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February 1943

THE FLEAS OF NORTH AMERICA

Classification, Identification, and Geographic Distribution
of These Injurious and Disease-Spreading Insects

By

H. E. EWING, Entomologist

and

IRVING FOX, Collaborator

Division of Insect Identification

Bureau of Entomology and Plant Quarantine

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By H. E. EWING, *entomologist*, and IRVING FOX, *collaborator*,¹ *Division of Insect Identification, Bureau of Entomology and Plant Quarantine.*

CONTENTS

	Page		Page
Introduction.....	1	The order Siphonaptera—Continued.	
The economic importance of fleas.....	3	The family Hystrichopsyllidae Tira-	
The structure of the siphonapteran head.....	4	boschi—Continued.	
The thorax.....	6	The subfamily Hystrichopsyllinae	
The modified terminal abdominal segments.....	8	Tiraboschi.....	84
The origin and relationships of the Siphonap-		The subfamily Macropsyllinae Oude-	
tera.....	10	mans.....	89
The order Siphonaptera.....	13	The subfamily Leptopsyllinae Roths-	
Key to the families and subfamilies of		child.....	89
Siphonaptera.....	14	The family Ichnopsyllidae Wahlgren.....	96
The family Dolichopsyllidae Baker.....	15	The family Pulicidae Stephens.....	101
The subfamily Vermipsyllinae Wag-		The subfamily Spilopsyllinae Oude-	
ner.....	15	mans.....	102
The subfamily Rhopalopsyllinae Oude-		The subfamily Chimaeropsyllinae,	
demans.....	20	new subfamily.....	115
The subfamily Dolichopsyllinae		The subfamily Pulicinae Tiraboschi.....	116
Baker.....	23	The family Stephanocircidae Wagner.....	119
The subfamily Uropsyllinae Oude-		The family Hectopsyllidae Baker.....	119
mans.....	73	List of synonyms of North American species	
The family Hystrichopsyllidae Tira-		and subspecies.....	123
boschi.....	74	Literature cited.....	124
The subfamily Ctenophthalminae		Illustrations (figs. 4-13).....	129
Rothschild.....	75	Taxonomic index.....	139

INTRODUCTION

The stress of war and the resulting concentration of people intensify flea problems and the danger of serious outbreaks of flea-borne diseases, for fleas figure prominently in the health, efficiency, and comfort of large numbers of people throughout the world. Such diseases as bubonic plague and endemic typhus are carried to man by these insects, which also play an important role as pests of livestock and in dwellings and warehouses.

¹ During the preparation of this work the writers have been aided in various ways by the following persons: Karl Jordan, of the Tring Museum, England; N. E. Good and F. M. Prince, of the U. S. Public Health Service; and E. A. Chapin, of the U. S. National Museum. They have also drawn to some extent upon data, published or unpublished (correspondence, notes with specimens, etc.), left by the late N. C. Rothschild, of England; the late Carroll Fox, of the U. S. Public Health Service; and B. J. Collins, formerly of the U. S. Public Health Service. Other specialists on the Siphonaptera have kindly deposited types at the U. S. National Museum and in this manner have greatly aided in the determination of the synonymy of our North American species. Among them are the following: W. L. Jellison and G. M. Kohls, of the U. S. Public Health Service; C. A. Hubbard, of Pacific University; and Chi-Ying Liu, of National University of Chekiang, Hangchow, China.

The proper identification of fleas forms a sound basis for disease prevention and flea control. This publication, prepared primarily as a taxonomic revision, will help those called upon to identify the species of these insects and recommend control procedures. Full descriptions are given of the genera and higher groups, accompanied in most instances by figures. For species, subspecies, and varieties formal descriptions are avoided, but data have usually been supplied for each as follows: Indication of synonymy, name of type host, type locality, statement relative to range, and remarks upon identification characteristics, nature of original description, references to figures, published notes on biology or economic importance, and redescriptions.

In the preparation of this work the literature has been reviewed up to the end of 1939, and in addition data from those papers that were published before October 1, 1940, are included, if the material upon which they were based was available for study.

Although the fleas of North America have probably been studied more extensively than those of any other continent, only two large and comprehensive papers dealing with them have been published. One of these was by Baker (4)² in 1904, revising all the American fleas, and the other by I. Fox (25) in 1940, revising the fleas of the eastern part of the United States. Thus an up-to-date treatment of all North American fleas is in order. In a limited way a review of the species of this continent is here presented, it being based largely upon the extensive collections of the United States National Museum and of the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture.

Since taxonomic categories are concepts, any extensive use of them should be preceded by definitions or a statement explaining their limitations. The difference between the genus and the subgenus, as these two categories are here used, lies in the nature of the characters employed. Characters which, from a morphological standpoint, would be considered as of only specific importance, if occurring in all species of a small natural group, are here regarded as being of subgeneric value. Characters of the terminalia of both sexes, if they have to do with the presence or absence of a structure or a change in the relationship of one structure to another, are regarded as supplemental generic characters, or in certain cases these sex characters alone may constitute the distinguishing characters of a subgenus. In other words, all first groupings of related species based exclusively on sex characters constitute subgenera. If, however, these sex characters are correlated with one or more other characters, even though the latter are rather insignificant, the group of so-characterized species is regarded under most conditions as a genus.

The differences implied between a subspecies and a variety, as the two terms are here employed, have to do not so much with the conspicuousness or morphological importance of the characters used as with their variation. Minor characters which are continuously variable, such as coloration (amount of pigmentation), length of certain setae, or the shape of some part of the terminalia, are considered of varietal importance if the variations are correlated with geographical

² Italic numbers in parentheses refer to Literature Cited, p. 124.

or host distribution. However, if there is a break in the variation of these characters, they are considered of subspecific importance regardless of whether the differences are correlated with geographical or host distribution. A subspecific character is considered as usually being morphologically more distinctive than a varietal character, and by that token a subspecies is regarded as taxonomically of more importance than a variety, although from the nomenclatorial point of view the two are treated alike.

Characters used for specific purposes less frequently refer to coloration, or length of setae, or even size. They are regarded as essentially the same as those used for the subspecies, except that they are more obvious, less variable, or have a greater morphological significance. Characters resulting from hybridization or local environmental influences are not here considered as good specific characters.

In preparing this taxonomic review an attempt has been made to follow a conservative policy in the treatment of the different categories, avoiding alike the extremes of the "splitter" and those of the "lumper." It is the writers' opinion that in the Siphonaptera the tendency has been toward too much "splitting." This is strikingly shown by the manner in which the genus *Ceratophyllus* Curtis has been split up in recent years. On this Jordan (43, p. 70) has commented as follows:

* * * The splitting-up of *Ceratophyllus* has begun, and there is no means of stopping the process of dissolution from going on. * * *. If I here inflict on science a number of new generic names, I plead the excuse that the divisions of *Ceratophyllus* I here define would inevitably be named by somebody else, probably by someone who does not know these fleas, as has happened in other orders of animals.

In regard to the splitting up of *Ceratophyllus* and certain other genera the present authors have dealt rather firmly. Many of the segregates are retained as subgenera, being in reality excellently fitted for such a rank, while others are reduced to synonymy.

In the part of this publication dealing with the taxonomy of species, subspecies, and varieties the paragraph headings "Cotype Hosts" and "Cotype Localities" have been introduced in those instances in which cotype material came from more than one host and more than one locality.

The number of described genera and species of North American fleas has increased very rapidly in recent years. In this paper 61 genera, 14 subgenera, 209 species, and 63 subspecies and varieties of fleas are listed from North America and the West Indies.

THE ECONOMIC IMPORTANCE OF FLEAS

Fleas are of economic importance in two ways. First, by their direct attacks on man and his domestic animals they cause irritation, loss of blood, and in severe cases the loss of life. Second, because of their blood-sucking habits they are important transmitters of certain internal parasites and disease-producing organisms.

Fleas are probably best known as household pests. Their presence in houses, under certain conditions, may cause the occupants great annoyance. Their occurrence there is due to the presence of their natural hosts, either in the houses or in nearby quarters. These are

such domesticated animals as cats, dogs, and pigs. During the early part of the summer the fleas lay large numbers of eggs on their hosts, which soon drop off into cracks of the flooring or into debris of various kinds. Here the larvae hatch and feed, grow to larval maturity, and transform into quiescent pupae. Then about the middle of the summer, frequently near the time when the occupants of the infested dwelling may be returning from a summer vacation, large numbers of the second generation of adults appear. It is this generation which, because of its great numbers, usually causes so much distress.

In the United States fleas are serious pests of dogs, cats, and poultry. Dogs may be greatly annoyed by fleas and when attacked spend much time gnawing at the affected parts, particularly the back near the root of the tail. As a result these parts become raw and sore, and infection often follows.

Poultry are frequently infested by fleas, and the sticktight flea of the South attaches permanently to the heads of its hosts. Here it sucks the blood and causes much irritation. Young chickens may become so heavily infested that they die from the attacks of these pests.

Some fleas are of much economic importance because they are the transmitters of certain diseases. This is particularly true of those that transmit plague, one of the worst scourges of man. In the United States, as well as in many foreign countries, the oriental rat flea (*Xenopsylla cheopis* (Rothschild)) is the most efficient carrier of the bacterial organism of plague. Also in this country four other species that readily feed on man are thought to be occasional carriers. They are the human flea (*Pulex irritans* Linnaeus), the cat flea (*Ctenocephalides felis* (Bouché)), the dog flea (*Ctenocephalides canis* (Curtis)), and the rat flea (*Nosopsyllus fasciatus* (Bosc)).

Plague organisms, developing in the "gizzard" of the oriental rat flea, frequently cause an obstruction so that when the flea attempts to feed again regurgitation results. It is this regurgitation that is believed to be generally responsible for the transmission of the organisms to man.

Plague first appeared in the United States in California, in 1900, and within 10 years was found to exist in native ground squirrels in several counties. Among these hosts the plague spread slowly until today diseased rodents have been found in the States of Oregon, Washington, Nevada, Idaho, Utah, New Mexico, and Montana. The squirrels act as reservoirs for the disease, and the fleas, becoming infected with the bacteria obtained from these rodents, may later feed on rats or man and thus increase the spread of the plague.

Fleas also are vectors of endemic typhus. This disease is a mild form of typhus found in several of the warm countries of the world.

THE STRUCTURE OF THE SIPHONAPTERAN HEAD

In many of the more generalized fleas, such as *Ctenocephalides canis* or *Hoplopsyllus affinis*, the division of the forehead into a front and a pair of genae is evident. The front extends, with its outwardly curved anterior margin, down to the anteroventral angle of the head. The genae form the lower margin of the head and extend upward at

least to the antennal grooves. They fuse anterodorsally, without a delimiting mark of any kind, with the front.

The front, which is so conspicuous in *Ctenocephalides* (fig. 1) and many other genera, becomes so reduced in certain families that it is very inconspicuous, and in *Craneopsyllus wolffhuegeli* it is vestigial, having been apparently overlooked in the past. As the front becomes smaller, the genae become increasingly larger. This process has gone so far in the family Stephanocircidae that almost all the forehead is composed of the greatly enlarged genae.

If it were not for the fact that the front usually can be identified by two of its structural features, the frontal tubercle and the dermal pits, confusion frequently would exist in regard to the part it takes in

FIGURE 1.—Head of a flea, female of *Ctenocephalides felis*, with the different parts labeled.

the composition of the head. The frontal tubercle, although sometimes absent, is a well-known structure on the anterior margin of the front. Usually it is sharply angulate at its apex and is situated in a small notch, the frontal notch. The dermal pits are small paired pits (fig. 1) which usually are located near the anterior margin of the front. The maximum number of pairs on the front is three, as in such genera as *Hoplopsyllus*, *Actenophthalmus*, and *Sternopsylla*. In *Neopsylla*, *Otenophthalmus*, and many other genera there are two pairs of dermal pits on the front. In *Craneopsylla* only a single pair persists. The presence of any of these pits always identifies the front.

When the genae become greatly enlarged at the expense of the front there is a tendency for each gena to become differentiated into an anterodorsal and a posteroventral part. This differentiation has pro-

gressed so far in the family Stephanocircidae that the two parts are completely separated. At the same time the anterodorsal parts of the genae still retain their fusion with the front, and these three fused sclerites form a conspicuous crownlike structure known as the helmet. Such a profound change in the basic structure of the head sets apart the family Stephanocircidae very distinctly from all the other families of fleas.

In the figure of the head and thorax of *Otenocephalides canis* given by Ewing (16, p. 154) the unpaired piercing element of the mouth parts was labeled, following the practice of certain former workers, the hypopharynx. This structure has been called the labrum-epipharynx by some workers, but it should be called the *labrum* (fig. 1), since there is no evidence that the epipharynx enters into its composition.

The postantennal portion of the head of a flea (fig. 1) has long been known as the occiput, or occipital region. These terms, however, should be restricted in their application to the posterior part of this postantennal region. The part of the head immediately posterior to the front must be the epicranium. Since the epicranium and the occiput are not separated by an occipital suture, the extent of each is not definitely known. The setae situated in oblique rows on the postantennal portion of the head in some fleas may be called the postantennal setae. Those of the posterior vertical row (fig. 1) may be called the occipital setae, or setae of the posterior, marginal row.

THE THORAX

Jordan and Rothschild (47, p. 23) have given an exposition of the external structure of the thorax of a flea. The description here given differs from that of those authors largely in the interpretation of the lateral sclerites of the metathorax.

The body of a flea, including the thorax, has become greatly compressed or laterally flattened. As a result the ventral sclerites have assumed largely or completely a lateral position. Although much modified in shape by compression, the generalized nature of the thorax is easily discerned. It is divided into three distinct segments (fig. 2), the prothorax, mesothorax, and metathorax, all of which are movably articulated into the body "chain" of segments. The upper part of each thoracic segment is covered with a single, undivided sclerite. These are the pronotum, mesonotum, and metanotum. The posterior margin of each of these dorsal thoracic sclerites overlaps the anterior margin of the following dorsal sclerite in the same manner as do the dorsal abdominal sclerites.

The sternal and pleural sclerites of each thoracic segment have become either fused or united (fig. 2) so as to make a single unit. Such a unit or section of a thoracic segment is typically made up of a ventral sternum, and on each side an anterodorsal episternum and a posterodorsal epimeron.

The sternal and pleural sclerites of the prothorax typically are fused into a movable saddlelike mass (fig. 2), the sternopleura. This sternopleura extends forward and has its longest dimension in an almost horizontal direction.

The sternal and pleural sclerites of the mesothorax (fig. 2) have a position and relationship more commonly found in other insects.

The sternum is ventral, and in lateral view usually appears to be the smallest of the sclerites. It is the most heavily pigmented. In nearly all genera it is without demarcation from the episternum, but in some genera, such as *Stenistomera* and *Cratynius*, the meso-

FIGURE 2.—Lateral view of the thorax of *Ctenocephalides felis*, with parts labeled.

sternum is separated from the mesepisternum on each side by an inner chitinous ridge, a character of generic importance. The mesepisternum similarly may be separated from the mesepimeron by an inner chitinous ridge (fig. 2), the pleural ridge, in many genera of

fleas such as *Otenocephalides*, *Spilopsyllus*, and *Chimaeropsylla*; or the two sclerites may be completely fused, without demarcation, as in *Moeopsylla*, *Pulex*, and others. This character has been used in separating the subfamily Pulicinae from the other subfamilies of Pulicidae.

The sternopleural sclerites of the metathorax (fig. 2) show the greatest diversification of those of any thoracic segment. Though typically of a similar arrangement to those of the mesothorax, in many genera the following important diversifications may be noted:

(a) The metepisternum may be divided into an upper and a lower part by an internal chitinous ridge as in the genus *Rectofrontia*. This division may be continued to such a degree that the upper part of the metepisternum becomes detached from the lower part and transferred to the metanotum, being fused with the latter as in the subgenus *Opisocrostis*.

(b) The metepimeron may be so expanded (fig. 2) as to be the largest of all the laterally placed sclerites of the body.

(c) The metepimeron usually is entirely free from the metanotum and is clearly separated from the metepisternum by an internal chitinous ridge, but in the genus *Rectofrontia* the metepimeron becomes completely fused, without demarcation, with the metanotum, while in the genus *Opisocrostis* the metepimeron is movably articulated with the metanotum by means of a condyle. Although usually separated from the metepisternum by an inner vertical ridge, in the genus *Trichopsylloides* the metepimeron is completely fused, without demarcation, with the former sclerite along its upper anterior end.

THE MODIFIED TERMINAL ABDOMINAL SEGMENTS

The abdomen of a flea usually has been regarded as being composed of 10 segments, but according to Wagner (81) there are in reality 12. Wagner's contention rests to a large extent upon whether the "cerci" of a flea (present in females) represent the true cerci. If they do, they indicate the presence of the eleventh segment. This follows since embryological studies have shown that in general the cerci of insects represent the appendages of the eleventh segment. Behind the segment in a flea that bears the stylets, or "cerci," there are always present sclerites which Wagner believes represent those of the twelfth abdominal segment. There are reasons, however, for not regarding the stylets as true cerci. In the first place they not only are restricted to the female sex, but are wanting in this sex in certain genera. Secondly, it has been shown by the recent study of the embryology of the fleas by Kessel (53) that there are 10 posterior pairs of ganglia belonging to the abdominal region; while the caudal segment has no ganglion. Thus it would appear that there are 11 abdominal segments in the flea embryo and probably the same number in the adult. If this reasoning is correct, then the anal segment of Wagner is the eleventh abdominal and the stylets are on the tenth, while true cerci are wanting.

The first seven segments of the abdomen usually are unmodified in both sexes.

The eighth abdominal segment is practically unmodified in the males of some genera. In the males of most genera, however, the eighth sternal plate is much modified. It may be greatly reduced

FIGURE 3.—Modified terminal abdominal segments of a male flea, *Nosopsyllus fasciatus*, with parts separated from one another so as to show their structure more clearly.

in size, or it may be extended into a long, posteriorly directed process or have other modifications. The eighth sternal plate may be somewhat rudimentary in the female.

The ninth abdominal segment is of greatest interest both morphologically and taxonomically because in the male (fig. 3) it bears what is believed to be a pair of segmental appendages, the clasping apparatus. The ninth tergal plate is either fused with the pygidium in both sexes, or, in the male, it may be fused with the dorsal plate of the clasping apparatus. Most of the ninth sternal plate of the male usually consists of a modification and elongation (which may be rather complicated) of the overlapping posterior margin of this plate. The same sternal plate is rudimentary or absent in the female.

The clasping apparatus of a flea, which is commonly regarded as representing a pair of segmental appendages, consists of the following parts on each side: The basal body, which is united with the body of the other side by the dorsal plate, an inwardly and forwardly projecting arm known as the manubrium (fig. 3), a dorsal process, and a posterior movable element known as the movable finger. Wagner regards the basal body, with its movable finger, as representing a gonopod.

The tenth abdominal segment usually is regarded as being represented by the pygidial plate. According to Wagner this plate is fused with the tergal plate of the twelfth segment in the female, and in the same sex the sternal plate of the tenth segment is absent. The tenth sternal plate usually is absent in the male, but, according to Wagner, may be present in the form of a subpygidial sclerite.

The eleventh segment, according to Wagner, has no tergal sclerotizations, but the sternal plate may be the subanal plate in the male, and the "cerci" of the female may be rudiments of the ventral part of the eleventh segment shifted to a dorsal position.

The twelfth segment, according to Wagner, is the so-called anal segment, consisting of a simple tergal and sternal plate in the female and a simple tergal plate and two cercuslike sternal sclerites or a single plate in the male.

It appears to the writers, however, that the anal sclerites of the so-called anal segment are more likely comparable to the epiproct and paraprocts of thysanurans and orthopterous insects, in which case they should represent the sternal and tergal plates of segment XI of the abdomen.

THE ORIGIN AND RELATIONSHIPS OF THE SIPHONAPTERA

The origin and the relationships of the Siphonaptera have been moot questions ever since the study of taxonomic entomology began, and during the last century many papers were published dealing with these subjects. Unfortunately the theories advanced were based not only upon wholly insufficient and largely faulty interpretations of the morphology of the fleas themselves but also of the morphology of insects in general. Those who are interested in a summary of the theories of these earlier workers are referred to a paper by Packard (61) published in 1894 under the title *On the Systematic Position of the Siphonaptera, with Notes on their Structure*. The prevailing tendency of these early workers was to regard the fleas as specialized Diptera or specialized Hemiptera. Some of them, however, considered the fleas as a distinct order having relationships with either the Diptera, the Hemiptera, the Coleoptera, or the Hymenoptera.

Packard himself, although giving an interpretation of the morphology of the fleas now known to be in error in many respects, had this to say about their relationships (61, p. 354):

The larva of the Siphonaptera apparently presents the nearest approach of any of the insects now existing to the shape of the primitive Diptera. It is certainly a more perfectly developed larva as regards its external structure and also the position of the brain than any dipterous one, and approaches nearer to our conception of the primitive, ancestral, dipterous larva than any other form.

Packard further says:

As regards the phylogeny of the Siphonaptera we can only say, with our present imperfect knowledge of their embryology, that they seem to stand nearer to the Diptera than to any other order, and that they must have diverged from the ancestral dipterous stem before the existing forms of Diptera had become so extremely specialized as we now find them to be.

Dahl (9) published in 1898 an interesting paper on the systematic position of the Siphonaptera. He would derive the fleas, the phorids, and the dipterous genus *Scatopse* from a common hypothetical stem which he called the Archiscatopse. Although, as pointed out by Ewing (15, p. 348) in 1924, Dahl's—

interpretation of the degeneration of the Phorid compound eye into the minutely spined area found in some fleas just above the antennal fossa, is certainly very speculative * * *

yet his theory is one of the best proposed, and he has given many data in support of it. Particularly convincing is his demonstration of the apparently complete homology between the antenna of certain male fleas and that of *Scatopse*. Not only does the antenna of the male flea have the same two basal segments, but the pseudosegments in the long club are the same in number as those distad of the second segment of the antenna in *Scatopse*.

Martini (56) in 1922 revived the old theory of the basic relationship of the fleas with the Coleoptera. He pointed out the many homologies between fleas and the genus *Oxytelus* and gave figures representing cross sections of a flea and an oxyteline in which the fundamental structures are homologized. It should be noted that some of the homologies mentioned by Martini as existing between structures of fleas on the one hand and those of the Staphylinioidea on the other are of a very general nature and doubtless exist between fleas and many other kinds of insects.

Crampton (7, p. 324) has pointed out the relationships of fleas to the Trichoptera and states that the latter—

could readily serve as the types ancestral to fleas since they have three-segmented labial palpi, their prothoracic sclerites are as much like those of the fleas as any insects, the mesothoracic and metathoracic coxae of Trichoptera are divided into a eucoxa and meron, and the Trichoptera have cerci and terminal structures suggestive of those of the fleas.

He opposed the theory that fleas could be derived from the Diptera because—

The labial palpi of fleas are frequently composed of at least three segments, while the labial palpi of Diptera (labella) and Mecoptera are never composed of more than two segments, and therefore could not serve as the prototypes of the labial palpi of fleas.

He also opposed the theory of the origin of fleas from the Diptera because the latter have no meron in the metathoracic leg.

Crampton assigns to the fleas the rank of a superorder, it being one of the three superorders into which holometabolous insects are divided. His arrangement of these superorders follows: The Pansiphonaptera, including the Siphonaptera only; the Panmecoptera, including the Neuroptera, Mecoptera, Diptera, Lepidoptera, and Trichoptera, with their fossil allies; the Pancoleoptera, including the Coleoptera, Strepsiptera, and Hymenoptera, with their fossil allies except the Protohymenoptera.

The theory that fleas have been derived from the Trichoptera was assailed by Tillyard (74, p. 39) who stated that—

There is not a shred of evidence in favor of Fleas having been derived from an aquatic ancestral type. . . . For Fleas to have been derived from Trichoptera, it would be necessary to postulate the loss of the ancestral functional mandibles and the evolution of the present type of elongated spear-like organ from the nonfunctional vestige of the Trichoptera! This also involves a belief in the loss and subsequent reappearance of the mandibular muscles, and contra-venes Dollo's Law.

* * * Fleas are smooth and shiny, very unlike the soft-haired Trichoptera in their body-covering. What hairs they possess are specialized into stiff bristles and combs.

Tillyard (74) claimed that the ancestors of the Siphonaptera must have possessed short antennae, elongated mandibles, four-segmented maxillary palpi, a smooth and leathery body, a metathorax not highly reduced, middle and hind coxae with a meron, and a terrestrial larva feeding on animal or vegetable debris. The pupa must have been a *pupa libera*, either in a cocoon or a primitive earthen cell. He believed that the only ancestors that meet these conditions are—

(a) a small, reduced type of primitive Mecopteron, probably of the Upper Permian family Permochoristidae, or (b) a related form classifiable definitely within the Paratrachoptera.

The objections of Crampton (7) and Tillyard (74) to deriving fleas from ancestral Diptera because of the absence of a meron from the third coxa of the latter is not well founded. Many Diptera have the second coxa with a well developed meron, although both coxa and its meron may be partly or largely transferred to the body wall. Such is the case in the Tabanidae. Other Diptera have the third coxa well developed, with the evidence indicating that there has been a reduction and fusion of the eucoxa and the meron.

A condition somewhat similar to this is found in certain fleas, as, for example, those of the genus *Echidnophaga*. In fleas of this genus the meron of the mesocoxa is reduced but separated from the eucoxa by a groove, while that of the metacoxa is partly fused with the eucoxa. Further, it is to be noted that the third coxa of some phorids is not very different in its major aspects from the third coxa of certain fleas, and although there is no suture or ridge dividing it into a true eucoxa and a meron, there exists an undifferentiated area which probably represents the meron.

The writers believe that much printed space has been wasted discussing the value of the labial palpus as a structure indicating the origin of the Siphonaptera. The segmentation of these appendages is such that they could have been evolved from those of almost any group of free-living insects. The most common number of true segments in the labial palpus of a siphonapteron is five. Yet there are several genera with four, three, or two segments in each palpus.

Fleas like those of the genus *Vermipsylla* have many so-called segments in the labial palpus. Most of these evidently are not true segments, but pseudosegments, as is indicated by the fact that they are very short and frequently only partly separated from one another by sutures that are incomplete and not transverse.

The present writers would derive the fleas and the Diptera from a common ancestral stock. However, the fleas are to be regarded as older and more primitive than the Diptera. There are two reasons for this, one being that the flea larva is decidedly of a more generalized type than the larvae of most of the Diptera, and the other, that fleas lack reduction and modification of the metathorax such as that found in flies. Fleas probably developed from ancestors that yet had functional metathoracic wings and hence were not true Diptera.

The Order SIPHONAPTERA

Small insects, with a complete metamorphosis; parasitic in adult state on warm-blooded vertebrates; without wings or wing vestiges; body greatly compressed and frequently provided with 1 or more combs of spines.

Head always divided into 2 regions by an oblique antennal groove and in some genera also divided into an anterior and a posterior part by the presence of a deep fronto-epicranial groove. Antennae short, stout, each contained in a deep sulcus known as the antennal groove; segments beyond the second greatly shortened and formed into a club. Eyes simple, consisting of a single pair; degenerate or absent in some genera. Mouth parts adapted for piercing and bloodsucking. Maxillae each with a filiform, segmented palpus and a subtriangular, ventrally projecting, acute, maxillary lobe. Labrum long, flattened, almost needlelike, together with the mandibles forming a piercing beak. Mandibles long, piercing blades, with parallel, saw-toothed margins. Labium with greatly reduced base, but with segmented palpi, grooved on inner surfaces, the 2 fitting together to form a labial beak.

Thorax composed of 3 freely moving segments. Prothorax with large pronotum, frequently bearing a transverse comb of spines; sclerites of sternal and pleural regions anchylosed, forming a saddlelike structure bearing the front pair of legs. Mesothorax larger than prothorax. Mesonotum usually somewhat expanded, never with comb of spines. Mesosternum, mesepisternum, and mesepimeron anchylosed, but the boundaries of union usually indicated by internal sclerotized ridges. Metathorax similar to mesothorax except that the metasternum is greatly reduced, the metepisternum is divided into 2 parts by a horizontal suture, and the metepimeron is greatly expanded posteriorly.

Abdomen apparently composed of 10 segments, but in reality of 11. Segment I greatly reduced ventrally, without sternum. Tergal plate VII usually with a clump of 1 to 4 large or stout bristles (antepygial bristles) on each side at posterior margin. Dorsum IX with a specialized, saddlelike plate known as the pygidium, which is studded with minute setae. In female, segment XI with a pair of small, 1-segmented stylets (? cerci) situated dorsally. In males of most genera sternal plate VIII modified, being either greatly reduced in size or extended posteriorly into a long process of a variety of shapes. Sternal plate VIII in the female occasionally somewhat rudimentary. Ninth abdominal segment in male bearing a pair of claspers. Sternal plate IX in male greatly modified, consisting usually of a pair of inner vertical processes and a long, highly modified, posterior or horizontal process or lobe. Male flea with a complicated protrusible penis and female with 1 or 2 receptacula seminis.

Legs typically insectan. Each with a large, long, flattened coxa; a small, ringlike trochanter; a large femur; a tibia enlarged distally; a 5-segmented tarsus, and each tarsus terminated by a pair of subequal, curved claws.

The order contains six families as follows: Dolichopsyllidae, Hystrihopsyllidae, Ischinopsyllidae, Pulicidae, Stephanocircidae, and Hectopsyllidae.

Besides the name Siphonaptera, which should be attributed to Latreille, two other names have been commonly applied to the fleas, *Aphaniptera* Kirby and *Suctoria* Retzius. In the selection of the names of orders more consideration should be given to appropriateness and usage than to priority. Hence, in this work the term Siphonaptera has been used.

The fleas have been divided into from three to about six families by most modern workers. All workers recognize the families Pulicidae and Ischnopsyllidae, and two other families are usually recognized, one containing the genus *Ceratophyllus* and related genera and the other containing the degenerate genus *Tunga* and related genera.

Wagner (86) has surpassed all others in the number of families and subfamilies he has recognized for the order. He recognizes 10 families and 28 subfamilies, in addition to many tribes. Since many of these subfamilies and tribes contain but a single genus each and many are hard to separate properly on morphological characters, a more conservative and usable classification appears desirable.

KEY TO THE FAMILIES AND SUBFAMILIES OF SIPHONAPTERA

1. Thorax not greatly reduced, thoracic terga taken together longer than first abdominal tergum; gravid females moderately, if at all, enlarged ----- 2
 Thorax greatly reduced, thoracic terga taken together shorter than first abdominal tergum; females sometimes with a reduced number of abdominal spiracles, and when gravid, abdomen greatly distended ----- Hectopsyllidae Baker.
2. Gena not divided by a vertical suture; head without helmet ----- 3
 Gena greatly enlarged, being extended dorsally in front of antennal groove and divided by a vertical suture; head with a helmet composed of the greatly reduced front and anterior parts of the greatly enlarged genae; postantennal region of head with a dorsal incrassation ----- Stephanocircidae Wagner.
3. Typical abdominal terga each with more than 1 transverse row of setae; fronto-epicranial groove frequently present ----- 4
 Typical abdominal terga each with but 1 transverse row of setae; fronto-epicranial groove usually absent; eyes usually present. ----- Pulicidae Stephens 12
4. Head seldom elongated, ventral flaps absent. Not parasitic on bats... 5
 Head usually elongated, always with 2 or 3 ventral flaps on each side adjacent to fronto-genal angle. Parasitic on bats. ----- Ischnopsyllidae Wahlgren.
5. Cephalic combs absent; front not reduced; abdominal combs rarely present; abdominal apical spines rarely numerous. ----- Dolichopsyllidae Oudemans 6
 Cephalic combs present; front frequently reduced; abdominal combs frequently present; abdominal apical spines frequently numerous. ----- Hystrichopsyllidae Baker 9
6. Frontal notch or frontal tubercle, or both notch and tubercle, present (although sometimes vestigial) ----- 7
 Frontal notch and frontal tubercle absent, there being no vestige of either ----- Uropsyllinae Oudemans.
7. Antepygidial bristles absent or very poorly differentiated; abdomen frequently distended in female ----- Vermipsyllinae Baker. 8
 Antepygidial bristles present, conspicuous; abdomen not distended; labial palpus usually with 5 or less segments -----
8. Pronotal comb absent ----- Rhopalopsyllinae Oudemans.
 Pronotal comb present ----- Dolichopsyllinae Oudemans.

9. Front never greatly reduced, forming at least one-half of anterior margin of head; genae usually not greatly enlarged, and usually longest horizontally; eyes sometimes present.----- 10
 Front greatly reduced, dorsal or anterodorsal in position, forming less than one-half of anterior margin of head, possessing 1 or 2 pairs of dermal pits and never more than a vestigial frontal tubercle; genae greatly enlarged, longest in a vertical or nearly vertical direction; eyes vestigial or absent.-----Leptopsyllinae Rothschild.
10. Labial palpus with few segments (not over 8); cephalic comb seldom extending along both ventral margin of gena and anterior margin of antennal groove.----- 11
 Labial palpus with many segments (more than 10); cephalic comb extending along ventral margin of gena and anterior margin of antennal groove; female with 2 receptacula seminis, 1 smaller than the other. Found only in Tasmania.-----Macropsyllinae Baker.
11. Frontal tubercle or frontal notch present, although either or both may be vestigial; genal comb never with more than 6 spines. Small to medium-sized fleas.-----Ctenophthalminae Rothschild.
 Frontal tubercle and frontal notch absent; genal comb sometimes with more than 6 spines. Medium-sized to giant fleas.
 Hystrichopsyllinae Tiraboschi.
12. Mesepisternum separated from mesepimeron by an internal, vertical ridge.----- 13
 Mesepisternum not separated from mesepimeron.-----Pulicinae Tiraboschi.
13. Fronto-epicranial suture indistinct or absent; postantennal region of head but slightly, if at all, incrassate dorsally.
 Spilopsyllinae Oudemans.
 Fronto-epicranial suture well developed; postantennal region of head dorsally incrassate; front considerably reduced, bringing fronto-genal angle up almost to level of eyes. Found only in Africa.
 Chimaeropsyllinae, new subfamily.

The Family DOLICHOPSYLLIDAE Baker

Head seldom divided into an anterior and a posterior part by presence of fronto-epicranial groove. Genae not greatly enlarged and not divided by suture. Cephalic combs absent. Forehead without helmet, seldom elongated, and always without ventral flaps. Eyes either well developed, vestigial, or absent. Thorax not greatly reduced; thoracic terga taken together longer than abdominal tergum I. Typical abdominal terga each with more than 1 transverse row of setae. Abdominal apical spines frequently present but rarely numerous. Abdominal combs absent. Females without a reduced number of abdominal spiracles, and when gravid not greatly distended.

This family contains four subfamilies, as follows: Vermipsyllinae, Rhopalopsyllinae, Dolichopsyllinae, and Uropsyllinae.

The subfamily Dolichopsyllinae was established by Baker (5, p. 127) in 1905, and in 1909 Oudemans (59, p. 156) raised it to family rank, attributing the family name to Baker. The family Ceratophyllidae Rothschild (66, p. 58), based on *Ceratophyllus* Curtis, should be regarded as a synonym of Dolichopsyllidae. The family as here described does not include the subfamily Ctenophthalminae which was included in it by Ewing (16, p. 166) in 1929. There is some doubt as to whether this subfamily constitutes a natural group, but its genera can readily be placed according to the arrangement given in this publication.

The Subfamily VERMIPSYLLINAE Wagner

Head not divided into an anterior and a posterior part by a frontoepicranial groove. Frontal tubercle present. Eyes present or absent. Labial palpus long and usually with more than 6 segments. Pronotal comb present in only 1 genus (*Trichopsylloides*). Antepygial bristles absent, or very poorly differentiated. Abdomen of gravid females sometimes considerably distended.

The subfamily Vermipsyllinae contains four genera, all but the type genus being represented in the North American fauna.

The subfamily dates from 1889, when it was established by Wagner (77, p. 205). It has been recognized as a family by Dalla Torre (10, p. 18) in his catalog of the fleas, and likewise by Wagner (80, p. 39) in the latter's catalog of Palaearctic Siphonaptera. In the structure of the head Vermipsyllinae has much in common with Pulicidae, but the characters of the body proper ally it with the Dolichopsyllidae.

KEY TO THE NORTH AMERICAN GENERA OF VERMIPSYLLINAE

1. Pronotal comb absent; eyes present.....	2
Pronotal comb present; eyes absent. Known only from the western part of the United States.....	<i>Trichopsylloides</i> Ewing.
2. Labial palpus with less than 7 segments.....	<i>Chaetopsylla</i> Kohaut.
Labial palpus with 7 to 10 segments.....	<i>Arctopsylla</i> Wagner.

The Genus CHAETOPSYLLA Kohaut

(Fig. 4, E)

Chaetopsylla Kohaut, 1903, Allattani Közlemények 2:37. Type, *Chaetopsylla rothschildi* Kohaut (by subsequent designation).

Frontal tubercle small to vestigial, not angulate but buttonlike. Antennal club either rounded or somewhat pointed at apex. Eyes somewhat reduced, poorly pigmented near center. Labial palpus short, with less than 7 segments. Postantennal region of head with 2 or 3 oblique rows of setae. Pronotal comb absent. Upper sclerite of metepisternum separated from metanotum by an inner pigmented ridge. Metepimeron somewhat reduced and sometimes ankylosed to some extent with upper sclerite of metepisternum. Abdomen of female with somewhat enlarged spiracles and when gravid sometimes considerably distended. Antepygidial bristles absent (not differentiated). Sternum VIII of male large, broad, practically undifferentiated; sternum IX of male narrowed, elongated, considerably modified.

The name *Trichopsylla* frequently has been used instead of *Chaetopsylla* Kohaut, the latter being considered as a synonym of the former. But according to the rules of nomenclature there is apparently no justification for such usage. The type species of *Trichopsylla* Kolenati was first selected by Baker (4, p. 371) in 1904 as *penicilliger* Grube. Jordan and Rothschild (50, p. 63) in 1920 pointed out that Kolenati, when he established the genus *Trichopsylla*, had misidentified *penicilliger* Grube, one of the included species, and stated that—

His *penicilliger* has no pronotal comb and therefore is not *penicilliger* Grube; from the descriptions of the genus and the species it is evident that the species erroneously identified as *penicilliger* is a *Vermipsylla*.

Hence Jordan reduced *Vermipsylla* Schimk. to synonymy with *Trichopsylla* Kolenati. At the same time *Chaetopsylla* Kohaut and *Oncopsylla* Wahlgren were sunk as synonyms of *Trichopsylla*.

Wagner (80, p. 39) in 1930 did not accept this synonymy but claimed that *Chaetopsylla* Kohaut was a valid genus. He identified *penicilliger* Grube as a species of *Ceratophyllus* Curtis, and stated that the systematic position of the species Kolenati identified as *penicilliger* Grube was unknown. It was identified by Jordan (42, p. 293) in 1932 as *Trichopsylla homoeus* Rothschild and listed as the genotype of *Trichopsylla* Kolenati. Again Jordan sunk *Oncopsylla* Wahlgren and *Chaetopsylla* Kohaut as synonyms of *Trichopsylla*.

This substitution of *Trichopsylla homoeus* Rothschild for *T. penicilliger* Grube as the type of *Trichopsylla* can hardly hold under Opinion 65 of the International Commission on Zoological Nomenclature. The "special Committee for recommendation as to action," whose report was adopted by the Commission and ordered published, stated:

The Committee is of the opinion that as a specimen is the type of a species, so a species is the type of a genus, and hence that when an author names a particular species as type of a new genus it is to be assumed that it has been correctly determined. If a case should present itself in which it appears that an author has based his genus upon certain definite specimens rather than upon a species it should be submitted to the Commission for consideration.

The genus *Chaetopsylla* is given first place in this work because preference is desired for it over *Arctopsylla* as the most generalized genus of fleas. The point at issue between the two genera is the number of segments in the labial palpi, there being a smaller number in *Chaetopsylla*. The most common number of segments in the labial palpi of the more generalized insects appears to be three. In fleas it is five, but four or two are not uncommon. In those genera in which the number of segments has been increased to more than five the evidence of secondary segmentation is easily detected. As pointed out by Tillyard (74, p. 40)—

if we examine the labial palpi of those types which possess a large number of palpal segments, we are forced to the conclusion that these supposed segments are actually only secondary annulations of more primitive segments * * *.

CHAETOPSYLLA FLORIDENSIS (I. Fox)

Trichopsylla floridensis I. Fox, 1939, Wash. Ent. Soc. Proc. 41: 45, pl. 6, fig. 6.

Chaetopsylla floridensis Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 40.

Type host.—Unknown.

Type locality.—Gainesville, Fla.

Range.—Known only from the type locality.

The original description of *floridensis* was based on specimens taken in garden truck leafmold and is accompanied by a drawing of the male terminalia. This species differs from *Chaetopsylla lotoris* (Stewart) particularly in the chaetotaxy of the head and metepimeron.

CHAETOPSYLLA GLOBICEPS (Taschenberg)

Pulex globiceps Taschenberg, 1880, Die Flöhe, p. 66, pl. 2, figs. 10, 10a, and 11.

Chaetopsylla globiceps Wagner, 1930, Katalog der palaearktischen Aphanipteren, p. 40.

Cotype hosts.—*Vulpes vulpes* (L.) (fox) and *Taxidea taxus* (Schreber) (American badger).

Type locality.—(?).

Range.—In North America known only from Greenland, as reported by Meinert (57, p. 187) in 1895.

Wagner, 1930, gives *Pulex vulpes* Motschulsky as a questionable synonym.

The head of *Chaetopsylla globiceps* is hardly globular or spherical. However, the upper and front margins of the head do make a continuous, broadly rounded head outline. Females of *globiceps* have the abdomen somewhat distended and the receptaculum seminis with a heavily sclerotized, subspherical head and a rather long, sausage-like tail.

CHAETOPSYLLA LOTORIS (Stewart)

(Fig. 4, E)

Trichopsylla lotoris Stewart, 1926, Insector Inscitiae Menstruus 14: 122, 1 fig.; I. Fox, 1940, Fleas of the Eastern United States, p. 33, pl. 8, figs. 35, 37, and 38, and pl. 9, fig. 42.

Chaetopsylla lotoris Wagner, 1936, Canad. Ent. 68: 195.

Type host.—*Procyon lotor* (L.) (raccoon).

Type locality.—Olcott, N. Y.

Range.—Eastern part of the United States.

This flea probably has the raccoon as an exclusive true host. That it should have existed so long on such a common and well-known host as the raccoon without discovery is remarkable. It is particularly significant that the host is related to the bears and that *Chaetopsylla setosa* Rothschild occurs on our black bear.

CHAETOPSYLLA SETOSA Rothschild

Chaetopsyllus setosus Rothschild, 1906, Canad. Ent. 38: 321, figs. 41 and 42.

Cotype hosts.—*Canis latrans* Say (coyote) and *Euarctos americanus* (Pallas) (black bear).

Cotype localities.—Eagle River, Sicamous, and Mabel Lake (British Columbia), Canada.

Range.—Known only from Canada.

The original description of *setosa* was based only on the female. A single male, taken from *Ursus horribilis bairdi* (grizzly bear), and considered as possibly this species, was described and figured by Wagner (83, p. 335, fig. 2) in 1936.

The Genus ARCTOPSYLLA Wagner

(Fig. 4, D)

Arctopsylla Wagner, 1930, Katalog der palaearktischen Aphanipteren, p. 40: 1933, Konowia 12: 94. Type, *Ceratophyllus tuberculaticeps* Bezzi (by original designation).

The genus *Arctopsylla* was proposed by Wagner in 1930, but without description. It was described by him in 1933.

Frontal tubercle vestigial. Antennal club pointed apically. Eyes present, well developed. Labial palpus long, extending to or beyond apex of trochanter I, with 7 to 10 segments. Postantennal region of head with 3 rows of setae, the posterior row submarginal. Pronotal comb absent. Upper sclerite of metepisternum not distinctly separated from metepisternum proper but separated from metanotum by an internal sclerotized ridge. Metepimeron not fused along upper part with metepisternum. Abdomen of gravid female but little distended. Antepygial bristles not differentiated from the others. Sternum VIII of male large, broad, unmodified; sternum IX much reduced but otherwise not greatly modified.

ARCTOPSYLLA URSI (Rothschild)

(Fig. 4, D)

Pulex ursi Rothschild, 1902, Ent. Rec. and Jour. Variation 14: 62, pl. 2, fig. 1.

Arctopsylla ursi Wagner, 1930, Katalog der palaearktischen Aphanipteren, p. 40 (as a synonym of *A. tuberculaticeps* (Bezzi)).

Type host.—*Ursus horribilis* Ord (grizzly bear).

Type locality.—Calgary, Alberta.

Range.—Known only from Canada and Alaska.

Wagner (80, p. 40), in his catalog of the Palaearctic fleas, gives *ursi* as a synonym of *tuberculaticeps* Bezzi, but the single male specimen of *ursi* available to the authors for study appears to be distinct. The absence of antepygidial bristles and the presence of an unmodified sternum VIII of the male at once mark this species, the only one of its genus in North America, as very unusual.

The Genus *TRICHOPSYLLOIDES* Ewing

(Fig. 4, A)

Trichopsylloides Ewing, 1938, Wash., Ent. Soc. Proc. 40: 94. Monotypic. Type, *Trichopsylloides oregonensis* Ewing.

Phaneris Jordan, 1939, Novitates Zool. 41: 317. Monotypic. Type, *Phaneris hubbardi* Jordan.

Frontal tubercle minute, angulate apically. Antennal club rounded apically. Eyes absent. Labial palpus not reaching to apex of trochanter I, 5-segmented. Postantennal region of head with 3 rows of setae, lowest seta in each row longest. Pronotal comb composed of long, well-pigmented spines. Upper sclerite of metepisternum more or less ankylosed with metanotum, but always showing at least a vestigial inner ridge along its upper boundary. Metepimeron fused along upper part of anterior end with metepisternum. Abdomen of gravid female not greatly distended. Antepygidial bristles either undifferentiated from other nearby setae or but slightly differentiated. Sternum VIII of male large, unmodified; sternum IX produced into a pair of large, semiclavate, setigerous lobes.

In the type species there is no evident differentiation of the antepygidial bristles from the other nearby setae, yet in *Phaneris hubbardi* Jordan, a specimen of which was lent to the author of *Trichopsylloides* for examination, there is a definite but slight differentiation of the antepygidial bristles. The presence in this genus of a pronotal comb and five-segmented palpi and the absence of eyes indicate its close relationship with the subfamily Dolichopsyllinae.

TRICHOPSYLLOIDES HUBBARDI (Jordan), new combination

Phaneris hubbardi Jordan, 1939, Novitates Zool. 41: 318, figs. 268 and 269.

Type host.—*Aplodontia rufa* (Raf.) (mountain beaver).

Type locality.—Springwater, Oreg.

Range.—Known only from Oregon.

Further study with an abundance of material may show that *hubbardi* is only a synonym of *oregonensis* Ewing. It is similar to *Trichopsylloides oregonensis* except for the clear differentiation of the antepygidial bristles and the fact that the upper sclerite of the metepisternum is more clearly demarcated from the metanotum in *hubbardi*.

TRICHOPSYLLOIDES OREGONENSIS Ewing

(Fig. 4, A)

Trichopsylloides oregonensis Ewing, 1938, Wash. Ent. Soc. Proc. 40: 94.

Type host.—*Aplodontia pacifica* Merr. (mountain beaver).

Type locality.—Delake, Oreg.

Range.—Known only from Oregon and Washington.

This unusual flea is readily identified by the lack of clear differentiation of the antepygidial bristles. The species is of medium size, the length of the male being 1.8 mm. and that of the female 2.7 mm.

