24.7 : 14.2 : 3.4 : 2.9 : 2 : 2.5 in mid, 2.85 (2.67-3.1) and 24.3 : 24.2 : 10.8 : 3.8 : 3.1 : 2 : 2.5 in hind leg. Wing (fig. 31) with pattern paler, pale spots small and obscure, costal pale spot II enveloping only apical tip of vein Rs, radial cell II almost entirely dark; macrotrichia sparsely spread only on marginal area of wing between tips of veins Rs and  $M_{3+4}$ ; venation: costa ending at basal 0.65 of wing length (44.8 : 68.5), RL-V 21.9 : 20.3 : 30.1 : 9.5 : 16.4, radial cell II slightly longer than I (6.5 : 5.5). Halter white. Abdomen whitish, with tergites pale, segment VIII brown, IX and cerci white; spermathecae (fig. 5a) brown, unequal, larger one short-oval or pyriform, 3.3+16 × 11.9 units, smaller one short-oval, 2.4+3.9 × 3.2 units, each with distinct chitinized part of duct, vestigial one tubular, 4.4 × 0.2 units.

*Male*: Body 1.1 (0.91–1.2) mm long. Wing 0.75 (0.73–0.78) × 0.32 (0.3–0.33) mm. Coloration and general structure as in ♀ with usual sexual differences. RL–P 3.8 : 3.1 : 6.8 : 3.5 : 5.3. Antenna 13-segmented, sometimes segments IX and X fused into single segment, X without plumose hairs; combined RL of II–X and XI–XIII taken together 64.8 : 74.8, RL–8A 7 : 6.6 : 6.6 : 6 : 6 : 23 : 23.1 : 27.5 (when 12-segmented IX+X=4+6); sensory tufts present on II and X–XII. Scutellum with median small setae 0–2. Legs paler than in ♀; TR and RL–L 3.0 (2.83–3.1) and 18.1 : 17 : 9.2 : 3.5 : 2.5 : 1.8 : 2.4 in fore, 3.84 (3.7–4.0) and 22.2 : 21.8 : 12.5 : 3.3 : 2.7 : 1.9 : 2.5 in mid, 2.78 (2.7–3.0) and 20 : 19.9 : 9.1 : 3.2 : 2.6 : 2 : 2.5 in hind leg. Wing paler, pale spots larger than in ♀, with macrotrichia sparsely spread along wing margin between apices of veins Rs and M<sub>2</sub>; venation: costa ending at basal 0.62 of wing length (35.6 : 57.6), RL–V 18.2 : 17 : 26.6 : 6.8 : 10.8, radial cell II subtriangular, hardly as long as I. Abdomen almost white, with tergites and sternites much reduced, caudal segments and hypopygium pale brown, parameres yellow. Hypopygium (fig. 5b) with tergite elongate, tapered, anal points short, subtriangular; sternite with caudal margin slightly concave; coxite slender, conical, with basal roots, one sharply pointed and subtriangular, one finger-like; style tapered, slender, as long as coxite (22 : 23.2), curved at tip; aedeagus broad on basal 1/2, slender on apical 1/2, with lateral thickenings, basal arch about 1/3 of total length, basal membrane smooth; paramere (fig. 5c) slender, undulate, with tubercular process at middle, apical 1/3 flattened and serrated into 7–8 teeth on one side.

DISTRIBUTION: New Guinea.

Holotype ♀ (BISHOP 3237), Maprik, Sepik Distr., New Guinea, I. 1959, Peters. Allotype: ♂ with holotype. Paratopotypes: 9 ♀♀, 4 ♂♂ with types; 5 ♀♀, 2 ♂♂, II. 1959, Peters. *Other specimens*: 36 ♀♀, 2 ♂♂ with types; 12 ♀♀, 1 ♂, Maprik, New Guinea, 7. III. 1959, Peters; 2 ♀♀, 3 ♂♂, Bainyik, Sepik Distr., New Guinea, III. 1959, Peters.

Resembles *palpalis* in pale wing pattern, but may be easily distinguished from it by more widely spread macrotrichia of ♀ wing, paler thoracic sclerites, non-cornuted aedeagus and tuberculate parameres of the ♂ hypopygium.

## 21. *Culicoides submagnesianus* Tokunaga, n. sp. Fig. 32.

Small, dark brown; generally similar to Australian *C. magnesianus* Lee & Reye, with slender yellow stripes on scutum, yellow bands on legs, large pale spots on wings; palp with scattered surface sensillae, legs with penultimate tarsal segments cordiform. Male unknown.

*Female*: Body 1.39 (1.27–1.5) mm long. Wing 0.98 (0.89–1.03) × 0.42 (0.39–0.44) mm. Head entirely dark brown, with eyes bare, narrowly separated, proboscis about 1/2 as long as head-capsule. Palp stout, segment III elongate-oval, without definite sensory pore but with scattered surface sensillae on apical 1/2, PR about 2.0 (14.8 : 7.8); RL–P 5.8 : 10.6 : 14.8 : 6.8 : 9.6. Antenna with scape dark brown, basal short flagellar segments pale ochreous, but gradually browner on apical segments, apical 5 segments brown, III–IX round to short-oval; sensory tuft present on II and VI–IX but rarely absent on VI; AR 1.02 (0.93–1.09), RL–8A 8.1 : 8.1 : 8 : 11.4 : 11.3 : 11.4 : 12.9 : 20.2. Thorax largely dark brown, scutum with slender yellow stripes along foveae, obscure ochreous clouds covering scutal sutures, scutellum yellow, with 2 lateral, 2 median bristles and 0–6 median small setae.

Legs: fore leg with coxa and trochanter pale brown or ochreous, femur pale brown but basal and preapical parts yellow, knee dark brown, tibia dark with yellow bands on subbasal and apical part; in middle leg, coxa dark brown, trochanter brown, femur and tibia as in fore but knee and middle part of tibia brown; in hind leg, coxa and trochanter as in middle, femur and tibia as in fore but femur darker and knee brown; tarsi of all legs pale brown. Claws simple; tarsal segment IV cordiform, hind tibial comb with apical bristles 5. TR and RL-L 2.79 (2.53-2.93) and 22.3 : 20.8 : 11.1 : 3.9 : 2.6 : 1.9 : 2.8 in fore, 3.43 (3.26-3.69) and 28.3 : 28 : 16.7 : 4.8 : 3.2 : 2 : 3.1 in mid, 2.27 (2.17-2.35) and 25.9 : 24.9 : 12.4 : 5.4 : 3.6 : 1.9 : 2.9 in hind leg. Wing (fig. 32) with marking of prevalent type, but pale, pale spots large, radial cell II and apical 1/2 of cell I covered by dark spot, rarely costal pale spot III reduced, separated from wing margin by pale fuscous cloud, and apical pale spot of cell  $M_1$  shorter than in figure, being more widely separated from basal pale spot; macrotrichia rather sparsely spread on apical 1/4, sparsely on cell  $M_4$  and anal cell or arranged in single line along wing margin; venation: costa ending at apical 2/5 of wing length (49.8 : 75.6), RL-V 22.8 : 21.8 : 32.6 : 11.4 : 18, radial cell II elongate-oval, shorter than I (5.2 : 6.6). Halter mainly white, but slightly fuscous on basal 1/2 of knob. Abdomen pale brown but browner on caudal segments, with cerci brown; spermathecae 2 brown, subequal, short-oval, 1+11.8×9.5 units and 1+10.8×9.3 units, each with minute chitinized part of duct, vestigial one tubular, brown, 4.9×1.4 units.

DISTRIBUTION: New Guinea (Papua).

Holotype ♀ (BISHOP 3238), Port Moresby, Papua, I. 1960, Peters. Paratypes: 20 ♀ ♀ with holotype.

Allied to *magnesianus* Lee & Reye from which it may be distinguished by palp without sensory pore, short basal flagellar segments not entirely round, segments X-XIII each much shorter than VIII-IX taken together, AR much smaller than 1.76, hind TR much larger than 1.93, and spermathecae not round but short-oval.

22. *Culicoides robertsi* Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77 : 386. Figs. 6, 33.

Minute, brown; eyes minutely pubescent in ♀, distinctly in ♂, palp slender, thorax almost uniformly brown, legs generally pale, but ♀ with white broad bands, wing pattern distinct on costal area but faint on posterior part. Male hypopygium with sternum widely V-shaped on caudal margin, anal point almost absent or obtuse, paramere small, wide on midportion and setiform apically.

*Female*: Body 1.0 (0.9-1.13) mm long. Wing 0.76 (0.72-0.82)×0.33 (0.31-0.34) mm. Head brown, with eyes minutely pubescent entirely, contiguous, proboscis long, about 0.64 as long as head-capsule. Palp slender, segment III elongate-oval, sensory pore on apical part small; PR about 2.4, RL-P 5 : 12.5 : 11.4 : 5.6 : 6.4. Antenna with scape dark brown, other segments brown, short basal flagellar segments short-oval to elongate-oval; AR 1.18 (1.09-1.23), RL-8A 7.3 : 7.6 : 8.4 : 11.2 : 11.7 : 13.2 : 12.6 : 20.2; sensory tufts present on II and XI-XIV. Thorax entirely brown, scutellum with 2 lateral small setae and single median bristle.

Legs pale brown, with white bands; coxae as brown as thorax, trochanters, femoral bases and tarsi white, femora and tibiae pale brown, but apical parts of fore and middle femora, sub-basal parts of all tibiae and apical parts of mid and hind tibiae broadly white;

hind tibial comb with apical bristles 5, rarely 6; TR and RL-L 2.55 (2.42-2.66) and 17 : 16.8 : 8.8 : 3.4 : 1.2 : 1.7 : 2.1 in fore, 2.92 (2.8-3.0) and 21 : 21 : 11.4 : 4 : 2.5 : 1.8 : 2.3 in mid, 1.86 (1.76-1.94) and 20.2 : 20.4 : 8.9 : 4.8 : 2.8 : 1.9 : 2.4 in hind. Wing (fig. 33) with distinct pattern on costal area and faint on posterior part, all marginal pale spots abutting on wing margin, costal pale spot II semi-circular, enveloping only apical tip of marginal vein of radial cell II or not enveloping, basal pale spot of cell  $M_1$  and pale area above vein  $M_{3+4}$  usually faint and ill-defined and sometimes almost absent; macrotrichia sparsely arranged along wing margin only; venation: costa ending at basal 0.6 of wing length, RL-V 17.2 : 16.2 : 26.8 : 7.6 : 11.8, radial cell II

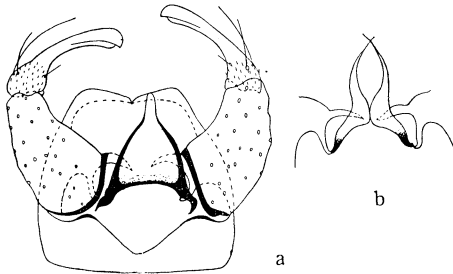


Fig. 6. *Culicoides robertsi*, ♂. a, hypopygium; b, parameres.

small, round, shorter than slit-like I. Halter white. Abdomen faintly fuscous, with tergites pale brown, caudal segments browner; cerci pale yellow, spermathecae brown, 2 functional, short-oval or round, equal,  $0.6+9.8 \times 8.3-8.2$  units respectively, each with minute sclerotized part of duct or without it, 1 vestigial tubular,  $3.5 \times 0.5$  unit, in 1 ♀ vestigial spermatheca abnormally well developed and almost as large as other 2.

*Male*: Body 1.21 (1.04-1.37) mm long. Wing  $0.88 (0.81-0.94) \times 0.31 (0.29-0.33)$  mm. General color similar to that of ♀ but legs almost entirely whitish, wing with fainter pattern and pale spots larger than in ♀, main structures also similar to those of ♀. Head with eyes distinctly pubescent. Palp slender, pale, RL-P 5 : 10.5 : 10.5 : 6.5 : 7. Antenna with scape brown, other segments and plumose hairs pale or whitish, but last 3 segments browner, XI normal, with plumose hairs; combined lengths of II-XI and XII-XIV 98.6 : 67.5. RL-8A 10.2 : 10.1 : 9.8 : 9.1 : 8.3 : 25.2 : 19.8 : 22.2; sensory tufts on II and XII-XIV. Thorax uniformly brown, but scutum paler on foveae and caudoscuteal area, scutellum with a single median bristle.

Legs with coxae as brown as thorax but other segments whitish, knees pale brown; claws cleft at extreme tips, hind tibial comb with apical bristles 5, rarely 4 or 6; TR and RL-L 2.5 (2.38-2.6) and 20.2 : 19.2 : 10.4 : 4.1 : 3.1 : 2 : 2.4 in fore, 2.7 (2.65-2.76) and 25 : 24.4 : 14.2 : 5.4 : 3.2 : 2 : 2.5 in mid and 1.73 (1.63-1.8) and 22.6 : 22.6 : 10.8 : 5.7 : 3.6 : 2.1 : 2.4 in hind. Wing elongate-oval, with faint pattern, pale spot somewhat larger than in ♀, radial cell II enveloped by pale spot only over tip of marginal vein, costal dark band III larger than II; Macrotrichia sparsely arranged in a line along wing margin; costa ending at basal 0.6 of wing length, RL-V 23.6 : 21.8 : 34.8 : 7.6 : 11, radial cell II short-oval, shorter than I, fMCu under tip of  $R_1$ ,  $Cu_1$  meeting anal margin with right angle. Abdomen whitish, caudal 3 or 4 segments brown; hypopygium (fig. 6a) brown, styles and parameres pale; tergite with caudal end broad, slightly concave, anal point obtuse and subtriangular; sternite with large V-shaped caudal concavity; coxite with 2 basal roots slender, equal; style slightly arcuate, almost as long as coxite (19.2 : 20.2); aedeagus elongate-triangular, with basal arch 1/4 of total length, median caudal lobe small, also 1/4 as long as total length; paramere (fig. 6b) small, as long as aedeagus, broad on midportion, tapered on apical 2/3, ending in setiform tip.

DISTRIBUTION: Australia, New Guinea, Solomon Is.

SPECIMENS EXAMINED: 20 ♀♀, 16 ♂♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 6 ♀♀, 3 ♂♂, ditto, II and 5. III. 1959, Peters; 24 ♀♀, 16 ♂♂, Minj, W. Highlands, NE New Guinea, 8. V. 1959, Peters; 2 ♀♀, Bubia, near Lae, New Guinea, 26–27. IV. 1959, Ardley; 1 ♀, Kieta, Bougainville I., Solomon Is., 26. V. 1959, Peters.

The ♂ from Hollandia which was reported in my previous paper as *orientalis* must be corrected to *robertsi*.

23. *Culicoides palpalis* Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77: 380. Figs. 7, 34.

Minute, dark brown or brown; palpal segment III large, oval, scutum with many pale brown spots, ♀ legs generally pale, with pale yellow bands, ♂ legs generally brown, with distinct white bands, wings with pale pattern and macrotrichia spread sparsely on almost entire surface of ♀ and on marginal area between ends of veins Rs and  $M_{3+4}$  in ♂. Male hypopygium: aedeagus with basal arch broad, 1 pair of conspicuous processes on shoulder parts, paramere strongly undulate, slender, with serration on apical part.

*Female*: Body length 1.19 (1.04–1.3) mm. Wing 0.94 (0.89–1.0) × 0.41 (0.39–0.43) mm. Head and mouth parts dark brown or brown, with eyes bare, narrowly separated, proboscis about 1/2 as long as head-capsule. Palp stout, brown, segment III large, oval, with sensory pore on preapical part large and deep; PR 1.7, RL-P 4.4 : 7.4 : 17.6 : 4.3 : 6.6. Antenna brown, with short basal flagellar segments short-oval, round or slightly discoidal; AR 1.43 (1.3–1.59), RL-8A 6.1 : 6.4 : 7.1 : 12.1 : 12.6 : 13.3 : 14.6 : 20.8; sensory tufts present on II–XIII and rarely II–XII. Thorax dark brown or brown, scutum pale brown on much of caudoscuteal area, with many small pale spots: 2 pairs of elongate median spots between foveae on anterior 1/2, 3 lateral spots before scutal suture, 1 larger lateral spot behind scutal suture, scutellum with 2 lateral, 2 or rarely 3 median bristles and 3–11 minute median setae.

