

**genitalia** (figs. 7, 8). Sternum 9 with very deep caudomedian excavation; tergum 9 tapering to rather narrow apex, apicolateral processes long and tapering to tips, distomedian margin between them with a small median notch. Basistyle with ventral root narrowly triangular, dorsal root long and slender; dististyle almost straight except for curved, pointed tip. Aedeagus with basal arms slender, divergent, basal arch to one-half of total length, distal portion broad with a square tip. Parameres with angular basal knob bent laterad, stem tapering to very slender tip curving laterad.

Holotype, female, Chibana, Okinawa, March 1959, C. Nibley, light trap (type no. 65055, USNM). Allotype, male, 1 mi. W. Shimabuku, Okinawa, August 1959, C. Nibley, light trap. Paratypes, 2 males, 9 females: 1 female, same data as holotype except Aug. 1959; 2 males, same data as allotype except September 1959; 4 females, Yaka, Okinawa, April and May 1959, C. Nibley, light trap; 3 females, Shirahama, Japan, 24 April, 19 May, and 26 May, 1955, P. Arnaud; 1 female, Shinhami, Chiba, Japan, 16 May 1955, P. Arnaud.

This species is most closely related to the Japanese *ponkikiri* Kono and Takahashi, which differs in having distal sensory tufts on antennal segments III-XV and has pale halteres. *Culicoides kibunensis* Tokunaga from Japan has a smaller antennal ratio of 1.3-1.4, and the pit on the third palpal segment has a small opening. We are naming this species after Paul Arnaud of the California Academy of Sciences in recognition of his important work on the *Culicoides* of Japan, Okinawa, and Korea.

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### PHLEBOTOMUS SANDFLIES FROM ANIMAL BURROWS IN EASTERN WASHINGTON

(DIPTERA: PSYCHODIDAE).<sup>1</sup>

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The most northern known occurrence of *Phlebotomus* in North America has hitherto been Modoc County in northern California

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(Fairchild and Hertig, 1957). The discovery by Harwood of four species in eastern Washington is thus quite unexpected. The purpose of this paper is to record the species discovered, to describe one of them as new, and to give notes on the ecological conditions under which the various species were found. It has seemed useful also to present short keys to both sexes of the four species. The present additions bring to ten the total of species and subspecies known from the United States.

The species discussed were collected within the Columbia Wildlife Refuge, U. S. Fish and Wildlife Service, near Othello in Adams County, Washington. They were trapped in mammalian burrows during a study of such locations as summer resting sites for mosquitoes. The trap employed has been previously described (Harwood and Halfhill, 1960).

Most of the burrows trapped were constructed by the yellow-bellied marmot, *Marmota flaviventris avara* (Bangs). However, a variety of other vertebrates invariably use such burrow sites; the droppings of bushy-tailed woodrats (*Neotoma cinerea occidentalis* Baird) and deer mice (*Peromyscus* sp.) were particularly in evidence. On one occasion a skunk was observed in one of the burrows trapped, and Oregon prairie rattle-snakes, bull snakes, and garter snakes have been obtained in summer, and hibernating in such locations.

*Phlebotomus* were by no means rare in burrows within the study area. Twenty-two burrows were more or less routinely trapped once a week during the summer of 1960. Of these, eighteen produced adult sandflies. Actual numbers obtained on a given night were generally low, averaging 4.57 adults per night of trapping in a total of 65 collections. A maximum of 52 were obtained from a single location in one night of trapping.