The Subfamily RHOPALOPSYLLINAE Oudemans

Fronto-epicranial groove usually poorly developed. Frontal notch present, also frontal tubercle, although the latter may protrude but slightly beyond the surface of the front. Antennal club long or short, symmetrical or asymmetrical. Labial palpus 4- or 5-segmented. Eyes unreduced and pigmented or reduced and pale. Pronotal comb absent. Antepygial bristles present. Abdomen in gravid females not greatly distended. Parasitic on both birds and mammals.

This subfamily contains three genera, only one of which (*Rhopalopsyllus*) is represented in North America.

Rhopalopsyllinae was established by Oudemans (59) in 1909 for the single genus *Rhopalopsyllus* Baker, 1905. In it the present writers place two additional genera, *Parapsyllus* Enderlein, 1903, and *Tetrapsyllus* Jordan, 1931. Members of this subfamily are confined to the Southern Hemisphere, except for a few species of *Rhopalopsyllus*.

In the characters of the head, thorax, and tarsi the Rhopalopsyllinae show relationships with the Pulicidae. They differ from the latter rather markedly in the characters of the abdomen. Furthermore, in the Rhopalopsyllinae the posterior borders of the labial palpi usually are well sclerotized, while in the Pulicidae usually they are either poorly sclerotized or membranous.

Wagner (86, p. 70) places the three genera of this subfamily in two subfamilies, leaving only the type genus in the Rhopalopsyllinae. Such a division hardly appears justified on the ground of either morphological characters or geographical distribution. Furthermore, the genera *Parapsyllus* Enderlein and *Tetrapsyllus* Jordan, included in the proposed subfamily Parapsyllinae, really differ more between themselves than the two together differ from *Rhopalopsyllus* Baker, and if the subfamily Rhopalopsyllinae, as here used, is to be broken up, it should be divided into three subfamilies. This number could hardly be justified.

The genus *Rhopalopsyllus* Baker is the only North American genus of this subfamily.

The Genus RHOPALOPSYLLUS Baker

(Fig. 4, B)

Rhopalopsyllus Baker, 1905, U. S. Natl. Mus. Proc. 29: 129. Type, *Pulex lutzii* Baker (by original designation).

Rothschildella Enderlein, 1912, Zool. Anz. 40: 72. Monotypic. Type, *Rothschildella cryptoctenes* Enderlein.

Frontal tubercle angulate apically, varying much in size and sometimes entirely contained in frontal notch. Antennal club short, asymmetrical, with segmentation less marked on front side. Upper margin of antennal groove with a long comb of closely set microsetae. Eyes well developed and well pigmented. Labial palpus 5-segmented, varying much in length. Postantennal region of head with 3 rows of setae, the posterior row being submarginal. Upper sclerite of metepisternum separated from the metanotum by an inner sclerotized ridge. Abdomen of gravid female not greatly enlarged. Sternum VIII of abdomen of male enlarged, but otherwise little modified; sternum IX extending distally as a single, median, unbranched, setigerous process.

This genus was divided into three genera by Jordan (46) in 1939. The chief characters used for this division are: The shape of the prosternum, the length of the mesosternum in comparison with its

height, and the length of the last segment of each tarsus, but more particularly the length of the last segment of tarsus III in comparison with the length of the second segment of tarsus II.

That the three genera derived from Baker's *Rhopalopsyllus* represent natural groups of species there can be little doubt. However, the writers have found it hard to place certain species into the newly derived genera because of the intergradation of characters and their individual variation; hence, the genera are here given the status of subgenera. One subgenus, *Tiamastus* Jordan, does not occur in North America.

The Subgenus RHOPALOPSYLLUS Baker

The subgenus *Rhopalopsyllus* Baker as here considered was defined by Jordan in 1939 (46, p. 443) and has *Rothschildella* Enderlein as a synonym.

Prosternum humped or extending downward anteriorly between the coxae. Mesosternum as high as long. Last segment of tarsus III longer than second segment of tarsus II. Pygidium with strong projecting anterodorsal margin. Head of receptaculum seminis without hump, being broadly rounded both above and below.

Type species.—By original designation (for the genus *Rhopalopsyllus*), *Pulex lutzii* Baker.

Three North American species are included in this subgenus.

RHOPALOPSYLLUS (RHOPALOPSYLLUS) AUSTRALIS AUSTRALIS (Rothschild)

Pulex australis Rothschild, 1904, Novitates Zool. 11: 613.

Rhopalopsyllus australis Jordan and Rothschild, 1923, Ectoparasites 1: 327, fig. 338.

Type host.—*Tayassu pecari* Fisch. (white-lipped peccary).

Type locality.—Santa Andrea, Tabasco, Mexico.

Range.—Mexico and Central and South America.

In addition to the type variety, *Rhopalopsyllus* (*R.*) *australis* is represented in South America by *R.* (*R.*) *a. tupinus* Jordan and Rothschild (Peru, Bolivia), and *R.* (*R.*) *a. tamoyus* Jordan and Rothschild (Paraguay, Brazil).

RHOPALOPSYLLUS (RHOPALOPSYLLUS) CACICUS SAEVUS Jordan and Rothschild

Rhopalopsyllus cacticus saevus Jordan and Rothschild, 1923, Ectoparasites 1: 325, fig. 322.

Type host.—*Felis pardalis mearnsi* Allen (Mearns' ocelot).

Type locality.—La Cabima, Panama.

Range.—Central and South America.

The typical variety of *Rhopalopsyllus* (*R.*) *cacticus* is from Peru.

RHOPALOPSYLLUS (RHOPALOPSYLLUS) MESUS Wagner

Rhopalopsyllus mesus Wagner, 1933, Berlin Zool. Mus. Mitt. 18: 349, figs. 9-12.

Type host.—"Saugetier mit dem einheimischen Namen: Haptschins."

Type locality.—Twenty-five kilometers east of Cartago, Costa Rica.

Range.—Known only from Costa Rica.

The female of *mesus* is easily identified by the peculiar S-shaped receptaculum seminis, which has a slender head and a rather stout tail.

The Subgenus POLYGENIS Jordan

Polygenis Jordan, 1939, Novitates Zool. 41: 444. Type, *Pulex roberti* Rothschild (by original designation).

Labial palpus not reaching apex of trochanter I. Prosternum not humped or extending downward anteriorly between the coxae. Mesosternum not so high as long. Last segment of tarsus III not longer than second segment of tarsus II. Head (body) of receptaculum seminis usually produced dorsally or anteriorly into a hump.

One of the outstanding characters of most species of this subgenus is the shape of the head of the receptaculum seminis of the female. It is produced into a hump above or in front. Usually this hump is angulate distally.

RHOPALOPSYLLUS (POLYGENIS) DUNNI Jordan and Rothschild

Rhopalopsyllus dunni Jordan and Rothschild, 1922, Ectoparasites 1: 269, figs. 261 and 262.

Type host.—*Sigmodon hispidus* Say and Ord (cotton rat).

Type locality.—Fort Clayton, Canal Zone, Panama.

Range.—Central America.

According to Jordan and Rothschild (52) this species is closely related to *bohlsi* Wagner, but the movable finger is shorter, not reaching to the apical bristle of the clasper, and also broader and without a tooth on the dorsal side near the apex.

RHOPALOPSYLLUS (POLYGENIS) GWYNI C. Fox

(Fig. 4, B)

Rhopalopsyllus gwyni C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 10, pl. 3, figs. 1-6.

Type host.—"Rats."

Type locality.—Brunswick, Ga.

Range.—Southeastern part of the United States.

At one time considered as a probable synonym of *bohlsi* Wagner, this species was shown by Jordan (42, p. 292) in 1932 to be distinct. It and *Rhopalopsyllus (Polygenis) sigmodoni* Stewart are the only species of the subgenus *Polygenis* known to occur in the United States.

RHOPALOPSYLLUS (POLYGENIS) KLAGEI SAMUELIS Jordan and Rothschild

Rhopalopsyllus klagesi samuelis Jordan and Rothschild, 1923, Ectoparasites 1: 331, figs. 342 and 344.

Type host.—"Didelphis marsupialis" (opossum).

Type locality.—San Esteban, Venezuela.

Range.—Central and South America.

The typical variety of *Rhopalopsyllus (Polygenis) klagesi* occurs in Venezuela and Brazil.

RHOPALOPSYLLUS (POLYGENIS) SIGMODONI Stewart

Rhopalopsyllus sigmodoni Stewart, 1930, Canad. Ent. 62: 175, pl. 15, figs. 1 and 2.

Type host.—*Sigmodon hispidus* Say and Ord (cotton rat).

Type locality.—Houston, Tex.

Range.—Known only from Texas.

This species is very near *gwyni* C. Fox, but the movable finger of the clasper appears to be more slender, and there may be a difference in the shape of the receptaculum seminis of the two species. A study of a large series of specimens coming from all the Gulf States would probably show the Georgia forms merging with those of Texas. The species fed readily on the arm of the describer.

The Subfamily DOLICHOPSYLLINAE Baker

Head either divided or not divided by development of fronto-epicranial groove. Frontal notch, or frontal tubercle, or both notch and tubercle present (although sometimes vestigial). Eyes either well developed and pigmented, reduced and poorly pigmented, vestigial, or absent. Labial palpus varying much in length, frequently surpassing the apex of trochanter I. Pronotal comb always present, but in a few genera composed of very short, poorly pigmented spines. Antepygial bristles varying in number on a side from 1 to 5 and usually in size or number as between the sexes. Plantar bristles on last segment of tarsi varying much in number and position, the first pair being frequently shifted ventrally so that they are out of line with the others.

This subfamily contains more genera than any other subfamily, 20 being represented in North America.

Baker (5, p. 127), in 1905, established the subfamily Dolichopsyllinae as one of four subfamilies of Pulicidae. He separated it from the subfamilies Anomlopsyllinae and Pulicinae on the basis of the number of antepygial bristles present. The characters of the Dolichopsyllinae are unusually variable. Its closest affinity appears to be with the Rhopalopsyllinae, from which it is especially differentiated by the presence of a pronotal comb.

One synonym of Dolichopsyllinae is known, Ceratophyllinae, proposed by Dampf (11, p. 19) in 1908 and recognized by Rothschild (66, p. 58) in 1915 and Wagner (85, p. 4) in 1936. A number of other families or subfamilies are partly synonymous with the Dolichopsyllinae as here defined.

KEY TO THE NORTH AMERICAN GENERA OF DOLICHOPSYLLINAE

1. With a row or patch of spinelets on inner surface of coxa III.....	2
Without a row or patch of spinelets on inner surface of coxa III....	4
2. Segment V of each tarsus with 5 pairs of lateral plantar bristles;
eyes not reduced.....	<i>Odontopsyllus</i> Baker.
Segment V of tarsus III with only 4 pairs of lateral plantar bristles....	3
3. Frons with 3 rows of setae and additional small ones	<i>Delotelis</i> Jordan.
Frons with only 2 rows of setae.....	<i>Catallagia</i> Rothschild.
4. None of the setae on front pigmented and thickened toward the
base.....	5
Some or all of the setae on front pigmented and spinelike or thick-
ened toward the base.....	19

5. Female with 4 to 5 antepygidial bristles on each side. Male with 3 large antepygidial bristles on each side and a conspicuous median process on tergum VII projecting over pygidium
Dolichopsylla Baker.
Female with less than 4 antepygidial bristles. Male seldom with 3 large antepygidial bristles and never with process on tergum VII. 6
6. Last segment of each tarsus with 6 pairs of lateral plantar bristles, the third being shifted ventrally and its place taken by a more slender lateral pair.----- *Dasypsyllus* Baker.
Last segment of each tarsus never with more than 5 pairs of lateral plantar bristles.----- 7
7. Tibia III with a comblike row of 3 or 4 shorter, outer setae between long, middle, and apical bristles; movable finger of male with 1 or more black, spinelike setae.----- *Amphipsylla* Wagner.
Tibia III without such a comblike row of setae.----- 8
8. Femur I never with more than a single seta on outer surface.----- 9
Femur I with several setae on outer surface.----- 11
9. Segment I of tarsus III longer than segments II to IV
Tarsopsylla Wagner.
Segment I of tarsus III shorter than segments II to IV.----- 10
10. Movable finger with a submarginal row of 4 to 7 short, black, subequal, spinelike setae. Ventral margin of sternum X of female not angulate.----- *Orchopeas* Jordan.
Movable finger with 3 to 4 unequal, submarginal, black, spinelike setae. Ventral margin of sternum X of female usually distinctly angulate
Opisodasys Jordan.
11. Front with 3 rows of setae. Female with 2 receptacula seminis
Atyphloceras Jordan and Rothschild.
Front seldom with 3 rows of setae. Female with 1 receptaculum seminis.----- 12
12. Eyes vestigial or absent; 4 or 5 setae in ocular row
Dactylopsylla Jordan (Subgenus: *Foxella* Wagner.)
Eyes present, although sometimes distinctly reduced in size, never vestigial; usually only 3 setae in ocular row.----- 13
13. Pronotal comb with short spines, not heavier in pigmentation than pronotum itself. Circumpolar.
Mioctenopsylla Rothschild (Syn.: *Boreopsyllus* Ewing).
Pronotal comb with usual long, heavily pigmented spines.----- 14
14. Inner surfaces of coxae II and III with thin setae from base to apex; labial palpus usually extending beyond apex of trochanter I.----- 15
Inner surfaces of coxae II and III with thin setae at most on distal half; labial palpus not reaching apex of trochanter I.----- 17
15. Sternum VIII of male broad, unreduced, bearing several to many setae. Basal abdominal sternum of female without patch of lateral setae. Restricted to North America.----- *Thrassis* Jordan.
Sternum VIII of male much reduced, narrowed and usually extended into a horizontal process.----- 16
16. Pronotal comb with less than 12 spines on a side.----- *Oropsylla* Wagner and Ioff (Subgen.: *Diamanus* Jordan) *Opisocrostitis* Jordan).
Pronotal comb with 12 or more spines on a side.----- *Amphalius* Jordan.
17. Sternum VIII of male vestigial, without setae. Old World species introduced into North America.----- *Nosopsyllus* Jordan.
Sternum VIII of male modified and bearing 1 or more setae.----- 18
18. Pronotal comb usually with less than 12 spines on a side; movable finger of male with 1 or more black, spinelike setae. Parasitic on mammals
Trichopsylla Kolenati (Synonyms: *Megabothris* Jordan, *Malaraeus* Jordan) (Subgen.: *Pleochaetis* Jordan).
Pronotal comb always with more than 12 spines on a side; movable finger of male usually without black, spinelike setae. Parasitic on birds.----- *Ceratophyllus* Curtis.
19. Only anterior submarginal row of frontal bristles pigmented and spine-like; front with anterior margin broadly rounded
Ctenophyllus Wagner.
All cephalic setae with black pigment and more or less spinelike; front with anterior margin subangulate. Nearctic *Stenistomera* Rothschild.

The Genus ODONTOPSYLLUS Baker

Odontopsyllus Baker, 1905, U. S. Natl. Mus. Proc. 29: 131. Type, *Pulex multispinosus* Baker (by original designation).

Frontal tubercle small, angulate at apex. Eyes well developed and well pigmented. Labial palpus not reaching apex of coxa I. 5-segmented. Pronotal comb with the usual long, black spines, which are acuminate apically. Coxa III with a patch of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV taken together; last segment of each tarsus with 5 pairs of lateral plantar bristles; apical bristle on segment II of tarsus III not reaching apex of segment V. Abdomen with apical spines not extending down almost to level of spiracles. Antepygial bristles 3 on each side in female, 2 in male. Female with but 1 receptaculum seminis and short or long stylet. In male, sternal plate VIII large, but slightly modified and bearing a bunch of subapical setae; sternal plate IX with vertical processes, distal lobe, and median apophysis; movable finger broad, with some long setae but no pigmented spines.

This genus was described by Baker to include four species, two of which, *charlottensis* Baker and *telegoni* Rothschild, have been removed to other genera. It now includes only three North American species, of medium to large size, having rabbits and hares for their natural hosts.

ODONTOPSYLLUS DENTATUS (Baker)

Ceratophyllus dentatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 390.

Odontopsyllus dentatus Baker, 1905, U. S. Natl. Mus. Proc. 29: 131.

Ceratophyllus ponerus Rothschild, 1909, Novitates Zool. 16: 54, pl. 8, fig. 5.
(New synonymy.)

Type host.—*Lynx canadensis* Kerr (Canada lynx).

Type locality.—Moscow, Idaho.

Range.—Western part of the United States.

Ceratophyllus ponerus Rothschild was described from a single female. In the United States National Museum are five males and two females which were identified as *C. ponerus* by Karl Jordan. These specimens were taken in the State of Washington. A comparison of the male specimens with the male type of *Odontopsyllus dentatus* (Baker) shows that the two species are the same. The type host of *dentatus* is evidently not a natural one. The natural hosts are rabbits.

Odontopsyllus dentatus (Baker) has been erroneously synonymized with *Nosopsyllus fasciatus* (Bosc) by Dalla Torre (10, p. 13).

ODONTOPSYLLUS MULTISPINOSUS (Baker)

Pulex multispinosus Baker, 1898, N. Y. Ent. Soc. Jour. 6: 54.

Ceratophyllus multispinosus Baker, 1904, U. S. Natl. Mus. Proc. 27: 389, pl. 12, figs. 1-5.

Odontopsyllus multispinosus Baker, 1905, U. S. Natl. Mus. Proc. 29: 129; I. Fox, 1940, Fleas of the Eastern United States, p. 47, pl. 7, figs. 29, 30, and 31.

Type host.—*Sylvilagus floridanus* (Allen) (cottontail rabbit).

Type locality.—Raleigh, N. C.

Range.—Eastern part of the United States.

This large, dark-brown flea can be easily distinguished by the characters of the movable finger of the male, which is very broad, triangular, and possesses a row of about five long setae on its lower margin.

ODONTOPSYLLUS SPENCERI Dunn

Odontopsyllus spenceri Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2765-2766.

Type host.—*Lepus bairdii* Hayden (snowshoe rabbit).

Type locality.—Bitterroot Mountains west of Hamilton, Mont.

Range.—Known only from Montana.

A rare flea and apparently not yet figured. According to the original description the male "is close to the male described as *dentatus* by Baker, differing from it mainly by having more bristles in the upper genal row and on the dorsal surface of the ninth sternite."

The Genus DELOTELIS Jordan

Delotelis Jordan, 1937, *Novitates Zool.* 40: 267. Monotypic. Type, *Ceratophyllus telegoni* Rothschild.

Material not being at hand for the description of this genus, the original description by Jordan is quoted in full:

♂ ♀. Like *Catallagia* Roths. 1915; but frons with three rows of bristles (2, 3, 7, or 1, 4, 7) and additional small bristles, some of which are placed below vestigial eye; stigma-cavity of tergum VIII narrow; hindtarsal segment V with one ventral bristle in between first lateral pair. In ♂ abdominal sternum VIII with dense apicimarginal row of bristles; process P of clasper much shorter than movable digitoid F. In ♀ duct of bursa copulatrix short; orifice of body of spermatheca terminal, apex of tail of spermatheca obliquely truncate.

This genus contains but a single species.

DELOTELIS TELEGONI (Rothschild)

Ceratophyllus telegoni Rothschild, 1905, *Novitates Zool.* 12: 172, pl. 9, figs. 27 and 30.

Delotelis telegoni Jordan, 1937, *Novitates Zool.* 40: 267.

Cotype hosts.—*Microtus drummondii* (Aud. and Bach.) (meadow mouse) and *Erotomys gapperi* (Vigors) (red-backed mouse).

Cotype localities.—Horse Creek, Upper Columbia Valley, British Columbia, and Kicking Horse Canyon, Alberta.

Range.—Known from Alberta and British Columbia.

In the original description of this species it was compared several times with *charlottensis*, now *Catallagia charlottensis* (Baker), with which it was said to be closely related. The two species evidently are very different, since they are now placed in different genera by Jordan.

The Genus CATALLAGIA Rothschild

(Fig. 5, C)

Catallagia Rothschild, 1915, *Ectoparasites* 1: 41. Type, *Pulex charlottensis* Baker (by original designation).

Frontal tubercle small to vestigial, frequently completely concealed in frontal notch. Forehead with 2 rows of lateral setae, none of which is spiniform. Eyes vestigial. Labial palpus not reaching apex of coxa I, 5-segmented. Post-antennal region of head with 3 rows of setae. Pronotal comb with usual long, dark-brown spines, which are either narrowly rounded or angulate at apex. Coxa III with a row or patch of spinelets on inner surface; last segment of posterior tarsus with 4 pairs of lateral plantar bristles. Abdomen with apical spines which do not extend down to near level of spiracles. Tergal plate VII without posterior median process. Antepygidial bristles 3 on each side of

abdomen in both sexes. Female with but 1 receptaculum seminis. In male, sternal plate VIII produced posteriorly into a semihyaline flap; sternal plate IX produced posteriorly into a spiniferous and setiferous process; movable finger of clasper broad at base and angulate apically, bearing several to many small setae.

This genus is confined to northern North America, the most southern locality being San Francisco. A key to the males and females, before *Delotelis* was split off, was published by Ewing (17, p. 126) in 1929.

CATALLAGIA BOREALIS Ewing

Catallagia borealis Ewing, 1929, Wash. Biol. Soc. Proc. 42: 127.

Type host.—*Microtus pennsylvanicus* (Ord) (meadow mouse).

Type locality.—Basin Pond, Mount Katahdin, Maine.

Range.—Known only from Maine.

At the time of its description this species was known only from a single female. *Catallagia onaga* Jordan may possibly be a synonym of *borealis*. The head of the female and sternal plate VII of the same sex have been figured by I. Fox (25, pl. 28, figs. 146 and 147).

CATALLAGIA CHAMBERLINI Hubbard

Catallagia chamberlini Hubbard, 1940, Pacific Univ. Bul. 37 (3): [4], 3 figs.

Type host.—(?). "Normal host is the Deer mouse."

Type locality.—Rocky Point (north of Klamath Falls), Oreg.

Range.—Given by Hubbard (31) as "Cascade and Siskiyou Mountains of Oregon, with encroachments into the Willamette Valley."

The original description of this species was based on 25 specimens and is accompanied by a drawing of the ninth sternal plate of the male, the characters of which are distinctive.

CATALLAGIA CHARLOTTENSIS (Baker)

(Fig. 5, C)

Typhlopsylla charlottensis Baker, 1898, N. Y. Ent. Soc. Jour. 6: 56.

Catallagia charlottensis Rothschild, 1915, Ectoparasites 1: 43, figs. 44 and 46.

Type host.—"Mouse nest."

Type locality.—Masset, Queen Charlotte Islands.

Range.—Known from British Columbia, Alberta, and Oregon.

This species, the type of its genus, was redescribed and the genitalia of the male figured by Rothschild (1915). It is very closely related to *decipiens* Rothschild. (See remarks under the latter species.)

CATALLAGIA DECIPIENS Rothschild

Catallagia decipiens Rothschild, 1915, Ectoparasites 1: 43, figs. 45 and 47.

Type host.—*Peromyscus* sp. (white-footed mouse).

Type locality.—Horse Creek, Upper Columbia Valley, British Columbia.

Range.—Known from British Columbia, Alberta, and the Great Basin of the western part of the United States.

This flea is very similar to *charlottensis*, from which it can best be separated on characters of the male genitalia. In *decipiens* the proc-

ess of the clasper extends to about the tip of the movable finger, while in *charlottensis* it extends considerably beyond that.

CATALLAGIA MONERIS Jordan

Catallagia moneris Jordan, 1937, Novitates Zool. 40: 267, fig. 50.

Type host.—*Marmota flaviventris* (Aud. and Bach.) (woodchuck).

Type locality.—Ravalli County, Mont.

Range.—Known only from Montana.

In his original description Jordan states that this species "Agrees in all details with *C. decipiens* Roths. 1915, from Alberta and British Columbia, except in the size and shape of the spermatheca." The shape of this spermatheca, or receptaculum seminis, is different from that of any other female of *Catallagia*, as far as known, in having the head not widened toward the tail and longer than the latter. Only a single female is known.

CATALLAGIA MOTEI Hubbard

Catallagia motei Hubbard, 1940, Pacific Univ. Bul. 37 (3): [4], 2 figs.

Type host.—Not mentioned by describer.

Type locality.—Banks, Oreg.

Range.—Known from Oregon and Washington.

The original description of *motei* was based entirely on females and is accompanied by a drawing of the receptaculum seminis and seventh sternal plate.

CATALLAGIA ONAGA Jordan

Catallagia onaga Jordan, 1929, Novitates Zool. 35: 172, fig. 7; I. Fox, 1940, Fleas of Eastern United States, p. 103, pl. 23, fig. 145.

Type host.—*Blarina brevicauda* (Say) (short-tailed shrew).

Type locality.—Adirondack Mountains, N. Y.

Range.—Known only from New York State.

This species is probably a synonym of *Catallagia borealis* Ewing, being based on the male of that species, but until the sexes of either *borealis* or *onaga* have been properly associated, it appears best to give *onaga* standing as a distinct species.

CATALLAGIA SCULLENI Hubbard

Catallagia sculleni Hubbard, 1940, Pacific Univ. Bul. 37 (3): [3], 3 figs.

Type host.—(?). "Normal host is the Deer mouse."

Type locality.—Forest Grove, Oreg.

Range.—According to a statement accompanying the original description: "The range extends from the Pacific Ocean east over the Coast Range into the Puget Sound Trough in Oregon and Washington."

This species was described from 35 specimens. The original description is accompanied by a drawing of the ninth sternal plate of the male, which is characterized by having 4 black, short, spine-like, subapical setae and a ventral, marginal fringe of long setae.

CATALLAGIA WYMANI (C. Fox)

Odontopsyllus wymani C. Fox, 1909, Ent. News 20: 241, figs. 1-5.

Catallagia wymani Rothschild, 1915, Ectoparasites 1: 42.

Type host.—*Microtus californicus* (Peale) (California field mouse).

Type locality.—San Francisco, Calif.

Range.—Known only from California.

This species can be distinguished from all others of its genus by the characters of sternal plate IX of the male, each posterior process of this structure having but a single subapical, ventral spine and being fringed throughout most of its ventral margin with a row of subequal setae.

The Genus DOLICHOPSYLLA Baker

(Fig. 5, E, F)

Dolichopsylla Baker, 1905, U. S. Natl. Mus. Proc. 29: 135. Monotypic. Type, *Ceratophyllus stylosus* Baker.

Frontal tubercle small, angulate apically. Forehead with 2 rows of lateral setae, none of which is spiniform. Eyes absent. Labial palpus long, extending to or beyond apex of trochanter I, 5-segmented. Postantennal region of head with 2 rows of setae. Pronotal comb with usual, long, black spines, which are either narrowly rounded or angulate apically. Coxa III without a row or patch of setae on inner surface; segment I of posterior tarsus not longer than II, III, and IV taken together; last segment of tarsus III with 5 pairs of lateral plantar bristles, the first being shifted slightly ventrally. Abdomen with apical spines not extending down almost to line of spiracles. Tergal plate VII with a posterior median process. Female with 4 antepygidial bristles on each side, male with 3. Female with a single receptaculum seminis. Male with sternal plate VIII produced posteriorly into a pair of semihyaline lobes, each having a fimbriated ventral margin; sternal plate IX much modified distally, with crescentic inner vertical lobes, and a dorsoventrally thickened median apophysis; movable finger of clasper broad, flat, subtriangular, with long setae but no pigmented spines.

This genus contains but a single species. It is the type genus of the family Dolichopsyllidae, the largest of all the families of Siphonaptera.

DOLICHOPSYLLA STYLOSA (Baker)

(Fig. 5, E, F)

Ceratophyllus stylosus Baker, 1904, U. S. Natl. Mus. Proc. 27: 418, pl. 14, figs. 1-7, and pl. 15, figs. 1 and 2.

Dolichopsylla stylosa Baker, 1905, U. S. Natl. Mus. Proc. 29: 135.

Type host.—*Aplodontia rufa* (Raf.) (mountain beaver).

Type locality.—Astoria, Oreg.

Range.—Known only from Oregon.

This species is a large flea, females frequently measuring 6 mm. in length. It is at once identified by its large size plus the generic characters. In the United States National Museum there is a fine series of six specimens of *stylosa* representing type material, each specimen mounted on a separate slide. Excellent figures accompany the original description of the species.

The Genus *DASYPSYLLUS* Baker

(Fig. 5, D)

Dasypsyllus Baker, 1905, U. S. Natl. Mus. Proc. 29: 129. Monotypic. Type, *Ceratophyllus perpinnatus* Baker.

Frontal tubercle minute, angulate apically. Forehead with 3 rows of lateral setae, none of which is spiniform. Eyes well developed and heavily pigmented. Labial palpus not reaching to apex of coxa I, 5-segmented. Post-antennal region of head with 3 rows of setae. Pronotal comb with long, dark-brown, approximate, apically angulate spines. Coxa III without a row or patch of spinelets on inner surface. Last segment of each tarsus with 6 pairs of lateral plantar bristles, the third pair being shifted ventrally and its place taken by a more slender lateral pair. Abdomen with a few apical spines, all situated dorsally. Tergal plate VII without a posterior median process. A single antepygial bristle, flanked by a pair of microsetae, on each side in both sexes. Female with 1 receptaculum seminis and a pair of short, stout stylets. In male, sternal plate VIII greatly shortened and bearing posteriorly a pair of semihyaline lobes, each with a fimbriated ventral margin; sternal plate IX with a pair of internal vertical processes, a conspicuous median apophysis, and a pair of long, setigerous, posterior processes; movable finger of clasper broad, flat, bearing both long setae and pigmented spines.

Dalla Torre (10, p. 12) in his catalog placed this genus as a synonym of *Ceratophyllus* Curtis.

DASYPSYLLUS GALLINULAE PERPINNATUS (Baker)

(Fig. 5, D)

Ceratophyllus perpinnatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 391, pl. 13, figs. 1-6.

Dasypsyllus perpinnatus (Baker), 1905, U. S. Natl. Mus. Proc. 29: 129.

Dasypsyllus gallinulae perpinnatus Wagner, 1930, Katalog der palaearktischen Aphanipteren, p. 14.

Type host.—Unknown.

Type locality.—Queen Charlotte Islands.

Range.—Known only from British Columbia.

This subspecies was regarded by Baker as a species in his original description, which was based on a single male and accompanied by six detail drawings. It is a medium-sized flea (length of male, 3 mm.) of light-brown color. The type variety of *gallinulae* occurs in Europe.

The Genus *AMPHIPSYLLA* Wagner

(Fig. 6, C)

Amphipsylla Wagner, 1909, Mitt. Kaukasischen Mus. 4: 196, 201. Type, *Amphipsylla schelkovnikovi* Wagner (by subsequent designation).

Front tubercle vestigial. Forehead with 3 rows of lateral setae, middle row frequently incomplete, and none of the setae in any row spinelike. Eyes small to vestigial. Labial palpus medium in length, usually not reaching apex of coxa I. Postantennal region of head with 3 rows of setae. Pronotal comb with usual long, black, or dark-brown spines. Coxa III without a row or patch of spinelets on inner surface; tibia III with a comblike row of 3 or 4 shorter outer setae between long middle and long apical bristles; last segment of tarsus III with 5 pairs of lateral plantar bristles, the first pair situated in between the bristles of the second pair. Abdomen with apical spines, nearly all of which are situated dorsally. Tergal plate VII without posterior median process. Three antepygial bristles on each side in both sexes. Female with but 1 receptaculum seminis. In male sternal plate VIII broad, not modified; sternal plate IX with internal vertical processes and much modified posterior processes; movable finger of clasper broad, flat, with 1 or more pigmented spines in addition to a few setae.

This genus is represented in America by only three species, but it is well represented in the Old World, where it ranges over much of Europe and central and northern Asia. The species are parasitic chiefly on rodents of the family Muridae and carnivores that feed on these rodents.

AMPHIPSYLLA EWINGI I. Fox

(Fig. 6, C)

Amphipsylla ewingi I. Fox, 1940, Wash. Ent. Soc. Proc. 42: 61, pl. 10, fig. 1.

Type host.—"Alaska short-tailed mouse."

Type locality.—Golovin, Alaska.

Range.—Known only from Alaska.

This is a medium-sized, dark-brown species which is known only from male specimens. The movable finger of the clasper has two black, posterior, submarginal spines, the upper one being much the shorter and somewhat stouter than the other and situated near the posterodorsal angle. Sternal plate VIII of the male has a distinctive comblike row of long setae on each side near the posterior margin.

AMPHIPSYLLA NEOTOMAE I. Fox

Amphipsylla neotomae I. Fox, 1940, Wash. Acad. Sci. Jour. 30: 273, fig. 3.

Type host.—*Neotoma desertorum* Merr. (wood rat).

Type locality.—Dos Palos, Calif.

Range.—Known only from the type locality.

The original description of *neotomae* was based on a single male and is accompanied by a figure of the clasper. This is the only species of its genus to be reported from the United States. It differs from the other two species of *Amphipsylla* known from North America in the structure of the male terminalia.

AMPHIPSYLLA SIBIRICA POLLIONIS (Rothschild)

Ceratophyllus pollionis Rothschild, 1905, Novitates Zool. 12: 171, pl. 9, figs. 28, 31, and 32.

Amphipsylla sibirica pollionis Wagner, Canad. Ent. 68: 195.

Cotype hosts.—*Microtus drummondii* (Aud. and Bach.) (meadow mouse) and *Evotomys saturatus* Rhoads (red-backed mouse).

Type locality.—Red Deer, Alberta.

Range.—Known only from Alberta.

This subspecies is similar to *ewingi* I. Fox, but in it the movable finger is much broader at the top and the upper spine on the same is longer and not so stout as in *ewingi*. Sternal plate VIII has a patch of long setae on each side instead of the submarginal comblike row of *ewingi*.

The Genus TARSOPSYLLA Wagner

(Fig. 6, B)

Otenonotus Kolenati, 1863 (not Fitzinger, 1843), Soc. Ent. Rossicae Horae 2: 34.

Monotypic. Type, *Otenonotus octodecimdentatus* Kolenati.

Tarsopsylla Wagner, 1927, Konowia 6: 108.

The name *Tarsopsylla* was proposed by Wagner to replace *Otenonotus* Kolenati, 1863, which was found to be preoccupied.

Frontal tubercle angulate apically and concealed in frontal notch. Forehead with 3 short rows of lateral setae, none of which is spiniform. Eyes present, pigmented. Labial palpus not reaching to apex of coxa I, 5-segmented. Postantennal region of head with 3 rows of setae, first 2 incomplete. Pronotal comb with usual, long, black spines. Femur I with not more than a single lateral seta; coxa III without a row or patch of setae on inner surface; segment I of tarsus III longer than II, III, and IV taken together; segment V of tarsus III with 5 pairs of lateral plantar bristles, pair I shifted ventrally. Abdomen without apical spines. Tergal plate VII without posterior median process. Male with 2 antepygial bristles on a side. Female with a single receptaculum seminis. In male sternal plate VIII modified, being much narrowed and curved upward distally; sternal plate IX with inner vertical processes and anterior median apophysis; movable finger of clasper long, flattened, without pigmented spines, but with several long setae.

Besides the type species, which occurs on squirrels in eastern and central Europe and northern Asia, *Tarsopsylla* includes a single North American species, also found on squirrels.

TARSOPSYLLA COLORADENSIS (Baker)

(Fig. 6, B)

Pulex coloradensis Baker, 1895, Canad. Ent. 27: 110.

Ceratophyllus coloradensis Baker, 1904, U. S. Natl. Mus. Proc. 27: 417, 441, pl. 25, figs. 6-9.

Type host.—"Fremont's chickaree."

Type locality.—Georgetown, Colo.

Range.—Known from Colorado and British Columbia.

A medium-sized, dark-brown flea, easily identified by the fact that segment I of tarsus III is longer than II, III, and IV taken together. Apparently this is a rare species, of which the United States National Museum contains only a single specimen, the type.

THE GENUS ORCHOPEAS JORDAN

(Fig. 7, C)

Orchopeas Jordan, 1933, Novitates Zool. 39: 71. Type, (*Pulex wickhami* Baker) = *Pulex howardii* Baker (by original designation).

Frontal tubercle small, angulate apically, and largely concealed in tubercular notch. Forehead with 1 to 2 complete rows of lateral setae, the third (front) row occasionally represented by 1 or 2 setae in some species. Eyes conspicuous, black. Labial palpus not reaching to apex of trochanter I, 5-segmented. Post-antennal region of head with but 1 row of setae, the marginal row. Pronotal comb with usual, long, black spines. Femur I with not more than 1 lateral seta; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV combined; last segment of each tarsus with 5 lateral plantar setae, first pair displaced ventrally. Abdomen with but a few apical spines, all situated dorsally. Tergal plate VII without a posterior median process; 3 antepygial bristles on each side in female, 2 in male. Female with but a single receptaculum seminis, and with ventral margin of sternal plate X angulate near middle. In male sternal plate VIII much modified, with apical membranous appendage; sternal plate IX with conspicuous inner vertical processes, 2 pairs of highly modified distal lobes, and anterior median apophysis; movable finger of clasper broad, expanded dorsally, with posterior, submarginal row of 4 to 7 upwardly directed, short, black, subequal spines.

This genus is exclusively Nearctic in distribution.

ORCHOPEAS CAEDENS (Jordan)

Ceratophyllus caedens Jordan, 1925, Novitates Zool. 32: 104, figs. 16 and 17.

Ceratophyllus caedens durus Jordan, 1929, Novitates Zool. 35: pl. 1, fig. 3.

Orchopeas caedens Jordan, 1933, Novitates Zool. 39: 71.

Type host.—*Martes americana* (Turt.) (marten).

Type locality.—Banff, Alberta.

Range.—United States, Canada, and Alaska.

The writers are following Wagner (84, p. 199) in the synonymy given above. Under the name of *Ceratophyllus caedens durus* Jordan, this species was reported from south Labrador by Eidmann (13, p. 100), the specimens having been determined by Jordan.

ORCHOPEAS DIETERI (C. Fox)

Ceratophyllus nepos dieteri C. Fox, 1929, Ent. News. 40: 218.

Orchopeas dieteri I. Fox, 1940, Wash. Ent. Soc. Proc. 42: 66, pl. 10, figs. 5 and 6.

Type host.—*Lynx rufus* (Schreber) (bobcat).

Type locality.—Los Angeles County, Calif.

Range.—Known only from California.

I. Fox (1940) redescribed *dieteri* as a species and gave drawings of the parts of the terminalia of both sexes.

ORCHOPEAS HOWARDII (Baker), new combination

Pulex howardii Baker, 1895, Canad. Ent. 27: 110.

Pulex wickhami Baker, 1895, Canad. Ent. 27: 109; I. Fox, 1940, Fleas of Eastern United States, p. 59, pl. 15, figs. 75-77.

Pulex gillettei Baker, 1895, Canad. Ent. 27: 109.

Cotype hosts.—"Squirrel," "gray or fox squirrel," "nest of field mouse."

Cotype localities.—Ithaca, N. Y.; Tallulah Falls, Ga.; Lincoln, Nebr.

Range.—United States east of the Great Plains.

The name *wickhami* has long been used for this species and has page precedence over *howardii*. However, Baker (3, p. 37) in 1899 selected *howardii* for the name of the species. He states:

Pulex howardii Baker. In the group which includes this flea and *fasciatus* and its allies, the males determine the species. For this reason *wickhami* and *gillettei* are not well founded. They were separated on characters whose values could not have been correctly estimated at the time. They should be reduced to synonyms of *howardii*.

The life history of this flea (under the name of *wickhami*) has been studied by Sikes (70), who gives a description of the eggs and first three larval instars.

A chalcidoid parasite, reared from a larva of *howardii*, was described by Waterston (89) under the name of *Bairamilia fuscipes*. Parasites of this type are very rarely reported from ectoparasites.

ORCHOPEAS LABIATUS (Baker)

Ceratophyllus labiatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 402, pl. 19, figs. 6-9.

Orchopeas labiatus Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Lynx canadensis* Kerr (Canada lynx).

Type locality.—Moscow, Idaho.

Range.—Known only from Idaho.

This species is based upon a single female which has not yet been associated with its opposite sex. According to Jordan (40, p. 29) it is very closely allied to *nepos* (Rothschild) and *caedens* (Jordan). I. Fox (26, pl. 19, fig. 7) gives a detail drawing of sternal plate VII of the female.

ORCHOPEAS LATENS (Jordan)

Ceratophyllus latens Jordan, 1925, Novitates Zool. 32: 105, figs. 19 and 20.

Orchopeas latens Jordan, 1933, Novitates Zool. 39: 72.

Type host.—"Gray squirrel."

Type locality.—Santa Cruz County, Calif.

Range.—Known only from California.

Jordan's description of this species was based on one male and two females from the Baker collection. It is accompanied by a drawing of the clasper of the male and one of sternal plate VII of the female.

ORCHOPEAS LEUCOPUS (Baker)

Ceratophyllus leucopus Baker, 1904, U. S. Natl. Mus. Proc. 27: 401.

Ceratophyllus aeger Rothschild, 1905, Novitates Zool. 12: 166, pl. 6, figs. 5, 7, and 9.

Orchopeas leucopus Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Peromyscus leucopus* (Raf.) (white-footed mouse).

Type locality.—Peterboro, N. Y.

Range.—Eastern part of the United States and Canada.

The original description of this species, one of the most common and one of the best known fleas in America, was based upon a single female. *Orchopeas leucopus* is very near *O. howardii* (Baker) but the clasper has a broad, truncate process and a more slender movable finger. I. Fox (25, pp. 64 and 159) has redescribed and figured the species.

ORCHOPEAS NEPOS (Rothschild)

Ceratophyllus nepos Rothschild, 1905, Novitates Zool. 12: 168, pl. 7, figs. 13 and 14.

Orchopeas nepos Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Spilogale phenax latifrons* Merr. (spotted skunk).

Type locality.—Chilliwack, British Columbia.

Range.—Known only from British Columbia.

The original description of this species was based on one male and one female. It is accompanied by drawings of part of the terminalia of the female and a side view of the male claspers. The species is closely related to *howardii* (Baker) but differs from that species in that the process of the clasper is rounded and not expanded apically instead of being truncate and expanded; also the distal half of the movable finger is not nearly so swollen as in *howardii*.

ORCHOPEAS SEXDENTATUS SEXDENTATUS (Baker)

(Fig. 7, C)

Ceratophyllus sexdentatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 403, pl. 26, figs. 8-14.

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

Type host.—*Neotoma* sp. (wood rat).

Type locality.—Boulder Creek, Calif.

Range.—The species is widely distributed in the United States and Canada, forming several subspecies. This particular subspecies is known only from California.

The original description of *sexdentatus* was based upon a single lot of material from the type locality. It is accompanied by several detail figures, but does not properly treat of the characters now considered of subspecific value. The various subspecies of *sexdentatus* parasitize different species of *Neotoma*.

ORCHOPEAS SEXDENTATUS AGILIS (Rothschild)

Ceratophyllus agilis Rothschild, 1905, *Novitates Zool.* 12: 167, pl. 7, figs. 16–18.
Ceratophyllus sexdentatus agilis Jordan, 1929, *Novitates Zool.* 35: 30.

Type host.—*Neotoma cinerea* (Ord) (wood rat).

Type locality.—Banff, Alberta.

Range.—Known from British Columbia and Alberta.

Rothschild's description of *agilis* was based on a large series of both sexes taken from several localities and is accompanied by three detail drawings. He states:

Both sexes differ from *sexdentatus* in the longest apical bristle on the hinder side of the first hindtarsal segment reaching nearly to the apex of the second segment.

ORCHOPEAS SEXDENTATUS CASCADENSIS Jordan

Orchopeas sexdentatus cascadenis Jordan, 1939, *Novitates Zool.* 41: 317, fig. 267.

Type host.—*Neotoma fuscipes fuscipes* Baird (wood rat).

Type locality.—Odell Lake, Oreg.

Range.—Western part of the United States.

The description was based on females and accompanied by a figure illustrating the variation in sternum VII, particularly its process above the sinus. This process is acutely angulate apically in *cascadenis* whereas it is long and obtuse in *agilis*.

ORCHOPEAS SEXDENTATUS NEVADENSIS (Jordan)

Ceratophyllus sexdentatus nevadensis Jordan, 1929, *Novitates Zool.* 35: 30, pl. 1, fig. 4.

Type host.—*Mustela arizonensis* (Mearns) (weasel).

Type locality.—Pine City, Calif.

Range.—Known from California and Utah.

The female of *Orchopeas sexdentatus nevadensis* is not always differentiated from that of *O. s. sexdentatus*, but the male is distinct, having the anterior lobe of sternal plate IX longer and the spinelike seta situated beyond its middle. The type host of *nevadensis* is not a natural one. The subspecies probably is a natural parasite of wood rats.

ORCHOPEAS SEXDENTATUS PENNSYLVANICUS (Jordan)

Ceratophyllus sexdentatus pennsylvanicus Jordan, 1928, *Novitates Zool.* 34: 184, figs. 8 and 9.

Type host.—*Neotoma pennsylvanica* Stone (wood rat).

Type locality.—Rolling Rock Club, Ligonier, Pa.

Range.—Eastern part of the United States.

The original description of this subspecies is accompanied by a drawing of the terminalia of each sex. In the female the upper lobe of sternal plate VII, which is long and slender, is dilated apically. The male genitalia differ from those of the other subspecies in minor details. A redescription of the subspecies is given by I. Fox (25, p. 63).

ORCHOPEAS SEXDENTATUS SCHISINTUS (Jordan)

Ceratophyllus sexdentatus schisintus Jordan, 1929, *Novitates Zool.* 35: 31, pl. 1, fig. 5.

Type host.—*Neotoma* sp. (wood rat).

Type locality.—Arizona.

Range.—Known only from Arizona.

The original short description of this subspecies is here quoted in full:

Apparently differs in the ♀ only: the upper lobe of sternite VII broad and short, the lower one absent or quite short. Exopodite of ♂ with 5 or 6 spiniforms.

The Genus OPISODASYS Jordan

(Fig. 7, B)

Opisodasys Jordan, 1933, *Novitates Zool.* 39: 72. Type, *Ceratophyllus vesperalis* Jordan (by original designation).

Frontal tubercle small to vestigial, angulate apically, and largely concealed in frontal notch. Forehead with a single row of setae, the ocular row, but each of other 2 rows frequently represented by a single large seta. Eyes well developed, black. Labial palpus 5-segmented, not reaching beyond apex of trochanter I. Postantennal region of head with a single row of setae, the posterior or marginal row; second row usually represented by a single large seta. Pronotal comb with usual long, black spines. Femur I with not more than a single lateral seta; coxa III without a patch or row of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV combined; last segment of each tarsus with 5 pairs of lateral, plantar setae, pair I being displaced ventrally. Abdomen with a few apical spines, all dorsal. Tergal plate VII without posterior median process. Antepygial bristles 3 or 4 on each side in female; 2 on each side in male. Female with a single receptaculum seminis and ventral margin of sternal plate X not distinctly angulate. In male sternal plate VIII much modified, with or without apical membranous appendage; sternal plate IX with conspicuous, inner, vertical processes, an anterior median apophysis, and a pair of expanded, setigerous, posterior lobes; movable finger of clasper large and flat, bearing 3 or 4 unequal pigmented spines, which usually are directed backward or downward.

This genus is very clearly near to *Orchopeas* Jordan, from which, however, it is easily distinguished by the nature of the pigmented spines on the movable finger of the clasper in the male. All species are North American and probably all are Nearctic.

OPISODASYS ENOPLUS (Rothschild)

Ceratophyllus enoplus Rothschild, 1909, *Novitates Zool.* 16: 53, pl. 8, fig. 6.

Opisodasys enoplus Jordan, 1933, *Novitates Zool.* 39: 72.

Type host.—"California grey squirrel."

Type locality.—Kings River, Calif.

Range.—Known only from California.

Rothschild based his description of *enoplus* upon a single male. The species is characterized by having two pigmented, spinelike setae

on the movable finger, the upper being acutely pointed apically and the lower rounded apically.

