# A Taxonomic Study of Hawaiian Ephydridae (Diptera) related to Scatella Robineau-Desvoidy

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*(Presented by E. C. Zimmerman at the meeting of December 8, 1947)*

## INTRODUCTION

The study here reported was begun in 1945, when the writer was stationed by the U. S. Public Health Service as quarantine entomologist in the Hawaiian Islands. Through 1946, numerous collections of aquatic Diptera were made in connection with airport surveillance activities, including many of the interesting family Ephydridae. In addition to the basic studies on Oahu, trips were also made to Kauai and Hawaii, where several species of Ephydridae were collected which are apparently undescribed.

The writer is greatly indebted to Dr. F. X. Williams, entomologist of the Hawaiian Sugar Planters' Association Experiment Station in Honolulu, whose praise-worthy "Biological Studies on Water-loving Insects" of Hawaii is so well known, for his kindly interest and helpful suggestions in the present study. Acknowledgment is also gratefully made to Mr. E. C. Zimmerman of Honolulu for arranging a loan of material from the Bishop Museum and H. S. P. A. collections, and to Dr. Curtis W. Sabrosky for arranging a loan of U. S. National Museum material. Dr. R. L. Usinger of the University of California also offered valuable advice on problems of nomenclature and of insect distribution among the islands of the Pacific.

The first known species of the *Scatella* group from the Hawaiian Islands was described by Grimshaw (1901) as *Scatella hawaiiensis*. Terry gave a manuscript name, *"S. hawaiiensis,* var. *sexnotata,"* to a form which was recorded by Fullaway (1914) from Laysan Island, and by Osborn (1915) from Waikiki, Oahu; this form was finally described by Cresson (1926) as *Scatella sexnotata.* Warren (1914) gave notes on a fly which he called *Ilythea* sp. and which subsequently has been included by other authors with a species from Maui described by Cresson (1926) as *Scatella warreni.* At the same time Cresson also described *S. bryani* and *S. terryi.* In 1935 Malloch erected the genus *Neoscatella* for a species from the Marquesas Islands, and in the same year Cresson transferred the five known Hawaiian species of *Scatella* to this genus. In 1938 Williams gave an excellent account of the biologies of the Hawaiian species of *Scatella,* describing a new species, *S. oahuense.*

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In 1935 Malloch erected the genus *Apulvillus* for a new species, *bronneci,* from the Marquesas Islands, and the genus *Chaetoscatella* for *cheesmanae* from the Society Islands and *unguiculata* Malloch (1934) from Samoa. These genera clearly belong to the *Scatella* group, and they are distinctive by their lack of pulvilli.

In the present study four new species and a new subspecies of *Neoscatella* are described from the Hawaiian Islands. The genus *Apulvillus,* with which *Chaetoscatella* is synonymized, is recorded from Hawaii for the first time, and two new species belonging to this genus are described; the close relationship of these Hawaiian species to *Neoscatella* is also indicated. A brief discussion of the generic classification according to the male genitalia is also given and keys are presented to the genera of the *"Scatella group"* of Ephydridae, to the species of *Apulvillus* and to the Hawaiian species of *Neoscatella.* The types of the new species are in the B. P. Bishop Museum collection; paratypes will be furnished the U. S. National Museum, the California Academy of Sciences and the Academy of Natural Sciences of Philadelphia, while the remainder are in the author's collections. Unless otherwise specified, all material listed here was collected by the writer.

## GENERIC CLASSIFICATION

The present writer, having studied the genera of Ephydridae most closely related to *Scatella,* would characterize this compact group as follows: (1) Second antennal segment without a spinose bristle at upper distal corner, arista bare or pubescent; (2) mesonotum with two or more pairs of dorsocentrals; (3) sternopleural bristle present; (4) face with bristles, the mouth opening large; and (5) costa extending to the fourth vein ($R_{4+5}$). The genera of the *Scatella* group may be distinguished by the following key:

Key to the Genera of the Scatella Group

1. Pulvilli undeveloped; tarsal claws large.....**Apulvillus** Malloch.
   Pulvilli present; tarsal claws normal ..... 2
2(1). Only one pair of divergent fronto-orbital bristles..**Limnellia** Malloch.
   Two pairs of divergent fronto-orbital bristles..... 3
3(2). Two post-sutural pairs of strong dorsocentral bristles, ante-sutural pair absent; genal bristles strong..**Scatella** Robineau-Desvoidy.
   Three or more pairs of strong dorsocentrals, or if two pairs, there are no long acrostichals..... 4
4(3). Only one pair of long acrostichal bristles, located at the suture, none present post-suturally.....**Neoscatella** Malloch.
   A row of short acrostichal bristles complete post-suturally to base of scutellum..... 5
5(4). Wings with hyaline spots; genal bristle well developed .....**Parascatella** Cresson.
   Wings without hyaline spots; genal bristle undeveloped .....**Lamproscatella** Hendel.

## Male genitalia of the *Scatella* Group

It has been suggested by Cresson that a study of the male genitalia of the genera of Ephydrinae would afford a better basis for classification, but the writer has been unable to find any important references in the literature to such a comparison. Cole (1927) did not treat any of the present genera in his study of dipterous male genitalia. However, Collin (1930) gave figures of the male genital plates of several British species of *Scatella,* Malloch (1925) figured the male genitalia of some Australian species, and Tonnoir and Malloch (1926) of some New Zealand species. Malloch (1925) stated "The hypopygia of the males possess a peculiar feature in this genus [*Scatella*], the claspers being connected about middle by a chitinous band which arches below . . ."

From the writer's study of material of *Scatella, Neoscatella, Apulvillus, Lamproscatella,* and *Limnellia,* the following notes can be given. The male genitalia of the first three genera are quite similar, supporting the opinion that these genera are very closely related (Fig. 1, a-c). The tergites of the male abdominal segments 2-4 are short and subequal in length and extend far ventrad on each side; the corresponding sternites are very much reduced to approximately square dimensions. The fifth tergite is elongated, often as much as twice the length of the fourth, and is tapered and curved caudad, making up the entire apex of the abdomen dorsally. Tergites 7 and 8 are reduced, and the 9th tergite is forced to assume a ventral position due to the enlargement of the 5th, with the apex directed forward and forming two more or less pointed lobes. The 9th tergite extends down on each side around and enclosing the 10th segment. The 10th segment is membranous except for two prominent lobes on each side of the anal opening which Collin calls the "anal lamellae," and Cole the "cerci." Articulating with the dorso-anterior margin of the 9th tergite (fig. 1, b) is a periphallic sclerotization consisting of a pair of anteriorly directed, more or less finger-shaped claspers which are connected by an arched sclerotized band. This band forms a sclerotized arch through which the aedeagus may be thrust or withdrawn; the latter is mostly membranous, but possesses a more or less sclerotized cylindrical sheath, sometimes with a pair of more strongly sclerotized hooks. The aedeagus, supported by a slender ribbonlike dorso-ventrally flattened apodeme (fig. 1, a) bearing a spoon-like or capitate tip, works through this sheath.

In *Lamproscatella quadrisetosa* Becker (fig. 1, d-e) from Contra Costa County, California, the shape of the 9th tergite is essentially as in the above genera, but it meets along the mid-ventral line along a very narrow but heavily sclerotized and laterally compressed ventral or basal arm of the aedeagus and clasping organs. The sclerotized apodeme of the aedeagus is an amber hyaline, arched

mesal blade, very thin distally and broadened basally in lateral view, arising near the level of the ventral extremities of the anal lamellae and extending forward well past the apices of the lobes of the 9th tergite. Arising at the base of this apodeme, and projecting along each side of and slightly arched anterior to it are a pair of very slender bands, straight and lamellate in dorso-ventral view, but very irregular in lateral view, their apices very slender and with a small knob. The claspers articulate basally with the ventral basal arm of the aedeagus, laterally with the lateral margin of the 9th tergite near the distal lobe-like tips, and sub-apically are fused with the membranous area caudad of the 5th sternite, the slender finger-like setose tips remaining free.

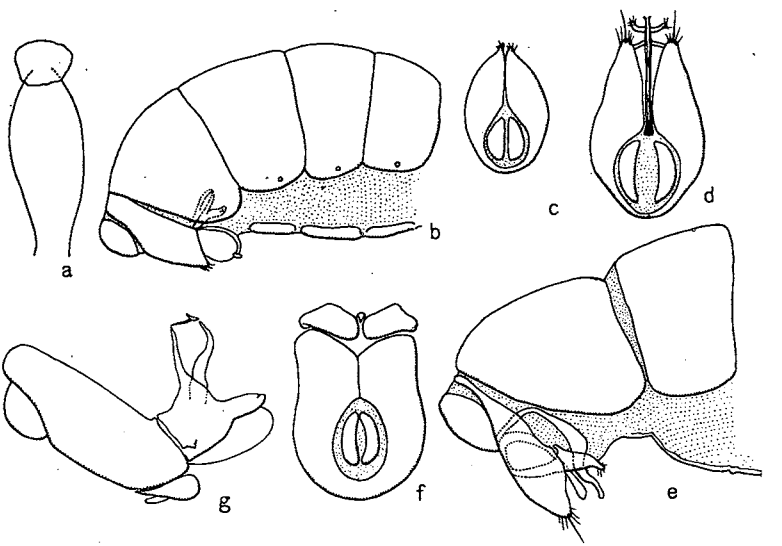


Figure 1. Male genitalia of the *Scatella* group. **a-c,** *Scatella* spp.; **a,** aedeagal apodeme, dorsal view, greatly enlarged; **b,** lateral view of male abdomen; **c,** ventral view of ninth tergite and associated structures.

In *Limnellia sejuncta* (Loew) (fig. 1, f, g) from Berkeley, California, the genitalia are quite different; the 9th tergite is stout and truncated at the apex, with a pair of stout irregular lobes closely appressed to the tergite proper, and with a median, posteriorly directed, stout blade-like hook. The claspers are very heavily sclerotized and prominent, articulating broadly at the base with the apico-lateral margin of the 9th tergite, bearing a distinct lateral ventrally-directed tooth, and a slender irregular tapered dorsal arm which connects with the very small aedeagal apodeme. The aedeagus bears a lateral pair of slender tapering sclerotized plates

arising basad between the bases of the claspers and articulating dorsally with the capitate end of the minute aedeagal apodeme.