Legs with coxae brown, other segments paler, knees brown, trochanters and tarsi pale ochreous, basal parts of femora and apical parts of tibiae pale yellow, fore and mid legs with pale yellow bands basad and apicad of knees, hind with similar band on sub-basal part of tibia; claws simple, hind tibial comb with apical bristles 4, rarely 5; TR and RL-L 2.67 (2.46–2.8) and 20.6 : 19.8 : 9.7 : 3.6 : 2.7 : 2.1 : 2.7 in fore, 3.43 (3.35–3.53) and 26.1 : 24.7 : 14.2 : 4.2 : 3.1 : 2.2 : 2.8 in middle, 2.28 (2.11–2.42) and 25.1 : 23.6 : 11 : 4.8 : 3.1 : 2.3 : 2.9 in hind leg. Wing (fig. 34) with pale but definite pattern, pale spots small, costal pale spot I oval, abutting on costa, costal pale spot II somewhat oblique, not enveloping radial cell II, costal pale spot III oval, separated from wing margin, other posterior marginal spots more or less abutting on wing margin, no pale spot just above fMCu; venation: costa ending at basal 0.61 of wing length (44 : 72.2), RL-V 21.6 : 19.4 : 30.2 : 10.4 : 15.8, radial cell II entirely dark, as long as I, macrotrichia spread on apical 1/2 of wing, on cell  $M_4$  and anal cell. Halter pale yellow.

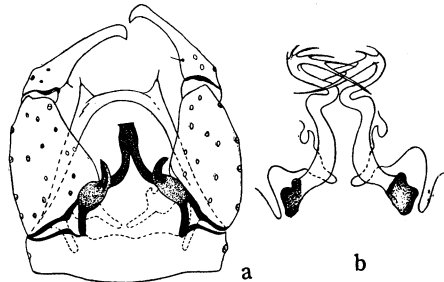


Fig. 7. *Culicoides palpalis*, ♂. a, hypopygium; b, parameres.

Abdomen pale brown, almost white, with caudal segments browner; cerci pale, spermathecae brown, 2 functional pyriform, subequal,  $4.8+14.4 \times 11.1$  units and  $4.7+12.4 \times 10$  units, each with sclerotized part of duct distinct, tapered, 1 vestigial tubular,  $7.8 \times 0.6$  unit.

*Male*: Body 1.33 mm long. Wing  $0.79 \times 0.31$  mm. General color and structure similar to ♀, but legs browner, with femora and tibiae brown and adorned with distinct white bands. Head with PR 1.7, RL-P 5 : 7.5 : 11 : 5 : 7. Antenna with scape dark brown, other parts pale brown, last 3 segments browner, combined lengths of II–XI and XII–XIV 82 : 56, RL–8A 7 : 7 : 7 : 7 : 8 : 20 : 15 : 21, sensory tufts on II, VII, IX–X and XII–XIII. Thorax dark brown, scutum with many irregular pale spots, scutellum with 2 lateral, 2 median bristles and 2 minute accessory setae.

Legs with coxae and trochanters brown, knees dark, tarsi white, femora and tibiae largely brown, with white bands on femoral bases, preapical parts of fore and mid femora, sub-basal parts of tibiae, and apical parts of mid and hind tibiae; TR and RL–L 2.54 and 19.5 : 18 : 9 : 3.4 : 2.8 : 2 : 3 in fore, 3.13 and 24.6 : 23 : 13 : 4 : 3 : 2 : 4.2 in middle, 2.1 and 21 : 20.5 : 10.5 : 4.7 : 3 : 2.5 : 4 in hind leg; claws bifid at tips, hind tibial comb with apical bristles 4. Wing with pattern as in ♀, but pale spots slightly larger, macrotrichia spread on apical 1/2 of cell  $R_5$ , apical 1/3 of cell  $M_1$  and apical corner of cell  $M_2$ ; venation: costa ending at basal 0.54 of wing length, RL–V 17 : 16 : 26 : 6 : 9, radial cell II short, subtriangular, about 1/2 as long as I, fMCu under septum between radial cells. Abdomen almost white; hypopygium (fig. 7a) brown, tergite tapered, with anal points short, triangular, caudal margin round; sternite with caudal margin faint, without distinct concavity; coxite short, tapered, with 2 basal roots distinctly unequal, anterior slender, posterior with small process on broad basal part; style slender, much shorter than coxite (21 : 26); aedeagus with broad basal arch, lateral sclerite inflated and with small process on shoulder part, median lobe short; paramere (fig. 7b) dark on base, yellow on other part, slender, strongly undulate, serrated on apical 1/4 into 5–6 sharp teeth.

DISTRIBUTION: Australia, New Guinea (Papua).

SPECIMENS EXAMINED: 14 ♀♀, Goldie River, near Port Moresby, Papua, 25. IX. 1959, Ardley; 12 ♀♀, 1 ♂, Port Moresby, Papua, I. 1960, Peters.

#### 24. *Culicoides pallidimaculosus* Tokunaga, 1959, Pac. Ins. 1 : 219. Fig. 8.

Many specimens of both sexes have been examined and the original description which was of 2 ♂ specimens is supplemented with the following observations:

Small, pale brown or brown and yellow; scutum with many yellow spots; wing with pale pattern, many large pale spots ill-defined, in ♀ macrotrichia sparsely spread on apical 1/4 of wing, in ♂ sparsely arranged along apical margin; legs with white bands; spermathecae: 1 large, 1 much smaller, 1 vestigial; ♂ hypopygium with tergite long, anal point well developed, paramere with preapical tubercle and serrate on apical margin. General color and structure of ♀ as in original description.

*Female*: Wing  $0.94 (0.91-1.0) \times 0.41 (0.4-0.43)$  mm. Head with eyes slightly pubescent on middle parts of frontal aspect or almost bare, proboscis about 0.45 of length of head-capsule. Palp with PR 1.65, RL–P 4.5 : 8.7 : 11.3 : 4.4 : 5. Antenna with sensory tufts on segments II, IX, XI and XIII, or II and IX–XIII and sometimes II and VIII–XIII, AR 1.6 (1.46–1.66), RL–8A 7.3 : 7.4 : 7.9 : 17.2 : 17.2 : 18.5 : 19.2 : 25.3. Thoracic scutellum



with 2 lateral, 1 median bristles and 2-3 small accessory setae.

Legs with claws simple, hind tibial comb with apical bristles 4; TR 2.99 (2.86-3.08) in fore, 4.17 (3.73-4.58) in mid, 2.62 (2.41-2.73) in hind leg. Wing with pattern as in original figure, small dark spot at preapical angle of vein Rs characteristic, vein  $M_1$ ,  $M_2$ ,  $M_{3+4}$  and  $Cu_1$  each ending in fuscous spot, costa ending at basal 0.65 of wing length (45.9 : 70.7). 3 spermathecae  $5.2+14.4 \times 11.3$  units,  $1.2+4.2 \times 3.2$  units and  $5.5 \times 0.6$  units respectively.

**Male:** Body 1.11 (1.04-1.24) mm long. Wing  $0.8 (0.74-0.82) \times 0.33 (0.31-0.34)$  mm. Coloration generally as in ♀. Head with eyes

slightly pubescent or almost bare, just contiguous. Palp stout, segment III short-oval, with sensory pore on apical 1/2 large, PR 1.16, RL-P 3.3 : 4.8 : 8 : 4.1 : 5.8. Antenna with scape brown, other segments and plumose hairs pale brown, XI without plumose hairs; combined lengths of II-XI and XII-XIV 80.2 : 63.8, RL-8A 7.6 : 7.4 : 7.3 : 6.7 : 7 : 21.8 : 19.4 : 22.4; sensory tufts present on II and XI-XIII and rarely II, XI and XIII.

Hind femur without apical white band and tibia with white apical band differing from those of fore and mid legs; claws cleft at extreme apices; TR 2.94 (2.71-3.09) in fore, 4.07 (3.84-4.36) in mid, 2.48 (2.28-2.6) in hind. Wing with pattern paler than in ♀, costal pale spot II extending towards wing base under dark radial cells to some extent, but small dark spot at preapical angle of Rs distinct, macrotrichia arranged along wing margin between tips of costa and vein  $M_2$ ; costa ending at basal 0.56 of wing length, RL-V 19.6 : 18.8 : 28.6 : 6.9 : 11.4, radial cell II subtriangular, a little longer than I, fMCu under radial septum. Abdomen whitish, pleural membranes faintly fuscous, sclerites reduced. Hypopygium (fig. 8a) brown; tergite elongate, tapered, with anal points well developed; sternite with caudal margin slightly arcuate; coxite with basal roots unequal; style shorter than coxite (21.6 : 24.4); aedeagus with lateral sclerites slender, basal arch large, about 1/2 of total length; paramere (fig. 8b) with tubercle beyond middle, apical 1/3 curved and serrate, with 5-7 teeth on one side. Other structures as in ♀.

**DISTRIBUTION:** New Guinea, New Britain, New Ireland, Solomon Is.

**SPECIMENS EXAMINED:** 14 ♀ ♀, 1 ♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 8 ♀ ♀, 4 ♂ ♂, ditto, II. 1959, Peters; 4 ♀ ♀, Bubia, near Lae, New Guinea, 2. II-18. III. 1959, Ardley; 6 ♀ ♀, 1 ♂, Bainyik, Sepik Distr., New Guinea, III. 1959, Peters; 1 ♂, Lowlands Agr. Sta. Keravat, New Britain, 22-26. VIII. 1960, Smee; 7 ♀ ♀, Kavieng, New Ireland, 4. VI. 1959, Peters; 7 ♀ ♀, Inis Atoll, Bougainville I., Solomon Is., 26-27. V. 1959, Peters; 68 ♀ ♀, 7 ♂ ♂, Kieta, Bougainville I., Solomon Is., 26. V. 1959, Peters.

## 25. *Culicoides flaviscriptus* Tokunaga, 1959, Pac. Ins. 1 : 252.

Small, brown and yellow; highly specific yellow markings on scutum as in *petersi* and *dikhros* and 3 equally well developed spermathecae.

**DISTRIBUTION:** New Guinea.

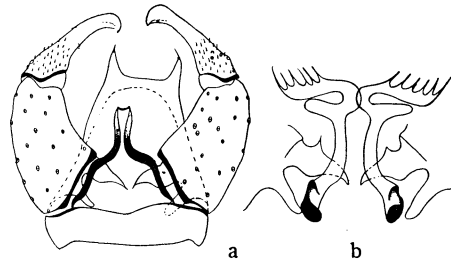


Fig. 8. *Culicoides pallidimaculosus*, ♂. a, hypopygium; b, parameres.

**26. *Culicoides petersi* Tokunaga, n. sp. Fig. 35.**

Small, dark and yellow; eyes distinctly pubescent, palp stout, scutum of thorax dark on anterior 1/2, yellow on posterior 1/2 as in *flaviscryptus*, wings with pattern and macrotrichial distribution as in *orientalis*, but radial cell II almost entirely dark, only apical end of vein Rs covered by costal pale spot II as in *robertsi*, spermatheca quite unequal. Male unknown.

*Female*: Body 1.16 (1.01–1.3) mm long. Wing 0.9 (0.87–0.95) × 0.41 (0.39–0.44) mm. Head brown, with eyes entirely pubescent, widely contiguous, proboscis short, only 0.4 as long as head-capsule. Palp brown, stout, segment III short-oval, with sensory pore on apical 1/2 deep; RL–P 4.8 : 7.8 : 11.8 : 4.8 : 4.9. Antenna with scape dark brown, other segments paler, basal short flagellar segments short-oval; AR 1.65 (1.55–1.83), RL–8A 6.9 : 7.1 : 9 : 17.3 : 17.3 : 19.4 : 19.8 : 23.5; sensory tufts present on II, IX, XI and XIII. Thorax mainly brown or dark brown, but scutum and scutellum with conspicuous yellow markings: scutum clear yellow on caudal 1/2, yellow areas not extending forwards beyond scutal sutures on lateral sides but yellow median area extending far forwards reaching level of humeral pits, dark brown areas extending backwards along foveae, dark anterior area with small yellowish clouds on humeral angles and behind humeral pits, yellow posterior area with small fuscous median clouds at center and just before middle of caudal margin, scutellum mainly yellow, with median fuscous cloud, 2 lateral, single median bristles and 0–3 median small setae.

Legs mainly dark brown, but bases of femora, tarsal segments, preapical part of hind femur, and apical part of hind tibia paler, fore and hind knees black, mid knee brown, fore and middle legs with distinct yellow bands basad and apicad of knees, hind leg with similar band apicad of knee; claws simple, hind tibial comb with apical bristles 4, rarely 5; TR and RL–L 3.1 (2.71–3.45) and 19.8 : 18.8 : 10.3 : 3.4 : 2.5 : 1.9 : 2.3 in fore, 3.98 (3.84–4.16) and 25.1 : 25.3 : 13.1 : 3.3 : 2.6 : 2 : 2.4 in mid, 3.08 (2.71–3.46) and 24.5 : 24 : 10.4 : 3.4 : 2.8 : 2 : 2.4 in hind leg. Wing (fig. 35) with pattern similar to that of *orientalis* but with obscure paler marginal spots, radial cell II almost entirely dark, except for apical part of vein Rs, costal pale spot II smaller than I, pale stripes along both sides of vein M<sub>1</sub> present but fuscous small cloud covering apical part of this vein; macrotrichia sparsely spread on apical 1/4 of wing; venation: costa ending at basal 0.65 of wing length (45 : 69.5), RL–V 22.3 : 20.5 : 31 : 9.8 : 16.8, radial cell II elongate-subtriangular, as long as I (6.3 : 6.8). Halter white. Abdomen pale gray, with tergites only slightly developed, caudal segments brown, cerci white; spermathecae unequal: larger one oval or elongate-oval, brown, 4+15.5×11.9 units, with chitinized part of duct distinct, smaller one similar in shape but much smaller and paler, 2+5×3.7 units, vestigial one tubular.

DISTRIBUTION: New Guinea.

Holotype ♀ (BISHOP 3239), Maprik, Sepik Distr., New Guinea, I. 1959, Peters. Paratypes: 4 ♀♀ with holotype.

Allied to *flaviscryptus* in coloration, but distinguished by single large spermatheca, larger hind TR, 2.71–3.46 instead of 2.58, and paler or ill-defined wing pattern, from allied species.

**27. *Culicoides tripallidus* Tokunaga, 1959, Pac. Ins. 1 : 221.**

Large, dark brown; wing broadly infusate and with only 3 large pale spots: one on

wing base covering arculus, one on midportion covering r-m and one covering 1/2 of radial cell II.

DISTRIBUTION: New Guinea.

28. *Culicoides novaguineanus* Tokunaga, 1959, Pac. Ins. 1: 223. Fig. 9.

Closely allied to *amamiensis*, but easily distinguished by the presence of 2 pale spots in wing cell  $M_4$ . The ♀ has been fully described from 8 specimens in the original report. The ♂, however, has been described from a single specimen. This supplement and correction of the original report is the result of examination of additional specimens.

*Female*: Antenna with sensory tufts on segments II and X–XIV. Hind tibial comb with apical bristles 5. Other characters as in original description.

*Male*: Wing  $0.99 (0.9-1.04) \times 0.36 (0.31-0.38)$  mm. Color as in original report. Mouthparts with RL–P 5 : 11.4 : 11.8 : 6.6 : 7.4. Antenna with sensory tufts on segments II and XII–XIV, combined lengths of II–XI and XII–XIV about 117.4 : 89.6, RL–8A 12.2 : 11.6 : 11.2 : 10.4 : 10.2 : 27.6 : 26 : 34.4. Thoracic scutellum with 2 small lateral and 1 large median setae. Legs with TR 2.77 (2.71–2.94) in fore, 3.09 (2.85–3.2) in mid, 2.16 (1.93–2.37) in hind. Wing with costa ending at basal 0.69 of wing length, RL–V 26.6 : 24.8 : 37.4 : 9.6 : 18.2, radial cell II elongate, longer than I (8.8 : 6.4). Hypopygium (fig. 9a) generally as in original drawing; tergite without anal points but with 2 close blunt median lobes on caudal margin; coxite with minute spicules on mesal side, 2 basal roots fused forming wide plate with 2 points; aedeagus elongate, triangular, with basal membrane bare; paramere (fig. 9b) with base thick, tapered apically, with pubescent apex. Other structures as in original report.

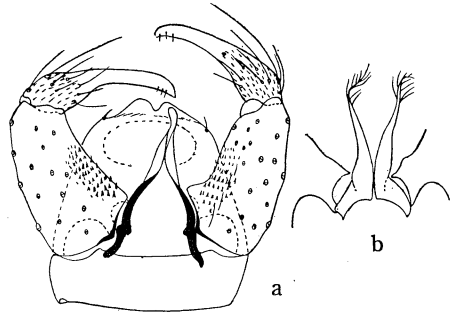


Fig. 9. *Culicoides novaguineanus*, ♂. a, hypopygium; b, parameres.

DISTRIBUTION: New Guinea, New Britain.