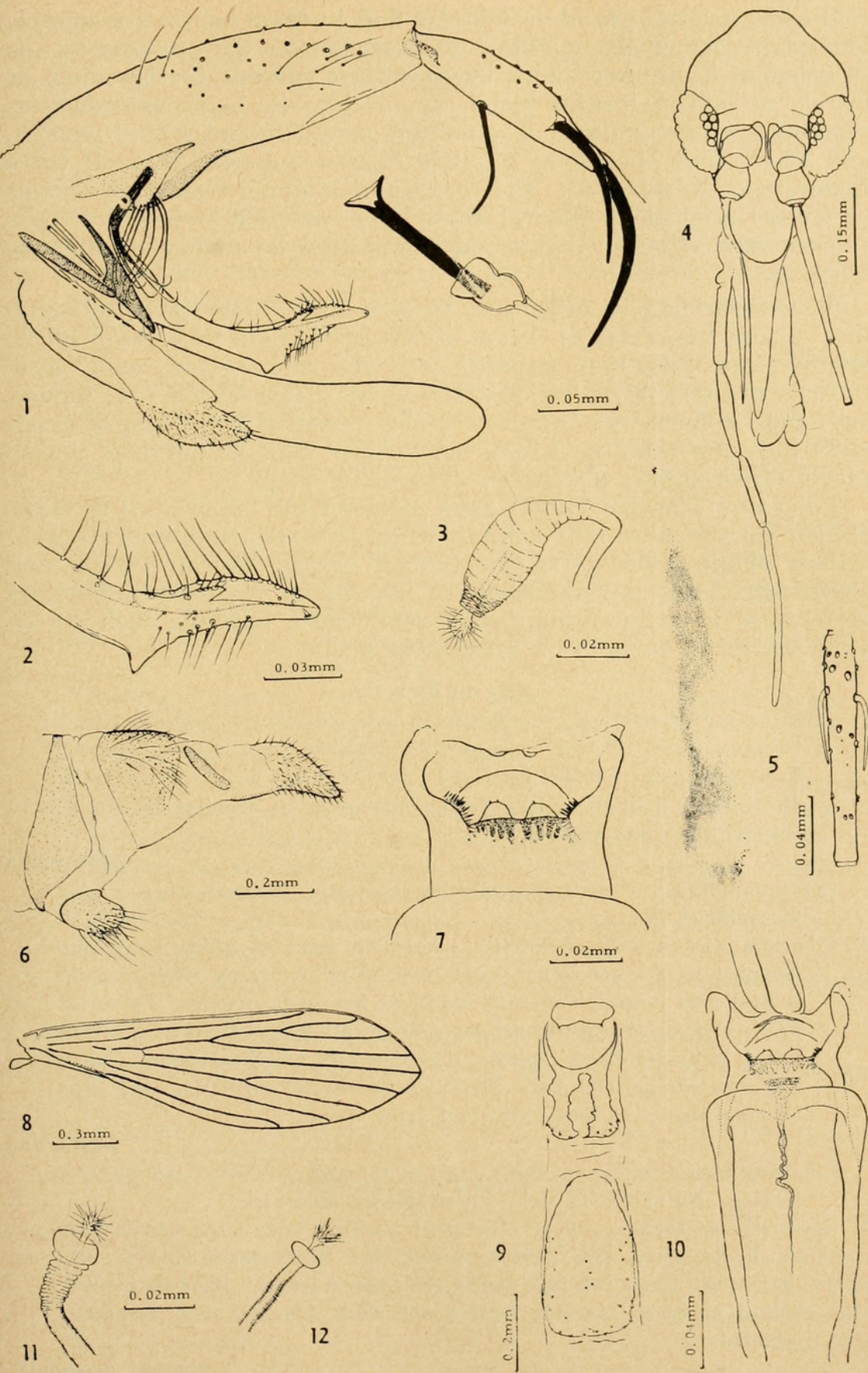
The seasonal span of adult activity has not been completely determined. The earliest collection consisted of two females of *P. oppidanus* obtained on 12 June 1960. Routine trapping ended 23 August, but four traps on 3 October yielded seven males, five of which were identified as *vexator occidentis*. Peak numbers for all sites were obtained on 12 July, and nearly as many the two succeeding weeks. *P. oppidanus* was the earliest species, followed the next week by *vexator occidentis* and *californicus*. Only four specimens of the new species were obtained in 1960, spanning the period of 26 July to 9 August. One specimen of the new species was obtained on 21 August 1959.

The association of sandflies with animal burrows in this area is obviously close, and suggests that all the local species of *Phlebotomus* as

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Figs. 1-10, *Phlebotomus aquilonius* n. sp. Fig. 1, male genitalia and sperm pump, slide 6894. Fig. 2, paramere, slide 6742. Fig. 3, spermatheca, drawn in phenol, slide 6727. Fig. 4, female head and appendages, slide 6864. Fig. 5, male, antennal segment IV, slide 6742. Fig. 6, female terminal abdominal segments, slide 6864. Fig. 7, female cibarium, enlarged, paratype, unnumbered slide. Fig. 8, female wing, slide 6864. Fig. 9, male first three sternites, slide 6742. Fig. 10, female cibarium, slide 6864. Fig. 11, *P. oppidanus*, spermatheca, slide 6813. Fig. 12, *P. vexator occidentis*, spermatheca, slide 6784.







well as a variety of local vertebrates find in these burrows a suitable habitat. Whether the sandflies are attracted to the burrows by the presence of a preferred host, by conditions suitable for breeding, or merely as daytime resting places in an otherwise harsh environment, remains to be determined. The finding of replete and gravid females, and of all four species in a single burrow suggests that all three factors may be involved. The capture of a single female of *vexator occidentis* is a timed-interval trap (Harwood, 1961) baited with a chicken also suggests that blood meals may be sought outside the burrows.