## Genus **Neoscatella** Malloch

*Neoscatella* Malloch, 1935, B. P. Bishop Mus. Bull. **114**: 9; Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 359.

Resembles *Scatella,* but differs in the possession of an antesutural dorsocentral bristle. No other characters are known which do not vary to form links with other genera.

Genotype: *Neoscatella atra* Malloch, 1935 (original designation).

Malloch (1935) proposed the genus *Neoscatella* for *atra,* a new species from the Marquesas Is., giving as generic characters, "distinguished from *Scatella* by the possession of three pairs of long dorsocentrals and one long and one short anterior pair of acrostichal bristles. The aristae are more distinctly short-haired than is usual in that genus, the wings lack hyaline spots in the genotype, and the scutellum has four well-developed bristles, the apical pair longer than the lateral pair". Malloch hesitated to give *Neoscatella* full generic rank because of evidence of connecting links between it and *Scatella* and *Lamproscatella.* He also mentioned that Cresson's *Scatella intermedia* from North America appeared to belong to *Neoscatella* and that it was possible that the Hawaiian species belonged here though having spotted wings.

Cresson, in 1935, supported Malloch's treatment of *Neoscatella* as a full genus, stating that the character of the presence of an antesutural dorsocentral was "very positive" and adding, "the lateral seta of the scutellum, is typically strong and basal, but this character varies, becoming a weak curved subapical seta as in *Scatella*". Cresson followed by transferring a number of species previously placed in *Scatella* to *Neoscatella,* including 2 North American species, 4 from South America, the 5 known Hawaiian species, 2 European species, and 1, possibly 2, from Australia, while describing an additional Australian species.

### Key to the Hawaiian species of *Neoscatella.*

1. Wings light, with an irregular subapical dark band (Kauai) ..... **kauaiensis** n. sp.
   Wings dark, usually with more or less definite light spots arranged in a characteristic pattern ..... 2
2(1). Wings with at most faint indication of two light spots ..... 3
   Wings with five or six well-defined light spots ..... 7
3(2). Size large (2.5-3.5 mm.); wings with two faint pale spots; fore tarsi of ♂ not swollen or with long fine hairs or erect bristles (fig. 3, a) (Maui, Hawaii) ..... **warreni** (Cresson).
   Size small (1.6-2.8 mm.); wings very rarely with a faint pale spot; fore tarsi of ♂ usually swollen and club-shaped or with long fine hairs or erect bristles ..... 4

4(3). Fore femora of ♂ swollen and post-flexor bristles reduced (fig. 3, c); fore tarsi of ♂ swollen and club-shaped, less than length of tibiae; genal bristle small (costa without long spines interspersed, wing tapered) ..... 5
Fore femora of ♂ normal, post-flexor bristles well-developed (fig. 3, b, d); fore tarsi of ♂ as long as or longer than tibiae, which bear a posterior row of bristles; genal bristle large..... 6
5(4). Fore tarsi of ♂ less than half as long as tibiae, the segments tightly appressed forming a compact club, with thickened erect spines (Hawaii) ..... **clavipes clavipes** n. sp.
Fore tarsi of ♂ over half as long as tibiae, the segments not forming a compact club, with long slender curved bristles (Oahu) ..... **clavipes tenda** n. sbsp.
6(4). Male with post-flexor bristles of fore femora twice as long as diameter of femur, apex of tibia with several long fine hairs, tarsi with abundant long wavy hairs dorsally (fig. 3, d); size smaller (1.5-2 mm.); color not light pollinose gray below (Oahu; Kauai) ..... **cilipes** n. sp.
Male with post-flexor bristles of fore femora about as long as diameter of femur, apex of tibiae without long fine hairs, tarsi with erect bristles dorsally (fig. 3, b); size larger (2-2.8 mm.); color light pollinose gray below (Oahu)..... **fimbriata** n. sp.
7(2). Wings 6-spotted, spot present in cell $R_1$ ..... 8
Wings 5-spotted, spot absent in cell $R_1$ ..... 9
8(7). Small species (2 mm.); dorsocentral bristles 1:2, acrostichals 1:0; mesonotal setulae not well developed; post-flexor bristles of fore femora about as long as diameter of femur (widespread) ..... **bryani** (Cresson).
Large species (over 2.5 mm.); dorsocentrals 1:3, acrostichals 1:1; mesonotal setulae prominent; post-flexor bristles of fore femora twice as long as diameter of femora (widespread) ..... **sexnotata** (Cresson).
9(7). Color opaque brownish olive (Oahu)..... **terryi** (Cresson).
Color shining black above, pollinose toward sides..... 10
10(9). Inner vertical bristles well developed (widespread)..... **hawaiiensis** (Grimshaw).
Inner vertical bristles greatly reduced (Oahu, Maui, Hawaii) ..... **oahuense** (Williams).

## **Neoscatella kauaiensis** Wirth, new species

A large shining, somewhat iridescent, dark brownish black species with moderate development of bristles and setulae; dorsocentrals 1:2 and acrostichals 1:1; wings light with an irregular subapical dark band.

♂, ♀. Frons shining iridescent brownish black with violet and greenish reflections; parafrons and ocellar tubercle dark brown pollinose; frontoorbitals, inner and outer verticals, and ocellar bristles strong; frontal setulae inconspicuous. Face dark brown pollinose; median facial prominence strongly protruding, arising at level of a line between lower margins of bases of antennae; a diagonal row of five or six strong bristles extends on each side from apex of prominence ventro-laterally well removed from facial margin, the lateral bristle quite strong and latero-reclinate and arising near oral margin; a row of about seven strong setae on each side bordering oral margin; setulae well-developed but scarcely involve the face above the row of facial bristles. Cheeks light gray pollinose, with a strong genal bristle and a posterior patch of strong setulae. Occiput light gray pollinose with a row of short fine setulae curving up over the posterior eye margin. Antennae with third segment about a third longer than broad, with grayish pubescence, second segment with a dorsal seta

and a row of mesal setae the longest of which are nearly as long as third antennal segment; arista about 2.5 times as long as third antennal segment, bare ventrally, dorsally with long pubescence nearly to apex.

Mesonotum and scutellum more or less shining brownish black, with purplish iridescence except at anterior margin which is more greenish; humeri, lateral margins, and most of mesopleura brownish pollinose, remainder of pleura and postnotum grayish pollinose. Three pairs of strong dorsocentrals (1:2) and two pairs of moderate acrostichals (1:1), although some strong anterior and intermediate setulae appear in each series. Scutellum broader than long, with subapical pair of setae about three-fourths as long as the strong apical pair.

Abdomen more or less shining iridescent brownish black without trace of segmental banding; lateral margins of segments gray pollinose, bristling strong, some of the longest half as long as length of third abdominal segment. Male with tergites progressively longer on distal segments, 5th about a quarter longer than 4th; clasper long and slender and distinctly curved at tip (fig. 2, f).

Legs dark brown, the coxae, trochanters, and proximal half to three-fourths of femora grayish pollinose; bristling moderate except a strong series on anterior surface of mid-femora, and the usual strong post-flexor series on fore femora about 1.5 times as long as the diameter of the segment.

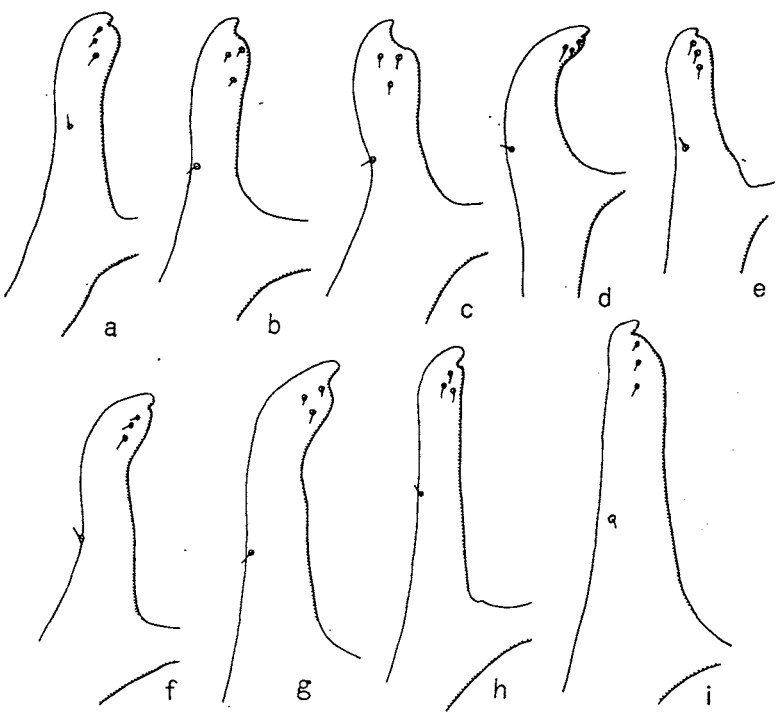


Figure 2. Male claspers of *Neoscatella* and *Apulvillus*. **a**, *hawaiiensis;* **b**, *oahuense;* **c**, *williamsi;* **d**, *clavipes clavipes;* **e**, *bryani;* **f**, *kauaiensis;* **g**, *warreni;* **h**, *fimbriata;* **i**, *sexnotata.*

Wings (Plate VI, figure 1) clear except for very narrow infuscation along the veins and for a more or less prominent dark infuscated irregular subapical band involving distal third of cell $R_1$, cell $R_2+_3$ at same level, and extending nearly or all the way across cell $R_4+_5$ (dark chocolate brown in the ♂, but often quite faint in the ♀). Costal fringe proximad of apex of vein $R_1$ with setae about three times thickness of costal vein; distad of $R_1$ the fringe with short blunt setae about as long as thickness of costal vein interspersed at about every fifth seta with a spinule about twice as long.

