

HOST-FLEA RELATIONSHIPS OF PAYNE COUNTY, OKLAHOMA

By

JOHN FRANCIS REINERT

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1962

Submitted to the Faculty of the Graduate School of  
the Oklahoma State University  
in partial fulfillment of the requirements  
for the degree of  
MASTER OF SCIENCE  
August 1965

NOV 23 1965

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Thesis Approved:

*A C Howell*

\_\_\_\_\_  
Thesis Adviser

*R R Walton*

*L Bush*

*J M Boyce*  
\_\_\_\_\_  
Dean of the Graduate School

## PREFACE

Fleas vary in importance as vectors of diseases of man and animals. It is therefore necessary to determine what species are prevalent in an area in order to appraise the possible disease significance.

While a member of the U. S. Army, it was my privilege to be assigned to Oklahoma State University for a course of instruction leading to the degree of master of science. Little work had been done on the flea fauna in this area of Oklahoma previous to the material presented in this paper. It is hoped this material will eliminate some of the gaps in the larger scheme, the fleas of Oklahoma.

I wish to thank my major adviser, Dr. D. E. Howell, for his encouragement, guidance, and assistance, and the other committee members, Dr. R. R. Walton and Dr. E. D. Besch, for their guidance in the preparation of this paper.

I also wish to acknowledge Dr. Cluff E. Hopla for his kind permission to examine flea specimens and records in the Oklahoma University museum, and Dr. D. E. Howell for his assistance in examining the fleas in the Oklahoma State University medical entomology collection.

My sincere thanks are expressed to my wife, Mary Helen, who labored many long hours typing the manuscript.

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LIST OF COLLECTORS

A. K. -- Abbott Kagan  
C. A. S. -- Clarence A. Sooter  
D. A. G. -- Dean A. Garrett  
D. E. B. -- Douglas E. Bryan  
D. E. H. -- D. E. Howell  
D. E. R. -- Daniel E. Russell  
E. E. I. -- E. E. Ivy  
E. R. B. -- Erwin R. Beilfuss  
G. C. R. -- George C. Rogers  
H. W. -- Harry Whitaker  
J. F. R. -- John F. Reinert  
K. C. E. -- Kary C. Emerson  
L. B. -- L. Barnard  
M. W. -- Major Willhite  
R. B. -- Robert Brown  
R. B. J. -- Russell B. Johnson  
R. E. P. -- Ray E. Parsons  
R. G. P. -- Richard G. Price  
R. J. B. -- Robert J. Baker  
V. B. C. -- Oklahoma State Univ. Vet. Bldg. Clinic  
V. H. Z. -- Victor H. Zeve  
W. T. N. -- W. T. Nailon

## INTRODUCTION

### Ecology and Life History

Oklahoma occupies an overlapping area between the Eastern and Western United States, and the flea and animal fauna correspond more or less with this condition. The ecology of fleas cannot be divorced from the ecology of their host animals; therefore, an understanding of the host and its habits must be studied also. Some fleas remain primarily on the host, while other species of fleas seldom leave the host's nest.

Fleas undergo a complete metamorphosis. The gravid female lays small batches of oval eggs in the host's nesting material or directly on the host. Those eggs laid on the host usually fall to the ground or into the nest of the host. Blood meals are required by the female for the development of the eggs.

A slender, apodous, eruciform larva bearing sparse, long setae on each body segment emerges from each egg. The larva, during its three instars, is equipped with chewing mouth parts and is quite active, moving about with a twisting motion. The larva feeds in the nest upon organic matter, dried blood, and the host's feces. The third instar larva makes a silken cocoon, with particles of debris adhering to the outside, within which it transforms into an exarate pupa.

The time of emergence of the adult varies with each species and also with the climatic conditions. Both adult male and female fleas

have piercing sucking mouth parts and require blood meals for survival, but may go for extended periods in a starved condition. The adults usually mate on the host animal.

Fleas, the adult and immature stages, are sensitive to extremes of humidity and temperature. This is probably why these parasites tend to occur in large numbers on species of mammals and birds that live in burrows, or whose nests are well protected from extreme weather conditions.

#### Medical and Economic Importance

Fleas not only cause annoyance to man and his domestic animals but also are potential carriers of disease. The most important diseases transmitted to man, by these parasites, are plague and murine typhus. Tularemia and several parasitic tapeworms are also transmitted to man by fleas.

Plague, in the United States, caused by Pasteurella pestis (Lehman and Neumann), is transmitted through the bite of infected fleas and is classified into two epidemiological types, sylvatic and urban. Sylvatic plague is normally transmitted by fleas between wild rodents. Man may become infected when he comes in contact with the fleas from infected animals, as is the case of hunters and persons living in rural areas. In cities where people have close contact with domestic rats and their fleas, urban plague is the type usually contracted.

Murine typhus, caused by Rickettsia typhi (Wolbach and Todd), is spread between rodents by infected fleas, lice, and mites. No apparent illness is caused by the organism in the rats or fleas, but when man becomes infected with the organism he shows clinical symptoms. The



infective organism is transmitted to man through the flea feces which may enter the body through skin abrasions.

Man may become infected with tularemia, caused by Pasteurella tularensis (McCoy and Chapin), in several ways other than through the bite of infected fleas. The most common methods of transmission are through ingestion, contact with infected animal tissue, and through animal bites. Fleas can remain carriers of the organism for over a month, but are probably not the most important vector of the disease to man.

The intermediate host of the common tapeworm of dogs and cats, Dipylidium caninum (Linnaeus), is a flea. The flea larva ingests the tapeworm eggs which reach the cysticeroid stage by the time the flea becomes an adult. Man becomes infected when he accidentally ingests whole or crushed infected fleas.

Other tapeworms, such as Hymenolepis diminuta (Rudolphi) and Hymenolepis nana Siebold, parasitize rats, mice, and man and may have fleas as their intermediate hosts.

Other diseases and conditions caused or believed to be caused by fleas are salmonellosis, fleabite dermatitis, entomophobia, myxomatosis, trypanosomiasis, canine filariasis, and exsanguination. Even though fleas are potential vectors of many diseases, it should be kept in mind that they differ greatly in their ability to transmit these diseases to man.

#### Flea Anatomy, as Applied to Systematics

Head: The flea's head is separated into a preantennal region and a postantennal region by the antennal fossae, a groove in which the three

segmented antenna lie. The preantennal region is further divided into a lower gena and an upper frons. The number and arrangement of bristles on these areas are of taxonomic importance. A small notch at the anterior margin of the frons is termed the frontal tubercle. The gena may have one or more spines along the ventral margin called the genal ctenidium; these spines vary in shape and may be present or absent. The ctenidium may be horizontal or obliquely vertical. The genal process is the posterior prolongation of the gena. An eye, with varying degrees of pigmentation, located in front of the antenna may be present or absent.

From anterior to posterior, the mouth parts consist of a tiny labrum, a pair of four segmented maxillary palpi, a stylelike epipharynx, a pair of serrated stiletto-like maxillary laciniae, a pair of broad, usually triangular, maxillae, and a pair of varying segmented labial palpi.

The postantennal region of the head is armed with varied numbers and arrangements of bristles that are used in differentiating between several species. The marginal row is a row of bristles or setae along the posterior margin of this region.

Thorax: The thorax is divided into three segments, the prothorax, mesothorax, and the metathorax. Dorsally, each segment bears an undivided notum. Each notum is armed with a characteristic arrangement of bristles. Frequently, the pronotum has a row of spines along the posterior margin termed the pronotal ctenidium.

Legs: Each thoracic segment bears a pair of legs. Each leg is composed of a large, flat coxa, a small trochanter, a thickened femur, an elongated tibia, and a five segmented tarsus. The number of setae

on the outer lateral surface of the fore femur is taxonomically important. The fifth tarsal segments bear several pairs of bristles along the inner lateral margins, the lateral plantar bristles, and a pair of apical claws.

**Abdomen:** The abdomen is usually considered to be composed of 10 segments, with the first 7 segments represented by dorsal tergites and ventral sternites. When counting the sternites, it must be remembered that the first sternite is missing so that the first visible one is sternite II. The number of rows of bristles and the presence or absence of dorsal spines on the tergites is of importance. Usually one or more conspicuous antepygidial bristles are located on the dorsal apical margin of tergite VII. Posterior to the antepygidial bristles is a sensory plate with many small setae and circular depressions termed the pygidium or sensillum.

The number of bristles and the posterior shape of sternite VII in the female is taxonomically important. The spermatheca in the female is divided into a dilated head and a constricted portion, the tail. The shape of the spermatheca is characteristic of the species.

Sternite VIII in the male may be modified into a large sclerite protecting the genitalia, reduced to a small ventral rod, or be modified otherwise. Sternite IX of the male consists of a pair of dorsal arms extending upwards on each side and a posteriorly projecting ventral arm. The ventral arm is usually significantly shaped and may be armed with bristles and spiniforms. The clasper and its movable finger are located posterior to the pygidium and extend dorsally, their shape being characteristic of each species. The movable finger is usually armed with

several small, black spiniforms. Traub (1950) does an excellent job of describing the comparative morphology of the aedeagus and the reader is referred to his work.

## REVIEW OF THE LITERATURE

A checklist of the Siphonaptera of Oklahoma compiled by Dr. Cluff E. Hopla suggests that there are approximately 34 genera and 55 species of fleas found in the state. In this thesis, 11 genera and 15 species are reported from Payne County.

The identification of specimens was primarily accomplished by the use of the books by Irving Fox (1940) and Clarence A. Hubbard (1947). Other useful publications used were those by George P. Holland (1949), Richard B. Eads (1950), Harold E. Stark (1959), F. G. A. M. Smit (1958), G. H. E. Hopkins and Miriam Rothschild (1953, 1956, and 1962), and W. L. Jellison (1945).

