

***Dermatophagoides pteronyssinus* (Trouessart)  
and Other Acarina in House  
Dust in Hawaii<sup>1,2</sup>**

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House dust is a ubiquitous material composed of many different substances such as animal dandruff, plant debris, food particles, arthropods, fibers, molds, bacteria, soil, etc. It is reported to be one of the most important causative antigens of bronchial asthma and allergic rhinitis (Miyamoto, *et al.*, 1968). Since the discovery of a specific allergen in house dust almost 5 decades ago (Kern, 1921; and Cooke, 1922), various investigators in different parts of the world have sought the causative agent. Many species of acarines were found; of which species of *Dermatophagoides* were most common (Oshima, 1964; Voorhorst, *et al.*, 1963; Fain, 1966 and 1967; Spieksma and Spieksma-Boezeman, 1967; Miyamoto, *et al.*, 1968; Maunsell, *et al.*, 1968; and Pepys, *et al.*, 1968).

The house-dust mite, *Dermatophagoides pteronyssinus* (Trouessart), is considered by many workers to be responsible for the major antigenic component of house-dust allergen (Voorhorst, *et al.*, 1963 and 1967; Spieksma and Spieksma-Boezeman, 1967; Maunsell, *et al.*, 1968; and Pepys, *et al.*, 1968); however, other species of *Dermatophagoides* commonly found in house dust have been shown to have antigenic substance similar to that of *D. pteronyssinus* (Miyamoto, *et al.*, 1968). Skin tests with extracts made of laboratory reared *D. pteronyssinus*, *D. farinae* Hughes and *D. culinae* De Leon have revealed that most people who are atopic to house dust are also atopic to these mite extracts (Voorhorst, *et al.*, 1967; Spieksma and Spieksma-Boezeman, 1967; Maunsell, *et al.*, 1968; Miyamoto, *et al.*, 1968; and Pepys, *et al.*, 1968).

Hawaii has an unusually high incidence of asthma and other allergic diseases of unknown etiology (Myers, 1961). Some of these allergic diseases maybe due to *Dermatophagoides*, for a species, *D. schereemetewskyi* Bodganow, was recovered as early as 1959 in Honolulu, Hawaii from dust taken from a house of an allergic patient (Haramoto, 1961). In light of the medical significance of the various species of *Dermatophagoides*, this study was undertaken to determine the distribution and abundance of *Dermatophagoides* as well as other acarines in house dust in Hawaii.

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## PROCEDURE

A quantitative and qualitative study of the acarine fauna in house dust was carried out from July 1968 to February 1969. Samples of house litter were collected monthly with vacuum cleaners from 5 houses each in Manoa and Waikiki, Oahu. In addition, samples were obtained at least once during the 8-month period of study from 30 different houses on Oahu, Kauai, Maui and Hawaii. These samples in most instances originated from houses of patients suffering from allergic diseases of unknown causes.

Since the material collected with vacuum cleaners varied so widely in composition and weight, only 5 g of the finer particles of each vacuum litter sample that passed through a 2.0 mm mesh sieve were processed further for acarines. Each 5 g sample was placed in a 0.088 mm mesh sieve, covered, and then sifted for 1 hour with a shaking machine. The remains in the sieve were transferred into 100 ml of a 5% sodium chloride solution, in which most of the acarines could be separated since they floated to the surface. This solution was centrifuged for 4 minutes at 600 rpm for separation of the acarines from the debris. The supernatant was used for making population counts of acarines.

Due to the nature of house dust, the tedious processing technique, and the great abundance of acarines, it was found to be extremely difficult to count all of the acarines. Therefore, an aliquot sampling method was used. While continuously stirring the supernatant, a 10 cc sub-sample was withdrawn with a pipette and distributed equally into a 4-compartmented petri dish. The mites were counted under a dissecting microscope with 60 × magnification. Unfamiliar acarines were mounted in Hoyer's medium on slides for critical examination under a compound microscope.

## RESULTS

*Dermatophagoides* was found in all house dust samples obtained from the islands of Hawaii, Kauai, Maui and Oahu. Two species of *Dermatophagoides* were found to be well established in house dust in this State. *D. pteronyssinus* was present more frequently and in greater numbers than *D. farinae*. In one of these 5 g samples there were 4,390 larvae, nymphs and adults of *Dermatophagoides*. Although reported from Hawaii earlier, *D. schereemetowskyi* was not found during this study.