Length—2.9 mm. (2.4-3.5); wing—3.0 mm. (2.4-3.7).

Holotype ♂, allotype ♀; paratypes 9 ♂♂, 39 ♀♀; Kokee, Kauai, Sept. 6, 1946 (4000 ft., at falls near tunnel; resting on wet rocks).

This species has the general appearance of *Neoscatella warreni*, differing by the very characteristic subapical dark band of the wings on a light background. In the latter respect *kauaiensis* resembles closely a New Zealand species of *Scatella, nubeculosa* Tonnoir and Malloch (1926), though differing according to their brief description as follows:

1. Size small (body 1.6 mm., wing 2 mm.); infuscation of wing extending to apex; face yellowish brown; mesonotum with traces of pale vittae anteriorly ..... *Scatella nubeculosa*
   Size large (body 2.9 mm., wing 3 mm.); infuscation of wing not extending to apex; face dark brown; mesonotum without trace of pale vittae ..... *Neoscatella kauaiensis*

**Neoscatella warreni** (Cresson)

*Scatella warreni* Cresson, 1926, Proc. Haw. Ent. Soc. **6**: 276; Williams, 1938, Proc. Haw. Ent. Soc. **10**: 102.

*Neoscatella warreni* Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 360 (gen. pos.).

A large subopaque dark brownish black species with slight purplish iridescence; bristles and setulae moderately developed; wings with two faint spots.

♂, ♀. Frons more or less shining brownish black, parafrons and ocellar tubercle pollinose; fronto-orbitals, the inner and outer verticals, and the ocellar bristles well-developed, frontal setulae inconspicuous. Face dark brownish black pollinose, with the facial setulae sparse but strong, a row of about six long setae on oral margin; median facial prominence well-developed, arising at level of a line between lower margin of bases of antennae; a diagonal row of about 4 facial bristles on each side extending ventro-laterally well removed from facial margin, the lower two bristles quite prominent. Cheek with prominent genal bristle. Antennae with the third segment almost as broad as long; arista about twice the length of third antennal segment, bare ventrally, with strong pubescence dorsally nearly to tip.

Mesonotum and scutellum subopaque brownish black, iridescent purplish except on anterior margin which is iridescent greenish; humeri and mesopleura pollinose brown, remainder of pleura and postnotum grayish pollinose; four pairs of dorsocentral bristles (1:3), the second pair small, the others strong; one pair of acrostichals (1:0), with some large setulae post-suturally, other mesonotal setulae sparse, but well developed near anterior margin;

mesopleura with about a dozen small setulae. Scutellum with two pairs of small lateral setulae, a moderate subapical pair which are almost half the length of the strong apical pair of bristles.

Abdomen dark brown with purplish iridescence, no trace of segmental banding. Male with 5th tergite half again as long as 4th, 2nd to 4th subequal; clasper long and slender and distinctly curved at tip (fig. 2, g).

Legs (fig. 3, a) with coxae, trochanters, and proximal three-fourths of femora dark-grayish pollinose, remainder dark brown; bristling moderate, the fore femora with the post-flexor bristles about as long as width of femora.

Wings iridescent purplish brown, lightly infuscated, with two faint spots, one about midway in cell $R_2+_3$ and the second about a fourth way from apex of cell $R_{4+5}$; veins not undulating; costal fringe distad of tip of vein $R_1$ with short spinules about as long as thickness of costal vein interspersed at every fourth spinule with strong dorsally-directed spines about twice as long. Wing rather slender, about three times as long as greatest width. Halteres yellow.

Length—3.1 mm. (2.5-3.4); wing 3.2 mm. (2.5-3.5) (Hawaii material only).

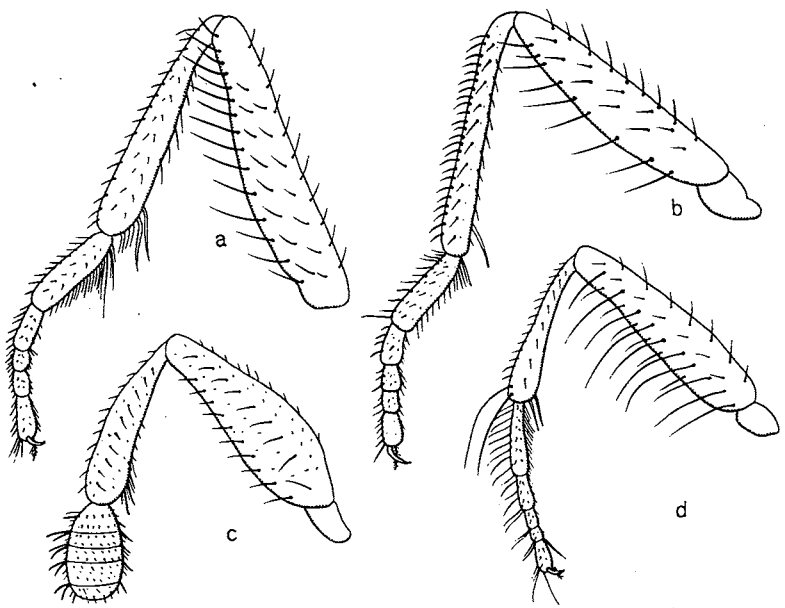


Figure 3. Fore legs of males of *Neoscatella*. **a**, *warreni;* **b**, *fimbriata;* **c**, *clavipes clavipes;* **d**, *cilipes.*

Material examined: Wirth collection. Hawaii: 10 ♂♂, 33 ♀♀, Akaka Falls, March 5, 1946; 3 ♂♂, 7 ♀♀, Rainbow Falls, Hilo, March 3, 1946. Bishop Museum collection. Hawaii: 1 ♂ 1 ♀, Akaka Falls, Oct. 21, 1931, F. X. Williams; 1 ♂, 8 ♀♀, Hilo, July, 1936, F. X. Williams (flume). Maui: 2 ♂♂, 1 ♀, Haipauena, June 25, 1920, E. H. Bryan, Jr. (the ♀ is one of Cresson's para-

types); 2 ♂ ♂ Iao Valley, Jan. 3, 1915, J. F. Illingworth; 1 ♂, Kailua, June 20, 1920, E. H. Bryan, Jr.; 1 ♂, Wailua-iki, July 3, 1920, E. H. Bryan, Jr.

Some specimens from Oahu, determined by Cresson as *warreni,* are smaller than the Maui paratype and the series from Hawaii; they lack the pale wing spots, the fore tibia of the ♂ has the posterior fringe of curved bristles, and they otherwise resemble *fimbriata* of Oahu, to which they are here referred. Williams (1938, p. 106) gives some very excellent notes on the biology of *warreni* from Hawaii, and from several points on Oahu; the latter notes probably refer to *fimbriata.* Of Oahu material treated by Dr. Williams as *warreni,* the writer examined specimens from Kalihi Stream and Waianae which were *fimbriata;* however Williams' figure of the wing of *warreni* from Lulumahu Stream near Honolulu shows one distinct and one faint pale wing spot characteristic of that species. One of Warren's specimens of *"Ilythea"* was also seen and appeared to be *fimbriata.* Williams (*l.c.*) states that *warreni* "varies much in size and, as the smallest forms are often associated, there may be really more than one form involved." With the material at hand it is therefore concluded that *warreni* definitely occurs on Maui and Hawaii, and less certainly on Oahu.

**Neoscatella fimbriata** Wirth, new species

*Scatella warreni,* Williams (in part, not Cresson), 1938, Proc. Haw. Ent. Soc. **10**: 102. (Oahu records.)

A medium-sized species with unmarked wings, costa with longer interspersed spines; color light pollinose gray below; genal bristle well-developed; male with moderate post-flexor bristles on fore femora, fore tarsi not swollen but with erect bristles dorsally, fore tibiae with a row or fringe of moderate curved bristles, no long fine hairs at apex.

♂, ♀. Frons shining iridescent brownish black, parafrons and ocellar tubercle pollinose; the fronto-orbitals, inner and outer verticals, and ocellar bristles strong; frontal setulae minute. Face opaque brownish black with the median protuberance well-developed, with a marked dorsal hump; a diagonal row of about five facial bristles extending ventro-laterally on each side, these all well-developed, progressively larger laterally, the latero-most pair arising about half as far from facial margin as from para-facialia; facial setulae sparse and fine and confined below facial bristles; oral margin fringed with about six moderate setae on each side. Cheeks light grayish pollinose, the genal bristle strong, with a sparse patch of less than a dozen setae on ventro-posterior corner. Antennae with the third segment less than a fourth longer than broad, with grayish pubescence; second segment with a long fine subapical dorsal seta and an apical fringe of moderate to long setae on mesal and ventral sides; arista about twice as long as third antennal segment, bare ventrally with long dorsal pubescence to tip.

Mesonotum and scutellum subopaque iridescent brownish black, humeri and upper half of pleura and postnotum pollinose brownish black, lower portion of pleura pollinose gray; three pairs of strong dorsocentrals (1:2), one pair of strong acrostichals (1:0) with two pairs of weaker setae in line anteriorly; other mesonotal setulae sparse but moderately developed anteriorly. Scutellum with a weak subapical pair of bristles about a third as long as the strong apical pair.

Abdomen dark brownish black with purplish iridescence, without trace of segmental banding; the 5th segment of ♂ bluntly tapered posteriorly, about as long as wide at base and half again as long as 4th, 2nd to 4th subequal; clasper extremely long and slender, more so than in any other Hawaiian species, the apex scarcely bent (fig. 2, h).

Legs (fig. 3, b) with coxae, trochanters, and bases of femora pollinose gray, remainder dark brown; bristling moderate. Fore legs of the ♂ with the femora not markedly swollen, the fore tarsi slightly longer than the tibiae; the postflexor bristles of the femora about as long as diameter of femur; posterior margin of tibia bearing a dense, even fringe of curved bristles slightly longer than thickness of the tibia; dorsal bristles of the tarsi erect and well-developed, about as long as width of tarsal segments; claws normal. Female with ratio of segments of leg as usual in the genus, the post-flexor bristles of the fore femur as in the ♂, the fore tibiae bearing only a sparse even fringe of fine posterior bristles, the tarsal bristles not unusual.

