Xenopsylla Fleas of the Hawaiian Islands (Siphonaptera: Pulicidae)

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There are two known species of fleas representing the genus *Xenopsylla* in the Hawaiian Islands. Of these, *X. cheopis* Rothschild is predominant, and undoubtedly the most efficient vector of plague within these islands (1)[2], as it has proven to be elsewhere.

In 1932, Jordan (3) erected a new species, *X. hawaiiensis,* to hold some fleas which were among a series he received from Dr. C. R. Eskey, U. S. Public Health Service, and Dr. H. R. Hagan, University of Hawaii. These fleas were pooled from rats (*Rattus hawaiiensis*) taken at Honokaa, Hawaii, and on Maui (exact locality not indicated). Jordan (3, p. 264) recognized in his original description of *X. hawaiiensis* that it was possibly only a geographical variety of *X. vexabilis,* a species he described from one pair in 1925 (2). However, in a recent letter (October, 1945) to E. C. Zimmerman, Curator of Entomology, B. P. Bishop Museum, Honolulu, Dr. Jordan indicated that in his opinion *X. hawaiiensis* is a distinct species closely allied to an Australian species—undoubtedly referring to *X. vexabilis* of that country.

After studying many topotypic specimens of *X. hawaiiensis,* the writer considers it to be a synonym of *X. vexabilis.* This view is elaborated upon in the following discussion and accompanying illustrations.

Foremost among the identifying features of members of the genus *Xenopsylla* are the spermatheca in the females, sternite IX and the terminal sclerite of the phallosome of the male genitalia. In Jordan's original description of *X. vexabilis* the spermatheca is not illustrated, but is included for comparison in his original descriptions of *X. hawaiiensis* (3, p. 265). It is noted in these illustrations that the only apparent difference in the two spermathecae is that the upper ventricose portion of the tail is collapsed in *X. vexabilis* but not in *X. hawaiiensis.* In the majority of topotypic females studied by the writer, of *X. hawaiiensis,* the spermatheca had this portion collapsed—a condition probably attributable to the methods of preserving the insect and/or to the subsequent process in preparing a permanent slide. The amount of pigmentation in the tail of the spermatheca is at the same level in both species, as is the amount of extension of the base of the tail below the body.

In regard to males of these two species their identity is likewise specifically the same. For many years the basic taxonomic distinc-

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[2] Figures in parentheses refer to the literature consulted, which is listed at the end of this paper.

tion between male members of the genus *Xenopsylla* has been the morphology of the penal tube and the terminal sclerite of its phallosome. Unfortunately these structures do not lend themselves well to a written analysis, and should be illustrated to insure exact identification. This has been done in Jordan's original descriptions for both *X. vexabilis* (2, fig. 9) and *X. hawaiiensis* (3, fig. 19). In comparing the writer's illustration of these structures (fig. 1, *a*) of topotypic males of *X. hawaiiensis* with those by Jordan for *X. vexabilis* and *X. hawaiiensis,* it is apparent that all three are identical.

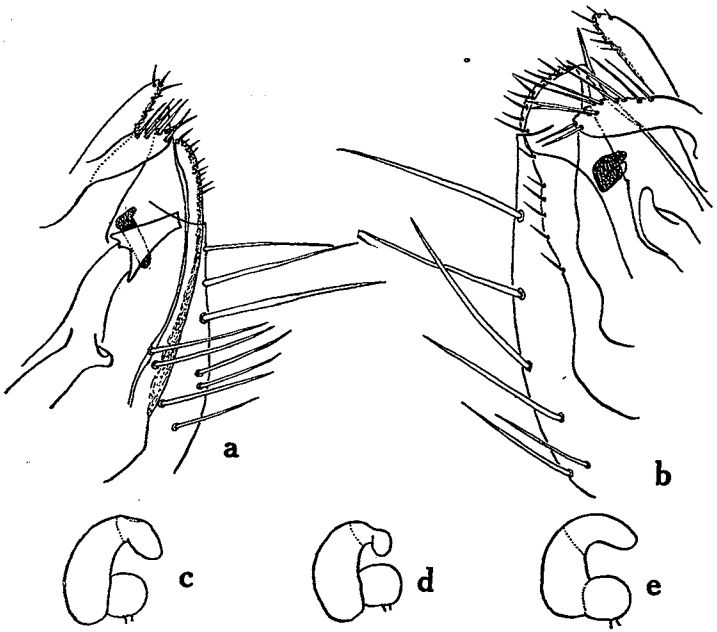

Figure 1.—Details of *Xenopsylla.*

a. *Xenopsylla vexabilis,* male genitalia.
b. *Xenopsylla cheopis,* male genitalia.
c. *Xenopsylla vexabilis,* female spermatheca.
d. *Xenopsylla vexabilis,* female spermatheca.
e. *Xenopsylla cheopis,* female spermatheca.

Particularly important is the exact identity in all three of the short dorsal tooth, with a longer ventral tooth of the ejaculatory duct, and the absence of a semi-detached "dagger" on the terminal sclerite of the phallosome (as is present in *X. cheopis* for instance, fig. 1, *b*). The comparison of other components of the genitalia, i.e. sternite IX, P^1 and P^2 of the clasper, also shows a definite similarity.