SPECIMENS EXAMINED: 27 ♀♀, 8 ♂♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 6 ♀♀, 1 ♂, ditto, II and 7. III. 1959, Peters; 9 ♀♀, 9 ♂♂, Bubia, near Lae, New Guinea, 2. II–12. III. 1959, Ardley.

29. *Culicoides marksii* Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77: 392. Fig. 36.

Medium-sized, dark brown; scutum with brown irregular spots, legs with distinct dark and yellow bands, wing pattern clear and with many pale spots, wing cell  $R_5$  with 3 pale spots on apical part beyond costal pale spot II, elongate spots straddling basal portions of veins  $M_1$  and  $M_2$ , cell  $M_4$  with 2 pale spots, small pale spot present just above fMCu, macrotrichia densely spread over almost all of surface, 3 spermathecae well developed, subequal, hemispheric.

*Female*: Body 1.47–1.65 mm long. Wing  $1.04-1.13 \times 0.44-0.51$  mm. Head dark brown, with eyes bare, separated by width of 1 facet or less, proboscis about 0.63 as long as head-capsule. Palp brown, slender, segment III with sensory pore on apical 1/2 shallow; PR

2.31, RL-P 8 : 17 : 18.5 : 9 : 9.5. Antenna with scape dark brown, segments II-VII yellow on each basal part, brown on apical part, VIII-XIV brown, III-IX oval to elongate-oval (with indistinct neck parts on apical segments); sensory tufts present on II and X-XIV; AR 1.03-1.09, RL-8A 9.8 : 9.8 : 10 : 14 : 14.5 : 15.8 : 16.5 : 24.8. Thorax mainly dark brown, scutum with complicated brown spots, scutellum pale ochreous, with median brown spot, 1 paratype with additional lateral small brown spots, with 2 lateral, 2-3 median bristles and 6-10 small accessory setae.

Legs with distinct yellow and dark bands, coxae brown, trochanters and tarsi yellow or pale yellow, knees black, basal 1/2 of femora and apical 1/3 of tibiae of fore and middle legs pale ochreous, basal 1/2 of hind femur and apical 1/2 of hind tibia yellow, legs with yellow bands basad and apicad of knees and dark bands just beyond middle of femora and on midportion of tibiae; claws simple, hind tibial comb with apical bristles 4 and sometimes 3; TR and RL-L 2.59 (2.35-2.75) and 23.5 : 22.3 : 11.7 : 4.6 : 3.3 : 2.7 : 3.3 in fore, 3.0-3.3 and 31 : 29 : 15.8 : 5 : 3.8 : 2.9 : 3.7 in mid, 2.33-2.48 and 28.2 : 27.2 : 14.5 : 6.8 : 4.4 : 3.5 : 4 in hind. Wing (fig. 36) with distinct pattern, many pale spot, cell  $R_5$  with 6 spots, 2 oblong spots straddling basal parts of vein  $M_1$  and  $M_2$ , apical pale spots of cell  $R_5$ ,  $M_1$  and  $M_2$  just separated from or just abutting on wing margin, pale spots of cell  $M_4$  and of apical part of anal cell double, small oval spot just above fMCu distinct; Rs ending at middle of costal pale spot II; venation: costa ending at basal 0.63 of wing length, RL-V 24.3 : 22.7 : 35 : 13.7 : 20, radial cell II subtriangular, shorter than I (5.7 : 7.3); macrotrichia densely spread over almost all of surface. Halter with knob brownish, stem yellow. Abdomen pale brown, caudal segments browner, tergites large, sternites reduced, pleural membranes slightly fuscous; cerci pale brown; 3 spermathecae brown, hemispheric, subequal 5.7×10 units, 5.4×9.3 units, 5.2×8.8 units respectively, each with large nonsclerotized neck part of duct.

DISTRIBUTION: Australia, New Guinea.

SPECIMENS EXAMINED: 2 ♀♀, Goldie River, near Port Moresby, Papua, 25. IX. 1959, Ardley; 1 ♀, Port Moresby, I. 1960, Peters.

### 30. *Culicoides pseudostigmatus* Tokunaga, 1959, Pac. Ins. 1 : 234.

Small, brown and yellow; characteristic wing pattern: pale spots straddling basal portion of veins  $M_1$  and  $M_2$  and pale spot of cell  $M_4$  double, 3 spermathecae equally developed, with wide openings.

DISTRIBUTION: New Guinea.

### 31. *Culicoides bougainvillae* Tokunaga n. sp. Figs. 10, 37.

Small, pale brown or ochreous, without distinct scutal ornament, with knees broadly yellowish, wings with distinct pattern as in Australian *magnimaculatus* Lee and Reye, with many pale spots, but distinctly differing from the allied species in the shape of spot in cell  $M_4$ . Male hypopygium similar to the allied species, but differing somewhat in the shapes of caudal part of last tergite and of parameres.

*Female*: Body 1.3 mm long. Wing 0.96×0.43 mm. Head dark brown, proboscis brown, short, only 0.39 as long as head-capsule, eyes bare, narrowly separated. Palp brown, stout, segment III oval, with sensory pore on preapical part distinct; PR 2.0, RL-P 5 : 12 : 16 :

7 : 7.5. Antenna with scape dark brown, other segments brown, segments III-IX short-oval, sensory tufts present on II-VIII or II, IV, VI, VIII and X-XIV; AR 1.08, RL-8A 9 : 9 : 9 : 14 : 13.5 : 14 : 15.5 : 23. Thorax mainly ochreous, but scutum with anterior and lateral marginal areas slightly fuscous, caudostutal area widely pale fuscous, postscutellum, pleura and sternum slightly fuscous brown, scutellum with 2 median bristles and 8 small setae arranged in transverse line.

Legs mainly pale fuscous brown, but trochanters and bases of femora pale, tarsal segments pale ochreous, except for fuscous hind basitarsus, knees and apical part of hind tibia broadly pale yellow; claws simple, hind tibial comb with apical bristles 4; TR and RL-L 2.52 and 23 : 22 : 11.5 : 4.5 : 3 : 2 : 2.5 in fore, 3.22 and 29 : 28 : 15.5 : 5 : 3.2 : 2.5 : 3 in mid, 2.28 and 27 : 26.5 : 12.5 : 5.5 : 3.5 : 2.2 : 3 in hind leg. Wing (fig. 37) elongate-oval, with many pale spots, costal dark band I slender, costal pale spot I large, enveloping basal 2/3 of radial cell I and r-m, costal pale spot II as large as III, enveloping apical 2/3 of radial cell II, pale costal spot III abutting on anterior wing margin but separated from apical part of cell R<sub>5</sub>, pale elongate spots straddling basal parts of veins M<sub>1</sub> and M<sub>2</sub> present, apical parts of veins M<sub>1</sub> and M<sub>2</sub> ending in pale spots, small pale spot present just above fMCu, pale spot of cell M<sub>4</sub> somewhat saddle-shaped; macrotrichia densely spread over almost all of surface; venation: costa ending at basal 0.7 of wing length (51 : 74), RL-V 23 : 21 : 33 : 12 : 20, radial cell II subtriangular, as long as I. Abdomen pale ochreous, pleural sides slightly fuscous, caudal segments more fuscous; cerci white; spermathecae: 2 brown, oval, subequal, 1+15×10 units and 1+14×11 units, each with minute sclerotized part of duct, 1 brown, minute, 3×1 units.

*Male*: Body length 1.37 mm. Wing 0.9×0.33 mm. General color much paler than in ♀. Structures as in ♀ with usual sexual differences. Head with palps stout, PR about 1.6 (11 : 7). RL-P 4 : 8 : 11 : 7 : 8. Antenna normal, sensory tufts present on II and XII-XIV, RL of II-XI and XII-XIV combined 91 : 67, RL-8A 8 : 7.6 : 7.4 : 7 : 8 : 27 : 19 : 21. Thorax with scutum and scutellum pale ochreous, but scutum with anterior marginal part fuscous, postscutellum, pleura and sternum fuscous pale brown, scutellum with 2 median bristles and 8 small setae arranged in transverse line.

Legs with coxae fuscous pale brown, other segments uniformly pale; claws cleft at apices; TR and RL-L 2.22 and 23 : 21 : 10.5 : 4.5 : 3 : 2.2 : 3 in fore, 3.05 and 30 : 27 : 15 : 5 : 3.5 : 2.5 : 2.8 in mid, 2.15 and 24 : 24 : 11.5 : 5.5 : 3.5 : 2.5 : 3 in hind leg. Wing elongate, with pale marking, cell M<sub>4</sub> with characteristic spot, radial cell II ending far before middle of costal pale spot II, macrotrichia sparsely spread along apical margins of cells R<sub>5</sub> and M<sub>1</sub>; venation: costa ending at basal 0.62 of wing length (43 : 69) and before middle of anal margin of cell M<sub>4</sub>, RL-V 21 : 20 : 33 : 9 : 14, radial cell II subtriangular, shorter than I (4 : 6), fMCu under septum of radial cells. Halter pale. Abdomen pale fuscous, almost white. Hypopygium (fig. 10a) brown; tergite broad, anal points slender,

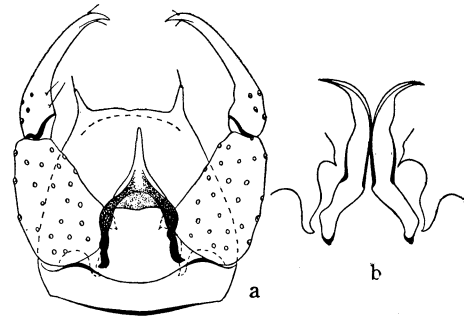


Fig. 10. *Culicoides bougainvillae*, ♂, a, hypopygium; b, parameres.

widely separated; sternite with caudal margin slightly arcuate; coxite conical, slender, with basal roots subtriangular; style slender, slightly arcuate, sharply pointed, as long as coxite (26 : 25); aedeagus with basal arch square, median lobe slender, basal membrane smooth; paramere (fig. 10b) stout, almost as long as aedeagus (23 : 24), slightly shorter than coxite (23 : 25), gradually tapered, with apical 1/4 curved and beak-like.

DISTRIBUTION: Solomon Is.

Holotype ♀ (BISHOP 3240), Kieta, Bougainville I., Solomon Is., 26. IV. 1959, Peters. Allotype: ♂ with holotype.

Closely allied to *magnimaculatus* Lee & Reye from Australia in wing pattern and ♂ hypopygium, but distinctly different in both sexes darker, ♀ proboscis longer, about 0.71 of head-capsule, wings larger, being 1.26×0.52 mm in ♀ and 1.08×0.38 mm in ♂, palp more slender, PR and RL-P 2.8 and 9 : 27 : 21 : 10 : 9 in ♀ and 2.6 and 6 : 13 : 13 : 8 : 9 in ♂, ♀ with short basal segments of antenna largely yellow, sensory tufts present on II and X-XIII (VIII ?), legs with knees dark, hind TR 2.1-2.2 in ♀ and 2.0 in ♂, wing without dark central spot in cell M<sub>4</sub>, without pale spot just above fMCu, with basal costal dark band much broader, ♂ hypopygium with tergite longer, tapered, anal points long, close to each other, separated only by distance equal to length of anal point (10 : 10), while in the new species points are widely separated, about 3× as wide as anal point (15 : 5), and paramere with apical 1/4 very slender, needle-like.

32. *Culicoides magnimaculatus* Lee & Reye, 1953, Linn. Soc. N. S. Wales, Proc. 77 : 388. —Tokunaga, 1959, Pac. Ins. 1 : 250.

Small, brown; wing pattern resembling that of *pseudostigmatus*, but much more infuscate and pale spot of cell M<sub>4</sub> quite simple.

DISTRIBUTION: Australia, New Guinea.

33. *Culicoides magnipictus* Tokunaga, n. sp. Fig. 38.

Medium-sized, dark brown; 2 pairs of large spots on scutum, wing pattern somewhat similar to that of Australian *magnimaculatus* Lee & Reye, legs with knees pale. Male unknown.

*Female*: Body 1.61 mm long. Wing 1.04×0.46 mm. Head dark brown, with eyes bare, narrowly separated, proboscis about 1/2 as long as head-capsule (12 : 22). Palp brown, slender, segment III with sensory pore just beyond middle shallow, not very large; PR 2.13, RL-P 6 : 16 : 17 : 8 : 8. Antenna with segments II-VIII pale brown, other segments brown, III round, IV-IX short-oval to oval, sensory tufts on II and X-XIV; AR 1.26, RL-8A 8.5 : 8.5 : 9 : 14 : 14.5 : 16 : 18 : 24.5 (W=5-6). Thorax mainly dark brown, but scutum with 2 oblong large yellow median spots on anterior 1/2, ill-defined large yellow lateral cloud on either lateral side in front of scutal suture, lateral sides of caudoscuteal area paler, scutellum yellow on lateral parts, brown on median part, with 2 lateral, 2 median bristles and 11 small setae.

Legs with coxae brown, trochanters ochreous, tarsi pale ochreous, other segment largely dark brown or brown, but bases of femora pale yellow, apical parts of fore and mid femora pale ochreous, apical part of mid femur yellow, basal and apical parts of tibiae yellow, hind basitarsus mainly brown, with apex paler; claws simple, hind tibial comb

with apical bristles 4; TR and RL-L 2.76-2.77 and 23.5 : 22 : 12.5 : 4.5 : 3 : 2.5 : 3 in fore, 2.95 and 29.5 : 29 : 15.5 : 5 : 4 : 3 : 4 in mid, 2.32 and 27 : 26.5 : 13.5 : 6 : 4 : 3 : ? in hind leg. Wing (fig. 38) with many large pale spots, costal pale spot I round, but abutting on costal vein, costal pale spot II semicircular, enveloping almost entire radial cell II, elongate pale spot just beneath costal pale spot II lying adjacent to vein  $M_1$ , large pale spot straddling basal part of vein  $M_2$ , elongate pale spot present just above fMCu, marginal pale spots abutting on wing margin, macrotrichia sparse but widely spread on apical 1/2 of wing; venation: costa ending at basal 0.78 of wing length, RL-V 24 : 22 : 35 : 15 : 23, radial cell II elongate, as long as I (9 : 8) and ending at basal 2/3 of costal margin of costal pale spot II. Halter white. Abdomen mainly pale ochreous, but caudal segments brown, tergites and hemisternites pale brown, pleural membranes pale; cerci white, spermathecae 2, brown, subequal, oval, 3+16×14 units and 2.5+15×13 units, each with short chitinized part of duct, vestigial one tubular, 5×1 units.

DISTRIBUTION: New Guinea (Papua).

Holotype ♀ (BISHOP 3241), Port Moresby, Papua, I. 1960, Peters.

Wing marking closely resembles that of *magnimaculatus*, but there is an oval pale spot lying adjacent to basal portion of vein  $M_1$  and not straddling vein  $M_1$ , and hind TR much larger being 2.32 instead of 1.73, differing from *magnimaculatus*.

34. *Culicoides jimmiensis* Tokunaga, 1959, Pac. Ins. 1 : 229. Fig. 11.

Medium-sized, brown or dark brown; closely allied to *amamiensis*, but distinctly separated by structure of palpal sensory organs. Male hypopygium without anal points, round on caudal margin of tergite, style stout, basal roots of coxite unequal, one vestigial and one distinct, aedeagus subtriangular, with basal arch subsquare, paramere somewhat L-shaped, apically setiform and with a few delicate hairs at tip.

*Male*: Body 1.69 mm long. Wing 1.31×0.49 mm. Color and structures of various parts of body as in ♀ reported in original paper. Head with eyes bare. Palp dark brown, slender, segment III with surface sensillae scattered on apical 1/2; PR 3.56, RL-P 7 : 14 : 16 : 9 : 11. Antenna with scape and plumose hairs dark brown, other segments brown, segments not modified or reduced; sensory tufts present on II and XII-XIV; combined lengths of II-XI and XII-XIV 137 : 95, RL-8A 13 : 13 : 13 : 13 : 15 : 31 : 27 : 36. Thorax mostly dark brown, scutum with pale ochreous median spots between foveae on anterior 1/2, scutellum with 2 lateral, 2 median bristles and 1 accessory minute hair.

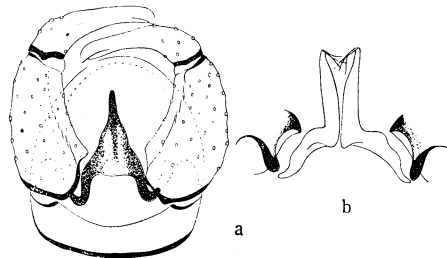


Fig. 11. *Culicoides jimmiensis*, ♂. a, hypopygium; b, parameres.

