Pacific Insects 3 (1): 11-26 April 20, 1961

NEW SPECIES AND RECORDS OF TAIWAN *CULICOIDES* (Diptera: Ceratopogonidae)

By Willis W. Wirth[1] and Alexander A. Hubert[2]

The purpose of this paper is to bring up to date the taxonomy of the species of biting midges of the genus *Culicoides* known from the island of Taiwan. Our previous knowledge of Taiwan *Culicoides* stems principally from three sources: (1) the H. Sauter Formosa Expedition in 1910-1912 from which Kieffer described the ceratopogonids (1912, 1916a, b, 1921 and 1922); (2) the collections of Shiraki, who described three species (1913); and (3) Tokunaga's collections in Taiwan in 1934, which were reported (1937) in his notable paper on the Japanese *Culicoides*.

Eighteen species of *Culicoides* are recorded from Taiwan. Most of them are common and widespread species of the Orient. It is almost certain that with systematic collecting, particularly from the mountain centers of endemism, this number will be greatly increased. Although the preliminary and incomplete nature of the present list of species limits its usefulness, a key to species is offered in the hope that it will encourage additional collecting and study in Taiwan of this medically important group of insects.

A number of *Culicoides* nominal species described from Taiwan are not found in our key. *Culicoides sugimotonis* Shiraki and *alboguttatus* Kieffer are synonyms of *arakawai* (Arakawa); *tainana* Kieffer is a synonym of *maculatus* Shiraki; *kagiensis* Tokunaga is a synonym of *amamiensis* Tokunaga (**New Synonymy**) and *raripalpis* Smith var. no. 1 of Tokunaga and Okada is the same as *humeralis* Okada. *Culicoides formosae* Kieffer is an *Atrichopogon* (NEW COMBINATION), while the generic position of *C. indecora* Kieffer is uncertain, but probably not in *Culicoides*.

This paper should be used in conjunction with Arnaud's (1956) excellent revision of the species of Japan, Korea and Ryukyu Islands, and the recent contribution by Wirth and Hubert (1959) on the subgenus *Trithecoides*, for discussion and illustration of the taxonomic characters.

Most of the material forming the basis of this report was submitted through the Commonwealth Institute of Entomology in London by Dr. Su-yung Liu of the Taiwan Malaria Research Institute in Chaochow, Pingtung, Taiwan. Regular collections from Taiwan mosquito light traps have very kindly been forwarded by Dr. Stephen M. K. Hu, formerly of the Naval Medical Research Unit no. 2 in Taipei. Specimens from the important Shiraki collection at the National Taiwan University College of Agriculture were borrowed for study through the very generous cooperation of Professor Shi-tao Yie and Dr. Fung-Ying

1. Entomology Research Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C.
2. Department of Entomology, Walter Reed Army Institute of Research, Washington, D. C.

Cheng, of the Department of Plant Pathology and Entomology. Major H. C. Barnett, of the Walter Reed Army Institute of Research in Washington, made a large collection of Taiwan *Culicoides* in 1951, which is deposited in the U. S. National Museum.

The types of the new species here described are deposited in the collection of the Taiwan Malaria Research Institute in Chaochow. Paratypes and other specimens, unless otherwise noted, in the collection of the U. S. National Museum, Washington, D. C. Miss Thelma Ford of the Walter Reed Army Institute of Research prepared the illustrations.

Key to the Species of Culicoides from Taiwan

(Females)

1. Wing with lumen of cell R_5 at least partly in a pale spot 2
   Wing with lumen of cell R_5 completely dark 12
2. Radial cell 2 very long and broad; 3 spermathecae present (subgenus *Trithecoides*).. 3
   Radial cell 2, if very long, narrow; 2 spermathecae present 6
3. Scutum uniformly dark brown; wing tip with separate, distinct pale spots at apices of cells R_5, M_1 and M_2, the one in cell R_5 filling apex of cell; spermathecae subequal, pyriform, with slender sclerotized necks; palpal segment 3 very slender, 4.4 × as long as broad..... **tenuipalpis** Wirth & Hubert
   Scutum yellow or with dark brown areas on anterior margin; wing tip without separate pale spots 4
4. Scutum uniformly yellow; mandible with 7 curved teeth, distal ones largest; spermathecae unequal, with large, unsclerotized entrances to the ducts ..... **palpifer** DasGupta & Ghosh
   Scutum yellow with dark brown areas on anterior margin 5
5. Mandible with 7 teeth, distal ones largest; halter knob pale; hind femur dark, unbanded; spermathecae very unequal, with large sclerotized entrance to ducts ..... **humeralis** Okada
   Mandible with 12–15 teeth, the proximal ones largest; halter infuscated; hind femur with broad, sometimes indistinct, subapical pale band; spermathecae subequal, pyriform with short, narrow, sclerotized necks; parasitic on mosquitoes... ..... **anophelis** Edwards
6. Second (distal) pale spot in cell R_5 longitudinally elongated and extending to apex of cell R_5..... 7
   Second pale spot (the distal one, except in *hui*) in cell R_5 usually transverse, never extending to near apex of cell R_5..... 8
7. Small species (wing about 1.0 mm long); pale wing markings not dominant, or interconnccted, pale spot covering only about distal 1/2 of radial cell 2; palpal segment 3 short, distal margin of pit nearly reaching apex ..... **maculatus** Shiraki
   Larger species (wing about 1.5 mm long); pale wing markings dominant, interconnected, pale spot covering radial cell 2 nearly to base of cell; palpal segment 3 very long and slender, pit just beyond middle, distal 1/3 of segment narrowed beyond pit..... **liui** n. sp.
8. Cell M_4 with 2 pale spots or areas, one at usual place near wing margin and 2nd at base of mediocubital fork bordering base of vein M_{3+4} with pale spots at wing margin ..... **peregrinus** Kieffer

Cell M_4 with 1 pale spot near wing margin, without pale spot bordering mediocubital fork; tips of veins M_1, M_2 and M_{3+4} dark or at most tip of vein M_1 pale..... 9

9. Cell R_5 with 2nd pale spot irregularly V-shaped, a 3rd spot at extreme tip of cell near, but not including, tip of vein M_1 ..... **hui**, n. sp.