Wings with greatest width about 2.8 the length, not especially tapered apically, evenly infuscated without trace of light spots, veins not undulating; costal fringe distad of tip of $R_1$ of short spinules about as long as diameter of costal vein interspersed at every fourth or fifth spinule with strong dorsally directed spines about twice as long. Halteres with knob yellow, base brownish.

Length—2.5 mm. (2.2-2.8); wing—2.7 mm. (2.3-2.9).

Holotype ♂, Palolo Valley, Oahu, Jan. 19, 1946 (1500 ft.; resting on moist rocks in stream bed). Allotype ♀, Kaluanui Valley, Oahu, May 14, 1946, (at stream, 2000 ft.). Paratypes: 1 ♂, Manoa Valley, Oahu, May 6, 1945; 1 ♂, 2 ♀ ♀, Kaluanui Valley, Oahu, May 14, 1946 (at stream, 2000 ft.); 1 ♂, Mt. Kaala, Oahu, Apr. 17, 1946; 2 ♂ ♂, 4 ♀ ♀, Makaleha, Oahu, Jan. 13, 1929, E. H. Bryan, Jr.; 2 ♂ ♂, 1 ♀, Waianae, Oahu, May 10, 1936, F. X. Williams (swift water ditch). Other specimens: 4 ♀ ♀, Kalihi Stream, Honolulu, Oahu, Mar. 13, 14, 1937, F. X. Williams (wet boulder); 2 ♂ ♂, 6 ♀ ♀, Moanalua, Oahu, Apr. 9, 1922, E. H. Bryan, Jr. (det. *"warreni"* by Cresson); 1 ♀, Palolo, Oahu, Feb. 25, 1922, E. H. Bryan, Jr.; Honolulu, Oahu, Oct. 26, 1913, A. Warren.

This species is intermediate between *clavipes* and *cilipes* on one hand and *warreni* on the other, being nearly as small in size as the former two species and also resembling them in having dark unspotted wings, but differing from them both by the prominent facial hump, shining black dorsal color and pollinose gray ventral aspect, wings not markedly tapering distally, and presence of long spines interspersed on the costa. *Fimbriata* further differs from *clavipes* in lacking the swollen fore femora and tarsi of the ♂ and possession of the long post-flexor femoral bristles and a row of distinct tibial bristles and a long genal bristle, and further differs from *cilipes* in lacking the long apical tibial hairs of the ♂. It differs from *warreni* in lacking the two pale wing spots, in the smaller size, and in possessing well-developed erect bristles on the fore tarsi of the ♂. The earlier confusion of *fimbriata* with Oahu

records of *warreni* is discussed above under *warreni*; it is believed likely that all Oahu records should be referred to *fimbriata*.

**Neoscatella cilipes** Wirth, new species

A small opaque dark brownish black species, with dark unspotted wings; the males with fore femora normal but the post-flexor bristles very long, the fore tibiae with several very long fine apical hairs, and fore tarsi with abundant long fine wavy dorsal hairs.

♂, ♀. General color opaque dark brownish black throughout as in *clavipes*, with purplish and greenish iridescence, only the mesofrons shining; ventral aspect generally dark gray pollinose.

Head with fronto-orbitals, the outer verticals, and ocellar bristles long, the ocellars rather slender, inner verticals about half the length of the outer; frontal setulae minute, alternating with the fronto-orbitals. Median facial prominence rather rounding, the dorsal hump moderate; a diagonal row of about 4 facial bristles extending ventro-laterad on each side from prominence, these well-developed, the latero-most pair strongest and arising midway between oral margin and parafacialia; facial setulae sparse and fine; oral margin with a fringe of about five long fine hairs on each side. Cheeks pollinose gray, with a prominent genal bristle and a sparse patch of about a dozen fine setae on ventro-posterior corner. Antennae with third segment about as broad as long, with grayish pubescence, second segment with apical fringe of fine setae on mesal and ventral sides; arista over twice as long as third antennal segment, bare ventrally, with long dorsal pubescence nearly to tip.

Mesonotum with three pairs of strong dorsocentrals (1:2), one pair of strong acrostichals; mesonotal setulae confined to a few strong ones on anterior and lateral margins. Scutellum with a weak subapical pair of bristles about a third as long as the strong apical pair.

Abdomen without trace of subapical banding, the bristles sparse but rather long, 5th tergite of ♂ only slightly longer than 4th, about a quarter broader than long and bluntly tapered distally, 2nd to 4th subequal.

Legs (fig. 3, d) with bristling moderate on four posterior pairs; fore legs of ♂ with the femora not swollen, with the prominent row of post-flexor bristles about twice as long as thickness of femur and markedly downcurved toward apices; the tibiae with a distinct row of outstanding bristles on posterior edge, these about as long as diameter of tibia, apex with two prominent subapical ventral spines and two apical dorsal long prominent bristles; tarsi subequal to length of tibiae, segments not markedly swollen, abundantly furnished with long fine wavy hairs dorsally, claws normal. In the ♀ the post-flexor bristles of the fore femora are fine and sparse but long and wavy as in the ♂, the tibial bristles are fine and inconspicuous, the ventral spines as in the ♂, but the apical dorsal bristles are short and inconspicuous as well as the dorsal tarsal hairs.

Wings distinctly tapered distally with the greatest width 2.8 the length; evenly infuscated without trace of light spots; veins not undulating; costal fringe distad of tip of $R_1$ of short spinules without any interspersed long dorsally directed spines present. Halteres with yellow knobs, bases brownish.

Length—1.8 mm. (1.6-2.0); wing—1.9 mm. (1.7-2.2).

Holotype ♂, Mt. Kaala, Oahu, July 25, 1946 (4000 ft., bog at summit). Allotype ♀, Waianae, Oahu, Apr. 19, 1936, F. X. Williams (edge of swift water). Paratypes: 1 ♂, Manoa Valley, Oahu, May 6, 1945; 2 ♂ ♂, *idem*, Apr. 10, 1946; 1 ♂, 1 ♀, Waihi-iki, Manoa Valley, Oahu, Feb. 28, 1937, F. X. Williams (wet rock); 1 ♀, Kokee, Kauai, Sept. 7, 1946 (4000 ft.); 2 ♂ ♂, 2 ♀ ♀, Wailua Falls, Kauai, Sept. 4, 1946 (wet rocks at stream margin).

This species resembles *clavipes* in size and color, tapered wing, and lack of long costal spines, but differs in lacking the swollen fore femora and tarsi in the ♂, and in possessing a long genal bristle, the long post-flexor femoral bristles, the row of tibial bristles and the long apical tibial hairs, and in the long hairy vestiture of the tarsi rather than the stout spines of the clubbed-foot of *clavipes*. The females of the two species are almost impossible to separate except for the size of the genal bristle, which is subject to a good deal of variation, but generally is very small in *clavipes* and long in *cilipes*.

**Neoscatella clavipes clavipes** Wirth, new species

A small opaque dark brownish black species, somewhat iridescent, with dark unspotted wings and the males with remarkably modified fore legs, the femora swollen and post-flexor bristles reduced, and the fore tarsi forming a swollen spinose club.

♂, ♀. General color opaque dark brownish black throughout, with purplish or greenish iridescence in certain lights, only the mesofrons shining.

Head with fronto-orbitals, the outer verticals, and ocellar bristles long but rather slender, inner verticals in the type reduced to about half the length of the outer pair, but may be subequal in other specimens; frontal setulae reduced to three minute pairs alternating with the fronto-orbitals. Median facial prominence rather rounding, without the usual marked dorsal hump; the diagonal row of five facial bristles extending ventro-laterally on each side, of which only the latero-most pair are conspicuous, these arise about midway between oral margin and parafacialia and are bent outward and slightly upward; facial setulae few and confined below facial bristles; oral margin with a row of about five moderate setae on each side. Cheeks with a patch of setae on ventro-posterior corner, without a prominent genal bristle. Antennae with third segment less than a fourth longer than broad; second segment with a few small apical setae on ventro-mesal corner; arista less than 1.5 times as long as third segment, bare ventrally, with long dorsal pubescence to tip.

Mesonotum with three pairs of strong dorsocentrals (1:2) and one pair of strong acrostichals (1:0); mesonotal setulae absent except for a few on anterior margin and humeri. Scutellum with a weak subapical pair of bristles about a third as long as the strong apical pair.

Abdomen without trace of segmental banding, the bristling not conspicuous. Male with 5th tergite slightly longer than 4th, bluntly tapering distally; 2nd to 4th subequal; clasper very short and markedly and evenly curved to apex (fig. 2, d).

Legs (fig. 3, c) with rather short bristles, the post-flexor series of the fore femora not developed. The fore legs remarkably developed; ♀ with the fore femora slightly thicker than usual in the genus and the tarsi much shorter than usual; ♂ with the femora greatly swollen with a greatest thickness of about a quarter the length, the tarsal segments remarkably shortened, swollen, and appressed, together forming an oval spinose club-like organ about 0.44 as long and half again as broad as the tibia; the claws more or less atrophied and the dorsal setae across each tarsal segment greatly developed forming strong erect protruding spines.

Wings distinctly tapered distally with greatest width about 0.37 of the length; evenly infuscated without trace of light spots; veins not undulating; costal fringe distad of tip of vein $R_1$ of short spinules about as long as thickness of costal vein, no long differentiated spines present. Halteres yellow.

Length—1.9 mm. (1.6-2.3); wing—2.1 mm. (1.7-2.4).

Holotype ♂, allotype ♀, Akaka Falls, Hawaii, March 5, 1946. Paratypes: 36 ♂ ♂, 35 ♀ ♀, same data as the types; 7 ♂ ♂, 15 ♀ ♀, Rainbow Falls, Wailuku River, Hilo, Hawaii, March 2, 1946.