The terminology and comparative morphology of the male aedeagus was taken from Traub (1950). The family classification is also that of Traub (1950).

The general morphology and terminology of fleas follows that of Hopkins and Rothschild (1953).

The synonymy used was adapted from literature cited above.

Abbreviations are those given in volume 43, number 1, of Biological Abstracts.

Mammal names are those found in Hall and Kelson (1959).

## MATERIALS AND TECHNIQUES

### Collection of Material

Fleas are usually collected from their animal host or from their host's nest. During this study, several methods and types of traps were employed in collecting mammals and their flea fauna. Small mammals, such as rodents, were collected in museum special snap traps, modified Blair live traps, and gopher traps, using a mixture of peanut butter and rolled oats as bait. Larger mammals were either shot with a .22-caliber rifle or trapped with number 1 1/2 steel jump traps, using meat as bait. The small animals collected were removed from the traps and placed in small paper bags, care being taken not to dislodge any fleas in the process. Only one animal was placed in each paper bag. Gauze swabs saturated with chloroform were placed in the paper bags to kill the animals and their fleas. The bags were sealed and labeled with the following collection data: location collected, type of trap, and ecological information. Larger animals were shot and placed in large paper bags, following the above-mentioned procedure. The bags, with their contents, were then taken to the laboratory for examination.

At the laboratory, each paper bag was opened and its contents placed in a shallow white enameled pan 8 inches by 12 inches by 2 inches. The collecting data from the paper bags and the identification of the animal were recorded in a catalogue. The seams of the paper bag

were torn open over the pan to find any fleas that might have collected there. The animal was then held over the pan and combed with a pocket comb to dislodge any fleas still attached to the body. The gauze swabs were also examined for fleas. The fleas in the pan were picked up with a camel's-hair brush, the tip being moistened with alcohol, and placed in a 1-dram screwcap vial containing 70 percent alcohol. A penciled label with a number corresponding to the number with the collecting data in the catalogue was also included in the vial. These vials were then stored until the fleas could be mounted.

Nests of host animals were collected, whenever possible, and placed in large paper bags, sealed, and marked with the collecting data and the identification of the animal. The paper bags were taken to the laboratory and the contents placed in Berlese funnels, each equipped with a 100-watt electric light bulb. Any fleas in the nesting material were driven down the apparatus by the heat from the light bulb and collected in a glass jar filled one-half full of 70 percent alcohol. The jars were removed after 24 hours and the contents poured into a petri dish for examination under a biocular microscope, set on low power, for flea adults and larvae. The fleas were taken from the petri dish with a pair of jeweler's forceps and placed into a screwcap vial as mentioned previously.

#### Mounting

The fleas were removed from the vial and transferred to a 10-percent sodium hydroxide solution in a small watchglass for 24 hours or for a greater or shorter period, depending on how heavily the fleas were

pigmented. The fleas and the collection number were moved from one solution to another with a pair of jeweler's forceps, taking particular care not to dislodge any bristles on the fleas. The specimens were taken from the sodium hydroxide solution and placed in a 1-percent acetic acid solution for 15 minutes, and then transferred to 50 percent alcohol for 3 to 4 hours. From the 50 percent alcohol, the fleas were transferred to 95 percent alcohol for 3 to 4 hours and then to a saturated carboxylol solution for 10 to 12 hours. The fleas were taken directly from the carboxylol and placed in a drop or two of Canada balsam in the center of a microscope slide. The flea was arranged with the legs to the top of the slide and the head to the right by using a small teasing needle.

A 12-mm. circular cover glass was placed over the flea and the collection number marked on the slide with a wax pencil. The slide was dried in a drying oven until the Canada balsam hardened. Only one flea was mounted on each microscope slide. The slide was labeled on the left side with the date collected, locality collected, host, collector's name, and the catalogue number. The label on the right side of the slide contained the identification of the specimen, the person's name that made the identification, and the type of mounting medium used.



FAMILY CLASSIFICATION

Family Hystrichopsyllidae

Genus Anomiopsyllus

Genus Gonorhinopsylla

Genus Ctenophthalmus

Genus Epitedia

Family Ceratophyllidae

Genus Foxella

Genus Monopsyllus

Genus Nosopsyllus

Genus Opisocrostis

Genus Orchopeas

Genus Thrassis

Family Ischnopsyllidae

Genus Myodopsylla

Genus Sternopsylla

Family Pulicidae

Genus Cediopsylla

Genus Ctenocephalides

Genus Hoplopsyllus

Genus Pulex

Genus Xenopsylla

Family Hectopsyllidae

Genus Echidnophaga

## KEY TO THE FLEA GENERA OF PAYNE COUNTY

1. With pronotal ctenidium. . . . . 5
- 1'. Without pronotal ctenidium . . . . . 2
- 2(1'). Combined thoracic terga longer than first abdominal tergum;  
     anterior margin of head smoothly rounded . . . . . 3
- 2'. Combined thoracic terga shorter than first abdominal tergum;  
     anterior margin of head angulate . . . . . Echidnophaga p. 15
- 3(2). Eyes present; frontal tubercle absent. . . . . 4
- 3'. Eyes absent; frontal tubercle prominent. . . . . Anomiopsyllus\*
- 4(3). Internal, vertical, rodlike sclerotization dividing meso-  
     sternite; ocular bristle in front of eye . . . . . Xenopsylla\*
- 4'. Mesosternite not divided; ocular bristle below  
     eye. . . . . Pulex p. 17
- 5(1). Without genal ctenidium. . . . . 11
- 5'. With genal ctenidium . . . . . 6
- 6(5'). Eyes developed, darkly pigmented; genal ctenidium of four  
     or more spines on a side . . . . . 10
- 6'. Eyes vestigial, lightly pigmented; genal ctenidium of two  
     or three spines on a side. . . . . 7
- 7(6'). Genal ctenidium with two spines on a side. . . . . 8
- 7'. Genal ctenidium with three spines on a  
     side . . . . . Ctenophthalmus p. 21
- 8(7). Genal ctenidium of two evenly spaced spines on a side,  
     anterior and at the same level as the eye. . . . . 9
- 8'. Genal ctenidium of two overlapping, pointed spines on a side  
     below the eye. . . . . Epitedia p. 24

- 9(8). Maxilla truncate; genal ctenidial spines wide and blunt. . . . . Myodopsylla p. 27
- 9'. Maxilla acuminate; genal ctenidial spines slender and pointed. . . . . Sternopsylla\*
- 10(6). Genal ctenidium horizontal with posteriorly curved, sharp spines . . . . . Ctenocephalides p. 29
- 10'. Genal ctenidium oblique with straight, blunt spines . . . . . Cediopsylla p. 33
- 11(5). Abdominal terga II to VII each with two rows of bristles . . .12
- 11'. Abdominal terga II to VII each with one row of bristles; pronotal ctenidium with eight to nine broad, obtuse spines on a side . . . . . Hoplopsyllus p. 35
- 12(11). Eyes normally pigmented, medium to large size. . . . .14
- 12'. Eyes lightly pigmented or vestigial. . . . .13
- 13(12'). Eyes small, oval, and lightly pigmented; labial palpus does not extend beyond apex of fore coxa. . . . . Foxella\*
- 13'. Eyes semicircular and lightly pigmented; labial palpus extends beyond apex of fore coxa by at least one segment . . . . . Conorhinopsylla p. 37
- 14(12). Several lateral setae on outer surface of fore femur . . . .15
- 14'. One lateral seta on outer surface of fore femur. . . . . Orchopeas p. 40
- 15(14). Labial palpus extending to base of the fore femur. . . . .16
- 15'. Labial palpus extending to the apex of the fore femur. . . . . Opisocrostitis p. 48

- 16(15). Preantennal region of head with one complete row of  
bristles . . . . .17
- 16'. Preantennal region of head with two complete rows of bris-  
tles . . . . .Monopsyllus\*
- 17(16). Antennal segment II with a row of seven to nine setae, most  
of which reach to (male) or beyond (female) the apex of  
segment III; pronotal ctenidium of 10 pointed spines on  
a side, the ventral one being short and slightly poster-  
ior. . . . . Thrassis\*
- 17'. Antennal segment II with setae not reaching apex of  
segment III; pronotal ctenidium of 8 to 10 apically  
rounded spines on a side, the ventral one not short  
and posterior. . . . . Nosopsyllus\*

NOTE: Genera marked with an asterisk have not been collected from Payne  
County but are likely to be collected since this area is included  
in their host's range.

Genus Echidnophaga Olliff

Echidnophaga Olliff, 1886. Proc. Linn. Soc. N. S. Wales, 1:171.

Argopsylla Enderlein, 1903. Deutsches Tief-See Exped. 1898-99.

3:263.

Xestopsylla Baker, 1904. Proc. U. S. Natl. Mus., 27:373.

Genotype: Echidnophaga ambulan Olliff

Head with frons angulate. Genal and pronotal ctenidia absent. Frontal tubercle absent. Hind coxa with a patch of spinelets on the inner side; apex developed into a broad tooth. The fifth tarsal segment of legs with three pairs of stout lateral plantar bristles; one or two pairs of slender bristles are located anterior. Conspicuous spiracles present on abdominal segments II to VIII.

Only one species of this genus, Echidnophaga gallinacea, was collected from Payne County.

A wide variety of hosts have been infested with Echidnophaga gallinacea in other areas of the United States. Eads (1950) reports this parasite taken from chicken, man, coyote, dog, wolf, fox, badger, skunk, raccoon, opossum, cat, bobcat, domestic rat, wood rat, pocket mouse, grasshopper mouse, kangaroo rat, gopher, rock squirrel, ground squirrel, prairie dog, domestic and cottontail rabbits, tree and burrowing owls, and calf. The only specimens of this flea from Payne County that I examined were collected from a dog.