Cell R_5 without 3rd pale spot at extreme tip of cell near tip of vein M_1..... 10

10. Hind femur dark to apex; tip of vein M_1 with small spot at wing margin 11

Hind femur with subapical pale band; tip of vein M_1 without pale spot .....
.....**jacobsoni** Macfie

11. Halter pale; palpal segment 3 with a definite sensory pit ..... **amamiensis** Tokunaga

Halter infuscated; palpal segment 3 with scattered sensoria ..... **nipponensis** Tokunaga

12. Two well-developed spermathecae (plus a rudimentary 3rd and a sclerotized ring) present 13

Only one spermatheca present..... 15

13. Wing with numerous distinct pale spots, including in cell R_5 a double, transverse distal one and a small round one between this and poststigmatic pale spot; scutum with prominent pattern of punctiform spots, these sometimes confluent; veins M_1, M_2, M_{3+4} and Cu_1 with pale apices ..... **schultzei** (Enderlein)

Wing with indistinct pale markings, other than over r-m crossvein and at end of radial cell 2; tips of veins dark; scutum without prominent pattern 14

14. Wing with very faint pale spots at extreme marginal tips of cells R_5, M_1 and M_2; all tibiae with distinct, contrasting pale rings; palpal segment 3 short, swollen, broadest near middle, with broad shallow pit; antenna with sensoria present on segments III–IX, XI–XV ..... **verbosus** Tokunaga

Wing without pale spots at tips of cells R_5, M_1 and M_2, a very faint one sometimes evident in cell M_4; tibiae with or without indistinct sub-basal pale rings; palpal segment 3 slender with small, moderately deep pit; antenna with sensoria present on segments III–XIV ..... **okinawensis** Arnaud

15. Wing without pale spots on distal 1/3, with 3 transverse pale bands across proximal portion..... **albifascia** Tokunaga

Wing with pale markings on distal portion..... 16

16. Cell R_5 with an irregular subapical pale spot distal to poststigmatic pale spot midway between radial cell 2 and wing tip; veins M_1, M_2 and M_{3+4} extensively pale margined, these pale areas confluent with pale spots in adjacent cells; scutum with pattern of punctiform dots; frontal tubercles present..... **homotomus** Kieffer

Cell R_5 without a subapical pale spot, but with an isolated pale spot in extreme distal portion of cell; veins M_1, M_2 and M_{3+4} not pale margined; scutum without punctate pattern; frontal tubercles absent 17

17. Pale wing spots fairly large, the poststigmatic pale spot in cell R_5 covering extreme tip of radial cell 2 and extending nearly to vein M_1; cell R_5 without additional pale spots posterior to radial cells; spermatheca oval, faintly sclerotized..... **duodenarius** Kieffer

Pale wing spots small; 2, separate, poststigmatic pale spots, the anterior one not covering extreme tip of radial cell 2, the posterior one located proximad of 1st and lying well separated from vein M_1, a 3rd pale spot often present in cell R_5 behind radial cells but closer to vein R_{4+5} than to vein M_1; spermatheca very elongate, saclike, well sclerotized ..... **arakawai** (Arakawa)

Culicoides (Trithecoides) anophelis Edwards

Culicoides anophelis Edwards, 1922, Bull. Ent. Res. **13**: 161.—Wirth and Hubert, 1959, Pacific Insects **1**: 8 (synonymy; redescription; figs.; dist.; hosts).

DISTRIBUTION: Malaya, India, Sumatra, Burma, Ceylon, Hong Kong, Indochina, Taiwan, Thailand.

NEW TAIWAN RECORDS: Tokuzanko, 21 May 1917, T. Shiraki, 1 ♀ (Nat. Taiwan Univ. coll.). Chaochow, near Kaohsiung, Apr.–Oct., S. M. K. Hu, light trap, 5 ♀.

Previously recorded from Taiwan by Okada (1942) from *Anopheles* mosquitoes, and Arnaud (1956) from light trap. The extensive bibliography of the association of this midge with mosquitoes, sucking blood from the abdomens of engorged females, is given in Wirth and Hubert (1959).

Culicoides (Trithecoides) humeralis Okada

Culicoides humeralis Okada, 1941, Tokyo Imp. Univ. Jour. Coll. Agr. **15**: 20 (♀; Honshu, Japan; fig. habitus, antenna, palpus, spermathecae).—Wirth and Hubert, Pacific Insects **1**: 24 (synonymy; redescr.; figs.; distribution).

DISTRIBUTION: Japan, Malaya, Taiwan, Thailand, Eastern Siberia.

This species was reported by Tokunaga (1940) and Okada (1942) from Taiwan under the name "*raripalpis* Smith, var. no. 1." Wirth and Hubert (1959) corrected the synonymy and recorded additional Taiwan specimens collected by Barnett at Tungshih, Taichung in 1951 and by Liu at Chialo, Chienshih, Hsinchu in 1953. Liu's specimens were taken biting cattle.

Culicoides (Trithecoides) palpifer Das Gupta and Ghosh

Culicoides palpifer DasGupta and Ghosh, 1956, Calcutta Sch. Trop. Med. Bull. **4**: 122 (♀; Calcutta).—Wirth and Hubert, 1959, Pacific Insects **1**: 25 (♂, ♀ redescr.).

DISTRIBUTION: India, Malaya, N. Borneo, Philippines, Sarawak, Sumatra, Taiwan, Thailand.

NEW TAIWAN RECORDS: All from National Taiwan University collection. Kappan San, 25 March 1920, T. Shiraki, 3 ♀. Arisan, 25 Apr. 1917, T. Shiraki, 6 ♀. Shishito, 25 May 1917, T. Shiraki, 1 ♀. Karenko [Hualien], 14 May 1919, T. Shiraki, 1 ♀. Taito [Taitung], 25 Feb.–27 March 1919, Inamura, Sonan and Yoshimo, 1 ♀.

Culicoides (Trithecoides) tenuipalpis Wirth and Hubert

Culicoides tenuipalpis Wirth and Hubert, 1959, Pacific Insects **1**: 16 (♀; Taiwan; fig. wing, sperm., palpus).

DISTRIBUTION: Taiwan.

NEW TAIWAN RECORD: Tungshih, Taichung, 13 Oct. 1951, H. Barnett, light trap, 1 ♀.

Distinguishing Characters: Presence of 3, subequal, ovate spermathecae; uniformly dark brown scutum with golden pollinosity; extremely slender palpal segment 3 with sensoria

scattered on surface; mandible with 8 teeth, the distal ones larger and more widely spaced; 5 tibial spines; sensoria present on antennal segments III, XI–XV. Wing with radial cell 2 very large and open, nearly all included in a pale spot, distal pale spot in cell R_5 large and filling apex of cell; the veins dark-bordered, cell M_1 with distal pale spot small and broadly meeting wing margin, a pale spot straddling middle of vein M_2, well defined pale spots at wing margin in apices of cells M_2 and M_4; 2 pale spots in distal portion of anal cell; base of wing broadly pale; large pale spot over r-m crossvein broadly meeting costal margin and a small pale spot in cell M_2 located in front of mediocubital fork.

This species was described from a ♀ collected by Su-yung Liu from water buffalo bait at Chialo, Chienshih, Hsinchu Hsien, 14 Dec. 1953. The type has been returned to the Taiwan Malaria Research Institute in Chaochow at the request of Dr. Liu.

Culicoides (Avaritia) jacobsoni Macfie

Culicoides jacobsoni Macfie, 1934, Tijdschr. v. Ent. **77**: 215 (♂; Sumatra; fig. genitalia).

Culicoides kitaokai Tokunaga, 1955, Saikyo Univ., Sci. Rept. Agr. **7**: 6 (♀; Japan; fig. wing).—Arnaud, 1956, Microent. **21**: 109 (Japan, Ryukyu Is.; redescr.; fig. ♀). **New Synonymy.**

DISTRIBUTION: Sumatra, Malaya, N. Borneo, Thailand, Philippines, Taiwan, Ryukyu Islands, Japan.

NEW TAIWAN RECORD: Tungshih, Taichung, 13 Oct. 1951, H. Barnett, light trap, 1 ♀.