One damaged specimen from Akaka Falls, collected by Dr. F. X. Williams and in the H. S. P. A. collection probably belongs here. *N. clavipes* exhibits the most extreme modifications of the variable structures possessed by the group of very small Hawaiian species with unspotted wings. The most striking of these are the remarkably swollen and modified fore femora and tarsi; others are the reduced median facial prominence, genal bristle, mesonotal setulae, the opaque dark color and the lack of long costal spines. In all the species of this group the modifications of the fore legs are confined to the male sex; the legs of the females are quite normal, and consequently, this sex may be very difficult to determine. There are 10 ♂ ♂ in the author's collection from both localities of Hawaii in which the fore legs are quite unmodified as in the ♀ of *clavipes;* furthermore in 5 of these and in another female there is a faint pale wing spot in the center of cell $R_{2+3}$; in all other respects these individuals resemble typical *clavipes* quite closely and, of course, some of the females placed in *clavipes* may belong to these males without wing spots. These possibly may be a variety of *clavipes* if they are the result of a recurrent genetic segregation of the obviously variable factors affecting the structure of the fore legs and wings. On the other hand the present collection can scarcely be said to represent an adequate sample of the population and it is therefore possible that two distinct species may be represented. The solution of this problem then must await further collecting and study.

**Neoscatella clavipes tenda** Wirth, new subspecies

♂, ♀. As in typical *clavipes,* with the following differences: Inner vertical bristles nearly as long as the outer pair; the facial bristles more conspicuous. Fore tarsi (Plate VI, figure 2) of ♂ about 0.75 the length of tibiae, the segments shortened and swollen, their thickness being slightly greater than that of apex of tibia; each segment bearing dorsally and ventrally a number of long bristles with curved tips, these slightly longer than thickness of tarsal segments; tarsal claws distinct but of distorted shape.

Length—1.8 mm. (1.7-2.0); wing—2.2 mm. (2.1-2.2).

Holotype ♂, allotype ♀, paratype 1 ♂, Kaluanui Valley, Oahu, May 14, 1946 (2000 ft.).

The three specimens are quite distinct from the three specimens of *fimbriata* collected at the same time and place, possessing the swollen and modified fore femora and tarsi in the ♂, the dark color and the reduced genal bristle of *clavipes.* It is believed that their differences from the typical sub-species given in the above description, together with their isolated occurrence on Oahu, warrant making them a subspecies of *clavipes.*

**Neoscatella bryani** (Cresson)

*Scatella bryani* Cresson, 1926, Proc. Haw. Ent. Soc. **6**:276; Williams, 1938, Proc. Haw. Ent. Soc. **10**: 102.

*Neoscatella bryani* Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 360 (gen. pos.).

Type: ♂, Awaawapuhi, Kauai; in Bishop Museum collection.

A small somewhat shining dark brown species with six-spotted wings including a spot in cell $R_1$; almost no mesonotal setulae and bristles not well-developed.

♂, ♀. Frons shining brown, parafrons and ocellar tubercle brown pollinose; the fronto-orbitals, inner and outer verticals, and ocellar bristles strong; frontal setulae inconspicuous. Face brownish pollinose; the facial setulae fine and short, confined below the diagonal row of 4-5 facial bristles extending ventro-laterally on each side from the apex of facial prominence to near oral margin, the ventral bristle of this series moderate, arising about twice as far from the lateral margin as from oral margin; the latter with about five moderate setae on each side. Cheeks gray pollinose, with a strong antero-directed bristle and behind this a small patch of fine setae on lower margin. Antennae with third segment about a third again as long as broad at base; setae of second segment fine; arista about twice as long as third antennal segment, bare below, finely pubescent above almost to tip.

Mesonotum and scutellum shining dark brown, slightly pollinose, becoming greenish on anterior margin and humeri; pteropleura and posterior portion of mesopleura brownish pollinose, remainder of pleura and postnotum dark gray pollinose. Three pairs of well developed dorsocentrals (1:2), one pair of moderate acrostichals (1:0); mesonotal setulae confined to a few minute setulae on anterior portion; a subapical pair of scutellar bristles which are about a third as long as apical pair.

Abdomen opaque dark brown, with faint indication of apical segmental bands, the setae not conspicuous; fourth and fifth tergites subequal in length, the fifth abruptly tapered to a blunt point; clasper short, the tip straight (fig. 2, e).

Legs dark brown, the coxae, trochanters, and proximal three-fourths of femora grayish pollinose; the bristling short, the post-flexor bristles of fore femora about as long as diameter of femora.

Wings lightly infuscated; with six faint spots located as follows: one at base of cell $R_1$, second midway in cell $R_2+_3$, third about a quarter way from base and fourth about a quarter way from apex of cell $R_4+_5$, the fifth at apex of cell M and sixth at base of cell $M_1$; some specimens may have two additional spots at apices of cells $R_2+_3$ and $R_4+_5$ very faintly indicated; veins distinctly undulating at the spots. Costa with a fringe of short setae, these about as long as thickness of costal vein. Halteres yellow.

Length—2.0 mm. (1.7-2.5); wing—2.1 mm. (1.7-2.4).

Material studied: Oahu: 5 ♂ ♂, 6 ♀ ♀, Kahuku, Feb. 1, 1946 (light trap); 1 ♀, Hering Valley, April 29, 1945; 1 ♀, Honolulu, April 2, 1923, E. H. Bryan, Hawaii: 1 ♀, Hawaii National Park, Kilauea, Oct. 1946, C. J. Davis (light trap).

According to Williams (1938, p. 100) who gives notes on the biology, *bryani* is found generally in lowland situations where there is standing water, from saline flats near the sea, lowland reservoirs, ponds, puddles, and ditches. The author's collections indicate further that *bryani* may invade higher altitudes (Kilauea is about 4000 ft.) and running streams (as at Hering Valley). The specimen from Kilauea was atypical however, in possessing the two

extra faint apical wing spots as indicated by Williams (1938, plate V, fig. 25) and was the only specimen seen by the writer with these spots at all apparent.

Of the Hawaiian species, *bryani* resembles *sexnotata* in possessing six-spotted wings, but differs greatly in its smaller size, reduced condition of bristles and setulae, and shining black color.

**Neoscatella sexnotata** (Cresson)

*Scatella sexnotata* Cresson, 1926, Proc. Haw. Ent. Soc. **6**: 275; Williams, 1938, Proc. Haw. Ent. Soc. **10**: 100.

*Neoscatella sexnotata* Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 360 (gen. pos.).

Type: ♂, Waimanalo, Oahu; in Bishop Museum collection.

A dark opaque species, with well-developed bristles and setulae; the wings with six light spots including one in cell $R_1$.

♂, ♀. Mesofrons shining black, parafrons, anterior margin, and ocellar tubercle distinctly pollinose; fronto-orbitals strong, alternating with three strong setulae, inner and outer verticals strong, two strong lateroclinate anterior ocellars and a moderate median proclinate posterior ocellar bristle. Face distinctly brownish gray pollinose; facial setulae strong and numerous, most strongly developed toward oral margin where there is a row of about seven strong oral bristles on each side; median facial prominence distinctly protruding, three pairs of facial bristles in a diagonal row extending from this prominence to ventro-lateral corner of face, the lateral pair quite strong. Cheeks grayish pollinose; genal bristle strong. Antennae with third segment nearly as broad as long; setae of second segment strong; arista slightly more than twice as long as third segment, with fine pubescence below on basal fourth and above on basal two-thirds.

Mesonotum dark sub-opaque brown, with grayish green pollinosity most pronounced on anterior margin and on humeri; four pairs of strong dorsocentrals, the second located just behind the suture and more or less reduced (1:3); two pairs of strong acrostichals (1:0); mesonotal setulae very prominent on anterior portion, reduced posteriorly. Pleura and postnotum dark brownish gray pollinose; mesopleura with numerous strong setulae. Scutellum with subapical bristles about half as long as the strong apical pair.

Abdomen opaque brownish black, with distinct broad grayish green banding on apices of segments. Fifth tergite of ♂ half again as long as fourth, second to fourth subequal; clasper stout, long, and straight (fig. 2, i).

Wings infuscated with six definite pale spots located as follows: a spot at base of cell $R_1$, second midway in cell $R_{2+3}$, third at basal fourth and fourth at distal fourth of cell $R_{4+5}$, fifth at apex of cell M, and sixth at base of cell $M_1$; veins slightly undulating at the spots; costal fringe distad of tip of vein $R_1$ with short spinules slightly longer than thickness of costal vein alternating at every fifth spinule with strong dorsally-directed spines about twice as long. Halteres yellow.

Length—2.8 mm. (2.5-3.2); wing—2.7 mm. (2.2-3.4).

Material examined: Oahu: 5 ♂ ♂, 6 ♀ ♀, Kalihi, Feb., 1946 (light trap); 1 ♂, 5 ♀ ♀, Kahuku, Feb. 1, 1946 (light trap); 3 ♀ ♀, Kaneohe, March 13, 1946 (marshy bay shore); 2 ♂ ♂, Waimea, Jan. 31, 1946 (on rocks by sea); 20 ♂ ♀, Ewa, March 14, 1946 (on stranded seaweed on beach).

According to Bryan (1934), *sexnotata* has been taken from Oahu, Hawaii, Nihoa, Necker, and Laysan Islands in the Ha-

waiian chain. Williams (1937) states that this species favors stagnant saline pools, such as are formed by high tides, marshes, mudflats, wet beach sand, and tide rocks, and even in reservoirs near the sea. Resembling *bryani* in having six-spotted wings, *sexnotata* differs in its larger size, better developed bristles and setulae, and its opaque brownish color.

**Neoscatella terryi** (Cresson)

*Scatella terryi* Cresson, 1926, Proc. Haw. Ent. Soc. **6**: 275; Williams, 1938, Proc. Haw. Ent. Soc. **10**: 100.

*Neoscatella terryi* Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 360.

Type: ♂, Wawamalu Beach near Koko Crater, Oahu; in Bishop Museum collection.

A robust dull olive-brown species with sparse mesonotal setulae and wings with five spots, none of which are in cell $R_1$.