Since, according to Adler and Theodor (1957), the larvae of sandflies require free water as well as atmospheric humidity close to 100%, burrows, especially those situated near lakes and streams, would seem the only available breeding sites in the area. The occurrence of numerous adults in burrows in a relatively dry situation at the base of basalt cliffs indicates that the adults may utilize sites as daytime resting places which appear unsuitable as breeding sites.

Adler and Theodor (1957) have reviewed the importance of mammalian burrows as sandfly habitats wherever harsh environmental conditions obtain, such as in the Sudan, North Africa, Arabia, and Turkestan. They also discussed the importance of burrow-inhabiting vertebrates in maintaining *Leishmania*, which suggests such an inquiry should be made in the area under study.

#### KEY TO FEMALES

1. Cibarium with a comb of 18-20 fine teeth, a broad pigment patch and weak chitinous arch. Pharynx armed with flattened erect spines. Spermatheca with large rounded head and finely annulate body, the individual ducts about 3 times as long as the spermathecae, opening by a short common duct into vagina ..... **californicus**  
 Cibarium without a comb of numerous fine teeth. Pharynx with at most fine spinules at apex ..... 2
2. Cibarium with a pair of heavily sclerotized rounded bosses, each surmounted by a short spine; erect teeth about 8, strong ridge-like, the central pair largest, and with scattered fine teeth distally. There are also a number of long slender inwardly-pointing lateral teeth. Pharynx broad, well sclerotized, the apex with minutely spinulose ridges. Chitinous arch strong and flat. Spermathecae ovoid, wrinkled, with long terminal knob and long individual ducts ..... **aquilonius**  
 Cibarium with 4 horizontal teeth, erect teeth weak or absent, lateral teeth lacking. No chitinous arch. Spermathecae otherwise ..... 3
3. Spermathecae slender, tubular, the finely annulate body more slender than the ducts, which they join imperceptibly. Head small, oblate, wider than long. Ducts separate nearly their whole length. Pharynx slender, ridged at apex. Ascoids clearly exceeding ends of their respective segments ..... **vexator occidentis**



Spermathecae as above, but head as long as wide. The more coarsely annulate body as wide as the wider and longer ducts. Pharynx and cibarium as above. Ascoids clearly shorter than their respective segments

.....*oppidanus*

# KEY TO MALES

1. Style with three spines and a subterminal seta. Coxite with two separate groups of setae at base. Parameres with a small dorsal finger-like projection and a ventral triangular process. Lateral lobes moderately inflated. Eyes relatively small, cibarium with strong small pigment patch and strong chitinous arch

.....*aquilonius*

Style with 5 spines, the apical two paired; no subterminal seta .....2

2. Most proximal spines of style paired, at same level. Tuft on base of coxite of about 10 subequal setae not in a row. Parameres evenly tapered. Lateral lobes clearly shorter than coxites. Third antennal segment short, about two-thirds length of proboscis on intact head

.....*californicus*

Proximal spines not paired. Tuft on base of coxite of fewer unequal setae set in a row. Parameres clubbed. Lateral lobes clearly longer than coxites. Third antennal segment longer .....3

3. Ventral outline of parameres an even curve from base to apex, the enlargement of tip of paramere only on dorsal side. Aedeagus not over half length of paramere. Tips of genital filaments slenderly spear-shaped. Genital pump with deep narrow plunger. Ascoids short, not nearly reaching ends of their respective segments

.....*oppidanus*

Ventral outline of parameres not an even curve, sharply reversed before apex so that enlargement of tip of paramere is largely on ventral side. Aedeagus exceedingly slender, over half length of paramere. Genital filaments more slender, the preapical widening less pronounced. Genital pump with shallow cup-like plunger. Ascoids longer, nearly reaching ends of segments.

.....*vexator occidentis*

## *Phlebotomus californicus* Fairchild and Hertig

1957, Ann. Ent. Soc. America, 50(4):328, figs. 20-23. (♂, ♀; Ft. Yuma, Imperial Co., Calif.)

Othello, Adams Co., Wash. 20 ♂, 10 ♀, Harwood, from 5 burrows.

## *Phlebotomus oppidanus* Dampf

(Fig. 11)

1944, Rev. Soc. Mexicana Hist. Nat., 5(3-4):247-248, figs. 1-8, 14 (♀; San Jacinto, Mexico, D.F.). Barretto, 1947, Arq. Zool. Est. S. Paulo, 5(4):215. Vargas and Diaz Najera, 1953, Rev. Inst. Salub. Enf. Trop. Mexico, 13(4):312. Fairchild and Hertig, 1957, Ann. Ent. Soc. America, 50(4):330, figs. 26-29 (♂; Nuevo Leon, Mexico); 1959, *op. cit.*, 52(2):124.



Othello, Adams Co., Wash. 14 ♂, 44 ♀, Harwood, from 7 burrows.