Echidnophaga gallinacea (Westwood)

Sarcopsyllus gallinaceus Westwood, 1875. Entomol. Monogr. Mag.,  
11:246.

Pulex pallulorum Johnson, 1890. Proc. Entomol. Soc. Wash., 1:59.

Sarcopsylla gallinacea Baker, 1895. Can. Entomol., 27:21.

Xestopsylla gallinacea Baker, 1904. Proc. U. S. Natl. Mus.,  
27:375.

Orgopsylla gallinacea Baker, 1905. Proc. U. S. Natl. Mus., 29:138.

Echidnophaga gallinacea Jordan and Rothschild, 1906. Liverpool  
Univ., Thompson Yates and Johnson Lab. Rept. 7, p. 52.

Echidnophaga gallinacea I. Fox, 1940. Fleas of E. U. S., p. 10.

Echidnophaga gallinacea Hubbard, 1947. Fleas of W. N. Amer., p. 50.

Echidnophaga gallinacea Eads, 1950. Fleas of Texas, p. 67.

MALE: Preantennal region of the head with two large bristles. Maxillary lacinia prominent and deeply serrated. Maxilla short and broad. Eye: oval and heavily pigmented. Second antennal segment with three or four long bristles. Postantennal region of head with two bristles, the caudal one being stout and longer than the cephalic one. Pronotum and mesonotum each with a row of long bristles. Abdominal tergites armed dorsally with at least one long bristle.

MODIFIED SEGMENTS: Clasper with a long and a short process; the long process armed with a number of bristles along the anterior margin. Movable finger of clasper rounded apically and curved toward the smaller

process of the clasper; armed with one long bristle and several smaller ones. Sternite IX with apical arm simple and unlobed. Penis rods not completing a 1/2-turn.

**FEMALE:** Chaetotaxy and general structure essentially as in the male. Spermatheca with head short and thick, broader ventrally than dorsally; tail longer than the head, thick at the base and tapering toward the apex.

**COLLECTION RECORDS:**

- 5 October 1933, Canis familiaris, 2♀ 2♂, E. E. I.  
 20 March 1937, Canis familiaris, 1♀, A. K.  
 16 December 1947, Canis familiaris, 1♀, D. E. H.

Genus Pulex Linnaeus

Pulex Linnaeus, 1758. Systema Naturae, 10th ed., p. 614.

Genotype: Pulex irritans Linnaeus

Preantennal region of head with two long bristles. Frons evenly rounded with frontal tubercle absent. Large heavily pigmented eye. Both genal and pronotal ctenidia absent; genal ctenidium may be represented by one small inconspicuous spine. Maxilla short and acuminate. Internal, vertical, rodlike sclerotization dividing mesosternite of thorax absent. One row of bristles on each abdominal tergite.

Two species of Pulex have been collected from Payne County. The normal hosts of Pulex simulans are wild carnivores, but domestic animals are also infested. Humans and domestic animals are the hosts for Pulex irritans.

Key to Payne County Species of Pulex

Sternite VII of female with six to nine bristles on a side; male with dorsal aedeagal sclerite evenly broad throughout, and with crochets small, elongate, and rodlike. . . . . P. simulans

Sternite VII of female with four to five bristles on a side; male with dorsal aedeagal sclerite long and slender, and with crochets much expanded apically . . . . . P. irritans

Pulex simulans Baker

Pulex simulans Baker, 1895. Can. Entomol., 27:65,67.

Pulex irritans var. dugesii Baker, 1899. Entomol. News, 10:37.

Pulex simulans Smit, 1958. Jour. Parasitol., 44:523.

**MALE:** Preantennal region of head with one row of two long bristles, one located near the base of the maxilla and the other near the eye. One curved row of microsetae extending from above base of first antennal segment to an area in front of the eye; several scattered microsetae along frontal area and over postantennal region of the head. Labial palpus extending slightly over 1/2 distance to apex of fore coxa; maxillary lacinia serrated and approximately equal in length to labial palpus. Maxillary palpus extending to apex of fore coxa; segments I and II equal in length, segment III the shortest, and segment IV the longest, several short bristles at apex of each segment and a few scattered over the segments. Postantennal region with one large bristle and a row of microsetae posterior to the club of the antenna. First antennal segment with



four to five short bristles; second antennal segment with 8 to 10 long bristles; club of the antenna short and somewhat rounded. Pronotum, mesonotum, metanotum, and abdominal segments II to VII each with one row of alternating long and short bristles. One long antepygidial bristle on a side.

**MODIFIED SEGMENTS:** Clasper formed into a broad, rounded lobe with numerous short bristles extending along the margin from anterior to posterior. Two movable fingers of the clasper in the form of pincers; the anterior finger being approximately straight with a caudally directed bristle at the apex, the posterior finger being curved anteriorly and apically pointed, armed with four or five short bristles along the caudal margin. Sternite IX with ventral portion extending into a long, slender arm apically armed with numerous short bristles. Penis rods long, completing at least one turn.

**FEMALE:** Chaetotaxy and general structure essentially as in the male. Sternite VII with sinus absent and six to nine bristles on a side. Spermatheca with head round, tail long and sharply curved about midway.

**COLLECTION RECORDS:**

- 27 April 1931, Canis familiaris, 1♀, H. W.  
 31 January 1946, Canis familiaris, 3♀♀, R. B. J.  
 15 June 1947, Canis familiaris, 1♀ 2♂♂, D. E. H.  
 17 May 1948, Canis latrans, 2♀♀ 2♂♂, D. E. H.  
 24 February 1952, Canis familiaris, 1♀, M. W.  
 1 April 1954, Canis familiaris, 1♀, D. A. G.

- 20 November 1959, Didelphis marsupialis, 1♀, R. G. P.  
 April 1953, Taxidea taxus, 6♀♀ 1♂, E. R. B.  
 20 October 1961, Canis familiaris, 1♀, J. F. R.  
 24 September 1964, Canis familiaris, 1♀, J. F. R.  
 9 October 1964, Canis familiaris, 1♂, J. F. R.  
 21 October 1964, Procyon lotor, 1♂, J. F. R.  
 1 December 1964, Canis latrans, 9♀♀ 5♂♂, J. F. R.  
 1964, Canis familiaris, 1♀, V. B. C.  
 30 January 1965, Mephitis mephitis, 2♀♀ 4♂♂, J. F. R.  
 31 January 1965, Mephitis mephitis, 1♀ 1♂, J. F. R.  
 3 March 1965, Urocyon cinereoargenteus, 1♀, G. C. R.  
 8 May 1965, Canis familiaris, 1♀, J. F. R.  
 21 May 1965, Canis familiaris, 1♀, J. F. R.  
 2 June 1965, Mephitis mephitis, 2♀♀ 1♂, J. F. R.

Pulex irritans Linnaeus

Pulex irritans Linnaeus, 1758. Systema Naturae, p. 614.

Pulex irritans Baker, 1895. Can. Entomol. 27:67.

Pulex irritans Jordan, 1929. Nov. Zool., 35:176.

Pulex irritans I. Fox, 1940. Fleas of E. U. S., p. 57.

Pulex irritans Eads, 1950. Fleas of Texas, p. 71

Many specimens of Pulex simulans were probably identified as Pulex irritans before publication of the paper by Smit (1958). I found this true in specimens that I examined from the Oklahoma State University museum.

The chaetotaxy and general structure of both the male and the female of P. irritans is similar to that of P. simulans. Differences between the two species is listed below.

MALE: In P. irritans the dorsal aedeagal sclerite of Smit (1958) (Traub's aedeagal crochet, 1950) is longer and more slender than the broad one in P. simulans. The crochets of Smit (1958) (Traub's pseudo crochets, 1950) in P. irritans are much expanded apically, while they are small, elongate, and rodlike in the aedeagus of P. simulans. P. irritans is usually larger in size than P. simulans.

FEMALE: Sternite VII with four to five bristles on a side in P. irritans and with six to nine bristles on a side in P. simulans. P. irritans is usually larger in size than P. simulans.

#### COLLECTION RECORDS:

27 April 1931, Canis familiaris, 1♂, H. W.

15 June 1947, Canis familiaris, 2♀♀, D. E. H.

16 December 1947, Canis familiaris, 1♀, D. E. H.

#### Genus Ctenophthalmus Kolenati

Ctenophthalmus Kolenati, 1856. Die Parasiten der Chiropteren,  
p. 33.

Genotype: Ctenophthalmus bisoctodentatus Kolenati

Head well rounded with a prominent frontal tubercle projecting beyond its anterior border. Three spines in genal ctenidium. Labial

palpus not extending beyond apex of the fore coxa. Eye vestigial. Fifth tarsal segment of forelegs and middle legs with four pairs of lateral plantar bristles and a basal and a distal submedian pair. Three pairs of lateral plantar bristles and a proximal subventral pair on fifth tarsal segment of hindlegs. Three antepygidial bristles on a side, the middle one longest, the upper one shortest, and the lower one medium in length.

Only one species, Ctenophthalmus pseudagyrtes, was found in Payne County. It was collected from a variety of small mammals.

Ctenophthalmus pseudagyrtes Baker

Typhlopsylla assimilis Baker, 1895. Can. Entomol., 27:190 (not T. assimilis Taschenberg).

Ctenophthalmus pseudagyrtes Baker, 1904. Proc. U. S. Natl. Mus., 27:421.

Ctenophthalmus pseudagyrtes Rothschild, 1904. Nov. Zool., 11:641.

Ctenophthalmus pseudagyrtes Jordan, 1928. Nov. Zool., 34:186.

Ctenophthalmus pseudagyrtes I. Fox, 1940. Fleas of E. U. S., p. 34.

Ctenophthalmus pseudagyrtes Hubbard, 1947. Fleas of W. N. Amer., p. 343.