♂, ♀. General color dull olivaceous brown, the notopleura, postnotum, and apical margins of abdominal segments more grayish.

Head broad, the frons about half again as broad as long, the frontoorbitals, the inner and outer verticals, and the ocellar bristles rather long but slender. Face protrudes in a rounded prominence located well up between bases of antennae; the facial setulae small and sparse; a diagonal row of facial bristles extending ventro-laterad at about width of parafacialia from facial margin, the lateral bristle of this row moderately strong; a row of six to seven oral setae on each side along oral margin. Antennae with third segment about a fourth longer than wide, the second segment almost devoid of setae; arista scarcely twice the length of third antennal segment, without apparent pubescence.

Mesonotum with three pairs of strong dorsocentrals (1:2) and a pair of moderate acrostichals (1:0); mesonotal setulae sparse and confined to anterior and lateral margins. Scutellum with the subapical pair of bristles about a third as long as the strong apical pair.

Abdomen without trace of segmental banding; fifth tergite of ♂ about half again as long as fourth, second to fourth subequal.

Legs short, the bristles moderate to short except those on mid femora and on fore femora, which are about as long as diameter of femora.

Wings brownish infuscated, with five well-defined light spots as follows: one about midway in cell $R_{2+3}$ of which there is a trace in the anterior margin of cell $R_{4+5}$, which also has a second spot at basal fourth and a third at distal fourth, fourth spot at apex of cell M and a fifth at base of cell $M_1$; all veins with distinct undulations at the spots; costal fringe distad of tip of vein $R_1$ of short spinules about as long as thickness of costal vein. Halteres yellow.

Length—2.5 mm. (2.3-2.8); wing—2.3 mm. (2.2-2.7).

Material examined: Oahu: 2 ♂ ♂, 2 ♀ ♀, Waimea, Jan. 15, 1946 (on rocks by sea); 1 ♂, Hanauma Bay, Jan. 4, 1946 (on rocks by sea).

Apparently this species is known only from Oahu, the type being from the beach near Koko Crater, and Williams (1938) has recorded specimens from the rocks at Waianae. The writer took the Waimea specimens in company with *sexnotata,* which they superficially resemble in their opaque brownish color, but differ with respect to their five-spotted wings and reduced mesonotal setulae.

**Neoscatella hawaiiensis** (Grimshaw)

*Scatella hawaiiensis* Grimshaw, 1913, Fauna Hawaiiensis **3**: 49; Williams, 1938, Proc. Haw. Ent. Soc. **10**: 104.

*Neoscatella hawaiiensis* Cresson, 1935, Trans. Amer. Ent. Soc. **61**: 360 (gen. pos.).

Types: 8 ♂♂, 6 ♀♀, Mt. Kaala, Oahu, 2000 ft.

A shining black species with five-spotted wings, no spot in cell $R_1$, almost no mesonotal setulae, and well developed inner vertical bristles.

♂, ♀. Frons shining black, parafrons brownish pollinose; the fronto-orbitals, the inner and outer verticals, and ocellar bristles well developed, frontal setulae inconspicuous. Face about a third of total width of head, brownish pollinose; facial setulae fine and sparse, becoming somewhat longer and denser toward oral margin, this with a row of about six moderately long oral setae on each side. Median facial prominence not markedly protruding, a row of four pairs of facial bristles extending diagonally on each side ventro-laterad from prominence, the two lower pairs strong. Cheeks grayish pollinose. Antennae with the third segment about a fourth longer than wide; the arista about twice as long as third antennal segment, with ventral pubescence on proximal third, dorsal pubescence to tip.

Mesonotum and scutellum shining black, brownish at extreme lateral margins, humeri grayish pollinose; three pairs of strong dorsocentrals (1:2), one pair of acrostichals just before the suture (1:0); mesonotal setulae restricted to a few at humeral margins. Pleura dark grayish pollinose, the pteropleura and posterior portion of mesopleura brownish. Subapical pair of scutellar bristles nearly half as long as apical pair.

Abdomen opaque brownish black with scarcely a trace of segmental banding, fifth tergite of ♂ a fifth longer than fourth which is slightly longer than third; clasper moderate, the tip slightly curved (fig. 2, a).

Legs dark brown, the coxae, trochanters and all but apices of femora dark grayish pollinose; the bristles moderate, fore femora with post-flexor bristles slightly longer than diameter of femur.

Wings infuscate, with five definite pale spots as follows: one about midway in cell $R_{2+3}$, second at basal fourth and third at distal fourth of cell $R_{4+5}$, fourth at apex of cell M, and fifth at base of cell $M_1$; the veins distinctly undulating at the spots; costa with the fringe of fine spinules about as long as thickness of costal vein.

Length—2.4 mm. (2.0-2.8); wing—2.6 mm. (2.2-2.9).

Material studied: From the author's collection: Oahu: Mt. Kaala (*topotypic*), Mar., 1946, 3 ♂♂, 1 ♀; Apr. 17, 1946, 2 ♀♀; July 25, 1946, 3 ♀♀ (bog at summit, 4000 ft.); 1 ♂, 1 ♀, Kaluanui Valley, May 14, 1946 (at stream, 2000 ft.); 1 ♂, 2 ♀♀, Hering Valley, Apr. 29, 1945; Manoa Valley, May 6, 1945, 2 ♂♂; Apr. 10, 1946, 3 ♂♂, 2 ♀♀; Oct. 19, 1946, 1 ♀. Hawaii: 1 ♀, Ohaikea Pond, Hawaii National Park (4200 ft.), Mar. 4, 1946. Kauai: 1 ♂, Kokee, Sept. 6, 1946 (4000 ft., at falls near tunnel). From the Bishop Museum and H. S. P. A. collections: Oahu: 7 ♀♀, Waianae Mts. (Illingworth); 2 ♂♂, 2 ♀♀, Palolo Falls, July, 1916 (Illingworth); 1 ♂, Moanalua, Apr. 9, 1922 (Swezy); 3 ♂♂, 7 ♀♀, Makaleha, Jan. 13, 1929 (Bryan); 3 ♂♂, 4 ♀♀, Niu, Jan. 13, 1924 (Swezy). Kauai: 1 ♀, Awaawapuhi, June 16, 1922 (Bryan). Maui: 1 ♂, Haleakala, Mar. 22, 1932 (Bryant); 1 ♀,

Olinda, Mar. 15, 1932 (Bryant); 1 ♀, Kula Pipe Line, 5000 ft. (Bryant).

Of the Hawaiian species with five-spotted wings, *hawaiiensis* is readily separted from *terryi* by its blackish color compared with the brownish olive color of the latter; and from *oahuense* by the inner vertical bristles which are strong in *hawaiiensis* and reduced in *oahuense*. This species quite closely resembles the very widely distributed genotype of *Scatella, stagnalis* (Fallen), but the presence of an ante-sutural dorsocentral in *hawaiiensis* will readily separate the two species which fall into separate genera on this criterion.

**Neoscatella oahuense** (Williams), new combination

*Scatella oahuense* Williams, 1938, Proc. Haw. Ent. Soc. **10**: 107.

Type: ♀, Hering Valley, Tantalus, Oahu; in Hawaiian Entomological Society collection.

A shining black species, wings with five rather faint spots, none of which are in cell $R_1$, greatly reduced inner vertical bristles, and post-flexor bristles of fore femora poorly developed.

♂, ♀. Frons shining black, parafrons brownish pollinose; the fronto-orbitals, and outer vertical bristle strong, inner verticals very weak and inconspicuous, two strong ocellars; frontal setulae inconspicuous. Face nearly half total width of head, brownish pollinose; median facial prominence moderately projecting, facial setulae short and fine, less than half as long as width of third antennal segment, confined below the oblique row of four facial bristles extending ventro-laterad on each side, the lateral pair strong; oral margin with five to six moderate setae on each side. Cheeks grayish pollinose; genal bristle strong. Antennae with third segment slightly longer than broad; arista about twice as long as third antennal segment, with fine dorsal pubescence extending to tip.

Mesonotum and scutellum shining black becoming brownish pollinose on sides; three pairs of strong dorsocentrals (1:2), one pair of acrostichals (1:0); mesonotal setulae confined to anterior margin. Posterior portion of mesopleura brownish pollinose, remainder of pleura, humeri, and postnotum grayish pollinose. The subapical pair of scutellar bristles about a third the length of the strong apical pair.

Abdomen opaque brownish black with scarcely a trace of segmental banding, 5th tergite of ♂ long and tapering, half again as long as 4th which in turn is longer than 3rd; clasper moderate, slightly bent (fig. 2, b; plate VII, figure 2).

Legs dark brown, the coxae, trochanters, and basal three-fourths of femora grayish pollinose; the bristles short; fore femora with only a few moderate post-flexor bristles near apex, these shorter than diameter of femur; pulvilli shorter and tarsal claws rather larger than usual in the genus.

Wings infuscated, with five rather faint pale spots as follows: one midway in cell $R_{2+3}$, second near base and third about two-thirds way to apex of cell $R_{4+5}$, fourth at apex of cell M, and fifth at base of cell $M_1$; the veins only slightly undulating at the spots; costa distad of tip of $R_1$ with fringe of short setae about as long as thickness of costal vein.

Length—2.4 mm. (2.0-2.8); wing—2.8 mm. (2.3-3.1).

Material studied: Oahu: 1♂, 5♀♀, Manoa Valley, May 6, 1945; 1♂, *idem*, Jan. 19, 1946 (on moist rocks in stream); 7♂♂, 4♀♀, Palolo Falls, July, 1916, (Illingworth); 4♂♂, Niu, Jan. 13, 1924, O. H. Swezey (waterfall).

This species was found by Williams on Oahu, Maui, and Hawaii, at altitudes up to and above 8000 ft. Its habitat coincides with that of *hawaiiensis,* so far as known, for the most part in and along mountain streams, wet banks, and the like, and very common at moderate elevations. The adults can be readily distinguished from *hawaiiensis* by the reduced inner vertical bristles, and in addition the wing spots are less distinct and the veins only slightly undulating at the spots.