Distinguishing Characters: A small, dark brown species, typical *Avaratia* except for the distal pale spot in cell R_5 of the wing, which does not fill the apex of the cell but is distinctly subapical and usually trilobed in shape; radial cell 2 short, pale on distal 1/2; typical pale streak of Orientalis Group species connecting proximal and distal pale spots in anal cell; antennal ratio 1.15, distal sensory tufts present on segments III, XI–XV; palpal segment 3 slender with small round pit distally, apex of segment only slightly tapered; ♂ aedeagus with spinules on distal portion, tergum 9 of ♂ bilobed, the lobes broadly rounded and longest laterally.

Comparison of Japanese material of *kitaokai* studied and redescribed by Arnaud (1956) with Southeast Asian specimens of *jacobsoni* convinces us that the 2 species are synonymous, with one continuous geographical range.

Culicoides (Avaritia) maculatus Shiraki

Culicoides maculatus Shiraki, 1913, Taiwan Sotokufu Noji Shikenjo Tokubetsu Hokoku **8**: 296 (not seen).—Tokunaga, 1937, Tenthredo **1**: 296 (♂, ♀ redescr.; Formosa: fig. ♀ antenna, palpus, wing, spermathecae, cercus, ♂ palpus, genitalia; syn.: *tainana*).

Culicoides tainana Kieffer, 1916, Suppl. Ent. **5**: 114 (♀; Anping, Formosa).

DISTRIBUTION: Taiwan.

NEW TAIWAN RECORDS: Arisan, 25 Apr. 1917, T. Shiraki, 7 ♀ (Nat. Taiwan Univ. coll.). Fenglin, Pingtung, 17 Apr. 1954, Lin and Lo, light trap in cow shed, 3 ♀. Hsin-she, near Taichung, March, May 1959, S. M. K. Hu, light trap, 2 ♀. Chaochow, near Kaohsiung, Dec. 1958, S. M. K. Hu, light trap, 1 ♀. Tungshih, Taichung, 13 Oct.

1951, H. Barnett, light trap, 1 ♀. Hokuzanko, 24 May 1917, T. Shiraki, 2 ♀ (Nat. Taiwan Univ. coll.).

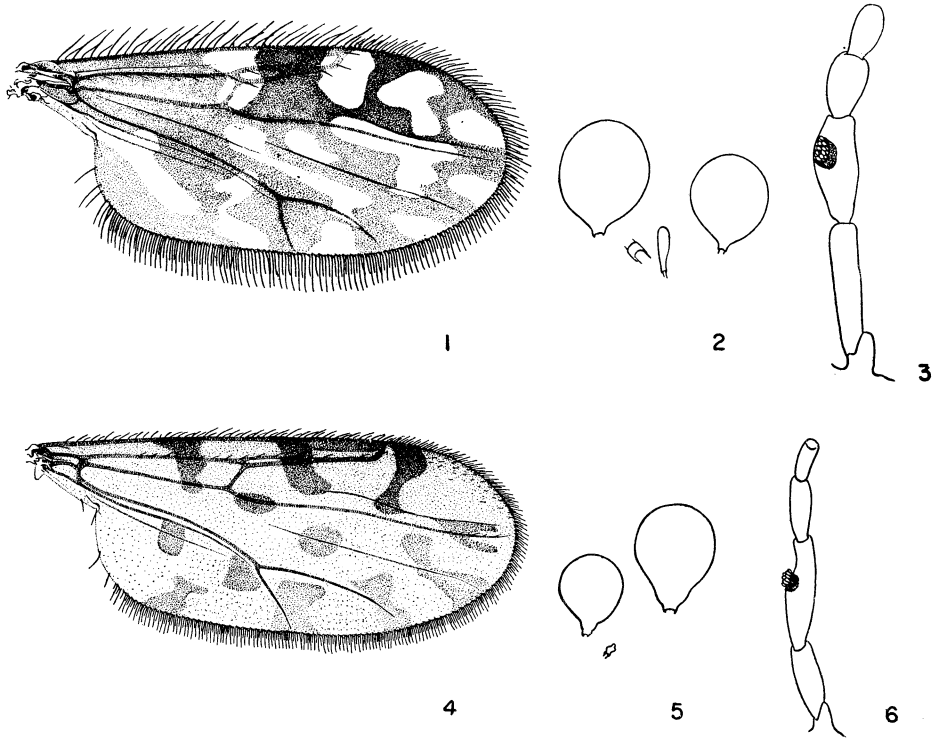
Closely related to the Japanese *C. sigaensis* Tokunaga, the ♀ being practically identical (the dark wing markings said by Tokunaga, 1937, p. 289, to be more definite in *sigaensis*) but the ♂ genitalia of *maculatus* have angular lateral lobes on tergum 9, while tergum 9 of *sigaensis* has rounded submedian lobes.

Culicoides (Avaritia) hui Wirth and Hubert, n. sp. Figs. 1–3.

Female: Length of wing 1.18 mm.

Head: Eyes contiguous a short distance, bare. Antenna with flagellar segments in proportion of 18–13–14–14–14–15–15–16–24–26–27–28–40, antennal ratio 1.21; distal sensory tufts present on segments III, XI-XV. Palpal segments in proportion of 9–25–22–12–12; segment 3 very slightly swollen distally 2.4× as long as greatest breadth, with a small definite, round moderately deep sensory pit just beyond middle. Proboscis 0.6 as long as eye height, mandible with 13–14 very fine teeth.

Thorax: Dark brown, scutal pattern not evident in slide-mounted specimen. Legs dark brown; knee spots blackish, fore tibia and femora slightly paler subapically, all tibiae with narrow sub-basal pale rings, hind tibia indistinctly paler at apex; hind tibial



Figs. 1–3. *Culicoides hui* n. sp. Figs. 4–6. *Culicoides liui* n. sp. 1 and 4, female wings; 2 and 5, female sparmathecae; 3 and 6, female palpi.

comb with 5 spines, the one nearest the spur longest.

Wing: With prominent pattern as figured; pale spot over r-m crossvein broadly continued to costal margin; poststigmatic pale spot more or less quadrate, covering distal 1/2 of radial cell 2 and extending caudad nearly to vein M_1; cell R_5 with 2 pale spots in distal portion, the distal one at extreme tip of cell near tip of vein M_1, and a larger, irregularly V-shaped subapical one, the open part of the V located distad; cell M_1 with 3 pale spots, one at base bordering vein M_2, one past middle confluent with long pale spot straddling middle portion of vein M_1 and shorter pale streak over distal 1/3 of vein M_2, and one at tip broadly meeting wing margin; cell M_2 with a pale streak at wing base, a pale spot behind medial fork, a pale streak connecting this and a subapical pale spot in front of mid-portion of cell M_4, the latter being confluent with a pale streak over middle of veins M_{3+4}, and a larger pale spot at tip broadly meeting wing margin; cell M_4 with an irregular pale spot meeting posterior wing margin but distinctly separated from vein M_{3+4}; anal cell with characteristic Orientalis Group pattern of a basal pale streak extending toward a bilobed distal pale area. Costa extending to 0.62 of distance to wing tip; radial cells both with broad lumens, 2nd slightly broader than 1st, lengths subequal; macrotrichia restricted to a few on distal 1/4 of wing. Halter brownish.