**MALE:** Preantennal region of head with two rows of bristles, upper row with five to six bristles, the lower row with three stout, long bristles; several microsetae scattered between the two rows of bristles. Genal ctenidium with three spines obliquely directed posteriorly, the first the shortest, the second wider than the other two, and the third the longest and most acuminate; sometimes a short fourth spine occurs

beneath the eye. Maxilla strongly acuminate. Maxillary palpus short, not reaching apex of fore coxa. Postantennal region of head with six bristles in addition to a marginal row of five. A row of 8 to 10 short, heavy setae located along the posterior margin of the antennal fossae. Eyespot lightly pigmented. Pronotum with a ctenidium of seven or eight spines on a side and a single row of alternating long bristles and weak setae. Metanotum and abdominal tergites with two or three rows of bristles. Abdominal tergites II to VI each armed with a short, stout dorsal tooth on a side. Antepygidial bristles three on a side; the dorsal being the shortest, the middle the longest, and the ventral one being intermediate in length.

MODIFIED SEGMENTS: Process of the clasper bifurcate, the anterior lobe distally armed with four long, stout bristles and a short one; the posterior lobe extending more dorsad than the anterior lobe and is armed with one stout bristle along the posterior margin. Movable finger of the clasper longer than the clasper. The base of the finger as broad as the dorsal surface, curved anteriorly, armed with four or five short bristles on the posterior margin, and with a subdorsal row of seven to eight setae. Penis rods short and completing a 1/4-turn.

#### COLLECTION RECORDS:

October to December 1960, Microtus pinetorum, 14♀ 14♂, D. E. H.

November 1960, Neotoma floridana, 1♂, D. E. H.

November to December 1960, Sigmodon hispidus, 4♀ 4♂, D. E. H.

January 1961, Peromyscus maniculatus, 3♀ 1♂, D. E. H.

January to June 1961, Peromyscus leucopus, 4♀ 3♂, D. E. H.

January to September 1961, Microtus pinetorum, 347♀♀ 290♂♂, D. E. H.

February to June 1961, Sigmodon hispidus, 10♀♀ 7♂♂, D. E. H.

June to July 1961, Neotoma floridana, 2♀♀ 1♂, D. E. H.

17 February 1965, Neotoma floridana NEST, 2♀♀ 1♂, J. F. R.

15 March 1965, Neotoma floridana NEST, 1♀, J. F. R.

13 April 1965, Blarina brevicauda, 1♀ 1♂, J. F. R.

Genus Epitedia Jordan

Epitedia Jordan, 1938. Nov. Zool., 41:124.

Genotype: Ctenophthalmus wenmanni Rothschild

Frontal tubercle prominent. Pronotal and genal ctenidia present; genal ctenidium of two overlapping spines. Labial palpus with five segments. Maxilla acuminate. Eye lightly pigmented. Hind coxa with a row of five to six small spiniforms on its inner surface. Forelegs and middle legs with fifth tarsal segment having four pairs of lateral plantar bristles and a basal submedian pair; hindlegs with fifth tarsal segment having four pairs of lateral plantar bristles and with the basal submedian pair absent.

Epitedia wenmanni was the only species, in this genus, collected from Payne County. It was collected from several small mammal species and also from their nests.

Epitedia wenmanni (Rothschild)

Etenophthalmus wenmanni Rothschild, 1904. Nov. Zool., 11:642.

Neopsylla similis Chapin, 1919. Bull. Brooklyn Entomol. Soc.,

14:50.

Neopsylla wenmanni Chapin, 1919. Bull. Brooklyn Entomol. Soc.,  
14:50.

Neopsylla wenmanni Jordan, 1929. Nov. Zool., 35:172.

Epitedia wenmanni Jordan, 1938. Nov. Zool., 41:124.

Epitedia wenmanni I. Fox, 1940. Fleas of E. U. S., p. 96.

Epitedia wenmanni Hubbard, 1947. Fleas of W. N. Amer., p. 310.

MALE: Preantennal region of head with two rows of bristles; lower row of three long bristles and one short bristle, upper row of five bristles. Frontal tubercle prominent and somewhat triangular. Genal ctenidium of two overlapping apically rounded spines, the upper one slender and almost twice as long as the lower one. Genal process long. Labial palpus extending slightly over 1/2 distance to apex of fore coxa. Maxilla acuminate. First antennal segment with two rows of setae, upper row of two and the lower row of four; second antennal segment with a row of seven to eight setae. Posterior margin of the antennal fossae with seven or eight short bristles. Eyes lightly pigmented. Postantennal region of head with three rows of bristles, each row with five or six bristles. Pronotum with a ctenidium of six to seven broad spines on a side, and a row of alternating bristles and setae. Abdominal tergites II to VII each with two rows of bristles, the posterior row composed of alternating bristles and setae. Three antepygidial bristles on a side with the middle one the longest.

MODIFIED SEGMENTS: Process of clasper bilobed; the upper lobe longest and with one long and several short bristles apically, the lower lobe with two to three long and several short bristles apically. Movable

finger of clasper triangular, rounded ventrally, and uniformly covered with short bristles. Sternite IX long, broader basally than apically, eight to nine short, sharp black spiniforms apically, and a row of several bristles along posterior margin. Penis rods completing a 1/2-turn.

**FEMALE:** Chaetotaxy and general structure essentially as in the male. Sternite VII with a deep sinus forming an upper acuminate lobe and a lower rounded lobe. Spermatheca with head slightly over twice as long as wide and the tail set deep into the head.

**COLLECTION RECORDS:**

- October to December 1960, Microtus pinetorum, 82♀♀ 40♂♂, D. E. H.  
 October to December 1960, Sigmodon hispidus, 164♀♀ 78♂♂, D. E. H.  
 November to December 1960, Peromyscus maniculatus, 102♀♀ 39♂♂, D. E. H.  
 November to December 1960, Neotoma floridana, 18♀♀ 6♂♂, D. E. H.  
 November to December 1960, Peromyscus leucopus, 30♀♀ 17♂♂, D. E. H.  
 January to March 1961, Neotoma floridana, 14♀♀ 6♂♂, D. E. H.  
 January to April 1961, Peromyscus leucopus, 96♀♀ 42♂♂, D. E. H.  
 January to April 1961, Microtus pinetorum, 126♀♀ 70♂♂, D. E. H.  
 January to April 1961, Sigmodon hispidus, 396♀♀ 169♂♂, D. E. H.  
 January to April 1961, Peromyscus maniculatus, 78♂♂ 37♂♂, D. E. H.  
 June to July 1961, Microtus pinetorum, 2♂♂, D. E. H.  
 December 1964, Sigmodon hispidus, 3♀♀, J. F. R.  
 December 1964, Peromyscus maniculatus, 1♀ 1♂, J. F. R.  
 January 1965, Sigmodon hispidus, 6♀♀ 3♂♂, J. F. R.  
 January 1965, Peromyscus leucopus, 26♀♀ 19♂♂, J. F. R.



- 29 January 1965, Reithrodontomys montanus, 1♀, J. F. R.  
 30 January 1965, Didelphis marsupialis, 1♂, J. F. R.  
 17 February 1965, Neotoma floridana NEST, 7♀♀ 2♂♂, J. F. R.  
 19 February 1965, Neotoma floridana, 1♂, J. F. R.  
 March 1965, Peromyscus leucopus, 5♀♀ 4♂♂, J. F. R.  
 15 March 1965, Neotoma floridana NEST, 1♀ 2♂♂, J. F. R.  
 11 April 1965, Neotoma floridana NEST, 1♀ 1♂, J. F. R.  
 7 May 1965, Sigmodon hispidus NEST, 1♀, J. F. R.  
 5 June 1965, Neotoma floridana NEST, 2♀♀ 1♂, J. F. R.  
 29 June 1965, Neotoma floridana NEST, 10♀♀ 10♂♂, J. F. R.

Genus Myodopsylla Jordan and Rothschild

Myodopsylla Jordan and Rothschild, 1911. Nov. Zool., 18:88.

Genotype: Ceratopsylla insignis Rothschild

Preantennal region of head with a large clear unsclerotized area; frontal tubercle absent; and a long, stout bristle at the anterior border of the antennal fossae near the vestigial eye. Genal ctenidium of two broad, blunt spines on a side. Maxilla truncate. Pronotal ctenidium consisting of many long, slender spines on a side. Dorsal bristles thickened, forming false ctenidia on mesonotum and abdominal tergites I to VII. Both male and female have one antepygidial bristle on a side.

Only one species of this genus of bat fleas has been collected from Payne County.

Myodopsylla collinsi Kohls

Myodopsylla collinsi Kohls, 1937. Jour. of Parasitol., 23:300.

Myodopsylla collinsi Hubbard, 1947. Fleas of W. N. Amer., p. 375.

Myodopsylla collinsi Eads, 1950. Fleas of Texas, p. 58.

**FEMALE:** Preantennal region with frons having a wide, cleared area covering most of the anterior region of the head; a row of microsetae, with the posterior three or four longer, extending from the base of genal ctenidial spine I to an area near the first antennal segment. Four bristles near the anterior border of the antennal fossae, the lowest bristle long and stout and located in the normal eye position. Eye vestigial. Gena with a number of small setae. Genal ctenidium of two broad, blunt black spines on a side; spine II wider than spine I. Genal process heavily pigmented and pointed. Labial palpus extending about 1/4 the distance to apex of fore coxa. First antennal segment with several short setae apically; second antennal segment with about five short bristles. Postantennal region with one long, stout bristle, about 15 medium to small bristles, a patch of short bristles posterior to the apex of the club of the antenna, and a marginal row of five or six bristles. Pronotal ctenidium of 17 to 18 spines on a side. Pronotum and metanotum each with three rows of bristles; mesonotum with four irregular rows of bristles. One antepygidial bristle on a side. Sternite VII with a long, shallow sloping sinus separating the blunt dorsal lobe from the angular lower lobe. Spermatheca with the head about as wide as long; the tail curved and over twice as long as the head.