It is believed that the related genus *Apulvillus* Malloch may possibly have arisen from *oahuense* or an ancestral species similar to it. Evidence pointing to this conclusion is summarized under the discussion of the genus *Apulvillus.*

## Genus **Apulvillus** Malloch

*Apulvillus* Malloch, 1935, B. P. Bishop Mus., Bull. **114**: 197.

*Chaetoscatella* Malloch, 1934, Insects of Samoa, pt. **6,** fasc. 8, p. 322 (*nomen nudum*) ; 1935, B. P. Bishop Mus. Bull. **114**: 199. New synonymy.

Pulvilli undeveloped, tarsal claws large; face with the facial series of bristles reduced, only the lateral pair strong, if any; facial setulae very short and fine; wings not spotted.

Genotype: *Apulvillus bronneci* Malloch 1935 (original designation).

Malloch first described the genus *Chaetoscatella* for *cheesmanae,* from the Society Islands. A short time later he described a second species, *unguiculata,* from Samoa. In neither paper did he definitely designate a genotype, though in the discussion of the Samoan species he stated that the genotype was from the Society Islands. The paper including the description of the genus and the Society Islands species was unfortunately delayed in publication and did not appear until 1935, a year later than the Samoan paper (1934). Thus according to one way of thinking, the genus might be considered to be monobasic and to date from 1934, the first publication of the genus, with *unguiculata* as the type. However according to Article 25 of the International Code, since the publication appeared subsequent to 1931, a definite unambiguous designation of the type species is required, and the 1934 paper indicated that the author considered the genotype to be the species from the Society Islands, which at the time was unpublished. The most desirable course at present then seems to be to follow Malloch's intent, and to designate *cheesmanae* as the genotype of *Chaetoscatella.*

The two Hawaiian species of *Apulvillus* are clearly related to Malloch's genera to the south, linking them to *Neoscatella.* Taxonomically one might preserve both of Malloch's genera, but it would be necessary to erect a third genus for the two Hawaiian

species. A much better course seems to be that followed herein: to group the lot in one genus for which the name *Apulvillus* is selected, and to recognize three segregates of the genus, which are treated as groups until more species may become known, when it may be desired to give them subgeneric rank.

The discovery of the two new representatives of *Apulvillus* in Hawaii at this time raises some very interesting problems of relationship and distribution which unfortunately cannot definitely be solved until the faunae of many more Pacific island groups are much better known. Based on the study of the known species of the genus, the analysis of characters shown in Figure 5 presents rather strong evidence that the genus is related to *Neoscatella* through *N. oahuense* or some ancestral species similar to it. The trend of variation in the Hawaiian species from *N. oahuense* through *Apulvillus mauiensis* to *A. williamsi* is clear; *A. bronneci* carries out this trend of variation of characters. From the distributional standpoint, it is puzzling to find what one would term annectant types in Hawaii, and distribution to the southeast from there. In most groups the ancestral types of Oceanic species are generally found in the southwestern Pacific, Australia, or New Guinea or thereabouts, and distribution procedes therefrom by two main routes, the one to the northeast toward Hawaii, and the other to the southeast toward the Marquesas Islands and other groups (Usinger, 1941). Possibly the distribution of *Apulvillus* from Hawaii to the south might be explained by their being carried as eggs on the feet or bodies of some migrating shore-birds (as suggested in a general way by Zimmerman, 1942, p. 10). Until the species of additional island groups, and particularly the New Guinea area, are better known, the present phylogeny should be regarded as highly speculative.

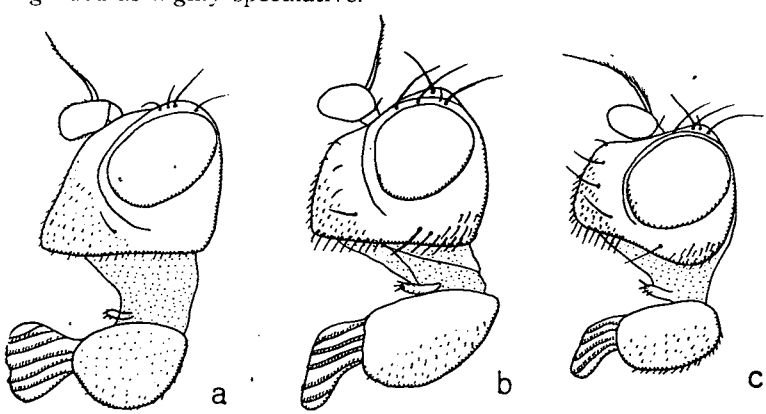


Figure 4. Comparison of heads in lateral view, of **a**, *Apulvillus bronneci;* **b**, *Apulvillus williamsi;* and **c**, *Neoscatella oahuense.*

## Key to the known species of *Apulvillus* Malloch

1. Face perpendicular, forming an angle of nearly 90° with the oral margin; with a prominent median hump or elevation just below level of bases of antennae as in *Neoscatella* (fig. 4, b) (Hawaiian Is.) Group A. *mauiensis* Group ..... 2
   Face long and oblique; the median prominence reduced (fig. 4, c) (South Pacific) ..... 3
2(1). Ocellar bristles strong; anterior dorsocentrals strong; one strong antesutural acrostichal (Maui) ..... **mauiensis** n. sp.
   Ocellar bristles weak; anterior dorsocentrals weak; two weak acrostichals (Hawaii) ..... **williamsi** n. sp.
3(1). Ocellar bristles minute; fourth tarsal segment with an apical pair of long ventral bristles; costa without long differentiated spines; female with fore femora emarginate below (Marquesas Is.) Group B. *Apulvillus* Mall., *s. str.* ..... **bronneci** Malloch.
   Ocellar bristles strong; fourth tarsal segment without long apical bristles; costa with some widely spaced spines much longer than diameter of costal vein. Group C. *Chaetoscatella* Mall. ..... 4
4(3). Knob of halteres yellow (Samoa) ..... **unguiculata** Malloch.
   Knob of halteres black (Society Is.) ..... **cheesmanae** (Malloch).

Group C. *Chaetoscatella*
- → *Apulvillus unguiculata* (halteres yellow)
- → *Apulvillus cheesmanae* (halteres black)

(4th tarsal segment without long bristles; costa with long spines)

Group B. typical *Apulvillus*
- → *Apulvillus bronneci* (ocellars minute, in. v. strong; ant. d.c. absent (0:2), no strong acr. (0:0); costa without long spines; ♂ costa thickened before $R_1$; 4th tarsal segment with long bristles; ♀ with fore femur emarginate below)

(face long and oblique)

Group A. *mauiensis* Group
- → *Apulvillus williamsi* (ocellars weak; in. v. moderate; ant. d.c. weak (1:2), 2 weak acr. (1:1); costa without long spines; 4th tarsal segment with long bristles)
- → *Apulvillus mauiensis* (ocellars strong; in. v. moderate; ant. d.c. strong (1:2), 1 strong acr. (1:0); costa without long spines; 4th tarsal segment with long bristles)

APULVILLUS — (pulvilli absent; claws large; bristles and setulae reduced; wings infuscated, no pale spots; marked pollinosity toward sides)
- → *Neoscatella oahuense* (ocellars strong; in. v. short; d.c. (1:2), acr. (1:0); pulvilli slightly reduced, claws larger; wing spots reduced, infuscation heavier toward costa)
- → *Neoscatella hawaiiensis* (ocellars strong; in. v. strong; d.c. (1:2), acr. (1:0); 5 distinct wing spots; claws normal, pulvilli large)

**Table 1. Relationships of the genus Apulvillus Malloch.**

**Apulvillus williamsi** Wirth, new species

A large pollinose black species with bristles and setulae very much reduced; ocellars weak, inner verticals moderate; anterior dorsocentrals weak, two weak acrostichals; costa without long spines; fourth tarsal segment with long bristles.

♂, ♀. Head (fig. 4, b) with mesofrons shining black, lateral and anterior margins and ocellar tubercle pollinose black; the two pairs of fronto-orbitals, the outer verticals, and ocellar bristles moderate, inner verticals about half the length of the outer. Face pollinose dark brown, grayish pollinose below the antennae; median facial prominence broadly rounding, the diagonal row of facial bristles extending ventro-laterad from prominence, these minute except for the moderate lateroclinate latero-most pair; facial setulae minute, densest toward oral margin which is fringed by a row of eight to ten small bristles. Cheeks gray pollinose, with a moderate genal bristle and a sparse ventro-posterior patch of setulae. Antennae with third segment about a fourth longer than broad, grayish pubescent; second segment with a small subapical dorsal seta and a ventral apical fringe of setulae; arista stout at base, about half again as long as third segment, bare below, with a strong pubescence above about three-fourths way to tip.

Mesonotum and scutellum shining black, faintly iridescent violet pollinose; a weak anterior and two strong posterior dorsocentrals (1:2); two pairs of weak acrostichals (1:1); and a few scattered mesonotal setulae in line with each row of bristles. Mesopleura, pteropleura, and postnotum dark grayish brown pollinose, remainder of pleura gray pollinose; two strong notopleurals, a strong posterior mesopleural and a strong central sternopleural bristle; pleura otherwise bare except for a few scattered minute setulae on mesopleura. Scutellum with the subapical pair of bristles about half as long as the strong apical pair.

Abdomen subopaque dark brownish black with violet iridescence; without segmental banding; the bristles moderate; grayish pollinose below posteriorly. Male with fifth tergite tapered and rounding apically, about half again as long as fourth which in turn is distinctly longer than third; clasper short and bent, with enlarged tip and prominent apical incision (fig. 2, c; plate VII, figure 1).

Legs opaque dark brownish black, the coxae, trochanters, and femora grayish pollinose; bristling very much reduced, fore femora practically bare; fifth tarsal segment twice as long as fourth in both sexes, apical bristles of fourth segment half as long as and appressed to the fifth segment; tarsal claws long and curved and pulvilli reduced as in the genus.