OPISODASYNS KEENI (Baker)

(Fig. 7, B)

Pulex keeni Baker, 1896, Canad. Ent. 28: 234.

Ceratophyllus keeni Baker, 1904, U. S. Natl. Mus. Proc. 27: 400, pl. 15, figs. 7-12.

Opisodasys keeni Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Peromyscus maniculatus keeni* (Rhoads) (white-footed mouse).

Type locality.—Queen Charlotte Islands, British Columbia.

Range.—Western part of the United States and Canada.

In this species the frontal tubercule and notch are either vestigial or absent. When vestigial they are easily overlooked.

OPISODASYNS PSEUDARCTOMYS (Baker)

Ceratophyllus pseudarctomys Baker, 1904, U. S. Natl. Mus. Proc. 27: 399, pl. 24, figs. 1-7.

Ceratophyllus acasti Rothschild, 1905, Novitates Zool. 12: 168, pl. 7, figs. 19 and 20.

Opisodasys pseudarctomys Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Marmota monax* (L.) (woodchuck).

Type locality.—Newport, Herkimer County, N. Y.

Range.—United States and Canada.

Baker's description of this common and well-known flea is accompanied by seven drawings, one being of the head of the male and one the head of the female. The movable finger of the clasper in *pseudarctomys* is striking in appearance and identifies the species. It is roughly sickle-shaped, with a long, stout, backwardly curved, blunt-pointed, apical, spinelike seta, and two short setae on the lower extremity, the upper being sharply pointed and the lower stout and rounded at the tip.

I. Fox (25, p. 57) has recently redescribed *pseudarctomys*.

OPISODASYNS ROBUSTUS (Jordan)

Ceratophyllus robustus Jordan, 1925, Novitates Zool. 32: 105, fig. 18.

Opisodasys robustus Jordan, 1933, Novitates Zool. 39: 72.

Opisodasys spatiosus I. Fox, 1940, Wash. Ent. Soc. Proc. 42: 65, pl. 10, fig. 2.

Type host.—Unknown.

Type locality.—White River, Cooley, Ariz.

Range.—Southwestern part of the United States.

The original description of this species was based entirely on the female. The male was described in 1939 by Jordan (45, p. 316), who examined specimens taken in the Catalina Mountains, Ariz., on *Sciurus arizonensis catalina*.

OPISODASYNS VESPERALIS (Jordan)

Ceratophyllus vesperalis Jordan, 1929, Novitates Zool. 35: 28, pl. 1, figs. 1 and 2.

Opisodasys vesperalis Jordan, 1933, Novitates Zool. 39: 72.

Type host.—*Glaucomys sabrinus alpinus* (Rich.) (flying squirrel).

Cotype localities.—"Okanagan and Okanagan Landing," British Columbia.

Range.—Known only from British Columbia.

The original description of *vesperalis* is accompanied by a drawing of the clasper of the male and the seventh sternal plate of the female. According to Jordan this species is close to *pseudarctomys* Baker. However, the male genitalia are very different, the clasper being without the posterior process, the movable finger being almost straight instead of crescentic, and the upper spinelike seta on the same being swordlike instead of rodlike.

The Genus ATYPHLOCERAS Jordan and Rothschild

(Fig. 6, E)

Atyploceras Jordan and Rothschild, 1915, Ectoparasites 1: 59. Type, *Ceratomyllus multidentatus* C. Fox (by original designation).

Frontal tubercle angulate apically, inconspicuous. Forehead with 3 rows of lateral setae, none of the latter being spiniform. Eyes much reduced or vestigial. Labial palpus with 5 to 8 segments. Postantennal region of head with 3 oblique rows of lateral setae in addition to posterior marginal row. Pronotal comb with usual, long, black spines. Femur I with several lateral setae; coxa III without a row or patch of setae on inner surface; segment I of posterior tarsus shorter than II, III, and IV taken together; last segment of tarsus III with 5 pairs of lateral plantar bristles, the first pair not being shifted ventrally. Abdomen with apical spines extending down almost to level of spiracles. Tergal plate VII without a posterior median process. Three antepygidial bristles usually on each side in female, and 1 large antepygidial bristle in addition to 1 or 2 small ones in male. Female with 2 equal receptacula seminis. In male sternal plate VIII large and practically unmodified; sternal plate IX with large inner vertical processes, no median apophysis or a vestigial one, and a long, setigerous, distal lobe; movable finger of clasper long, flat, with conspicuous setae but no pigmented spines.

Species of this genus are found exclusively on small North American mammals.

ATYPHLOCERAS ARTIUS Jordan

Atyploceras artius Jordan, 1933, Novitates Zool. 39: 69, fig. 19.

Type host.—*Peromyscus* sp. (white-footed mouse).

Type locality.—British Columbia.

Range.—Known only from British Columbia.

This species was described from a single female and was said to be close to *multidentatus* C. Fox, "but the bursa copulatrix of the same long shape as in *A. echis* J. & R. 1915."

ATYPHLOCERAS BISHOPI Jordan

Atyploceras bishopi Jordan, 1933, Novitates Zool. 39: 63, figs. 11 and 12.

Type host.—*Blarina brevicauda* (Say) (short-tailed shrew).

Type locality.—Fairport, N. Y.

Range.—Known only from New York.

As indicated in the original description, this species is identified by having the labial palpus composed of five segments instead of a larger number and by the distance of the frontal tubercle from the fronto-genal angle "being more than one-third as long as the distance of the anterior oral angle from the nearest point of anterior margin of antennal groove."

ATYPHLOCERAS ECHIS Jordan and Rothschild

Atyploceras echis Jordan and Rothschild, 1915, Ectoparasites 1: 59, fig. 64.

Type host.—*Mus*. sp. (mouse).

Type locality.—Paradise, Ariz.

Range.—Southwestern part of the United States.

The original description of this species was based on a single female. The male is unknown.

ATYPHLOCERAS FELIX Jordan

Atyploceras felix Jordan, 1933, Novitates Zool. 39: 69, fig. 18.

Type host.—*Peromyscus truei* (Shufeldt) (white-footed mouse).

Type locality.—Cuddy Valley, Ventura County, Calif.

Range.—Known only from California.

The original description of this species, based on a single male specimen, is accompanied by a drawing of the male terminalia. In this species the labial palpus is seven-segmented.

ATYPHLOCERAS MULTIDENTATUS (C. Fox)

(Fig. 6, E)

Ceratophyllus multidentatus C. Fox, 1909, Ent. News 20: 107, 3 figs.

Atyploceras multidentatus Jordan and Rothschild, 1915, Ectoparasites 1: 59.

Type host.—"Nest of *Neotoma* sp." (wood rat).

Type locality.—San Francisco, Calif.

Range.—Western part of the United States.

This is a medium-sized species in which the body of the penis is much swollen and heavily pigmented.

The Genus DACTYLOPSYLLA Jordan

(Fig. 5, A)

Dactylopsylla Jordan, 1929, Novitates Zool. 35: 37. Type, *Dolichopsylla bluei* C. Fox (by original designation).

Frontal tubercle very small, angulate apically. Forehead with 2 rows of lateral setae, none of which is spiniform. Eyes vestigial. Labial palpus 5-segmented. Postantennal region of head with but a single row of setae, the marginal row. Pronotal comb with the usual long, black spines. Mesosternum not separated from mesepisternum by an inner ridge. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV taken together; last segment of each tarsus with 5 pairs of lateral plantar bristles, the first pair of which is shifted ventrally. Abdomen with but few apical spines. Tergal plate VII without a posterior median process. Antepygial bristles 3 on each side in female, 1 in male. Female with 1 receptaculum seminis. Modified segments of male of 3 different types which are described under the 3 included subgenera.

Although the type species of this genus was originally designated under the generic name of *Odontopsylla*, it was originally described by C. Fox (22, p. 195) in *Dolichopsylla*. The genus *Dactylopsylla* as here recognized is composed of three subgenera. These subgenera are practically identical except for the modified segments of the male.

The Subgenus DACTYLOPSYLLA Jordan

This subgenus is here diagnosed for the first time.

With the characters of the genus *Dactylopsylla* and in addition: In male, sternal plate VIII large, divided posteriorly into a pair of large, flat lobes; sternal plate IX with a pair of large, inner, vertical processes, a conspicuous, anterior, median apophysis, and a pair of large, conspicuous, posterior processes, each being divided into a proximal and a distal lobe by a broad ventral sinus; movable finger of clasper long, slender, hooked backward at apex; penis with dorsal portion of outer sheath modified into a long, downwardly curved, finger-like process.

Type species.—Same as for the genus *Dactylopsylla*, *Dolichopsylla bluei* C. Fox.

Although at first glance the modified segments of the male in this subgenus appear to be of an entirely different type from those of the other subgenera of *Dactylopsylla*, yet upon closer study the differences observed are found to be in the shape and size of parts rather than in the general plan of the terminalia or in the relations of the parts to one another. This point is further discussed under the description of the subgenus *Foxella* Wagner.

DACTYLOPSYLLA (DACTYLOPSYLLA) BLUEI (C. Fox)

(Fig. 5, A)

Dolichopsyllus bluei C. Fox, 1909, Ent. News 20: 195, figs. 1-4.

Dactylopsylla bluei Jordan, 1929, Novitates Zool. 35: 38.

Type host.—*Mustela xanthogenys* Gray (weasel).

Type locality.—San Francisco, Calif.

Range.—Known only from California.

The original description of this species, which is based on females only, is accompanied by a drawing of parts.

DACTYLOPSYLLA (DACTYLOPSYLLA) COMIS Jordan

Dactylopsylla comis Jordan, 1929, Novitates Zool. 35: 38, pl. 2, fig. 26.

Type host.—*Thomomys fuscus* (Merr.) (pocket gopher).

Type locality.—Okanagan Landing, British Columbia.

Range.—Known only from British Columbia.

The male of *comis* is unknown. According to the original description of the female the apical margin of sternal plate VII is rounded and not produced into an angular lobe as in *bluei*.

DACTYLOPSYLLA (DACTYLOPSYLLA) STIMSONI (C. Fox)

Ceratophyllus stimsoni C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 12, pl. 4, figs. 4-6.

Dactylopsylla stimsoni Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 49.

Type host.—*Thomomys* sp. (pocket gopher).

Type locality.—Los Angeles, Calif.

Range.—Known only from California.

The original description of *stimsoni* was based on the male sex. It is accompanied by drawings of the head, terminalia, and posterior tarsus.

The Subgenus FOXELLA Wagner

Foxella Wagner, 1929, *Konowia* 8: 314, footnote. Type, *Pulex ignotus* Baker (by original designation).

With the characters of the genus *Dactylopsylla* and in addition: In male, sternal plate VIII somewhat reduced, ending posteriorly in a pair of small, simple lobes, each of which bears a large, heavily pigmented, marginal bristle at its base; sternal plate IX with a pair of large, inner, vertical processes, a conspicuous, anterior, median apophysis, and a pair of large, posterior processes, each being divided into a proximal and a distal lobe by a broad ventral sinus; movable finger of clasper long, slender, but not hooked backward at apex.

As already stated (see paragraph following the description of the subgenus *Dactylopsylla*), the male terminalia of the three subgenera of the genus *Dactylopsylla* are essentially the same in general plan. In *Foxella* sternal plate VIII is much more reduced than in the type subgenus and possesses a very large, pigmented bristle at the base of each distal lobe, the movable finger is not hooked backward at the apex, and the outer sheath of the penis is less modified.

DACTYLOPSYLLA (FOXELLA) IGNOTA IGNOTA (Baker), new combination

Pulex ignotus Baker, 1895, *Canad. Ent.* 27: 110.

Typhlopsylla americana Baker, 1895, *Canad. Ent.* 27: 189.

Ceratophyllus ignotus Baker, 1904, U. S. Natl. Mus. Proc. 27: 416, pl. 21, figs. 1-6.

Foxella ignota Wagner, 1930, *Konowia* 8: 315, footnote; I. Fox, 1940, *Fleas of Eastern United States*, p. 39, pl. 11, figs. 52, 54, and 55.

Type host.—Unknown.

Type locality.—Ames, Iowa.

Range.—The species is common in the western part of the United States and Canada, forming several varieties. This particular variety occurs in Iowa, Minnesota, and Illinois.

This variety is a rodent flea, yet Jellison (24, p. 794) found 55 individuals in a nest containing 5 half-grown fledglings of the burrowing owl, *Speotyto cunicularia* (Molina), in the sylvatic-plague area of Montana. In addition to the specimens of *Dactylopsylla ignota ignota*, Jellison found in this same nest rodent fleas of 5 other species, making a total of 109 flea specimens. These observations show how important the burrowing owl may become in disseminating fleas occurring on plague-infested rodents.

DACTYLOPSYLLA (FOXELLA) IGNOTA ALBERTENSIS (Jordan and Rothschild), new combination

Ceratophyllus ignotus albertensis Jordan and Rothschild, 1915, *Ectoparasites* 1: 56, figs. 58 and 60.

Cotype hosts.—*Geomys* sp. (pocket gopher), *Mustela* sp. (weasel), and *Lynx canadensis* Kerr (Canada lynx).

Type locality.—Blackfalls, Alberta.

Range.—Known only from Alberta.

In this variety the eighth sternal plate of the abdomen in the male is shorter than in the varieties *ignota*, *apachina*, *recula*, and *franciscana* and has very short apical lobes. The movable finger is provided with four long setae on its posterior margin.

DACTYLOPSYLLA (FOXELLA) IGNOTA APACHINA (C. Fox), new combination

Ceratophyllus apachinus C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 14, pl. 5, figs. 1-3.

Ceratophyllus ignotus apachinus Jordan and Rothschild, 1915, Ectoparasites 1: 56, figs. 59 and 62.

Type host.—"Prairie dog."

Type locality.—"Apache County, N. Mex."

Range.—Western part of the United States.

The type locality of this variety was given as in the State of New Mexico, but since there is no Apache County in New Mexico it is probable that the specimens really came from Apache County, Ariz. In this variety the eighth sternal plate of the male is intermediate in relation to that of the varieties *ignota* and *albertensis*. The movable finger of the clasper has three long setae on the posterior margin.

DACTYLOPSYLLA (FOXELLA) IGNOTA FRANCISCANA (Rothschild), new combination

Ceratophyllus franciscanus Rothschild, 1910, Ent. Monthly Mag. (2) 21: 88, pl. 3, figs. 1 and 2.

Ceratophyllus ignotus franciscanus Jordan and Rothschild, 1915, Ectoparasites 1: 58.

Type host.—*Thomomys bottae* (Eyd. and Gerv.) (pocket gopher).

Type locality.—San Francisco, Calif.

Range.—Known only from California.

This variety differs from the others in having a shorter process of the clasper and a shorter movable finger. The process of the clasper is about as broad at its base as it is high.

DACTYLOPSYLLA (FOXELLA) IGNOTA RECUA (Jordan and Rothschild), new combination

Ceratophyllus ignotus recula Jordan and Rothschild, 1915, Ectoparasites 1: 58, figs. 59 and 61.

Type host.—*Mustela arizonensis* (Mearns) (weasel).

Type locality.—Okanagan Landing, British Columbia.

Range.—Known only from British Columbia.

This variety is characterized by having only 16 to 18 spines in the pronotal comb and a broad emargination near the middle of the posterior margin of the movable finger of the clasper.

DACTYLOPSYLLA (FOXELLA) IGNOTA UTAHENSIS (Wagner), new combination

Foxella ignotus utahensis Wagner, 1936, Ztschr. f. Parasitenk. 8: 655.

Type host.—*Thomomys* sp. (pocket gopher).

Type locality.—Wellsville, Utah.

Range.—Known only from Utah.

In this variety there are three or four antepygial bristles on each side of the abdomen, the two lower ones being well developed. The eighth sternal plate of the male is as in *Dactylopsylla ignota apachina* (Jordan and Rothschild).

DACTYLOPSYLLA (FOXELLA) MEXICANA I. Fox, new combination

Foxella mexicana I. Fox, 1939, Iowa State Col. Jour. Sci. 13: 337, pl. 1, figs. 1 and 4.

Type host.—"Pocket gopher."

Type locality.—Cerro Potosi, Nuevo Leon, Mexico.

Range.—Known only from the type locality.

The original description of this species was based on two females and is accompanied by a drawing of the head and terminalia. According to the original description of *mexicana* it is "readily separated from *Foxella ignota* (Baker) by the distinctive chaetotaxy of the head and by the genitalia."

The Subgenus SPICATA I. Fox

Spicata I. Fox, 1940, Wash. Acad. Sci. Jour. 30: 275. Monotypic. Type, *Dactylopsylla (Spicata) rara* I. Fox.

With the characters of *Dactylopsylla* and in addition: In male sternal plate VIII produced posteriorly into a strong, upwardly curved process which bears a ventral fringe of setae, the 6 posterior of which are heavily pigmented and enlarged into stout bristles; sternal plate IX with a pair of long, inner, vertical processes, a conspicuous median apophysis, and a pair of large, posterior processes, each being divided into a proximal and a distal lobe; movable finger of clasper long, slightly curved, not hooked backward at apex; manubrium narrow and tapering distally.

As stated by I. Fox in the original description:

* * * In the type subgenus [*Dactylopsylla*] sternite VIII is large but not armed with heavy pigmented bristles. In *Foxella* this sternite is small and bears but a single long bristle near the apex. The manubrium of the new subgenus [*Spicata*], being narrow and tapering distally, is markedly different from both *Foxella* and *Dactylopsylla* (*Dactylopsylla*) where this structure is short, broad, and triangular.

DACTYLOPSYLLA (SPICATA) RARA I. Fox

Dactylopsylla (Spicata) rara I. Fox, 1940, Wash. Acad. Sci. Jour. 30: 275, figs. 5 and 6.

Type host.—*Thomomys fessor* Allen (pocket gopher).

Type locality.—Jackson County, Colo.

Range.—Known only from the type locality.

The original description of this species was based on a single male and is accompanied by drawings of part of the male terminalia.

The Genus MIOCTENOPSYLLA Rothschild

(Fig. 5, B)

Mioctenopsylla Rothschild, 1922, Rpt. Norwegian Exped. Novaya Zemlya 1921, No. 4, p. 3. Monotypic. Type, *Mioctenopsylla arctica* Rothschild.
Boreopsyllus Ewing, 1929, A Manual of External Parasites, pp. 168 and 201. Monotypic. Type, *Amphipsylla hadweni* Ewing.

Frontal tubercle small, almost hyaline, angulate apically. Forehead with 2 rows of lateral setae, none of which is spiniform. Eyes large, black. Labial palpus 5-segmented, not reaching to apex of coxa I. Postantennal region of head with 1 incomplete row of setae in addition to a complete marginal row. Pronotal comb with very short, sharply pointed spines which are not heavier in pigmentation than the pronotum itself. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV taken together; last segment of

posterior tarsus with 5 pairs of lateral plantar bristles, the first pair not being shifted ventrally. Abdomen with but few apical spines. Tergal plate VII with a small, posterior, median process. Female with 1 or 2 antepygial bristles on each side of abdomen and a single receptaculum seminis. In male, sternal plate VIII with large, fringed, membranous flap; sternal plate IX with large, inner, vertical processes, an anterior median apophysis, and long, 2-lobed, posterior processes; movable finger of clasper large, broad, flat, somewhat rectangular and with 3 pigmented, marginal spines.

This genus, not being given in Dalla Torre's catalogue, was overlooked at the time *Boreopsyllus* was established.

MIOTENOPSYLLA ARCTICA Rothschild

(Fig. 5, B)

Miotenopsylla arctica Rothschild, 1922, Rpt. Norwegian Exped. Novaya Zemlya 1921, No. 4, p. 4, figs. 1-5.

Amphipsylla hadweni Ewing, 1927, Wash. Biol. Soc. Proc. 40: 89.

Type host.—*Rissa tridactyla* (L.) (Atlantic kittiwake).

Type locality.—Gribovii Fjord, Novaya Zemlya.

Range.—Novaya Zemlya, Alaska, and probably most of coastal regions inside of Arctic Circle.

Notwithstanding the fact that *Amphipsylla hadweni* Ewing was described from North America, while *Miotenopsylla arctica* Rothschild came from Novaya Zemlya, the two forms appear to be identical. The species should be regarded as circumpolar. It is well illustrated by the figures which accompany Rothschild's original description.

The Genus THRASSIS Jordan

(Fig. 7, A)

Thrassis Jordan, 1933, Novitates Zool. 39: 72. Type, *Ceratophyllus acamantis* Rothschild (by original designation).

Frontal tubercle small, apically angulate. Forehead with but a single row of lateral setae, the ocular row. Eyes well developed, fully pigmented. Labial palpus 5-segmented, extending to or beyond apex of trochanter I. Postantennal region of head with a single row of setae, the marginal row. Pronotal comb with usual, long, black spines. Femur I with several lateral setae; coxa III without a row or patch of spinelets on the inner surface; segment I of posterior tarsus not longer than II, III, and IV taken together; last segment of each tarsus with 5 pairs of lateral, plantar bristles, the first pair being in line with the others. Abdomen with but few apical spines, all of which are situated dorsally. Tergal plate VII with either no posterior, median process, or a very small one. Two or 3 antepygial bristles on each side of abdomen in female; 1 long and 2 minute setae on each side in male. Female with 1 receptaculum seminis, the head of which is spherical or subspherical; stylet with 2 or 3 prominent lateral bristles. In male, sternal plate VIII large, broad, without long, filamentous, apical appendage; sternal plate IX with long, slender, elbowed, inner vertical processes, a somewhat enlarged anterior apophysis, and a posterior process which usually has 2 lobes and a pair of pigmented spines; movable finger of clasper broad, flat, curved, with a few long setae on posterior margin.

The posterior process of the ninth sternal plate of the male in this genus has never been properly studied. Male specimens should have the modified abdominal segments dissected so as to show the structure of this process and also that of the penis, which is of almost equal taxonomic importance. *Thrassis* is exclusively a Nearctic genus. Its species parasitize various rodents.

THRASSIS ACAMANTIS (Rothschild)

(Fig. 7, 4)

Ceratophyllus acamantis Rothschild, 1905, *Novitates Zool.* 12: 156, pl. 8, figs. 24 and 25.

Thrassis acamantis Jordan, 1933, *Novitates Zool.* 39: 72.

Cotype hosts.—*Mephitis occidentalis spissigrada* (Bangs) (skunk), *Marmota flaviventris* (Aud. and Bach.) (woodchuck), *Mustela vison energumens* (Bangs) (weasel), *Canis latrans* Say (coyote).

Cotype localities.—Okanagan, Sumas, and Eagle River, British Columbia.

Range.—Western part of the United States, Canada, and Alaska.

This widely distributed species is of medium size and has marmots for natural hosts. In it the posterior process of the ninth sternal plate of the male bears near the ventral margin of its proximal lobe a pair of long, flat, apically acuminate, modified, pigmented spines, the shape of which is characteristic of the species.

THRASSIS ARIZONENSIS ARIZONENSIS (Baker)

Pulex arizonensis Baker, 1898, *N. Y. Ent. Soc. Jour.* 6: 55.

Ceratophyllus proximus Baker, 1904, *U. S. Natl. Mus. Proc.* 27: 412, pl. 19, figs. 1-5.

Thrassis arizonensis Jordan, 1933, *Novitates Zool.* 39: 73.

Type host.—"Nest of silvery mouse."

Type locality.—Tucson, Ariz.

Range.—Western part of the United States.

The original description of the species *arizonensis* was based upon a single male and unaccompanied by figures.

THRASSIS ARIZONENSIS LITTORIS (Jordan)

Ceratophyllus arizonensis littoris Jordan, 1929, *Novitates Zool.* 35: 31, pl. 1, fig. 6.

Type host.—"Citellus turdicaudatus" (ground squirrel).

Type locality.—San Diego, Calif.

Range.—Known only from California.

The original description of *littoris* is based upon a single female which is like the type subspecies, "but the ventral, widened area of tergite VIII with 21 bristles on one side and 20 on the other, instead of from 14 to 16 as in *C. a. arizonensis*."

THRASSIS BACCHI (Rothschild)

Ceratophyllus bacchi Rothschild, 1905, *Novitates Zool.* 12: 159, pl. 9, fig. 34.

Thrassis bacchi Jordan, 1933, *Novitates Zool.* 39: 73.

Type host.—"Citellus tridecemlineatus" (Mitch.) (13-striped ground squirrel).

Type locality.—Red Deer, Alberta.

Range.—Western part of the United States and Canada.

The original description of this species, based exclusively on the male, is accompanied by drawings of the terminalia.

THRASSIS DESERTORUM Stewart

Thrassis desertorum Stewart, 1937, Canad. Ent. 69: 273, figs. 1 and 2.

Type host.—*Ammospermophilus leucurus* (Merr.) (antelope squirrel).

Type locality.—Riverside County, Calif.

Range.—Known only from California.

A comparison of a male paratype of *Thrassis desertorum* with the male holotype of *T. arizonensis* shows that the two species are very close to each other. Probably a further study of a large series of specimens of each species will indicate the reduction of *desertorum* to a subspecies or variety of *T. arizonensis*.

THRASSIS FOTUS (Jordan)

Ceratophyllus fatus Jordan, 1925, Novitates Zool. 32: 107, fig. 30.

Ceratophyllus citelli Stewart, 1928, Canad. Ent. 60: 150, figs. 3 and 4.

Thrassis fatus Jordan, 1933, Novitates Zool. 39: 73.

Type host.—*Citellus tridecemlineatus* (Mitch.) (13-striped ground squirrel).

Type locality.—Colorado Springs, Colo.

Range.—Western part of the United States.

The original description of this species is accompanied by a figure of the clasper of the male and sternal plate VIII of the same sex.

THRASSIS FRANCISI (C. Fox)

Ceratophyllus francisi C. Fox, 1927, Amer. Ent. Soc. Trans. 53: 210.

Thrassis francisi Jordan, 1933, Novitates Zool. 39: 73.

Type host.—*Citellus mollis* (Kenn.) (ground squirrel).

Type locality.—Utah.

Range.—Known only from Utah.

In this species each spine of the pair situated on the proximal lobe of the posterior process of sternal plate IX of the male is greatly flattened and bladelike, with an exceedingly long and finely pointed apex. Wagner (83, p. 343) in 1935 redescribed this species, illustrating the terminalia of the two sexes.

THRASSIS GLADIOLIS GLADIOLIS (Jordan)

Ceratophyllus gladiolis Jordan, 1925, Novitates Zool. 32: 108, figs. 32 and 33.

Thrassis gladiolis Jordan, Novitates Zool. 39: 73.

Type host.—"Citellus turdicaudatus" (ground squirrel).

Type locality.—San Diego, Calif.

Range.—Known only from California.

The original description of *gladiolis* is accompanied by a drawing of the clasper of the male and the posterior process of the sternal plate IX of the same sex.

THRASSIS GLADIOLIS CADUCUS (Jordan)

Ceratophyllus gladiolis caducus Jordan, 1930, Novitates Zool. 35: 268-269, fig. 2.

Type host.—*Ammospermophilus leucurus* (Merr.) (antelope squirrel).

Type locality.—Vernal, Utah.

Range.—Known only from Utah.

Very similar to type variety but: "Exopodite F [movable finger] a little broader than in *C. g. gladiolis*; anterior angle of paramere slightly less projecting * * *."

THRASSIS HOWELLI HOWELLI (Jordan)

Ceratophyllus howelli Jordan, 1925, Novitates Zool. 32: 109, figs. 34 and 35.

Thrassis howelli Jordan, 1933, Novitates Zool. 39: 73.

Cotype hosts.—*Mustela arizonensis* (Mearns) (weasel) and *Marmota flaviventris sierrae* How. (woodchuck).

Type locality.—Pine City, Mono County, Calif.

Range.—For the species as a whole, western part of the United States; for this particular subspecies, California only.

Thrassis howelli is near *acamantis* Rothschild, but sternal plate VIII (a figure of which accompanies the original description) is much more slender than in the latter species. The receptaculum seminis is as in *acamantis*.

THRASSIS HOWELLI UTAHENSIS Wagner

Thrassis howelli utahensis Wagner, 1936, Ztschr. f. Parasitenk. 8: 340, fig. 12.

Type host.—*Marmota flaviventris engelhardti* (Allen) and *M. f. nosophora* How. (woodchucks).

Cotype localities.—Salina and Logan, Utah.

Range.—Utah.

This subspecies is said by its author to unite *Thrassis howelli* Jordan with *T. acamantis* Rothschild. Drawings of the eighth sternum and tergum of the male accompany the original description.

THRASSIS PANDORAE Jellison

Thrassis pandorae Jellison, 1937, U. S. Pub. Health Serv. Rpts. 52: 727, figs. 1, 2, and 4.

Cotype host.—*Citellus elegans* (Kenn.) (ground squirrel).

Type locality.—P. and O. Ranch, Beaverhead County, Mont.

Range.—Known only from Montana.

In this species the posterior process of the ninth sternal plate of the male has, in addition to the usual two ventral lobes, a third ventral lobe which is situated at its base. The basal lobe is flattened, subdiscoidal, and without setae. The receptaculum seminis has a broadly oval, somewhat asymmetrical head and a button on the apex of the tail.

THRASSIS PANSUS (Jordan)

Ceratophyllus pansus Jordan, 1925, Novitates Zool. 32: 109, fig. 38.

Thrassis pansus Jordan, 1933, Novitates Zool. 39: 73.

Type hosts.—*Citellus* sp. (ground squirrel) and *Mephitis* sp. (skunk).

Type locality.—Paradise, Ariz.

Range.—Known only from Arizona.

The original description of this species, which is accompanied by a drawing of the distal end of the penis, is based exclusively on the male.

THRASSIS PETIOLATUS (Baker)

Ceratophyllus petiolatus Baker, 1903, U. S. Natl. Mus. Proc. 27: 415, pl. 18, figs. 7-11.

Thrassis petiolatus Jordan, 1933, Novitates Zool. 39: 73.

Type host.—*Lynx canadensis* Kerr (Canada lynx).

Type locality.—Moscow, Idaho.

Range.—Western part of the United States and Canada.

The type host of this species is undoubtedly not a natural one, as the species occurs normally on rodents. The original description of it is accompanied by illustrations but is based on a single male.

THRASSIS SPENCERI Wagner

Thrassis spenceri Wagner, 1936, Ztschr. f. Parasitenk. 8: 635.

Type host.—*Marmota* sp. (woodchuck).

Type locality.—Birch Island, British Columbia.

Range.—Known only from British Columbia.

This species is, according to its describer, most nearly related to *Thrassis acamantis* Rothschild, from which it differs in having shorter labial palpi and in a few other characters.

THRASSIS STANFORDI Wagner

Thrassis stanfordi Wagner, 1935, Ztschr. f. Parasitenk. 8: 344, figs. 15-18.

Cotype hosts.—*Marmota flaviventris engelhardti* (Allen) and *M. f. nosophora* How. (woodchucks).

Cotype localities.—Fish Lake, Salina, and Logan, Utah.

Range.—Utah.

This species belongs to a group of species in which the labial palpi are very long and the parameres are rounded distally.

The Genus OROPSYLLA Wagner and Ioff

(Fig. 7, D)

Oropsylla Wagner and Ioff, 1926, Rev. de Microbiol. et d'Epidémiol. Saratov 5: 86 and 120. Type, *Ceratophyllus silantjewi* Wagner (by original designation).

Frontal tubercle small, either rounded or angulate apically. Forehead with 1 complete ocular row of lateral setae and usually with an additional incomplete row. Eyes well developed, black. Labial palpus 5-segmented and extending beyond apex of coxa I. Postantennal region of head with but a single row of lateral setae, the posterior, marginal row. Pronotal comb with usual long, black spines. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus not longer than II, III, and IV taken together; last segment of posterior tarsus with 5 pairs of lateral, plantar bristles none of which is shifted ventrally. Abdomen with few apical spines, all of which are dorsal or nearly dorsal in position. Tergal plate VII without posterior, median process. Female with 2 to 4 antepygial bristles on each side of abdomen; male with 2 on each side, 1 of which may be very small. Female with a single receptaculum seminis. In male, sternal plate VIII much reduced and modified; sternal plate IX with conspicuous, inner, vertical processes and an anterior, median apophysis.

The genus *Oropsylla*, as here recognized, is composed of three subgenera, the type subgenus *Oropsylla* and the subgenera *Diamanus*

Jordan and *Opisocrostitis* Jordan. The genus as a whole is Holarctic in distribution, but the subgenus *Opisocrostitis* is confined to the Nearctic Region.

The Subgenus OROPSYLLA Wagner and Ioff

Typical subgenus of genus *Oropsylla* Wagner and Ioff. Type, *Ceratophyllus silantjewi* Wagner.

With the characters of the genus *Oropsylla* and in addition: Frontal tubercle acutely angulate apically and largely concealed in frontal notch. Labial palpus long, extending beyond apex of trochanter I. In male, setae on segment II of antenna not reaching middle of club. Basal abdominal sternal plate without patch of bristles on side. Female with 3 or more antepygial bristles, male with 1 long and 1 minute bristle. Female with head of receptaculum seminis ovate or pyriform and the tail short. In male, sternal plate VIII narrow, rodlike, without apical membranous appendage; sternal plate IX with posterior process divided into a pair of long, broad lobes, each of which is itself divided into a proximal and a distal lobe by a deep ventral incision; movable finger of clasper broad, flattened, somewhat clavate; spring of penis with a single, complete convolution.

Several species, both Nearctic and Palaearctic, belong in this subgenus. It is particularly characterized by the length of the labial palpus, which may extend beyond the middle of femur I in some species.

OROPSYLLA (OROPSYLLA) ALASKENSIS (Baker)

Ceratophyllus alaskensis Baker, 1904, U. S. Natl. Mus. Proc. 27: 394.

Oropsylla alaskensis Wagner, 1929, Konowia 8: 313.

Type host.—*Citellus barrowensis* (Merr.) (ground squirrel).

Type locality.—Point Barrow, Alaska.

Range.—Known only from Alaska.

The type locality of this species represents the farthest-north record for the order in continental North America. It is a flea above medium size and is seldom found in flea collections.

OROPSYLLA (OROPSYLLA) ARCTOMYS (Baker)

Ceratophyllus arctomys Baker, 1904, U. S. Natl. Mus. Proc. 27: 411, pl. 22, figs. 1-6.

Oropsylla arctomys Wagner, 1929, Konowia 8: 315; I. Fox, 1940, Fleas of Eastern United States, p. 45, pl. 9, figs. 40, 41, and 43.

Type host.—*Marmota monax* (L.) (woodchuck).

Type locality.—Peterboro, N. Y.

Range.—Northern part of the United States, Canada, and Alaska.

OROPSYLLA (OROPSYLLA) IDAHOENSIS (Baker)

(Fig. 7, D)

Ceratophyllus idahoensis Baker, 1904, U. S. Natl. Mus. Proc. 27: 413, pl. 18, figs. 1-6.

Ceratophyllus potantis Rothschild, 1905, Novitates Zool. 12: 155, pl. 7, figs. 22 and 23.

Ceratophyllus bertholfti C. Fox, 1927, Amer. Ent. Soc. Trans. 53: 211.

Oropsylla idahoensis Wagner, 1930, Konowia 8: 314.

Type host.—*Citellus columbianus* (Ord) (ground squirrel).

Type locality.—Moscow, Idaho.

Range.—Western part of the United States, Canada, and Alaska. The original description of this species appears to be in error in stating that the frontal tubercle is lacking. An examination of the type specimens on which it is based shows that the male and female each have a minute, angulate, almost hyaline frontal tubercle.

OROPSYLLA (OROPSYLLA) RUPESTRIS (Jordan)

Ceratophyllus rupestris Jordan, 1929, *Novitates Zool.* 35: 32, pl. 1, figs. 8 and 9.
Oropsylla rupestris Wagner, 1929, *Konowia* 8: 314.

Cotype hosts.—*Mustela longicauda* Bonap. (weasel) and *Citellus richardsonii* (Sab.) (ground squirrel).

Type locality.—Calgary, Alberta.

Range.—Western Canada.

According to the remarks given by Jordan accompanying the original description, *rupestris* is similar to *arctomys* Baker, but smaller, and "the bristles on the whole less numerous, the lowest bristle of the posterior row of the abdominal tergite II posterior to the stigma, not directly below it." The original description is accompanied by a drawing of the genitalia of both sexes.

The Subgenus DIAMANUS Jordan

Diamanus Jordan, 1933, *Novitates Zool.* 39: 73. Type, *Pulex montanus* Baker (by original designation).

Labial palpus very long. In male, bristles of antennal segment II short, not reaching middle of club. Sternal plate VIII of male very short and largely or completely contained inside of VII; sternal plate IX with each posterior process setigerous and conspicuously bilobed because of a deep ventral emargination; movable finger of clasper long, flattened, somewhat swordlike, and curved forward apically. Female with 2 subequal antepygial bristles on each side of abdomen, and with dorsolateral bristle of stylet smaller than ventral bristle.

This subgenus includes but two species, the Nearctic *montanus* Baker and the Palaearctic *mandarinus* Jordan and Rothschild. It is separated from the other subgenera of *Oropsylla* entirely on sex characters.

OROPSYLLA (DIAMANUS) MONTANA (Baker)

Pulex montanus Baker, 1895, *Canad. Ent.* 27: 32.

Ceratophyllus montanus Baker, 1904, *U. S. Natl. Mus. Proc.* 27: 411, pl. 22, figs. 7-8, and pl. 23, figs. 1-5.

Ceratophyllus acutus Baker, 1904, *Invert. Pacifica* 1: 40.

Oropsylla montanus Wagner, 1929, *Konowia* 8: 314; Stanford, 1931, *Utah Acad. Sci., Arts and Letters Proc.* 1931: 154.

Diamanus montanus Jordan, 1933, *Novitates Zool.* 39: 72.

Type host.—"Large mountain grey-squirrel (*Sciurus aberti*?)."

Type locality.—Fort Collins, Colo.

Range.—Western part of the United States and Mexico.

This squirrel-infesting species is well illustrated by Baker (1904). It is medium sized and dark brown and can be identified by the characters of the terminalia as given in the description of the subgenus.

The Subgenus OPISOCROSTIS Jordan

Opisocrostis Jordan, 1933, *Novitates Zool.* 39: 73. Type, *Pulex hirsutus* Baker (by original designation).

Frontal tubercle variable in shape and size, but never large and never acutely angulate apically but frequently narrowly rounded or broadly rounded

at apex. In some species frontal tubercle not distinctly differentiated but merged into frontal margin of head. Bristles on antennal segment II long, in female extending beyond apex of club. In male, sternal plate VIII much reduced, slender, with 2 long, ventral, subapical bristles and a pair of setalike, semihyaline, filamentous, apical appendages; sternal plate IX with a pair of conspicuous, flattened, posterior processes, each of which is divided into a basal and a distal lobe by a deep ventral emargination; movable finger of clasper large, broad, flat, with upper portion curved or bent somewhat forward. In female, 2 antepygial bristles on each side, the lower being the shorter. Receptaculum seminis with head broader than long and tail sausage shaped.

Except for the characters of the eighth sternal plate in the male and the antepygial bristles in the female, *Opisocrostis* is ill defined, hence is here reduced to a subgeneric status. That it constitutes a natural group of Nearctic fleas parasitizing hosts of the rodent family Sciuridae appears very probable.

OROPSYLLA (OPISOCROSTIS) BRUNERI (Baker)

Pulex bruneri Baker, 1895, Canad. Ent. 27: 131.

Ceratophyllus bruneri Baker, 1904, U. S. Natl. Mus. Proc. 27: 413, pl. 25, figs. 1-5.

Oropsylla bruneri Wagner, 1929, Konowia 8: 313.

Opisocrostis bruneri Jordan, 1933, Novitates Zool. 39: 73; I. Fox, 1940, Fleas of eastern United States, p. 43, pl. 11, figs. 50-51, 53.

Cotype hosts.—*Citellus tridecemlineatus* (Mitch.) (thirteen-striped ground squirrel) and *C. franklinii* (Sab.) (Franklin's ground squirrel.)

Cotype localities.—Lincoln, Nebr., and Fort Collins, Colo.

Range.—Middlewestern part of the United States (Idaho eastward to Illinois).

Baker (1904) published detail drawings of this species.

OROPSYLLA (OPISOCROSTIS) HIRSUTA (Baker), new combination

Pulex hirsutus Baker, 1895, Canad. Ent. 27: 130.

Ceratophyllus hirsutus Baker, 1904, U. S. Natl. Mus. Proc. 27: 392, pl. 17, figs. 1-4.

Opisocrostis hirsutus Jordan, 1933, Novitates Zool. 39: 73; Jellison, 1939, U. S. Pub. Health Serv. Rpts. 54: 840, 3 figs.

Type host.—*Cynomys ludovicianus* (Ord) (prairie dog).

Type locality.—Stove Prairie, Larimer County, Colo.

Range.—Western part of the United States.

This species has been known as the prairie dog flea. Baker (1904) redescribed and figured the female, and Jellison (1939) for the first time described and figured the male.

OROPSYLLA (OPISOCROSTIS) LABIS (Jordan and Rothschild)

Ceratophyllus labis Jordan and Rothschild, 1922, Ectoparasites 1: 275, figs. 267-268.

Oropsylla labis Stewart, 1930, Canad. Ent. 62: 152.

Opisocrostis labis Jordan, 1933, Novitates Zool. 39: 73; Jellison, 1939, U. S. Pub. Health Serv. Rpts. 54: 841, 3 figs.

Type host.—*Mustela longicauda* Bonap. (weasel).

Type locality.—Calgary, Alberta.

Range.—Western part of the United States and Canada.

The female originally described for this species did not belong to it, as was pointed out by Jordan (40, p. 32) in 1929. It was in fact the female of *Oropsylla* (*O.*) *rupestris* (Jordan) and has been described, along with other material, under the name of *Ceratophyllus*

rupestris by Jordan (40, p. 32). Drawings of part of the terminalia of both sexes of *labis* were given by Jellison in 1939.

OROPSYLLA (OPISOCROSTIS) OREGONENSIS (Good and Prince), new combination

Opisocrostitis oregonensis Good and Prince, 1939, U. S. Pub. Health Serv. Rpts. 54: 1867, figs. 1-2.

Type host.—*Citellus oregonus* (Merr.) (ground squirrel).

Type locality.—Baker County, Oreg.

Range.—Oregon and Idaho.

The original description of *oregonensis* is accompanied by a drawing of the posterior part of the abdomen of each sex. The species is especially characterized by the triangular manubrium of the clasper in the male and the very deep V-shaped emargination on each lateral posterior margin of sternal plate VII of the female.

OROPSYLLA (OPISOCROSTIS) SAUNDERSI (Jordan), new combination

Ceratophyllus saundersi Jordan, 1933, Entomologist 66: 16, figs. 6-7.

Opisocrostitis saundersi Jordan, 1933, Novitates Zool. 39: 73.

Type host.—*Citellus richardsonii* (Sab.) (ground squirrel).

Type locality.—Saskatchewan, Canada.

Range.—Known only from Canada.

The original description of *saundersi* is accompanied by drawings of a part of the terminalia of each sex. The species is especially characterized by the broad, straight, movable finger of the clasper in the male and the absence of the notch usually observed in the posterior, lateral margin of sternal plate VII of the female.

OROPSYLLA (OPISOCROSTIS) TUBERCULATA CYNOMURIS (Jellison), new combination

Opisocrostitis tuberculatus cynomuris Jellison, 1939, U. S. Pub. Health Serv. Rpts. 54: 843, 3 figs.

Type host.—*Cynomys ludovicianus* (Ord) (prairie dog).

Type locality.—Jefferson Canyon, Broadwater County, Mont.

Range.—Montana, Colorado, and Wyoming.

Drawings of part of the terminalia of each sex accompany the original description of this variety. It differs from the type variety in that the apex of the movable finger in the male is rounded, instead of being acute as in *tuberculata tuberculata*, and in that the upper lobe on the posterior margin of sternal plate VII of the female is broad and truncate instead of being narrow and acutely angulate as in *t. tuberculata*.

OROPSYLLA (OPISOCROSTIS) TUBERCULATA ORNATA (I. Fox), new combination

Opisocrostitis ornatus I. Fox, 1940, Wash. Ent. Soc. Proc. 42: 67, pl. 10, fig. 8.

Type host.—*Cynomys gunnisoni* (Baird) (prairie dog).

Type locality.—Saguache County, Colo.

Range.—Known only from the type locality.

The original description of *ornata* was based on the male and is accompanied by a drawing of the clasper. This variety is near *cynomuris*, but the movable finger of the male is distinctly broadened opposite the apex of the dorsal process, and it terminates apically in a more acute angle. It also is near the type variety of *tuberculata*, but the movable finger is stouter.

OROPSYLLA (OPISOCROSTIS) TUBERCULATA TUBERCULATA (Baker), new combination

Ceratophyllus tuberculatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 393, pl. 13, figs. 7-9.

Opisocrostitis tuberculatus Jordan, 1933, Novitates Zool. 39: 73.

Type host.—*Citellus columbianus* (Ord) (ground squirrel).

Type locality.—Moscow, Idaho.

Range.—Western part of the United States and Canada for the species and western part of the United States for the variety.

The original description of this variable species and its type variety was based on a single male and female. It is accompanied by three detail drawings. Tellison (35, p. 842) in 1939 gave drawings of part of the terminalia of each sex.

OROPSYLLA (OPISOCROSTIS) WASHINGTONENSIS (Good and Prince), new combination

Opisocrostitis washingtonensis Good and Prince, 1939, U. S. Pub. Health Serv. Rpts. 54: 1691, figs. 3-4.

Type host.—*Citellus washingtoni* How. (ground squirrel).

Type locality.—Adams County, Wash.

Range.—Washington and Oregon.

This species is closely related to *oregonensis* but differs from the latter in having the manubrium of the clasper of the male longer and less triangular and in having a small, instead of a large and deep, notch in each posterior, lateral margin of sternal plate VII of the female. The original description of *washingtonensis* is accompanied by drawings of the terminalia of both sexes.

The Genus *AMPHALIUS* Jordan

Amphalius Jordan, 1933, Novitates Zool. 39: 74. Type, *Ceratophyllus rufatus* Jordan and Rothschild (by original designation).

Frontal tubercle angulate, partly sunk into frontal notch. Eyes well developed. Labial palpus long, extending to apex of trochanter I. Setae on antennal segment II of female long. Pronotal comb with more than 24 spines. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; first pair of plantar bristles of segment V of each tarsus shifted somewhat ventrally. Basal sternal plate of abdomen without lateral bristles. Antepygidial bristles on each side of abdomen in female 3. Stylet of female cylindrical, apex rounded, bearing several bristles. In male, sternal plate VIII narrow, fringed on upper surface, with large, fringed, apical flap; sternal plate IX with vertical inner process bearing a tooth above middle of posterior margin; process of clasper long, narrow, truncate or rounded apically; movable finger broad, flat, curved forward at apex, with large, black, sub-apical bristle and a posteroventral process which may be as long as the finger proper.

Species of this genus are rather remarkable for the very conspicuous posteroventral process of the movable finger of the male claspers. In the Asiatic species *clarus* Jordan and Rothschild this process is actually longer than the finger itself and is dilated apically into a disklike lobe. Besides this Asiatic species, *Amphalius* contains a Nearctic species and another Asiatic species.

AMPHALIUS NECOPINUS (Jordan)

Ceratophyllus necopinus Jordan, 1925, Novitates Zool. 32: 110, fig. 37.

Amphalius necopinus Jordan, 1933, Novitates Zool. 39: 74.

Type host.—*Ochotona schisticeps muiri* (Grinn. and Stor.) (cony).

Type locality.—Pine City, Mono County, Calif.

Range.—Known only from California.

The very striking characters of the claspers of the male at once distinguish this species from all other American fleas. These characters are represented in a figure which accompanies the original description of *necopinus*.

The Genus NOSOPSYLLUS Jordan

(Fig. 3)

Nosopsyllus Jordan, 1933, Novitates Zool. 39: 76. Type, *Pulex fasciatus* Bosc (by original designation).