Out of the 10,613 acarines recovered from the monthly samples of house dust from Manoa and Waikiki, Oahu 7,995 or 73.3% of them were *D. pteronyssinus* and *D. farinae*. The former species was abundant in all of the houses in both areas during the 8 months from July 1968 to February 1969. The latter species was less widely distributed and less abundant than *D. pteronyssinus*. *D. farinae* was especially numerous in 2 of the houses

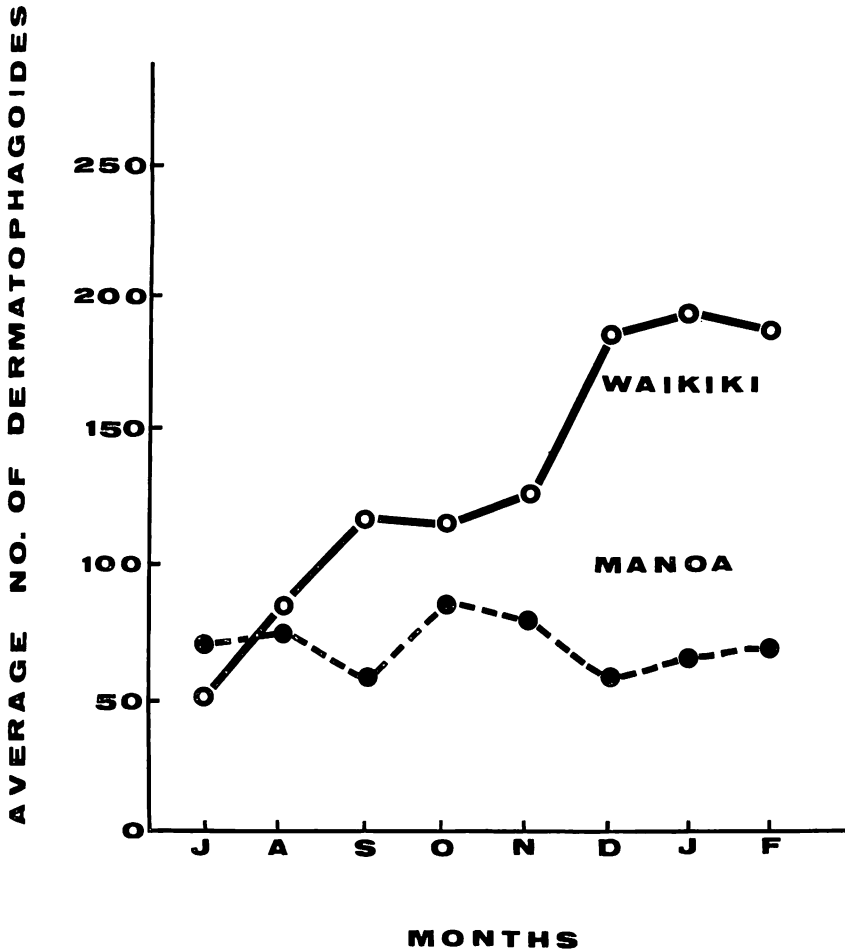


FIG. 1. *Dermatophagoides* populations in house dust in Manoa and Waikiki, Oahu from July 1958 to February 1969

in Waikiki, but in these also, *D. pteronyssinus* outnumbered it by as much as 4 to 1.

Except in July 1968, the population of *Dermatophagoides* in the 5 houses in Waikiki was much higher than in those in Manoa during the subsequent 7 months (Fig. 1). The population density of *Dermatophagoides* in Waikiki increased from 50.0 in July 1968 to a high of 193.8 individuals per 10 cc sub-sample in January 1969, while it remained at about the same density, 68.9 individuals per 10 cc, during the same 8 months in Manoa. By the final month of sampling, February 1969, the *Dermatophagoides* population was about 3 times higher in Waikiki than in Manoa.

House dust samples from carpeted houses yielded significantly more *Dermatophagoides* than those from uncarpeted ones. Also, in houses in which only certain rooms were carpeted, the carpeted rooms had more *Dermatophagoides* than those that were not carpeted. In one such house, 593 specimens were obtained in 2 minutes of vacuuming with a small hand cleaner from the carpeted living room and less than 10 from the uncarpeted kitchen and bedroom.

Besides the 2 species of *Dermatophagoides*, there were many other species of acarines in house dust. Sixty-five species representing 24 families were encountered in house dust from Manoa and Waikiki. Many of them were represented by less than a dozen specimens and were recovered only once from 1 or 2 of the houses during the 8-month period of study. These such as the species of tetranychoid and oribatids are not acarines that normally inhabit house dust but undoubtedly were present fortuitously. However, there were a few species such as *Tyrophagus putrescentiae* (Schränk), *Glycyphagus domesticus* (De Geer), *Suidasia medanensis* Oudemans and *Blomia* sp. that competed with *D. pteronyssinus* and *D. farinae* for the same food or niche. The populations of these species were much higher in Manoa than in Waikiki. They increased in abundance each month in Manoa, while they remained about the same density throughout the 8 months in Waikiki. Therefore, when the numbers of these acarines were considered in addition to *D. pteronyssinus* and *D. farinae*, the total acarine population in house dust in Manoa was not significantly different from that in Waikiki. About 35% of the acarines in the Manoa samples were species other than of *Dermatophagoides*, whereas less than 10% were other than of *Dermatophagoides* in the Waikiki samples.