Abdomen: Dark brown; spermathecae 2, ovoid to subsperical, with short, narrow sclerotized necks, unequal, measuring 0.044 mm by 0.034 mm and 0.055 mm by 0.044 mm.

Male: Unknown.

DISTRIBUTION: Taiwan.

Holotype ♀ (USNM), Utai, Pingtung, Taiwan, 24 Feb. 1954, J. K. Ni and S. Y. Liu, light trap near house (no. 55018).

The slender palpal segment 3 with small round distal pit and distal portion not narrowed, the antennal sensorial pattern, the short, broad radial cell 2 covered distally with a pale spot and the pattern of pale spots in the anal cell place this species in the Orientalis Group of the subgenus *Avaritia*. It differs from all other known species of this group and resembles *pseudostigmatus* Tokunaga from New Guinea in having 2 distinct pale spots in the distal portion of cell R_5. The New Guinea species, however, has 3 well developed spermathecae similar to those of *Trithecoides*, the legs are broadly yellow banded and the anal cell lacks the Orientalis Group type of longitudinal pale streak.

We are very pleased to name this species in honor of Dr. Stephen M. K. Hu, formerly of the U. S. Naval Medical Research Unit No. 2 in Taipei in appreciation of his important contributions to Oriental medical entomology.

Culicoides (Culicoides) amamiensis Tokunaga

Culicoides amamiensis Tokunaga, 1937, Tenthredo **1**: 325 (♀; Ryukyu Is.; fig. wing, antenna, palpus); Arnaud, 1956, Microent. **21**: 90 (Japan; Manchuria, Ryukyu Is., redescr., figs. of ♂, ♀).—Tokunaga, 1959, Pacific Insects **1**: 230 (New Guinea; ♂, ♀ redescr.; fig. ♀).

Culicoides kagiensis Tokunaga, 1937, Tenthredo **1**: 327 (♀; Formosa; fig. wing, antenna, palpus). **New Synonymy.**

DISTRIBUTION: Ryukyu Islands, Japan, Manchuria, Taiwan to India, Indonesia and New Guinea.

NEW TAIWAN RECORDS: Taiwan, 25 March 1954, S. Y. Liu (no. 60161), taken 6:30–8:00 PM on water buffalo, 44 ♀. Chaochow, near Kaohsiung, Sept. 1959, S.M.K. Hu, light trap, 1 ♀. Kappan San, 28 March 1920, T. Shiraki, 4 ♀ (Nat. Taiwan Univ. coll.).

Arnaud (1956) noted that the characters used by Tokunaga to separate *amamiensis* and *kagiensis* broke down in his study material from Japan and the Ryukyus. The same is true in our long series from Taiwan; in particular may be mentioned the following characters of our Taiwan specimens which fit *amamiensis*: hind tibia with distinct proximal and distal pale bands; eyes contiguous; wing with pale spot always present, but sometimes indistinct, at apex of vein M_1 at wing margin; the distal pale spot in cell R_5 usually does not reach anterior wing margin, and the dark spot on the humeral crossvein is variable in extent.

Culicoides (Culicoides) nipponensis Tokunaga

Culicoides peregrinus of authors, misident., not Kieffer, 1910; Tokunaga (in part), 1937, Tenthredo **1**: 305 (Formosa; ♀; fig. wing, palpus); Arnaud, 1956, Microent. **21**: 122 (Japan, Korea; ♂, ♀; fig. antenna, palpus, mouthparts, head, scutum, legs, tibial comb, tarsal claw, spermathecae, ♂ genitalia).

Culicoides nipponense Tokunaga, 1955, Saikyo Univ., Sci. Rept. Agr. **7**: 4 (♂, ♀; Japan; fig. wing. ♂ genitalia).

Female: Length of wing 1.29 (0.98–1.62, n=8) mm.

Head: Eyes contiguous a short distance, bare. Antenna with flagellar segments in proportion of 19–14–15–16–17–16–16–17–22–24–27–31–45, antennal ratio 1.15 (1.10–1.23, n=13); distal sensory tufts present on segments III, V, VII, IX, XI-XV. Palpal segment with lengths in proportion of 10–19–28–10–12 segment 2 short and stout; segment 3 somewhat swollen, spindle-shaped, 2.6 (2.3–2.9, n=13) × as long as greatest breadth, with sensoria scattered over all of mesal and most of dorsal and ventral surfaces. Mandible with 12 (10–14, n=19) fine even teeth.

Thorax: Pruinose dark brown; scutum with faint blackish sublateral bands, median area somewhat paler brown. Legs dark brown; fore and mid femora with apices pale; bases of all tibiae, apex of hind tibia and all of tarsi pale yellow; hind tibial comb with 6 (n=11) spines, the 2nd from the spur longest.

Wing: Pattern as figured by Arnaud (1956, fig. 84 F), radial cell 2 very short and square-ended, covered on distal 1/2 by poststigmatic pale spot, but vein R_{4+5} darkened distad for a short distance into pale spot; distal pale spot in cell R_5 transverse, sometimes extending to anterior wing margin but not reaching vein M_1; vein M_1 bordered by slightly paler area along distal 1/2, extreme tip pale at wing margin; apices of veins M_2, M_{3+4} and Cu_1 not pale; middle of vein M_2 bordered by a pale spot on each side; one small pale spot in distal portion of cell M_1 failing by its own length to meet wing margin; rounded pale spots in apices of cells M_2 and M_4 meeting wing margin; double pale spot in cell M_2 extending from behind medial fork to front of mediocubital fork; pale spot over r-m crossvein broadly reaching costal margin, sometimes narrowly interrupted in costal cell; anal cell with 2 distal pale spots, and base of cell pale. Macrotrichia scanty on distal 1/2 of wing and in cells M_4 and anal cell, absent elsewhere; costa extending to 0.62 (0.61–0.65, n=14) of distance to wing tip. Halter knob very dark brown.

Abdomen blackish; spermathecae 2, ovate with very short sclerotized necks; slightly unequal, measuring 0.059 by 0.042 and 0.051 by 0.039 mm.

Male Genitalia (as figured by Arnaud, 1956, fig. 85 E, F, G). Sternum 9 with shallow caudomedian excavation, the ventral membrane not spiculate; tergum 9 with well developed distomedian lobe, the apicolateral processes not developed. Basistyle with dense, stout spinose hairs on mesal surface, ventral and dorsal roots short and stout; dististyle slender and curving to slender, rounded tip. Aedeagus long and narrow, 2× as long as width of base, the basal arch very short, attaining only 1/5 of total length, heavily sclerotized, sides of aedeagus not bulging, distal portion long and slender ending in a rounded papilla, without internal peg-like mesal sclerotization. Parameres each with stout, laterally bent basal arm; stem very slender, long and tapering gradually to very fine filament bearing short apical and subapical hairs.

DISTRIBUTION: Japan, Korea, Taiwan.