Since no males were collected from Payne County, I am using the following description as given by Eads (1950).

MODIFIED SEGMENTS: VIII sternite with a stout distal arm, toward apex covered with fine hairs on inner surface and with bristles on outer surface; IX sternite with 2 stout bristles on ventral border toward apex; clasper produced into a dorsal and ventral process, dorsal process partially overlapping the movable finger, ventral process with a stout and a slender bristle on posterior border.

Eads (1940) also suggests that the chaetotaxy of the male is essentially as in the female.

COLLECTION RECORD:

15 March 1954, Bat, 2♀♀, D. E. R.

Genus Ctenocephalides Stiles and Collins

Ctenocephalus Kolenati, 1859. Jahresber. d. Marischen Gesellsch.

z. Beford d. Naturk., p. 65.

Ctenocephalides Stiles and Collins, 1930. U. S. Publ. Health Serv.

Rept., 45:1308 (new name for Ctenocephalus Kolenati, preoccupied).

Genotype: Pulex canis Curtis

Both genal and pronotal ctenidia present and consisting of long, slightly curved, sharp spines. Genal ctenidium horizontal. Distinct frontal incrasation. Ocular bristle located on a level with or above the heavily pigmented eye. Labial palpus not reaching apex of the fore coxa. Abdominal tergites each with one row of bristles.

In Payne County, Ctenocephalides felis is common on cats and dogs, while specimens of C. canis are uncommon.

Key to Payne County Species of Ctenocephalides

Head with length about twice the height; frons low, somewhat flattened, and not well rounded; genal ctenidial spine I as long, or only slightly shorter, than spine II. . . . . C. felis

Head with length about 1 1/2 times the height; frons well rounded; genal ctenidial spine I much shorter than spine II . . . . . C. canis

Ctenocephalides felis (Bouche)

Pulex felis Bouche, 1835. Nov. Act. Acad. Leop. Carol., 17:505.

Pulex felis Rothschild, 1901. Entomol. Rec., 13:126.

Ctenocephalus felis Banks, 1910. U. S. Publ. Health and Mar. Hosp. Serv. Bull. 30, p. 75.

Ctenocephalus felis Jordan, 1929. Nov. Zool., 35:176.

Ctenocephalides felis Stiles and Collins, 1930. U. S. Publ. Health Rept., 45:1308.

Ctenocephalides felis Jordan, 1937. Nov. Zool., 40:283.

Ctenocephalides felis I. Fox, 1940. Fleas of E. U. S., p. 24.

Ctenocephalides felis Hubbard, 1947. Fleas of W. U. S., p. 60.

Ctenocephalides felis Eads, 1950. Fleas of Texas, p. 65.

MALE: Preantennal region of head with two bristles, one cephalad of the heavily pigmented eye and one dorsad of third genal ctenidial spine. Forehead evenly sloping. Genal ctenidium of seven to eight dark, posteriorly curved spines on a side, spine I slightly shorter than spine II. Well developed spine at the apex of the genal process. First

antennal segment with five or six bristles and several microsetae, second segment with six or more bristles. Postantennal region with two stout bristles in addition to the four or five bristles of the marginal row. Two irregular rows of stout microsetae along the dorsal margin of the antennal fossae opposite club of the antenna. Pronotum with a ctenidium of about eight spines on a side. Pronotum, mesonotum, metanotum, and abdominal tergites II to VII each armed with one row of bristles.

**MODIFIED SEGMENTS:** Process of clasper lobelike, twice as long as broad, armed with 18 to 20 marginal bristles, two stout lateral bristles, and one bristle ventrally at its base. Movable finger of clasper small with base nearly equaling length, armed with about a dozen bristles, and lying below the base of the clasper. Sternite VIII with a short posterior arm with several bristles at the apex and along the posterior margin.

**FEMALE:** Forehead longer and narrower than in the male. Chaetotaxy of the head and general structure essentially as in the male, except the two irregular rows of stout microsetae are absent in the female. Genal ctenidium with spine I as long, or longer than, spine II. Spermatheca with curved tail widest near apex and longer than the head; head longer than wide.

**COLLECTION RECORDS:**

- 28 February 1934, Felis catus, 1♀, C. A. S.  
6 December 1937, Canis familiaris, 1♀, K. C. E.  
16 December 1947, Canis familiaris, 5♀♀ 1♂, D. E. H.  
1 March 1954, Canis familiaris, 1♀, D. A. G.

- June 1958, Canis familiaris, 17♀♀, V. H. Z.
- 29 October 1964, Canis familiaris, 4♀♀ 5♂♂, D. E. H.
- 8 September 1964, Felis catus, 17♀♀ 4♂♂, J. F. R.
- 18 December 1964, Canis familiaris, 62♀♀ 22♂♂, V. B. C.
- 1964, Canis familiaris, 471♀♀ 205♂♂ V. B. C.
- 29 October 1961, Canis familiaris, 35♀♀ 4♂♂, J. F. R.
- 19 June 1963, Home, 7♀♀ 4♂♂, D. E. H.
- 1 November 1964, Felis catus, 3♀♀ 4♂♂, J. F. R.
- 16 June 1965, Homo sapiens, 11♀♀ 4♂♂, R. E. P.

Ctenocephalides canis (Curtis)

Pulex canis Curtis, 1826. British Entomol., 3:114.

Pulex serraticeps Baker, 1895. Can. Entomol., 27:164.

Pulex canis Rothschild, 1901. Entomol. Rec., 13:126.

Ctenocephalus canis Baker, 1904. Proc. U. S. Natl. Mus., 27:384.

Ctenocephalus canis Jordan, 1929. Nov. Zool., 35:176.

Ctenocephalides canis Stiles and Collins, 1930. U. S. Publ. Health Serv. Rept., 45:1308.

Ctenocephalides canis I. Fox, 1940. Fleas of E. U. S., p. 26.

Ctenocephalides canis Eads, 1950. Fleas of Texas, p. 65.

The chaetotaxy and general structure of Ctenocephalides canis is similar to that of Ctenocephalides felis. Separation of typical forms can be made on the following points. Forehead of C. canis much rounder and higher and is about 1 1/2 times as long as high, while in C. felis the forehead is obliquely rounded and is twice as long as high. Ctenocephalides canis has genal ctenidial spine I much shorter than spine II,

while in C. felis spine I is as long as, or only slightly shorter than, spine II. The hind tibia of C. canis with seven or eight dorsal notches; third notch from base of the tibia bearing two bristles rarely replaced by hairlike setae, while C. felis has third notch armed with two hairlike setae. The abdominal spiracles are larger in C. canis. Traub (1950), in comparing both, cleared and dissected specimens found that the dorsal process of the inner tube of the aedeagus is longer in C. felis than C. canis and the median dorsal lobe produced further dorsad apically in C. canis than C. felis.

#### COLLECTION RECORDS:

29 April 1931, Canis familiaris, 1♀ 1♂, H. W.

28 February 1934, Felis catus, 1♀, C. A. S.

9 February 1946, Canis familiaris, 1♀, R. B.

21 May 1965, Canis familiaris, 1♀, J. F. R.

#### Genus Cediopsylla Jordan

Cediopsylla Jordan, 1925. Nov. Zool., 32:103.

Genotype: Pulex simplex Baker

Frons with a distinct incrassation and angulate in front. Genal ctenidium obliquely vertical, consisting of straight, heavily pigmented, blunt spines. Four segmented labial palpus. Maxillary lacinia heavily serrated. Pronotal ctenidium present.

Only one species, primarily infesting rabbits, was collected from Payne County.

Cediopsylla simplex (Baker)

- Pulex inaequalis var. simplex Baker, 1895. Can. Entomol., 27:164.  
Ctenocephalus simplex Baker, 1904. Proc. U. S. Natl. Mus., 27:385.  
Spilopsyllus simplex Baker, 1905. Proc. U. S. Natl. Mus., 29:131.  
Cediopsylla simplex Jordan, 1925. Nov. Zool., 32:103.  
Spilopsylla cuniculi Schwartz and Shook, 1928. U. S. Dept. Agric.  
 Farm. Bull. 1568, p. 10.  
Cediopsylla simplex I. Fox, 1940. Fleas of E. U. S., p. 21.  
Cediopsylla simplex Eads, 1950. Fleas of Texas, p. 63.

MALE: Head angulate with frons having a long, rounded, dorsally directed incassation. Preantennal region of head with two large bristles and numerous microsetae. Genal ctenidium composed of eight blunt spines. Maxillary lacinia deeply serrated and extending about 3/5 distance to apex of the fore coxa. Eye prominent and heavily pigmented. Postantennal region armed with eight bristles in addition to the six bristles of the marginal row. Pronotum with a ctenidium of seven spines on a side. Pronotum, mesonotum, and metanotum each with one row of bristles.

MODIFIED SEGMENTS: Apical portion of the posterior arm of sternite IX and the two movable fingers of the clasper partially enclosed in a membranous flap, the margin of which has hairlike setae dorsally. The anterior movable process of the clasper straight and about as long as the curved posterior process; the latter having five or six small bristles along the posterior margin. Sternite VIII tapering to a point apically where it is curved outward and has three or four bristles on the outer margin. Penis rods long and completing a 1/2-turn.



FEMALE: Chaetotaxy and general structure essentially as in the male. Maxillary lacinia longer than in the male, reaching beyond the apex of the fore coxa. Sternite VII without a sinus. Spermatheca with head slightly longer than wide and the tail curved, slender, and almost twice as long as the head.