In addition to these species, there were several acarines representing predaceous families, such as *Cheyletus malaccensis* Oudemans, *Cheyletus eruditus* (Schränk), *Cheyletogenes ornatus* (Canestrini and Fanzago), *Mexeches hawaiiensis* (Baker), *Grallacheles bakeri* De Leon, *Blattisocius dentriticus* (Berlese) and *Typhlodromus jackmickleyi* De Leon which preyed on *D. pteronyssinus*, *D. farinae* and the other species of acarines in house dust. These predaceous species represented 3.0% and 6.6% of the total acarines collected in house dust from Waikiki and Manoa respectively.

#### DISCUSSION

Since Hawaii is subtropical and oceanic in location, the temperature in most of the residential areas rarely drops below 18°C. As a result, acarines that have become established in house dust are never subjected to severe temperatures. Thus, they have ample opportunity to reproduce the year around. However, temperature and humidity do vary from area to area, and within each area, it is much cooler and wetter during the winter than summer. In addition, Waikiki which is located about 3 miles

from Manoa has a much drier and warmer climate than Manoa. The mean relative humidity and temperature readings in one of the houses in Manoa during July–August 1968 were 61.5% and 27.9°C and during January–February 1969 were 68.1% and 23.4°C, whereas in Waikiki they were 48.0% and 31.1°C during July–August 1968 and 57.4% and 25.9°C during January–February 1969. The total rainfall during July 1968 to February 1969 was 62.1 inches in Manoa and 26.9 inches in Waikiki with 4 to 8 times more falling during January–February 1969 than during July–August 1968. These differences in climate between areas and seasons seem to greatly influence the abundance and species complex of acarines in house dust. Such species as *S. medanensis*, *G. domesticus*, *T. putrescentiae* and *Blomia* sp. which were shown to thrive better under high humidity conditions in laboratory experiments were much more abundant in Manoa than in Waikiki, especially during December 1968 to February 1969 when rainfall averaged more than 12.0 inches per month. *D. pteronyssinus* and *D. farinae* seemed to prefer a much drier environment than the above-mentioned species, but they too were much more abundant in Waikiki during December 1968 to February 1969 when rainfall averaged 5.8 inches per month than during July to November 1968 when it averaged less than 2 inches per month. The occurrence of high populations of these acarines in house dust during the winter is of considerable significance because the incidence of asthma and allergic diseases due to unknown causes is also highest during this season (Myers and Price, 1954).

Besides the climatic factors, biotic factors such as predators appear to influence the populations of acarines in house dust. The lower and fairly stable population of *Dermatophagoides* in Manoa may have been due to the presence of greater numbers of predatory mites in houses in this area than in Waikiki. However, interspecific competition for food and niche from other acarines may have been involved, for such species as *T. putrescentiae*, *G. domesticus* and *S. medanensis* were especially numerous in house dust in Manoa.

One of the most important factors that appears to favor population buildup of acarines within houses is carpeting. Regardless of whether the carpets were of wool, cotton, or synthetic fibers, house dust from carpets invariably had a higher population of acarines than those from floors without carpeting or with other types of coverings. Although there was no indication that acarines did actually feed on the materials used in making carpets, carpets seemed to provide an excellent protective niche and suitable microenvironment for them. Large amounts of animal dandruff, fungi, bacteria, scraps of human and pet foods, plant debris, etc. readily accumulate between the fibers of carpets. Apparently, some of these substances serve as food for acarines that inhabit house dust. If this is so, then older carpets not cared for would have greater amounts of accumulated house dust and should support a higher population of acarines than newer ones

or those cleaned and washed often. Data obtained during this study tend to support this hypothesis.

#### SUMMARY

House dust in Hawaii is heavily populated with many kinds of acarines. Some 65 different species representing 24 families were found in house dust from Manoa and Waikiki, Oahu. Of these, *Dermatophagoides pteronyssinus* (Trouessart) was present in every house dust sample obtained from the islands of Hawaii, Maui, Kauai and Oahu. Specimens of this species and *D. farinae* Hughes comprised about 75% of all the acarines found in house dust. An average of 68.8 and 131.0 specimens of *Dermatophagoides*, predominantly of *D. pteronyssinus*, was recovered each month per 10 cc sample from each house in Manoa and Waikiki respectively. The maximum number of *Dermatophagoides* in a 5 g of house dust was 4,390. This density is much higher than any reported in house dust from other parts of the world.

Other species of acarines found in large numbers in house dust were *Tyrophagus putrescentiae* (Schrank), *Glycophagus domesticus* (De Geer), *Suidasia medanensis* Oudemans, *Blomia* sp. and predatory species of the families Cheyletidae, Phytoseiidae and Ascidae. These acarines were much more numerous in the house dust samples from Manoa than those from Waikiki. However when the numbers of these acarines were considered in addition to the numbers of *D. pteronyssinus* and *D. farinae*, the total acarine population in house dust in both areas was not significantly different. It averaged 132.7 acarines per 10 cc sample per house per month. The acarine population was much higher during December 1968-February 1969 than during July-November 1968, and was much higher in house dust from carpeting than from other sources.

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