Leg color as in ♀, being pale broadly on knees; claws probably bifid at extreme tips, hind tibial comb with apical bristles 5; TR and RL-L 2.44 and 30 : 29 : 16 : 7 : 4 : 3 : 3 in fore, 2.85 and 38 : 37 : 21.5 : 7.5 : 4.5 : 3.2 : 3.5 in mid, 2.17 and 34 : 33 : 17 : 8 : 4.8 : 3.3 : 3.7 in hind. Wing with clear pattern, many pale spots, well separated, costal pale spot II semicircular, covering apical 1/3 of radial cell II which extends beyond basal 2/3 of costal margin of pale spot, veins  $M_1$  and  $M_2$  ending in small but distinct margin-

al pale spots, pale spot straddling vein  $M_2$  large, pale spot of cell  $M_4$  abutting on vein  $M_{3+4}$  above and wing margin below, apical pale spots of anal cell confluent; macrotrichia spread on marginal area between costal end and apex of vein  $M_2$ ; costa ending at basal  $2/3$  of wing length (67 : 101), RL-V 36 : 33 : 49 : 13 : 22, radial cell II elongate, as long as I, fMCu just before septum of radial cells. Hypopygium (fig. 11a) dark brown, tergite and styles yellowish; tergite oval, round on caudal margin, without anal points; sternite with caudal margin slightly concave; coxite with vestigial and prominent basal roots; style strong, slightly shorter than coxite (27 : 31); aedeagus elongate-triangular, a little shorter than style (24 : 27), with basal arch subsquare, strongly curved at bases; paramere (fig. 11b) L-shaped, stout, apically tapered, ending in setiform tip with a few delicate hairs.

DISTRIBUTION: New Guinea.

SPECIMEN EXAMINED: 1 ♂, Kwiena, near Minj, W. Highlands, NE New Guinea, 11. V. 1959, Peters.

The ♀ was reported in detail with drawings in my previous paper.

35. *Culicoides gentilis* Macfie, 1934, Ann. Trop. Med. Parasit. 28 : 191.—Tokunaga, 1959, Pac. Ins. 1 : 221. Fig. 12.

The previous paper on this species from New Guinea was based on the study of 3 ♀♀. Since then, examination of specimens of both sexes has shown that this species exhibits a wide range of individual variation especially in the development of wing pattern. When dark areas are well developed, wing shows *gemellus*-appearance and, when pale areas broadened, wing shows typical *gentilis*-appearance. There are many intermediate forms of wing pattern. The main differences of specific characters between the 2 species, reported by Macfie, may be summarized as follows: In *gentilis*, palpal segment III much longer than IV-V (44 : 17+15), antennal segments X-XIII successively longer, AR 1.083, scutellum with 4-5 small successory hairs, wing with macrotrichia spread between tips of veins Rs and  $M_1$ , costal pale spot III wider than adjacent dark band III and widely abutting on anterior wing margin, apical pale spot of cell  $M_2$  just touching wing margin, hind TR 2.0; in *gemellus*, palpal segment III slightly longer than IV+V, scutellum with 1-2 small hairs, wing with macrotrichia spread between tips of Rs and  $M_2$ , costal pale spot III as wide as dark band III and distinctly separated from anterior wing margin, apical pale spot of cell  $M_2$  widely abutting on wing margin, hind TR 2.3.

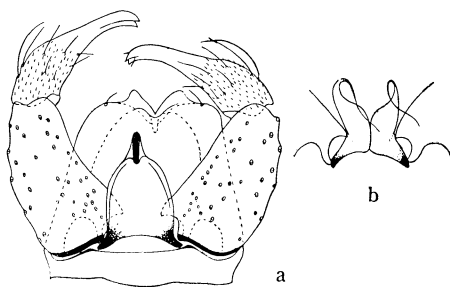


Fig. 12. *Culicoides gentilis*, ♂. a, hypopygium; b, parameres.

The individual variation of New Guinea *gentilis* covers almost all of the above-mentioned differences as shown in the following description, excepting hind TR and relative lengths of antennal segments X-XIII.

*Female*: Wing 1.44 (1.27-1.74) × 0.55 (0.49-0.66) mm. Palp with RL-P 8 : 19.4 : 24.4 : 10.9 : 13.1, segment III sometimes much longer than IV+V (28 : 11.3+13.3) and often shorter (23 : 13+14). Antenna with sensory tufts always present on II, X-XIV; AR 1.17 (1.08-1.31), RL-8A 14.6 : 14.4 : 15 : 21.7 : 22.2 : 25.4 : 27.8 : 40.2, X-XIII successively longer



apically. Thoracic sclerites entirely dark brown, scutellum with 4 strong bristles and 0-2 small accessory setae. Hind leg with apical bristles of tibial comb usually 6 and often 7, TR 2.68 (2.44-2.93) in fore, 2.77 (2.56-3.14) in mid, 2.23 (2.1-2.47) in hind leg.

Wing with distinct pattern, costal pale spot II varying in size and shape: in paler wing, spot wider than adjacent dark band III, oval or gourd-like, widely abutting wing margin as in *gentilis*; in dark wing, spot as wide as or narrower than dark band III, somewhat gourd-like, narrowly but distinctly separated from wing margin as in *gemellus*; in both types of wings apical pale spot of cell  $M_1$  oval, small, apical spot of cell  $M_2$  usually widely abutting on wing margin; apical margins of cells  $R_5$  and  $M_1$  almost always narrowly and faintly paler; macrotrichia sparsely spread along wing margin between apices of  $R_5$  and  $M_2$  or  $M_{3+4}$ ; venation: costa ending at basal 0.73 of wing length (80.2 : 110.2) and above tip of  $M_{3+4}$  extending just costal dark band III, RL-V 48 : 35.2 : 45.3 : 17 : 33.8, fMCu under or just beyond origin of r-m. Abdomen with 2 functional spermathecae slightly unequal or subequal,  $0.8+14.7 \times 11.7$  units and  $0.8+13.6 \times 11.4$  units, each with minute sclerotized part of duct, 1 vestigial tubular,  $4.7 \times 1.3$  units. Other structures and color as in the previous report.

*Male*: Body length 1.89 (1.69-2.03) mm. Wing  $1.29 (1.16-1.39) \times 0.41 (0.39-0.43)$  mm. General color, structure and variation of wing pattern as in ♀ with usual sexual differences, but wing with 2 radial cells. Head with eyes broadly contiguous. Palp with RL-P 6.8 : 15.8 : 20.5 : 9.2 : 13.5. Antenna with sensory tufts on segments II and XII-XIV; combined lengths of II-XI and XII-XIV 142.8 : 112.8, RL-8A 13.2 : 13.2 : 13 : 11.8 : 13 : 36.9 : 33.8 : 41.4. Thoracic scutellum with only 4 bristles.

Legs with claws simple, hind tibial comb with apical bristles usually 6, rarely 7; TR and RL-L 2.65 (2.53-2.75) and 33.1 : 33.2 : 20 : 7.6 : 5.3 : 2.9 : 3.9 in mid, 2.11 (2.0-2.2) and 40.2 : 40 : 20.5 : 9.7 : 5.9 : 3.6 : 4.3 in hind.

Wing with macrotrichia sparse and close along wing margin of cell  $R_5$  beyond costal end; costa ending far before tip of  $M_{3+4}$  and at basal 0.72 of wing length (71.3 : 98.9), RL-V 37.2 : 35.5 : 44.7 : 12 : 24.7, 2 radial cells present differing from wing of ♀, radial cell I narrow, II long, about  $1.6 \times$  as long as I (13.7 : 8.5). Abdomen brown, pleural membranes fuscous. Hypopygium (fig. 12a) brown, styles and parameres yellow; tergites broad, without anal points, with median caudal lobes variously developed, when well developed caudal incision V-shaped as in figure; when reduced, lobes minute and incision small; sternite short, with caudal margin almost straight; coxite slender, with 2 basal roots unequal, small; style stout, with double points at apex; aedeagus elongate-triangular, with basal arch very low, basal membrane quite bare, median caudal lobe small; paramere (fig. 12b) short, but broad on basal 3/5, apically slender and filiform.

DISTRIBUTION: Malaya, New Guinea, New Ireland.

SPECIMENS EXAMINED: 25 ♀♀, 7 ♂♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 13 ♀♀, ditto, 7. III. 1959, Peters; 1 ♀, Bubia, near Lae, NG, 8. III. 1959, Ardley; 2 ♀♀, Bainyik, Sepik Distr., NG, III. 1959, Peters; 1 ♀, Kavieng, New Ireland, 3. VI. 1959, Peters.

Variation of wing markings, values of AR and TR and other structures show *gentilis* and *gemellus* characters. There is some question as to whether or not the 2 species are identical in following points: In *gentilis*, ♀ antennal segments X-XIII successively longer apically and ♀ scutellum with 4-5 small accessory setae, while in *gemellus* these

antennal segments subequal and scutellum with 1-2 small setae. It may be noted that the ♂ of this species is distinctly different from the ♀ in the development of radial septum.

36. *Culicoides* sp. near *magnesianus* Lee & Reye. Figs. 13, 39.

Rather large, pale ochreous; palp without sensory pore but with many scattered surface sensillae as in *bancrofti*, thoracic tergites without definite pattern, legs almost entirely pale ochreous, without distinct bands, tarsal segments IV cordiform, similar to ♀ of *magnesianus*, wings generally pale, with faint fuscous clouds and closely allied to those of *magnesianus*. Hypopygium with anal points rudimental, styles strongly arcuate, basal membrane of aedeagus pubescent. Female unknown.

*Male*: Body 2.21 mm long. Wing  $1.51 \times 0.5$  mm. Head dark brown, eyes bare and barely separated, proboscis 0.47 as long as head-capsule. Palpal segment III elongate, with surface sensillae scattered on apical 1/2, without sensory pore; PR 4.3, RL-P 9:17:30:11:10. Antenna with scape dark brown, other parts pale ochreous, segments X-XI almost without plumose hairs, reduced in size; combined lengths of II-XI and XII-XIV 109:126, RL-8A 9:9:7.5:4:5:43:35:45; sensory tufts present on II and XII-XIV. Thorax almost entirely pale ochreous, but scutum slightly browner on anterior marginal area, paler on caudoscuteal area, scutellum and post-scutellum brown, scutellum with 2 lateral, 3 median bristles and 9 accessory small setae.

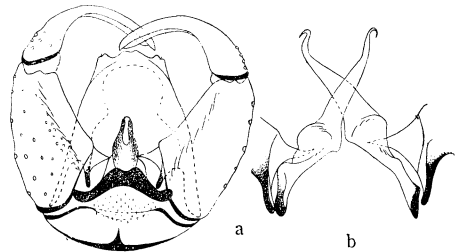


Fig. 13. *Culicoides* sp. near *magnesianus*, ♂. a, hypopygium; b, parameres.

Legs entirely pale ochreous; claws bifid at apices, hind tibial comb with apical bristles 5, tarsal segment IV cordiform; TR and RL-L 2.46 and 45:43:26:11:6.4:3.5:5 in fore, 2.54 and 55:54:32:12.9:7.4:4:5.2 in mid, 2.01 and 51:53:28:14:8.5:4:6 in hind. Wing (fig. 39) with pattern faint, broadly pale, dark clouds small and separated, radial cell II ending at middle of costal margin of costal pale spot II, apical 1/4 of cell  $R_5$  entirely pale, cell  $M_1$  without fuscous band on midportion, cell  $M_2$  also without fuscous band between veins  $M_2$  and  $M_{3+4}$ ; macrotrichia densely spread only on apical wing margin between tips of vein  $R_5$  and  $M_{3+4}$  and arranged in line along margin of cell  $M_4$ ; venation: costa ending at basal 0.67 of wing length, extending long for ♂ wing, RL-V 41:38:54:15:26, radial cell II elongate-subtriangular, longer than I (11:9). Halter pale yellow. Abdomen pale ochreous, without distinct tergites and sternites, caudal segments and pleural membranes slightly fuscous. Hypopygium (fig. 13a) with tergite elongate, tapered, anal points rudimental; coxite conical, basal roots broadly fused with each other; style large, fully as long as coxite (89:86), strongly curved; aedeagus with basal bar-like sclerite strong, median lobe elongate-oval, basal membrane pubescent; paramere (fig. 13b) stout, thickened on midportion, tapered, sharply pointed and curved at apex.

DISTRIBUTION: Solomon Is.

SPECIMEN EXAMINED: 1 ♂, Kieta, Bougainville I., Solomon Is., 26. V. 1959, Peters.

Taking shape of tarsal segments IV of legs and pattern of wings into consideration,

this ♂ is probably the same as *magnesianus*, which was taken in mangroves of Magnetic I., Queensland, Australia and described by Lee & Reye (1953). The ♂ of that species is not yet known, and there is some doubt about the structure of the maxillary palpus. In related species palpal segment III is distinctly expanded, bears a single, small but deep sensory pore and PR is about 1.86, legs have distinct pale bands on the basal parts of dark brown tibiae, being distinctly different from the present ♂. Palpal structure is similar to *bancrofti* Lee and Reye taken from N. S. Wales, Australia, and is known only from the ♀. Examination of the ♀ of *bancrofti*, determined by Lee, disclosed following differences which are thought to be of more importance than just sexual: palpal segment III is very long, tapered and somewhat undulate, mid leg bears TR very large being 3.37, tarsal segments IV are quite cylindrical, wing is much more broadly fuscous bearing apical pale spot of cell R<sub>5</sub> much smaller and separated from wing margin.

**37. *Culicoides maculiscutellaris* Tokunaga, 1959, Pac. Ins. 1: 249.**

Small, brown and yellow; wing pattern similar to that of *magnimaculatus* and *longiradialis*, but distinguished by presence of scattered surface sensillae on palpal segment III and absence of pale spots straddling wing vein M<sub>1</sub> from *magnimaculatus* and by larger costal pale spot II of wing which is broadly confluent with spots beneath it from *longiradialis*.

DISTRIBUTION: New Guinea.

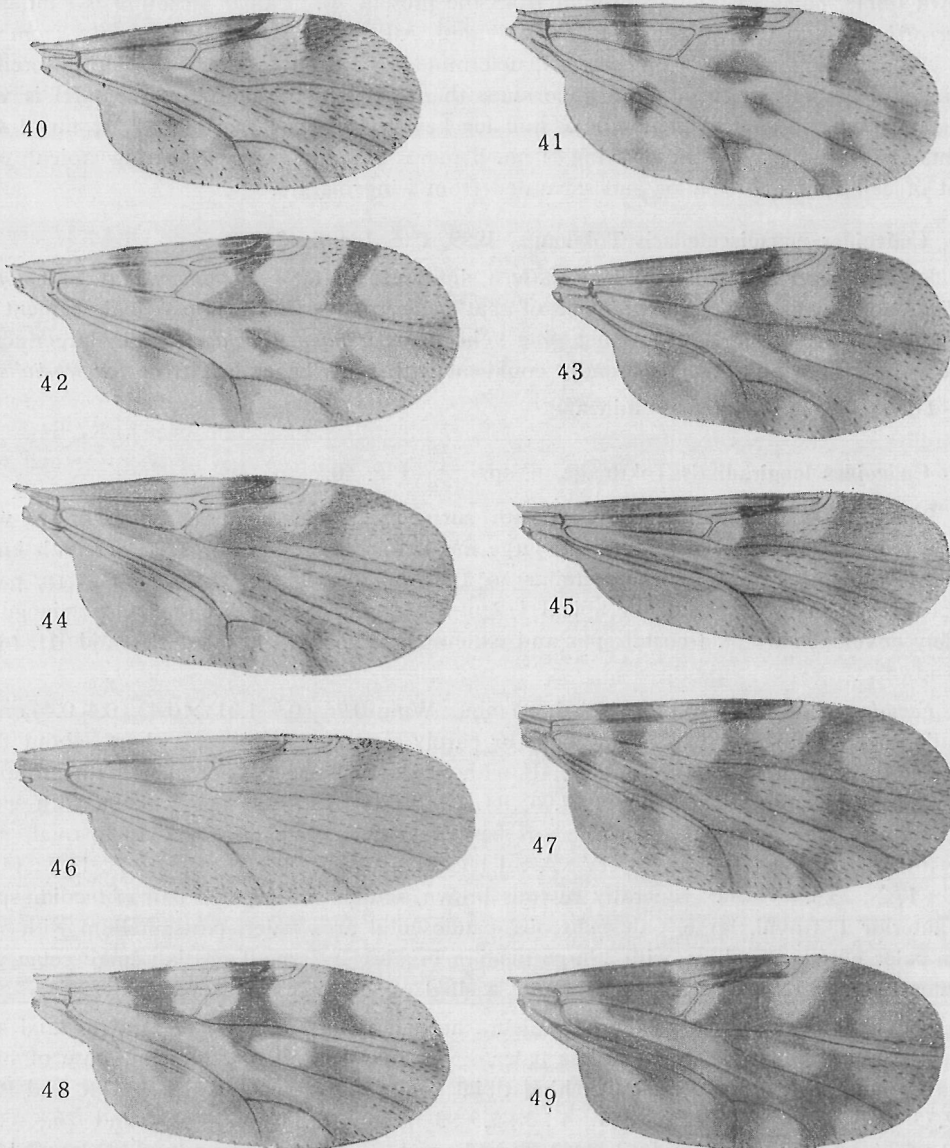
**38. *Culicoides longiradialis* Tokunaga, n. sp. Fig. 40.**

Small, brown; palpal segment III with surface sensillae, scutum fuscous brown with single pair of oval, pale ochreous and large median spots on anterior 1/2, legs with knees widely whitish, wing somewhat similar to that of *maculiscutellaris*, but pattern paler, macrotrichia mainly spread on apical 1/2 of wing, radial cell II elongate-subtriangular, widely enveloped by pale costal spot and extending almost to costal dark band III. Male unknown.