Frontal tubercle small, angulate apically. Forehead with a single complete row of setae, the ocular row. Eyes black, not reduced. Labial palpus of medium length, scarcely reaching apex of trochanter I. Postantennal region of head with a single row of setae, the posterior marginal row. Pronotal comb with the usual long, dark-brown spines. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; segment I of hind tarsus a little shorter than II and III taken together; apical bristles of segment II of tarsus III not extending beyond apex of segment IV; tarsal segment V of tarsus III with 5 pairs of lateral plantar bristles, none being shifted ventrally. Abdomen with few apical spines, all of which are dorsal or nearly so. Tergal plate VII without posterior median process. In female, anal sternal plate angulate in middle; a single receptaculum seminis present, the head of which is more strongly rounded above than below. In male, sternal plate VIII very small, without setae, and entirely contained inside of sternal plate VII; sternal plate IX with almost straight inner vertical processes, a conspicuous, anterior, median apophysis, and a pair of long, flat, setae-bearing, posterior lobes, each of which is divided into proximal and distal parts by a deep, ventral emargination; clasper with rather small manubrium, 2 large, acetabular bristles, and a broad, flattened, distally out-curved, movable finger.

This genus is particularly noted for the extreme reduction in size of the nonsetigerous sternal plate VIII of the male. All its contained species were originally confined to the Old World. Two of them have been introduced into America.

NOSOPSYLLUS FASCIATUS (Bosc)

(Fig. 3)

Pulex fasciatus Bosc, 1801, Paris, Soc. Philomath., Bul. des Sci. 2: 156.

Ceratophyllus oculatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 396, pl. 19, figs. 10-14.

Ceratophyllus canadensis Baker, 1904, U. S. Natl. Mus. Proc. 27: 407, pl. 20, figs. 1-4.

Ceratophyllus californicus Baker, 1904, U. S. Natl. Mus. Proc. 27: 395, pl. 17, figs. 5-8.

Nosopsyllus fasciatus Jordan, 1933, Novitates Zool. 39: 76.

Type host.—"Myoxus nitela."

Type locality.—Unknown.

Range.—Found in all or nearly all temperate countries and in many others.

The three species given as synonyms above were each described from a single specimen, and in the case of *canadensis* the host was

not known. Among the more recent figures of this species are those by C. Fox (23, p. 138, fig. 65) and I. Fox (25, pl. 20).

The rat flea, *Nosopsyllus fasciatus*, is of considerable importance in the transmission of plague in certain countries. It is not a species that bites man as readily as does *Xenopsylla cheopis* and is more commonly found in temperate regions where plague is less likely to be present.

Bacot (1), in his extended studies on the biology of some common fleas, gave us in 1914 facts as follows for *Nosopsyllus fasciatus*: Warmth (75° F.), combined with low humidity, favors the fertility of the eggs. The newly hatched larvae were able to live in some cases for over a month without food, provided the environment was not otherwise unfavorable. According to Bacot there is a difference in the kind of food necessary for *fasciatus* as compared with *Pulex irritans* and *Xenopsylla cheopis*, the first mentioned apparently requiring faeces of the adults as a necessity. The maximum duration for the various stages of *fasciatus* was found to be "egg stage 10 days, larval 114, cocoon 450, adult when fed 106, unfed 95."

NOSOPSYLLUS LONDINIENSIS (Rothschild)

Ceratophyllus londiniensis Rothschild, 1903, Ent. Rec. and Jour. Variation 15: 64, pl. 3.

Ceratophyllus italicus Tiraboschi, 1904, Arch. de Parasitol. 8: 266, fig. 20.

Nosopsyllus londiniensis Jordan, 1933, Novitates Zool. 39: 77.

Type host.—*Mus musculus* L. (house mouse).

Type locality.—South Kensington, London.

Range.—In North America known only from California.

The first record of the occurrence of this species in North America was published by C. Fox (21, p. 11) in 1909.

The Genus TRICHOPSYLLA Kolenati

Trichopsylla Kolenati, 1863, Soc. Ent. Rossicae Horae 2: 32. Type, *Pulex penicilliger* Grube (by designation of Baker, 1904).

Malareus Jordan, 1933, Novitates Zool. 39: 76. Type, *Ceratophyllus telchinum* Rothschild (by original designation). (New synonymy.)

Megabothris Jordan, 1933, Novitates Zool. 39: 77. Type, *Ceratophyllus walkeri* Rothschild (by original designation). (New synonymy.)

Frontal tubercle small to vestigial, frequently partly contained in frontal notch. Forehead usually with 2 or 3 rows of lateral setae, the upper or third row, when present, usually not complete. Eyes present, pigmented, but frequently reduced. Labial palpus short to medium in length, not extending beyond apex of trochanter II. Pronotal comb with usual, long, dark spines which are usually less than 24 in number. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; inner surface of coxae II and III with thin setae at most on distal half; last segment of posterior tarsus with 5 pairs of lateral plantar bristles, the first of which may be very slightly shifted or bent ventrally. Abdomen with a few apical spines, all of which are dorsal or nearly dorsal in position. Tergal plate VII without a posterior median process. Female with a single receptaculum seminis, the head of which is variously shaped. Sternum VIII of male modified and frequently bearing 1 or more setae; movable finger of clasper with 1 or more black, spinelike setae.

Since the present writers recognize the first designation of the type species of *Trichopsylla* by Baker (4) in 1904 as valid under the International Rules, and this species, *penicilliger* Grube, is now in-

cluded among those placed in *Malaræus* Jordan, they believe the genus *Trichopsylla* should displace *Malaræus*.

Furthermore, the characters used to separate *Malaræus* from *Megabothris* can hardly be regarded as of generic importance. In the key given by Jordan (43, p. 79) *Megabothris* is separated from *Malaræus* and closely related genera by the size of the stigma of tergum VIII. Although this stigma is much enlarged in the type species of *Megabothris*, *M. walkeri* (Rothschild), it is not so enlarged in some of the others, and hardly makes a good distinguishing character. Hence *Megabothris*, as well as *Malaræus*, should fall into the synonymy of *Trichopsylla*.

The genus *Monopsyllus* Kolenati requires consideration in connection with the synonymy of *Megabothris*. To this genus, which has as its type species *Pulex sciurorum* Schrank, 1803, Jordan (43, p. 78), in 1933, referred a number of Nearctic species. The species are not regarded by the authors as congeneric with the Palaearctic type of the genus, hence the genus *Monopsyllus* Kolenati is believed not to occur in North America. The species listed by Jordan in it from the Nearctic Region are here given under *Trichopsylla*. In 1936 Ioff (33, pp. 96-98) divided *Monopsyllus* into three groups of species, including in the third group the American species which had been referred to it and one other from Siberia. To this group he gave the name *Amonopsyllus* but did not designate a type species, and further stated that he did not desire to introduce any change in nomenclature. The species Ioff included in his *Amonopsyllus* are so very closely related to those in *Megabothris* that if *Amonopsyllus* had a valid nomenclatorial standing there would be some justification in regarding it as a synonym of *Trichopsylla* Kolenati.

The Subgenus TRICHOPSYLLA Kolenati

This subgenus has the same synonyms as given for the genus *Trichopsylla* Kolenati. It is here regarded as a subgenus for the first time.

Eyes well pigmented, frequently reduced. Bristles on segment II of male antenna short, never reaching to more than slightly beyond middle of club. Stigmata of abdominal segment VIII sometimes much enlarged. In male, sternal plate VIII either much reduced and without setae or long, narrow, and with 1 or 2 apical bristles and a membranous flap on each side; sternal plate IX with vertical process apically rounded on posterior side and sometimes dilated apically. In female, stylet with or without lateral bristles; head of receptaculum seminis much longer than broad and sometimes longer than tail.

Type species.—Same as for the genus *Trichopsylla*.

The type subgenus of *Trichopsylla* is hard to differentiate from *Pleochaetis* on any one character because there is a tendency for the characters of the two subgenera to overlap. It appears, however, that these two subgenera represent natural groups.

The subgenus *Trichopsylla*, as here recognized, could be further divided into two groups or subgenera on the basis of the male terminalia. In one group, including *penicilliger* Grube, would be placed those species in which the eighth sternal plate of the male is long and narrow and bears apically on each side one or two bristles and a membranous flap. In the other group, including such

species as *sinoma* (Jordan) and *telchinum* (Rothschild), would be placed those species in which the eighth sternal plate of the male is greatly reduced, being very short, without setae, and contained in the seventh sternal plate. This latter condition of the eighth sternal plate of the male is the same as is found in the genus *Nosopsyllus* Jordan.

The subgenus *Trichopsylla* is a large one including both Palaearctic and Nearctic species.

TRICHOPSYLLA (TRICHOPSYLLA) ABANTIS (Rothschild), new combination

Ceratophyllus abantis Rothschild, 1905, *Novitates Zool.* 12: 164, pl. 6, fig. 10.

Cotype hosts.—*Mustela longicauda* Bonap. (weasel) and *Microtus drummondii* (Aud. and Bach.) (meadow mouse).

Cotype localities.—Canadian National Park, Alberta, and Horse Creek, Upper Columbia Valley, British Columbia.

Range.—Western Canada.

The original description of *abantis*, which is accompanied by a figure of the eighth sternal plate of the male, was based on two male specimens. The length of the male was given as 2.80 mm.

TRICHOPSYLLA (TRICHOPSYLLA) ACERBA (Jordan), new combination

Ceratophyllus acerbus Jordan, 1925, *Novitates Zool.* 32: 111, fig. 43.

Megabothris acerbus Jordan, 1933, *Novitates Zool.* 39: 77; I. Fox, 1940, *Fleas of Eastern United States*, p. 69, pl. 18, figs. 91-93.

Type host.—*Tamias striatus* L. (eastern chipmunk).

Type locality.—Canada.

Range.—Eastern part of the United States and Canada.

The original description of *acerba* is accompanied by a figure of part of the female terminalia and was based on a single specimen of that sex. This species was redescribed by I. Fox (1940), drawings being given of parts of both sexes.

TRICHOPSYLLA (TRICHOPSYLLA) ADVERSA (Wagner), new combination

Megabothris adversus Wagner, 1936, *Ztschr. f. Parasitenk.* 8: 656, fig. 4.

Type host.—*Peromyscus maniculatus* (Wag.) (white-footed mouse).

Type locality.—Vancouver, British Columbia.

Range.—Known only from the type locality.

Only a single female specimen is known. According to the author of this species, it stands very near to *abantis* Rothschild, but the duct of the receptaculum seminis is not "chitinized."

TRICHOPSYLLA (TRICHOPSYLLA) ASIO ASIO (Baker), new combination

Ceratophyllus asio Baker, 1904, *U. S. Natl. Mus. Proc.* 27: 406.

Megabothris asio Jordan, 1933, *Novitates Zool.* 39: 77; I. Fox, 1940, *Fleas of Eastern United States*, p. 67, pl. 17, figs. 85-86, 88-89.

Type host.—*Otus asio* (L.) (screech owl).

Type locality.—Wellesley, Mass.

Range.—This variety is widely distributed in the eastern part of the United States and may occur in British Columbia, since Wagner

(84, p. 201) reported *asio* from that Province in 1936 without indicating the subspecies or variety.

The original description of *asio* was based on a single female. A recent description, based on both sexes and accompanied by detail figures of the same, was given by I. Fox (1940). The species, like some of the others of its genus, is characterized by the peculiar nature of the movable finger in the male. This structure is large and in the shape of an inverted L with two toothlike, black spines at the apex. Although *asio* was originally described from an owl, birds do not constitute natural hosts, which are wild mice.

TRICHOPSYLLA (TRICHOPSYLLA) ASIO ORECTA (Jordan), new combination

Megabothris asio orectus Jordan, 1938, Novitates Zool. 41: 122, figs. 72-73.

Type host.—"Nest of a mouse."

Type locality.—Ravalli County, Mont.

Range.—Known only from Montana.

According to the original description of *orecta*, it differs from the type subspecies in that the distal part of the movable finger in the male is produced farther backward and the upper lobe of sternal plate VII of the female is slightly longer.

TRICHOPSYLLA (TRICHOPSYLLA) ATROX (Jordan), new combination

Ceratophyllus atrox Jordan, 1925, Novitates Zool. 32: 112, figs. 45-46.

Megabothris atrox Jordan, 1933, Novitates Zool. 39: 77.

Type host.—*Mustela* sp.

Type locality.—Blackfalls, Alberta.

Range.—Known only from Alberta.

This species was supposed by Jordan to be a bird flea when he wrote the original description. Later, in 1933, when he erected *Megabothris*, he included *atrox* with this statement, "*M. atrox* with its comb of more than 25 spines recalls the Bird-fleas (*Ceratophyllus* s. str.)." In addition to having more than 25 spines in the pronotal comb, *atrox* is especially characterized by the very broad and deep sinus in sternal plate VII of the female.

TRICHOPSYLLA (TRICHOPSYLLA) BAKERI (Wagner), new combination

Ceratophyllus bakeri Wagner, 1933, Berlin Zool. Mus. Mitt. 18: 352, fig. 13.

Type host.—"Hausmaus."

Type locality.—Labrador.

Range.—Known only from Labrador.

Wagner (84, p. 200), in 1936, stated that this species, which is based upon a single female, possibly represents a race of *wagneri* (Baker).

TRICHOPSYLLA (TRICHOPSYLLA) BITTERROOTENSIS (Dunn), new combination

Ceratophyllus bitterrootensis Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2771.

Ceratophyllus isus Jordan, 1925, Novitates Zool. 32: 110, figs. 39-40.

Type host.—*Neotoma cinerea* (Ord) (pack rat).

Type locality.—Spoon Creek, southwest of Darby, Mont.

Range.—Western part of the United States and Canada.

The original description of *bitterrootensis* was based on two male specimens. In this species sternal plate VIII of the male is long and slender and bears four subapical bristles.

TRICHOPSYLLA (TRICHOPSYLLA) CILIATA CILIATA (Baker), new combination

Ceratophyllus ciliatus Baker, 1904, U. S. Natl. Mus. Proc. 27: 397, pl. 16, figs. 1-6.

Type host.—"Chipmunk."

Type locality.—Mountain View, Calif.

Range.—For the species as a whole, western part of the United States and Canada. This particular subspecies is known from the Western States.

The original description of this subspecies is accompanied by detail figures of both sexes. The subspecies occurs chiefly upon chipmunks, which apparently are the natural hosts.

TRICHOPSYLLA (TRICHOPSYLLA) CILIATA MONONIS (Jordan), new combination

Ceratophyllus ciliatus mononis Jordan, 1929, Novitates Zool. 35: 35, pl. 1, figs. 17-18.

Cotype hosts.—*Mustela arizonensis* (Mearns) (weasel) and *Eutamias speciosus frater* (Allen) (western chipmunk).

Type locality.—Pine City, Mono County, Calif.

Range.—Known only from California.

In this subspecies the process of the clasper is narrower than in either of the other subspecies and the upper lobe of sternal plate VII of the female is broadly rounded and very much broader than the lower lobe. The original description of *mononis* is accompanied by a drawing of the clasper of the male and sternal plate VII of the female.

TRICHOPSYLLA (TRICHOPSYLLA) CILIATA PROTINA (Jordan), new combination

Ceratophyllus ciliatus protinus Jordan, 1929, Novitates Zool. 35: 34, pl. 1, figs. 15-16.

Type host.—*Eutamias townsendii* (Bach.) (western chipmunk).

Type locality.—Sumas, British Columbia.

Range.—Known only from British Columbia and Alaska.

In the subspecies *protina* the process of the clasper is broader than in *mononis* but narrower than in *ciliata*. The upper lobe of sternal plate VII of the female is triangular with an acute apex. The original description of *protina* is accompanied by a drawing of the clasper and another of sternal plate VII of the female.

TRICHOPSYLLA (TRICHOPSYLLA) EREMICA (Baker), new combination

Ceratophyllus eremicus Baker, 1904, U. S. Natl. Mus. Proc. 27: 417.

Malariaeus eremicus Jordan, 1933, Novitates Zool. 39: 76.

Type host.—"Nest of *Peromyscus eremicus*" (white-footed mouse).

Type locality.—Santa Rita Mountains, Ariz.

Range.—Known only from Arizona.

The original description of *eremica* was based upon two females. The species is especially characterized by the length of the first segment of the hind tarsus, which exceeds that of the second, third,

and fourth combined. A note by Jordan (1933) states that the male genitalia of *eremica* are remarkably different from those of its congeners (comprising his genus *Malaraeus*).

TRICHOPSYLLA (TRICHOPSYLLA) EUMOLPI EUMOLPI (Rothschild), new combination

Ceratophyllus eumolpi Rothschild, 1905, Novitates Zool. 12: 161, pl. 6, figs. 2-4.

Cotype hosts.—*Eutamias minimus borealis* (Allen) and *Eutamias amoenus affinis* (Allen) (western chipmunks).

Cotype localities.—A number of localities in Alberta and British Columbia.

Range.—The species is known from the western part of the United States and Canada. The range of this particular subspecies is also the western part of the United States and Canada.

The original description of *eumolpi* is accompanied by drawings of the terminalia of both sexes. This subspecies parasitizes chipmunks by preference.

TRICHOPSYLLA (TRICHOPSYLLA) EUMOLPI CYRTURA (Jordan), new combination

Ceratophyllus eumolpi cyrturus Jordan, 1929, Novitates Zool. 35: 34, pl. 1, fig. 14.

Type host.—*Mephitis* sp. (skunk).

Type locality.—Paradise, Ariz.

Range.—Known only from Arizona.

According to the original description, *cyrtura* differs from the type subspecies in that the process of the clasper and the movable finger are broader, and the second pigmented spine is much nearer to the long one than to the short subapical pigmented spine. In the female of *cyrtura* the lobe of sternal plate VII is said to be less rounded than in the type subspecies.

TRICHOPSYLLA (TRICHOPSYLLA) EUPHORBI (Rothschild), new combination

Ceratophyllus euphorbi Rothschild, 1905, Novitates Zool. 12: 165, pl. 6, fig. 11.

Type host.—"Peromyscus canadensis" (white-footed mouse).

Type locality.—Horse Creek, Upper Columbia Valley, British Columbia.

Range.—Known only from British Columbia.

The original description of *euphorbi*, which was based on a single male, is accompanied by a figure of part of the terminalia. The species appears to be rare.

TRICHOPSYLLA (TRICHOPSYLLA) EXILIS EXILIS (Jordan), new combination

Megabothris exilis Jordan, 1937, Novitates Zool. 40: 264, fig. 46.

Type host.—*Onychomys leucogaster* (Wied.) (grasshopper mouse).

Type locality.—Powderville, Powder River County, Mont.

Range.—The species as a whole occurs in the western part of the United States. The type subspecies occurs in Montana.

The original description of this species, based on two males, is accompanied by a figure of the male terminalia.

TRICHOPSYLLA (TRICHOPSYLLA) EXILIS OPADA (Jordan), new combination

Monopsyllus exilis opadus Jordan, 1938, Novitates Zool. 41: 121, fig. 70.

Type host.—*Onychomys leucogaster capitulatus* Holl. (grass-hopper mouse).

Type locality.—Yavapai, Ariz.

Range.—Known only from Arizona.

According to the original description of *opada* it differs from the type subspecies in that the lower apical "spiniform" of the movable finger is narrower and much shorter than the upper.

TRICHOPSYLLA (TRICHOPSYLLA) EXILIS TRIPTA (Jordan), new combination

Monopsyllus exilis triptus Jordan, 1938, Novitates Zool. 41: 122, fig. 71.

Type host.—"Dipodomys or *Onychomys*" (mice).

Type locality.—Rugger, Colo.

Range.—Known only from Colorado.

The original description of *tripta* is based on two females. This subspecies can be distinguished from the other two in that the sinus of sternal plate VII of the female "is deeper and narrower" and the upper lobe projects "farther distad."

TRICHOPSYLLA (TRICHOPSYLLA) FORNACIS (Jordan), new combination

Monopsyllus fornacis Jordan, 1937, Novitates Zool. 40: 263, fig. 45; Jellison, 1940, U. S. Pub. Health Serv. Rpts. 55: 491, fig. 2.

Type host.—*Sciurus griseus* Ord (squirrel).

Type locality.—Sevenoaks, Calif.

Range.—Known only from California.

From the original description of this species, which is based on two females and accompanied by a drawing of the female terminalia, the authors quote as follows: "Closely related to *M. eumolpi* Roths. 1905, apparently differing only in the shape of sternum VII and in bursa copulatrix." The male of *fornacis* was described by Jellison (1940). He states, "The male, like the female, shows very close relationship to *M. eumolpi* . . ." In the male of *fornacis* there are only two large setae on sternal plate VIII, instead of five or six as in *eumolpi*, and the lowest spinelike bristle of the movable finger is but slightly longer than the middle instead of being over twice as long.

TRICHOPSYLLA (TRICHOPSYLLA) GROENLANDICA (Wahlgren), new combination

Ceratophyllus groenlandica Wahlgren, 1903, Arkiv. für Zool. 1: 183, pl. 7, figs. 1-2.

Type host.—"Myodes torquatus."

Type locality.—Kaiser Franz Josephs Fjord, East Greenland.

Range.—Known only from East Greenland. The record from the type locality for this species probably represents the farthest north for any flea in the New World.

The original description of *groenlandica* was based on a single male and is accompanied by two detail figures. In Wagner's catalogue of Palaearctic Siphonaptera this species is listed (*sc.*, p. 9) only

from East Greenland and the host is questioned. According to Wahlgren's figure of the clasper, its dorsal process is peculiar in that it is bent or hooked backward at its apex.

TRICHOPSYLLA (TRICHOPSYLLA) IMMITIS (Jordan), new combination

Ceratophyllus immitis Jordan, 1929, *Novitates Zool.* 35: 33, pl. 1, fig. 13.

Type host.—"Lemming."

Type locality.—Canada.

Range.—Known only from Canada.

The original description of *immitis* was based on the female. The species is said to be nearest *acerba* (Jordan), but: "Sinus of VII st. much shallower, the lower lobe hardly at all projecting."

TRICHOPSYLLA (TRICHOPSYLLA) JORDANI (I. Fox), new combination

Malaraeus jordani I. Fox, 1939, *Iowa State Col. Jour. Sci.* 13: 335, pl. 1, fig. 2.

Type host.—"Peromyscus" (white-footed mouse).

Type locality.—Cerro Potosi, Nuevo Leon, Mexico.

Range.—Known only from the type locality.

The original description of *jordani* was based on a single male and is accompanied by a drawing of the clasper. The species is separated from its congeners by the details of the terminalia.

TRICHOPSYLLA (TRICHOPSYLLA) LUCIFER (Rothschild), new combination

Ceratophyllus lucifer Rothschild, 1905, *Novitates Zool.* 12: 170, pl. 6, fig. 12.

Type host.—*Microtus drummondii* (Aud. and Bach.) (meadow mouse).

Type locality.—Red Deer, Alberta.

Range.—Western Canada.

The original description of *lucifer* was based on two female specimens. According to this description and the figure which accompanies it, the eighth tergal plate bears two stout, spinelike setae near apex.

TRICHOPSYLLA (TRICHOPSYLLA) MEGACOLPA (Jordan), new combination

Ceratophyllus megacolpus Jordan, 1929, *Novitates Zool.* 35: 33, pl. 1, fig. 12.

Type host.—*Microtus drummondii* (Aud. and Bach.) (meadow mouse).

Type locality.—Okanagan Landing, British Columbia.

Range.—Known only from British Columbia.

The original description of this species was based on a single female in the United States National Museum. The species is identified by the shape and size of the emargination or sinus of sternal plate VII of the female. This sinus is very large and makes an almost perfect semicircle, which in diameter is equal to about twice the width of the lobe above it.

TRICHOPSYLLA (TRICHOPSYLLA) PENICILLIGER DISSIMILIS (Jordan),
new combination

Malaracus penicilliger dissimilis Jordan, 1938, *Novitates Zool.* 41: 119, figs. 65-66.

Cotype hosts.—*Evotomys* sp. (red-backed mouse) and *Microtus* sp. (meadow mouse).

Type locality.—Rapids, Alaska.

Range.—Known from Alaska and British Columbia.

The original description of *dissimilis* is accompanied by a drawing of the male terminalia made by Jordan from a specimen in the United States National Museum. The name *dissimilis* was suggested by W. L. Jellison, who has supplied the same museum with a female paratype. It applies to the American representatives of *penicilliger*, which differ from the Old World subspecies particularly in that the process of the clasper is longer and the acetabular bristles are smaller.

TRICHOPSYLLA (TRICHOPSYLLA) QUIRINI (Rothschild), new combination

Ceratophyllus quirini Rothschild, 1905, *Novitates Zool.* 12: 163, pl. 6, fig. 1.

Megabothris quirini Jordan, 1933, *Novitates Zool.* 39: 77; I. Fox, 1940, *Fleas of Eastern United States*, p. 70, pl. 18, figs. 90, 94.

Cotype hosts.—*Evotomys gapperi* (Vigors) (red-backed mouse) and "*Evotomys saturatus*."

Type locality.—Red Deer, Alberta.

Range.—United States, Canada, and Alaska.

Rothschild based his description of this species on five males and gave a drawing of the male terminalia. I. Fox (1940) gave a re-description of the species (accompanied by figures), which was based on both sexes. Rothschild considered *quirini* as being closely related to *eumolpi*, stating that "the first midtarsal segment is long and hairy as in *eumolpi*." The peculiar shape of the movable finger, with its broad and deep posterior emargination, identifies the species.

TRICHOPSYLLA (TRICHOPSYLLA) SINOMA (Jordan), new combination

Ceratophyllus sinomus Jordan, 1925, *Novitates Zool.* 32: 110, fig. 41.

Type host.—"Mus."

Type locality.—Paradise, Ariz.

Range.—Western part of the United States.

This is a medium-sized, dark-brown species, identified by the characters of the movable finger of the male clasper, which is very broad and somewhat triangular. Its ventral margin is about straight, posterior margin broadly outcurved, and anterior margin broadly incurved. Near the posterior margin is a row of submarginal, enlarged, dark setae, the lowest of which is longest, the uppermost next in length, and the two others much shorter and subequal.

TRICHOPSYLLA (TRICHOPSYLLA) TELCHINUM (Rothschild), new combination

Ceratophyllus telchinum Rothschild, 1905, *Novitates Zool.* 12: 153, pl. 8, fig. 21.

Cotype hosts.—*Evotomys gapperi* (Vigors) (red-backed mouse) and *Sorex richardsonii* Bach. (shrew).

Type locality.—Kicking Horse Canyon, British Columbia.

Range.—Western part of the United States and Canada.

The original description of *telchinum* was based on two males and is accompanied by a figure of the male terminalia. The movable finger of the male bears five dark, enlarged setae near the posterior border, the upper and lower of which are long and setiform, the other three short, subequal, and spiniform. Female specimens from California are in the United States National Museum.

TRICHOPSYLLA (TRICHOPSYLLA) THAMBA (Jordan), new combination

Ceratophyllus thambus Jordan, 1929, *Novitates Zool.* 35: 36, pl. 2, fig. 21.

Type host.—*Lynx* sp.

Type locality.—Red Deer, Alberta.

Range.—Known only from Alberta.

The original description of *thamba*, based on a single male, is accompanied by a drawing of part of the male genitalia. Jordan has suggested that the type host is not the true host of this species. The true host is probably a mouse.

TRICHOPSYLLA (TRICHOPSYLLA) VISON (BAKER), new combination

Ceratophyllus vison Baker, 1904, U. S. Natl. Mus. Proc. 27: 408.

Ceratophyllus lucidus Baker, 1904, U. S. Natl. Mus. Proc. 27: 410, pl. 20, figs. 5-9.

Megabothris vison I. Fox, 1940, *Fleas of Eastern United States*, p. 72, pl. 19, figs. 95, 98-99.

Type host.—*Mustela vison* Schreber (mink).

Type locality.—Peterboro, N. Y.

Range.—United States, Canada, and Alaska.

The type host of *vison* is not a true host. The true hosts are squirrels. This flea has been recently redescribed and figured by I. Fox (1940). The movable finger of the male has the posterior margin incurved and bears two enlarged, darkened, subequal, submarginal setae.

TRICHOPSYLLA (TRICHOPSYLLA) WAGNERI OPHIDIUS (Jordan), new combination

Ceratophyllus wagneri ophidius Jordan, 1929, *Novitates Zool.* 35: 36, pl. 2, fig. 20.

Type host.—*Mustela xanthogenys* Gray (weasel).

Type locality.—San Francisco, Calif.

Range.—Known only from California.

The name *ophidius* of this subspecies was suggested to Jordan by the shape of the receptaculum seminis, "the organ recalling a snake." The same author differentiates *ophidius* from the other subspecies stating that the movable finger is "on the whole broader than in the two previous subspecies [*wagneri* and *systaltus*]," and reaches "well above process P of the clasper." The type host probably is not a true host of this flea.

TRICHOPSYLLA (TRICHOPSYLLA) WAGNERI SYSTALTA (Jordan), new combination

Ceratophyllus wagneri systaltus Jordan, 1929, *Novitates Zool.* 35: 35, pl. 2, fig. 19.

Type host.—"Mouse."

Type locality.—Blackfalls, Alberta.

Range.—Known only from Alberta.

According to Jordan's original description of *sysalta*, the movable finger of the male is "somewhat narrower than in the previous subspecies [*wagneri*], and its anterior margin more incurved." A figure of the female genitalia accompanies the original description.

TRICHOPSYLLA (TRICHOPSYLLA) WAGNERI WAGNERI (Baker), new combination

Ceratophyllus wagneri Baker, 1904, U. S. Natl. Mus. Proc. 27: 405, pl. 15, figs. 4-7.

Ceratophyllus peromysci Stewart, 1928, Canad. Ent. 60: 148, pl. 3, figs. 1-2.

Megabothris wagneri I. Fox, 1940, Fleas of Eastern United States, p. 71, pl. 19, figs. 96-97.

Type host.—*Peromyscus leucopus* (Raf.) (white-footed mouse).

Type locality.—Moscow, Idaho.

Range.—The species occurs in the western part of the United States and Canada. This particular subspecies has been indicated by Jordan (40) in 1929 as occurring in British Columbia, Idaho, Wyoming, and western Montana. I. Fox (1940) reported it from Iowa.

The original description of *wagneri* was based on two males, one of which came from the type host and one from the house mouse. A description based on both sexes, and accompanied by figures, has been given by I. Fox (1940). In the type subspecies the movable finger of the clasper is intermediate in width between that of the other two subspecies, and the head of the receptaculum seminis is less differentiated from the tail.

The Subgenus PLEOCHAETIS Jordan

Pleochaetis Jordan, 1933, Novitates Zool. 39: 77. Type, *Ceratophyllus mundus* Jordan and Rothschild (by original designation).

Eyes well pigmented. Bristles on segment II of antenna short, in female not reaching apex of club. Forehead with 2 or 3 rows of lateral setae; postantennal region with 2 or more bristles behind base of antennal groove and 3 or more near middle of region. In male, sternal plate VIII slender, of varying length, with 1 or more subapical bristles and sometimes with membranous flap. In female, stylet with 1 or 2 lateral bristles and head of receptaculum seminis subglobular to oblong.

This subgenus is best differentiated from the type subgenus by the chaetotaxy of the head, the middle and upper rows of lateral bristles on the forehead being well represented in some species of *Pleochaetis* and poorly represented or not represented in *Trichopsylla*. The male terminalia in *Pleochaetis* tend to unite the two types found in the type subgenus. *Pleochaetis* is essentially a Neotropical group, but extends northward into Arizona.

TRICHOPSYLLA (PLEOCHAETIS) DOLENS (JORDAN AND ROTHSCHILD),
new combination

Ceratophyllus dolens Jordan and Rothschild, 1914, Novitates Zool. 21: 257, figs. 1-2.

Type host.—*Sciurus hoffmanni* (Peters) (squirrel).

Type locality.—Irazu, Costa Rica.

Range.—Known only from Costa Rica.

The original description of this species was based on a single male and female. It is accompanied by figures of the male and female terminalia.

TRICHOPSYLLA (PLEOCHAETIS) GRAPHIS (Rothschild), new combination

Ceratophyllus graphis Rothschild, 1909, Novitates Zool. 16: 62, pl. 10, figs. 3-4.

Type host.—*Sciurus deppei* Peters (squirrel).

Type locality.—Nicaragua.

Range.—Known only from Nicaragua.

The original description of *graphis* is accompanied by a drawing of the terminalia of each sex. The movable finger of the clasper bears three large, subequal, dark bristles.

TRICHOPSYLLA (PLEOCHAETIS) MUNDUS (Jordan and Rothschild),
new combination

Ceratophyllus mundus Jordan and Rothschild, 1922, Ectoparasites 1: 272, fig. 266.

Type host.—"Field mouse (*rato de campo*)."

Type locality.—"Facubaya," Mexico.

Range.—Known only from Mexico.

This very small flea (length of male "1.9 mm.") was described from a single male. The original description is accompanied by a drawing of the male terminalia.

TRICHOPSYLLA (PLEOCHAETIS) SIBYNUS (Jordan), new combination

Ceratophyllus sibynus Jordan, 1925, Novitates Zool. 32: 110, fig. 42.

Type host.—"Skunk."

Type locality.—Paradise, Ariz.

Range.—Southwestern part of the United States and northern Mexico.

This is a small flea. The movable finger of the clasper bears a row of five stout, darkened, submarginal setae, the uppermost of which is the longest, the lowermost the shortest and stoutest; while the other three are almost subequal in length, each being slightly longer than the lowermost. A specimen of *sibynus* in the United States National Museum was taken in the Mogollon Mountains, N. Mex.

The Genus CERATOPHYLLUS Curtis

(Fig. 7, E)

Ceratophyllus Curtis, 1829, A Guide to an Arrangement of British Insects, Column 201, No. 1136; 1832, British Entomology, v. 9, No. 417; Jordan, 1933, Novitates Zool. 39: 75. Type, *Ceratophyllus hirundinis* Curtis (by original designation).

The generic name *Ceratophyllus* was first used by Curtis in 1829, but the genus itself was not described until 1832. For almost a century after its establishment it included a large percentage of all the species of fleas. *Ceratophyllus* is here used as it was redefined in a restricted sense by Jordan in 1933.

Frontal tubercle small to minute, angulate at apex. Forehead frequently with 2 complete rows of lateral setae; third row never complete. Eyes black, not reduced. Labial palpus not extending beyond tip of coxa I. Setae on antennal segment II of female extending beyond apex of club. Postantennal region of

head with 2 lateral median bristles. Pronotal comb with 24 or more long, black spines. Femur I with several lateral setae; coxa III without a row or patch of spinelets on inner surface; last segment of posterior tarsus with 5 pairs of lateral plantar bristles, the first of which is not shifted ventrally. Abdomen with a small number of apical spines which never extend down to level of spiracles. Tergal plate VII without posterior median process. Antepygidial bristles, 1 long and 2 minute in male, 1 long and 1 or 2 much shorter but not minute in female. Female with 1 receptaculum seminis, the head of which is cylindrical, concave dorsally, much longer than broad, and much longer than tail. In male, sternal plate VIII long, slender, with stout apical bristles and apical membranous flap; sternal plate IX with a pair of prominent, bent, internal vertical processes, an anterior median apophysis, and a pair of distal lobes each of which is divided by a deep ventral incision; movable finger of clasper broad, flattened, and with 1 or more enlarged bristles or pigmented spines on or near posterior margin.

This genus is probably fully justified as here used because of the host relationships of its species, all of which are probably true bird parasites. Morphologically the generic group has unity and as a unified group can easily be described. The chief trouble in using the genus as restricted to bird-parasitizing species is that its characters almost completely dovetail with those of other genera. It is particularly to be noted that the male terminalia of species of *Ceratophyllus* are of the same type as those found in some of the species of *Trichopsylla*. This is true even when the shape and chaetotaxy of the movable finger are considered. In such a species as *C. riparius* Jordan and Rothschild the movable finger is broad, flattened, almost vertical, and possesses a row of 5 stout bristles along the posterior margin. In *Trichopsylla* the same condition exists in such species as *T. (Pleochaetis) sibynus* (Jordan). The number of spines in the pronotal comb in *Ceratophyllus* is 24 or more, yet in *Trichopsylla* (*T.*) *atrox* (Jordan) there are more than 24 spines in the pronotal comb. One species of *Ceratophyllus*, *C. adustus* Jordan, may not have a bird as a true host.

The genus *Ceratophyllus*, even in its restricted sense, is a large one. It is confined entirely to the Holarctic Region.

CERATOPHYLLUS ADUSTUS Jordan

Ceratophyllus adustus Jordan, 1932, Novitates Zool. 38: 253, figs. 10-11.

Type host.—*Erethizon epixanthum* Brandt (American porcupine).

Type locality.—Atlin, British Columbia.

Range.—Known only from British Columbia.

This species is known only from a single female which may have been taken from an unnatural host. It is a typical bird flea except for the reduction in the number of spinelike setae on the tibiae and the loss of the upper one of the three antepygidial bristles. Jordan gives two detail drawings of *adustus* accompanying the original description and adds:

The Porcupine probably is the true host of this modified bird-flea, the peculiarities of the new species presumably being due to a change of host from Bird to Mammal.

CERATOPHYLLUS BOREALIS Rothschild

Ceratophyllus borealis Rothschild, 1907, Ent. Monthly Mag. 18: 11, 1 fig.

Type host.—" * * * probably came from the nest of a gannet (*Sula bassana*)."

Type locality.—Island of Saint Kilda, Scotland.

Range.—In North America known only from west Greenland.

The original description of *borealis*, based on a single female, is accompanied by a drawing of the terminalia. The species is said to be particularly characterized by the shape of the seventh sternal plate of the female: "This is truncate, with the upper angle produced into a lobe."

CERATOPHYLLUS CELSUS APRICUS Jordan

Ceratophyllus celsus apricus Jordan, 1929, *Novitates Zool.* 35: 37, pl. 2, fig. 24.

Type host.—*Petrochelidon fulva cavicola* Bar. and Brooks (cliff swallow).

Type locality.—Soledad, Cuba.

Range.—Known only from Cuba.

There are several evident differences between *apricus* and the typical subspecies of *celsus*. The process of the clasper is not so slender in *apricus*, and it is of a different shape and bears a large bristle at the apex. Also in *apricus* there are three large bristles along the posterior margin of the movable finger instead of two. Type specimens (male and female) of this subspecies are in the United States National Museum.

CERATOPHYLLUS CELSUS CELSUS Jordan

Ceratophyllus celsus Jordan, 1926, *Novitates Zool.* 33: 387, fig. 4; I. Fox, 1940, *Fleas of Eastern United States*, p. 49, pl. 12, figs. 56, 57.

Type host.—*Riparia riparia* (L.) (bank swallow).

Type locality.—Okanagan Falls, British Columbia.

Range.—The species is known from the United States, Canada, and Cuba. This subspecies occurs only in the United States and Canada.

The original description of *celsus* was based on a single male and is accompanied by a drawing of the clasper. I. Fox (1940) published a redescription of the subspecies based on both sexes and accompanied by figures.

CERATOPHYLLUS DIFFINIS Jordan

Ceratophyllus diffinis Jordan, 1925, *Novitates Zool.* 32: 111, fig. 44; I. Fox, 1940, *Fleas of Eastern United States*, p. 50, pl. 12, figs. 58, 59.

Ceratophyllus rileyi Liu, 1935, *Ent. Soc. Amer. Ann.* 28: 123, pl. 1, figs. 4-6.

Type host.—*Colymbus holboellii* (Rein.) (grebe).

Type locality.—Okanagan Falls, British Columbia.

Range.—United States and Canada.

The original description and detail figure of *diffinis* were based on a single male. A redescription of the species, based on both sexes, is given by I. Fox (1940). Closely related to *Ceratophyllus diffinis* is *C. garei* Rothschild, but *diffinis* differs from the latter in having a broader paramere and in the chaetotaxy of the movable finger.

CERATOPHYLLUS GALLINAE (Schrank)

Pulex gallinae Schrank, 1803, Fauna Boica, v. 3, p. 195.

Pulex avium Taschenberg, 1880, Die Flöhe, p. 70, pl. 2, figs. 14-14a.

Ceratophyllus gibsoni C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 15, pl. 5, figs. 4-5. (New synonymy.)

Cotype hosts.—"Hühnern, Mäusen, Fledermäusen, Maulwürfen."

Type locality.—Not indicated.

Range.—In North America known from the eastern part of the United States and southeastern Canada.

This species is at times a rather serious pest of chickens and is now found in several of the Northern States east of the Great Plains and in the southeastern part of Canada. It was introduced into North America apparently early in the present century, for our first record of it (under the name of *Ceratophyllus gibsoni* C. Fox) was based on specimens taken in a hen house at Ottawa, Canada, July 13, 1909. A few years later the species appeared in hen houses in the northeastern part of the United States.

For a number of years after *gallinae* was encountered in North America it was not positively identified. In 1924 one of the present writers (Ewing, 15, p. 342) made direct comparisons between specimens taken in this country and those taken in Europe and positively identified them as *gallinae*. In this same paper (p. 344) *Ceratophyllus gibsoni* C. Fox was listed as a distinct species, with this statement:

* * * The receptaculum seminis is short and stout and not at all like that of either *gallinae* or *niger*; however, the type specimens of *gibsoni* are considerably distorted, as if they had been boiled too long in caustic. In view of this condition of the specimens some allowance should be made for the distortion of the receptaculum seminis. Until more records are obtained in the eastern part of North America for chicken infesting *Ceratophylli* the sinking of this species can hardly be justified.

Since this was written further records of *gallinae*, both from chickens and from other hosts, have been made, but in no case have specimens showing the characteristics attributed to *gibsoni* been taken. Under these circumstances it appears that the synonymizing of *gibsoni* is justified.

Wagner (80, p. 13), in his catalogue of 1930, indicates several synonyms of this species.

CERATOPHYLLUS GAREI Rothschild

(Fig. 7, E)

Ceratophyllus garei Rothschild, 1902, Ent. Monthly Mag. (2) 13: 225, pl. 4, figs. 1-3.

Ceratophyllus utahensis Chapin, 1919, Brooklyn Ent. Soc. Bul. 14: 60.

Type host.—"Nest of a waterhen (*Gallinula chloropus*)."

Type locality.—Near Tring, England.

Range.—In North America known from western part of the United States, Canada, and Alaska.

The male of *Ceratophyllus garei* is very similar to the males of *gallinae* and *niger*, but the manubrium of the clasper is broader. The female of *C. garei* is very distinct in that the head of the receptaculum seminis is more nearly oblong than cylindrical and hence is not typical for the genus *Ceratophyllus*.

Wagner (80, p. 14) lists two additional synonyms which have been used by European authors.

CERATOPHYLLUS GILVUS Jordan and Rothschild

Ceratophyllus gilvus Jordan and Rothschild, 1922, Ectoparasites 1: 270, figs. 264-265.

Type host.—"Swallow."

Type locality.—"Facubaya," Mexico.

Range.—Known only from Mexico.

The original description of *gilvus*, based on a single specimen of each sex, is accompanied by drawings of the terminalia. The species is a small, pale one, said to be "similar to *C. rusticus* Wagn."

CERATOPHYLLUS IDIUS Jordan and Rothschild

Ceratophyllus idius Jordan and Rothschild, 1920, Ectoparasites 1: 73, figs. 70-72; I. Fox, 1940, Fleas of Eastern United States, p. 51, pl. 12, figs. 60-61.

Type host.—*Iridoprocne bicolor* (Vieill.) (tree swallow).

Type locality.—Okanagan Landing, British Columbia.

Range.—United States and Canada.

The original description of this common swallow flea is accompanied by drawings of the terminalia of both sexes. An important feature of the species is that the upper half of the movable finger is strongly rounded.

CERATOPHYLLUS NIGER C. Fox

Ceratophyllus niger C. Fox, 1908, Ent. News 19: 434.

Ceratophyllus niger inflexus Jordan, 1929, Novitates Zool. 35: 37, pl. 2, fig. 25.

Cotype hosts.—Man and *Rattus norvegicus* (Erx.) (house rat).

Type locality.—Not indicated.

Range.—Western and northern parts of the United States, Canada, and Alaska.

Wagner (84, pp. 200-201), in 1936, stated that he found "typical *C. niger* as well as *C. nig. inflexus*" from "one and the same hen house" in British Columbia, hence concluded that *inflexus* has no valid status as a distinct variety.

Ceratophyllus niger is a species of some economic importance, being a serious pest of hen houses in parts of western North America. Control measures for this flea (under the name of *Pulex avium*) as a hen-house pest have been published by Ewing (14). It readily attacks man.

Figures of the terminalia are given by I. Fox (25, p. 155).

CERATOPHYLLUS PETROCHELIDONI Wagner

Ceratophyllus petrochelidoni Wagner, 1936, Ztschr. f. Parasitenk. 8: 655, fig. 2.

Type host.—*Petrochelidon albifrons albifrons* (Raf.) (a cliff swallow).

Type locality.—Chilcotin, British Columbia.

Range.—British Columbia.

A figure of the male genitalia accompanies the original description of *Ceratophyllus petrochelidoni*.

CERATOPHYLLUS QUEBECENSIS I. Fox

Ceratophyllus riparius Jordan and Rothschild, 1920, Ectoparasites 1: 71, figs. 67-69.

Type host.—"Eider down."

Type locality.—Saint Mary's Island, Quebec.

Range.—Known only from Quebec.

This species is readily separated from the other North American species of the genus by the characters of the male and female genitalia, drawings of which accompany the original description.

CERATOPHYLLUS RIPARIUS Jordan and Rothschild

Ceratophyllus riparius Jordan and Rothschild, 1920, Ectoparasites 1: 71, figs. 67-69.

Type host.—*Riparia riparia riparia* (L.) (bank swallow).

Type locality.—Bay View, Milwaukee, Wis.

Range.—United States and Canada.

The original description of *riparius* is accompanied by drawings of the terminalia of both sexes. The type host of this species is a bird common to North America, Europe, and north Africa. In the Old World *Riparia riparia riparia* is parasitized by a flea, *Ceratophyllus styx* Rothschild, which is very closely related to *C. riparius*, differing only in the details of the terminalia. It is rather unusual to find two very closely related species of ectoparasites belonging to the same genus parasitizing the same host species. A redescription of *C. riparius* is given by I. Fox (25, p. 55).

CERATOPHYLLUS SWANSONI Liu

Ceratophyllus swansoni Liu, 1935, Ent. Soc. Amer. Ann. 28: 121, pl. 1, figs. 1-3.

Type host.—*Asio wilsonianus* (Less.) (long-eared owl).

Type locality.—Fertile, Minn.

Range.—Minnesota and Montana.

Detail drawings accompany the original description of *swansoni*. It is a species belonging to the *gallinae* group, differing from *gallinae* in having a stouter movable finger, "the exopodite [movable finger] is less than three times as long as wide, whereas in *gallinae* it is four times as long as wide."

CERATOPHYLLUS VAGABUNDUS (Boheman)

Pulex vagabunda Boheman, 1865, Öfvers. af Finska Vetensk. Soc. Förhandl. 22: 576, pl. 35, fig. 1.

Ceratophyllus vagabundus Baker, 1905, U. S. Natl. Mus. Proc. 29: 152.

Type host.—None.

Type locality.—"Cap Todsen in Isfjorden," Spitsbergen.

Range.—In North America known only from Alaska, as reported by Jellison and Kohls (37) in 1939.

This is a large bird flea. In Alaska it was found on fledglings and in the nest of the golden eagle, *Aquila chrysaetos*. According

to Wagner (80, p. 6), *digitalis* Wahlgren and *monedulae* Wahlgren are synonyms of *vagabundus*. The present writers have seen no specimens of Wahlgren's species.

The Genus CTENOPHYLLUS Wagner

(Fig. 6, A)

Ctenophyllus Wagner, 1927, Konowia 6: 108. Type, *Ceratophyllus armatus* Wagner (by subsequent designation).