NEW TAIWAN RECORDS: Hsinshe, near Taichung, May 1959, S. M. K. Hu, light trap, 7 ♀. Chaochow, near Kaohsiung, Mar., Oct. 1959, S. M. K. Hu, light trap, many ♂, ♀. Sankon Li, Chaochow, Kaohsiung, 16 Feb. 1954, C. C. Lin, light trap in stable, (no. 50678), 47 ♀. Taipei, 7 Oct. 1951, H. Barnett, light trap, 4 ♂, 43 ♀. Fengshan, Kaohsiung, 21 Oct. 1951, H. Barnett, light trap, 10 ♀.

C. peregrinus can readily be distinguished from *nipponensis* by having the base of the mediocubital fork distinctly pale, radial cell 2 longer and not so square-ended, the dark line along vein R_{4+5} extending further into the poststigmatic pale spot, distinct pale spots present on the wing margin at the apices of veins M_1, M_2 and M_{3+4}, the pale spot over r-m crossvein divided into 2 separate spots by a dark line along the radius, antennal sensoria present only on segments III, XI-XV, palpal segment 3 with a definite, double, sensory pit, and the ♂ genitalia with tergum 9 bilobed, the aedeagus with bulging sides, and the parameres with stouter tips having longer subapical and apical hairs on ventral side. *C. nipponensis* is probably more closely related to *amamiensis* Tokunaga, which also lacks the pale spots at the base of the mediocubital fork and at the apices of veins M_2 and M_{3+4}, but *amamiensis* has sensoria on antennal segments III, XI-XV, the palpus has a definite round sensory pit and the halter is pale.

Culicoides (Culicoides) peregrinus Kieffer

Culicoides peregrinus Kieffer, 1910, Indian Mus., Mem. **2**: 191 (India; ♀; fig. wing).—Edwards, 1922, Bull. Ent. Res. **13**: 164 Malaya; fig. wing).—Macfie, 1937, R. Ent. Soc. London, Proc. **6**: 113 (Malaya; key; syns.: *esmoneti* Salm, *judicandus* Bezzi, *philippinensis* Kieffer).—Causey, 1938, Amer. Jour. Hyg. **27**: 408 (Thailand; fig. spermathecae, ♂ genitalia).—Macfie, 1941, R. Ent. Soc. London, Proc. **10**: 69 (Malaya; notes on variation).—Sen and DasGupta, 1959, Ent. Soc. Amer., Ann. **52**: 136 (India; figs. wing, scutum, spermathecae, ♂ genitalia).

Culicoides esmoneti Salm, 1917, Soc. Zool. France, Bull. **42**: 136 (♂, ♀; Java; figs.).

Culicoides judicandus Bezzi, 1917, Philippine Jour. Sci. **12**: 108 (♀; Philippines).

Culicoides philippinensis Kieffer, 1921, Philippine Jour. Sci. **18**: 564 (♀; Philippines).

DISTRIBUTION: India to New Guinea, Indonesia and Taiwan.

NEW TAIWAN RECORDS: Taipei, 7 Oct. 1951, H. Barnett, light trap, 2 ♀. Chao-

chow, near Kaohsiung, Oct. 1959, S. M. K. Hu, light trap, 2 ♀. Fengshan, Kaohsiung, 21 May 1951, H. Barnett, light trap, 2 ♀. Szeckun, 24 Oct. 1951, H. Barnett, light trap 1♂.

Tokunaga's (1937) Taiwan records, redescription and figures of *peregrinus* refer to *nipponensis* Tokunaga. *C. peregrinus* is easily recognized by the characters given in the discussion of *nipponensis.*

Culicoides (Culicoides) liui Wirth and Hubert, n. sp. Figs. 4–6.

Female: Length of wing 1.46 (1.34–1.59, n=10) mm.

Head: Eyes contiguous a short distance, bare. Antenna with flagellar segments in proportion of 22–20–21–23–24–22–23–23–34–33–37–41–52, antennal ratio 1.09 (1.06–1.15, n=9); distal sensory tufts present on segment III, XI-XV. Palpal segments in proportion of 12–29–40–19–19, segment 3 slightly swollen in mid portion, 3.1 (2.8–3.4, n=9)×as long as greatest breadth, with a definite, small, round, shallow sensory pit. Proboscis long; mandible with 18 (16–20, n=19) fine, even teeth.

Thorax: Dark brown (from slide-mounted specimens only). Legs dark brown, knees pale, distal 1/3 of mid and hind femora and distal 1/4 of fore femur yellow; all tibiae with basal yellow bands, narrow on fore leg and broadest on hind leg, and apex of hind tibia yellow; tarsi yellowish brown, hind basitarsus dark brown; hind tibial comb with 6 (5–6, n=5) spines, 2nd from the spur longest.

Wing: With prominent pattern, the pale markings dominant, interconnected; large pale area over r-m crossvein extending broadly to costal margin; radial cell 2 pale except at extreme base, costa dot extending through post-stigmatic pale spot to the very narrowly transverse distal dark spot in cell R_5; cell R_5 with distal pale spot very large, nearly filling cell to wing tip but with a narrow dark line bordering anterior side of vein M_1; vein M_1 pale bordered except for dark spots at extreme base and just before apex, end of vein pale margined; vein M_2 pale margined except for small dark spots near base and at extreme apex; cell M_1 with distal pale spot elongate, extending to wing tip, vein M_2 with large pale area straddling mid portion; cell M_2 nearly all pale on proximal 2/3; pale areas on distal portion interconnected, large pale spot at apex open to wing margin; apices of veins M_1, M_{3+4} and Cu_1 dark; cell M_4 with large pale spot filling distal portion and extending narrowly proximad along vein M_{3+4} and expanding slightly in a pale area at base of mediocubital fork; anal cell with 3 large pale spots interconnected in a zig-zag pattern. Costa long, extending to 0.69 (0.68–0.70, n=10) of distance to wing tip; two well-formed, long, narrow, radial cells present; macrotrichia confined to a few in distal extremity of cells R_5 and M_1. Halter pale.

Abdomen: Dark brown; spermathecae 2, unequal, measuring 0.048 by 0.036 and 0.060 by 0.044 mm, pyriform, with conical necks to base of ducts.

Male. Unknown.

DISTRIBUTION: Taiwan, Thailand.

Types: Holotype, ♀, 21 ♀ paratypes, Tao Shan, Wufeng, Hsinchu Hsien, Taiwan, 12 Dec. 1953, Su-Yung Liu, water buffalo shelter, no. CSF-0015 (type deposited in collection of Taiwan Malaria Research Institute; paratypes in U. S. National Museum, Washington, Bishop Museum, Honolulu, British Museum (N. H.), London).

Other Specimens Examined: Thailand, Loei Dansai, Koksato, 27 Nov. 1945, R. E. El-

bel, 2 ♀ (USNM).

Culicoides klossi Edwards from North Borneo is quite similar to *liui* but can be readily distinguished by its subcylindrical palpal segment 3 with scattered sensoria on the surface and by the much less extensive pale wing markings, which are scarcely interconnected. *C. tritenuifasciatus* Tokunaga from New Guinea differs in having a much paler wing, the three dark transverse bands very narrow and quite regular without the dark extensions at the apices of veins M_1, M_2 and M_{3+4}, and the spermathecae have slender necks without the conically tapering portion.

We take great pleasure in naming this species in honor of its collector in Taiwan, Dr. Su-yung Liu of the Taiwan Malaria Research Institute.