*Female*: Body length 1.32 (1.21–1.39) mm. Wing 0.96 (0.9–1.01) × 0.43 (0.4–0.44) mm. Head brown, with eyes bare, contiguous or barely separated, proboscis short, about 0.57 as long as head-capsule. Palp short, III without distinct sensory pore, but with group of surface sensillae on apical 1/2; PR 2.06, RL–P 4.5 : 15 : 13 : 6.3 : 6. Antenna with scape dark brown, other segments brown, short basal flagellar segments short-oval to oval, sensory tufts present on II and X–XIV; AR 1.1 (1.07–1.14), RL–8A 9 : 9.3 : 9.7 : 14.8 : 14.8 : 15.8 : 17.2 : 23.3. Thorax generally fuscous brown, scutum with single pair of median spots on anterior 1/2 oval, large, pale ochreous, caudoscuteal area paler, postscutellum with median paler cloud, scutellum with 2 large median bristles, 3–8 small median small setae and 2 lateral large bristles each accompanying a single small accessory seta.

Legs mainly as brown as thoracic pleura and sternum, but bases of femora, tarsi and apical part of hind tibia more or less paler, knees of fore and mid legs and base of hind tibia broadly whitish; claws simple, hind tibial comb with apical bristles 4; TR and RL–L 2.75 (2.7–2.8) and 22 : 20.8 : 11 : 4 : 3 : 2.5 : 3 in fore, 3.17 (3.11–3.23) and 26.8 : 27 : 14.2 : 4.2 : 3.5 : 2.7 : 3 in mid, 2.42 (2.38–2.47) and 26.7 : 26 : 11.8 : 4.8 : 3.6 : 2.6 : 3.1 in hind leg. Wing (fig. 40) with markings similar to those of *maculiscutellaris*, but paler, paler spots larger, marginal spots widely abutting on wing margin, costal pale spot I oval, II enveloping apical 2/3 of radial cell II, pale spots between fMCu and base of vein M<sub>2</sub>

obscure; macrotrichia spread on apical 1/2 of wing, but anal cell with sparse macrotrichia; venation: costa ending at basal 0.7 of wing length (51.3 : 74), radial cell II elongate-subtriangular, as long as I (8.7 : 8), almost reaching costal dark band III, RL-V 22.3 : 21.3 : 33 : 14.3 : 21.3. Halter with knob pale brown or pale ochreous, stem pale yellow. Abdo-



Figs. 40-49. Wings of *Culicoides* species: 40, *longiradialis* ♀; 41, *dikhros* ♀; 42, *fragmentum* ♀; 43, *crassus* ♀; 44, *monothecalis* ♀; 45, sp. near *longiradialis* ♂; 46, *novairelandi* ♀; 47, *papuensis* ♀; 48, *orientalis* ♀; 49, *pungens* ♀.

men brown, with sclerites well developed, pleural membranes fuscous brown; cerci pale yellow, spermathecae brown, 2 short-oval, subequal,  $2+13.3 \times 10.5$  units and  $2+12 \times 10$  units, each with short sclerotized part of duct, 1 vestigial, tubular,  $5 \times 1$  units.

DISTRIBUTION: New Guinea.

Holotype ♀ (BISHOP 3242), Maprik, Sepik Distr., New Guinea, 7. III. 1959, Peters. Paratypes: 2 ♀♀ with holotype.

Closely resembles *maculiscutellaris* in wing pattern, scattered surface sensillae of palpal segment III, and scutal marking, but can easily be separated from it by the uniformly brown scutellum, larger TR of legs, and smaller pale spots of wing.

### 39. *Culicoides flavescens* Macfie. Fig. 14.

*Culicoides anophelis* var. *flavescens* Macfie, 1937, R. Ent. Soc. Lond., Proc. B 6: 114.

*Culicoides flavescens*, Wirth & Hubert, 1959, Pac. Ins. 1: 13.—Tokunaga, 1959, Pac. Ins. 1: 247.

This midge is well known, being widely distributed in the Oriental Region and reported from New Guinea as in case of *palpifer*. The ♂, however, has not been reported previously.

*Male*: Body 0.98 mm long. Wing  $0.77 \times 0.33$  mm. Coloration as in ♀, being yellow and dark. Head brown, with eyes bare, just contiguous. Palp pale brown, RL-P 4: 7: 8: 5: 5, segment III only a little longer than II, differing from that of ♀. Antenna with scape dark brown, other segments pale brown, plumose hairs paler, not well developed, being absent on segments X and XI; combined lengths of II-XI and XII-XIV about 82: 76; RL-8A 8: 8: 7: 4: 5: 20: 24: 30.5; sensory tufts present on II and XII-XIV; segments X and XI reduced, without distinct setae, but distinctly segmented. Scutum and dorsal 1/2 of pleura yellow, other sclerites brown or fuscous, scutellum brown, with single median seta.

Legs with coxae and trochanters fuscous brown, tarsi largely pale yellow or white, but segments I of fore and middle pale brown, fore leg with basal 3/5 of femur and apical 3/5 of tibia fuscous, broad yellow bands basad and apicad of pale ochreous knee, middle with basal 1/2 of femur and apical 1/2 of tibia fuscous, knee broadly yellow including joint, hind with basal 1/2 of femur fuscous, knee dark, apical 1/2 of femur and almost entire tibia yellow; hind tibial comb with apical bristles 4, claws probably simple; TR and RL-L 2.6 and 19: 18: 10.5: 3.5: 3: 2: 2.2 in fore, 3.27 and 24: 23: 13: 4: 3: 2: 2.3 in mid, 2.3 and 22: 22: 10: 4.5: 3: 2.2: 2.5 in hind leg. Wing with pattern as in ♀, but costal pale spot II and apical pale area of cell  $R_5$  smaller, former semicircular, enveloping apical 3/4 of radial cell II, latter very faint, narrow along apical margin of cell  $R_5$ ; costa ending at basal 0.73 of wing length and extending slightly before costal dark band III, RL-V 20: 19: 27: 7: 18, radial cell II broad, triangular, about  $2 \times$  as long as I,  $M_{3+4}$  ending at level of costal apex; fMCu

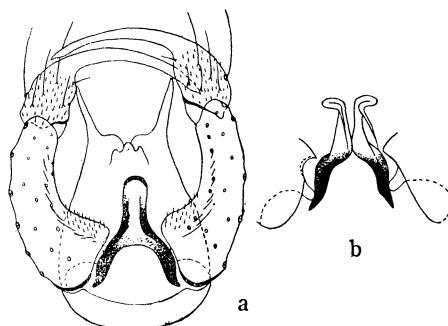


Fig. 14. *Culicoides flavescens*, ♂. a, hypopygium; b, parameres.

under middle of radial cell I; macrotrichia sparsely and closely arranged along apical margin between apices of veins  $R_s$  and  $M_2$ . Halter with stem white, knob pale brown. Abdomen mainly whitish, without distinct sclerites, hypopygium (fig. 14a) dark with tergite and styles yellow; tergite elongate-oval, tapered, with anal points long, slender, separated by distance equal to their length basally, median caudal lobes indistinct, median caudal cleft V-shaped, large; sternite with caudal margin slightly concave; coxite slender, arcuate, with 2 basal roots unequal, small; style distinctly inflated on basal 2/5, slender and arcuate on apical 3/5, sharply pointed at apex, total length equal to length of coxite (28 : 27); aedeagus stout, about 0.6 as long as coxite (17 : 27), with basal arch wide, about 0.4 of total length, median caudal lobe wide, as long as anal point (10 : 11), apex round, basal membrane bare; paramere (fig. 14b) small, with basal 2/5 thickened, apical 3/5 tapered, strongly curved at 3 points and sharply pointed.

**DISTRIBUTION:** Malaya, Borneo, Philippine, Sarawak, Thailand, NE New Guinea.

**SPECIMEN EXAMINED:** 1 ♂, Bubia, near Lae, New Guinea, 3. II. 1959, Ardley.

Coloration variable especially on legs, scutellum usually yellow to pale brown. The ♂ differs from ♀ only in having scutellum distinctly brown. I cannot find any other differences from *flavescens*. Structure of paramere is related to that of Oriental *raripalpis* Smith and aedeagus to Oriental *elbeli* Wirth & Hubert, but structures of caudal part of tergite IX and style are quite specific, differing from the other known ♂♂.

#### 40. *Culicoides barnetti* Wirth & Hubert, 1959, Pac. Ins. 1 : 32.

This is thought to be common in the region of New Guinea. Specific characters were discussed in original paper; present material, however, shows somewhat different ranges of variation in following points from material treated by Wirth and Hubert:

*Female:* Mandible with teeth 11 (10–13); palp with RL–P 4.3 : 13 : 12.3 : 5.1 : 6.6. Antenna with AR 0.92 (0.88–0.95), RL–8A 12.8 : 12.2 : 12.5 : 16 : 15.3 : 16.5 : 18.2 : 27.6. Scutellum dark, with 3 chaetae. Legs with TR 3.02 (2.83–3.38) in fore, 3.98 (3.85–4.25) in mid, 2.4 (2.2–2.6) in hind. Spermathecae usually distinctly longer than wide, especially the largest one almost always elongate-oval, 12.8×8.7 units, 7.6×6.2 units and 7.3×6.1 units respectively, rarely largest (round) being 8×9 units and smaller 2 being equal, 5×5.5 units. Wing with pattern distinct but sometimes apical pale area not clearly demarcated, differing from types. Other structures and coloration as in original description.

*Male:* Body 1.14 (1.08–1.24) mm long. Wing 0.83 (0.82–0.83)×0.35 (0.34–0.35) mm. General character as in ♀, but paler. Head brown, thoracic scutellum fuscous yellow. Eyes bare, just contiguous. Palp white, with RL–P 4 : 6.5 : 8 : 3.5 : 6. Antenna with scape dark brown, other segments pale, almost white, plumose hairs pale brown; segments X–XI reduced, without plumose hairs; sensory tufts present on II and XII–XIV; combined lengths of II–XI and XII–XIV 83.7 : 75.3, RL–8A 8.3 : 9 : 6.7 : 5.3 : 4.7 : 22 : 23 : 29. Scutellum with single median bristle only.

Hind leg with apical bristles of tibial comb 4 as in ♀; TR and RL–L 2.95 (2.86–3.14) and 19.5 : 18.7 : 10.3 : 3.5 : 2.6 : 2 : 2.3 in fore, 4.0 and 24.7 : 23.8 : 14 : 3.5 : 2.6 : 2 : 2.5 in mid, 2.4 (2.33–2.5) and 22.8 : 22.5 : 10 : 4.2 : 3 : 2 : 2.4 in hind leg. Wing with markings paler than in ♀; costa ending at basal 0.7 of wing length (45 : 63.7), RL–V 21.7 : 20 : 30.3 : 8 : 16.7,  $R_s$  2× as long as  $R_1$ , radial cell II 2× as long as I (10.3 : 5.3),

fMCu under septum of radial cells; macrotrichia arranged closely along apical margin between apices of Rs and M<sub>2</sub>. Abdomen white, without distinct tergites. Hypopygium pale, only coxites dark; tergite with anal points sharply pointed, separated by distance equal to 2× length of anal point, median V-shaped cleft on caudal margin; sternite with caudal margin almost straight; coxite with 2 basal roots unequal, one triangular and one slender; style tapered, slender, slightly curved, as long as coxite (22 : 21.3); aedeagus triangular, basal arch low, median caudal lobe short; paramere with basal 1/2 elongate-triangular, apical 1/2 slender, tape-like.

**DISTRIBUTION:** Malaya, Philippines, New Guinea, New Britain, New Ireland, Solomon Is.

**SPECIMENS EXAMINED:** 4 ♀♀, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 43 ♀♀, 6 ♂♂, Maprik, Sepik, NG, II and 7. III. 1959, Peters; 30 ♀♀, 4 ♂♂, Bubia, near Lae, NG, 28. I–18. III. 1959, Ardley; 6 ♀♀, 1 ♂, Bainyik, Sepik, NG, III. 1959, Peters; 32 ♀♀, Inis Atoll, Bougainville I., Solomon Is., 26. V. 1959, Peters; 4 ♀♀, Kieta, Bougainville I., Solomon Is., 26. V. 1959, Peters; 23 ♀♀, Kavieng, New Ireland, 3–4. VI. 1959, Peters; 2 ♀♀, Lowlands Agr. Stat., Keravat, New Britain, 22–26. VIII. 1960, Smee.

**41. *Culicoides palpifer*** DasGupta & Ghosh, 1959, *Calcutta Sch. Trop. Med., Bull.* 4: 122. *Culicoides (Trithecooides) palpifer*, Wirth & Hubert, 1959, *Pac. Ins.* 1: 25.—Tokunaga, 1959, *Pac. Ins.* 1: 246.

Characters of this species were reported in detail by Wirth & Hubert and Tokunaga. Specimens of New Guinea region, however, differ somewhat in following points, from those of Oriental Region: thoracic scutellum entirely yellow as scutum, not brownish, hind femur never entirely dark being provided with distinct broad yellow band on preapical part, mandible almost always with 7 teeth (single ♀ of 9 specimens with 8 teeth). The result of measurement of various parts is as follows:

*Female:* RL–P 4.4 : 11 : 10.3 : 6.9 : 6.1, PR 1.82. AR 1.02 (0.98–1.08), RL–8A 12 : 12 : 12 : 16.2 : 15.7 : 17.7 : 18.5 : 27.7, sensory tufts always present on II and X–XIV. Hind tibia with apical bristles of comb always 4; TR 3.02 (2.9–3.08) in fore, 3.89 (3.75–4.0) in mid, 2.41 (2.2–2.6) in hind. Wing with costa ending at basal 0.72 of wing length, RL–V 23.5 : 21.7 : 32.7 : 10.7 : 20.3, radial cell II about 1.2× as long as I (10.3 : 8.7). Spermathecae 8.5×8.5 units, 6.7×6.7 units and 6.3×6.3 units. Other characters as in reports of Wirth & Hubert and Tokunaga.

**DISTRIBUTION:** India, Thailand, Malaya, Borneo, Sarawak, Sumatra, Philippines, Taiwan, New Guinea.

**SPECIMENS EXAMINED:** 4 ♀♀, Maprik, Sepik Distr., New Guinea, 7. III. 1959, Peters; 8 ♀♀, Maprik, Sepik Distr., NG, I. 1959, Peters; 10 ♀♀, Bubia, near Lae, NG, 28. I–18. III. 1959, Ardley.

**42. *Culicoides amamiensis*** Tokunaga, 1937, *Tenthredo* 1: 325; 1941, *Ins. Mats.* 15: 93; 1950, *Japan. Jour. Sanit. Zool.* 1: 66; 1959, *Pac. Ins.* 1: 230.—Okada, 1954, *Jour. Japan. Appl. Zool.* 19: 7.—Komyo, 1955, *Seto Mar. Biol. Lab., Publ.* 4: 372.—Arnaud, 1956, *Microent.* 21: 90.

The ♀ was described in detail from New Guinea specimens. Included here are mea-

surements of some important specific characters and variations of wing patterns. The ♂ from New Guinea is also recorded.

*Female*: Wing 1.16 (1.05–1.24) × 0.49 (0.45–0.52) mm. Palp with RL–P 6.5 : 15.3 : 18.6 : 9.6 : 9. Antenna with AR 1.1 (1.03–1.12), RL–8A 12.2 : 12.3 : 12.6 : 16.3 : 16.5 : 20.5 : 21.6 : 31.8, sensory tufts present on segment II and X–XIV but rarely II and IX–XIV. Legs with apical bristles of hind tibial comb almost always 5; TR 2.59 (2.5–2.66) in fore, 3.21 (2.92–3.43) in mid, 2.11 (2.06–2.29) in hind leg.