Frontal tubercle small to vestigial. Forehead with 2 distinct rows of lateral setae, those of the upper row being thickened and thornlike. A third indistinct row may be between these 2 rows. Eyes present, pigmented. Labial palpus 5-segmented, not extending beyond apex of trochanter I. Setae on end of antennal segment II in female short. Postantennal region of head with 2 or 3 rows of lateral setae. Pronotal comb with less than 24 long, black spines. Femur I with several lateral setae; tibia and tarsal segment I of each leg not hirsute; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus shorter than II, III, and IV taken together; last segment of each tarsus with 5 pairs of lateral plantar bristles, the first pair being only slightly, if at all, shifted ventrally; apical bristle on segment II of tarsus III not extending beyond apex of segment V. Abdomen with a few apical spines, all of which are dorsal or subdorsal. Tergal plate VII without a posterior median process. Antepygidial bristles on each side of abdomen, 3 in female. Female with a single receptaculum seminis. In male, sternal plate VIII large, broad.

This genus contains four species of rodent-infesting fleas, three of which are Asiatic and one North American. Three of the four species have been found on conies (*Ochotona* sp.).

CTENOPHYLLUS TERRIBILIS (Rothschild)

(Fig. 6, A)

Ceratophyllus terribilis Rothschild, 1903, Novitates Zool. 10: 317, pl. 9, figs. 1-3. *Ctenophyllus terribilis* Wagner, 1936, Canad. Ent. 68: 195.

Type host.—*Ochotona princeps* (Rich.) (cony).

Cotype localities.—Canadian National Park and Banff, Alberta.

Range.—Western Canada.

The original description of *terribilis* is accompanied by three detail drawings, one of which represents the head and pronotum of the male.

The Genus STENISTOMERA Rothschild

(Fig. 6, D)

Stenistomera Rothschild, 1915, Novitates Zool. 22: 307. Monotypic. Type, *Typhlopsylla alpina* Baker.

Frontal tubercle small, almost completely hidden in frontal notch. Front somewhat angulate. Forehead with 3 irregular rows of thickened and darkened setae. Eyes absent. Labial palpus 4-segmented, extending beyond apex of coxa I. Postantennal region of head with 3 rows of setae. Pronotal comb with less than 24 long, black spines. Femur I without lateral setae; each tibia with a posterior, marginal row of heavy, black setae; coxa III without a row or patch of spinelets on inner surface; segment I of posterior tarsus longer than II, III, and IV taken together; last segment of each tarsus with 5 pairs of lateral plantar bristles, the first pair shifted ventrally and situated between the 2 setae of second pair. Abdomen with a few apical spines which are dorsal or subdorsal in position. Tergal plate VII without a posterior median process. Female with 3 long, subequal, antepygidial bristles on each side of abdomen; male with 1 long (central) and 2 short antepygidial bristles on each side. Female with a

single receptaculum seminis. In male, sternal plate VIII much reduced in width and bearing a pair of stout, pigmented, apical spines; sternal plate IX reduced, anterior apophysis apparently absent, distal lobes reduced.

Only a single rare species is included in this genus. In the original diagnosis of *Stenistomera*, Rothschild states, "Vestige of eye exceedingly slight, without pigment." The present writers have been unable to find even the "vestige."

STENISTOMERA ALPINA (Baker)

(Fig. 6, D)

Typhlopsylla alpina Baker, 1895, Canad. Ent. 27: 189.

Stenistomera alpina Rothschild, 1915, Novitates Zool. 22: 307.

Type host.—"Mountain rat."

Type locality.—Georgetown, Colo.

Range.—Known only from Colorado.

The original description of this species apparently was based on a single male and female, now in the United States National Museum and marked "Types of *Typhlopsylla alpina*" in Baker's own handwriting. *Stenistomera alpina* is clothed in a striking fashion with peculiarly shaped setae or bristles. Each is heavily pigmented and swollen toward the base but drawn out distally into a very fine, almost invisible filament. Setae of this type are commonly found on sucking lice, particularly those of the genus *Hoplopleura*, but are rare on fleas.

The Subfamily UROPSYLLINAE Oudemans

Head with fronto-epicranial groove poorly developed. Frontal notch and frontal tubercle absent. Eyes usually well developed. Labial palpus with a small number of segments and seldom extending beyond tip of trochanter I. Pronotum with or without comb, and with 1 or 2 transverse rows of setae. Antepygidial bristles present except in the genus *Uropsylla*. Abdomen in female never greatly distended.

The subfamily includes at least 10 valid genera of which only 1, *Conorhinopsylla* Stewart, is represented in North America.

Uropsyllidae was proposed as a new family by Oudemans (58, p. 326) in 1909 for the single genus *Uropsylla* Rothschild. It was reduced to a subfamily in 1929 by Ewing (16, p. 166).

The Genus CONORRHINOPSYLLA Stewart

(Fig. 4, C)

Conorhinopsylla Stewart, 1930, Canad. Ent. 62: 178. Monotypic. Type, *Conorhinopsylla stanfordi* Stewart.

Forehead with 2 rows of lateral setae, none of which is spiniform. Eyes vestigial, each in the form of a triangular dark spot. Gena not produced ventrally to form an acuminate lobe. Labial palpus 6-segmented, extending beyond apex of coxa I but not reaching to apex of trochanter I. Setae on end of antennal segment II short, in male not reaching to middle to club. Postantennal region of head with but 1 row of setae, the posterior, submarginal row, the setae of which are much reduced except for the most ventral one, which is much enlarged. Pronotum with a single row of setae; pronotal comb present, with less than 14 long, black spines. Tarsal segments I and II of leg III densely hirsute with long, hairlike setae on dorsal surface; coxa III without a row or patch of setae on inner surface; last segment of each tarsus with 5 pairs of

lateral plantar bristles, the first pair of which is shifted to a submedian position. Abdomen without combs of spines but with a few apical spines which are dorsal or subdorsal in position. Antepygial bristles present; 3 on each side in female, and 1 large bristle flanked with 2 microsetae on each side in male. Female with 1 receptaculum seminis, the head of which is large and oblong. In male, sternal plate VIII extended posteriorly into a long, slender process which is armed apically with several downcurved, hooklike spines and a small, semihyaline hood, fringed on its upper margin with several setae; sternal plate IX with a half-circle bend instead of the usual elbow bend at junction of distal lobe with vertical process, median apophysis vestigial, distal lobe very long, slender, upcurved distally, and bearing setae along central part of ventral surface; body of clasper considerably lengthened, movable finger flattened, foliaceous, angulate apically,

This genus and its only species are so peculiar in the shape of the head, its chaetotaxy, and the terminalia of the male that there would be some justification in erecting a subfamily for its exclusive reception. Previous descriptions of the male terminalia are decidedly in error in certain respects, and although the present writers have a male specimen for study in which the terminalia are spread apart, yet they are not sure that the present description of them is free from error. In order to understand the male terminalia properly in this genus, a ventral and a posterior view of them under high magnification is desirable. More material, making possible a dissection of the male genitalia, is much desired.

CONORHINOPSYLLA STANFORDI Stewart

(Fig. 4, C)

Conorhinopsylla stanfordi Stewart, 1930, *Canad. Ent.* 62: 178, pl. 15, figs. 3-5.

Type host.—*Sciurus hudsonicus* (Erx.) (red squirrel).

Type locality.—Ithaca, N. Y.

Range.—Eastern part of the United States and as far west as Utah.

The original description of this species is accompanied by three detail drawings. One of these is of the head and represents the labial palpus as being five-segmented. This apparently is an error. The labial palpus is really six-segmented as stated in a redescription of the species by I. Fox (25, p. 41). The male terminalia in this species need much further study and a new description.

The Family HYSTRICHOPSYLLIDAE Tiraboschi

Head usually divided by a fronto-epieranial groove into anterior and posterior parts. Gena sometimes enlarged and extended dorsally in front of antennal groove but not divided by a groove. Forehead without helmet, seldom elongated, and never with ventral flaps. Eyes well developed, vestigial, or absent. Cephalic combs present. Thorax not greatly reduced; thoracic terga taken together longer than abdominal tergum I. Typical abdominal tergal plates each with more than 1 transverse row of setae. Abdominal apical spines frequently numerous. Abdominal combs frequently present. Females never with number of abdominal spiracles reduced, and, when gravid, abdomen not greatly distended.

This family contains four subfamilies as follows: Ctenophthalminae, Hystrichopsyllinae, Macropsyllinae, and Leptopsyllinae.

Hystrichopsyllidae as a family name dates from 1905, when Baker (5, p. 136) raised Hystrichopsyllinae Tiraboschi, 1904, to family rank. Oudemans in 1909 (59, p. 155) attributed the authorship of

the family to Tiraboschi. Ctenopsyllidae Baker, 1905, and Typhloceratidae Oudemans, 1900, should be regarded as synonyms of Hystrichopsyllidae, as also Leptopsyllidae Rothschild, 1915.

The family Hystrichopsyllidae, as here recognized, includes the subfamily Ctenophthalminae, which had been previously included (16, p. 166) in the Dolichopsyllidae.

The Subfamily CTENOPHTHALMINAE Rothschild

Head either divided or not divided by development of fronto-epicranial groove. Front not greatly reduced, forming at least one-half of anterior margin of head, and not dorsal in position. Frontal tubercle or frontal notch present, although either or both may be vestigial. Gena seldom much enlarged and longest in a horizontal direction. Eyes usually vestigial or absent. Labial palpus with less than 9 segments. Cephalic comb seldom situated along both ventral margin of gena and anterior margin of antennal groove, and never with more than 6 spines. Hind coxae with or without a row or patch of spinelets on inner surface. Abdomen with or without apical spines.

Included in the subfamily are 21 genera, 11 of which are represented in the North American fauna.

Ctenophthalminae was established by Rothschild (66, p. 77) in 1915, but the subfamily name as here used includes the genus *Neopsylla* Wagner, upon which the family Neopsyllidae Oudemans, 1909, is based. The better known subfamily name Ctenophthalminae is here retained, although it is not the oldest.

The subfamily Ctenophthalminae is believed to represent a natural group of genera and species, although according to the classification of Oudemans (59, p. 155) some species would fall into the suborder Integricipita, some into Fracticipita, while others could not with any certainty be placed into either suborder. Largely because of the difficulty in placing the genera and species of this subfamily properly into the suborders of Oudemans, most recent workers have abandoned his grouping of the families. However, the character he uses for dividing the whole order into two suborders may be used to advantage in defining certain families and subfamilies.

KEY TO NORTH AMERICAN GENERA OF CTENOPHTHALMINAE

1. Coxa III with a row or patch of spinelets on inner surface..... 2
Coxa III without a row or patch of spinelets on inner surface..... 6
2. Genal comb with only 2 spines 3
Genal comb with 3 or more spines..... 4
3. Plantar bristles of segment V of tarsi I and II all lateral
Tamiphila Jordan
Plantar bristles of first pair on segment V of tarsi I and II shifted ventrally; segment V of tarsus III with only 4 pairs of plantar bristles
Epitedia Jordan.
4. Segment V of each tarsus with 6 pairs of lateral plantar bristles.
Known only from California *Actenophthalmus* Fox.
- Segment V of each tarsus with 4 or 5 pairs of lateral plantar bristles 5
5. Upper sclerite of metepisternum fused with metanotum
Micropsylla Dunn.
Upper sclerite of metepisternum separated from metanotum by internal chitinous ridge; metanotum sometimes fused with metepimeron *Rectofrontia* Wagner.
6. Genal comb never with more than 4 spines 7
Genal comb with 6 spines; segment V of tarsus III with 6 lateral plantar bristles; labial palpus with 8 segments. Known from Oregon..... *Paratyphloceras* Ewing.

7. Genal comb with 4 spines -----	8
Genal comb with 3 spines -----	9
8. Genal process visible above uppermost genal spine; abdominal tergal plate VII produced into a process between the 2 sets of antepygidial bristles -----	<i>Corrodopsylla</i> Wagner.
Without these characters -----	<i>Doratopsylla</i> Jordan and Rothschild.
9. None of spines of genal comb overlapping; tip of each palpus usually with a terminal hooklike bristle -----	<i>Ctenophthalmus</i> Kolenati.
Ventral spine of genal comb overlapped by middle spine; tip of each palpus without terminal hooklike bristle; bristles on posterior borders of tibiae in groups of 3 -----	<i>Carteretta</i> C. Fox.

The Genus TAMIOPHILA Jordan

(Fig. 10, B)

Tamiophila Jordan, 1938, Novitates Zool. 41: 124. Type, *Typhlopsylla grandis* Rothschild (by original designation).

Frontal tubercle acuminate. Head with a fronto-epicranial groove. Genal comb consisting of 2 spines, of which the first is short and broad and overlaps the more slender and much larger second one. Eyes vestigial. Labial palpus consisting of 6 segments (counting the somewhat shortened basal segment). Pronotum with comb. Antepygidial bristles present, at least in female. Coxa III without a patch of spinelets on inner surface. Fifth tarsal segment of legs I and II with 5 pairs of lateral plantar bristles. Fifth tarsal segment of leg III with 4 pairs of lateral plantar bristles.

Two species are placed in this genus, one doubtfully so.

TAMIOPHILA GRANDIS (Rothschild)

(Fig. 10, B)

Typhlopsylla grandis Rothschild, 1902, Ent. Rec. and Jour. Variation 14: 62, fig. 3.

Neopsylla striata Stewart, 1926, Insecutor Inscitiae Menstruus 14: 124.

Tamiophila grandis Jordan, 1938, Novitates Zool. 41: 124.

Type host.—*Tamias striatus* (L.) (eastern chipmunk).

Type locality.—Branchtown, Ontario.

Range.—Eastern part of the United States and Canada.

This species was first misidentified as *Pulex gigas* Kirby by Baker (2, p. 163) in 1895, and for many years thereafter that name was applied to it. In 1929, however, Jordan (41, p. 172) pointed out that *Pulex gigas* Baker is identical with *grandis* and that *Pulex gigas* Kirby is an altogether different flea belonging in the genus *Hys-trichopsylla*.

The original description of *grandis* was accompanied by an illustration of the male genitalia. The female terminalia and the head have been figured by I. Fox (25, p. 179).

This species seems to be exceedingly rare and not often encountered in collections. The extensive collections of the United States National Museum include but a single female specimen.

TAMIOPHILA (?) TEXANA (Stewart), new combination

Neopsylla texana Stewart, 1930, Canad. Ent. 62: 179, pl. 15, fig. 6.

Type host.—*Rattus norvegicus* (Erx.) (house rat).

Type locality.—Houston, Tex.

Range.—Known only from Texas.

This species is placed in *Tamiophila* with hesitation because of the chaetotaxy of the fifth tarsal segment of the hind legs. In the orig-

inal description Stewart says, "There are four pairs of lateral plantar bristles and a proximal median pair on the fifth tarsal segments of the hind legs." The members of *Tamioiphila*, *Epitedia*, and *Neopsylla* are characterized by the possession of four pairs of lateral plantar bristles, without a proximal median pair, on the fifth tarsal segment of the hind legs. In *Epitedia* there are four pairs of lateral plantar bristles and a basal ventral pair on segment V of tarsi I and II; hence this species, which is said to have five pairs of lateral plantar bristles on these structures, would not go into *Epitedia*. The presence of five pairs of lateral plantar bristles on the fifth segments of tarsi I and II is diagnostic for *Tamioiphila*, to which this species is provisionally referred.

Tamioiphila texana (Stewart) was based upon a single female, and no further record of its occurrence has been reported since the original description.

The Genus EPITEDIA Jordan

(Fig. 8, B)

Epitedia Jordan, 1938, *Novitates Zool.* 41: 124. Type, *Ctenophthalmus wenmanni* Rothschild (by original designation).

Frontal notch prominent, frontal tubercle small, acuminate. Genal comb consisting of 2 spines, of which the first is short and broad and overlaps the more slender and much longer second one. Eyes vestigial; eye region darkly discolored. Labial palpus consisting of 5 segments. Coxa III with a row or patch of spinelets on inner surface. Fifth segment of tarsi I and II with 4 pairs of lateral plantar bristles and a basal ventral pair located near median line. Fifth segment of tarsus III with 4 pairs of plantar bristles, all of which are lateral. Base of tail of receptaculum seminis projecting well into lumen of head.

Epitedia was the name given to a group of Nearctic species withdrawn from *Neopsylla* by Jordan. The genus *Neopsylla*, established by Wagner (79, p. 138) in 1903, included several different genera. The type of *Neopsylla* is *Typhlopsylla bidentatiformis* Wagner (78, p. 351), described in 1893, but, unfortunately, because of the unavailability of a specimen of this species, it has not been possible to ascertain which, if any, of the various North American species described in *Neopsylla* are congeneric with the type species. Hence *Neopsylla* is regarded as not occurring in our fauna, and the North American species referred to it are considered to be members of either *Epitedia* or *Tamioiphila*, which were split off from *Neopsylla* by Jordan.

EPITEDIA FACETA (Rothschild)

Neopsylla faceta Rothschild, 1915, *Ectoparasites* 1: 32, figs. 34-35.

Epitedia faceta Jordan, 1938, *Novitates Zool.* 41: 124.

Type host.—*Sciurus hudsonicus* (Erx.) (red squirrel).

Type locality.—Wilbraham, Mass.

Range.—Known only from Massachusetts.

This species is known from the original pair only, according to the literature. It has not been rediscovered since its description. It is separated from *Epitedia wenmanni*, its closest ally, by having the posterior lobe of the process of the clasper higher than the anterior and by the movable finger, which is not longer than the distance from its base to the tip of the lower lobe of the clasper.

EPITEDIA INOPINA (Rothschild), new combination

Neopsylla inopina Rothschild, 1915, Ectoparasites 1: 30, figs. 32-33.

Type host.—*Citellus richardsonii* (Sab.) (ground squirrel).

Type locality.—Calgary, Alberta.

Range.—Western part of the United States and Canada.

In this species the fifth segment of tarsi I and II has the basal pair of plantar bristles shifted ventrally but not so close to the median line as in the other species of *Epitedia*. Hence it is possible that this species goes into *Neopsylla* s. str., but without a close study of the type species of *Neopsylla* its true status cannot be ascertained.

EPITEDIA JORDANI Hubbard

Epitedia jordani Hubbard, 1940, Pacific Univ. Bul. 37 (2): 10, 5 figs.

Type host.—Nest of "Trowbridge's shrew."

Type locality.—Newberg, Oreg.

Range.—Oregon and Washington.

This species and *Epitedia stewarti* are distinguished from the other members of the genus by having the process of the clasper undivided. *E. stewarti* and *E. jordani* may be separated by the structure of the terminalia, which have been illustrated in the original descriptions.

EPITEDIA SCAPANI (Wagner), new combination

Neopsylla scapani Wagner, 1936, Ztschr. f. Parasitenk. 8: 657.

Type host.—*Scapanus orarius* True (mole).

Type locality.—Vancouver, British Columbia.

Range.—Known only from British Columbia.

George P. Holland has indicated in personal correspondence that this species belongs in *Epitedia* rather than in *Neopsylla*. It is based upon two male specimens. The female has not been described.

EPITEDIA STEWARTI Hubbard

Epitedia stewarti Hubbard, 1940, Pacific Univ. Bul. 37 (2): 11, 6 figs.

Cotype hosts.—"Pacific shrews."

Type locality.—Smith River, Calif.

Range.—Recorded only from California.

Hubbard, in his original description of this species, states that it differs from *Epitedia jordani* primarily in the shape of sternal plate IX in the male and sternal plate VII in the female.

EPITEDIA TESTOR (Rothschild)

Neopsylla testor Rothschild, 1915, Ectoparasites 1: 34, fig. 36.

Epitedia testor Jordan, 1938, Novitates Zool. 41: 124.

Type host.—"Nest (of a mouse)."

Type locality.—Lansingburgh, N. Y.

Range.—Known only from the type locality.

The original description of this species is based upon a single female and is accompanied by a figure of the female terminalia. The male is unknown.

EPITEDIA WENMANNI (Rothschild)

(Fig. 8, B)

Ctenophthalmus wenmanni Rothschild, 1904, *Novitates Zool.* 11: 642, pl. 14, figs. 75, 77, 79.

Neopsylla similis Chapin, 1919, *Brooklyn Ent. Soc. Bul.* 14: 58.

Epitedia wenmanni Jordan, 1938, *Novitates Zool.* 41: 124.

Cotype hosts.—*Peromyscus leucopus* (Raf.) (white-footed mouse) and *Neotoma cinerea* (Ord) (wood rat).

Type locality.—British Columbia.

Range.—Eastern part of the United States and Canada.

This species has recently been redescribed and illustrated by I. Fox (25, pp. 96 and 183). It is the most common species of its genus in the Eastern States.

The Genus ACTENOPHTHALMUS C. Fox

(Fig. 10, D)

Actenophthalmus C. Fox, 1925, *Ent. News* 36: 121. Monotypic. Type, *Ctenophthalmus heiseri* McCoy.

Frontal notch small, not acuminate. Genal comb consisting of 5 spines, of which the uppermost is separated from the rest of the spines. Eyes vestigial. Labial palpus 5-segmented. Coxa III with a row or patch of spinelets on inner surface. Fifth tarsal segment of all legs armed with 6 pairs of lateral plantar bristles. Pronotal comb present. Females with 2 antepygial bristles on a side.

The members of this genus superficially resemble those of *Rectofrontia* but may be immediately distinguished from them by the presence of six pairs of lateral plantar bristles on the fifth tarsal segments of all the legs.

This genus includes but one species.

ACTENOPHTHALMUS HEISERI (McCoy)

(Fig. 10, D)

Ctenophthalmus heiseri McCoy, 1911, *Ent. News* 22: 445, 2 figs.

Actenophthalmus heiseri C. Fox, 1925, *Ent. News* 36: 121.

Type host.—Unknown.

Type locality.—Mojave, Calif.

Range.—Known only from type locality.

This species is based upon a single female, and no further record of its occurrence has been made known. The original description is thoroughly illustrated.

The Genus MICROPSYLLA Dunn

(Fig. 9, E)

Micropsylla Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2767. Monotypic. Type, (*Micropsylla peromyscus* Dunn) = *M. scutellus* (Jordan).

Frontal tubercle acuminate. Head without a fronto-epicranial groove. Genal comb consisting of 4 spines, of which the first is short and broad while the others are longer and more slender. Eyes absent. Labial palpus 5-segmented. Pronotum with a comb. Upper sclerotized ridge separating metepisternum from metanotum lacking, the former structure being fused with the latter. Antepygial bristles present, at least in female. Coxa III with a patch of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles. Tail of receptaculum seminis short, not well separated from head.

MICROPSYLLA SECTILIS (Jordan and Rothschild)

(Fig. 9, E)

Rhadinopsylla sectilis Jordan and Rothschild, 1923, Ectoparasites 1: 314, fig. 318.*Micropsylla peromyscus* Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2767.*Micropsylla sectilis* Jordan, 1937, Novitates Zool. 40: 270.*Cotype hosts*.—*Peromyscus* sp. and *Mus* sp.*Type locality*.—Kelowna, British Columbia.*Range*.—Western part of the United States and Canada.

The original description of this species was based on females and is accompanied by a figure of the female terminalia. In 1936 Wagner (84, p. 203) described and illustrated the male.

The Genus RECTOFRONTIA Wagner and Argyropulo

(Fig. 9, D)

Rectofrontia Wagner and Argyropulo, 1934, Ztschr. f. Parasitenk. 7: 230.

Type. (*Rectofrontia pentactenus* Wagner and Argyropulo) = *Typhlopsylla pentacanthus* Rothschild (by original designation).

Frontal tubercle acuminate. Head without a fronto-epicranial groove. Genal comb consisting of 5 spines, of which 4 are long and 1, the uppermost, is short. Eyes absent. Labial palpus 5-segmented, last segment with 2 apical setae of which 1 is long and hooklike and the other very short. Pronotum with a comb. Upper sclerite of metepisternum separated from metanotum by internal ridge. Males without antepygial bristles, females with 2 or 3 on a side. Coxa III with a patch of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles.

In their description of this genus Wagner and Argyropulo state, "Als Type der *Rectofrontia* ist *pentactenus* Rothschild (1897) zu betrachten." This is obviously a *lapsus calami*, since *pentactenus* is a bat flea attributed to Kolenati. The name *Rectofrontia pentactenus* should be attributed to Wagner and Argyropulo.

The genus *Rectofrontia* includes but a single North American species.

RECTOFRONTIA FRATERNA (Baker)

(Fig. 9, D)

Typhlopsylla fraterna Baker, 1895, Canad. Ent. 27: 189.*Neopsylla hamiltoni* Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2770.*Rectofrontia fraterna* Jordan, 1937, Novitates Zool. 40: 270.*Type host*.—Unknown.*Type locality*.—Brookings, S. Dak.

Range.—United States and Canada. Reported from British Columbia and Alberta by Holland (29, p. 11) in 1940.

The female holotype of this species is in the United States National Museum. The male terminalia were figured by I. Fox (25, p. 149) in 1940.

The Genus CORRODOPSYLLA Wagner

(Fig. 8, C)

Corrodopsylla Wagner, 1929, Konowia 8: 317; 1936, Canad. Ent. 68: 205. Type, *Doratopsylla curvata* Rothschild (by present designation).

Although originally proposed as a subgenus of *Doratopsylla* Jordan and Rothschild, *Corrodopsylla* was given generic status by Wagner in 1936.

Frontal tubercle absent. Head divided by a fronto-epicranial groove. Genal comb consisting of 4 spines. Genal process visible above uppermost genal spine. Eyes vestigial, eye area heavily pigmented. Labial palpus consisting of 4 segments. Pronotum with a comb. Abdominal tergal plate VII produced into a process between the 2 sets of 3 antepygial bristles. Coxa III without a row or patch of spinelets on the inner surface. Fifth tarsal segment of each leg armed with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair.

Corrodopsylla is represented in North America by two described species.

CORRODOPSYLLA CURVATA CURVATA (Rothschild)

(Fig. 8, C)

Doratopsylla curvata Rothschild, 1915, Ectoparasites 1: 25, figs. 28-29.

Corrodopsylla curvata Wagner, 1936, Canad. Ent. 68: 205.

Type host.—*Blarina brevicauda* (Say) (short-tailed shrew).

Type locality.—Iowa City, Iowa.

Range.—United States and Canada.

The original description of this subspecies is accompanied by illustrations of the male and female terminalia.

CORRODOPSYLLA CURVATA OBTUSATA (Wagner)

Doratopsylla curvata obtusata Wagner, 1929, Konowia 8: 318.

Corrodopsylla curvata obtusata Wagner, 1936, Canad. Ent. 68: 205.

Type host.—Not given.

Type locality.—British Columbia.

Range.—Known only from British Columbia.

The original description of this subspecies is based upon two females and is accompanied by an illustration of the female terminalia. The male has not yet been described.

CORRODOPSYLLA JELLISONI (Hubbard), new combination

Doratopsylla jellisoni Hubbard, 1940, Pacific Univ. Bul. 37 (2): 8, 7 figs.

Type host.—"Trowbridge shrew."

Type locality.—Forest Grove, Oreg.

Range.—Known only from Oregon.

This species is closely allied to *Corrodopsylla curvata* (Rothschild), from which it may be separated by the genitalia of the male. In *C. curvata* the anterior of the two processes of the clasper is subequal to the posterior; in *C. jellisoni*, however, the anterior process is much shorter than the posterior. Male and female paratypes of this species deposited in the United States National Museum have been studied by the authors.

The Genus *DORATOPSYLLA* Jordan and Rothschild

(Fig. 8, H)

Doratopsylla Jordan and Rothschild, 1912, Novitates Zool. 19: 62. Monotypic.

Type, *Typhlopsylla dasynemus* Rothschild.

Stenopsylla Cunha, 1914, Inst. Oswaldo Cruz Mem. 6: 125. Monotypic. Type,

Stenopsylla cruzi Cunha.

Tritopsylla Cunha, 1929, Sci. Med. Rio de Janeiro 7: 349. (Proposed to replace

Stenopsylla Cunha, 1914, not *Stenopsylla* Kuwayama, 1909.)

Frontal tubercle absent. Head with a fronto-epicranial groove. Genal comb consisting of 4 spines, of which the most posterior is closely appressed to the genal border and partially covers the genal process. Genal process extending farther distad than adjacent genal spine; rounded apically. Eye vestigial; eye area pigmented. Labial palpus consisting of 4 segments. Pronotum with a comb. Three antepygial bristles present on a side. Coxa III without a patch of spinelets on inner surface. Fifth tarsal segment of each leg armed with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair.

This genus is represented in North America by two species. According to Dalla Torre (10, p. 2) *Stenopsylla* Cunha is a synonym of *Doratopsylla*.

DORATOPSYLLA BLARINAE C. FOX

(Fig. 8, H)

Doratopsylla blarinae C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 11, pl. 4, figs. 1-3.

Type host.—*Blarina brevicauda* (Say) (short-tailed shrew).

Type locality.—Washington, D. C.

Range.—Eastern part of the United States.

This species has recently been redescribed and figured by I. Fox (25, pp. 92 and 181).

DORATOPSYLLA INTERMEDIA COPHA (Jordan), new combination

Stenopsylla intermedia coph Jordan, 1926, Novitates Zool. 33: 391, figs. 15-16.

Type host.—"Didelphys azarae" (opossum).

Type locality.—Boquete, Panama.

Range.—Known only from Panama.

The original description of this subspecies is accompanied by illustrations of the male and female terminalia.

DORATOPSYLLA INTERMEDIA VIDUA (Jordan), new combination

Stenopsylla intermedia vidua Jordan, 1926, Novitates Zool. 33: 392, fig. 17.

Type host.—*Didelphis* sp. (opossum).

Type locality.—Misantla, Mexico.

Range.—Known only from Mexico.

This subspecies was based upon a single female. The original description is accompanied by an illustration of the female terminalia. It is exceedingly brief, reading as follows: "The sinus of sternite VII (text fig. 17) very shallow, the incrassation weak, the upper bristle far in front of the subapical pair and thin."

The Genus CTENOPHTHALMUS Kolenati

(Fig. 9, B)

Ctenophthalmus Kolenati, 1856, Die Parasiten der Chiroptern, p. 33. Type, *Ctenophthalmus bisocotodentatus* Kolenati (by subsequent designation).

Frontal tubercle large and prominent, acuminate. Head without a fronto-epicranial groove or with a very slight one in male; head with a fronto-epicranial groove in the female. Genal comb consisting of 3 spines, the first 2 being much shorter than the third. Eyes vestigial. Labial palpus consisting of 5 segments, the distal one armed with a curved apical bristle. Pronotum with a comb. Three antepygial bristles present on a side. Coxa III without a patch of spinelets on inner surface. Fifth tarsal segments of legs I and II armed with 4 pairs of

lateral plantar bristles and a basal, submedian, ventral pair. Fifth tarsal segment of leg III armed with 3 pairs of lateral plantar bristles and a basal, submedian, ventral pair.

This genus is represented in North American by but one species.

CTENOPHTHALMUS PSEUDAGYRTES Baker

(Fig. 9, B)

Ctenophthalmus pseudagyrtes Baker, 1904, U. S. Natl. Mus. Proc. 27: 421, pl. 11, figs. 7-12.

Type host.—*Geomys bursarius* (Shaw) (pocket gopher).

Type locality.—Agricultural College, Mich.

Range.—Eastern part of the United States.

This species has been redescribed and figured by I. Fox (25, pp. 34 and 149). It is one of the most common fleas occurring in the eastern part of the United States.

The Genus CARTERETTA C. Fox

(Fig. 10, A)

Carteretta C. Fox, 1927, Amer. Ent. Soc. Trans. 53: 209. Monotypic. Type, *Carteretta carteri* C. Fox.

Frontal tubercle acuminate. Head divided by a fronto-epicranial groove. Genal comb consisting of 3 spines, of which the first is overlapped and almost completely covered by the second. Eyes pigmented, each with a ventral emargination. Labial palpus with 5 segments. Pronotum with a comb. Three antepygial bristles present on a side. Coxa III without a row or patch of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair.

This genus includes but a single species.

CARTERETTA CARTERI C. Fox

(Fig. 10, A)

Carteretta carteri C. Fox, 1927, Amer. Ent. Soc. Trans. 53: 209.

Type host.—*Neotoma fuscipes* Baird (wood rat).

Type locality.—Los Angeles, Calif.

Range.—Known only from California.

The original description of this species was based upon a single male specimen which is now in the United States National Museum collection. Both the male and female were illustrated by Jellison (36, p. 490) in 1940.

The Genus PARATYPHLOCERAS Ewing

(Fig. 9, C)

Paratyphloceras Ewing 1940, Wash. Biol. Soc. Proc. 53: 35. Monotypic. Type, *Paratyphloceras oregonensis* Ewing.

Frontal tubercle small, angulate apically. Gena broad, truncate apically, with an oblique comb of 5 or 6 pointed spines. Eyes absent. Labial palpus with 8 segments. Pronotum with a comb of long spines. Coxa III without a row or patch of spinelets on inner surface. Fifth segment of tarsus II with 5 pairs of lateral plantar bristles; fifth segment of tarsus III with 6 pairs of lateral plantar bristles; in each case first pair of plantar bristles not displaced. Abdominal tergal plate VII of female produced into a short process between 2 groups of antepygial bristles.

This genus is nearest *Typhloceras* Wagner, from which it differs in having the labial palpus composed of eight segments rather than five. The genus includes but one species.

PARATYPHLOCERAS OREGONENSIS Ewing

(Fig. 9, C)

Paratyphloceras oregonensis Ewing, 1940, Wash. Biol. Soc. Proc. 53: 35.

Type host.—"Mink."

Type locality.—Mercer Lake, Oreg.

Range.—Known only from the type locality.

This species was based upon a single female, and no further specimens have been recorded. At first glance it seems to belong to one of the genera of the Hystrichopsyllinae, but the presence of a frontal tubercle and less than seven spines in the genal comb (fig. 9, C) immediately separate it from the members of that subfamily.

The Subfamily HYSTRICHOPSYLLINAE Tiraboschi

Fronto-epicranial groove distinct. Front not greatly reduced, forming at least one-half of anterior margin of head and not dorsal in position. Gena seldom much enlarged and nearly always longest in a horizontal direction. Frontal tubercle and frontal notch absent. Labial palpus with small number of segments. The genal comb may have more than 6 spines. Hind coxae with or without a row or patch of spinelets on inner surface. The abdomen may have 1 or more combs of spines, some of them being composed of short apical spines.

Included in the subfamily are nine genera, four of which occur in North America.

Tiraboschi (75, p. 296) in 1904 established the subfamily Hystrichopsyllinae. The next year Baker (5, p. 136) raised it to the rank of a family. Since then many and diverse genera have been added to the family, hence the necessity for dividing it into subfamilies. Two of the included genera, *Hystrichopsylla* Taschenberg and *Stenoponia* Jordan and Rothschild, contain the largest known fleas.

The interpretation of Wagner (86, p. 80) concerning the grouping of genera about the genus *Hystrichopsylla* is very different from that of the present writers, and, exclusive of *Hystrichopsylla* itself, no genus is common to both concepts of the subfamily. This is due to a difference of opinion in regard to the significance of the double receptaculum seminis, which is the chief character in Wagner's diagnosis of the subfamily. Inasmuch as the double receptaculum seminis is a sex character, the present writers are unwilling to regard it as of more than generic significance. Even in this capacity it is not always reliable, for it is sometimes abnormally present in species which ordinarily have a single receptaculum seminis. For example, in the United States National Museum collection there is a specimen of *Stenoponia americana* (Baker) from *Microtus pennsylvanicus* at Edgartown, Mass., which possesses a double receptaculum seminis.

For the genus *Stenoponia*, Wagner has established a subfamily which includes no other genera, and here again the writers are not in agreement with him. The various characters used to diagnose his subfamily Stenoponiinae are, in the opinion of the writers, of no more than generic significance.

KEY TO NORTH AMERICAN GENERA OF HYSTRICHOPSYLLINAE

1. Coxa III with a row or patch of spinelets on inner surface; genal comb with only 2 spines which overlap each other.....	2
Coxa III without a row or patch of spinelets on inner surface.....	3
2. Labial palpus reaching to apex of coxa I; anterior abdominal tergal plates with apical spines.....	<i>Phalacropsylla</i> Rothschild.
Labial palpus not reaching beyond three-fourths the distance to apex of coxa I; anterior abdominal tergal plates without apical spines.....	<i>Meringis</i> Jordan.
3. Abdomen with 1 complete comb of long spines in addition to small apical spines; segment V of each tarsus with only 4 pairs of lateral plantar bristles; labial palpus with only 2 segments; female with 1 receptaculum seminis.....	<i>Stenoponia</i> Jordan and Rothschild.
Abdomen without a comb of long spines, but with combs of short apical spines; segment of V of each tarsus with 5 pairs of lateral plantar bristles; labial palpus with 5 segments; female with 2 receptacula seminis.....	<i>Hystrichopsylla</i> Taschenberg.

The Genus PHALACROPSYLLA Rothschild

Phalacropsylla Rothschild, 1915. Ectoparasites 1: 39. Monotypic. Type, *Phalacropsylla paradisea* Rothschild.

No species belonging to this genus has been available to the authors for study. The following redescription is compiled from the literature.

Genal comb consisting of 2 spines so arranged that 1 crosses the other. Eyes vestigial. Labial palpus reaching to apex of coxa I. Pronotum with a comb. Anterior abdominal tergal plates with apical spines. Three antepygial bristles present on a side. Coxa III with a patch of small bristles and spinelets on the inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair. Ventral arm of sternal plate IX with a row of several stout, spinelike setae, below which are several longer ones.

This genus includes but two species, both from North America.

PHALACROPSYLLA ALLOS Wagner

Phalacropsylla allos Wagner, 1936, Ztschr. f. Parasitenk. 8: 657, fig. 6.

Type host.—*Neotoma cinerea* Ord (wood rat).

Type locality.—Logan, Utah.

Range.—Known only from the type locality.

The original description of this species is accompanied by a figure of the apical end of the ventral arm of sternal plate IX of the male. In 1939 Wagner (86, p. 88) published a figure of the male head.

PHALACROPSYLLA PARADISEA Rothschild

Phalacropsylla paradisea Rothschild, 1915, Ectoparasites 1: 39, figs. 42-43.

Cotype hosts.—*Epimys* sp. and *Mus*. sp. (mice).

Type locality.—Paradise, Ariz.

Range.—Known only from Arizona.

The original description of this species is accompanied by illustrations of the male and female terminalia.

The Genus *Meringis* Jordan

(Fig. 10, C)

Meringis Jordan, 1937, Novitates Zool. 40: 268; *Meringis* Jordan, 1937, Novitates Zool. 40: 332. Type, *Meringis parkeri* (Jordan) (by designation of Jordan, 1937).

Jordan described *Meringis* in 1937 without type designation, but later the same year validated the genus by designating a type.

Genal comb consisting of 2 spines, 1 of which overlaps the other. Eyes vestigial. Labial palpus 5-segmented, reaching to three-fourths the length of the fore coxa. Pronotum with comb. Anterior abdominal tergal plates without apical spines. Three antepygial bristles usually present on a side. Coxa III with a row of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair. Posterior process of sternal plate IX armed apically with 1 to several stout, spinelike setae which are heavily pigmented.

This genus includes six species.

MERINGIS ARACHIS (Jordan)

Phalacroscylla arachis Jordan, 1929, Novitates Zool. 35: 38, pl. 2, fig. 27.
Meringis arachis Jordan, 1937, Novitates Zool. 40: 268.

Type host.—*Dipodomys spectabilis* (Merr.) (kangaroo rat).

Type locality.—McCleary's Ranch, 30 miles southeast of Tucson, Ariz.

Range.—Known only from Arizona.

The original description of this species is accompanied by an illustration of the male terminalia.

MERINGIS CUMMINGI (C. Fox)

Phalacroscylla cummingi C. Fox, 1926, Pan-Pacific Ent. 2: 182, figs. 1-2.
Meringis cummingi Jordan, 1937, Novitates Zool. 40: 268.

Type host.—*Dipodomys agilis* (Gam.) (kangaroo rat).

Type locality.—Los Angeles, Calif.

Range.—Known only from California.

The original description of this species was based upon a single male, now in the United States National Museum collection, and is accompanied by illustrations of the male head and terminalia. The female has not been described.

MERINGIS DIPODOMYS Kohls

(Fig. 10, C)

Meringis dipodomys Kohls, 1938, U. S. Pub. Health Serv. Rpts. 53: 1219, figs. 6-7.

Type host.—*Dipodomys* sp. (kangaroo rat).

Type locality.—Imperial County, Calif.

Range.—Known only from California.

The original description of this species is accompanied by illustrations of the male and female terminalia.

MERINGIS HUBBARDI Kohls

Meringis hubbardi Kohls, 1938, U. S. Pub. Health Serv. Rpts. 53: 1217, figs. 1-3.

Type host.—*Sylvilagus* sp. (cottontail rabbit).

Type locality.—Mayfield, Idaho.

Range.—Western part of the United States.

The original description of this species is accompanied by illustrations of the male and female genitalia.

MERINGIS PARKERI Jordan

Meringis parkeri Jordan, 1937, *Novitates Zool.* 40: 269, figs. 54-55.

Type host.—*Dipodomys* sp. (kangaroo rat).

Type locality.—Ravalli County, Mont.

Range.—Known only from Montana.

The original description of this species is accompanied by illustrations of the male and female terminalia.

MERINGIS SHANNONI (Jordan)

Phalacrocylla shannoni Jordan, 1929, *Novitates Zool.* 35: 38, pl. 2, figs. 28-29.

Meringis shannoni Jordan, 1937, *Novitates Zool.* 40: 369-370.

Cotype hosts.—"Field mice."

Type locality.—Ritzville, Wash.

Range.—Known only from Washington.

The original description of this species is accompanied by illustrations of the male terminalia and of the female receptaculum seminis.

The Genus STENOPONIA Jordan and Rothschild

(Fig. 9, A)

Stenoponia Rothschild, 1911, [London] *Zool. Soc. Proc.*, p. 391. Type, *Hystrihopsylla tripectinata* Tiraboschi (by original designation).

Genal comb consisting of many long, slender spines. Eyes absent. Labial palpus short, consisting of 2 segments, not extending much beyond apex of maxilla. Pronotum with a comb consisting of numerous long, slender spines. Abdominal tergal plate I with a comb of many long, slender spines. Abdominal tergal plates II to V with rows of many apical spines. Antepygial bristles present. Females normally with only 1 receptaculum seminis. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal, ventral, submedian pair. Length, 4 or 5 mm.

The labial palpus in the members of this genus is usually described as having but one segment. The writers, however, are of the opinion that this structure consists of two segments, and present an illustration (fig. 9, A), which was drawn from a dissected specimen. Wagner (86, p. 13) in 1939 published an illustration of the head of a *Stenoponia* in which the structure they believe to be the first segment of the labial palpus is labeled the labium.

STENOPONIA AMERICANA (Baker)

(Fig. 9, A)

Hystrihopsylla americana Baker, 1899, *Ent. News* 10: 37.

Stenoponia americana Rothschild, 1915, *Ectoparasites* 1: 30.

Stenoponia wetmorei Chapin, 1919, *Brooklyn Ent. Soc. Bul.* 14: 52.

Type host.—*Eutamias* sp. (red-backed mouse).

Type locality.—Orono, Maine.

Range.—Eastern part of the United States.

This species has been redescribed and figured by I. Fox (25, p. 81).

The Genus *HYSTRICHOPSYLLA* Taschenberg

(Fig. 10, F)

Hystrichopsylla Taschenberg, 1880, Die Flöhe, p. 83. Type, *Pulex talpae* Curtis (by original designation).

Genal comb consisting of at least 5 long, slender spines. Eyes vestigial or absent. Labial palpus consisting of 5 segments. Pronotum with a comb consisting of many long, slender spines. Abdominal tergal plates II, III, and IV with rows of apical spines. Antepygial bristles present. Females with 2 receptacula seminis. Fifth tarsal segment of each leg armed with 5 pairs of lateral plantar bristles, without a basal ventral pair. Length, 4 to 8 mm.

This genus is represented in North America by three species.

HYSTRICHOPSYLLA GIGAS GIGAS (Kirby)

Pulex gigas Kirby, 1837, Fauna Boreali-Americana 4: 318.

Hystrichopsylla gigas Jordan, 1929, Novitates Zool. 35: 174.

Type host.—Unknown.

Type locality.—Boreal America. "Two specimens taken in Lat. 65°."

Range.—This subspecies is known only from the type locality.

The identity of this species has remained doubtful because of the inadequate original description, which consists of a paragraph on the coloration and an illustration in colors of a large flea with a prominent genal comb and conspicuous abdominal spines. Largely on the basis of the great size indicated in the description, Baker (2, p. 163) referred a flea now known to be *Tamioiphila grandis* (Rothschild) to this species, and the mistake was repeated by Baker (4, p. 421) in 1904 and Stewart (72, p. 869) in 1928. Jordan (1929), however, clarified the situation by pointing out that the genal comb in Kirby's illustration is more like that of a *Hystrichopsylla* than anything else. Jordan writes that—

It is, therefore, highly probable, that *Pulex gigas* is the same flea as *Hystrichopsylla dippiei* Roths. 1900 from Calgary, Alberta. However, before establishing the synonymy, it would be advisable to wait for material from the North of Alberta and to treat *H. dippiei* and *H. gigas* for the present as subspecies of one species, of which the name would be *H. gigas*.

HYSTRICHOPSYLLA GIGAS DIPPIEI Rothschild

(Fig. 10, F)

Hystrichopsylla dippiei Rothschild, 1902, Ent. Rec. and Jour. Variation 14: 63, fig. 2.

Cotype hosts.—*Mustela longicauda* (Bonap.) (weasel) and "*Lutreola energamos*" (mink).

Cotype localities.—Alberta; Chilliwack, British Columbia.

Range.—Western part of the United States and Canada.

The original description of this subspecies is accompanied by a figure of the male terminalia.

HYSTRICHOPSYLLA GIGAS TAHAVUANA Jordan

Hystrichopsylla gigas tahavuana Jordan, 1929, Novitates Zool. 35: 173, fig. 8

Type host.—*Microtus pennsylvanicus* (Ord) (meadow mouse).

Type locality.—Adirondack Mountains, N. Y.

Range.—Northeastern part of the United States.

The original description is accompanied by a figure of the ventral arm of sternal plate IX of the male. The female has been redescribed and figured by I. Fox (25, pp. 78 and 171).

HYSTRICHOPSYLLA MAMMOTH Chapin

Hystrichopsylla mammoth Chapin, 1921, Wash. Ent. Soc. Proc. 23: 25.

Type host.—*Aplodontia rufa californica* (Peters) (mountain beaver).

Type locality.—Mammoth, Mono County, Calif.

Range.—Western part of the United States.

The male sternal plate IX of this species was figured by Jordan (44, p. 270). This species is characterized by its very large size, some females being as much as 8 mm. in length.

HYSTRICHOPSYLLA SCHEFFERI Chapin

Hystrichopsylla schefferi Chapin, 1919, Brooklyn Ent. Soc. Bul. 14: 50.

Type host.—"Nest of *Aplodontia rufa* (mountain-beaver)."

Type locality.—Puyallup, Wash.

Range.—Known only from Washington.

This species was described from a single female specimen and has not been rediscovered. It is distinguished from *Hystrichopsylla gigas dippei* by the difference in the number of spines in the pronotal comb, there being 46 in *H. schefferi* and 36 in *H. g. dippei*.

The Subfamily MACROPSYLLINAE Oudemans

Head divided into anterior and posterior parts by the development of fronto-epicranial groove; postvertical tubercle present. Front not greatly reduced and not dorsal in position. Gena not greatly enlarged. Eyes reduced. Labial palpus with many segments (over 10) and greater in length than head. Cephalic comb composed of spines with rounded tips and situated both along ventral margin of gena and anterior margin of antennal groove. Antenna with short club, segments not ankylosed. Abdomen provided with combs.