Culicoides (Oecacta) okinawensis Arnaud

Culicoides okinawensis Arnaud, 1956, Microent. **21**: 118 (♂, ♀; Sukiran, Okinawa; fig. wing, antenna, palpus, and scutum of both sexes, head, mandible, spermathecae, and legs of ♀, ♂ genitalia).

DISTRIBUTION: Okinawa, Taiwan.

NEW TAIWAN RECORD: Utai, Pingtung, 24 Feb. 1954, J. K. Ni and S. Y. Liu, light trap near house, 2 ♀.

Distinguishing Characters: *C. okinawensis* is distinguished by the presence of distinct pale spots only over r-m crossvein and past end of costa on anterior wing margin and a very faint pale spot in cell M_4; the virtual absence of leg bands; palpal segment 3 long and relatively slender, 2.7 × as long as greatest breadth, with a moderately deep sensory pit opening by a slightly smaller pore; and antenna with distal sensory tufts present on segments III–XIV.

The three most closely related species, *Culicoides verbosus* Tokunaga, *kibunensis* Tokunaga and *ponkikiri* Kono and Takahashi, all have rather strong pale wing spots in cell M_4 and in the distal part of the anal cell. *C. verbosus* Tokunaga, which in our material also has dark halteres, can be recognized by the faint pale spots at the apices of cells R_5, M_1, and M_2, and sensorial pattern of III–IX, XI–XV.

The species described and figured by Arnaud (1956) as *kibunensis* Tokunaga was misidentified by Tokunaga (according to Arnaud, p. 109) in recent determinations and should be known under the name *ponkikiri* Kono and Takahashi. *C. ponkikiri* can be recognized by its pale halteres, antenna with distal sensory tufts on segments III–XV, antennal ratio of 1.8, and swollen palpal segment 3 with very broad shallow pit.

The true *C. kibunensis* Tokunaga also has pale halteres, and can be recognized by the wing having a pale streak in cell M_2 in front of mediocubital fork, antennal ratio of 1.3–1.4, and palpal segment 3 with a small pit.

Culicoides (Oecacta) verbosus Tokunaga

Culicoides verbosus Tokunaga, 1937, Tenthredo **1**: 303 (♀; Shijukei, Formosa; fig. ♀ wing, palpus, antenna).

DISTRIBUTION: Taiwan.

NEW TAIWAN RECORD: Utai, Pingtung, 24 Feb. 1954, J. K. Ni and S. Y. Liu, light trap near house, 2 ♀.

Distinguishing Characters: Eyes contiguous, bare; antenna with proximal flagellar segments very short, antennal ratio 1.5, distal sensory tufts present on segments III–IX, XI–XV; palpal segment 3 greatly swollen, 2× as long as greatest breadth, with a very broad, shallow, sensory pit; wing with distinct pale spots over r-m crossvein and on anterior margin at end of costa, faint spots present at apices of cells R_5, M_1, and M_2 at wing margin, distinct pale spots in cell M_4 and in distal part of anal cell; halter infuscated; legs with a distinct sub-basal pale ring on each tibia.

The present material differs from Tokunaga's description in having infuscated halteres and in the absence of subapical pale rings on the fore and mid femora. However, the other characters show that it is the same species. *C. verbosus* is compared with the closely related species in the discussion on *okinawensis*.

Culicoides (Oecacta) schultzei (Enderlein)

Ceratopogon schultzei Enderlein, 1908, Denkschr. med.-naturw. Ver. Jena **13**: 459 (S. W. Africa; ♂, ♀; fig. wing, ♂ genitalia).

Culicoides schultzei, Carter, Ingram and Macfie, 1920, Ann. Trop. Med. Parasit. **14**: 231 (comb.; Gold Coast; redescr., figs.).—Tokunaga, 1959, Pacific Insects **1**: 210 (New Guinea; redescr., figs.).—Okada, 1954, Jap. Jour. Appl. Zool. **19**: 5 (N. China, Manchuria, Korea; syn.: *oxystoma* K., *kiefferi* Patton).

Culicoides oxystoma Kieffer, 1910, Ind. Mus., Rec. **2**: 193 (Calcutta; ♀; fig. proboscis, palpus).—Tokunaga, 1937, Tenthredo **1**: 295 (Japan, Formosa; redescr., figs.).—Arnaud, 1956, Microent. **21**: 120 (Japan; dist., redescr., figs.).

Culicoides kiefferi Patton, 1913, Indian Jour. Med. Res. **1**: 336 (Madras).

Culicoides pattoni Kieffer, 1921, Soc. Ent. France, Bull. **1921**: 7 (n. nom. for *C. kiefferi* Patton 1913 non Goetghebuer 1910).

Culicoides housei Causey, 1938, Amer. Jour. Hyg. **27**: 407 (Siam; ♂; fig. wing, ♂ genitalia). **New Synonymy.**

Culicoides punctigerus Tokunaga, 1951, Saikyo Univ. Agr. Sci. Rept. no. 1, p. 101 (♂, ♀; Java; fig. wing, ♂ genitalia).

Culicoides alatus Das Gupta & Ghosh, 1956, Calcutta Sch. Trop. Med., Bull. **4**: 162 (Calcutta; ♂, ♀).—Sen and Das Gupta, 1959, Ent. Soc. Amer., Ann. **52**: 617 (redescr.; India; figs.). **New Synonymy.**

DISTRIBUTION: Africa, Asia to Iraq, W. Pakistan, Ussuri Land, Japan, Ceylon, Indonesia and New Guinea.

NEW TAIWAN RECORDS: Tungshih, Taichung, 13 Oct. 1951, H. Barnett, light trap, 4 ♀, Fengshan, Kaohsiung, 12 Oct. 1951, H. Barnett, light trap, 3 ♀. Szeckun, 24 Oct. 1951, H. Barnett, light trap, 2 ♀. Chaochow, near Kaohsiung, Mar.–Sept. 1959, S. M. K. Hu, light trap, many ♂, ♀. Hsinshe, near Taichung, Mar.–Apr., 1959, S. M. K. Hu, light trap, many ♂, ♀. Chung Ho, near Taipei, Nov. 1958, S. M. K. Hu, light trap, 3 ♀.

Distinguishing Characters: Wing with radial cell 2 dark to tip, cell R_5 with a small round pale spot between poststigmatic pale spot and bilobed subapical pale spot, veins pale margined distally; scutum with prominent pattern of small round blackish spots which often fuse in large dark patches on midline and on sublateral bands; antenna short, antennal ratio 1.03, distal sensory tufts on segments III, VIII–X; palpal segment 3 short and moderately stout with a broad, moderately deep sensory pit; 2 well-developed ovate sper-

mathecae with long sclerotized necks; ♂ aedeagus with broad tip, parameres slender with sinuate stem, and tip with very fine fringing hairs, apicolateral processes long and closely approximated.

Comparison of the type of *housei* Causey and paratypes of *alatus* Das Gupta and Ghosh in the U. S. National Museum collection indicates that these species are synonymous with *schultzei*.

Meijerehelea Wirth and Hubert, N. Subgen.