Wing with costa ending at basal 0.7 (62.2 : 88.2), RL–V 36.1 : 29.2 : 40.6 : 13.7 : 24.1, radial cell II about 1.5 × as long as I (12.5 : 8.6). Wing pattern variable (drawing in previous paper is typical); in darker wing, pale spots smaller, costal dark band III broader than adjacent costal pale spots, costal pale spot III reduced, reniform, distinctly separated from anterior wing margin, apical pale spot at end of vein  $M_1$  very small, pale spot under vein  $M_{3+4}$  faint or absent, basal pale spot of cell  $M_1$  reduced, smaller than apical spot, distinctly separated from pale spot just below it, apical pale spot of cell  $M_2$  reduced, as large as apical spot of cell  $M_1$ , narrowly separated from wing margin, preapical spot of cell  $M_2$  separated from basal spot of cell  $M_1$  and reduced to small spot; in paler wing, costal dark band III narrower than costal pale spot II, which is broadened on anterior part enveloping about apical 2/3 of radial cell II and entire costal margin of cell, costal pale spot III widely abutting on anterior wing margin, 2 preapical pale spots of cells  $M_1$  and  $M_2$  united and straddling vein  $M_2$ , apical pale spot of cell  $M_2$  just or distinctly abutting wing margin; intermediate forms of development of pale spots more often occurring. Other structures and coloration as in previous report.

*Male*: Body 1.52 mm long, wing 1.2 × 0.4 mm. General color and structure as in ♀ with usual sexual differences. Head with proboscis about 0.6 as long as head-capsule, eyes bare, contiguous. Palp slender, segment III with sensory pore just beyond middle of the segment very shallow, RL–P 5 : 13 : 17 : 10 : 10. Antenna with sensory tufts present on II and XII–XIV; RL–8A 14 : 13 : 12 : 11 : 11 : 34 : 34 : 44. Thorax with sclerites uniformly brown, scutellum with only 4 bristles. Hind tibial comb with apical bristles 5–6; TR and RL–L 2.47 and 30 : 30 : 18.5 : 7.5 : 5 : 2.8 : 3.5 in fore, 2.61 and 40 : 40 : 23.5 : 9 : 5 : 3.5 : 3.2 in mid, 2.06 and 36 : 35 : 18.5 : 9 : 5.5 : 4 : 4 in hind.

Wing pattern paler than in ♀, costal pale spot III hardly reaching to anterior margin, apical pale spot of cell  $M_2$  also just abutting on wing margin, 2 preapical pale spots of cells  $M_1$  and  $M_2$  faint and obscure; costa ending at basal 0.7 of wing length, RL–V 34 : 33 : 42 : 11 : 22, radial cell II slightly longer than I. Abdomen with tergite brown, pleural membranes fuscous. Hypopygium brown; tergite with caudal margin round, without anal points; sternite with caudal margin slightly concave; coxite slender, with 2 basal roots small, pointed and approximated; style yellowish, slightly curved; aedeagus elongate, with basal arch indistinct, median caudal lobe slender, curved ventrad at extreme tip; paramere strong on sub-basal 2/5, tapered on apical 2/5, with 5–6 delicate hairs at tip.

**DISTRIBUTION**: Manchuria, Japan, New Guinea, New Britain, New Irelands.

**SPECIMENS EXAMINED**: 52 ♀♀, 7 ♂♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 26 ♀♀, 1 ♂, ditto, II and 7. III. 1959, Peters; 541 ♀♀, 3 ♂♂, Bubia, near Lae, NG, 2. II–22. IV. 1959, Ardley; 3 ♀♀, Bainyik, Sepik, NG, III. 1959, Peters; 9 ♀♀, Lowlands Agr. Stat., Keravat, New Britain, 13. VI–26. VIII. 1960, Smee; 15 ♀♀, Kavieng, New Ireland, 3–4. VI. 1959, Peters.



43. *Culicoides unisetiferus* Tokunaga, 1959, Pac. Ins. 1: 40.

Most closely resembles *buckleyi* in wing pattern and coloration of thorax and legs, but can be distinguished by costal pale spot III of wing which distinctly abuts on wing margin, and single bristle of scutellum instead of 3-4 scutellar bristles of related species.

DISTRIBUTION: New Guinea, New Britain.

44. *Culicoides buckleyi* Macfie, 1937, R. Ent. Soc. Lond., Proc. B 6: 117.—Tokunaga, 1959, Pac. Ins. 1: 238. Fig. 15.

Small, brown or dark brown; thorax almost entirely dark brown or brown, but scutum with paler median spots between foveae on anterior 1/2, legs with pale yellow or white bands, wing with pattern distinct, paler spots few in number, small, apical pale spot of cell  $R_5$  reniform, usually distinctly separated from wing margin, macrotrichia sparsely spread along marginal area of apical 1/3 of wing. Male hypopygium without anal points, caudal margin of sternite shallowly concave, paramere basally swollen, apically filiform, with a few minute hairs at tip.

*Female*: Wing 0.88 (0.81-1.24)  $\times$  0.4 (0.35-0.57) mm. General color and structure as in my previous report. Eyes bare, just contiguous; proboscis 0.6 as long as head-capsule. Palp slender; PR 2.57, RL-P 4.6: 14.2: 11.8: 6.8: 7. Antenna with AR 1.11(0.95-1.17), RL-8A 8.9: 9.5: 10.4: 14.1: 14.2: 15: 15.4: 23.2, sensory tufts on II and II-XIII. Legs with claws simple, hind tibial comb with apical bristles 5, rarely 6; coxae brown, trochanters pale yellow, tarsal segment I pale brown, II-V white, femora and tibia mainly brown, femoral bases almost white, preapical 1/5 part of fore and apical 1/3 of mid femora, sub-basal 1/5 of fore, basal 1/3 of mid, basal 1/4 and apical 1/4 of hind distinctly paler being pale yellow or white; TR 2.8 (2.62-3.07) in fore, 3.41 (3.29-3.66) in mid, 2.38 (2.2-2.78) in hind.

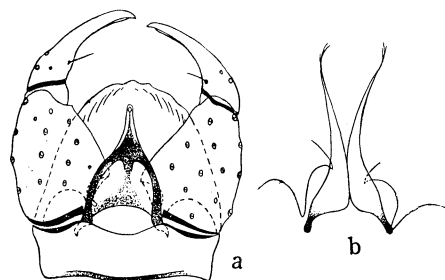


Fig. 15. *Culicoides buckleyi* ♂. a, hypopygium; b, parameres.

Wing as in my previous paper, but usually paler spots slightly larger than in original figure, apical pale spot of cell  $R_5$  as large as costal pale spot II and sometimes larger, apical pale spot of cell  $M_1$  usually oval, as large as basal, costal dark band III narrower than 2 adjacent pale spots; in specimens with larger pale spots, apical spot of cell  $R_5$  always reniform, widely separated from apex of cell. Abdomen with cerci pale brown or pale ochreous; spermathecae brown, 2 larger round, equal, rarely unequal, 1.1+11.7 $\times$ 10.6 units and 1+10.7 $\times$ 9.8 units, each with minute chitinized part of duct.

*Male*: Body 1.37 mm long. Wing 0.72 $\times$ 0.31 mm. Coloration and main characters as in ♀ with usual sexual differences. Head with eyes narrowly separated. Palp slender, PR about 2.0, RL-P 4: 8: 10: 6: 5.5. Antenna with scape and last 3 segments brown, other segments and plumose hairs pale ochreous; sensory tufts on II and XII-XIV; combined lengths of II-XI and XII-XIV about 100: 66, RL-8A 10: 10: 10: 9: 9: 21: 20: 26.5. Scutellum with 2 lateral and 2 median bristles. Legs with claws cleft at tips, hind

tibial comb with apical bristles 4; TR and RL-L 2.93 and 21 : 20 : 12 : 4 : 2.5 : 2 : 2.5 in fore, 3.47 and 26.5 : 26 : 15.5 : 4.3 : 3 : 2.2 : 2.7 in mid, 2.18 and 23.5 : 23.5 : 11.4 : 5.2 : 3 : 2.1 : 3 in hind.

Wing elongate-oval, paler on apical marginal area, with macrotrichia sparsely arranged along apical margin between tips of Rs and  $M_{3+4}$ , costa ending at basal 0.67, extending to middle of pale spot, RL-V 21 : 20 : 30 : 15 : 19, radial cell II triangular, as long as I. Halter white. Abdomen with sclerites brown; hypopygium (fig. 15a) brown, but styles yellow; sternite with caudal margin slightly concave; tergite round on caudal margin, without anal points; coxite with 2 basal roots unequal; style claw-like, sharply pointed, as long as coxite; aedeagus similar to *unisetiferus*, elongate-triangular, with basal arch very low, basal membrane bare; paramere (fig. 15b) long, swollen on sub-basal part, tapered, filiform apically, terminating in filiform tip which is provided with a few minute hairs.

DISTRIBUTION: Malaya, New Guinea, New Britain.

SPECIMENS EXAMINED: 28 ♀♀, Maprik, Sepik Distr., New Guinea, I. 1959, Peters; 16 ♀♀, ditto, II and 7. III. 1959, Peters; 7 ♀♀, 1 ♂, Bubia, near Lae, New Guinea, 8. III-26-27. IV. 1959, Ardley; 3 ♀♀, Bairyik, Sepik, New Guinea, III. 1959, Peters; 1 ♀, Lowlands Agr. Sta., Keravat, New Britain, 22-26. VIII. 1960, Smee.

**45. *Culicoides quaterifasciatus* Tokunaga, 1959, Pac. Ins. 1: 240.**

Small, brown; wing with 4 slender fuscous bands. General appearance similar to *mollis* Edwards from Samoa.

DISTRIBUTION: New Britain.

Species closely related to *mollis* and probably identical with Macfie's species near *mollis* from Rabaul. However, it can be distinctly separated from *mollis* by absence of fuscous longitudinal clouds of wing covering veins  $M_1$ ,  $M_2$ , stem of fMCu and  $M_{3+4}$ .

**46. *Culicoides tritenuifasciatus* Tokunaga, 1959, Pac. Ins. 1: 242.**

Large, brown or dark brown and yellow, with characteristic wing pattern. Main specific characters as shown in original description. Additional notes based on a new ♀ specimen as follows:

*Female*: Body length 1.66-1.95 mm. Wing 1.51-1.69×0.7-0.75 mm. Proboscis 0.6-0.68 as long as head-capsule; palp with PR 2.0, RL-P 9.5 : 23 : 24 : 10 : 10. Antenna with short basal flagellar segments elongate-oval, each with short and indistinct neck-part; AR 1.14-1.15, RL-8A 13 : 13.5 : 14 : 21.5 : 21.5 : 24.5 : 26.5 : 32.5; sensory tufts present on segments II and X-XIV. Thoracic scutellum with 3-4 strong bristles and several minute setae. Knee of fore leg narrowly dark brown differing from holotype which is provided with fore and mid knees widely yellowish; claws simple, rather stout, each with 3 basal setiform processes instead of 1 in general case, hind tibial comb with apical bristles 4; TR 2.28-2.3 in fore, 2.28-2.57 in mid, 1.95-2.17 in hind. Wing pattern as in original drawing, but  $M_1$  ending in a small faint fuscous cloud and marginal parts of  $M_2$  beyond dark band III faintly fuscous. Abdomen with tergites large; 2 functional spermathecae subequal or unequal, 1.8+19.8×14.5 units and 1.8+17×15 units respectively, pale punctures faint, 1 vestigial 6.5×2 units.

DISTRIBUTION: NE New Guinea.

SPECIMEN EXAMINED: 1 ♀, Minj, W. Highlands, NE New Guinea, 8. V. 1959, Peters.

47. *Culicoides dikhros* Tokunaga, n. sp. Fig. 41.

Small, dark and yellow; scutum distinctly bicolored, anterior part dark and posterior part yellow as in *flaviscryptus*, legs broadly yellow on knees, wings mainly white, dark spots small as in *fragmentum*. Male unknown.

*Female*: Body length 1.3–1.82 mm. Wing 0.94–1.11 × 0.46–0.49 mm. Head dark brown, with eyes bare, contiguous, proboscis longer than 1/2 of head-capsule (12.5 : 20). Palp brown, slender, segment III elongate-oval, with sensory pore on apical 1/2 shallow, PR 2.0, RL–P 5.7 : 14 : 14 : 8 : 7.5. Antenna with scape dark, short basal flagellar segments yellow on basal parts, brown on apical parts, short-oval to elongate-oval, distal elongate segments brown; AR 1.27 (1.14–1.29), RL–8A 9.3 : 9.7 : 10 : 15.8 : 16.7 : 18 : 19.7 : 27.3; sensory tufts present on II, IV, VI and VIII–XIII. Thorax with scutum clearly bicolored: dark on anterior part, yellow on posterior part, lateral yellow parts extending forward just past scutal sutures, median yellow part extending forward to level of humeral pits, yellow caudoscuteal area containing a small fuscous spot just in front of scutellum; other sclerites entirely dark; scutellum with 2 lateral, single median bristles and 0–3 small median setae.

Legs dark and yellow: coxae and trochanters dark, basal 1/2 of fore and mid femora and entire length of hind femur dark, fore knee dark, apical 1/2 of fore and mid femora yellow, basal 1/2 of fore and mid tibiae and basal 1/3 of hind tibia yellow, remaining apical parts of tibiae dark, tarsal segments mainly pale yellow, but segment I of fore leg mainly dark and apically paler, I of hind leg entirely dark; claws simple, hind tibial comb with apical bristles 5; TR and RL–L 2.94 (2.62–3.14) and 23.5 : 22.8 : 12.6 : 4.3 : 3.3 : 2.3 : 3 in fore, 3.3 (3.21–3.5) and 29.2 : 29.2 : 16.5 : 5.1 : 3.4 : 2.2 : 3 in mid, 2.19 (2.16–2.24) and 28 : 28 : 13.2 : 6.3 : 3.9 : 2.6 : 3.1 in hind leg. Wing (fig. 41) largely white, dark spots small and separated from each other as in *fragmentum*, dark costal spot II strongly constricted, vein  $M_1$  ending in small pale spot passing through preapical small dark spot; macrotrichia sparsely spread on apical 1/4 of wing and arranged in single line along anal margin; costa ending at about basal 2/3 of wing length (55.8–80.7), RL–V 27.3 : 24 : 39 : 13.3 : 20.7, Rs ending at middle of costal margin of pale spot II, radial cell II hardly as long as I. Halter white. Abdomen pale yellow with tergites and hemisternites pale brown, caudal segments dark, pleural membranes dark, cerci pale or yellow; spermathecae 2 brown, oval, unequal, 1.3 + 15.5 × 12 units and 1.3 + 13.5 × 10 units, each with small sclerotized part of duct, rudimental spermatheca invisible.

DISTRIBUTION: New Guinea.

Holotype ♀ (BISHOP 3243), Bubia, near Lae, New Guinea, 8. III. 1959, Ardley. Paratypes: 1 ♀, same place as holotype, 18. III. 1959, Ardley; 1 ♀, Maprik, Sepik Distr., New Guinea, I. 1959, Peters.

Superficially resembles *flavidorsalis* in coloration of various parts of body, but can be distinguished easily by clear demarcation of dark and yellow parts of scutum, entirely dark and less setigerous scutellum, less hairy wings, and separated small fuscous spots of wings.

48. *Culicoides fragmentum* Tokunaga, n. sp. Fig. 42.

Medium-sized, dark brown; single pair of yellow oblong median spots on scutum and

ill-defined large pale cloud covering scutal suture, yellowish white bands on legs, wings extensively pale, with dark separated or subconfluent spots, general structure and coloration similar to those of *orientalis* Macfie. Male unknown.

*Female*: Body 1.26–1.5 mm long. Wing  $0.96-1.0 \times 0.44-0.46$  mm. Head dark brown, eyes bare, contiguous, proboscis slightly longer than  $1/2$  of head-capsule (12 : 21.5). Palp brown, slender, segment III elongate-oval, with large sensory pore just beyond middle, PR 2.03 (1.78–2.15), RL–P 5.7 : 15 : 15 : 7.7 : 7.7. Antenna with scape dark, other segments brown, short basal flagellar segments short-oval to oval or elongate-oval; AR 1.13 (1.01–1.28), RL–8A 8.8 : 10 : 9.8 : 14.3 : 14.8 : 14.8 : 15 : 25; sensory tufts present on II, VI, VIII and X–XIV, but in 1♀ II, VI–VIII and X–XIV. Thorax largely dark brown, scutum with 2 large distinct yellow median spots on anterior  $1/2$ , broadly paler on caudoscuteal area and lateral areas including scutal sutures; scutellum with 2 lateral and single median bristles.