Contains but a single genus, *Macropsylla* Rothschild, which is restricted to Tasmania.

Oudemans (59, p. 155) in 1909 established the family Macropsyllidae for *Macropsylla* Rothschild and *Stephanocircus* Skuse. The first of these is restricted to Tasmania, while the second occurs in Australia and Tasmania. Oudemans even went further and erected for this family the superfamily Posttuberata. This was separated from his superfamily Intuberata because of the presence of the postvertical tubercle. More recent collections of fleas from the Southern Hemisphere have shown that other genera possess this tubercle and that the dividing of the genae and the presence of the helmet in *Stephanocircus* ally it with certain South American genera.

The Subfamily LEPTOPSYLLINAE Rothschild

Fronto-epicranial groove usually deep, dividing head into anterior and posterior parts. Front greatly reduced, anterodorsal or dorsal in position, and forming less than one-half of anterior margin of head, possessing not more than 2 pairs of dermal pits and never more than a vestigial frontal tubercle.

Gena much enlarged and extended dorsally in front of antennal groove. Eyes greatly reduced or absent. Cephalic comb may be situated along anterior margin of antennal groove and composed of as few as 2 or as many as 15 or more spines. Hind coxa with or without a row or patch of spinelets on inner surface.

Nine genera are included in the subfamily, five being represented in the North American fauna.

The subfamily Leptopsyllinae dates from 1915, when Rothschild (66, p. 80) proposed for the group the family name Leptopsyllidae. Ctenopsyllinae Wagner, 1927, based on (*Ctenopsyllus* Kolenati, 1863, not Kolenati, 1856) = *Leptopsylla* Jordan and Rothschild, 1911, is to be regarded as a synonym. Ctenopsyllidae Baker, 1905, can hardly be regarded as a synonym, since the author included in it the very unusual genus *Stephanocircus* Skuse.

KEY TO NORTH AMERICAN GENERA OF LEPTOPSYLLINAE

1. Cephalic comb with 2 or 4 spines; abdominal terga without incrassations. 2
 Cephalic comb with 5 or more flattened spines arranged in a row
 parallel or nearly so with anterior margin of antennal groove. 3
2. Cephalic comb with 2 spines.-----*Peromyscopsylla* I. Fox
 Cephalic comb with 4 spines arranged in a row at about a right
 angle to anterior margin of antennal groove
 Leptopsylla Jordan and Rothschild.
3. Five spines in cephalic comb; abdominal tergal plates without trans-
 verse incrassation; no sexual dimorphism in pronotal comb
 Nearctopsylla Rothschild.
- Six spines in cephalic comb.----- 4
4. Third spine from bottom in genal comb longer than the others and
 acuminate; abdominal tergal plates with transverse incrassations
 Corypsylla C. Fox.
 Third spine from bottom in genal comb not long and not acuminate;
 abdominal tergal plates without transverse incrassations
 Corypsylloides Hubbard.

The Genus PEROMYSCOPSYLLA I. Fox

Peromyscopsylla I. Fox, 1939, Wash. Ent. Soc. Proc. 41: 47. Type, *Ctenopsyllus hesperomys* Baker (by original designation).

Head subangulate in front; anterior margin with a series of bristles, some of which may be heavily pigmented. Genal comb consisting of 2 spines varying in size and shape according to species. Genal process usually conspicuous, varying in size and shape. Eyes vestigial. Labial palpus consisting of 5 segments. Pronotum with a comb of many long, slender spines. Abdominal terga each with 1 to several apical spines. Coxa III without a patch or row of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal ventral pair.

This genus is represented in North America by eight species.

PEROMYSCOPSYLLA ADELPHA (Rothschild)

Leptopsylla adelpha Rothschild, 1915, Novitates Zool. 22: 304, fig. 4.

Peromyscopsylla adelpha Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 121.

Type host.—*Mus* sp. (mouse).

Type locality.—Paradise, Ariz.

Range.—Known only from Arizona.

The original description of this species is accompanied by a figure of the female sternal plate VII. Jordan and Rothschild (49, p. 59) published an illustration of the male terminalia in 1915.

PEROMYSCOPSYLLA CATATINA (Jordan)

Leptopsylla catatina Jordan, 1928, Novitates Zool. 34: 186, fig. 10.

Peromyscopsylla catatina I. Fox, 1940, Fleas of Eastern United States, p. 87, pl. 22, figs. 110, 114, and 115.

Type host.—*Didelphis virginiana* Kerr (opossum).

Type locality.—Rolling Rock Club, Ligonier, Pa.

Range.—Eastern part of the United States and Labrador.

PEROMYSCOPSYLLA EBRIGHTI (C. Fox)

Leptopsylla ebrighti C. Fox, 1926, Pan-Pacific Ent. 2: 182, figs. 3-4.

Peromyscopsylla ebrighti Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 121.

Type host.—*Neotoma fuscipes* Baird (wood rat).

Type locality.—Los Angeles, Calif.

Range.—Known only from California.

The original description of this species is accompanied by illustrations of the male and female terminalia.

PEROMYSCOPSYLLA HAMIFER HAMIFER (Rothschild)

Ctenopsyllus hamifer Rothschild, 1906, Canad. Ent. 38: 324, fig. 44.

Peromyscopsylla hamifer hamifer Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 121.

Type host.—*Mustela* sp. (weasel).

Type locality.—Blackfalls, Alberta.

Range.—The species is known from the western part of the United States and Canada, the typical subspecies only from Alberta.

The original description of this subspecies, which was based on a single male, is accompanied by an illustration of the male terminalia. No records of its occurrence have been published since the original description, and the female has not been described.

PEROMYSCOPSYLLA HAMIFER LONGILOBA (Jordan), new combination

Leptopsylla hamifer longiloba (Jordan), 1939, Novitates Zool. 41: 319.

Type host.—*Microtus* sp. (meadow mouse).

Type locality.—Valdez Creek Trail, 3,500 ft., Alaska.

Range.—Known only from Alaska.

The male of this subspecies is unknown. The original description is accompanied by an illustration of the female terminalia.

PEROMYSCOPSYLLA HAMIFER VIGENS (Jordan)

Leptopsylla hamifer vicens Jordan, 1937, Novitates Zool. 40: 265, figs. 47-48.

Peromyscopsylla hamifer vicens Jellison and Good, 1942, U. S. Pub. Health Serv. Natl. Inst. Health Bul. 178: 122.

Type host.—*Microtus* sp. (meadow mouse).

Type locality.—Ravalli County, Mont.

Range.—Known only from Montana.

The original description of this subspecies is accompanied by illustrations of the male and female terminalia.

PEROMYSCOPSYLLA HESPEROMYS (Baker)

(Fig. 8, E)

Ctenopsyllus hesperomys Baker, 1904, U. S. Natl. Mus. Proc. 27: 428.

Peromyscopsylla hesperomys I. Fox, 1939, Wash. Ent. Soc. Proc. 41: 49.

Peromyscopsylla spinifrons I. Fox, 1939, Wash. Ent. Soc. Proc. 41: 48, pl. 6, figs. 1-2.

Type host.—*Peromyscus* sp. (white-footed mouse).

Type locality.—Franconia, N. H.

Range.—Eastern part of the United States.

This species has been redescribed and illustrated by I. Fox (25, pp. 84 and 175), and the above synonymy indicated.

PEROMYSCOPYLLA RAVALLIENSIS (Dunn)

Ctenopsyllus ravalliensis Dunn, 1923, U. S. Pub. Health Serv. Rpts. 38: 2768.

Peromyscopylla ravalliensis Jellison and Good, 1942, U. S. Pub. Health Serv., Natl. Inst. Health Bul. 178: 122.

Type host.—*Neotoma cinerea* (Ord) (wood rat).

Type locality.—Tin Cup Creek in the foothills of Bitterroot Mountains southwest of Darby, Mont.

Range.—Western part of the United States and Canada.

The female terminalia of this species were figured by Wagner (84, p. 204) in 1936.

PEROMYSCOPYLLA SCOTTI I. FOX

Peromyscopylla scotti I. Fox, 1939, Wash. Ent. Soc. Proc. 41: 49, pl. 6, figs. 4-5.

Type host.—*Peromyscus leucopus* (Raf.) (white-footed mouse).

Type locality.—Dubuque, Iowa.

Range.—Eastern part of the United States.

This species has been redescribed and figured by I. Fox (25, pp. 86 and 173).

PEROMYSCOPYLLA SELENIS (Rothschild)

Ctenopsyllus selenis Rothschild, 1906, Canad. Ent. 38: 322, fig. 43.

Peromyscopylla selenis Jellison and Good, 1942, U. S. Pub. Health Serv., Natl. Inst. Health Bul. 178: 123.

Cotype hosts.—Various field mice.

Cotype localities.—Various localities in British Columbia and Alberta.

Range.—Canada.

The original description of this species is accompanied by an illustration of the male terminalia.

The Genus LEPTOPSYLLA Jordan and Rothschild

(Fig. 8, G)

Leptopsylla Jordan and Rothschild, 1911, Novitates Zool. 18: 85. Type, (*Pulex musculi* Dugès) = *P. segnis* Schönherr (by original designation).

This generic name was proposed to replace *Ctenopsyllus* Kolenati, 1863, not Kolenati, 1856.

Head subangulate in front; anterior margin with a series of bristles, of which at least 2 are heavily pigmented. Genal comb consisting of 4 spines. Eyes vestigial. Labial palpus consisting of 5 segments. Pronotum with a comb of many long, slender spines. Antepygial bristles present. Coxa III without a patch or row of spinelets on the inner surface. Posterior margin of hind tibia armed with a series of about 14 bristles, among which are 3 or 4 very long ones. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles and a basal, submedian, ventral pair.

Jordan and Rothschild (48, p. 85) held that *Ctenopsyllus* Kolenati, 1862 [really 1863], was a homonym of *Ctenopsyllus* Kolenati, 1856.

The latter name was proposed, according to the opinion of these authors, as a more appropriate name than *Ceratopsyllus* Curtis for bat fleas. This substitution of the name *Leptopsylla* for *Ctenopsyllus* Kolenati, 1863, has not been accepted by Wagner, who has held that Kolenati (55, p. 31) in 1856 did not really propose a new generic name but only mentioned the name incidentally in his discussion of the lack of appropriateness of the name *Ceratopsyllus* Curtis. It is not exactly clear from the language used by Kolenati whether he intended to propose *Ctenopsyllus* as a new name. In this connection it is to be noted that in the text of his paper he used *Ceratopsyllus* Curtis, while the name *Ctenopsyllus* appears in a footnote.

In 1932 Jordan (42, p. 291) upheld and justified the substitution of the name *Leptopsylla* for *Ctenopsyllus* Kolenati, 1863, although apparently admitting that *Ctenopsyllus* Kolenati, 1856, was proposed conditionally. He states:

* * * A name published in this way is as valid from the date of publication as if Kolenati had said: "I name the comb-bearing fleas *Ctenopsyllus*." A very large number of names have been published conditionally. Phrases in meaning like the following are quite frequent: "If the differences here mentioned should turn out to be constant, the name *X-us* would be appropriate." * * * A name published with a description or as an alternate name is valid whatever phraseology is employed.

While not entirely agreeing with Jordan's opinion, the writers believe that the conditional language used by Kolenati is not sufficient to exclude this name from consideration under the rules.

Leptopsylla is represented in North America by a single species.

LEPTOPSYLLA SEGNIS (Schönherr)

(Fig. 8, G)

Pulex segnis Schönherr, 1811, Svenska Vetensk. Akad. Handl. (ser. 2) 32: 98, fig.

Pulex musculi Dugès, 1832, Ann. des. Sci. Nat. Zool. (ser. 1) 27: 160, pl. 4, figs. 3 and 10.

Typhlopsylla mexicana Baker, 1896, Canad. Ent. 28: 85.

Leptopsylla musculi Jordan and Rothschild, 1911, Novitates Zool. 18: 85.

Type host.—*Mus musculus* L. (house mouse).

Type locality.—Sweden.

Range.—In North America, the coastal areas of the United States and Mexico.

This species may be immediately recognized by the character of the genal comb (fig. 8, G). Illustrations of diagnostic structures in both the male and female may be found in I. Fox's work (25, p. 177).

Two additional synonyms are indicated in Wagner's catalog (80, p. 22).

Wagner (82) claims that samples of *segnis* taken from squirrels in the Old World differ from those taken from other hosts and has proposed for them the name of *sciurobius*. North American specimens all appear to be typical representatives of *segnis*.

The Genus NEARCTOPSYLLA Rothschild

(Fig. 8, D)

Nearctopsylla Rothschild, 1915, Novitates Zool. 22: 307. Type, *Ctenopsyllus brooksi* Rothschild (by original designation).

Head flattened in front. Genal comb vertical, consisting of 5 unequal,

more or less spatulate spines. Eyes absent. Labial palpus composed of 5 segments. Pronotum with a comb of many long, slender, acuminate spines. Anterior abdominal tergal plates, at least, with 2 or more apical spines. Antepygial bristles present. Coxa III with a patch of spinelets on inner surface. Fifth tarsal segment of legs I and II with 5 pairs of lateral plantar bristles; fifth tarsal segment of leg III with 4 pairs of lateral plantar bristles.

This genus contains four species.

NEARCTOPSYLLA BROOKSI (Rothschild)

Ctenopsyllus brooksi Rothschild, 1904, Novitates Zool. 11: 649, pl. 15, figs. 86 and 88, and pl. 16, fig. 89.

Nearctopsylla brooksi Rothschild, 1915, Novitates Zool. 22: 307.

Cotype hosts.—*Martes americana* (Turt.) (marten), *Mustela longicauda* Bonap. and *M. cicognanii richardsonii* (Bonap.) (weasels).

Cotype localities.—Various localities in Alberta and British Columbia.

Range.—Canada.

The original description of this species is accompanied by illustrations of the male head and terminalia and the female terminalia.

NEARCTOPSYLLA GENALIS GENALIS (Baker)

(Fig. 8, D)

Ctenophthalmus genalis Baker, February 1904, U. S. Natl. Mus. Proc. 27: 424.
Ctenopsyllus hygini Rothschild, September 1904, Novitates Zool. 11: 650, pl. 15, fig. 85, and pl. 16, figs. 93, 94.

Nearctopsylla hygini Rothschild, 1915, Novitates Zool. 22: 307.

Nearctopsylla genalis Jellison and Good, 1942, U. S. Pub. Health Serv., Natl. Inst. Health Bul. 178: 96.

Type host.—The original description indicates *Geomys bursarius* as the type host, but the type slide is labeled, "On *Scalops*." Hence, it seems very likely that the common garden mole, *Scalopus aquaticus*, is the type host of this species, rather than the pocket gopher, *Geomys bursarius*.

Type locality.—Agricultural College, Mich.

Range.—Eastern part of the United States and Canada.

This species has been redescribed and illustrated by I. Fox (25, pp. 91, 175).

NEARCTOPSYLLA GENALIS LAURENTINA Jordan and Rothschild

Nearctopsylla hygini laurentina Jordan and Rothschild, 1923, Ectoparasites 1: 315, figs. 319, 321.

Type host.—*Mustela* sp. (weasel).

Type locality.—New Brunswick, Canada.

Range.—Known only from New Brunswick.

The original description of this species is accompanied by illustrations of the male and female terminalia.

NEARCTOPSYLLA HYRTACI (Rothschild)

Ctenopsyllus hyrtaci Rothschild, 1904, Novitates Zool. 11: 652, pl. 16, figs. 92, 95.
Nearctopsylla hyrtaci Rothschild, 1915, Novitates Zool. 22: 307.

Cotype hosts.—*Mustela vison energumenos* (Bangs) (mink) and *Sorex obscurus* Merr. (shrew).

Cotype localities.—Cariboo and another unnamed locality in British Columbia.

Range.—Known only from British Columbia.

The original description of this species is accompanied by illustrations of the male and female terminalia.

NEARCTOPSYLLA JORDANI Hubbard

Nearctopsylla jordani Hubbard, 1940, Pacific Univ. Bul. 37 (1): [5], 9 figs.

Type host.—*Scapanus townsendii* (Bach.) (Townsend's mole).

Type locality.—Forest Grove, Oreg.

Range.—"Probably that of the Townsend mole, which is west of the Cascade Mountains in Oregon and Washington." (Hubbard, in the original description.)

The original description of this species is accompanied by illustrations of the head and terminalia of the male and female.

The Genus CORYPSYLLA C. Fox

(Fig. 8, 4)

Corypsylla C. Fox, 1908, Ent. News 19: 452. Monotypic. Type, *Corypsylla ornata* C. Fox.

Head rounded in front. Genal comb consisting of 6 spatulate spines, unequal in length. Eyes absent. Labial palpus consisting of 5 segments, the terminal segment tapering distally. Pronotum with a comb of spines, exhibiting marked sexual dimorphism, several of the most ventral spines in the female being pale and fused together for most of their length. Mesopleuron not divided by a pleural ridge. Metanotum fused with metepisternum. Each abdominal tergal plate, except VII, with a heavy, transverse incrustation which bears several heavily pigmented spines. Antepygial bristles present. Coxa III with a patch of spinelets on inner surface. Fifth tarsal segment of each leg with 4 pairs of lateral plantar bristles.

This genus includes but two species, both being Nearctic.

CORYPSYLLA JORDANI Hubbard

Corypsylla jordani Hubbard, 1940, Pacific Univ. Bul. 37 (1): [9], 7 figs.

Type host.—Nest of *Peromyscus maniculatus rubidus* (Osg.) (white-footed mouse).

Type locality.—Gaston, Oreg.

The original description of this species is accompanied by illustrations of the male and female heads and terminalia which show the points in which this species differs from *Corypsylla ornata* C. Fox, to which it is closely allied.

CORYPSYLLA ORNATA C. Fox

(Fig. 8, 4)

Corypsylla ornatus C. Fox, 1908, Ent. News 19: 452, 2 figs.

Type host.—"Scapanus californicus" (mole).

Type locality.—San Francisco, Calif.

Range.—Western part of the United States.

The original description of this species is accompanied by illustrations of the male head and terminalia. Hubbard (30) has published further illustrations, which include a figure of the female terminalia.

The Genus *CORYPSYLLOIDES* Hubbard

Corypsylloides Hubbard, 1940, Pacific Univ. Bul. 37 (2): 7. Monotypic. Type, *Corypsylla kohlsi* Hubbard.

Front reduced; frontal tubercle and notch absent. Gena much enlarged; genal comb obliquely vertical, consisting of 6 spines of about the same length. Eyes absent. Labial palpus 5-segmented, the terminal segment tapering distally. Pronotum rounded cephalad, well separated from head, bearing on posterior margin a comb consisting of spines of various sizes. Mesopleuron not divided by a vertical rodlike sclerotization into a mesepisternum and a mesepimeron. Abdominal tergal plates armed with prominent apical spines but without heavy transverse incrassations. Coxa III with a patch of spinelets on inner surface. Last segment of each tarsus armed with 4 pairs of lateral plantar bristles.

This genus is most closely allied to *Corypsylla* C. Fox, from which it may be distinguished by the absence of heavy transverse incrassations on the abdominal tergal plates and by the character of the genal comb. It is separated from *Nearcotopsylla* Rothschild, which it superficially resembles, by the structure of the thorax. The genus is represented in North America by one described species.

CORYPSYLLOIDES KOHLSI (Hubbard)

Corypsylla kohlsi Hubbard, 1940, Pacific Univ. Bul. 37 (1): [10], 7 figs.
Corypsylloides spinata I. Fox, 1940, Wash. Acad. Sci. Jour. 30: 373, figs. 1, 2.

Type host.—*Sorex obscurus bairdi* Merr. (Baird's shrew).

Type locality.—Cannon Beach, Oreg.

Range.—Oregon.

This species was well illustrated in the original description. The movable finger, however, is shown to have but two setae on the posterior margin. The specimens upon which I. Fox based the name *Corypsylloides spinata* indicate three larger setae and two minute ones, as is shown in his illustration.

The Family ISCHNOPSILLIDAE Wahlgren

Head divided into anterior and posterior parts by fronto-epicranial groove. Gena neither greatly enlarged nor divided by a suture. Forehead without helmet, usually elongated, and always with 2 or 3 ventral flaps on each side adjacent to fronto-genal angle. Eyes reduced, vestigial, or absent. Cephalic combs represented by the 2 or 3 flaps on each side of head. Postantennal region with or without dorsal incrassations. Thorax not greatly reduced; thoracic terga taken together longer than abdominal tergum I. Typical abdominal terga each with more than 1 transverse row of setae. Antepygial bristles present or absent. Abdominal apical spines frequently present and may form 1 or more combs. True or false combs of long spines may be present on abdomen. Females without a reduced number of abdominal spiracles and, when gravid, abdomen not greatly distended.

The family Ischnopsyllidae was established by Wahlgren (87, p. 89) in 1907. The following synonyms are recorded: Ceratopsyllidae Baker (5, p. 137) and Ischnopsyllinae Wagner (89, p. 29). Ceratopsyllidae is based upon *Ceratopsyllus Kolenati*, 1857, which is a synonym of *Ischnopsyllus* Westwood, 1883.

Wagner (86, p. 75) has divided this family into two subfamilies. The characters are: The presence or absence of a wide clear area on the frons, the presence or absence of antepygial bristles, and the presence or absence of a comb of thickened bristles on abdominal

plate VII. The members of his subfamily Ischnopsyllinae are said to possess the wide, clear area on the head and the antepygidial bristles, while the members of the subfamily Nycteridopsyllinae are characterized by the absence of the wide, clear area on the head and by the presence of a comb of bristles on tergal plate VII which takes the place of the absent antepygidial bristles. Accordingly, the genera *Myodopsylla*, *Sternopsylla*, and *Rhinolophopsylla* are referred to the Ischnopsyllinae by Wagner; but of these genera only *Myodopsylla* has a distinct, clear area on the frons. Hence this character does not apply generally and is not satisfactory as a basis for the establishment of a subfamily. The other characters used, i. e., the presence or absence of antepygidial bristles and the presence or absence of a comb of spines, while of great generic value, are not here regarded sufficiently important, when used by themselves, to distinguish subfamilies. In our fauna only the genus *Eptesopsylla* would go into the subfamily Nycteridopsyllinae. No provision was made by Wagner for the genus *Ptilopsylla*, which he believes is separated from both subfamilies and cannot be placed until more is known about it.

The present writers are of the opinion that the Ischnopsyllidae, as the family is now constituted, does not break into subfamilies. However, the discovery of more genera and species, which will undoubtedly come with time, may lead to a revision of this belief.

KEY TO THE NORTH AMERICAN GENERA OF ISCHNOPSYLLIDAE

1. Maxillae either acuminate or narrowly rounded apically----- 2
 Maxillae truncate or nearly truncate apically----- 3
2. Antepygidial bristles present; abdominal tergal plate VII without
 a comb of thickened bristles----*Sternopsylla* Jordan and Rothschild.
 Antepygidial bristles absent; abdominal tergal plate VII with a
 comb of thickened bristles-----*Eptesopsylla* I. Fox.
3. Abdomen without combs, but sometimes with rows of minute teeth
 Rhinolophopsylla Oudemans.
 Abdomen with false combs composed of enlarged setae in some of the
 transverse rows-----*Myodopsylla* Jordan and Rothschild.

The Genus STERNOPSYLLA Jordan and Rothschild

(Figs. 8, F, and 11, D)

Sternopsylla Jordan and Rothschild, 1921, Ectoparasites 1: 158. Type, *Ischnopsyllus texanus* C. Fox (by original designation).

Aptilopsylla Ewing, 1940, Wash. Biol. Soc. Proc. 53: 36. Monotypic. Type, *Aptilopsylla carlsbadensis* Ewing.

Head without dorsal incassations. Frontal tubercle present or absent. Ventral flaps long, slender, curved, tapering to the acuminate apex, with posterior flap longer than anterior. Genal process acuminate. Eye vestiges large. Ocular bristle present. Maxilla acuminate. Pronotum with a true comb. Abdominal terga without combs. Antepygidial bristles present. Tarsi long, first segment of mid and hind tarsi with numerous small, hairlike setae, particularly in male. Fifth tarsal segment of each leg with 5 pairs of plantar bristles, of which the first pair is ventral, the other 4 lateral.

This genus is represented in North America by two species. Both were described from females, but recently the males have been described by Guimarães (27), and the writers have received a large consignment of *Sternopsylla*, including males, from G. M. Kohls, taken in Carlsbad Cavern, N. Mex.

The genus is remarkable in that the females of the two species and their varieties appear to be identical, except that in one situation, Carlsbad Cavern, N. Mex., some of the females possess a very distinct frontal tubercle and the others not so much as a vestige of such a tubercle. The males corresponding to the two kinds of females in this cavern are so nearly alike that they cannot be separated except for the presence or absence of the frontal tubercle.

While the females from other localities appear to be alike, the males show slight differences in the shape of the posterior process of the clasper, in the shape of the movable finger, and especially in the chaetotaxy of the latter.

Guimarães (27) gives a drawing of the clasper of the male of what he identifies as *Sternopsylla texana* (C. Fox), based on material from Mexico. According to this drawing the Mexican male is different from all those known to the writers from the United States in the shape of the posterior process of the clasper, which is longer in proportion to its width than in forms occurring in the United States. Also the chaetotaxy and shape of the movable finger are different.

When the known males of *Sternopsylla* from the United States are compared, they are observed to fall into three groups according to the following differences in the claspers:

1. Those from Carlsbad Cave, N. Mex., in which the movable finger is about as broad as long and the anterior margin is very broadly incurved, the two lower, posterior, marginal, spinelike setae of the movable finger are situated at a distance from each other, and the seta adjacent to the third posterior, marginal, spinelike seta is large and longer than the third seta itself.

2. The one male from Georgia, in which the movable finger is distinctly longer than broad and the third spinelike seta is very slender and unaccompanied externally by another seta, and in which there are two external discal setae above the middle of the finger.

3. The one from Florida, in which the movable finger is about as broad as long, with the anterior margin deeply incurved or notched below its middle, the two lower, posterior, marginal, spinelike setae are situated approximate to each other, and the seta adjacent to the third posterior, marginal, spinelike seta is flagelliform and shorter than the third seta itself.

These differences in the genitalia of the males from the United States together with the differences in the presence or absence of the frontal tubercle suggest that we have at least four varieties. But four varieties of *Sternopsylla texana* or *S. carlsbadensis*? In view of the fact that Guimarães has figured a male (rightly or wrongly associated with the proper female) of *S. texana*, they are here regarded as varieties of *S. carlsbadensis*, but are not named.

STERNOPSYLLA CARLSBADENSIS (Ewing), new combination

(Fig. 8, F)

Aptilopsylla carlsbadensis Ewing, 1940, Wash. Biol. Soc. Proc. 53: 36.

Type host.—Unknown. Type labeled "on bat guano."

Type locality.—Carlsbad, N. Mex.

Range.—The typical form (with frontal tubercle) known only from Carlsbad Cavern, N. Mex.

As already explained in the discussion following the formal description of the genus *Sternopsylla*, there may be as many as four varieties of this species.

STERNOPSYLLA TEXANA (C. Fox)

(Fig. 11, D)

Ischnopsyllus texanus C. Fox, 1914, U. S. Pub. Health Serv. Hyg. Lab. Bul. 97: 16, pl. 5, figs. 6-8.

Sternopsylla texana Jordan and Rothschild, 1921, Ectoparasites 1: 158.

Type host.—*Tadarida mexicana* (Sauss.) (bat).

Type locality.—Pecos, Tex.

Range.—Southern Texas and (?) northern Mexico.

For a discussion of the taxonomy of this species read the discussion following the formal description of *Sternopsylla*. This species was redescribed and figured by I. Fox (25, pp. 108, 191) in 1940.

The Genus EPTESCOPSYLLA I. Fox

(Fig. 11, A)

Eptescopsylla I. Fox, 1940, Fleas of Eastern United States, p. 107. Monotypic. Type, *Nycteridopsylla chapini* Jordan.

Head without dorsal incassations. Frontal tubercle absent. Ventral flaps long, slender, nearly straight, tapering to the acuminate apex, with posterior flap much longer than anterior. Genal process rounded posteriorly. Eye vestiges large. Ocular bristle absent. Maxilla acuminate. Pronotum with a true comb. Metanotum and anterior abdominal tergal plates each armed with 2 or 3 dorsal teeth on a side. Abdominal tergal plate VII with a false comb. Antepygial bristles absent. Fifth tarsal segment of each leg with 5 pairs of plantar bristles, of which the first pair is ventral, the other 4 lateral.

This genus may be separated from *Nycteridopsylla* Oudemans, to which it is allied, by the absence of combs on the anterior abdominal tergal plates I to III. The genus *Nycteridopsylla* does not occur in North America. *Eptescopsylla* is represented by two species.

Although the generic host name upon which the name *Eptescopsylla* was based has the letter *i* in it, this letter was omitted in the formation of the latter for the sake of euphony.

EPTESCOPSYLLA CHAPINI (Jordan)

(Fig. 11, A)

Nycteridopsylla chapini Jordan, 1929, Novitates Zool. 35: 39, pl. 2, figs. 30, 31.

Eptescopsylla chapini I. Fox, 1940, Fleas of Eastern United States, p. 107, pl. 30.

Type host.—*Eptesicus fuscus* (Beauv.) (big brown bat).

Type locality.—Glen Echo, Md.

Range.—Probably eastern part of the United States.

Sexual dimorphism is shown in the chaetotaxy of the head, the female being armed with heavily pigmented, spinelike bristles near the antennal groove, while such bristles are absent in the male.

EPTESCOPSYLLA VANCOUVERENSIS (Wagner)

Nycteridopsylla vancouverensis Wagner, 1936, Ztschr. f. Parasitenk. 8: 658, figs. 7-8.

Type host.—*Lasionycteris noctivagans* (LeC.) (silver-haired bat).

Type locality.—Vancouver, British Columbia.

Range.—Known only from British Columbia.

In the description of his species, Wagner states that *Eptescopsylla vancouverensis* is distinguished from *E. chapini* by the possession of

a much narrower head, which is acuminate anteriorly, and by the structure of the movable finger of the male. Paratype male and female specimens of this species have been studied through the courtesy of G. J. Spencer and G. P. Holland.

The Genus RHINOLOPHOPSYLLA Oudemans

Rhinolophopsylla Oudemans, 1910, Ent. Ber. 3: 3. Monotypic. Type, *Typhlopsylla unipectinata* Taschenberg.

Head without dorsal incassations. Frontal tubercle absent. Ventral flaps short and broad, the posterior longer than the anterior. Genal process acuminate. Eye vestiges indistinct. Ocular bristle present. Maxilla truncate. Pronotum with a true comb. Abdomen without combs and without dorsal apical spines. Antepygidial bristles present. Fifth tarsal segment of each leg with 5 pairs of plantar bristles, of which the first pair is ventral, the other 4 lateral.

This genus is represented in North America by but one species.

RHINOLOPHOPSYLLA PALPOSA (Rothschild)

Ceratopsylla palposus Rothschild, 1904, Novitates Zool. 11: 652.

Rhinolophopsylla palposus Wagner, 1936, Canad. Ent. 68: 206.

Type host.—"Brown bat."

Type locality.—Cowichan Demeans, British Columbia.

Range.—Known only from British Columbia.

The male of this species has not yet been described.

The Genus MYODOPSYLLA Jordan and Rothschild

(Fig. 11, B, C, E)

Myodopsylla Jordan and Rothschild, 1911, Novitates Zool. 18: 88. Monotypic.

Type, *Ceratopsylla insignis* Rothschild.

Frons a wide, clear area without sclerotization. Frontal tubercle absent. Ventral flaps short and broad, the posterior slightly longer and much wider than the anterior. Genal process acuminate. Eye vestiges large. Ocular bristle present. Maxillae truncate. Pronotum with a true comb. Metanotum and abdominal tergal plates I to VII each with a false comb formed by thickening of dorsal bristles. Antepygidial bristles present. Fifth tarsal segment of each leg with 5 pairs of plantar bristles, of which the first pair is ventral, the other 4 lateral.

This genus is represented in North America by four species.

MYODOPSYLLA COLLINSI Kohls

(Fig. 11, B, E)

Myodopsylla collinsi Kohls, 1937, Jour. Parasitol. 23: 300, figs. 1, 2.

Type host.—"Bats."

Type locality.—Madera Canyon, Santa Rita Mountains, Santa Cruz County, Ariz.

Range.—Known only from Arizona.

The original description of this species is accompanied by four figures of the male and female terminalia. The species may be readily distinguished by the structure of the male terminalia (fig. 11, B).

MYODOPSYLLA DIASI Costa Lima

Myodopsylla diasi Costa Lima, 1938, Rev. Med. Cirurg. do Brasil 46 (2): 182, 6 figs.

Type host.—*Myotis velifer* (Allen) (bat).

Type locality.—S. Cristobal, Ecatepec, Mexico.

Range.—Known only from Mexico.

This species is most closely allied to *Myodopsylla collinsi* Kohls, with which it may possibly be identical. Since no specimens are at hand for comparison with those of *collinsi*, it is best to regard it as a separate species for the present.

MYODOPSYLLA GENTILIS Jordan and Rothschild

Myodopsylla gentilis Jordan and Rothschild, 1921, Ectoparasites 1: 152, fig. 131.

Type host.—"Bat."

Type locality.—Okanagan Landing, British Columbia.

Range.—Western part of the United States and Canada.

The male terminalia are well illustrated in the original description of this species. The seventh and eighth abdominal segments of the female, however, are indicated as being the same as in *Myodopsylla insignis*.

MYODOPSYLLA INSIGNIS (Rothschild)

(Fig. 11, C)

Ceratopsylla insignis Rothschild, 1903, Novitates Zool. 10: 319, pl. 9, figs. 8-12. *Ceratopsyllus crosbyi* Baker, 1905, U. S. Natl. Mus. Proc. 29: 137. (New synonymy.)

Myodopsylla subulata Chapin, 1919, Brooklyn Ent. Soc. Bul. 14: 55.

Type host.—*Myotis lucifugus* (Lec.) (little brown bat).

Type locality.—Waterloo, Ontario, Canada.

Range.—Eastern part of the United States and Canada.

Through the kindness of Robert Matheson, the writers have been able to examine a single female specimen labeled "*Ischnopsyllus crosbyi* Baker," belonging to Cornell University. This specimen appeared to be the type of Baker's *crosbyi*. Our examination of it revealed that *crosbyi* was identical with *M. insignis* (Rothschild).

Jordan and Rothschild (51, p. 151), in 1921, placed *Myodopsylla subulata* Chapin as a synonym of *M. insignis* (Rothschild), stating: "An incorrectness in our original figure of the exopodite of *M. insignis* has unfortunately been the cause of the creation of a synonym." This species has been redescribed and figured by I. Fox (25, pp. 105, 187).

The Family PULICIDAE Stephens

Head not divided by a fronto-epicranial groove. Gena not greatly enlarged and extended dorsally in front of antennal groove, and not divided by a suture. Forehead without helmet, not elongated and never provided with ventral flaps. Cephalic combs present or absent. Thorax not greatly reduced; thoracic terga taken together longer than tergum I of abdomen. Typical abdominal terga each with a single transverse row of setae. Abdominal combs absent. Antepygial bristles present. Females without a reduced number of abdominal spiracles, and, when gravid, abdomen seldom greatly distended.

The family Pulicidae contains three subfamilies, as follows: Spilopsyllinae, Chimaeropsyllinae, and Pulicinae.

The family name Pulicidae was first used in 1829, by Stephens (71, p. 328), who applied it to all the fleas. Oudemans (59, p. 157), in 1909, attributed the family to Taschenberg, and Wagner (80, p. 5) did likewise. Dalla Torre (10, p. 22) attributed the family to Oudemans. In the restricted sense in which the name Pulicidae is here used, it has no synonyms.

The Subfamily SPILOPSYLLINAE Oudemans

Fronto-epicranial suture poorly developed or absent. Eyes usually well developed and heavily pigmented but may be absent. Front not greatly reduced, with rounded or angulate margin; frontal tubercle present or absent. Genal comb present or absent. Pronotal comb present or absent. Mesepisternum separated from mesepimeron by an internal, vertical ridge. Episternum III usually divided into upper and lower parts. Hind coxa either with or without a row or patch of spinelets on inner surface.

Included in this subfamily are 25 genera, of which 8 are represented in the North American fauna.

The subfamily Spilopsyllinae was established by Oudemans (59, p. 156), in 1909, for the single genus *Spilopsyllus* Baker. Dalla Torre (10, p. 7), in 1924, added three more. The family Pulicidae and the subfamily Spilopsyllinae are closely related to the family Dolichopsyllidae through the genus *Megarthroglossus* Jordan and Rothschild. There has never been any agreement among workers on the fleas as to just where the family limits should be placed.

KEY TO NORTH AMERICAN GENERA OF SPILOPSYLLINAE

1. Coxa III with a row or patch of spinelets on inner surface..... 2
Coxa III without a row or patch of spinelets on inner surface..... 6
2. Pronotal comb absent..... 3
Pronotal comb present..... 4
3. Segment V of each tarsus with only 3 pairs of lateral plantar bristles.
North American..... *Actenopsylla* Jordan and Rothschild.
Segment V of each tarsus with 4 pairs of lateral plantar bristles;
episternum III divided into upper and lower parts; antennal club
not segmented on anterior surface..... *Xenopsylla* Glinkiewicz.
4. Genal comb absent; club of antenna subcapitate..... *Hoplopsyllus* Baker.
Genal comb present..... 5
5. Genal comb about horizontal and extending forward to fronto-genal
angle of head; front not angulate..... *Ctenocephalides* Stiles and Collins.
Genal comb more nearly vertical than horizontal and composed of spines
that are rounded at apex; front somewhat angulate dorsally; labial
palpus 4-segmented. Occurring on North American hares and rabbits.
..... *Cediopsylla* Jordan.
6. Pronotal comb present..... 7
Pronotal comb absent; frontal tubercle present; eyes absent
..... *Anomiopsyllus* Baker.
7. Labial palpus 4-segmented; femora without lateral setae
..... *Callistopsyllus* Jordan and Rothschild.
Labial palpus 5-segmented, the fifth segment equal to, or longer than,
II, III, and IV taken together; lobe on posterior margin of coxa III
acute..... *Megarthroglossus* Jordan and Rothschild.

The Genus *ACTENOPSYLLA* Jordan and Rothschild

Actenopsylla Jordan and Rothschild, 1923, Ectoparasites 1: 309. Monotypic.
Type, *Actenopsylla suavis* Jordan and Rothschild.

This genus includes but a single rare species, representatives of which are not available for study, hence the original description by Jordan and Rothschild is here given in full.

Near *Spilopsyllus* Baker (1905). Without ctenidia. Mandibles normal, not enlarged.

Frons strongly rounded, without tubercle or angle, with two long bristles, one in front of the eye, the other near the ventral margin above the maxillary palpus; internal projection above maxilla small. Occiput with many small bristles above antennal groove. Club of antenna as in *Spilopsyllus* segmented all round, longer in ♂ than in ♀, bristles on upperside of segment II. long. Labial palpus with four segments.

Pro- and mesothoracic tergites and abdominal tergites II. to VII. with one row of bristles. Metepimerum with a bristle above stigma, the distance of the stigma from the upper margin of the epimerum being much greater than in *Spilopsyllus*. Stigmata III. to IX. of equal size, not so large as in *Spilopsyllus*, but the diameter of a stigma more than twice the diameter of the groove of a large bristle of the posterior row of the respective segment; cavity of last stigma very large. Hindcoxa on inner side with a row of (about) six to eight small spines; mid- and hindfemora with a subventral row of bristles on the inside; segment I. of midtarsus as long as II., V. of all the tarsi with only 3 pairs of plantar bristles.

The authors of this genus place it nearest *Spilopsyllus* Baker. It is also closely related to *Parapulex* Wagner.

ACTENOPSYLLA SUAVIS Jordan and Rothschild

Actenopsylla suavis Jordan and Rothschild, 1923, Ectoparasites 1: 309. figs. 312, 313.

Type host.—“Nest of *Ptychoramphus aleuticus*” (Cassin’s auklet).

Type locality.—Coronado Island, Mexico.

Range.—Known only from Mexico.

The original description of this species was based on one male and seven females, and is accompanied by a drawing of the genitalia of the male and the tip of the abdomen of the female.

The Genus *XENOPSYLLA* Glinkiewicz

(Fig. 12, D and G)

Xenopsylla Glinkiewicz, 1907, Akad. der Wiss. Wien, Math.-Nat. Kl. Sitzber. 116: 385. Monotypic. Type (*Xenopsylla pachyruromydis* Glinkiewicz) = *X. cheopis* (Rothschild).

Loemopsylla Jordan and Rothschild, 1908, Parasitology 1: 15. Type, *Pulex cheopis* Rothschild (by original designation).

Front short, high, with anterior margin broadly rounded. Frontal tubercle absent. Genal comb absent. Eye large, unreduced, black. Labial palpus 4-segmented, both anterior and posterior margins well sclerotized. Antennal club short, not segmented on anterior surface. Episternum III. divided into upper and lower parts by a deep suture. Pronotal comb absent; pronotum with a single transverse row of setae. Hind coxa with a row or patch of spinelets on inner surface. Femora almost devoid of lateral setae. Segment V of each tarsus with 4 pairs of lateral plantar bristles. Abdomen with long setae, but without apical spines. Sternal plate VIII. of male large, broad, unmodified. Sternal plate IX. of male with an anterior, whiplike apophysis, a pair of poorly sclerotized, inner, vertical processes, and a pair of simple, more or less clavate, posterior processes.

Xenopsylla includes a large number of closely related species, some of which should probably be considered more appropriately as varieties. Originally it apparently was confined to Africa, or to Africa and western Asia. Through commercial activities some of the species have been introduced into Europe and the Western Hemisphere as well as into various parts of Asia.

XENOPSYLLA CHEOPIS (Rothschild)

(Fig. 12, D and G)

Pulex cheopis Rothschild, 1903, Ent. Monthly Mag. (2) 14: 85, pl. 1, figs. 3, 9; pl. 2, figs. 12, 19.

Xenopsylla cheopis Rothschild, 1909, Novitates Zool. 16: 132.

Loemopsylla cheopis Jordan and Rothschild, 1908, Parasitology 1: 42.

Cotype hosts.—Seven hosts were indicated by Rothschild in his original description.

Type locality.—Shendi, Egypt.

Range.—Although this species is not cosmopolitan in its distribution, it has been very widely disseminated through the introduction of its favored hosts into many countries. However, since much of its life cycle is spent detached from the warm bodies of the hosts, this more or less tropical species apparently has not been able to follow them into all the areas they have invaded.

The distribution of *Xenopsylla cheopis*, or the oriental rat flea, in the United States is interesting. For many years it was reported only from the larger port cities, where it frequently made up a considerable percentage in the total rat flea population. In 1925, however, F. N. Wallace (88) reported finding *cheopis* on rats in Indianapolis, Ind., but noted that no infestation of houses was observed. About this time W. A. Riley identified a specimen from St. Paul, Minn., taken from a rat. Then, in 1934, Roudabush and Becker (68) reported the finding of many specimens of *cheopis* on rats shot on the dumping ground of the city of Ames in Iowa. They called attention to the statement of C. Fox (23, p. 133) in 1925 that the oriental rat flea was not known to occur in the interior of the United States. This infestation at Ames has continued since the observations of Roudabush and Becker and constitutes, as far as known, a permanent infestation. In 1939 Roudabush (67) also recorded the flea from Des Moines, Iowa. Owen (60), in 1936, reported an infestation of a dairy barn at the University of Minnesota Farm, St. Paul, Minn., and in 1938 the present writers, Ewing and I. Fox (19), added new records from Illinois and Ohio. Trembley and Bishopp (76) reported the species from Nashville, Tenn. The specimens came from rats captured in a grain store in the city near the Cumberland River in March 1938. These authorities have reviewed their United States records, as well as those from the literature, and find that *Xenopsylla cheopis* has now been reported from 19 States and the District of Columbia. Of these 19 States, 13 are coastal with ports for foreign commerce. The scattered records of this flea from the interior States are of recent date and indicate the establishment of "islands" of infestation, in a region the climate of which might be thought adverse to their existence.

Xenopsylla cheopis has been much studied, but only a few references to the literature dealing with it can be given here. Bacot (1), in

1914, in a lengthy paper reports some exhaustive studies on the economics of this and a few other species. He found that cold (40° F.) was fatal to the eggs of *cheopis*, that conditions of drought did not affect egg production, but that low temperatures either checked or prevented oviposition. Bacot found that the larvae of *cheopis* were able to live from several days to over a month without food and that the time consumed by the active larval period ranged from 12 to 84 days. The duration of the cocoon period was found to range from 7 to 182 days. Adults kept in a box and fed on their natural host lived for 100 days.

The oriental rat flea is the chief agent in the transmission of bubonic plague, a disease that formerly took a frightful toll of life in the Old World. According to Waterston (90) over seven million deaths resulted from this disease in India between 1896 and 1911. This flea also is implicated in the transmission of certain types of endemic typhus.

Two species, *Xenopsylla brasiliensis* and *X. astia*, as well as some others, are frequently confused with *X. cheopis*. As pointed out by Rothschild (65, p. 84) in 1914, *brasiliensis* differs from the other two by having the antepygidial bristle situated on "a long pedestal" in the male sex; while *astia* differs from *brasiliensis* and *cheopis* by having, in the male, a somewhat curved and ribbonlike posterior process or lobe of the ninth sternal plate instead of a club-shaped one.

Wagner (80, p. 35), in his catalog, indicates four synonyms of this species.

The Genus HOPLOPSYLLUS Baker

(Fig. 12, C)

Hoplopsyllus Baker, 1905. U. S. Natl. Mus. Proc. 29: 128. Type, *Pulex anomalus* Baker (by original designation).

Anterior margin of front rounded. Genal comb absent. Frontal tubercle absent. Eyes well developed, subcircular, black. Labial palpus 4-segmented, anterior margin thickened and well sclerotized, posterior margin weak, but slightly sclerotized. Antennal club capitate or strongly clavate. Episternum III divided into upper and lower parts by a deep horizontal suture. Pronotal comb present, composed of more than 8 black, apically acute spines, and not extending ventrally on either side to lower margin of pronotum. Hind coxa with a row or patch of spinelets on inner surface. Segment V of each tarsus with 4 pairs of lateral plantar bristles. Abdomen without apical spines.

Hoplopsyllus is confined entirely to the Northern Hemisphere, and largely to the Nearctic Region. Two subgenera are recognized.

The Subgenus HOPLOPSYLLUS Baker

Antennal club capitate, segments anchylosed anteriorly. Antennal groove closed posteriorly in both sexes. Clasper of male with a rather small but broad anterior process, but without posterior fingerlike process; movable finger broad, crescentic.

Certain kinds of squirrels are natural hosts.

The type species of the genus *Hoplopsyllus* Baker has been recognized, since its description, as a species apart from its congeners. For this reason the genus was recently divided into two subgenera. The chief differences between these two subgenera lie in the male genital armature.

HOPLOPSYLLUS (HOPLOPSYLLUS) ANOMALUS Baker

(Fig. 12, C)

Pulex anomalus Baker, 1904, U. S. Natl. Mus. Proc. 27: 381, pl. 10, figs. 1-6.*Hoplopsyllus anomalus* Baker, 1905, U. S. Natl. Mus. Proc. 29: 128.*Type host*.—"A large gray-brown spermophile."*Type locality*.—Arboles, Colo.*Range*.—Western part of the United States.

The original description of *anomalus*, based on a single male and female, is accompanied by six detail figures.

The Subgenus EUHOPLOPSYLLUS Ewing

Euhoplopsyllus Ewing, 1940, Wash. Biol. Soc. Proc. 53: 37. Type, *Holopsyllus affinis* Baker (by original designation).