COLLECTION RECORDS:

- 20 December 1960, Sylvilagus floridanus, 1♂, R. G. P.  
 1 June 1961, Microtus pinetorum, 1♀, D. E. H.  
 30 January 1965, Didelphis marsupialis, 1♀, J. F. R.  
 2 May 1965, Didelphis marsupialis, 1♀, J. F. R.  
 2 May 1965, Sylvilagus floridanus, 8♀♀ 2♂♂, J. F. R.  
 13 May 1965, Canis familiaris, 1♀, J. F. R.  
 18 May 1965, Sylvilagus floridanus, 2♀♀ 1♂, J. F. R.  
 18 May 1965, Sylvilagus floridanus, 1♀, J. F. R.

Genus Hoplopsyllus Baker

Hoplopsyllus Baker, 1905. Proc. U. S. Natl. Mus., 29:128.

Genotype: Fulex anomalus Baker

Frons high and rounded; head somewhat flattened dorsally. Pronotal ctenidium present and genal ctenidium absent. A rodlike sclerotization divides the mesosternite vertically. Large, round, and heavily pigmented eye. Labial palpus four segmented. Abdominal tergites II to VII each armed with one row of bristles.

Species of the genus Hoplopsyllus are true parasites of rabbits and hares. Only one species, Hoplopsyllus affinis, has been collected from Payne County.

Hoplopsyllus affinis (Baker)

Pulex affinis Baker, 1904. Proc. U. S. Natl. Mus., 27:382.

Hoplopsyllus affinis Baker, 1905. Proc. U. S. Natl. Mus., 27:130.

Hoplopsyllus affinis I. Fox, 1940. Fleas of E. U. S., p. 14.

Hoplopsyllus affinis Hubbard, 1947. Fleas of W. N. Amer., p. 71.

Hoplopsyllus affinis Eads, 1950. Fleas of Texas, p. 68.

MALE: Preantennal region of head armed with two large bristles, one just cephalad of the eye and the other near base of the maxillary palpus. Dorsal surface of head somewhat flattened, giving the head an angulate appearance. Eye large and heavily pigmented. Four or five long bristles on second antennal segment. Maxillary palpus extending slightly over 1/2 distance to apex of the fore coxa. Postantennal region of head with two bristles in addition to the four or five bristles of the marginal row. Pronotum, metanotum, and abdominal tergites II to VII each with one row of bristles. One long antepygidial bristle on a side.

MODIFIED SEGMENTS: Clasper with two processes. The anterior process is broad and lobular with eight stout bristles apically, while the posterior process is slender with a blunt, black thumblike spiniform and several bristles apically. Sternite IX with a large caudally-curved bristle and numerous smaller bristles. Penis rods completing a 1/2-turn.

FEMALE: Chaetotaxy and general structure essentially as in the male. Apical outline of sternite VII slightly concave. Spermatheca with head oval and the tail curved, slender, and twice as long as the head.

COLLECTION RECORDS:

- 1 May 1940, Rabbit, 1♂, D. E. H.  
 6 April 1954, Lepus californicus, 2♂♂, D. A. G.  
 27 October 1964, Sylvilagus floridanus, 1♂, R. J. B.  
 2 May 1965, Sylvilagus floridanus, 2♀♀ 2♂♂, J. F. R.  
 2 May 1965, Sylvilagus floridanus, 1♀, J. F. R.  
 18 May 1965, Sylvilagus floridanus, 1♀, J. F. R.  
 18 May 1965, Sylvilagus floridanus, 2♂♂, J. F. R.

Genus Conorhinopsylla Stewart

Conorhinopsylla Stewart, 1930. Can. Entomol., 62:178.

Genotype: Conorhinopsylla stanfordi

Frons without a frontal tubercle, gently rounded, and armed with two rows of bristles. Labial palpus long, composed of five to eight segments. Maxilla broad and triangular, not tapering into a long point. Genal ctenidium absent. Eye lightly pigmented. Pronotal ctenidium with six broad spines on a side. Pronotum with one row of bristles; mesonotum; metanotum, and abdominal segments II to VII each with two rows of bristles. Three antepygidial bristles on a side; male with two bristles much reduced. Long hairlike bristles on first and second tarsal segments of

hindleg. Four pairs of lateral plantar bristles and a basal submedian pair on fifth tarsal segment of each leg.

Conorhinopsylla nidicola is the only species of this genus collected from Payne County.

Conorhinopsylla nidicola Jellison

Conorhinopsylla nidicola Jellison, 1945. Jour. Kans. Entomol. Soc.,  
18:109-110.

MALE: Preantennal region of head with two rows of bristles; the lower row with three to four bristles, the upper irregular row with about four small bristles. A few small setae along anterior and posterior margins of antennal fossae. Labial palpus 8 to 11 segmented, extending beyond apex of fore coxa by a segment. Eye triangular and lightly pigmented. Postantennal region of head with two bristles, a small one near the apex of the first antennal segment and a longer one near the apex of the second antennal segment, in addition to a marginal row of four or five small bristles. Pronotum with a row of alternating bristles and setae in addition to a ctenidium of six broad spines on a side. Mesonotum, metanotum, and abdominal tergites II to VII armed with two rows of bristles, the anterior row with short bristles and the posterior row with long bristles. Abdominal tergites II to V armed dorsally with one to three stout teeth on a side. Three antepygial bristles present on a side with the middle one long and stout while the other two are very short.

MODIFIED SEGMENTS: Movable finger of clasper wide, diamond-shaped with a few scattered short bristles and extends far dorsad of the

clasper; process of clasper covering only a basal portion of the movable finger and armed along the posterior margin with six to seven long bristles and about eight small bristles extending dorsally to the apex.

Sternite VIII with posterior arm wide apically and armed with an upper patch of about 10 small, lightly pigmented spiniforms and a lower row of about seven spiniforms, the two rows being separated by an irregular row of about 12 bristles. Sternite IX with the posterior arm short, broad, and the apex curved dorsally in a short hook, giving it the appearance of a hawk's head; several short bristles along the posterior margin and sides. Penis rods not completing a 1/2-turn.

**FEMALE:** Chaetotaxy and general structure essentially as in the male. Three antepygidial bristles with the middle the longest and the other two slightly over half as long. Sternite VII without a distinct sinus. Spermatheca large with head over twice as long as wide and an acutely recurved tail.

#### COLLECTION RECORDS:

27 October 1960, Neotoma floridana, 3♀♀, D. E. H.

9 December 1960, Peromyscus maniculatus, 1♂, D. E. H.

22 January 1961, Peromyscus leucopus, 1♀, D. E. H.

January to February 1961, Sigmodon hispidus, 3♀♀ 4♂♂, D. E. H.

13 March 1961, Neotoma floridana, 1♀, D. E. H.

21 October 1964, Procyon lotor, 1♀ 1♂, J. F. R.

9 December 1964, Peromyscus leucopus, 1♀, J. F. R.

26 January 1965, Peromyscus leucopus, 1♀, J. F. R.

15 March 1965, Neotoma floridana NEST, 6♀♀ 4♂♂, J. F. R.

Genus Orchopeas Jordan

Orchopeas Jordan, 1933. Nov. Zool., 39:71.

Genotype: Pulex wickhami Baker (= howardii Baker 1895)

Frontal tubercle small and inconspicuous. Genal ctenidium absent. Labial palpus five segmented and extends slightly beyond apex of fore trochanter. Eye prominent and heavily pigmented. Pronotal ctenidium with 9 to 10 spines on a side. Fifth tarsal segment of each leg armed with four pairs of lateral plantar bristles and one submedian pair at the base and apex of the segment. Fore femur with one small lateral seta. Two stout antepygidial bristles and one minute bristle on a side in the male. Three stout antepygidial bristles, with the middle one the longest, on a side in the female. Movable finger of male with the clasper more or less ham-shaped and a row of four to seven short, black spiniforms on a side. Spermatheca of female with head barrel-shaped and tail curved at a right angle.

Three species represent this genus in Payne County and are found inhabiting the nests of small mammals as well as infesting the animals themselves.

Key to Payne County Species of Orchopeas

1. Preantennal region of head with two complete rows of bristles. . . 2
- 1'. Preantennal region of head with only one complete row of bristles . . . . . O. howardii

2. Postantennal region of head with three bristles in addition to those of the marginal row. . . . . O. leucopus
- 2'. Postantennal region of head with two bristles in addition to those of the marginal row. . . . . O. sexdentatus

Orchopeas howardii (Baker)

- Pulex wickhami Baker, 1895. Can. Entomol., 27:109.
- Pulex gillettei Baker, 1895. Can. Entomol., 27:109.
- Pulex howardii Baker, 1895. Can. Entomol., 27:110.
- Pulex howardii Baker, 1899. Entomol. News, 10:37.
- Ceratophyllus wickhami Baker, 1904. Proc. U. S. Natl. Mus., 27:403.
- Ceratophyllus wickhami Jordan, 1928. Nov. Zool., 34:183.
- Orchopeas wickhami Jordan, 1933. Nov. Zool., 39:71.
- Orchopeas wickhami I. Fox, 1940. Fleas of E. U. S., p. 59.
- Orchopeas howardii Erving and Fox, 1943. U. S. Dept. Agric. Misc. Publ., 500:33. (The name howardii revived on the authority of Baker's 1899 paper.)
- Orchopeas howardi (sic) Hubbard, 1947. Fleas of W. N. Amer., p. 107.
- Orchopeas howardii Eads, 1950. Fleas of Texas, p. 46.

The usual hosts of Orchopeas howardii in Payne County are Didelphis marsupialis and Sciurus niger; however, specimens have been taken from other mammalian hosts.

MALE: Preantennal region of head with three stout bristles in the ocular row and two to four smaller bristles arranged in an oblique line above the ocular row. Labial palpus extending by about 1/2-segment

beyond apex of fore coxa, the apical segment the longest. Postantennal region of head with a large bristle and two to three smaller bristles in addition to the marginal row. Marginal row of four bristles alternating with small setae. Pronotum with one row of alternating strong and weak bristles and with a ctenidium of eight to nine spines on a side. Mesonotum and metanotum with two rows of bristles. Metanotum and first four abdominal tergites armed with one or two stout dorsal teeth. Two antepygidial bristles on a side, one long and one short.