Legs mainly brown, bases of femora and entire tarsi pale brown, fore knee dark, fore leg with pale yellow bands basad and apicad of knee, mid leg with knee widely pale yellow, hind tibia with both ends widely pale yellow; claws simple, hind tibial comb with apical bristles 5; TR and RL–L 2.87–2.13 and 23.5 : 22.8 : 12.3 : 4 : 3 : 2.4 : 3 in fore, 3.31–3.33 and 28.3 : 28.5 : 15.5 : 4.1 : 3.5 : 2.4 : 3 in mid, 2.18 (2.04–2.33) and 26.5 : 26 : 12.8 : 6 : 3.5 : 2.2 : 3 in hind leg. Wing (fig. 42) broadly white, dark spots small, costal dark spot II distinctly constricted beneath  $R_s$ ,  $M_1$  ending in fuscous cloud, costal dark spots I and III narrow and oblique, area above  $fMCu$  pale; macrotrichia sparsely spread on marginal area between tips of  $R_s$  and  $M_{3+4}$ ; venation: costa extending slightly beyond basal  $2/3$  of wing length (51 : 75.5), RL–V 24.5 : 22 : 36 : 12 : 20, radial cell II not pointed, as long as I (8 : 7.5). Abdomen brown, with pleural membranes fuscous, cerci pale ochreous; spermathecae 2 brown, round, unequal,  $1+12 \times 12$  units and  $1+9.8 \times 9.5$  units, each with small sclerotized part of duct, vestigial one brown, elongate-oval,  $3.5 \times 1.3$  units.

DISTRIBUTION: New Guinea, New Britain, New Ireland.

Holotypes ♀ (BISHOP 3244), Bubia, near Lae, New Guinea, 8. III. 1959, Ardley. Paratypes: 1 ♀ with holotype; 11 ♀♀, Maprik, Sepik Distr., NG, I and 7. III. 1959, Peters; 3 ♀♀, Kavieng, New Ireland, 4. IV. 1959, Peters. *Other specimens*: 3 ♀♀, Lowlands Agr. Stat., Keravat, New Britain, 22–26. VIII. 1960, Smees; 133 ♀♀, Maprik, Sepik, NG, I and 7. III. 1959, Peters; 1 ♀, topotype, 5. III. 1959, Ardley.

Closely allied to *orientalis* Macfie but may be distinguished by the following: palps not very slender, antennal sensory tufts present on II, VI, VIII and X–XIV instead of II and X–XIV or X–XIII, scutum with distinct yellow median spots instead of almost entirely brown scutum, wings with small dark spots differing from broader and confluent spots.

#### 49. *Culicoides crassus* Tokunaga, n. sp. Fig. 43.

Minute, brown; palps slender, eyes distinctly pubescent, scutum brown and with dark ill-defined stripes, hind legs stout, wing short-oval, with usual pale spots, but costal pale spot II round and distinctly separated from costal margin, radial cell II large, triangular and extending to just before costal dark spot III. Male unknown.

*Female*: Body 0.87 mm long. Wing  $0.73 \times 0.34$  mm. Head dark brown, with eyes dis-

tinctly pubescent, separated by width of a facet, proboscis about  $2/3$  as long as head-cap-sule. Palp brown, slender, segment III elongate-oval, with sensory pore on preapical part, PR about 2.33, RL-P 4 : 10 : 14 : 4.5 : 6. Antenna with scape dark, other segments brown, basal short flagellar segments round to short-oval, X-XI oval, about  $1.5\times$  as long as wide (8.5 : 5.5), XII-XIII elongate-oval, about  $2\times$  as long as wide (10.5 : 5.5), XIV about  $3\times$  as long as wide (15 : 5); AR 1.0, RL-8A 5.5 : 6 : 6 : 8.5 : 8.5 : 10.5 : 10.5 : 15; sensory tufts present on II and X-XIV. Thorax entirely brown, scutum with dark stripes arising from anterior dark area and extending along mid-dorsal line and paired foveae; scutellum with 3 large bristles and 7 small setae including 2 lateral accessory setae.

Legs mainly brown, basal parts of femora and basal tarsal segments pale brown, apical tarsal segments almost white, basal parts of fore and hind tibiae pale ochreous, mid knee part broadly yellow, other knees ochreous; hind leg, especially tibia, thick, claws simple, hind tibial comb with apical bristles 4. TR and RL-L 3.11 and 15 : 15 : 7.2 : 2.5 : 1.5 : 1.5 : 2.5 in fore, 3.3 and 19 : 18 : 9 : 3 : 2.4 : 2 : 2.5 in mid, 2.82 and 20 : 18 : 9 : 3 : 2.5 : 2 : 2.5 in hind leg. Wing (fig. 43) short-oval, with usual pale spots, but costal pale spot I round, separated from costal margin, costal pale spot II large, subsquare, enveloping apical  $2/3$  of radial cell II which just reaches costal dark spot III; macrotrichia sparsely spread on apical  $1/3$  of wing and on cell  $M_4$ , arranged in single line along anal margin of anal cell; venation: costa extending about basal  $2/3$  of wing (37 : 56), RL-V 16 : 15 : 24 : 10 : 16, radial cell II large, triangular, as long as I. Halter pale yellow. Abdomen with tergites large, hemisternites small, both brown, pleural membranes fuscous, cerci pale yellow; spermathecae 2 brown, round, equal,  $3+10\times 10$  units, each with slender sclerotized part of duct.

DISTRIBUTION: NE New Guinea.

Holotype ♀ (BISHOP 3245), Maprik, Sepik Distr., New Guinea, I. 1959, Peters.

Wing venation and adornment of this species resemble some of *Trithecoides*, but the functional spermathecae differ greatly from members of subgenus. Wing marking of this species is common among the *orientalis*- and *obsoletus*-groups and there are many allied species, from which this new species can be distinguished by presence of distinct pubescence on eyes, large triangular radial cell II which almost reaches costal dark spot III, circular costal pale spot I separated from costal vein and strongly thickened hind legs.

50. *Culicoides monothecalis* Tokunaga, n. sp. Figs. 16, 44.

Small, dark brown or brown; large yellow spots on thoracic tergites, palp rather stout and ♀ with large shallow palpal sensory pore, legs with distinct white bands basad and apicad of black knee parts, wing with pattern similar to that of *orientalis* Macfie, ♀ with only 1 large functional spermatheca. Male hypopygium: lateral sclerite of aedeagus with preapical tooth and minute serrulation on midportion, paramere with tubercular thickening on midportion and serrate apical lamella.

*Female*: Body 1.36 (1.26-1.43) mm long. Wing  $0.95 (0.92-1.01)\times 0.43 (0.42-0.47)$  mm. Head brown, with eyes bare, just contiguous or narrowly separated, proboscis about  $1/2$  as long as head-capsule (9.4 : 19.2). Palp brown, stout, segment III oval, inflated at middle, with sensory pore on apical  $1/2$  large and shallow, PR 1.65, RL-P 4.3 : 10.8 : 15.8 : 5.5 : 7.8. Antenna with scape brown, other segments brown or pale brown, short basal flagellar

segments round to oval, sensory tufts present on II and IV-IX; AR 1.29 (1.12-1.51), RL-8A 7.5 : 7.7 : 8 : 13.9 : 14.6 : 15.8 : 17.2 : 25.2. Thorax dark brown or pale brown, but tergites with large yellow or yellowish spots: scutum with 2 oblong median spots on anterior 1/2, 2 similar median spots on lateral sides of caudoscuteal area, 2 ill-defined lateral spots before either scutal suture, 1 or 2 ill-defined lateral spots behind either scutal suture, these lateral spots often subconfluent with each other and in a paratype lateral spots confluent with posterior median spot, scutellum largely yellow, with fuscous or brown clouds on either lateral side and on midportion, postscutellum mainly dark brown, but median part usually yellowish; scutellum with 2 lateral and 2 median bristles and 3-6 small setae on middle area.

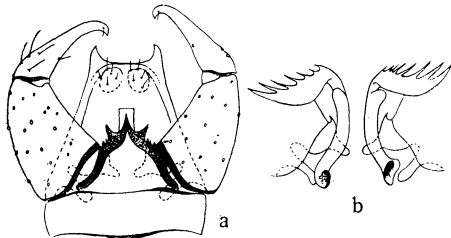


Fig. 16. *Culicoides monotheccalis*, ♂. a, hypopygium; b, parameres.

Legs mainly dark brown or brown, but pale on bases of femora, with distinct white bands basad and apicad of black knees, apical ends of tibiae pale, tarsal segments pale brown, but paler or whitish on distal segments; claws simple, hind tibial comb with apical bristles 4, rarely 5; TR 2.85 (2.73-2.92) in fore, 3.74 (3.59-4.0) in mid, 2.36 (2.19-2.5) in hind leg. Wing (fig. 44) with pattern similar to that of *orientalis*, vein  $M_1$  pale-margined except for base, with small dark cloud at apex of vein  $M_1$ , cell  $M_2$  without pale spot beneath basal spot of cell  $M_1$ , Rs ending at middle of costal margin of costal pale spot II; macrotrichia sparsely spread on apical part beyond level of costal end, cell  $M_4$  with or without macrotrichia; venation: costa ending at basal 0.67 of wing length (50 : 74.2), RL-V 24.2 : 22.2 : 34.4 : 12 : 19.4, radial cell II subtriangular fully as long as I (8 : 7.4). Halter white. Abdomen whitish, with tergites and sternites highly reduced, but caudal segments brown; cerci yellow or white, spermatheca single, brown, large, oval, 3.6+15.8×11.5 units, with slender chitinized part of duct.

**Male:** Body 1.23 mm long. Wing 0.87×0.34 mm. Coloration similar to ♀ but scutal yellow spots more distinct and well defined, scutellum with only 1 median brown spot, fore tibia without pale part on apical end, wing with pale spots larger. Head with eyes just contiguous. Palp with sensory pore just beyond middle of segment III shallow and smaller. PR 1.7, RL-P 4 : 7 : 11 : 6 : 7. Antenna with plumose hairs pale brown, sensory tufts present on II and IX-XI, RL-8A 8.5 : 8.5 : 8 : 8 : 8 : 26 : 20 : 25, II-XI : XII-XIV = 95 : 50.

TR and RL-L 3.73 and 22.5 : 19 : 11 : 4 : 2.5 : 1.3 : 2 in fore, 4.0 and 28.5 : 25.5 : 16 : 4 : 3 : 2 : 3 in mid, 2.26 and 24 : 23 : 11.5 : 4.5 : 3 : 2 : 3 in hind leg. Wing elongate-oval, with macrotrichia sparsely spread on apical 1/2 of cell  $R_5$ , on apical marginal area of cell  $M_1$  and apical corner of cell  $M_2$ ; cell  $R_5$  with small elongate spot lying adjacent to vein  $M_1$  under costal pale spot II, basal pale spot of cell  $M_1$  larger than apical, elongate well-defined pale spot present just above fMCu. Abdomen whitish, tergites and hemisternites pale brown. Hypopygium (fig. 16a) brown but apical 1/2 of tergite and entire length of style yellow; tergite long, tapered, with anal points triangular; sternite without caudal concavity; coxite slender, tapered, with 2 basal roots or apodemes: one slender and other subtriangular; style shorter than coxite (22 : 27), slender, tapered, curved at tip;

aedeagus triangular, with sclerotized lateral sclerites slender, each bearing minute serrulation on middle and single tooth on preapical part, basal membrane bare; paramere (fig. 16b) broadened on apical 1/3 and serrated into 6-7 teeth, with small tubercle on middle.

DISTRIBUTION: New Guinea, New Britain.

Holotype ♀ (BISHOP 3246), Maprik, Sepik Distr., New Guinea, I. 1959, Peters. Allotype: ♂, Lowlands Agr. Stat., Keravat, New Britain, 22-26. VIII. 1960, Smee. Paratypes: 10 ♀♀, Bubia, near Lae, NG, 18. II, 5-8. III and 26-27. IV. 1959, Ardley; 2 ♀♀, Keravat, New Britain, 13-18. VI. 1960, Smee.

Closely related to *orientalis*, both having similar wing pattern, but readily distinguished by the presence of numerous yellowish spots on scutum and scutellum, dark knees, 4 scutellar bristles, single large spermatheca, cornuate aedeagus and serrate parameres of ♂ hypopygium.

51. *Culicoides* sp. allied to *longiradialis* n. sp. Figs. 17, 45.

Small, pale brown or brown; scutum with ill-defined yellow clouds, scutellum entirely yellow, wing pattern and leg markings similar to those of *longiradialis* n. sp., but palpal segment III elongate-oval with shallow but distinct sensory pore and wing radial cell II not subtriangular but elongate. Hypopygium with aedeagus triangular, basal arch large, median lobe small, paramere stout, thickened on basal 3/5, tapered on apical part, ending in blunt or poorly serrated apex. Female unknown.

*Male*: Body 1.43 mm long. Wing  $1.03 \times 0.38$  mm. Head brown, with eyes bare, just contiguous. Palp slender, segment III elongate-oval, with sensory pore on apical part large but shallow; PR 2.5, RL-P 6 : 12 : 15 : 6 : 9.5. Antenna with scape dark brown, other parts paler, segment IX normal, with plumose hairs and short neck part, sensory tufts present on II and XII-XIV; combined lengths of II-XI and XII-XIV 125 : 125, RL-8A 12 : 11.5 : 11 : 10 : 10 : 43 : 35 : 45. Thorax brown, scutum with anterior part more brownish, caudo-scutal area paler, 4 pairs of yellow clouds which are large, subconfluent, ill-defined and widely occupying middle of scutum, scutellum entirely yellow, with 2 lateral, 1 median bristles and few accessory median small setae.

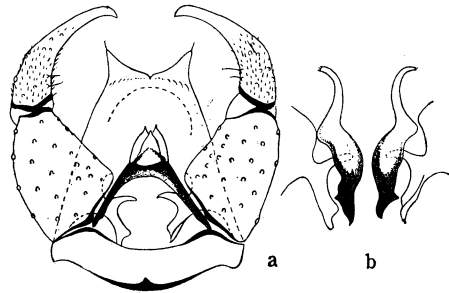


Fig. 17. *Culicoides* sp. near *longiradialis*, ♂. a, hypopygium; b, parameres.

Legs mainly brown, with yellow bands basad and apicad of knee-part of fore, on apical part of femur and basal part of tibia of mid and on both ends of tibia of hind leg; claws probably simple, hind tibial comb with apical bristles 4; TR 3.1 in fore, 3.5 in mid, 2.36 in hind leg. Wing (fig. 45) with pattern similar to that of *longiradialis*, costal pale spot II semicircular, covering apical 2/3 of radial cell II, apical 1/3 of cell  $R_5$  pale, radial cell II almost reaching costal dark band III; macrotrichia spread on apical 1/2 of wing and sparsely on anal cell; venation: costa ending at basal 0.7, extending long for ♂ wing, RL-V 28 : 27 : 36 : 12 : 21, 2 radial cells elongate, about equal in length. Halter white. Abdomen pale brown, with tergites broad, sternite reduced, pleural membranes almost colorless. Hypopygium (fig. 17a) brown, but styles, anal points and parameres

pale; tergite long, tapered, with anal point subtriangular, caudal margin with minute median cleft; coxite short, with basal roots prominent; style large, as long as coxite, arcuate, setigerous and pubescent on basal 1/2; aedeagus short, triangular, with basal arch large, median lobe small; paramere (fig. 17b) thickened on basal 3/5, apical part tapered, but not sharply pointed, ending in blunt or poorly serrated apex.

DISTRIBUTION: NE New Guinea.

SPECIMEN EXAMINED: 1 ♂, Maprik, Sepik Distr., New Guinea, I. 1959, Peters.

Similar to *longiradialis* n. sp. in coloration of legs and wing markings, but structure of palpal segment III, TR of fore leg and color of scutellum, which are important for specific characters, are distinctly different from allied species. Specimens of ♀♀ are required for naming.

**52. *Culicoides flavidorsalis* Tokunaga, 1959, Pac. Ins. 1: 245.**

Small, brown and yellow; extensively yellow scutum and scutellum, wing densely hairy over almost all of surface, pattern resembling that of *maculiscutellaris*, legs with knees broadly yellow.

DISTRIBUTION: New Guinea.

**53. *Culicoides novairelandi* Tokunaga, n. sp. Fig. 46.**

Medium-sized, pale brown; palps and antenna slender, scutum pale, legs pale brown, without distinct bands, wings pale, with markings ill-defined, but radial cell II elongate and almost entirely covered by costal pale spot II, with macrotrichia spread over all of surface, spermatheca with slender chitinized part of duct. Male unknown.