This material represents a new record for the United States and a very considerable extension of range for the species. The Washington specimens differ slightly from Mexican examples, the males having the parameres slightly more clubbed, the females with spermathecae slightly larger, though the differences seem insufficient to warrant formal recognition of a named segregate. The type was taken at light, the specimens reported by Fairchild and Hertig (1957) in a cave.

***Phlebotomus vexator occidentis* Fairchild and Hertig**

(Fig. 12)

1957, Ann. Ent. Soc. America, 50(4):334, figs. 12-13 (♂, ♀: California, taken in light traps and *Citellus* burrows).

Othello, Adams Co., Wash. 36 ♂, 45 ♀, Harwood, from 9 burrows.

The nominate subspecies has been reported from various localities in the eastern United States (Fairchild and Hertig, 1957). Dampf (1944, p. 238) reported it also from Sonora, Mexico, a reference overlooked by us in 1957, but whether his specimens were *v. occidentis* or *v. vexator* is unknown. Several reports indicate that the eastern subspecies is primarily a reptile feeder, so it will be interesting to determine the host preferences of the western form.

***Phlebotomus aquilonius*, n. sp.**

(Figs. 1-10)

**Male.**—Wing length 1.6-1.8 mm, venation as figured. Whole insect pale, mesonotum but little darker than pleura. Abdominal setae erect, sparse, denser on hind margins of tergites. Upper anepisternal setae 3 to 5, lower mesanepisternals 2 to 4. Head and its appendages similar to female, but proboscis shorter and third antennal segment longer, the latter reaching well beyond end of second palpal segment. Ascoids simple, short, as figured, paired on all but last two segments, the terminal three segments but slightly shorter than last preceding. Palpal formula 1-(2-4)-3-5, the fifth longer than any two preceding segments but less than 2+3+4. Pharynx slender with rather strong transverse denticulate ridges at apex. Cibarium with minute lateral denticles, the chitinous arch strong laterally, obsolete in middle, lower and more rounded than in female. Genitalia as figured, the filaments about 3.5 times length of pump, their tips unmodified. First three sternites as figured. Legs short, the femora, tibiae and basitarsi of slide 6894 measuring, in millimeters, as follows: fore leg, 0.75, 0.8 and 0.45; mid leg, 0.7, 0.95 and 0.5; hind leg, 0.8, 1.15 and 0.7.

**Female.**—Wing length 1.9 mm, venation as in male. Color and vestiture as in male. Upper anepisternal setae 6 to 7, lower mesanepisternals 4 to 5. No setae on sides of eighth abdominal segment. Head and appendages as figured. Ascoids as in male, though slightly longer, paired on all but last segment, the terminal three segments much shortened. Pharynx broad and well sclerotized, with finely denticulate transverse ridges at apex. Cibarium as figured, the two rounded eminences in place of the usual horizontal teeth apparently with one or two short fine teeth at apex. Lateral teeth numerous, slender. Vertical teeth difficult to see



in the preparations, but seeming to be formed of about 8 transverse rows of 2 to 4 blunt overlapping heavily sclerotized teeth, shown as single stippled vertical bars in the figure. Spermathecae as figured, though in none of the preparations are the ducts clearly visible throughout. From what can be made out, the ducts appear to be several times as long as spermathecae, slender, and joining in a short common duct. Cerci as figured. Sternites as in male. Legs apparently as in male, though no specimen has a complete set.

*Holotype* male, slide 6894, Columbia Wildlife Refuge, Othello, Washington, Site 42, 26 July 1960, R. Harwood coll. This specimen has an extra small spine on one style basad of the median spine, not shown in figure.

*Allotype* female, slide 6727, Columbia Wildlife Refuge, Othello, Washington, Site 42a, 9 Aug. 1960, R. Harwood coll. This specimen is the only one that shows the spermathecae at all well.

*Paratypes*, same locality and collector, 3 males, 21 Aug. 1959, 26 July and 9 Aug. 1960; 2 females, 21 Aug. 1959 and 26 July 1960.

Holotype, allotype to be deposited in the U.S.N.M. Paratypes are in the authors' collections.

This species seems most nearly related to the *vespertilionis* group and the male will key out to *P. vesiciferus* F. & H. in Fairchild and Hertig (1958). This sex differs from *vesiciferus* in the presence of a small dorsal lobe on the paramere and a double tuft of setae on the base of the coxite, as well as in other details. The female of the present species comes nearest *P. viriosus* F. & H., but differs considerably in the shape of spermathecae and especially in the very different cibarium. It differs from all other members of the *vespertilionis* group in the shorter third antennal segment, smaller eyes and relatively longer fourth palpal segment, but shares with them the inflated lateral lobes, similar wing venation, and generally similar genitalia.

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