**MODIFIED SEGMENTS:** Movable finger of clasper swollen ventrally with the apex angular; armed with four short, sharp black spiniforms. Movable finger and process of clasper approximately equal dorsally. Process of clasper length three times that of the apical width. Sternite IX with lower lobe armed with three bristles and one black spiniform inserted in the lobe  $1/4$  the way down the posterior margin; lower angle of the lobe well rounded. Penis rods short, not completing a  $1/2$ -turn.

**FEMALE:** Preantennal region with only one or two short bristles in addition to the three stout bristles of the ocular row. Three antepygidial bristles on a side; the middle one the longest and the dorsal one the shortest. Sternite VII with a small distinct sinus situated low down on the sternite; the upper lobe being prominent and triangular. Spermatheca with the head about twice as long as wide and longer than the tail.



## COLLECTION RECORDS:

- 21 March 1954, Sciurus niger, 2♀♀, D. A. G.  
 19 December 1960, Sciurus niger, 6♀♀ 2♂♂, D. E. B.  
 21 October 1964, Didelphis marsupialis, 10♀♀ 4♂♂, J. F. R.  
 9 December 1964, Sigmodon hispidus, 1♀ J. F. R.  
 10 January 1965, Sciurus niger, 1♀ 1♂, J. F. R.  
 10 January 1965, Sciurus niger, 1♀, J. F. R.  
 29 January 1965, Reithrodontomys montanus, 1♀, J. F. R.  
 10 March 1965, Didelphis marsupialis, 2♀♀, J. F. R.  
 2 May 1965, Didelphis marsupialis, 3♀♀ 3♂♂, J. F. R.  
 2 May 1965, Didelphis marsupialis, 1♀ 2♂♂, J. F. R.

Orchopeas leucopus (Baker)

- Ceratophyllus leucopus Baker, 1904. Proc. U. S. Natl. Mus., 27:387.  
Ceratophyllus aeger Rothschild, 1905. Nov. Zool., 12:166.  
Ceratophyllus leucopus C. Fox, 1914. U. S. Publ. Health Serv. Hyg. Lab. Bull., 97.  
Ceratophyllus leucopus Jordan, 1928. Nov. Zool., 34:179.  
Orchopeas leucopus Jordan, 1933. Nov. Zool., 39:72.  
Orchopeas leucopus I. Fox, 1940. Fleas of E. U. S., p. 64.  
Orchopeas leucopus Hubbard, 1947. Fleas of W. N. Amer., p. 105.  
Orchopeas leucopus Eads, 1950. Fleas of Texas, p. 47.

Species of the white-footed mouse are the principal hosts of Orchopeas leucopus in Payne County.

**MALE:** Frontal tubercle prominent. Preantennal region of head with a lower row of three bristles, an upper row of three or four bristles, and three short bristles along the antennal fossae. Labial palpus extending about  $3/4$  distance to apex of fore coxa. Postantennal region of head with three bristles, the lower one being stout and longest; marginal row of five or six bristles. First antennal segment with a row of about seven short bristles. Pronotum with one row of alternating setae and bristles, and a ctenidium of eight spines on a side. Mesonotum and metanotum each with three rows of bristles. Metanotum and first four abdominal tergites armed with one or two stout dorsal teeth. Abdominal tergites I to VII armed with two rows of bristles. One long and one short antepygidial bristle on a side.

**MODIFIED SEGMENTS:** Movable finger of clasper ham-shaped, armed with four short, sharp black spiniforms. Movable finger extends further dorsal than the clasper. Process of clasper height equal to that of the apical width. Sternite IX with lower lobe armed with three bristles and with one black spiniform inserted in the dorsal posterior angle; lower angle of the lobe angulate. Penis rods short, not completing a  $1/2$ -turn.

**FEMALE:** Chaetotaxy of preantennal region of the head as in the male, except the short bristles along the antennal groove are absent. Postantennal chaetotaxy as in the male. Three antepygidial bristles present, one long and two short. Sternite VII with a shallow sinus separating the two rounded lobes. Spermatheca with the head twice as long as wide and longer than the tail.

## COLLECTION RECORDS:

- 7 January 1948, Sigmodon hispidus, 14♀♀ 4♂♂, D. E. H.
- August to November 1960, Neotoma floridana, 6♀♀ 4♂♂, D. E. H.
- August to December 1960, Microtus pinetorum, 94♀♀ 48♂♂, D. E. H.
- October to December 1960, Sigmodon hispidus, 234♀♀ 133♂♂, D. E. H.
- October to December 1960, Peromyscus maniculatus, 64♀♀ 37♂♂, D. E. H.
- November to December 1960, Peromyscus leucopus, 6♀♀ 2♂♂, D. E. H.
- January to May 1961, Sigmodon hispidus, 443♀♀ 261♂♂, D. E. H.
- January to May 1961, Peromyscus maniculatus, 41♀♀ 19♂♂, D. E. H.
- January to June 1961, Peromyscus leucopus, 86♀♀ 47♂♂, D. E. H.
- January to August 1961, Microtus pinetorum, 616♀♀ 367♂♂, D. E. H.
- April to June 1961, Neotoma floridana, 3♀♀ 8♂♂, D. E. H.
- 12 July 1961, Sigmodon hispidus, 1♀, D. E. H.
- 8 August 1961, Neotoma floridana, 2♂♂, D. E. H.
- 8 August 1961, Peromyscus maniculatus, 1♀, D. E. H.
- December 1964, Peromyscus maniculatus, 7♀♀ 2♂♂, J. F. R.
- December 1964, Peromyscus leucopus, 5♀♀ 5♂♂, J. F. R.
- December 1964, Sigmodon hispidus, 5♀♀ 6♂♂, J. F. R.
- January 1965, Sigmodon hispidus, 10♀♀ 5♂♂, J. F. R.
- January 1965, Peromyscus leucopus, 20♀♀ 16♂♂, J. F. R.
- January 1965, Peromyscus maniculatus, 1♂, J. F. R.
- February to March 1965, Neotoma floridana, 1♀ 1♂, J. F. R.
- March to April 1965, Peromyscus leucopus, 6♀♀ 3♂♂, J. F. R.
- 30 March 1965, Peromyscus leucopus NEST, 1♀, R. E. P.
- 11 April 1965, Neotoma floridana NEST, 1♂, J. F. R.

May 1965, Sigmodon hispidus, 12♀♀ 4♂♂, J. F. R.

7 May 1965, Sigmodon hispidus NEST, 1♂, J. F. R.

Orchopeas sexdentatus (Baker)

Ceratophyllus sexdentatus Baker, 1904.. Proc. U. S. Natl. Mus.,  
27:403.

Orchopeas sexdentatus Jordan, 1933. Nov. Zool., 39:72.

Orchopeas sexdentatus Eads, 1950. Fleas of Texas, p. 47.

MALE: Preantennal region of head with two rows of bristles, a lower row of three stout bristles and an upper row of five medium-sized bristles. Head flattened on top with several fine microsetae along dorsal surface; frontal tubercle small. Genal ctenidium absent. Labial palpus extending almost to apex of fore coxa. Maxilla short and acuminate. Heavily pigmented oval eye. Several microsetae along anterior and posterior margins of the antennal fossae. Postantennal region of head with two medium-sized bristles in addition to a marginal row of five to six bristles, the lower one being the longest. Pronotum with a ctenidium of 9 to 10 spines on a side and with one row of alternating long and short bristles. Mesonotum with one row of bristles; metanotum with three rows of bristles; abdominal tergites II to VII each with two rows of bristles. First four abdominal tergites armed with one or two stout dorsal teeth on a side. Two long antepygidial bristles on a side.

MODIFIED SEGMENTS: Process of clasper rounded apically and with short bristles at apex. Movable finger of clasper with five black pointed spiniforms in a row along posterior portion of finger, one

moderately lengthened bristle and one short bristle dorsad of spiniforms; one rudimentary, lightly pigmented spiniform along anterior margin of finger about 1/4 way down from apex; several small microsetae scattered over lateral surface of finger. Sternite IX with lower lobe having one long, curved black spiniform at the dorsal angle, two bristles below and one beside the spiniform.

**FEMALE:** Chaetotaxy and general structure essentially as in the male. Three antepygidial bristles on a side, the middle one being the longest. Sternite VII somewhat variable in shape but usually with a deep, wide sinus separating the long, somewhat rectangular upper lobe and the triangular lower lobe. Spermatheca with a long barrel-shaped head, head over twice as long as wide, and a short curved tail, curved at a right angle, with an apical appendage; tail set somewhat into the head.

**COLLECTION RECORDS:**

- 4 April 1954, Neotoma floridana NEST, 2♀ 1♂, D. A. G.  
 2 November 1959, Neotoma floridana, 1♀, R. G. P.  
 August to December 1960, Neotoma floridana, 29♀ 28♂, D. E. H.  
 15 September 1960, Sigmodon hispidus, 1♀, D. E. H.  
 1 November 1960, Peromyscus maniculatus, 1♀ 2♂, D. E. H.  
 14 February 1961, Microtus pinetorum, 1♀, D. E. H.  
 11 March 1961, Sigmodon hispidus, 1♀, D. E. H.  
 March to July 1961, Neotoma floridana, 61♀ 52♂, D. E. H.  
 10 May 1961, Peromyscus leucopus, 1♂, D. E. H.