Antenna with distal sensorial tufts usually present on segments III–XIV, sometimes absent on some or all of segments IX–X. Wing with radial cell 2 dark, sometimes post-stigmatic pale spot barely encroaches on vein R_{4+5} closing distal end of cell; cell R_5 with costal pale spot immediately distal to radial cell 2 and a rounded pale spot at extreme apex of cell, sometimes with one or more additional pale spots behind radial cell 2; cell M_1 with 2 pale spots; cell M_2 with pale spot adjacent to basal part of mediocubital stem, pale spot behind medial fork and 2 pale spots distal to this; anal cell usually with zig-zag pale streak near base and 2 pale spots near apex. One spermatheca present, ovate to sac-like or sagittate in shape, usually with duct very elongated. Male genitalia with well developed apicolateral processes on tergum 9; aedeagus with fairly stout basal arms, distal stem rather stout and usually flaring at tip; parameres with large basal knob directed laterad, stem short, rather stout and simple, the tip without distal fringing spines.

Type Species: *Ceratopogon guttifer* de Meijere.

A new subgeneric name is needed for *Culicoides arakawai* (Arakawa), *duodenarius* Kieffer and the other species belonging to what has been known as the Guttifer Group. This subgenus is named in honor of the celebrated Dutch dipterist, J. C. H. de Meijere, who pioneered in Oriental Dipterology. Other species included in the subgenus *Meijerehelea* are *mackayensis* Lee and Reye, *toyamaruae* Arnaud, *hegneri* Causey, *distinctipennis* (Austin) and *praetermissus* Carter, Ingram and Macfie.

Culicoides (Meijerehelea) arakawai (Arakawa)

Ceratopogon arakanae [sic] Matsumura, Arakawa, 1910, Konchu-Sekai **14**: 411 (Japan).

Ceratopogon arakawae Matsumura 1915, Konchu Bunrui Gaku Gekan, p. 56.

Culicoides arakanae (Arakawa), Okada, 1941, Coll. Agr. Tokyo Imp. Univ., Jour. **15**: 14 (Japan; synonymy, distribution).

Culicoides arakawae Arakawa, Tokunaga, 1943, Iyo Konchugaku **2**: 857 (distribution; biting habits; descr.); Tokunaga, 1950, Sanitary Zoology **1**: 66 (Japan); Okada, 1954, Japanese Jour. Appl. Zool. **19**: 3 (N. China, distribution); Arnaud, 1956, Microent. **21**: 92 (♂, ♀; synonymy; figures).

Culicoides sugimotonis Shiraki, 1913, Taiwan Sotokufu Noji Shikenjo Tokubetsu Hokoku **8**: 289 (Formosa); Tokunaga, 1937, Tenthredo **1**: 290 (♂, ♀; Formosa, Japan, fig. wing, antenna, palpus, spermatheca, ♂ genitalia; syn.: *alboguttatus* K., *arakawae* M.); Tokunaga, 1940, Tenthredo **3**: 142, 145 (syn.: *shimai* Sasaki); Tokunaga, 1941, **15**: 93 (Manchuria).

Culicoides alboguttatus Kieffer, 1921, Philippine Jour. Sci. **18**: 563 (Formosa; ♀).

Ceratopogon shimai Sasaki, 1928, Imp. Acad. Japan, Proc. **3**: 687 (♀, larva, Japan); Kuwayama, 1938, Manshukoku Sangyobu Shiryo **33**: 92 (fowl biting).

Culicoides daleki Smith and Swaminath, 1932, Ind. Med. Res. Mem. **25**: 185 (♀; Assam; fig. wing, sperm., palpus); Macfie, 1937, Roy. Ent. Soc. London, Proc. (B) **6**: 112 (Malaya); Causey, 1938, Amer. Jour. Hyg. **27**: 402 (Siam; ♂, ♀; fig. genitalia). **New Synonymy.**

Culicoides micropunctatus Tokunaga, 1951, Saikyo Univ., Sci. Rept. Agr. no. 1, p. 105 (♀; fig. wing; Java). **New Synonymy.**

DISTRIBUTION: Japan to Manchuria, China, Taiwan, Siberia, Indonesia, New Guinea, India.

NEW TAIWAN RECORDS: Chaochow, near Kaohsiung, Mar.–Oct. 1959, S. M. K. Hu, light trap, many ♂, ♀. Chung Ho, near Taipei, Mar.–Nov. 1959, S. M. K. Hu, light trap, many ♂, ♀. Hsinshe, near Taichung, Mar.–May, 1959, S. M. K. Hu, light trap, many ♂, ♀. Mutan, Pingtung, 15 Apr. 1954, C. C. Lin and T. S. Lo, light trap in cow shed, 4 ♂, 62 ♀. Matsuyama, near Taipei, 17 Sept. 1918, T. Shiraki 3 ♀ (Nat. Taiwan Univ. coll.). Hokuzanko, 21 May 1917, T. Shiraki, 1 ♀ (Nat. Taiwan Univ. coll.). Taipei, 25 Apr. 1918, Yoshino, 1 ♀ (Nat. Taiwan Univ. coll.) Tungshih, Taichung, 13 Oct. 1951, H. Barnett, light trap, 27 ♂, ♀.

Distinguishing Characters: Cell R_5 with 3 small round pale spots, 1 at extreme wing tip and 2 in poststigmatic region, the posterior one separate from vein M_1 and lying slightly proximad of the one at end of costa, an additional 4th small round pale spot, when present, lies behind radial cells but closer to vein R_{4+5} than to vein M_1; antennal ratio 1.52, distal sensory tufts present on segments III-XIV; palpal segment 3 long and moderately swollen, distally with a very broad, shallow, sensory pit; mandible with 12 teeth; hind tibial comb with 4 spines; one very elongate, sac-like spermatheca, broadest near rounded distal end; ♂ genitalia with apicolateral processes not very broadly separated, rather short and blunt; aedeagus with blunt, flaring tip, parameres each with laterally directed basal arm, slender stem and rather stout, simple, laterally bent tip.

A careful comparison of specimens of *arakawai* from Japan, Taiwan, the Philippines, Borneo, Thailand, Malaya and India in the U. S. National Museum collection, with the descriptions and figures of *daleki* Smith and Swaminath and *micropunctatus* Tokunaga, leads us to believe that these species are synonymous. Tokunaga (1959) erroneously assigned *micropunctatus* and *mackayensis* Lee and Reye to the synonymy of *guttifer* (de Meijere). The V-shaped poststigmatic pale spot in cell R_5 and conical spermatheca of *mackayensis* will readily serve to identify it as a distinct species. The proximal pale spot in cell R_5 touches the base of vein M_1 in *guttifer* while it is closer to vein R_{4+5} in the form of *arakawai* which Tokunaga named as *micropunctatus*.

Culicoides (Meijerehelea) duodenarius Kieffer

Culicoides duodenarius Kieffer, 1921, Soc. Linn. Lyon, Ann. **68**: 157 (♀; Daitotei, Formosa).—Tokunaga, 1937, Tenthredo **1**: 315 (♂; ♀ redescr.; Formosa; fig. ♂ parameres, ♀ wing).

DISTRIBUTION: Taiwan.