*Female*: Body 1.26 (1.14–1.37) mm long. Wing 1.16 (1.09–1.27) × 0.44 (0.42–0.48) mm. Head brown including mouth parts, with eyes bare, narrowly separated, proboscis 0.62 as long as head-capsule (13.8 : 22.4). Palp slender, segment III elongate, with sensory pore at middle deep; PR 3.0, RL–P 7.2 : 16.4 : 21.2 : 8 : 10.3. Antenna long, slender, with scape deep brown, other segments brown, III–IX elongate-oval, sensory tufts present on II and X–XIII; AR 1.29 (1.19–1.37), RL–8A 14 : 13.8 : 14 : 23.6 : 24.6 : 27.2 : 26.7 : 38.6. Thorax mainly brown, scutum broadly yellow on middle, scutellum yellow, with 4 large bristles and 4–8 small setae.

Legs mainly pale brown, with coxae brown, knees dark, but knees of fore and mid leg, both ends of hind tibia widely whitish; claws simple, hind tibial comb with apical bristles 4; TR and RL–L 2.94 (2.9–3.0) and 30.4 : 29.4 : 17.1 : 6 : 4 : 3 : 4 in fore, 3.51 (3.34–3.66) and 37.2 : 37.2 : 20.9 : 6.2 : 4.2 : 3.2 : 4 in mid, 2.19 (2.1–2.26) and 35 : 35 : 16.8 : 7.7 : 4.8 : 3.9 : 4.3 in hind. Wing (fig. 46) elongate-oval as in ♂ wing, almost entirely hairy, with pattern pale and ill-defined, paler spots large, costal pale spot II enveloping almost entire radial cell II, all marginal pale spots large, abutting widely on wing margin; venation: costa ending just before dark costal band III and at basal 0.7 of wing length (63 : 89.1), RL–V 28.8 : 26.8 : 36.2 : 13.6 : 25.6, radial cell II elongate, longer than I, fMCu under or slightly beyond base of r-m. Halter with knob pale ochreous, stem white. Abdomen pale brown, with tergites and hemisternites broad, pleural membranes fuscous pale brown, caudal segments brown; cerci pale brown or pale yellow, spermathecae brown, 2 functional oval, subequal 4+17×12.3 units and 4+16.3×11.5 units, each with slender chi-



tinized part of duct, 1 vestigial, tubular,  $6.6 \times 1.9$  units.

DISTRIBUTION: New Ireland, Solomon Is., 26. V. 1959, Peters.

Holotype ♀ (BISHOP 3247), Kavieng, New Ireland, 4. VI. 1959, Peters. Paratypes: 15 ♀♀ with holotype; 1 ♀, Kieta, Bougainville I., Solomon Is.

Allied to *nigrigenus* Wirth & Hubert, known from C. America. There seems to be no allied species from New Guinea, Australian and Oriental region. Similar to *nigrigenus* in coloration and wing pattern, but easily distinguished by slender palpal segment III, much smaller AR than 2.0 and oval spermathecae each of which bears slender chitinized part of duct.

54. *Culicoides papuensis* Tokunaga, n. sp. Fig. 47.

Medium-sized, dark brown; wing pattern closely resembling that of *orientalis* and *monothecalis*, but veins  $M_1$  and  $M_2$  not accompanied by adjacent pale stripes along sides, and macrotrichia more broadly spread on basal area before level of fMCu, thorax entirely dark brown, without pale or yellowish spots, legs with preapical parts of femora not white or yellow but only paler, sub-basal parts of tibiae white. Male unknown.

*Female*: Body 1.4–1.56 mm long. Wing  $1.05\text{--}1.11 \times 0.48$  mm. Head dark brown, with eyes bare, narrowly separated, proboscis slightly longer than  $1/2$  of head-capsule (13 : 22). Palp brown, stout, segment III large, elongate-oval, with sensory pore just beyond middle, distinct; PR 1.75, RL-P 6 : 15 : 21 : 7 : 8. Antenna with scape darker, other segments entirely brown, II–XI round to short-oval, sensory tufts present at least on II–XI (XII–XIV missing); RL-8A 8.5 : 8.5 : 9 : 16.5 : 18 : ? : ? : ? (W=7.5–7). Thorax dark brown, without paler or yellowish spots; scutellum with 4 bristles, 2 lateral accessory and 5–13 median small setae.

Legs with coxae brown, trochanters pale brown, tarsi pale brown, but hind basitarsus brown, femora mainly brown but with bases and preapical parts paler, knees dark, tibiae mainly brown, but with sub-basal white bands, apical parts of 2 anterior tibiae paler, apical  $1/3$  of hind tibia pale yellow; tarsal segment IV flattened, bell-shaped, hind tibial comb with apical bristles 4; TR and RL-L 2.32–2.4 and 25.8 : 24 : 12.5 : 5 : 3.5 : 2.8 : ? in fore, 3.1 and 31.5 : 29.5 : 16 : 5.2 : 3.5 : 2.5 : ? in mid, 2.0–2.15 and 30.3 : 28.5 : 14 : 6.7 : 4.3 : 2.8 : ? in hind leg. Wing (fig. 47) with distinct markings, pale spots large, marginal spots widely abutting on wing margin, both sides of veins  $M_1$  and  $M_2$  not pale, no pale spot just above fMCu, costal pale spot II enveloping only apical part of radial cell II; macrotrichia widely spread over almost all of surface, but not densely; venation: costa extending to basal 0.66 of wing length, ending above or just before tip of  $M_{3+4}$ , radial cell II elongate, ending slightly before costal dark band III, as long as cell I, RL-V 25.5 : 23 : 36.5 : 14.5 : 21.5. Halter white, but in paratype slightly brownish at junction between stem and knob. Abdomen brown or pale ochreous, with tergites, hemisternites and pleural membranes brown or pale, cerci paler; spermathecae 2 brown, elongate-oval, subequal,  $2+18 \times 12.5$  units and  $2.8+17 \times 13$  units, each with small chitinized part of duct.

DISTRIBUTION: New Guinea (Papua).

Holotype ♀ (BISHOP 3248), Port Moresby, Papua, I. 1960, Peters. Paratype: 1 ♀ with holotype.

Wing pattern is similar to that of *orientalis* and *monotheccalis*, but details of other specific characters, such as distribution of macrotrichia of wing, scutal color, shape of tarsal segment IV, are different.

55. *Culicoides orientalis* Macfie, 1932, Ann. Mag. Nat. Hist. ser. 10, 9: 490.—Tokunaga, 1959, Pac. Ins. 1: 254. Figs. 18, 48.

Small, dark brown or brown; scutum with or without pale brown central spots between foveae on anterior 1/2 in ♀, always with them in ♂, legs with white or pale yellow bands distinct, wing with distinct pattern, pale spots large, costal pale spot II enveloping apical 1/2 of radial cell II, vein  $M_1$  with pale stripes on both sides, ending in small fuscous spot, macrotrichia spread on marginal area between tips of Rs and  $M_{3+4}$  in ♀, arranged along apical margin in ♂. Male hypopygium without anal points, basal membrane of aedeagus slightly pubescent on lateral parts, paramere slender, filiform on apical part. Male reported in my previous paper is not *orientalis* but is *robertsi* Lee & Reye.

*Female*: Body 1.34 (1.17–1.56) mm long. Wing 0.97 (0.87–1.01) × 0.43 (0.39–0.46) mm.

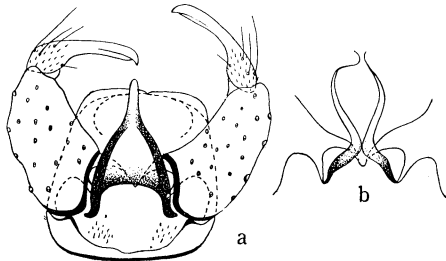


Fig. 18. *Culicoides orientalis*. ♂. a, hypopygium; b, parameres.

Head with eyes bare, just contiguous, proboscis 0.72 as long as head-capsule. Palp slender, segment III elongate-oval; PR 3.16, RL-P 5.4: 18.2: 17.6: 9: 8.5. Antenna with sensory tufts present on II and X–XIII or II and X–XIV; AR 1.15(1.04–1.24), RL-8A 8.6: 8.8: 9.4: 14.2: 14.3: 14.7: 14.7: 22.6. Legs dark brown or brown, with white or pale yellow bands basad and apicad of knees of fore and mid legs and on both ends of hind tibia; claws simple, hind tibial comb with apical bristles 5 and sometimes 6; TR and RL-L 2.61 (2.47–2.76) and

22.9: 21.5: 11.5: 4.3: 2.8: 2.2: 2.5 in fore, 3.16 (3.0–3.38) and 27.8: 27.5: 15.7: 5: 3.1: 2: 2.8 in mid, 2.03 (1.91–2.14) and 27: 26.5: 12.4: 6.1: 3.5: 2.1: 3.0 in hind.

Wing (fig. 48) typically with pattern as in figure, pale spots large, costal dark bands II and III sometimes more constricted, costal pale spot II always enveloping apical 1/2 of radial cell II, pale spot, straddling vein  $M_1$  long, 2 pale spots of cell  $M_1$  sometimes confluent, no distinct pale spots above  $M_{3+4}$  and just above fMCu, vein  $M_1$  ending in small fuscous cloud, costa ending at middle of costal margin of pale spot, venation: costa extending to basal 0.67 of wing length, RL-V 23.6: 21.6: 36.8: 13.2: 19.6, radial cell II subtriangular. Abdomen with spermathecae 2 larger, subequal, short-oval, 1+11.9×10.6 units and 1+11.1×9.7 units, 1 vestigial 3.8×2 units. Other structure and color as in my previous report.

*Male*: Body 1.34 (1.2–1.56) mm long. Wing 0.97 (0.86–0.97) × 0.34 (0.33–0.35) mm. General color slightly paler than in ♀. Palpal segment III short-oval, with sensory pore beyond middle, RL-P 3.7: 9.3: 9.4: 6.2: 6.8. Antenna with plumose hairs; combined length of II–XI and XII–XIV 103.5: 72.5, RL-8A 10.2: 10.3: 10.1: 9.6: 8.8: 24.8: 20.3: 26.4; sensory tufts present on II and XII–XIV. Thorax mainly dark brown, with median pale brown spots on anterior 1/2 between foveae, scutellum with only single median bristle. Legs with white bands as in ♀, but mid leg widely white on knee; claws cleft at

extreme apices, hind tibial comb with apical bristles 5, rarely 4; TR 2.86 (2.62–3.0) in fore, 3.3 (3.0–3.56) in mid, 2.05 (1.91–2.2) in hind.

Wing with pattern as in ♀, but pale spots larger, costal dark band III wider than II, radial cell II ending at or just beyond middle of pale spot, wing apex with small pale spot at extreme tip and small fuscous cloud at preapical part of  $M_1$ , cell  $M_2$  with pale spot between vein  $M_{3+4}$  and basal 1/2 of vein  $M_2$ , anal cell broadly pale; macrotrichia sparsely arranged in a line along margin between tips of veins  $R_s$  and  $M_{3+4}$ ; costa ending at basal 0.65 of wing length,  $RL-V$  22.8 : 21.3 : 34.5 : 8.8 : 14,  $fMCu$  under tip of  $R_1$ , radial cell II subtriangular, as long as I (4.7 : 4.5). Abdomen pale brown, pleural membranes dark, tergites transverse, hemisternites slender; hypopygium (fig. 18a) dark brown, but styles pale; tergite broad, slightly tapered, with caudal margin wide, without distinct anal points; sternite with caudal incision wide; coxites with basal roots slender; style slender, slightly arcuate, much shorter than coxite (20.7 : 28.5), aedeagus elongate-triangular, with basal arch about 1/4 of total length, basal membrane with slight pubescence only on lateral parts; paramere (fig. 18b) slender filiform on apical part. Other structures mainly as in ♀.

**DISTRIBUTION:** Malaya, India, Java, New Guinea, New Ireland, Solomon Is.

**SPECIMENS EXAMINED:** 188 ♀♀, 90 ♂♂, Maprik, Sepik Distr., NG, I, II and 7. III. 1959, Peters; 8 ♀♀, Bubia, near Lac, New Guinea, 8–12. III and 26. IV. 1959, Ardley; 2 ♀♀, Goldie River, near Port Moresby, Papua, 25. IX. 1959, Ardley; 1 ♂, Port Moresby, I. 1960, Peters; 13 ♀♀, Bainyik, Sepik, NG, III. 1959, Peters; 1 ♀, Keravat, New Britain, 13–17. IV. 1960, Smeë; 43 ♀♀, Kieta, Bougainville I., Solomon Is., 26. V. 1959, Peters; 55 ♀♀, Kavieng, New Ireland, 3–4. VI. 1959, Peters.

The ♂ resembles *robertsi*, but may be distinguished by apical 1/2 of radial cell II enveloped by pale spot and ending at middle of pale spot, instead of extreme tip of cell and ending far before middle, sternite of hypopygium with caudal incision not V-shaped, paramere slender and filiform at tip, instead of setiform, basal membrane of aedeagus with slight pubescence on lateral sides.

56. *Culicoides pungens* de Meijere, 1909, Tijdsch. Ent. 52 : 200.—Edwards, 1922, Bull. Ent. Res. 13 : 164; 1929, Notulae Ent., IX. Philippine Nematoceros Dipt. 2 : 9.—Macfie, 1937, R. Ent. Soc. Lond., Proc. B, 6 : 115. Fig. 49.

Small, brown, allied to *orientalis* Macfie in coloration, with thorax entirely dark brown or brown, legs with pale yellow bands on sub-basal part of fore tibia and both ends of hind tibia, broadly pale yellow on mid knee, wing pattern more obscure than in allied species, apical and caudal pale spots ill-defined and faint, palp stout.

*Female:* Body 1.0 (0.88–1.11) mm long. Wing 0.88 (0.86–0.9) × 0.4 (0.39–0.4) mm. Head dark, with eyes bare, just contiguous, proboscis about 0.57 as long as head-capsule. Palp brown, stout, segment III oval, with sensory pore on preapical part large; PR 1.85,  $RL-P$  5 : 12.2 : 12.4 : 6.6 : 7.1. Antenna with scape dark brown, other segments brown, segments II–IX short-oval to oval; sensory tufts present on II and X–XIV; AR 1.41 (1.32–1.51),  $RL-8A$  7.6 : 7.8 : 8.4 : 14.7 : 15.1 : 15 : 15.1 : 23.6. Thorax dark brown or brown, without pale or yellowish spots, scutellum with 2 lateral and single median bristles.

Legs mainly brown, bases of femora pale yellow, fore knee dark, mid knee widely pale yellow, apical parts of fore and hind femora pale brown, sub-basal part of fore tibia

and both ends of hind tibia pale yellow, tarsi pale brown on basal and whitish on apical segments, claws simple, hind tibial comb with apical bristles 5; TR and RL-L 2.98 (2.76-3.25) and 20.3 : 20 : 10 : 3.2 : 2.6 : 1.6 : 2.4 in fore, 3.5 (3.26-3.64) and 25.6 : 24.7 : 13.3 : 3.7 : 2.8 : 1.9 : 2.6 in mid, 2.14 (2.11-2.23) and 24.2 : 22.8 : 10.5 : 4.8 : 2.9 : 1.9 : 2.8 in hind. Wing (fig. 49) with pattern as in *orientalis*, but dark areas broader, pale spots smaller, apical and posterior spots more faint and ill-defined, pale stripes along vein  $M_1$  reaching wing margin, no small fuscous cloud at end of vein  $M_1$ , radial cell II ending at midportion of pale spot; macrotrichia sparsely spread on apical marginal area; costa ending at basal 0.67 of wing length, RL-V 21.6 : 20.2 : 32.2 : 11.6 : 17.6, radial cell II broad, almost as long as I (6.2 : 6.8). Halter with knob brown, stem yellowish white. Abdomen pale brown, tergites broad, pleural membranes slightly fuscous; cerci pale brown, spermathecae brown, 2 short-oval, subequal, 1+12.4 × 10.6 units and 1+12.2 × 10.2 units respectively, each with minute sclerotized part of duct, 1 minute, tubular, 4×1.4 units.

DISTRIBUTION: Sumatra, Malaya, Philippines, New Ireland.

SPECIMENS EXAMINED: 10 ♀♀, Kavieng, New Ireland, 3-4. IV. 1959, Peters.

The present ♀♀ probably belong to *pungens*, although there is some doubt because of wide paler part and wide inner space of radial cell II of wing.

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## RECENT LITERATURE ON PACIFIC INSECTS

### GENERAL

(Continued from page 456)

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