- 26 May 1961, Sigmodon hispidus, 1♀ 2♂♂, D. E. H.  
 2 June 1961, Microtus pinetorum, 1♀, D. E. H.  
 9 December 1964, Sigmodon hispidus, 1♀, J. F. R.  
 17 February 1965, Neotoma floridana NEST, 26♀♀ 6♂♂, J. F. R.  
 7 March 1965, Neotoma floridana NEST, 10♀♀ 15♂♂, J. F. R.  
 9 March 1965, Neotoma floridana, 6♀♀ 2♂♂, J. F. R.  
 15 March 1965, Neotoma floridana NEST, 5♀♀ 5♂♂, J. F. R.  
 11 April 1965, Neotoma floridana NEST, 15♀♀ 12♂♂, J. F. R.  
 5 June 1965, Neotoma floridana NEST, 6♀♀ 2♂♂, J. F. R.

Genus Opisocrostis Jordan

Opisocrostis Jordan, 1933. Nov. Zool., 39:73.

Genotype: Ceratophyllus hirsutus Baker

Frontal tubercle external and distinct. Labial palpus extending beyond apex of fore coxa by a segment. Several long bristles on the second antennal segment. Pronotal ctenidium with eight or nine spines on a side. Basal abdominal sternite armed with a number of slender setae on the upper anterior half. Several lateral setae on fore femur. Several long, thin setae on inner surface of midcoxa and hind coxa extending from the base to the apex. Males with one long and two short antepygidial bristles on a side. Females with two antepygidial bristles on a side, the dorsal one longest.

Opisocrostis hirsutus, from ground squirrels, was the only species collected from Payne County.

Opisocrostitis hirsutus (Baker)

Pulex hirsutus Baker, 1895. Can. Entomol., 27:130.

Opisocrostitis hirsutus Jordan, 1933. Nov. Zool., 39:73.

Opisocrostitis hirsutus Hubbard, 1947. Fleas of W. N. Amer., p. 158.

Opisocrostitis hirsutus Eads, 1950. Fleas of Texas, p. 44.

**MALE:** Preantennal region of head armed with two rows of bristles, the lower row with three stout bristles and the upper row with two bristles. Labial palpus extending beyond apex of fore coxa by a segment. Eye small, egg-shaped, and moderately pigmented. Postantennal region of head with one long bristle, a marginal row of four or five bristles, and a series of small setae along margin of antennal fossae. Several setae of various lengths on second antennal segment. Pronotal ctenidium of eight or nine spines on a side. Pronotum with one row of bristles. Mesonotum, metanotum, and abdominal tergites each with two rows of bristles. Metanotum and first four abdominal tergites armed with one or two stout dorsal teeth. Only one antepygidial bristle on a side.

**MODIFIED SEGMENTS:** Clasper rounded at apex, reaching to about the middle of the long movable finger and bearing three setae at the apex, the middle setae being the longest; two long actabular bristles, the ventral the longest. Movable finger long and slender armed with four bristles on the posterior margin close to the apex, the two lower ones stout and longest. Sternite VIII long and slender with a median ventral pair of bristles, three pairs of subterminal bristles, and one pair of long terminal filaments. Ventral arm of sternite IX ending in a single lobe.

FEMALE: Chaetotaxy and general structure essentially as in the male. Two long antepygidial bristles equal in length on a side. Sternite VII with one lobe and having the upper angle angulate, the lower angle well rounded, and the posterior margin slightly concave. Spermatheca with the head globular and the tail twice as long as the head, its apical half slightly swollen and curved at a right angle.

COLLECTION RECORD:

15 June 1947, Spermophilus tridecemlineatus, 4♀♀ 4♂♂, D. E. H.



## SUMMARY

All available host-flea relationship records from Payne County, Oklahoma, were examined and recorded. Eleven genera and fifteen species of fleas were collected from a total of twenty-one species of mammals. Dichotomous keys to genus and species, a list of the families present and their generic breakdown, description and synonymy of each genus and species collected, and collection records are presented. The collection records for each species of flea includes the dates collected, hosts, number and sex of fleas, and the collector's initials.

A summary of the host-flea relationships is as follows:

### ORDER MARSUPIALIA

#### Family Didelphidae

Didelphis marsupialis (Linnaeus)--Opossum

Cediopsylla simplex

Epitedia wenmanni

Orchopeas howardii

Pulex simulans

### ORDER INSECTIVORA

#### Family Soricidae

Blarina brevicauda (Say)--Short-Tailed Shrew

Ctenophthalmus pseudagyrtis

## ORDER CHIROPTERA

Bat

Myodopsylla collinsi

## ORDER CARNIVORA

Family Canidae

Canis familiaris Linnaeus--Domestic DogCediopsylla simplexCtenocephalides canisCtenocephalides felisEchidnophaga gallinaceaPulex irritansPulex simulansCanis latrans Say--CoyotePulex simulansUrocyon cinereoargenteus (Schreber)--Grey FoxPulex simulans

Family Felidae

Felis catus Linnaeus--Domestic CatCtenocephalides canisCtenocephalides felis

Family Mustelidae

Mephitis mephitis (Schreber)--Striped SkunkPulex simulansTaxidea taxus (Schreber)--BadgerPulex simulans

## Family Procyonidae

Procyon lotor (Linnaeus)--RaccoonConorhinopsylla nidicolaPulex simulans

## ORDER RODENTIA

## Family Cricetidae

Microtus pinetorum (LeConte)--Pine VoleCediopsylla simplexCtenophthalmus pseudagyrtisEpitedia wenmanniOrchopeas leucopusOrchopeas sexdentatusNeotoma floridana (Ord)--Eastern Wood RatConorhinopsylla nidicolaCtenophthalmus pseudagyrtisEpitedia wenmanniOrchopeas leucopusOrchopeas sexdentatusPeromyscus leucopus (Rafinesque)--White-Footed MouseConorhinopsylla nidicolaCtenophthalmus pseudagyrtisEpitedia wenmanniOrchopeas leucopusOrchopeas sexdentatus

Peromyscus maniculatus (Wagner)--Deer Mouse

Conorhinopsylla nidicola

Ctenophthalmus pseudagyrtis

Epitedia wenmanni

Orchopeas leucopus

Orchopeas sexdentatus

Reithrodontomys montanus (Baird)--Harvest Mouse

Epitedia wenmanni

Orchopeas howardii

Sigmodon hispidus Say and Ord--Cotton Rat

Conorhinopsylla nidicola

Ctenophthalmus pseudagyrtis

Epitedia wenmanni

Orchopeas howardii

Orchopeas leucopus

Orchopeas sexdentatus

Family Sciuridae

Spermophilus tridecemlineatus (Mitchill)--Ground Squirrel

Opisocrostitis hirsutus

Sciurus niger Linnaeus--Fox Squirrel

Orchopeas howardii

## ORDER LAGOMORPHA

## Family Leporidae

Lepus californicus Gray--Black-Tailed Jack Rabbit

Hoplopyllus affinis

Sylvilagus floridanus (Allen)--Eastern Cottontail

Cediopsylla simplex

Hoplopyllus affinis

## ORDER PRIMATES

## Family Hominidae

Homo sapiens Linnaeus--Modern Man

Ctenocephalides felis

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PLATE I

- Fig. 1. General anatomy of adult female flea.\*  
 Fig. 2. General anatomy of adult male genitalia.\*  
 Fig. 3. Measurements of female spermatheca.\*

\*These figures are diagrammatic drawings showing the principal parts of the flea used in the taxonomic part of this paper.

LIST OF ABBREVIATIONS USED IN FIGURES

A1	--Antennal segment I	Lp	--Labial palpus
A2	--Antennal segment II	Lt	--Length of tail
A3	--Club of antenna	M	--Maxilla
Aa	--Aedeagal apodeme	Ma	--Manibrium
Ab	--Antepygidial bristle	Mf	--Movable finger of clasper
Af	--Antennal fossa	ML	--Maxillary lacinia
Ag	--Aedeagus	Mn	--Mesonotum
As	--Anal style	Mp	--Metepimeron
C	--Clasper	Mt	--Metanotum
BS10	--Long bristle of sternite X	Mx	--Maxillary palpus
Dt	--Dorsal tooth	Ob	--Ocular bristle
E	--Eye	P	--Pygidium
Ep	--Epipharynx	Pb	--Plantar bristles
F	--Frons	Pc	--Pronotal ctenidium
Fc	--Fore coxa	Pn	--Pronotum
Ff	--Fore femur	Pr	--Penis rods
Fi	--Fore tibia	S	--Spiracle
Fo	--Fore trochanter	S5-8	--Sternites V to VIII
Fs	--Fore tarsus	Sp	--Spiniform
Ft	--Frontal tubercle	T1-8	--Tergites I to VIII
Gc	--Genal ctenidium	T10	--Tergite X
Gp	--Genal process	Tc	--Tarsal claw
Hs	--Head of spermatheca	Ts	--Tail of spermatheca
Ht1-4	--Hind tarsal segments I to IV	Wh	--Width of head
Lb	--Lateral bristle	Wt	--Width of tail
Lh	--Length of head		



VITA

JOHN FRANCIS REINERT

Candidate for the Degree of  
Master of Science

Thesis: HOST-FLEA RELATIONSHIPS OF PAYNE COUNTY, OKLAHOMA

Major Field: Entomology

Biographical:

Personal Data: Born near Fairmont, Oklahoma, March 21, 1940.  
the son of Andrew J. and Emma K. Reinert.

Education: Attended grade school in Douglas, Oklahoma; graduated from high school in Douglas, Oklahoma; received the Bachelor of Science degree from the Oklahoma State University, with a major in Entomology, in May 1962; completed requirements for the Master of Science degree in August 1965.

Professional Experience: Instructor of medical entomology for officer and enlisted courses at the Medical Field Service School, Fort Sam Houston, Texas, since 1962; part of an Army Research and Development team surveying for fleas and other ectoparasites at Big Bend National Park, Texas, Brownsville, Texas, and Cerro Potosi, Mexico; member of Entomological Society of America, Entomological Society of Canada, Kansas Entomological Society, and Phi Sigma.