Antennal club clavate to strongly clavate, but not capitate, segments separated anteriorly by grooves. Antennal groove partly or entirely open in the male, closed in the female. Clasper of male with a broad, setigerous, anterior process and a slender, fingerlike, posterior process (immovable finger), armed apically with a stout, pigmented, spinelike seta; movable finger subclavate, almost straight.

Rabbits and hares are the natural hosts.

This subgenus includes three species listed in this paper as valid, one of which (*glacialis* Taschenberg) is circumpolar, the other two being North American only. The species show a high degree of individual variation.

HOPLOPSYLLUS (EUHOPLOPSYLLUS) AFFINIS (Baker)

Pulex affinis Baker, 1904, U. S. Natl. Mus. Proc. 27: 382.*Hoplopsyllus affinis* Baker, 1905, U. S. Natl. Mus. Proc. 29: 139.*Type host*.—*Lepus* sp. (hare).*Type locality*.—Near Grand Canyon, Ariz.*Range*.—Western part of the United States eastward to Iowa.

This species has recently been figured by I. Fox (25, p. 137). It is a common flea upon different species of rabbits throughout its range.

HOPLOPSYLLUS (EUHOPLOPSYLLUS) EXOTICUS Jordan and Rothschild

Hoplopsyllus exoticus Jordan and Rothschild, 1923, Ectoparasites 1: 311, fig. 314.

Type host.—*Felis* sp.*Type locality*.—Boquete, Panama.*Range*.—Known only from Panama.

This species was described from a single female. The male is unknown. According to the original description it is similar to *lynx* Baker, but sternal plate VII of female is "more widely excised beneath than in *H. lynx*" and the stylet is "much longer than in *H. lynx*."

HOPLOPSYLLUS (EUHOPLOPSYLLUS) GLACIALIS GLACIALIS (Taschenberg)

Pulex glacialis Taschenberg, 1880, Die Flöhe, p. 76, pl. 3, figs. 17-17a.*Hoplopsyllus glacialis* Baker, 1905, U. S. Natl. Mus. Proc. 29: 130.*Type host*.—*Lepus arcticus* Ross (polar hare).*Type locality*.—"Nordpole."

Range.—Northern North America, including Greenland.

Hoplopsyllus glacialis glacialis and *H. glacialis lynx* are very close to each other, and according to Kohls (54, p. 2019)—

the only difference between the two appears to be in size, *glacialis lynx* being notably smaller. However, on the grounds of host relationships and geographical distribution, it is probably desirable for the present, at least, to retain the subspecific distinction.

HOPLOPSYLLUS (EUHOPLOPSYLLUS) GLACIALIS LYNX (Baker)

Pulex lynx Baker, 1904, U. S. Natl. Mus. Proc. 27: 383, pl. 10, figs. 7-11, and pl. 11, figs. 1-2.

Hoplopsyllus glacialis lynx Wagner, 1936, Canad. Ent. 68: 194.

Hoplopsyllus lynx I. Fox, 1940, Fleas of Eastern United States, p. 15, pl. 4, figs. 11, 13.

Type host.—*Lynx canadensis* Kerr (Canada lynx).

Type locality.—Moscow, Idaho.

Range.—United States, Canada, and Alaska.

This variety is very close to *Hoplopsyllus glacialis glacialis*, but it is considerably smaller than the latter. The type host undoubtedly is not a natural host of *H. g. lynx*. Natural hosts are rabbits.

HOPLOPSYLLUS (EUHOPLOPSYLLUS) GLACIALIS FOXI Ewing

Hoplopsyllus foxi Ewing, 1924, Parasitology 16: 350.

Hoplopsyllus powersi C. Fox, 1926, Pan-Pacific Ent. 2: 184, figs. 8-9.

Hoplopsyllus minutus C. Fox, 1926, Pan-Pacific Ent. 2: 185, figs. 6, 10.

Type host.—*Sylvilagus bachmani* (Waterh.) (cottontail rabbit).

Type locality.—San Francisco, Calif.

Range.—Known only from California.

Hoplopsyllus glacialis foxi is distinguished from the other two varieties of *H. glacialis* in having the posterior process of the clasper of the male almost twice as long as the anterior process instead of being only about one and a third times as long. The synonymy here given under *foxi* is that of Kohls (54, p. 2020). *Hoplopsyllus minutus* C. Fox appears to have been based on a dwarfed specimen of *foxi*.

The Genus CTENOCEPHALIDES Stiles and Collins

(Fig. 12, F)

Ctenocephalus Kolenati, 1859 (not Hawle and Corda, 1847), Fauna des Altvaters, Brünn, p. 66. Type, *Ctenocephalus novemdentatus* Kolenati (by subsequent designation).

Ctenocephalides Stiles and Collins, 1930, U. S. Pub. Health Serv. Rpts. 45: 1308. Type, *Pulex canis* Curtis (by original designation).

This generic name was proposed to take the place of *Ctenocephalus* Kolenati, which is preoccupied by *Ctenocephalus* Hawle and Corda, 1847.

Front with anterior margin rounded. Frontal tubercle absent. Genal lobe not extending downward so as to produce a ventral marginal angle. Genal comb present, about horizontal and extending anteriorly along ventral margin of gena to frontogenal angle. Spines of genal comb heavily pigmented and sharply pointed apically. Upper margin of antennal fossa in male with patch of microsetae. Eyes large, black. Labial palpus 5-segmented: anterior margin thickened, well sclerotized; fifth segment not equal to II, III, and IV taken together. Episternum III divided into upper and lower parts by a horizontal suture. Pronotal comb present, composed of heavily pigmented spines, sharply

pointed apically. Hind coxa with a row or patch of spinelets on inner surface. Femora with very few or no lateral setae. Segment V of each tarsus with 4 pairs of lateral plantar bristles. Abdomen without apical spines. Sternal plate VIII of male large, broad, setigerous, unmodified. Sternal plate IX of male with an anterior whiplike apophysis, a poorly sclerotized pair of inner, vertical processes, and a simple pair of distal lobes.

Members of this genus were probably originally confined to Africa. Two species, *canis* Curtis and *felis* Bouché, have been introduced into many parts of the world.

CTENOCEPHALIDES CANIS (Curtis)

(Fig. 12, F)

Pulex canis Curtis, 1826, British Ent., vol. 3, No. 114.

Ctenocephalides canis Stiles and Collins, 1930, U. S. Pub. Health Serv. Rpts. 45: 1308.

Type host.—Not indicated.

Type locality.—Not indicated.

Range.—Almost cosmopolitan, but being apparently absent in certain regions inhabited by man although occurring on certain wild carnivores in areas not yet reached by man.

In their summary of the distribution of *Ctenocephalides canis* in the United States Trembley and Bishopp (76) record this flea from 31 States and the District of Columbia. The Rocky Mountain and Intermountain regions are not represented. Hosts for which two or more records are given include dog, man, cat, and gray fox.

Typical forms of *Ctenocephalides canis* are distinguished from those of *C. felis* in having a much shorter forehead and in having spine I of the head comb very distinctly shorter than spine II, while in *C. felis* spine I is about equal in length to spine II. In *C. canis*, as well as in *C. felis*, there are certain sexual differences in the head characters. These are shown in some figures by I. Fox (25, p. 141).

Ctenocephalides canis is an important intermediate host of the dog tapeworm, *Dipylidium caninum*, a species very common in dogs and cats and occasionally found in man. *C. canis* has also been reported as an intermediate host of the following parasites: *Hymenolepis diminuta*, *Dirofilaria immitis*, *Leishmannia donovani*, and *L. infantum*. This flea may be of importance in the transmission of plague during epidemics.

The complete life cycle of *Ctenocephalides canis* is passed in from 2 to 4 weeks, which means that there may be several generations in a year in the warmer sections of the world. Bacot (1) found that *C. canis* would live as long as 234 days when fed exclusively on man.

Three synonyms of this species are listed in Wagner's catalog (80).

CTENOCEPHALIDES FELIS (Bouché)

(Figs. 1 and 2)

Pulex felis Bouché, 1835, Nova Acta Phys.-Med. Acad. Caes. Leop. Carol. 17: 505, fig. 2.

Ctenocephalides felis Stiles and Collins, 1930, U. S. Pub. Health Serv. Rpts. 45: 1309.

Type host.—"Housecat."

Type locality.—Not indicated.

Range.—Almost cosmopolitan, yet absent in many regions not inhabited by man. Reported from several of the islands of the South Pacific.

Trembley and Bishopp (76), summarizing their United States records, list *Ctenocephalides felis* from 28 States and the District of Columbia. They state that this flea is abundant in the eastern part of the country but relatively scarce in the West. They had no specimens from the Great Plains and Rocky Mountain regions, and among material from the far West only Idaho, Oregon, and California were represented. Numerous hosts are listed by these authors, but most of the records are from man, dog, cat, and opossum.

In *Ctenocephalides felis* spine I and spine II of the head comb are of about equal length, which fact distinguishes it from *C. canis*. It has been noted by the present writers that the differential characters for separating these two species tend to become intermediate where both species occur at the same locality, thus indicating the possibility of hybridization.

Ctenocephalides felis and *C. canis* are almost cosmopolitan, both species having followed man into many parts of the world. However, in certain regions one species may occur to the exclusion of the other.

Ctenocephalides felis has been recorded as an intermediate host for the tapeworm *Dipylidium caninum* and the nematode *Dirofilaria immitis*. It also may be an important vector of plague during epidemics of this disease.

The larva of *Ctenocephalides felis* has been made the object of a special study by Pinto (63).

Wagner (80, p. 34) indicates three synonyms of this species in his catalog.

The Genus CEDIOPSYLLA Jordan

(Fig. 13, E)

Cediopsylla Jordan, 1925, Novitates Zool. 32: 103. Type, *Pulex inaequalis* var. *simplex* Baker (by original designation).

Anterior margin of front somewhat angulate. Genal comb more nearly vertical than horizontal, composed of heavily pigmented spines with rounded apices. Eyes large, black. Labial palpus 4-segmented, rather poorly sclerotized. Antennal club subcapitate, segments anchylosed anteriorly. Episternum III divided by a suture into upper and lower parts. Pronotal comb composed of heavily pigmented spines with sharply pointed apices. Hind coxa with a row or patch of spinelets on inner surface. Femora with few or no lateral setae. Segment V of each tarsus with 4 nearly equal pairs of lateral plantar bristles. Abdomen short and high, without apical spines.

Jordan established *Cediopsylla* for the American species of *Spilopsyllus*. These he found differed from the European type species in having the labial palpus four-segmented instead of two-segmented. The type species of *Cediopsylla*, *simplex* Baker, which occurs in the eastern part of the United States, differs from the two forms occurring in western States rather markedly in the size of the mandibles and the nature of the modified sternal plates of the male. Hence the genus is divided into two subgenera.

The Subgenus CEDIOPSYLLA Jordan

Mandibles but slightly enlarged, not reaching tip of coxa I. Genal comb composed of more than 5 spines. Sternal plate VIII of male almost completely

overlapped by VII, with a pair of simple, slender, slightly curved, horizontal, posterior processes. Sternal plate IX of male with anterior whiplike apophysis and a pair of conspicuous, lobed, setigerous, posterior processes.

Type species.—The same as for the genus.

Besides the type, which is a common parasite of rabbits in the eastern part of the United States, this subgenus includes *Cediopsylla spillmanni* Jordan, a South American species.

CEDIOPSYLLA (CEDIOPSYLLA) SIMPLEX (Baker)

Pulex inaequalis var. *simplex* Baker, 1895, Canad. Ent. 27: 164.

Cediopsylla simplex Jordan, 1925, Novitates Zool. 32: 103.

Type host.—*Lepus* sp. (hare).

Type locality.—Michigan.

Range.—Eastern part of the United States.

This species, the only one of its genus in the eastern part of the United States, is easily identified by its angulate forehead and subvertical genal comb composed of eight black spines. It has been figured recently by I. Fox (25, p. 135).

Larvae of this species were placed individually in vials which contained a variety of materials thought to be suitable for their food or environment, the object being to observe their habits and rear adults. In such vials no cocoons were made by the larvae before their transformation into the pupal instar. In one vial, in which a flea larva was left without debris from the rabbit nest, a pupa was found. This pupa was entirely concealed in the husk of a weed seed. When the husk was broken open, only a naked pupa was seen. There was no evidence of any silk to be found. This pupa was translucent to whitish, with the legs extending free from the body and suggesting in their shape, to a certain degree, the legs of an adult flea.

Data on the total length of the life cycle of *Cediopsylla* (*Cediopsylla*) *simplex* were not obtained, but a larva that was isolated in a breeding vial on April 11 had transformed into an adult flea on April 29.

The Subgenus ACEDIOPSYLLA Ewing

Acediopsylla Ewing, 1940, Wash. Biol. Soc. Proc. 53: 37. Type, *Pulex inaequalis* Baker (by original designation).

Mandibles much enlarged, reaching considerably beyond tip of coxa I. Genal comb composed of 5 spines. Sternal plate VIII of male not greatly overlapped by VII, large, with a deep, broad, seta-margined, posteroventral depression and a pair of expanded, broadly rounded, posterodorsal lobes. Sternal plate IX of male with an anterior whiplike apophysis, a pair of curved, vertical, internal lobes, and a pair of conspicuous, lobed, setigerous, posterior processes.

This subgenus includes one species which has two varieties, both parasitic on rabbits.

CEDIOPSYLLA (ACEDIOPSYLLA) INAEQUALIS INAEQUALIS (Baker)

(Fig. 13, E)

Pulex inaequalis Baker, 1895, Canad. Ent. 27: 163 and 164.

Cediopsylla (*Acediopsylla*) *inaequalis* Ewing, 1940, Wash. Biol. Soc. Proc. 53: 37.

Cotype hosts.—"Cottontail and jack rabbits."

Type locality.—Near Grand Canyon, Ariz.

Range.—Southwestern part of the United States.

The original description of this species, although based upon a series of specimens, is very short and unaccompanied with drawings.

CEDIOPSYLLA (ACEDIOPSYLLA) INAEQUALIS INTERRUPTA Jordan

Cediopsylla inaequalis interrupta Jordan, 1925, *Novitates Zool.* 32: 103.

Cotype hosts.—*Sylvilagus bachmanni* (Waterh.), and "fox."

Cotype localities.—Palo Alto, San Francisco, and Claremont, Calif.

Range.—Known only from California.

The short original description of this variety, which is based on both sexes, follows:

Genal comb usually with 6 or 7 spines, sometimes 5. Row of long bristles at ventral margin of ♂-clasper divided into a proximal group of 4 to 6 and a distal group of 2 or 3.

The Genus CALLISTOPSYLLUS Jordan and Rothschild

Callistopsyllus Jordan and Rothschild, 1915, *Ectoparasites* 1: 46. Type, *Ceratophyllus terinus* Rothschild (by original designation).

Genal comb absent. Eye vestigial, halfmoon shaped. Labial palpus 4-segmented. Antennal groove not extending upward across vertex; second antennal segment widened on outside covering a third of club. Pronotal comb composed of many spines. Hind coxa without a row or patch of spinelets on inner surface. Femora without lateral setae. Segment V of each tarsus with 5 pairs of lateral plantar bristles, the first being displaced ventrally. Abdomen with a few apical spines which are confined to first 3 terga. Sternum VIII of female angulate posteriorly and bearing a marginal, apical row of very short micro-setae.

This genus includes but two species, one of which is known only by the female sex. The presence of apical spines on the abdomen indicates a relationship with Dolichopsyllidae and Hystrichopsyllidae.

CALLISTOPSYLLUS DEUTERUS Jordan

Callistopsyllus deuterus Jordan, 1937, *Novitates Zool.* 40: 266, fig. 49.

Type host.—*Peromyscus* sp. (white-footed mouse).

Type locality.—Big Bear Lake, Calif.

Range.—Known only from California.

The original description of this species was based upon a single female and is accompanied by a drawing of the female genitalia.

CALLISTOPSYLLUS TERINUS (Rothschild)

Ceratophyllus terinus Rothschild, 1905, *Novitates Zool.* 12: 158, pl. 8, fig. 26 and pl. 9, fig. 29.

Callistopsyllus terinus Jordan and Rothschild, 1915, *Ectoparasites* 1: 46.

Type host.—*Citellus columbianus* (Ord) (ground squarrel).

Type locality.—Mabel Lake, British Columbia.

Range.—Known only from British Columbia.

This species is known only from female specimens.

The Genus *MEGARTHROGLOSSUS* Jordan and Rothschild

(Fig. 13, A)

Megarathroglossus Jordan and Rothschild, 1915, Ectoparasites 1:46. Type, *Megarathroglossus procus* Jordan and Rothschild (by original designation).

Anterior margin of front rounded. Frontal tubercle small to vestigial. Genal comb absent. Eyes vestigial. Labial palpus 5-segmented, fifth segment being equal to or longer than II, III, and IV taken together. Episternum III divided into an upper and a lower part by a horizontal suture. Pronotal comb present, composed of heavily pigmented spines with angulate apices. Hind coxa without a row or patch of spinelets on inner surface and with acute lobe on posterior margin. Femur I without or almost without lateral setae. Segment V of last tarsus with 5 pairs of lateral plantar setae, the first pair being shifted ventrally. Abdomen much longer than high; with some apical spines. Sternal plate VIII of male much shortened, practically without setae, overlapped for much of its length by sternal plate VII and closely encasing sternal plate IX. Sternal plate IX with a much reduced, anterior, whiplike apophysis, a pair of somewhat expanded, internal, vertical processes, and a somewhat clavate, setigerous, posterior process.

This genus includes seven species from Western North America. They are all very closely related and make a very compact natural group.

MEGARTHROGLOSSUS BISETIS Jordan and Rothschild

Megarathroglossus bisetis Jordan and Rothschild, 1915, Ectoparasites 1:54.

Type host.—*Neotoma* sp. (wood rat).

Type locality.—Beulah, N. Mex.

Range.—Known only from New Mexico.

The very short original description of this species is based on two females. It is said to be—

Like *M. longispinus* [now *divisus*], but with only two antepygidial bristles on each side, the upper bristle being a little (one-fifth or one-sixth) longer than the lower one.

MEGARTHROGLOSSUS DIVISUS DIVISUS (Baker)

(Fig. 13, A)

Ceratophyllus divisus Baker, 1904, U. S. Natl. Mus. Proc. 27: 416, pl. 21, figs. 7-10. *Megarathroglossus longispinus* Jordan and Rothschild, 1915, Ectoparasites 1:52, figs. 55, 56.

Type host.—"Fremont's chickaree."

Type locality.—Georgetown, Colo.

Range.—Both the species and variety occur in the western part of the United States and Canada.

The name *divisus* was proposed by Baker to replace *longispinus* Baker, 1895, preoccupied by *Pulex longispinus* Wagner, 1893. Baker's *Pulex longispinus* is a primary homonym and as such cannot, according to the International Code, be resurrected because of the transfer of *Pulex longispinus* Wagner to *Xenopsylla*, as has been done by Jordan and Rothschild (1915).

MEGARTHROGLOSSUS DIVISUS EXSECATUS Wagner

Megarathroglossus longispinus exsecatus Wagner, 1936, Canad. Ent. 68:196.

Type host.—*Sciurus douglasii* (Bach.) (red squirrel).

Type locality.—Avola, British Columbia.

Range.—Known only from British Columbia.

The original description of this variety was based upon a single female and is included in its entirety in the following sentence:

This sinus in the ♀ [apical sinus of abdominal sternal plate VII] from Avola surprises by its bigness and I propose to name this variation *exsecatus* var. nov.

MEGARTHROGLOSSUS PROCUS Jordan and Rothschild

Megarthroglossus procus Jordan and Rothschild, 1915, Ectoparasites 1: 47, figs. 50-52.

Type host.—*Spilogale* sp. (spotted skunk).

Type locality.—Chilliwack, British Columbia.

Range.—Known only from British Columbia.

The original description of this species is very complete and is accompanied by three detail drawings.

MEGARTHROGLOSSUS PYGMAEUS Wagner

Megarthroglossus pygmaeus Wagner, 1936, Canad. Ent. 68: 196, pl. 11, fig. 4.

Type host.—*Neotoma cinerea* (Ord) (wood rat).

Type locality.—Nicola, British Columbia.

Range.—Known only from British Columbia.

The original description of *pygmaeus* is based on a single male. The species is very close to *divisus* and *sicamus*, but is distinct from these two species in the structure of the genitalia. The species also may be, according to Wagner's statement, based only on the male of *Megarthroglossus bisetis* Jordan and Rothschild, which was taken from a *Neotoma*.

MEGARTHROGLOSSUS SICAMUS Jordan and Rothschild

Megarthroglossus sicamus Jordan and Rothschild, 1915, Ectoparasites 1: 50, figs. 53, 54.

Type host.—*Canis latrans* Say (coyote).

Type locality.—Eagle River, Sicamous, British Columbia.

Range.—Known only from British Columbia.

The type host of *sicamus* is probably not a natural one. Natural hosts most probably are rodents. The original description of this species is accompanied by three detail drawings.

MEGARTHROGLOSSUS SIMILIS Wagner

Megarthroglossus similis Wagner, 1936, Canad. Ent. 68: 196, pl. 11, fig. 1.

Type host.—*Neotoma cinerea occidentalis* (Baird) (wood rat).

Type locality.—Beaverdell, British Columbia.

Range.—Known only from British Columbia.

The original description of *similis* is very short and based on two males. However, it is accompanied by a drawing of part of the male terminalia. According to the description, the structure of the male genitalia of *similis* is intermediate between that of *procus* and that of (*longispinus*) = *divisus*.

MEGARHTHROGLOSSUS SPENCERI Wagner

Megarthroglossus spenceri Wagner, 1936, Canad. Ent. 68: 196, pl. 11, figs. 2, 3.

Type host.—*Ochotona princeps* (Rich.) (cony).

Type locality.—Nicola, British Columbia.

Range.—Known only from British Columbia.

The original description of *spenceri* was based on a single female, but is accompanied by a drawing of the forehead and one of the female terminalia.

The Genus ANOMIOPSYLLUS Baker

(Fig. 12, E)

Anomiopsyllus Baker, 1904, U. S. Natl. Mus. Proc. 27: 425. Monotypic. Type, *Typhlopsylla nudata* Baker.

Anterior margin of front rounded. Frontal tubercle present, angulate apically. Genal comb absent. Eyes absent. Labial palpus 4-segmented, never extending to tip of trochanter I, well and equally sclerotized along anterior and posterior borders. Antennal club long, segments not anchylosed anteriorly. Antennal groove open posteriorly. Metathorax reduced, being shorter than mesothorax; upper part of metepisternum, metepimeron, and metanotum fused, without a delimiting suture or inner ridge between them. Pronotal comb absent. Coxa II and coxa III each with a posteroventral, spinelike lobe separated from coxa proper by a deep incision. Coxa III without a row or patch of spinelets on inner surface. Femora each with not more than a single lateral seta. Segment V of tarsi I and II with 5 pairs of plantar bristles, the first pair being situated between setae of second pair; segment V of tarsus III with only 4 pairs of plantar setae, all being lateral and forming 2 parallel rows. Abdomen much longer than high, without apical spines. Sternal plate VIII of male considerably shortened and without posterior processes. Sternal plate IX of male without anterior apophysis, with a pair of large, expanded, inner, vertical processes, and a pair of more or less flattened, clavate, posterior, spinigerous processes.

Baker (5, p. 127), in 1905, established for this genus the subfamily Anomiopsyllinae. Although in this work the genus is not recognized as constituting a subfamily, it is regarded as a somewhat isolated one, particularly in the degree to which the metathorax has been reduced and in the manner in which most of its sclerites have been fused. The included species are all Nearctic.

ANOMIOPSYLLUS AMPHIBOLUS Wagner

Anomiopsyllus amphibolus Wagner, 1936, Ztschr. f. Parasitenk. 8: 654, fig. 1.

Type host.—*Neotoma desertorum* Merr. (wood rat).

Type locality.—Salina, Utah.

Range.—Known only from type locality.

In this species the movable finger bears two posterior, submarginal, stumplike spines, and sternal plate IX of the male possesses four terminal spines.

ANOMIOPSYLLUS FALSICALIFORNICUS C. Fox

(Fig. 12, E)

Anomiopsyllus californicus C. Fox, 1926, Pan-Pacific Ent. 2: 183, figs. 5 and 9.

Anomiopsyllus falsicalifornicus C. Fox, 1929, Ent. News 40: 218.

Cotype hosts.—*Neotoma fuscipes* Baird (wood rat) and *Spilogale phenax* Merr. (spotted skunk).

Type locality.—Los Angeles, Calif.

Range.—Known only from California.

C. Fox (1926) misidentified this flea and described it under the name of *Anomiopsyllus californicus* Baker. In 1929, after Jordan had pointed out that it was really a new species, C. Fox proposed for it the new name *falsicalifornicus*.

ANOMIOPSYLLUS MONTANUS Collins

Anomiopsyllus montanus Collins, 1936, Ent. News 47: 129, figs. 1 and 2.

Type host.—*Bubo virginianus occidentalis* Stone (Montana horned owl).

Type locality.—Canyon Creek, west of Hamilton, Mont.

Range.—Known only from Montana.

The original description of *montanus* is accompanied by two drawings, one of a part of the male terminalia and the other a part of the female terminalia. The type host of this species is probably not a true host. True hosts are probably rodents.

This species was based upon material misidentified as *Anomiopsyllus nudatus* (Baker) by Dunn and Parker (12, p. 2774) in 1923.

ANOMIOPSYLLUS NUDATUS (Baker)

Typhlopsylla nudata Baker, 1898, N. Y. Ent. Soc. Jour. 6: 56.

Anomiopsyllus californicus Baker, 1904, Invertebrata Pacifica 1: 39.

Type host.—*Neotoma albigula* (Hart) (wood rat).

Type locality.—Tucson, Ariz.

Range.—Western part of the United States.

The original description of this species was based on two females. Collins (6, p. 129), in 1936, published a drawing of sternal plate VII of the abdomen of the female. Dunn and Parker (12, p. 2774), in 1923, misidentified as *Anomiopsyllus nudatus* material which was later described as representing a new species (*A. montanus* Collins) by Collins (6, p. 129), in 1936.

The Subfamily CHIMAEROPSYLLINAE, new subfamily

Head divided into 2 parts by the presence of a well developed fronto-epicranial groove or suture; postantennal region of head dorsally incrassate. Eyes present, pigmented. Front considerably reduced, anterodorsal; gena extending dorsally to level of upper margin of eye. Labial palpus short, not reaching apex of coxa I. Pronotal comb present. Mesepisternum separated from mesepimeron by an internal, vertical ridge. Hind coxa with a row of spinelets on inner surface. Abdomen without apical spines.

Contains a single African genus, *Chimaeropsylla* Rothschild.

The genus for which this subfamily Chimaeropsyllinae is proposed was described by Rothschild (64, p. 269) in 1911, being based on a single species. He pointed out certain peculiarities of the mouth parts stating:

* * * The mandibles as well as the labrum are very broad, particularly the former, and closely resemble those of *Spilopsyllus cuniculi*. Dale (1878), and the Sarcopsyllidae. This peculiar parallelism also obtains in the labial palpi, which show a reduction similar to that which occurs in the fleas mentioned, being but feebly chitinized and consisting of only three distinct segments.

Rothschild further states that the single included species probably fixes itself to the host by means of the enlarged labrum and mandibles. *Chimaeropsylla* is restricted entirely to Africa.

The Subfamily PULICINAE Tiraboschi

Head not divided by fronto-epicranial groove; postantennal region not dorsally incassate. Eyes large, nearly circular, and heavily pigmented. Front not greatly reduced; frontal tubercle absent. Labial palpus short, not reaching apex of coxa I. Pronotal comb absent. Mesepisternum not separated from mesepimeron. Hind coxa with either 1 or 2 rows or a patch of spinelets on inner surface. Abdomen without apical spines.

This subfamily contains but three genera, *Pulex* Linnaeus, *Justapulex* Wagner, and *Moeopsylla* Rothschild. Only the two first-mentioned genera are represented in the North American fauna.

The subfamily Pulicinae was proposed as such by Tiraboschi (75, p. 243) in 1904. It represents a very clear-cut natural group of genera. The subfamily Pulicinae, as here recognized, does not include the same genera as were included in Jordan's classification of the Pulicidae published in 1926 (39, p. 600). He included in the subfamily the genera *Tunga* Jarocki, *Hectopsylla* Frauenfeld, and *Echidnophaga* Olliff.

KEY TO NORTH AMERICAN GENERA OF PULICINAE

Mandibles but slightly enlarged; front margin of head never angulate; genal comb never represented by more than 1 pale, toothlike process. Occurring in both New and Old Worlds-----*Pulex* Linnaeus.

Mandibles much enlarged, as long as, or longer than, maxillary palpi; front either round or angulate; genal comb represented by 2 short, pale, toothlike processes. Occurring in tropical and subtropical America

Justapulex Wagner.

The Genus PULEX Linnaeus

(Fig. 12, A)

Pulex Linnaeus, 1758. Systema Naturae, ed. 10, p. 614. Type, *Pulex irritans* Linnaeus (by subsequent designation).

Frontal region of head much higher than long. Eyes large, black, subangulate ventrally. Two or 3 setae in ocular row. Antennal groove closed. Gena with very broad ventral lobe; genal comb absent or represented by a single tooth. Mandible not enlarged, much shorter than maxillary palpus. Labial palpus with 4 distinct segments; anterior margin sclerotized. Metepimeron very much more extended vertically than longitudinally. Hind coxa with a patch of spinelets on inner surface. Sternal plate VIII of male large, broad, unmodified; sternal plate IX with vertical internal processes.

Linnaeus included two species in *Pulex*, the type species and *P. penetrans* (now the type species of *Tunga* Jarocki). As the genus is defined in the present work, it includes but two species, the type species and *P. coneptati* Cunha, 1914.

PULEX IRRITANS DUGESII Baker

(Fig. 12, A)

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

Pulex dugesii Baker, 1904, U. S. Natl. Mus. Proc. 27: 379.

Type host.—“*Spermophilus macrourus*” (ground squirrel).

Type locality.—Guanajuato, Mexico.

Range.—Known only from Mexico.

Baker originally described *dugesii* as a variety. Later (1904) he raised it to the rank of species, stating:

First described as a variety of *irritans*, this form is now given the rank of a species. The examination of a large series shows the characters to be uniform and thoroughly distinctive.

An examination of the type specimens of *dugesii* by the writers indicates that, except for the longer labial palpus, it agrees fairly well with *irritans*. Hence it is given only the status of a subspecies in this paper.

PULEX IRRITANS IRRITANS Linnaeus

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

Pulex simulans Baker, 1895, Canad. Ent. 27: 65.

Type host.—"Man."

Type locality.—Sweden (?).

Range.—Of all the species of fleas, *Pulex irritans* is probably the most nearly cosmopolitan in distribution. Yet there are good reasons for not regarding it as truly cosmopolitan. It is now established in all the major zoogeographical regions, yet there is evidence that it does not occur in many wild areas uninhabited by man, and in addition it probably is absent or extremely rare in certain large cities.

Jordan and Rothschild (47, p. 9), in 1908, said regarding *irritans*:

* * * Our knowledge of the variation and the present and former distribution of this insect is extremely meagre.

They stated:

* * * The nearest allies of this species which are found on various animals are all inhabitants of the Old World. The fleas found in America are only distantly related to *P. irritans*. It may therefore be concluded that the present species originated from the Old World stock of Siphonaptera.

This statement was made a long time ago. Since then *Juxtapulex porcinus* (Jordan and Rothschild) and *J. echidnophagoides* Wagner have been described from native hosts in the New World, the former being originally placed in *Pulex*. In view of these discoveries the present writers are of the opinion that *Pulex*, as well as *Juxtapulex*, was originally an American genus, and that it was in the New World that *P. irritans* originated.

The apparent absence of *Pulex irritans* in certain regions of the Old World was noted by Jordan and Rothschild (47, p. 9). They state that—

The tropical countries of the eastern hemisphere do not appear to be inhabited by *P. irritans* except where European settlements exist, or, at least, where intercourse with Europeans goes on. * * *

The absence of *Pulex irritans* from the oases of the Sahara and from the Haussa countries south of the Sahara appears to be a well-established fact.

The distribution of *Pulex irritans* in the United States has been especially considered by Ewing (18, p. 363), who stated in 1931:

* * * The unusual thing about its distribution has to do rather with its sparseness in certain large areas than its absence in them. Yet certain areas exist in which repeated search for this flea has failed to reveal its presence.

These areas are chiefly wooded regions not inhabited by man. They probably are free from infestation because of the absence of true

hosts, at least two of which are known, the pig and the prairie dog. In the city of Washington it is questionable whether there is a true infestation, and C. Fox and Sullivan (24, p. 1917) found that of the 4,408 fleas taken in the rat-flea survey of New York City, extending from April 18, 1923, to February 28, 1925, not a single specimen was *Pulex irritans*.

Concerning the occurrence of this flea in the United States, Trembley and Bishop (76) state:

* * * The human flea causes severe annoyance in buildings, farmhouses, stables, and surrounding premises, especially in the Middle West and South and on the Pacific Coast. It is the predominant species affecting man on the Pacific Coast.

Bacot (1) has done much work on the biology and ecology of *irritans*. He found that cold (40.9° F.) was fatal to the eggs and that warmth (75° F.) combined with low humidity favored the fertility of the eggs. According to Bacot the newly hatched larvae were able to survive for several days to over a month without food. The cocoon period ranged from 7 to 239 days, and adults, at 45°–50° F. with nearly saturated air, lived without food for 125 days.

Pulex irritans varies considerably in America. Besides the variety *dugesii* Baker, already considered in this paper, Cunha (8, p. 134) described in 1914, as a new American variety, *bahiensis*, from Brazil.

The Genus JUXTAPULEX Wagner

(Fig. 12, B)

Juxtapulex Wagner, 1933, Berlin Zool. Mus. Mitt. 18: 341. Type, *Juxtapulex echidnophagoides*-Wagner (by original designation).

Front with anterior margin either broadly rounded or angulate. Eyes sub-angulate ventrally. Two setae in ocular row. Antennal groove closed. Gena with broad ventral lobe; genal comb composed of 2 short, apically angulate, brown, spinelike processes on posteroventral aspect of gena. Mandibles enlarged, extending almost to apex of coxa I. Labial palpus indistinctly 4-segmented. Metepimeron very much more extended vertically than longitudinally. Hind coxa with a row or patch of spinelets on inner surface. Sternal plate VIII of male large, broad, unmodified.

Juxtapulex Wagner was established for two North American species, the type species and *Pulex porcinus* Jordan and Rothschild. As pointed out by Wagner, the genus, through the characters of its type species, shows a decided affinity with *Echidnophaga* Olliff.

JUXTAPULEX ECHIDNOPHAGOIDES Wagner

Juxtapulex echidnophagoides Wagner, 1933, Berlin Zool. Mus. Mitt. 18: 343, fig. 1A and figs. 2-6.

Type host.—“*Dasypus novemcinctus*” (nine-banded armadillo).

Type locality.—East of Cartago, Costa Rica.

Range.—Known only from Costa Rica.

The original description of this species is extensive and accompanied with six detail drawings. *Juxtapulex echidnophagoides* is easily distinguished from *J. porcinus* (Jordan and Rothschild) because of the angulate front margin of its head. This margin in *porcinus* is broadly rounded as in most fleas.

JUXTAPULEX PORCINUS (Jordan and Rothschild)

(Fig. 12, B)

Pulex porcinus Jordan and Rothschild, 1923, Ectoparasites 1: 312, figs. 315-317.
Juxtapulex porcinus Wagner, 1933, Berlin Zool. Mus. Mitt. 18: 341.

Type host.—*Tayassu* sp. (white-lipped peccary).

Type locality.—Texas.

Range.—Known only from Texas.

This species is easily distinguished from its congener by the shape of the front margin of the head, which is broadly rounded instead of angulate. *Juxtapulex porcinus* is of particular interest because of the nature of the genal comb. This is made up of from two to three short, pale, triangular spines which appear to be true morphological spines, since none of them is provided with a seta pit or a trichopore. The anterior spine of the genal comb, when present, is smaller than the other two. It may be represented by a vestigial spur at the base of the second spine.

The Family STEPHANOCIRCIDAE Wagner

Head divided by fronto-epicranial groove into an anterior and a posterior part. Gena greatly enlarged, being extended dorsally in front of antennal groove and divided by a vertical suture. Forehead with a helmet composed of greatly reduced front and anterior parts of enlarged genae; not elongated and without ventral flaps. Eyes reduced or vestigial. Postantennal region of head with 1 or more transverse, dorsal incassations. Thorax not greatly reduced, thoracic terga taken together longer than tergum I of abdomen. Typical abdominal terga with more than 1 transverse row of setae. Antepygial bristles present. Abdominal apical spines usually present. Abdominal combs present or absent. Females without a reduced number of abdominal spiracles, and when gravid not greatly distended.

This family, as here recognized, is composed of five genera, three of which are Neotropical and two Australian. While members of the family Stephanocircidae exhibit probably the greatest modifications of the head of any group of the fleas, they are in most respects generalized.

The Family HECTOPSYLLIDAE Baker

Head not divided into an anterior and a posterior part by fronto-epicranial groove. Gena not greatly enlarged and not divided by transverse suture. Forehead without helmet, not elongated, and not bearing ventral flaps. Eyes present, pigmented. Both cephalic and pronotal combs absent. Postantennal region without dorsal incassations. Thorax greatly reduced; thoracic terga taken together not so long as tergum I of abdomen. Abdomen almost nude, but some or all of its segments with a single transverse row of small setae. Antepygial bristles absent. Abdominal apical spines and combs absent. Females sometimes with a reduced number of abdominal spiracles. Gravid females greatly distended.

This family is not divided into subfamilies.

Hectopsyllidae was established by Baker (4, p. 375) in 1904 for the single genus *Hectopsylla* Frauenfeld, 1860. As recognized in this work it includes three other known genera, *Echidnophaga* Olliff, *Rhynchopsyllus* Haller, and *Tunga* Jarocki. The following five synonyms of Hectopsyllidae are known: *Sarcopsyllidae* Taschenberg, 1880, based on *Sarcopsylla* Westwood, 1840, = *Tunga* Jarocki,

1838; Rhynchoprionidae Baker, 1906, based on *Rhynchoprion* Oken, 1815, = *Tunga* Jarocki, 1838; Hectoropsyllidae Oudemans, 1906, based on *Hectoropsyllus* Oudemans, 1906, = *Hectopsylla* Frauenfeldt, 1860; Dermatophilidae Oudemans, 1906, based on *Dermatophilus* Guérin, 1839, = *Tunga* Jarocki, 1838; and Tungidae, apparently first used by C. Fox (23, p. 130) in 1925 and based on *Tunga*.

KEY TO THE NORTH AMERICAN GENERA OF HECTOPSYLLIDAE

Coxa III with a patch of spinelets on inner surface; abdominal segments II and III each with a pair of spiracles. Occurring chiefly in tropical and subtropical regions of the World

Echidnophaga Olliff.

Coxa III without a patch of spinelets; abdominal segments II and III of female without spiracles. Restricted to the warmer regions of Asia and Africa and to tropical America

Tunga Jarocki.

The Genus ECHIDNOPHAGA Olliff

(Fig. 13, C)

Echidnophaga Olliff, 1886, Linn. Soc. N. S. Wales, Proc. (2) 1: 171. Monotypic.

Type, *Echidnophaga ambulans* Olliff.

Argopsylla Enderlein, 1903, Deutsches Tief—See Exped. 1898–99, v. 3, p. 263.

Monotypic. Type, *Sarcopsylla gallinacea* Westwood.

Xestopsylla Baker, 1904, U. S. Natl. Mus. Proc. 27: 373. Monotypic. Type, *Sarcopsylla gallinacea* Westwood.

Front angulate along anterior margin, but not produced into a tubercle. Maxilla triangular, sharply pointed at apex, and largely concealed within head. Labial palpus very poorly pigmented and sclerotized, indistinctly segmented, and closely ensheathing the large mandibles. Eyes large, black, without anterior marginal incision. Hind coxa with a patch of spinelets on inner surface. Femur III without toothlike projection at its base. Plantar bristles on segment V of each tarsus of the usual kind, being short, well pigmented, and composing 4 pairs. Abdominal segments II and III each with a pair of spiracles. Sternum VIII of male enlarged, broad, without long setae and posterior lobes, and completely overlapping sternum IX. Sternum IX of male with conspicuous anterior apophysis, a pair of inner vertical processes, and a pair of simple, slender, curved, posterior processes.

Type species.—A monotypic genus with *Echidnophaga ambulans* Olliff as type.

ECHIDNOPHAGA GALLINACEA (Westwood)

(Fig. 13, C)

Sarcopsyllus gallinaceus Westwood, 1875, Ent. Monthly Mag. 11: 246.

Pulex pullulorum Johnson, 1890, Wash. Ent. Soc. Proc. 1: 204.

Echidnophaga gallinacea Jordan and Rothschild, 1906, Liverpool Univ., Thompson Yates and Johnson Lab. Rpts. (n. s.) 7: 52.

Type host.—"Domestic fowl."

Type locality.—Columbo, Ceylon.

Range.—Widely distributed in the tropical and subtropical regions of the world, including Australia. In North America found throughout the southern part of the United States and permanently established as far north as Virginia and Kansas. Occasionally introduced into the Northern States but not known to be established there. In North Carolina Shaftesbury (69) examined 38 collections of this flea taken from 39 counties and found that its distribution approximated the extent of the Lower Austral Life Zone.

Trembley and Bishopp (76) have summarized their United States records for *Echidnophaga gallinacea*, listing this flea from 22 States and citing numerous hosts.

Echidnophaga gallinacea, known as the sticktight flea, occurs on many wild hosts and undoubtedly is yearly carried in large numbers outside of its normal range. Its dispersal because of this fact has been discussed by Stewart (73).

This flea, in the adult stage, attaches firmly to its host and engorges with blood. The females, as a rule, do not change their position of attachment, but according to Illingworth (32) the "males move about during the night, being attached in different positions each morning * * *."

Many kinds of warm-blooded vertebrates are attacked by *Echidnophaga gallinacea*. It has been reported from a considerable number of our wild birds and is a serious pest of poultry in the South, where chickens frequently have dark flea-covered patches about the eyes, comb, or wattles. Dogs and cats, as well as man himself, are attacked. Rats, as hosts to this pest, play an important part in its distribution, although the fleas are not very abundant on these rodents. According to C. Fox and Sullivan (24, p. 1923), out of 3,928 fleas taken in a rat-flea survey of New Orleans in 1922-23, only 12 specimens were *E. gallinacea*.

The life history of this species has been worked out by Parman (62). He found that the incubation period lasted from 4 to 14 days, the larval period from 14 to 31 days, and the pupal period from 9 to 19 days. The females became engorged and oviposition began in from 6 to 10 days after attachment. Adults were killed by freezing temperature and could not endure an incubator temperature of 100° F.

The Genus *TUNGA* Jarocki

(Fig. 13, B, D)

Tunga Jarocki, 1838, Zoology or General Description of Animals, p. 50.

Monotypic. Type, *Pulex penetrans* Linnaeus.

Front produced into an angular tubercle along anterior margin. Maxilla greatly reduced, narrowly rounded at apex, and entirely concealed within head. Labrum, as well as mandibles, large. Labial palpus very weak, poorly pigmented, with indistinct segmentation, and practically devoid of setae. Eye large, black. Hind coxa without a patch of spineless on inner surface. Femur III without toothlike projection at its base. Plantar bristles on segment V of each tarsus slender, not darker than other setae on tarsi. Abdominal segments II and III of female without spiracles. Sternum VIII of male enlarged, very broad, without long setae. Clasper slender; process similar in size and shape to movable finger and forming with the latter a pair of forceps. Penis complicated, consisting of a basal or anterior part hinged to a distal or posterior part; anterior part composed of a dorsal, pellicellate, basal plate, arising from segments I and II of abdomen, and a ventral, elbowed part attached to distal part by a strong ligament; posterior part of penis bearing distally a pair of slender, forked, almost straight parameres and a somewhat longer, unpaired, slender process. Female with a spherical receptaculum seminis, situated in posteroventral region of abdomen.

Tunga has the following synonyms: *Dermatophilus* Guérin, 1839; *Dermatophylus* Lucas, 1839; *Rhynchoprion* Oken, 1815 (not Hermann, 1804); *Sarcophaga* Westwood, 1836 (not Meigen, 1826); *Sarcopsylla* Westwood, 1840 (proposed to replace *Sarcophaga* Westwood); and *Sarcopsyllus* Kolenati, 1857.

Besides the type species, which is restricted to the tropical regions of Africa and the New World, five other species of *Tunga* are known, including *Tunga caecatus* Enderlein, which is found in Brazil, and *T. caecigena* Jordan and Rothschild, which has been taken from the ears of sewer rats in China.

TUNGA PENETRANS (Linnaeus)

(Fig. 13, B, D)

Pulex penetrans L., 1758, Systema Naturae, ed. 10, p. 614.

Type host.—Man

Type locality.—"America."

Range.—Widely distributed in the tropical regions of America and Africa. Although reported from Florida, Louisiana, and Texas, it probably is not permanently established in the United States.

This species is known as the jigger, the sand flea, or the chigoe. Also it has been termed the chigger, but incorrectly so, as this last term is more appropriately applied to the larvae of mites of the subfamily Trombiculinae which parasitize vertebrates.

L. C. Johnson (38, p. 203) sent a note to the Entomological Society of Washington in 1889 reporting the occurrence of a flea in Florida on chickens, turkeys, etc., with habits somewhat similar to those of *Tunga penetrans*. Unfortunately he referred to this flea as the jigger flea, a name which should have been reserved for *T. penetrans*. His flea, which he named *Pulex pullulorum*, proved to be a synonym of *Echidnophaga gallinacea* (Westwood).

Faust and Maxwell (20), in 1930, reported an unusual case of the infestation, by the larvae of *Tunga penetrans*, of the skin of the pubic and inguinal regions of a man in New Orleans. The source of infestation appeared to be sisal hemp from Yucatan, since the patient gave a history of having sat on piles of this hemp as the cargo was being checked.

The life history of *Tunga penetrans* is rather remarkable, since the fertilized female actually burrows into the skin of the host. Here her engorgement with blood and the development of many eggs brings about a great enlargement of the abdomen. This distension may increase until the abdomen is spherical in shape and many times its original size. The dilation of the abdomen takes place entirely through the stretching of the intersegmental membrane between the second and third abdominal segments. According to Hicks (28) eggs hatch in from 3 to 4 days, while the entire life cycle is about 17 days.

In the case of man the favorite points of attack by this flea are between the toes and under the toe nails. Here the enlarging females cause intense itching and inflammation and produce swellings and ulceration. Finally secondary infection may result in tetanus or gangrene. In addition to man, many of his domestic animals are attacked. One of the writers (Ewing) identified specimens of this flea (including eggs) taken from an adult male gorilla at Djaposten, Africa, by H. Raven, February 1920. He also extracted many eggs of *penetrans* from a lump of skin of a baby gorilla taken in the Belgian Congo by Benjamin Burbridge in 1923.

According to Dalla Torre (10, p. 21) this species has as a synonym *Sarcopsyllus canis* Westwood, described in 1840 (19, p. 203).