NEW TAIWAN RECORDS: Sankon Li, Chaochow, Kaohsiung, 16 Feb. 1954, C. C.

Lin, light trap in stable, 3 ♀. Chaochow, near Kaohsiung, Mar., Sept. 1959, S. M. K. Hu, light trap, 2 ♀.

Distinguishing Characters: Closely related and very similar to *arakawai* (Arakawa), but differs in having much more extensive pale wing spots, only one large poststigmatic pale spot in cell R_5, this covering extreme tip of radial cell 2 and extending nearly to vein M_1; halteres faintly infuscated; antennal ratio 1.43, distal sensory tufts present on segments III, V, VII, IX, XI-XIV, also sometimes on IV, VI and VIII; palpal segment 3 shorter than in *arakawai* 2.2 × as broad as long, pit shallow and somewhat irregular; 13–15 mandible teeth; 4 spines in hind tibial comb; one faintly sclerotized elongate oval spermatheca present.

This species is most closely related to *hegneri* Causey from Thailand, but that species has much more faintly marked wings in which the second radial cell is dark to the tip, paler legs, dark brown halteres, and sensoria present only on segments III and XI-XV. *C. toyamaruae* Arnaud from Japan is also closely related but has a shorter spermatheca, the pale wing spots are much smaller and definite, and the second radial cell is not pale distally.

Culicoides (Subgenus ?) **albifascia** Tokunaga

Culicoides albifascia Tokunaga, 1937, Tenthredo **1**: 319 (♀; Arisan, Formosa; fig. wing, antenna, palpus).

DISTRIBUTION: Taiwan.

Distinguishing Characters: A small brown species with reddish brown shining scutum; wing dark with 3 transverse pale bands, the 1st across wing base into base of anal cell; 2nd made up of the pale spot from costa across r-m crossvein, a pale spot in cell M_2 and a double pale spot in distal part of anal cell; 3rd made up of a transverse pale spot in cell R_5 just past end of costa, a pale spot at base of cell M_1, a spot behind this in cell M_2 and a spot in cell M_4; distal 1/3 of wing entirely dark and with sparse macrotrichia; antennal ratio 1.12; palpal segment 3 slender with a small round pit in distal portion; segments of palpus with lengths in proportion of 6–25–21–11–12; halteres pale; legs brownish with bases of femora and sub-basal rings on tibiae pale; one (?) subspherical spermatheca.

This species has not been reported since the original description. It appears to be most closely related to *Culicoides japonicus* Arnaud and *lacicola* Arnaud from Japan. Each species has a single spermatheca, but *japonicus* has a spotted scutum, antennal ratio 1.22 and pale spots at the apices of cells R_5, M_1 and M_2, and *lacicola* has a swollen palpal segment 3 with large pit, antennal ratio 1.78 and a hairier wing with 2nd transverse band differing in having only a single spot distally in anal cell.

Culicoides (**Monoculicoides**) **homotomus** Kieffer

Culicoides homotomus Kieffer, 1922, Soc. Linn. Lyon, Ann. **68**: 158 (Formosa).—Arnaud, 1956, Microent. **21**: 105 (descr. ♂, ♀; figs., distr., syn.).

Culicoides osakensis Iwata, 1935, Ent. Soc. Hiroshima, Trans. **2**: 7 (Japan).

Culicoides nubeculosus of authors (misident., not Meigen, 1830), Tokunaga 1937, Tenthredo **1**: 280 (♂, ♀ descr., figs.; Japan, Formosa; syn.: *osakensis*).

DISTRIBUTION: Taiwan, Japan.

NEW TAIWAN RECORDS: Sankon Li, Chaochow, Kaohsiung, 15 Feb. 1954, C. C. Lin, light trap in stable, 6–12 P. M. (50767), 15 ♀. Arisan, 21 Apr. 1917, T. Shiraki, 1 ♀ (Nat. Taiwan Univ. coll.). Taipei, 9 Oct. 1951, H. Barnett, 2 ♂, 2 ♀. Hsinshe, near Taichung, Feb. 1959, S. M. K. Hu, light trap, 100 specimens. Chaochow, near Kaohsiung, Mar. 1959, S. M. K. Hu, light trap, 100 specimens. Chung Ho, near Taipei, 11 months, S. M. K. Hu, light trap, thousands of specimens.

Distinguishing Characters: Wing gray with pattern of pale streaks; scutum with pattern of brown dots at bases of setae; spermatheca one, elongate, broadest near apex, with broad, unsclerotized opening to duct; frontal tubercles present; palpal segment 3 slender, 3× as long as greatest breadth, with open, irregular sensory pit; 13–14 mandible teeth; antennal ratio 0.65, distal sensory tufts present on segments III, VIII–X; hind tibial comb with 5 or 6 spines, 2nd from spur usually longest; ♂ genitalia with apicolateral processes angular and flaring, aedeagus with bifid tip, parameres fused at middle, distal free portions simple slender filaments.

This species is very closely related to the North American *Culicoides variipennis* (Coquillett), a proven vector of the blue tongue virus disease of sheep. It was taken by the thousands in the light trap at Chung Ho in summer months and sparingly in winter collections. At Hsinshe and Kaohsiung, however, it was collected in numbers only in February and March. This species was collected on water buffalo at Kaohsiung and at light in a stable at Sankon Li, so it can be expected to be a pest of livestock.

REFERENCES CITED

Arnaud, P. 1956. The heleid genus *Culicoides* in Japan, Korea and Ryukyu Islands (Insecta: Diptera). Microentomology **21**: 84–207.

Kieffer J. J. 1912. Tendipedidae (Chironomidae) [Dipt.]. H. Sauter's Formosa-Ausbeute. Supp. Ent. 1, pp. 27–43.

———— 1916a. Tendipedidae (Dipt.). H. Sauter's Formosa-Ausbeute. Supp. Ent. 5, pp. 114–117.

———— 1916b. Tendipedides (Chironomides) de Formose. Mus. Nat. Hungarici, Ann. **14**: 81–121.

———— 1921. Étude sur les Chironomides de Formose. Soc. Linn. Lyon, Ann. **68**: 149–163.

———— 1922. Chironomides des Philippines et de Formose. Philippine Jour. Sci. **18**: 557–593.

Okada, T. 1942. Notes on a biting midge parasitic on Anopheline mosquito with a revision of its allies (Diptera, Heleidae). Nat. Hist. Soc. Formosa, Trans. **32**: 137–146.

Shiraki, T. 1913. Investigations on general injurious insects. Taiwan Sotokufu Noji Shikenjo Tokubetsu Hokoku **8**: 286–297.

Tokunaga, M. 1937. Sand flies (Ceratopogonidae, Diptera) from Japan. Tenthredo **1**: 233–337, plates 24–29.

———— 1940. Biting midges from Japan and neighbouring countries, including Micronesian Islands, Manchuria, North China and Mongolia. Tenthredo **3**: 58–165.

———— 1959. New Guinea biting midges (Diptera: Ceratopogonidae). Pacific Insects **1**: 177–313.

Wirth, W. W. and A. A. Hubert. 1959. *Trithecoides*, a new subgenus of *Culicoides* (Diptera, Ceratopogonidae). Pacific Insects **1**: 1–38.