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THE SUCKING LICE

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"In the progress of this work, however, the author has had to contend with repeated rebukes from his friends for entering upon the illustration of a tribe of insects whose very name was sufficient to create feelings of disgust."—Henry Denny, 1842.

PREFACE

This volume represents an attempt to summarize existing knowledge on the systematics of the sucking lice, which are here considered to be the Order Anoplura of the Insecta. Since sound taxonomy should rest upon morphology and anatomy, an extended consideration will be given to these subjects. Included also will be a review of the historical development of our knowledge of the group; a consideration of the classification here adopted; keys to the families, subfamilies, genera, and species and a review of all these categories; illustrations of all the available types of genera and of the species occurring on domestic animals; an extended discussion of the species occurring on man and other Primates; a list of the mammalian hosts; and finally, a consideration of the problems of geographical distribution.

I wish here to express my appreciation of the assistance given me by my collaborator, Mr. Chester Stojanovich, whose unusual skill in minute dissection and in illustration has made possible the sections on the mouthparts and internal anatomy. Mr. Stojanovich began this work while he was a graduate student at Stanford University and later was granted leave from his duties with the Communicable Disease Center of the United States Public Health Service, which enabled him to return to my laboratory during the summer of 1950 and complete it. I wish here to express my thanks to Dr. R. A. Vonderlehr, Medical Director in charge of the Communicable Disease Center, by whom this leave was officially granted and to Dr. G. H. Bradley, by whom it was recommended. My part in the preparation of the sections in question has been that of supplying the textual material. Mr. Stojanovich assisted also in the preparation and testing of various of the longer keys to species.

The purely taxonomic portion of the work, all names therein proposed, and all opinions herein expressed are to be ascribed strictly to myself. This work has its basis in a series of studies published by me over a period of years from 1919 to 1935, in eight papers entitled "Contributions Toward a Monograph of the Sucking Lice." These appeared as Volume II of what was in part entitled Leland Stanford Junior Publications, University Series, and in part Stanford University Publications, University Series, Biological Sciences. In them will be found illustrations of almost all of the species known up to 1935, together with a statement of the sources of the material upon which the work was based. Owing to the cumbersome nature of the full citation, this work will herein be cited merely as "Contributions Toward a Monograph of the Sucking Lice."

This volume is closed as of July 1, 1951.

A handwritten signature in cursive script that reads "J. F. Ferris". The signature is written in dark ink and is positioned to the right of the main text block.

Stanford University, California



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CHAPTER I

The Ectoparasites of Birds and Mammals

When in the course of their evolution the birds achieved feathers and the mammals achieved hair, a new world to conquer was offered to the Arthropoda which must have swarmed upon the earth from almost the earliest ages of terrestrial life. Some of the arthropods moved into this new world and became adjusted to the peculiar conditions of life that it presented. From these pioneers came the ectoparasites that today infest in some measure probably every species of bird and every species of mammal except the Cetacea and the Sirenia.

These ectoparasites, as we see them today, have been derived from many sources. One may surmise that the earliest to enter this world of hair and feathers were mites, for the mites are a very ancient group and they may very well have fed upon the blood of hairless amphibians and reptiles, even as they do today, before the birds and mammals had evolved. Today the mites constitute probably the major ectoparasitic fauna of the vertebrates. They have penetrated into the lungs of their hosts, into the ears, into the skin, and even at times into the intestine and bladder and they swarm in the hair and the feathers. They induce pathological conditions of their hosts by their own activities and they act as transmitting agents of numerous diseases that are already known and undoubtedly many more that are not yet known. They are the greatest of all the groups of ectoparasites and scarcely more than a beginning of their study has yet been achieved.

It seems probable that only after hair and feathers had become well developed did the insects move in. These insect ectoparasites have come from various Orders. There are the blood-sucking flies of the family Hippoboscidae, which occur on both birds and mammals, and the families Streblidae and Nycteribiidae, which occur only on bats. There are the "bedbugs," which are Hemiptera, of the family Cimicidae, and which occur chiefly on birds and bats. There is the more or less closely related Hemipterous family Polytectenidae, which occurs only on bats and which numbers scarcely two dozen known species. There is at least one species of the Order Dermoptera, which occurs on an African rodent. There are a few beetles, including that singular parasite, *Platypsylla castoris* Ritsema, which occurs only on beavers. There is even a moth which lives in its larval stages in the hair of a sloth and which may justifiably be included in the list. There is the whole Order Siphonaptera, the fleas, which in their adult stage live upon both birds and mammals and feed upon their blood.