The chaetotaxy of the body segments and appendages of *X. vexabilis* was dealt with briefly by Jordan in his original description of

this species, but was discussed extensively on a comparative basis in his description of *X. hawaiiensis*. For ease of comparison, the writer has prepared a table from this description, and from topotypic specimens on hand of *X. hawaiiensis*, showing the relationship of the number of bristles present on the body segments or appendages for this species and on the corresponding ones for *X. vexabilis*.

Table 1. Comparative chaetotaxy of **X. hawaiiensis**, and **X. vexabilis.**

Segment or appendage	Sex	**X. hawaiiensis** (after Jordan)	Topotypic **X. hawaiiensis**	**X. vexabilis** (after Jordan)
Outer lateral surface of hindtibia	♂ ♀	8 to 11	8	7 to 9
Subventral, lateral outer surface of hindtibia	♂	1 to 4	3	2
	♀	4 to 5	3	2
Outer surface of hindtarsus I	♂ ♀	3 to 5	4	3 to 4
Outer surface of sternite VIII	♂	14 to 17	16	13, or fewer
Outer surface of tergite VIII	♀	27 to 33	32	19 (28 to 30*)
Metepimerum	♂ ♀	12 to 14	12	8 to 11
Tergite I	♂ ♀	7-10 or 6-7	7–7	5–6 or 6–6
Tergite II	♂ ♀	15 to 17	15	14 to 15
Tergite III	♂ ♀	16 to 17	16	14 to 15
Sternite III	♂	8 rarely 7	8	6
Sternite IV	♂	8 rarely 7	8	6
Sternite V	♂	7 to 9	7	6
Sternite VI	♂	8 to 10	9	6
Sternite VII	♂	9 to 10	10	6
Sternite III	♀	8 to 10	9	6
Sternite IV	♀	9 to 10	9	7
Sternite V	♀	10	10	8
Sternite VI	♀	10 to 13	12	8
Sternite VII	♀	10 to 12	12	(10*)
P^1 of clasper	♂	6	6	5 or 6
P^2 of clasper	♂	6	6	?

* Number given in original description.

The efficacy of using a descriptive analysis of the chaetotaxy of body segments and appendages for the specific identification of many fleas is a matter of conjecture. The arrangement and number of bristles on certain structures may be fairly constant, whereas on others they may be variable. The differences noted in the above table do not specifically separate *X. hawaiiensis* from *X. vexabilis*, but indicate variability among individuals that actually constitute a single species.

It is noteworthy that *X. hawaiiensis* was not included in Jordan's key to the *Xenopsylla* (4), which was adopted for use in determining members of the genus which are known to be vectors, or potential vectors, of plague. Eskey (1, p. 53) definitely demonstrated

that *X. hawaiiensis* (per se) is capable of transmitting the bacillus of plague as well as being able to subsist for some time on human blood. In view of the fact that Eskey actually was dealing with *X. vexabilis* these findings are of greater importance because of the known wide distribution of this species. It is important that public health workers of the Hawaiian Islands dealing with plague surveys be cognizant of Eskey's findings, and recognize that *X. vexabilis* is not a flea endemic to these islands but actually an exotic species, as is *X. cheopis,* and should be considered with some suspicion in the dissemination of plague. As Eskey (id.) has shown, *X. vexabilis* apparently retains most of its host specificity in the Hawaiian Islands, being found in greater abundance on rats of urban areas, namely *Rattus hawaiiensis.* Pooled rats of this urban species have repeatedly been shown to be naturally infected with the plague bacillus, as have autopsied rats found dead from unknown causes.[3]

The distribution of *X. cheopis* within the Hawaiian Islands parallels its distribution in warmer climates elsewhere in the world. As mentioned previously, it is the predominant species of the genus in these islands, but unlike *X. vexabilis* is found in equal abundance on most species of rats present. *X. cheopis* is easily separated from *X. vexabilis.* The spermatheca of female *X. cheopis* (fig. 1, *e*) has the upper portion of the tail less ventricose than in *X. vexabilis.* Also the base of the tail of the spermatheca in the former species does not protrude beyond its body as it does in the latter species. In male specimens the terminal sclerite of the phallosome (paramere of authors) in *X. vexabilis* is narrow and attenuated, and without a semi-detached "dagger," whereas in *X. cheopis* (fig. 1, *b*) this sclerite is very broad and does have the semi-detached "dagger." The two species can also be distinguished in that sternite IX is scleritized ventrally in *X. vexabilis* and not so in *X. cheopis.*

The writer wishes to acknowledge his appreciation to E. C. Zimmerman of the Bishop Museum for his kindness in the loan of topotypic specimens of *Xenopsylla hawaiiensis* Jordan, and the use of the facilities of his laboratory.

REFERENCES

1. Eskey, C. R., 1934, "Epidemiological Study of Plague in the Hawaiian Islands." U. S. P. H. S. Bull. 213: 1-70.
2. Jordan, Karl, 1925, "New Siphonaptera." Novitates Zoologicae, 32: 96-112, text fig. 9.
3. ———, 1932, "A new *Xenopsylla* from Hawaii." Novitates Zoologicae, 38: 264-266, text figs. 19-22.
4. ———, 1943, chapter on Siphonaptera in "A Handbook for the identification of Insects of Medical Importance," John Smart. British Museum (Natural History), London, pp. 202-223, text figs. 128-143.

[3] The reader is referred to reports of the Director, Division of Rodent Control, Board of Health, Territory of Hawaii.