LIST OF SYNONYMS OF NORTH AMERICAN SPECIES OF SIPHONAPTERA

(Synonyms are in italics, valid names in Roman)

- Amphipsylla hadweni* Ewing, 1927=*Mioctenopsylla arctica* Rothschild, 1922.
Anomiopsyllus californicus Baker, 1904=*Anomiopsyllus nudatus* (Baker), 1898.
Ceratophyllus acasti Rothschild, 1905=*Opisodasys pseudarctomys* (Baker), 1904.
Ceratophyllus acutus Baker, 1904=*Oropsylla* (Diamanus) *montana* Baker, 1895.
Ceratophyllus aeger Rothschild, 1905=*Orchopeas leucopus* (Baker), 1904.
Ceratophyllus bertholfi C. Fox, 1927=*Oropsylla idahoensis* (Baker), 1904.
Ceratophyllus caedens durus Jordan, 1929=*Orchopeas caedens* (Jordan), 1925.
Ceratophyllus californicus Baker, 1904=*Nosopsyllus fasciatus* (Bosc), 1801.
Ceratophyllus canadensis Baker, 1904=*Nosopsyllus fasciatus* (Bosc), 1801.
Ceratophyllus citelli Stewart, 1928=*Thrassis fatus* (Jordan), 1925.
Ceratophyllus gibsoni C. Fox, 1914=*Ceratophyllus gallinae* (Schränk), 1803.
Ceratophyllus isus Jordan, 1925=*Malaraeus bitterrootensis* (Dunn), 1923.
Ceratophyllus italicus Tiraboschi, 1904=*Nosopsyllus londiniensis* (Rothschild), 1903.
Ceratophyllus lucidus Baker, 1904=*Trichopsylla vison* (Baker), 1904.
Ceratophyllus niger inflexus Jordan, 1929=*Ceratophyllus niger* C. Fox, 1908.
Ceratophyllus oculus Baker, 1904=*Nosopsyllus fasciatus* (Bosc), 1801.
Ceratophyllus peromysci Stewart, 1928=*Trichopsylla wagneri wagneri* (Baker), 1904.
Ceratophyllus ponus Rothschild, 1909=*Odontopsyllus dentatus* (Baker), 1904.
Ceratophyllus pocantis Rothschild, 1905=*Oropsylla idahoensis* (Baker), 1904.
Ceratophyllus proximus Baker, 1904=*Thrassis arizonensis* (Baker), 1898.
Ceratophyllus rileyi Lin, 1935=*Ceratophyllus diffinis* Jordan, 1925.
Ceratophyllus utahensis Chapin, 1919=*Ceratophyllus garei* Rothschild, 1902.
Ceratophyllus crosbyi Baker, 1905=*Myodopsylla insignis* (Rothschild), 1903.
Corypsyllioides spinata I. Fox, 1940=*Corypsyllioides kohlsi* (Hubbard), 1940.
Ctenopsyllus hygini Rothschild, 1904=*Nearctopsylla genalis genalis* (Baker), 1904.
Hoplopsyllus minutus C. Fox, 1926=*Hoplopsyllus* (*Euhoplopsyllus*) *glacialis foxi* Ewing, 1924.
Hoplopsyllus powersi C. Fox, 1926=*Hoplopsyllus* (*Euhoplopsyllus*) *glacialis foxi* Ewing, 1924.
Micropsylla peromyscus Dunn, November 23, 1923=*Micropsylla sectilis* (Jordan and Rothschild), November 10, 1923.
Neopsylla hamiltoni Dunn, 1923=*Rectofrontia fraterna* (Baker), 1895.
Neopsylla similis Chapin, 1919=*Epitedia wenmanni* (Rothschild), 1904.
Neopsylla striata Stewart, 1926=*Tamiochloa grandis* (Rothschild), 1902.
Opisodasys spatiosus I. Fox, 1940=*Opisodasys robustus* (Jordan), 1925.
Peromyscopsylla spinifrons I. Fox, 1939=*Peromyscopsylla hesperomys* (Baker), 1904.
Pulex gillettei Baker, 1895=*Orchopeas howardii* (Baker), 1895.
Pulex longispinus Baker, 1895=*Megarhthroglossus divisus divisus* (Baker), 1904.
Pulex musculi Dugès, 1832=*Leptopsylla segnis* (Schönherr), 1811.
Pulex pullulorum Johnson, 1890=*Echidnophaga gallinacea* (Westwood), 1875.
Pulex serraticeps Gervais, 1844=*Ctenocephalides canis* (Curtis), 1826.
Pulex simulans Baker, 1895=*Pulex irritans irritans* Linnaeus, 1758.
Pulex wickhami Baker, 1895=*Orchopeas howardii* (Baker), 1895.
Sarcopsyllus canis Westwood, 1840=*Tunga penetrans* (Linnaeus), 1758.
Stenoponia wetmorei Chapin, 1919=*Stenoponia americana* (Baker), 1899.
Typhlopsylla americana Baker, 1895=*Dactylopsylla ignota ignota* (Baker), 1895.
Typhlopsylla mexicana (Baker), 1896=*Leptopsylla segnis* (Schönherr), 1811.

LITERATURE CITED

- (1) BACOT, A.
1914. A STUDY OF THE BIONOMICS OF THE COMMON RAT FLEAS AND OTHER SPECIES ASSOCIATED WITH HUMAN HABITATIONS . . . Jour. Hyg. [London], Plague Sup. 3: 447-654, illus.
- (2) BAKER, C. F.
1895. PRELIMINARY STUDIES IN SIPHONAPTERA.—III, IV, V, VI. Canad. Ent. 27: 108-112, 130-132, 162-164, 186-191.
- (3) ———
1899. ON TWO NEW AND ONE PREVIOUSLY KNOWN FLEA. Ent. News 10: 37-38.
- (4) ———
1904. A REVISION OF AMERICAN SIPHONAPTERA, OR FLEAS, TOGETHER WITH A COMPLETE LIST AND BIBLIOGRAPHY OF THE GROUP. U. S. Natl. Mus. Proc. 27: 365-469, illus.
- (5) ———
1905. THE CLASSIFICATION OF THE AMERICAN SIPHONAPTERA. U. S. Natl. Mus. Proc. 29: 121-170.
- (6) COLLINS, B. J.
1936. A NEW SPECIES OF ANOMIOPSYLLUS FROM MONTANA (SIPHONAPTERA). Ent. News 47: 128-130, illus.
- (7) CRAMPTON, G. C.
1931. A PHYLOGENETIC STUDY OF THE POSTERIOR METATHORACIC AND BASAL ABDOMINAL STRUCTURES OF INSECTS, WITH PARTICULAR REFERENCE TO THE HOLOMETABOLA. N. Y. Ent. Soc. Jour. 39: 323-357, illus.
- (8) CUNHA, R. DE A.
1914. CONTRIBUICAO PARA O ESTUDO DOS SIFONAPTEROS DO BRASIL. Inst. Oswaldo Cruz, Trabalho, 212 pp., illus. [Tese inaugural.]
- (9) DAHL, F.
1898. DEN FLOH UND SEINE STELLUNG IM SYSTEM. [Berlin] Gesell. Naturf. Freunde Sitzber. (1898) 10: [185]-199, illus.
- (10) DALLA TORRE, C. G.
1924. APHANIPTERA ORBIS TERRARUM. Naturw.-Med. Ver. Innsbruck Ber., Abhandl. B, 39: [1]-29.
- (11) DAMPF, A.
1908. SYSTEMATISCHE ÜBERSICHT DER FLÖHE (APHANIPTERA S. SIPHONAPTERA) OST-UND WESTPREUSSENS. Phys. Ökonom. Gesel. Königsberg Schr. 49 (1): [13]-50, illus.
- (12) DUNN, L. H., and PARKER, R. R.
1923. FLEAS FOUND ON WILD ANIMALS IN THE BITTERROOT VALLEY, MONT. U. S. Pub. Health Serv. Rpts. 38 (47): 2763-2775.
- (13) EIDMANN, H.
1935. ZUR KENNTNIS DER INSEKTENFAUNA VON SÜDLABRADOR. Arb. über Morph. u. Taxonom. Ent. 2: [81]-105.
- (14) EWING, H. E.
1913. SOME EXTERNAL PARASITES OF POULTRY. Oreg. Agr. Col. Bul. 92, 16 pp., illus.
- (15) ———
1924. NOTES ON THE TAXONOMY AND NATURAL RELATIONSHIPS OF FLEAS, WITH DESCRIPTIONS OF FOUR NEW SPECIES. Parasitology 16: 341-354, illus.
- (16) ———
1929. A MANUAL OF EXTERNAL PARASITES. 225 pp., illus. Springfield, Ill., and Baltimore, Md.
- (17) ———
1929. NOTES ON THE SIPHONAPTERAN GENUS CATALLAGIA ROTHSCILD, INCLUDING THE DESCRIPTION OF A NEW SPECIES. Wash. Biol. Soc. Proc. 42: 125-127.

- (18) EWING, H. E.
1931. SOME FACTORS AFFECTING THE DISTRIBUTION OF AND VARIATION IN NORTH AMERICAN ECTOPARASITES. *Amer. Nat.* 65: 360-369, illus.
- (19) EWING, H. E., and FOX, I.
1938. OCCURRENCE OF THE ORIENTAL RAT FLEA IN THE INTERIOR OF THE UNITED STATES. *Science* 88: 427.
- (20) FAUST, E. C., and MAXWELL, T. A.
1930. THE FINDING OF THE LARVAE OF THE CHIGO, TUNGA PENETRANS, IN SCRAPINGS FROM HUMAN SKIN. *Arch. Dermat. and Syph.* 22: [94]-97, illus.
- (21) FOX, C.
1909. A REPORT ON THE SPECIES OF THE SIPHONAPTERA FOUND WITHIN THE BOUNDARIES OF THE CITY AND COUNTY OF SAN FRANCISCO, CAL. *Ent. News* 20: 10-11.
- (22) ———
1909. A NEW SPECIES OF DOLICHOPSYLLUS—A GENUS OF THE SIPHONAPTERA. *Ent. News* 20: 195-196.
- (23) ———
1925. INSECTS AND DISEASE OF MAN. 349 pp., illus. Philadelphia.
- (24) FOX, C., and SULLIVAN, E. C.
1925. A COMPARATIVE STUDY OF RAT-FLEA DATA FOR SEVERAL SEAPORTS OF THE UNITED STATES. *U. S. Pub. Health Serv. Rpts.* 40: 1909-1934, illus.
- (25) FOX, I.
1940. FLEAS OF EASTERN UNITED STATES. 191 pp., illus. Ames, Iowa.
- (26) ———
1940. NOTES ON NORTH AMERICAN DOLICHOPSYLLID SIPHONAPTERA. *Wash. Ent. Soc. Proc.* 42: 64-68, 69, illus.
- (27) GUIMARÃES, L. R.
1941. NOTAS SOBRE SIPHONAPTERA E REDESCRIÇÃO DE POLYGENIS OCCIDENTALIS (ALMEIDA CUNHA, 1914). *Arq. de Zool. Estado de São Paulo* 2: 215-250, illus.
- (28) HICKS, E. P.
1930. THE EARLY STAGES OF THE JIGGER, TUNGA PENETRANS. *Ann. Trop. Med. and Parasitol.* 24: 575-586, illus.
- (29) HOLLAND, G. P.
1940. NEW RECORDS OF SIPHONAPTERA FROM BRITISH COLUMBIA. *Ent. Soc. Brit. Columbia Proc.* (1939) 36: 11-12.
- (30) HUBBARD, C. A.
1940. WEST COAST CRESTED FLEAS CORYPSYLLA AND NEARCTOPSYLLA. *Pacific Univ. Bul.* 37 (1), [12] pp., illus.
- (31) ———
1940. WEST COAST CATALLAGIAS. *Pacific Univ. Bul.* 37 (3), [4] pp., illus.
- (32) ILLINGWORTH, J. F.
1916. NOTES ON THE HEN FLEA ("ECHIDNOPHAGA GALLINACEA" WESTW.). *Hawaii. Ent. Soc. Proc.* (1915) 3: 252-254.
- (33) IOFF, I.
1937. ZUR SYSTEMATIK DER FLÖHE AUS DER UNTERFAMILIE CERATOPHYLLINAE. *Ztschr. f. Parasitenk.* 9: [73]-124, illus.
- (34) JELLISON, W. L.
1939. SYLVATIC PLAGUE: STUDIES OF PREDATORY AND SCAVENGER BIRDS IN RELATION TO ITS EPIDEMIOLOGY. *U. S. Pub. Health Serv. Rpts.* 54: 792-798.
- (35) ———
1939. NOTES ON THE FLEAS OF PRAIRIE DOGS, WITH THE DESCRIPTION OF A NEW SUBSPECIES. *U. S. Pub. Health Serv. Rpts.* 54: 840-844, illus.
- (36) ———
1940. SIPHONAPTERA: NOTES ON TWO CALIFORNIA SPECIES. *U. S. Pub. Health Serv. Rpts.* 55: 489-492, illus.
- (37) ——— and KOHLS, G. M.
1939. SIPHONAPTERA: A LIST OF ALASKAN FLEAS. *U. S. Pub. Health Serv. Rpts.* 54: 2020-2023.
- (38) JOHNSON, L. C.
1890. THE JIGGER FLEA OF FLORIDA. *Wash. Ent. Soc. Proc.* 1: 203-205.
- (39) JORDAN, K.
1926. ON XENOPSYLLA AND ALLIED GENERA OF SIPHONAPTERA. *3d Internatl. Ent. Kong. Verhandl.* (1925) 2: [593]-627, illus.

- (40) JORDAN, K.
1929. NOTES ON NORTH AMERICAN FLEAS. *Novitates Zool.* 35: 28-39.
- (41) ———
1929. ON A SMALL COLLECTION OF SIPHONAPTERA FROM THE ADIRONDACKS, WITH A LIST OF THE SPECIES KNOWN FROM THE STATE OF NEW YORK. *Novitates Zool.* 35: 168-177.
- (42) ———
1932. NOTES ON SIPHONAPTERA. *Novitates Zool.* 38: 291-294.
- (43) ———
1933. A SURVEY OF THE CLASSIFICATION OF THE AMERICAN SPECIES OF CERATOPHYLLUS S. LAT. *Novitates Zool.* 39: 70-79.
- (44) ———
1937. ON SOME NORTH AMERICAN SIPHONAPTERA. *Novitates Zool.* 40: 262-271, illus.
- (45) ———
1939. ON SOME NEARCTIC FLEAS. *Novitates Zool.* 41: 316-320, illus.
- (46) ———
1939. ON RHOPALOPSYLLUS BAKER 1905 (SIPHONAPTERA). *Novitates Zool.* 41: 443-448, illus.
- (47) ——— and ROTHSCILD, N. C.
1908. REVISION OF THE NON-COMBED EYED SIPHONAPTERA. *Parasitology* 1: 1-100, illus.
- (48) ——— and ROTHSCILD, N. C.
1911. KATALOG DER SIPHONAPTEREN DES KÖNIGLICHEN ZOOLOGISCHEN MUSEUMS IN BERLIN. *Novitates Zool.* 18: 57-89, illus.
- (49) ——— and ROTHSCILD, N. C.
1915. CONTRIBUTION TO OUR KNOWLEDGE OF AMERICAN SIPHONAPTERA. *Ectoparasites* 1: 45-60, illus.
- (50) ——— and ROTHSCILD, N. C.
1920. ON THE SPECIES AND GENERA OF SIPHONAPTERA DESCRIBED BY KOLENATI. *Ectoparasites* 1: 61-64.
- (51) ——— and ROTHSCILD, N. C.
1921. NEW GENERA AND SPECIES OF BAT-FLEAS. *Ectoparasites* 1: 142-162, illus.
- (52) ——— and ROTHSCILD, N. C.
1922. NEW SIPHONAPTERA. *Ectoparasites* 1: 266-283, illus.
- (53) KESSEL, E. L.
1939. THE EMBRYOLOGY OF FLEAS. *Smithsn. Inst. Misc. Collect.* 98 (3): 1-78, illus.
- (54) KOHLS, G. M.
1939. SIPHONAPTERA: NOTES ON SYNONYMY OF NORTH AMERICAN SPECIES OF THE GENUS HOPLOPSYLLUS BAKER. *U. S. Pub. Health Serv. Rpts.* 54: 2019-2020.
- (55) KOLENATI, F. A.
1856. DIE PARASITEN DER CHIROPTERN. 51 pp.
- (56) MARTINI, E.
1922. DIE EIDONOMIE DER FLÖHE, ALS BEWEIS FÜR IHRE STAMMESGESCHICHTLICHE HERKUNFT. *Centbl. f. Bakt. [etc.] Originale* (I) 88: 205-221, illus.
- (57) MEINERT, F.
1895. PULCIDÆ DANICÆ (DE DANSKE LOPPER). *Ent. Meddel. (ser. 1)* 5: [183]-192.
- (58) OUDEMANS, A. C.
1909. AANTEKENINGEN OVER SUCTORIA XIII. *Ent. Ber.* 2: 321-329.
- (59) ———
1909. NEUE ANSICHTEN ÜBER DIE MORPHOLOGIE DES FLOHKOPFES, SOWIE ÜBER DIE ONTOGENIE, PHYLOGENIE UND SYSTEMATIK DER FLÖHE. *Novitates Zool.* 16: 133-158, illus.
- (60) OWEN, W. B.
1936. AN INFESTATION BY THE ORIENTAL RAT FLEA, XENOPSYLLA CHEOPIS ROTHSCILD, IN MINNESOTA. (Research note) *Jour. Parasitol.* 22: 512-513.
- (61) PACKARD, A. S.
1894. ON THE SYSTEMATIC POSITION OF THE SIPHONAPTERA, WITH NOTES ON THEIR STRUCTURE. *Boston Soc. Nat. Hist. Proc.* 26: 312-355, illus.

- (62) **PARMAN, D. C.**
1923. BIOLOGICAL NOTES ON THE HEN FLEA, ECHIDNOPHAGA GALLINACEA. Jour. Agr. Res. 23: 1007-1009.
- (63) **PINTO, C.**
1931. CARACTERISTICAS MORFOLOGICAS DA LARVA DE CTENOCEPHALIDES FELIS (BOUCHÉ, 1835). Bol. Biol. 18: 28-34, illus.
- (64) **ROTHSCHILD, N. C.**
1911. ON A NEW GENUS AND SPECIES OF SIPHONAPTERA FROM NYASALAND. Bul. Ent. Res. 2: 269-272, illus.
- (65) ———
1914. ON THREE SPECIES OF XENOPSYLLA OCCURRING ON RATS IN INDIA. Bul. Ent. Res. 5: 83-85, illus.
- (66) ———
1915. A SYNOPSIS OF THE BRITISH SIPHONAPTERA. Ent. Monthly Mag. 51: 49-112, illus.
- (67) **ROUDABUSH, R. L.**
1939. SURVIVAL OF THE TROPICAL RAT FLEA IN UNITED STATES. Science 89: 79-80.
- (68) ——— and **BECKER, E. R.**
1934. THE TROPICAL RAT FLEA IN THE INTERIOR OF THE UNITED STATES. Science 80: 97.
- (69) **SHAFTESBURY, A. D.**
1934. THE SIPHONAPTERA (FLEAS) OF NORTH CAROLINA, WITH SPECIAL REFERENCE TO SEX RATIOS. Elisha Mitchell Sci. Soc. Jour. 49: 247-263, illus.
- (70) **SIKES, E. K.**
1930. LARVAE OF CERATOPHYLLUS WICKHAMII AND OTHER SPECIES OF FLEAS. Parasitology 22: 242-259, illus.
- (71) **STEPHENS, J. F.**
1829. A SYSTEMATIC CATALOGUE OF BRITISH INSECTS. Pt. 2, 388 pp. London.
- (72) **STEWART, M. A.**
1928. SIPHONAPTERA. In Leonard, M. D. A List of the Insects of New York. N. Y. (Cornell) Agr. Expt. Sta. Mem. 101: 868-869.
- (73) ———
1932. DISPERSAL OF THE STICKTIGHT FLEA OF HENS (ECHIDNOPHAGA GALLINACEA WESTW.). Jour. Econ. Ent. 25: 164-166.
- (74) **TILLYARD, R. J.**
1935. THE EVOLUTION OF THE SCORPION-FLIES AND THEIR DERIVATIVES. Ent. Soc. Amer. Ann. 28: 1-45, illus.
- (75) **TIRABOSCHI, C.**
1904. LES RATS, LES SOURIS ET LEURS PARASITES CUTANÉES, DANS LEURS RAPPORTS AVEC LA PROPAGATION DE LA PESTE BUBONIQUE. Arch. de Parasitol. 8: [161]-349, illus.
- (76) **TREMBLEY, H. L., and BISHOPP, F. C.**
1940. DISTRIBUTION AND HOSTS OF SOME FLEAS OF ECONOMIC IMPORTANCE. (Scientific Note) Jour. Econ. Ent. 33: 701-703.
- (77) **WAGNER, J.**
1889. APHANIPTEROLOGISCHE STUDIEN. I. ANATOMIE DER VERMIPSYLLA ALACURT SCHIMK. Soc. Ent. Rossica Horae 23: [199]-261, illus.
- (78) ———
1893. APHANIPTEROLOGISCHE STUDIEN. II. DREI NEUE PULICIDEN, NEBST BEMERKUNG ÜBER DIE GATTUNG TYPHLOPSYLLA TASCH. Soc. Ent. Rossica Horae 27: [347]-358, illus.
- (79) ———
1903. APHANIPTEROLOGISCHE STUDIEN. V. ÜBER DEN GEGENSEITIGEN BEZUG DER GRUPPEN-APHANIPTERA UND DER SÄUGETIERE UND ÜBER DIE EINTEILUNG DER GATTUNG TYPHLOPSYLLA TASCH. Soc. Ent. Rossica Horae 36: [125]-156, illus.
- (80) ———
1930. KATALOG DER PALAEARKTISCHEN APHANIPTEREN. 55 pp. Wien.
- (81) ———
1932. ZUR MORPHOLOGIE DER LETZTEN ABDOMINALSEGMENTE DER FLÖHE. Zool. Jahrb., Abt. f. Anat. u. Ontog. Tiere 56: [54]-120, illus.
- (82) ———
1934. APHANIPTEROLOGISCHE NOTIZEN. III. EIN FALL DER MORPHOSE BEIM FLOH DER HAUSMAUS (CTENOPSYLLUS SEGNI). Konowia 13: [253]-259, illus.

- (83) WAGNER, J.
1936. EINIGE NEUE ODER WENIG BEKANNTE FLOHARTEN. Ztschr. f. Parasitenk. 8: [332]-350, illus.
- (84) ———
1936. THE FLEAS OF BRITISH COLUMBIA. Canad. Ent. 68: 193-207, illus.
- (85) ———
[1936.] ORDNUNG: FLÖHE, APHANIPTERA (SIPHONÁPTERA, SUCTÓRIA). Tierwelt Mitteleuropas. Bd. 6, Lief. 2, Teil 3, 24 pp., illus.
- (86) ———
1939. ORDNUNG: APHANIPTERA KIRBY & SPENCE 1818. Bronn's Klassen u. Ordnungen des Tierreichs, B. 5, Abt. 3, Buch 13, Teil f., S. 1-114, illus.
- (87) WAHLGREN, E.
1907. SVENSKA SIPHONAPTERA. Ent. Tidskr. 28: [85]-91, illus.
- (88) WALLACE, F. N.
1925. REPORT OF THE DIVISION OF ENTOMOLOGY. Ind. Dept. Conserv. Ann. Rpt. (1924) 6: 28-50.
- (89) WATERSTON, J.
1929. ON A CHALCIDOID PARASITE BREED FROM A FLEA LARVA. Parasitology 21: 103-106, illus.
- (90) ———
1937. FLEAS AS A MENACE TO MAN AND DOMESTIC ANIMALS. Brit. Mus. Nat. Hist. Econ. Ser. 3, 20 pp., illus.
- (91) WESTWOOD, J. O.
1840. ON THE CHARACTERS OF THE CHIGOE OR JIGGER. Ent. Soc. London. Trans. (1) 2: 199-203.

ILLUSTRATIONS

(Figs. 4-13)

FIGURE 4.—Side view of heads: A, *Trichopsylloides oregonensis*, male; B, *Rhopalopsyllus gwyni*, male; C, *Conorhinopsylla stanfordi*, male; D, *Arctopsylla ursti*, male; E, *Chaetopsylla lotoris*, female.

FIGURE 5.—A, head of *Dactylopsylla bluei*, male; B, head of *Mioctenopsylla arctica*, female; C, head of *Catallagia charlottensis*, female; D, fifth tarsal segment of leg II of *Dasypsyllus gallinulae perpinnatus*; E, antepygidial bristles of *Dolichopsylla stylosa*, male; F, antepygidial bristles of *Dolichopsylla stylosa*, female.

FIGURE 6.—A, head of *Ctenophyllus terribilis*, female; B, tarsus of leg III of *Tarsopsylla coloradensis*; C, tibia of leg III of *Amphipsylla ewingi*; D, head of *Stenistomera alpina*; E, receptacula seminis of *Atyphloceras multidentatus*.

FIGURE 7.—A, movable finger, process of clasper, and sternal plate VIII of *Thrassis acamantis*, male; B, movable finger and process of clasper of *Opisdasys keeni*; C, movable finger and process of clasper of *Orchopeas sexdentatus*; D, head and prothorax of *Oropsylla idahoensis*, male; E, movable finger and process of clasper of *Ceratophyllus garei*.

FIGURE 8.—A, head of *Corypsylla ornata*, male; B, genal comb of *Epitedia wenmanni*, male; C, genal comb of *Corrodopsylla curvata*, male; D, genal comb of *Nearctopsylla genalis*, male; E, genal comb of *Peromyscopsylla hesperomys*; F, head of *Sternopsylla carlsbadensis*, female; G, genal comb of *Leptopsylla segnis*; H, genal comb of *Doratopsylla blarinae*, male.

FIGURE 9.—A, labial palpus of *Stenoponia americana*, female; B, genal ctenidium of *Ctenophthalmus pseudagyrtis*, male; C, head of *Paratyphloceras oregonensis*, female; D, metathorax of *Rectofrontia fraterna*, female; E, metathorax of *Micropsylla sectilis*.

FIGURE 10.—A, head of *Carteretta carteri*, male; B, fifth tarsal segment of leg III of *Tamiophila grandis*; C, head of *Meringis dipodomys*; D, head of *Actenophthalmus heiseri*, female; E, fifth tarsal segment of leg III of *Actenophthalmus heiseri*, female; F, head of *Hystrihopsylla pigas dippei*, female.

FIGURE 11.—A, combs of *Eptesocopsylla chapini*, female; B, genitalia of *Myodopsylla collinsi*, male; C, combs of *Myodopsylla insignis*, female; D, head of *Sternopsylla texana*, male; E, head of *Myodopsylla collinsi*, female.

FIGURE 12.—A, head of *Pulex irritans dugesii*, male; B, head of *Jurtapulex porcinus*; C, genitalia of *Hoplopsyllus (Hoplopsyllus) anomalus*, male; D, fifth tarsal joint of leg III of *Xenopsylla cheopis*, male; E, coxa III of *Anomiosyllus falsicalifornicus*, female; F, head, prothorax, and mesothorax of *Ctenocephalides canis*, male; G, coxa III of *Xenopsylla cheopis*, male.

FIGURE 13.—A, head of *Megarthroglossus divisus divisus*, female; B, coxa III of *Tunga penetrans*, female; C, coxa III of *Echidnophaga gallinacea*, male; D, head of *Tunga penetrans*, male; E, head of *Cediopsylla (Acediopsylla) inaequalis*, male.

TAXONOMIC INDEX

(Valid names are in Roman, synonyms are in italics)

- abantis, 57.
- acamantis, 44, 45, 47, 48, 132.
- acasti*, 37, 123.
- Acediopsylla, subgenus of Cediopsylla, 110.
- acerba, 57, 62.
- Actenophthalmus, 5, 75, 79.
- Actenopsylla, 102, 103.
- acutus*, 50, 123.
- adelpa, 90.
- adustus, 67.
- adversa, 57.
- aeger*, 34, 123.
- affinis, 4, 106.
- agilis, subspecies of sexdentatus, 35.
- alaskensis, 49.
- albertensis, variety of ignota, 41, 42.
- allos, 85.
- alpina, 72, 73, 131.
- ambulans, 120.
- americana*, species of subgenus Foxella, 41.
- americana, Stenoponia, 84, 87, 123, 134.
- Amonopsyllus, 56.
- Amphalius, 24, 53.
- amphibolus, 114.
- Amphipsylla, 24, 30.
- anomalus, 105, 106, 137.
- Anomiopsyllinae, 23.
- Anomiopsyllus, 102, 114.
- apachina, variety of ignota, 41, 42.
- Aphaniptera, 14.
- apricus, subspecies of celsus, 68.
- Aptilopsylla*, 97.
- arachis, 86.
- Archiscatopse, 11.
- arctica, 43, 44, 123, 130.
- aretomys, 49, 50.
- Arctopsylla, 16, 17, 18.
- Argopsylla*, 120.
- arizonensis, 45, 46, 123.
- arizonensis, subspecies of arizonensis, 45.
- armatus, 72.
- artius, 38.
- asio, 57, 58.
- asio, subspecies of asio, 57.
- astia, 105.
- atrox, 58, 67.
- Atyphloceras, 24, 38.
- australis, subspecies of australis, 21.
- avium, 69, 70.
- bacchi, 45.
- bahiensis, variety of irritans, 118.
- bakeri, 58.
- bertholfti*, 49, 123.
- bidentatiformis, 77.
- bisetis, 112, 113.
- bishopi, 38.
- bisodontentatus, 82.
- bitterrootensis, 58, 123.
- blarinae, 82, 133.
- bluei, 39, 40, 130.
- bohlsi, 22.
- borealis, Catallagia, 27, 28.
- borealis, Ceratophyllus, 67, 68.
- Boreopsyllus*, 24, 43, 44.
- brasiliensis, 105.
- brooksi, 93, 94.
- bruneri, 51.
- cacicus, 21.
- caducus, subspecies of gladiolis, 46.
- caecatus, 122.
- caecigena, 122.
- caedens, 33, 34, 123.
- californicus*, Anomiopsyllus, 114, 115, 123.
- californicus*, Nosopsyllus, 54, 123.
- Callistopsyllus, 102, 111.
- canadensis*, 54, 123.
- caninum, Dipylidium, 108, 109.
- canis, Ctenocephalides, 4, 6, 107, 108, 109, 123, 137.
- canis*, Tunga, 122, 123.
- carlsbadensis, 97, 98, 133.
- Carteretta, 76, 83.
- carteri, 83, 135.
- cascadensis, subspecies of sexdentatus, 35.
- Catallagia, 23, 26, 28.
- catatina, 91.
- Cediopsylla, 102, 109.
- Cediopsylla, subgenus of Cediopsylla, 109.
- celsus, 68.
- celsus, subspecies of celsus, 68.
- Ceratophyllidae, 15.
- Ceratophyllinae, 15.
- Ceratophyllus, 3, 14, 15, 16, 24, 30, 66, 67.
- Ceratopsyllidae, 96.
- Ceratopsyllus*, 92, 93, 96.
- Chaetopsylla, 16, 17.
- chamberlini, 27.
- chapini, 99, 136.
- charlottensis, 25, 26, 27, 28, 130.
- cheopis, 4, 55, 103, 104, 105, 137.
- Chimaeropsylla, 8, 115.
- Chimaeropsyllinae, 15, 102, 115.
- ciliata, 59.
- ciliata, subspecies of ciliata, 59.
- citelli*, 46, 123.
- clarus, 53.
- Coleoptera, 11, 12.
- collinsi, 100, 101, 136.
- coloradensis, 32, 131.
- comis, 40.
- conepati, 116.
- Conorhinopsylla, 73.
- copa, subspecies of intermedia, 82.
- Corrodopsylla, 76, 80, 81.
- Corypsylla, 90, 95.
- Corypsylloides, 90, 96.
- Craneopsylla, 5.
- Cratynus, 7.
- crooby*, 101, 123.
- cruzi, 81.
- cryptocetes, 20.
- Ctenocephalides, 5, 8, 102, 107.
- Ctenocephalus*, 107.
- Ctenonotus*, 31.
- Ctenophthalminae, 15, 74, 75.
- Ctenophthalmus, 5, 76, 82.
- Ctenophyllus, 24, 72.
- Ctenopsyllidae*, 75, 90.
- Ctenopsyllinae, 90.
- Ctenopsyllus, 90, 92, 93.
- cummingi, 86.
- cuniculi, 115.
- curvata, 80, 81, 133.
- curvata, subspecies of curvata, 81.
- cynomuris, variety of tuberculata, 52.
- cyrtura, subspecies of eumolpi, 60.
- Dactylopsylla, 24, 39, 40, 41, 43.
- Dactylopsylla, subgenus of Dactylopsylla, 40.
- dasychnemus, 81.
- Dasypsyllus, 24, 30.
- decipiens, 27, 28.
- Delotellus, 23, 26, 27.
- dentatus, 25, 26, 123.
- Dermatophilidae*, 120.
- Dermatophilus*, 120, 121.
- Dermatophytus*, 121.
- desertorum, 46.
- deuterus, 111.

- Diamanus*, subgenus of *Oropsylla*, 24, 48, 50.
diasi, 101.
dieteri, 33.
diffinis, 63, 123.
digitalis, 72.
diminuta, *Hymenolepis*, 108.
dipodomys, 86, 135.
dippiei, 88, 89, 135.
Diptera, 11, 12, 13.
dis similis, subspecies of *penicilliger*, 63.
divisus, 112, 113.
divisus, variety of *divisus*, 112, 123, 138.
dolens, 65.
Dolichopsylla, 24, 29, 39.
Dolichopsyllidae, 13, 14, 15, 16, 29, 75, 102.
Dolichopsyllinae, 14, 15, 23.
donovani, *Leishmania*, 108.
Doratomyssa, 76, 80, 81, 82.
dugei, subspecies of *irritans*, 116, 117, 118, 137.
dunni, 22.
durvus, subspecies of *caedens*, 33, 123.
ebrighti, 91.
Echidnophaga, 12, 116, 118, 119, 120.
echidnophagoides, 117, 118.
echis, 38, 39.
enoplus, 36.
Epitedia, 75, 77, 78.
Eptesopsylla, 97, 99.
eremica, 59, 60.
Euhoplosyllus, subgenus of *Hoplosyllus*, 106.
eumolpi, 60, 61, 63.
eumolpi, subspecies of *eumolpi*, 60.
euphorbi, 60.
ewingi, 31, 131.
exilis, 60.
exilis, subspecies of *exilis*, 60.
exoticus, 106.
exsecutus, variety of *divisus*, 112.
faceta, 77.
falsicalifornicus, 114, 115, 137.
fasciatus, 9, 25, 33, 54, 55, 123.
felis, 4, 5, 7, 108, 109.
felix, 39.
floridensis, 17.
fornacis, 61.
fotus, 46, 123.
Foxella, subgenus of *Dactylopsylla*, 24, 40, 41, 43.
foxi, variety of *glacialis*, 107, 123.
Fracticipita, 75.
franciscana, variety of *ignota*, 41, 42.
francisi, 46.
fraterna, 80, 123, 134.
gallinacea, 120, 121, 123, 138.
gallinae, 69, 71, 123.
gallinulae, 30.
garei, 68, 69, 123, 132.
genalis, 94, 133.
genalis, subspecies of *genalis*, 94, 123.
gentilis, 101.
gibsoni, 69, 123.
gigas Baker, syn. of *grandis*, 76.
gigas Kirby, *Hystrichopsylla*, 76, 88.
gigas, subspecies of *gigas* Kirby, 88.
gilletti, 33, 123.
gilvus, 70.
glacialis, 106.
glacialis, variety of *glacialis*, 106, 107.
gladiolis, 46.
gladiolis, subspecies of *gladiolis*, 46, 47.
globeiceps, 17.
grandis, 76, 88, 123, 135.
graphis, 66.
groenlandica, 61.
gwyni, 22, 23, 129.
hadweni, 43, 44, 123.
hamifer, 91.
hamifer, subspecies of *hamifer*, 91.
hiltoni, 80, 123.
Hectopsylla, 116, 119.
Hectopsyllidae, 13, 14, 119.
Hectoropsyllidae, 120.
Hectoropsyllus, 120.
heiseri, 79, 135.
Hemiptera, 10.
hesperomys, 90, 91, 123, 133.
hirsuta, 50, 51.
hirundinis, 66.
homoeus, 16, 17.
Hoplopleura, 73.
Hoplosyllus, 5, 102, 105.
Hoplosyllus, subgenus of *Hoplosyllus*, 105.
howardii, 32, 33, 34, 123.
howelli, 47.
howelli, subspecies of *howelli*, 47.
hubbardi, species of *Meringis*, 86.
hubbardi, species of *Trichopsyllodes*, 19.
hygini, 94, 123.
Hymenoptera, 12.
hyrtaci, 94.
Hystrichopsylla, 84, 85, 88.
Hystrichopsyllidae, 13, 14, 74, 75.
Hystrichopsyllinae, 15, 74, 84.
idahoensis, 49, 123, 132.
idius, 70.
ignota, 41, 42, 43.
ignota, variety of *ignota*, 41, 123.
immitis, species of *Dirofilaria*, 108, 109.
immitis, species of subgenus *Trichopsylla*, 62.
inaequalis, 109, 110, 138.
inaequalis, variety of *inaequalis*, 110.
infantum, *Leishmania*, 108.
inflexus, subspecies of *niger*, 70, 123.
inopina, 78.
insignis, 100, 101, 123, 136.
Integricapita, 75.
Interrupta, variety of *inaequalis*, 111.
Intuberata, 89.
irritans, 4, 55, 116, 117, 118.
irritans, subspecies of *irritans*, 117, 123.
Ischnopsyllidae, 13, 14, 96, 97.
Ischnopsyllinae, 96, 97.
Ischnopsyllus, 96.
isus, 58, 123.
italicus, 55, 123.
jellisoni, 81.
jordani, *Corypsylla*, 95.
jordani, *Epitedia*, 78.
jordani, *Nearectopsylla*, 95.
jordani, *Trichopsylla*, 62.
Juxtapulex, 116, 117, 118.
keeni, 37, 132.
Klagesi, 22.
kohlsi, 96, 123.
labiatus, 33.
labis, 51, 52.
latens, 34.
laurentina, subspecies of *genalis*, 94.
Lepidoptera, 12.
Leptopsylla, 90, 92, 93.
Leptopsyllidae, 75.
Leptopsyllinae, 15, 74, 89, 90.
leucopus, 34, 123.
littoris, subspecies of *arizonensis*, 45.
Loemopsylla, 103.
londiniensis, 55, 123.
longiloba, subspecies of *hamifer*, 91.
longispinus, 112, 113, 123.
lotoris, 17, 18, 129.
lucidus, 64, 123.
lucifer, 62.
lutzii, 20, 21.
lynx, variety of *glacialis*, 106, 107.
Macropsylla, 89.
Macropsyllinae, 15, 74, 89.
Malariae, 24, 55, 56, 60.
mammoth, 89.
mandarinus, 50.
Mecoptera, 12.
Megabothris, 24, 55, 56, 58.
megacolpa, 62.
Megarhroglossus, 102, 112.
Meringis, 85, 86.
mesus, 21, 22.
mexicana, in subgenus *Foxella*, 43.
mexicana, synonym of *segnis*, 93, 123.
Micropsylla, 75, 79.
minutus, 107, 123.
Mioctenopsylla, 24, 43.
Moeopsylla, 8, 116.
monedulae, 72.
moneris, 28.
mononis, subspecies of *ciliata*, 59.

- Monopsyllus*, 56.
montana, species of subgenus *Diamanus*, 50, 123.
montanus, *Anomiopsyllus*, 115.
motei, 28.
multidentatus, 38, 39, 131.
multispinosus, 25.
mundus, 65, 66.
musculi, 92, 93, 123.
Myodopsylla, 97, 100.
Nearctopsylla, 90, 93, 96.
necopinus, 54.
Neopsylla, 5, 75, 77, 78.
Neopsyllidae, 75.
neotomae, 31.
nepos, 33, 34, 35.
Neuroptera, 12.
nevadensis, subspecies of *sexdentatus*, 35.
niger, 69, 70, 123.
Nosopsyllus, 24, 54, 57.
novemdentatus, 107.
nudatus, 114, 115, 123.
Nycteridopsylla, 99.
Nycteridopsyllinae, 97.
obtusata, subspecies of *curvata*, 81.
octodecimdentatus, 31.
oculatus, 54, 123.
Odontopsyllus, 23, 25, 39.
onaga, 27, 28.
Oncopsylla, 16.
opada, subspecies of *exilis*, 61.
ophidius, subspecies of *wagneri*, 64.
Opisocrostitis, subgenus of *Oropsylla*, 8, 24, 49, 50, 51.
Opisodasys, 24, 36.
Orchopeas, 24, 32.
orecta, subspecies of *asio*, 58.
oregonensis, *Paratyphloceras*, 83, 84, 134.
oregonensis, species of subgenus *Opisocrostitis*, 52, 53.
oregonensis, *Trichopsylloides*, 19, 129.
ornata, *Corypsylla*, 95, 133.
ornata, variety of *tuberculata*, 52.
Oropsylla, 24, 48, 50.
Oropsylla, subgenus of *Oropsylla*, 48, 49.
Oxytelus, 11.
pachyruromydis, 103.
palposa, 100.
Pancoleoptera, 12.
pandorae, 47.
Pannecoptera, 12.
Pansiphonaptera, 12.
pansus, 47.
paradisea, 85.
Parapsyllinae, 20.
Parapsyllus, 20.
Parapulex, 103.
Paratrichoptera, 12.
Paratyphloceras, 75, 83.
parkeri, 86, 87.
penetrans, 116, 121, 122, 123, 138.
penicilliger, 16, 17, 55, 56, 63.
pennsylvanicus, subspecies of *sexdentatus*, 35.
pentacanthus, 80.
pentactenus, 80.
Permochoristidae, 12.
peromysci, 65, 123.
Peromyscopsylla, 90.
peromyscus, 79, 80, 123.
peripinnatus, subspecies of *gallinulae*, 30, 130.
petiolatus, 48.
petrochelidoni, 70, 71.
Phalacropsylla, 85.
Phaneris, 19.
Pleochaetis, subgenus of *Trichopsylla*, 24, 56, 65.
poecantis, 49, 123.
pollionis, subspecies of *sibirica*, 31.
Polygenis, subgenus of *Rhopalopsyllus*, 22.
ponera, 25, 123.
porcinus, 117, 118, 119, 137.
Posttuberata, 89.
poweri, 107, 123.
procus, 112, 113.
protina, subspecies of *ciliata*, 59.
Protohymenoptera, 12.
proximus, 45, 123.
pseudagyrtes, 83, 134.
pseudarctomys, 37, 38, 123.
Ptilopsylla, 97.
Pulex, 8, 116.
Pulicidae, 13, 14, 16, 20, 23, 101.
Pulicinae, 15, 23, 102, 116.
pullulorum, 120, 122, 123.
pygmaeus, 113.
quebecensis, 71.
quirini, 63.
rara, 43.
ravalliensis, 92.
Rectofrontia, 8, 75, 79, 80.
recla, variety of *ignota*, 41, 42.
Rhadinopsylla, 80.
Rhinolophopsylla, 97, 100.
Rhopalopsyllinae, 14, 15, 20, 23.
Rhopalopsyllus, 20, 21.
Rhopalopsyllus, subgenus of *Rhopalopsyllus*, 21.
Rhynchoprion, 120, 121.
Rhynchoprionidae, 120.
Rhynchopsyllus, 119.
rileyi, 68, 123.
riparius, 67, 71.
roberti, 22.
robustus, 37, 123.
Rothschildella, 20, 21.
rothschildi, 16.
runatus, 53.
rupestris, 50, 51, 52.
rusticus, 70.
saevus, subspecies of *cacicus*, 21.
samuelis, subspecies of *klagesi*, 22.
Sarcophaga, 121.
Sarcopsylla, 119, 121.
Sarcopsyllidae, 119.
Sarcopsyllus, 121.
saundersi, 52.
scapani, 78.
Scatopse, 11.
schefferi, 89.
schelkovnikovi, 30.
schisintus, subspecies of *sexdentatus*, 36.
sciurobius, 93.
sciurorum, 56.
scotti, 92.
sculleni, 28.
sectilis, 79, 80, 123, 134.
segnis, 92, 93, 123, 133.
selenis, 92.
serraticeps, 123.
setosa, 18.
sexdentatus, 34, 35, 132.
sexdentatus, subspecies of *sexdentatus*, 34.
shannoni, 87.
sibirica, 31.
sibynus, 66, 67.
sicamus, 113.
sigmodoni, 22, 23.
silantjewi, 48, 49.
similis, species of *Epitedia*, 79, 123.
similis, species of *Megarhroglossus*, 113.
simplex, 109, 110.
simulans, 117, 123.
sinoma, 57, 63.
Siphonaptera, 12, 13, 14, 16.
spatiosus, 37, 123.
spenceri, species of *Megarhroglossus*, 114.
spenceri, species of *Odontopsyllus*, 26.
spenceri, species of *Thrassis*, 48.
Spicata, subgenus of *Dactylopsylla*, 43.
spillmanni, 110.
Spilopsyllinae, 15, 102.
Spilopsyllus, 8, 102, 103, 109.
spinata, 96, 123.
spinifrons, 91, 123.
stanfordi, species of *Conorhinopsylla*, 73, 74, 129.
stanfordi, species of *Thrassis*, 48.
Staphylinioidea, 11.
Stenistomera, 7, 24, 72, 73.
Stenoponia, 84, 85, 87.
Stenoponiinae, 84.
Stenopsylla, 81, 82.
Stephanocircidae, 13, 14, 119.
Stephanocircus, 89, 90.
Sternopsyllus, 5, 97, 98, 99.
stewarti, 78.

- stimsoni, 40.
 Strepsiptera, 12.
 striata, 76, 123.
 stylosa, 29, 130.
 suavis, 103.
 subulata, 101.
 Suctoria, 14.
 swansoni, 71.
 systalta, subspecies of wagneri, 64, 65.
 Tabanidae, 12.
 tahavuaana, subspecies of gigas, 88.
 talpae, 88.
 Tamiophila, 75, 76, 77.
 tamoyus, subspecies of australis, 21.
 Tarsopsylla, 24, 31, 32.
 telchinum, 55, 57, 63, 64.
 telegoni, 25, 26.
 terinus, 111.
 terribilis, 72, 131.
 testor, 78.
 Tetrapsyllus, 20.
 texana, species of Sternopsylla, 97, 98, 99, 136.
 texana, species of Tamiophila, 76, 77.
 thamba, 64.
 Thrassis, 24, 44.
 Tiamastus, subgenus of Rhopalopsyllus, 21.
 Trichopsylla, 16, 17, 24, 55, 56, 67.
 Trichopsylla, subgenus of Trichopsylla, 56, 65.
 Trichopsylloides, 8, 15, 16, 19.
 Trichoptera, 11, 12.
 tripectinata, 87.
 tripta, subspecies of exilis, 61.
 Tritypsylla, 81.
 tuberculata, 53.
 tuberculata, variety of tuberculata, 52, 53.
 tuberculaticeps, 18, 19.
 Tunga, 14, 116, 119, 120, 121.
 Tungidae, 120.
 tupinus, subspecies of australis, 21.
 Typhloceras, 84.
 Typhloceratidae, 75.
 unipectinata, 100.
 Uropsylla, 73.
 Uropsyllinae, 14, 15, 73.
 ursi, 18, 19, 129.
 utahensis, Ceratophyllus, 69, 123.
 utahensis, subspecies of howelli, 47.
 utahensis, variety of ignota, 42.
 vagabundus, 71, 72.
 vancouverensis, 99.
 Vermipsylla, 13, 16.
 Vermipsyllinae, 14, 15, 16.
 vesperalis, 36, 37, 38.
 vidua, subspecies of intermedia, 82.
 vigena, subspecies of hamifer, 91.
 vison, 64, 123.
 vulpes, 17.
 wagneri, 58, 65.
 wagneri, subspecies of wagneri, 64, 65, 123.
 walkeri, 55, 56.
 washingtonensis, 53.
 wenmanni, 77, 79, 123, 133.
 wetmorei, 87, 123.
 wickhami, 32, 33, 123.
 wolffhuegeli, 5.
 wymani, 29.
 Xenopsylla, 102, 103, 104, 112.
 Xestopsylla, 120.

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