There are two groups of what are commonly called lice. One of these groups comprises what are frequently called "bird lice," although a considerable number of them live upon mammals. They are more appropriately called "biting lice" and constitute what is here considered to be the Order Mallophaga, which includes something more than 2,000 known species. And finally, there is the little group which is the subject of this volume, the sucking lice, comprising what is here called the Order Anoplura. At present scarcely more than 225 species of Anoplura are known. They live exclusively upon mammals and feed upon the blood of their hosts.

The ectoparasites of birds and mammals present many features of general biological interest. Some of them are zoological curiosities because of their unusual modifications of structure or habit. Thus, the parasitic bat flies of the families Streblidae and Nycteribiidae are strange forms because of their structural modifications alone. But combined with this strangeness of form, the members of these two families and of the more or

less related family Hippoboscidae have the habit, rare among insects, of retaining the larva within the body of the female where it is nourished by glandular secretions until it is ready to pupate. The members of the little family Polyctenidae likewise retain the immature insect within the body of the female until it is partly grown, but in this case it is nourished through what is functionally a placenta that is developed from the body of the young itself. The extraordinary developments of both structure and habit which occur among the mites offer an endless variety, the exploration of which has scarcely more than begun.

Throughout the entire series of these ectoparasites there are phenomena of special interest from the point of view of evolution. There are beautiful examples of what appears to be convergent evolution which has resulted in the development of similar habits and similar structures in quite unrelated forms. There is the problem of perennial interest which has to do with the occurrence of related parasites upon related hosts and the consequent suggestion that the relationships of the parasites may perhaps throw some light upon the phylogeny of the hosts and, conversely, that the relationships of the hosts may throw some light on those of the lice. This will be discussed in detail in a section of this work.

Above all there is the circumstance that certain of these ectoparasites are concerned with the transmission of disease. Most of what is known concerning this has to do with the transmission of disease in man, but it seems clear that the same thing must occur in the case of many other animals. Since numerous diseases of man have unquestionably come over to him from other animals the whole picture of the epidemiology of these diseases cannot be grasped until the background in the animals from which a particular disease has come is understood. In many instances the occurrence of a particular disease in man is to be regarded as purely an accident. This, for example, seems to be true of "murine typhus," which arises each time independently from the background formed by certain rodents and their parasites. One of the most illuminating instances of this sort is the recognition—as late as 1947—of the disease called "rickettsial pox," a disease that was previously unknown and was shown to have been transmitted to man through the agency of mites from the ordinary house mouse, an animal that had previously not been known to be connected with any disease of man.

We are not here attempting to recite the story of the relation of ectoparasitic insects to the transmission of disease. The intention is merely to emphasize the principle that no blood-sucking arthropod, even if it occurs only on a bat on some remote island, may be eliminated entirely from the range of our interest. The time is at hand for the building up of greater knowledge of blood-sucking ectoparasitic insects in all groups. Almost none of these groups, except perhaps the fleas, has received the attention which it deserves. And, as will appear in subsequent sections of this volume, our knowledge of the little Order of the sucking lice is still barely past its earliest stages.

CHAPTER II

The Morphology and Anatomy of the Anoplura

As has already been noted, the sucking lice are very peculiar forms. They are commonly described as degenerate, but this is a word which has no proper place in a biological vocabulary, since it carries with it certain purely anthropomorphic connotations that involve a flavor of reproach. It would be better to say merely that they are highly specialized for life in the peculiar environment which they occupy. The evolutionary processes which have been at work upon them have produced a large amount of specialization by loss and reduction of parts. There is not the slightest vestige of wings. The eyes have been very greatly reduced, being scarcely or not at all recognizable in the majority of species and consisting of a single facet even when best developed. The tarsi have been reduced from five to one or at the most two segments. The antennae have been reduced to at the most five segments. In many species the sclerotization of the abdomen has been almost completely lost. There has been a reduction of the number of spiracles, no known species having more than one pair on the thorax and six pairs on the abdomen. The structures which comprise the ovipositor of the more generalized insects are reduced to mere vestiges.