Wings brownish hyaline with brownish black veins, without markings; veins not undulating; costa not particularly thickened between apices of humeral cross-vein and tip of Sc; $R_{2+3}$ and $R_{4+5}$ not more closely approximated at apices in either sex; costa distad of tip of $R_1$ with even fringe of spinules about as long as thickness of costal vein, not interspersed with longer spines. Halteres brown at base, apex yellow.

Length—2.9 mm. (2.4-3.1); wing—3.2 mm. (2.9-3.5).

Holotype, ♀; allotype, ♂; paratypes, 3 ♂♂, 4 ♀♀; Akaka Falls, Hilo, Hawaii, March 5, 1946.

These specimens were taken in company with *Neoscatella warreni,* which they resemble superficially in size and color, and also *N. clavipes,* while resting on wet rocks in the swift stream above Akaka Falls. One damaged specimen from Akaka Falls, Oct. 24, 1931, F. X. Williams (about water), from the H. S. P. A. collection belongs here. This species is dedicated with pleasure to Dr. F. X. Williams.

**Apulvillus mauiensis** Wirth, new species

A large sub-opaque dark brownish black species, with strong ocellars, weak inner verticals; strong anterior dorsocentrals, one pair of strong acrostichals; costa without long spines; wing more deeply infuscated toward costa; and fourth tarsal segment with long bristles.

♂. Mesofrons shining iridescent black, lateral margins and ocellar tubercle pollinose black; the two pairs of fronto-orbitals, outer verticals, and ocellar bristles strong, the inner verticals very fine and reduced to about half the length of the outer. Face pollinose dark brown, median facial prominence broadly rounding but quite distinct; four pairs of facial bristles in a diagonal row extending ventro-laterad from prominence, the upper pair on the prominence minute, the others progressively larger, with the lateral pair rather strong; facial setulae short and fine; the oral margin fringed by a row of about ten short fine bristles. Cheeks grayish pollinose, with a moderately strong genal bristle and a broad sparse patch of fine setulae behind this to ventro-posterior margin of head. Antennae with third segment about a fourth longer than broad, grayish pubescent; second segment with a small subapical dorsal seta and a ventral apical fringe of setulae; arista stout at base, nearly twice as long as third segment, bare below, with strong pubescence above about three-fourths way to tip.

Mesonotum and scutellum shining black, faintly iridescent violet pollinose; three strong dorsocentrals (1:2); a pair of moderately strong presutural acrostichals (1:0). Mesopleura, pteropleura, and postnotum dark grayish brown pollinose, remainder of pleura gray pollinose; two strong notopleurals, a strong posterior mesopleural and a strong central sternopleural bristle, pleura otherwise bare except for a few scattered minute setulae on mesopleura. Scutellum with the subapical pair of bristles about half as long as the strong apical pair.

Abdomen subopaque dark brownish black with violet iridescence, without segmental banding, the bristle moderate; grayish pollinose below posteriorly. Fifth tergite markedly tapered and rounding pointed apically, about half again as long as fourth, which in turn is longer than third.

Legs subopaque dark brownish black, the coxae, trochanters, and femora grayish pollinose; bristling very much reduced, fore femora practically bare; fourth tarsal segment with a pair of ventral apical bristles half as long as and appressed to fifth segment; tarsal claws long and moderately stout; pulvilli very much reduced to two small pads hardly projecting beyond the bases of the claws; empodium large, nearly as long as the claws.

Wings brownish hyaline with brownish black veins, without markings, but the brownish microtrichiae denser toward costal margin deepening the infuscation there; veins not undulating; costa not thickened between apices of humeral cross-vein and tip of Sc; $R_{2+3}$ and $R_{4+5}$ not more closely approximated at apex; costa distad of tip of $R_1$ with even fringe of short spinules about as long as thickness of costal vein, not interspersed with longer spines. Halteres yellow.

Length—3.3 mm.; wing—3.6 mm.

Holotype ♂, Haipuaena, Maui, June 25, 1920, E. H. Bryan, Jr. Deposited in the B. P. Bishop Museum collection.

Closely related to *Apulvillus williamsi* from which it can be separated by the strong ocellar bristles, strong anterior dorsocentrals, and strong antesutural acrostichals. These characters would link the present species to *Neoscatella oahuense* Williams.

**Apulvillus bronneci** Malloch

*Apulvillus bronneci* Malloch, 1935, B. P. Bishop Mus. Bull. **114**: 198.

Three of Malloch's ♂ paratypes from Uapou, Marquesas Is., which were in the Bishop Museum collection, were examined through the courtesy of Mr. E. C. Zimmerman. The face of one of these is figured in profile (fig. 4, a). The most distinctive features of the insect are as figured by Malloch for the costal thickening of the wing and the distal tarsal segments. In addition the following notes can be added: The face is broad and slanting, and quite similar to that of *cheesmanae;* with the median prominence very faintly indicated, arising well up between the bases of the antennae; there are only two very small lateral facial bristles, and the fringe of bristles on the oral margin is not distinct.

**Apulvillus cheesmanae** (Malloch), new combination

*Chaetoscatella cheesmanae* Malloch, 1935, B. P. Bishop Mus. Bull. **114**: 199.

Three specimens (1 ♂, 2 ♀ ♀) from Faraura Valley, Hitiaa, Tahiti, Society Is., Nov. 17, 1928, A. M. Adamson, coll., from the Bishop Museum collection were examined and compared with Malloch's description. These bear a determination label apparently in Malloch's handwriting. They are clearly closely related to *bronneci,* and are here treated as congeneric, although, when more species of *Apulvillus* may become known, they might readily be segregated into a subgenus *Chaetoscatella* on the basis of the absence of long bristles on the fourth tarsal segment and the presence of long differentiated spines on the costa.

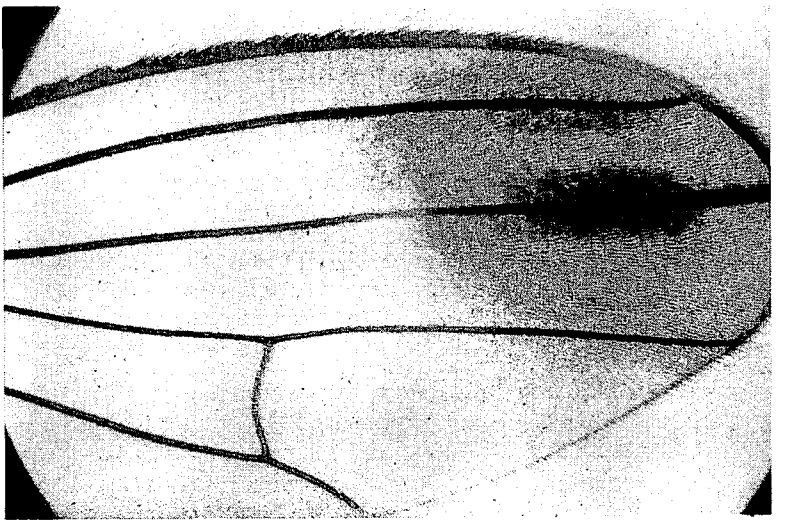

Figure 1. Wing of *Neoscatella kauaiensis.*

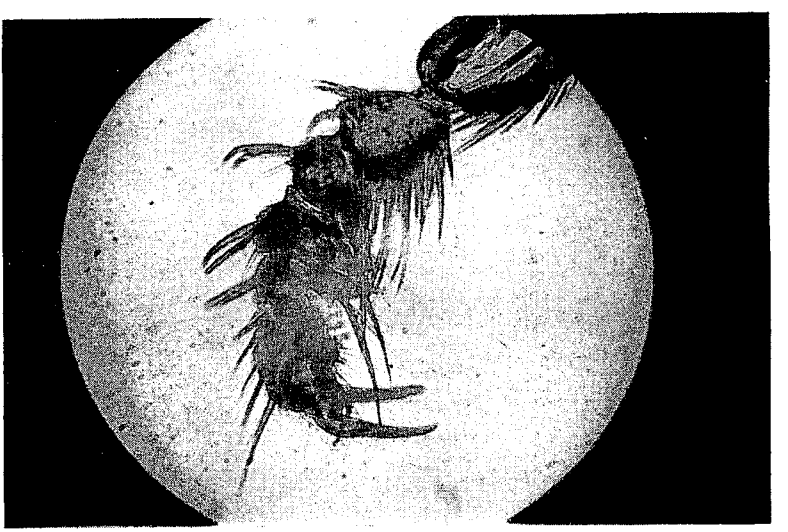

Figure 2. Fore tarsus of ♂ of *Neoscatella clavipes tenda,* enlarged.

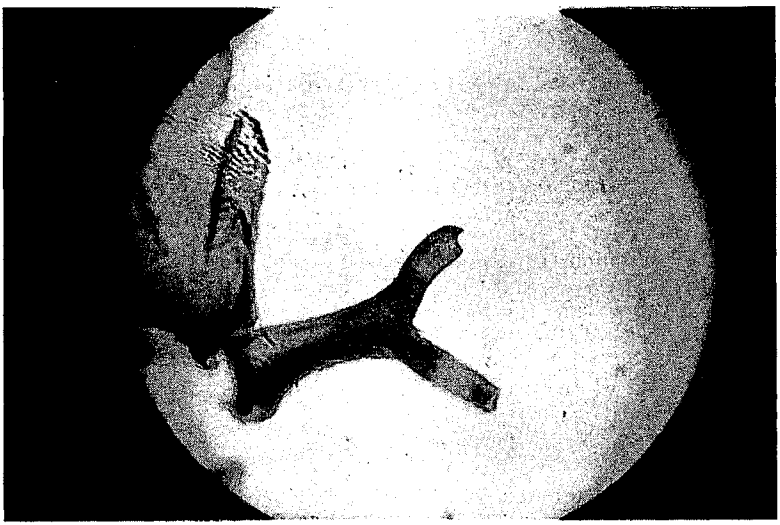

Figure 1. *Apulvillus williamsi,* ♂ clasper.

Figure 2. *Neoscatella oahuense,* ♂ clasper and aedeagal apodeme.

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