Along with these reductions and losses there have gone some specializations of a quite different type. Thus, the mouthparts of the sucking lice are perhaps as highly specialized as are to be found anywhere among the insects and the claws have become highly developed in correlation with the habit of clinging to hair.

The great degree of reduction and modification found in these insects has led to much misunderstanding concerning their morphology and this misunderstanding has centered especially about the mouthparts. Here, even yet, we cannot give a final answer to all the questions involved although we are undoubtedly somewhere near that answer.

In the preparation of the following section on morphology and anatomy, Mr. Stojanovich has done all the laborious work of dissection and of preparing the illustrations. Parts of this material have already been published by him in a paper entitled "The Head and Mouthparts of the Sucking Lice," which appeared in "Microentomology," Volume 10, Part 1 (1945).

There are certain minor points concerning the anatomy of the lice which have not yet been adequately explored, but the following account will cover the major features, especially those which may at some time have a bearing upon problems of taxonomy.

The Head Preliminary Statement

The most difficult problems connected with the morphology of the sucking lice are those which concern the mouthparts. The head itself is not difficult to understand, but before entering into a discussion of its morphology it may be well to review certain developments which have occurred within recent years in the study of the comparative morphology of the insects. These developments have resulted chiefly from a series of papers which have appeared in the journal "Microentomology," which is published from the Natural History Museum of Stanford University. A brief summary of the conclusions which have been derived from this work and which are pertinent to an understanding of the Anopluran head follows.

There has long been difference of opinion among morphologists as to the segmentation of the insect head, opinion as to the number of segments involved having varied from as low as four segments to as many as nine. Furthermore, there has been much disagreement as to the arrangement of these segments and certain concepts that we believe to be based upon grievous errors have become deeply imbedded in the literature of the comparative morphology of the insects. Not until those errors have been removed is it possible to arrive at any understanding of the morphology of a specialized head such as that of the Anoplura.

The work that has been done in this laboratory has involved studies of external structure, of musculature, and of the segmental distribution of nerves. The study of the nervous system of the head region has been carried through a long series of forms ranging from the Oligochaete and Polychaete worms to the insects and has demonstrated that a unified system of segmentation of this region exists throughout the Annulata. The following conclusions have been derived from these studies.

1. The head of insects involves a total of six segments, these—in morphological order—being the labral, clypeal, ocular-antennal, mandibular, maxillary, and labial segments.

2. The labral segment is segment one of the body and the anterior portion of the alimentary canal, which is called the stomodaeum, is an invagination of this segment. The ventral portions of this segment are much reduced and seem to involve only the "hypopharyngeal suspensor plates," upon which the mouth angle retractor muscles insert.

3. The clypeus is the dorsal element of segment two and the hypopharynx is basically the ventral portion of this segment.

4. The hypopharynx is primarily a ventral lobe of segment two, but it is possible that in some insects elements derived from the mandibular segment may be involved in it.

5. The ocular-antennal segment bears the antennae, the ocelli, and the compound eyes. It is commonly divided transversely by a suture, usually called the epicranial suture, which usually forms a V-shaped line across the head, with the lateral arms terminating on each side between the compound eye and the corresponding antenna. This suture is definitely intra-segmental and is something more than a mere line of weakness along which the derm splits at the times of ecdysis. It is a line of very ancient origin, the antecedents of which can be seen even in the Polychaete worms. The area anterior to this suture and posterior to the clypeofrontal suture may properly be called the frons.

No ventral element ascribable to the ocular-antennal segment can be identified in any insect thus far examined, although morphologically some such element, however much reduced, should theoretically be present. No muscles ascribable to this segment, other than those of the antennae and certain evanescent muscles of the ptilinum in flies, are known to exist. The anterior tentorial pits apparently belong to this segment.

6. In cases where the mandibles have been lost the mandibular segment may entirely disappear, at least as far as any muscles and any sclerotized elements are concerned.

7. The maxillary segment is usually much reduced and in many insects is entirely membranous. In many insects it forms no part of the sclerotized head capsule. The posterior tentorial pits seem to belong to this segment.

8. The labial segment is always much reduced dorsally and no insect is known in which the dorsal wall of this segment is sclerotized and enters into the composition of the sclerotized head capsule. The area called the submentum, however, is commonly sclerotized and forms a portion of the ventral—or posterior—wall of the head capsule, although at times this area may be entirely membranous. The submentum is merely a portion of the ventral wall of segment six. The salivary glands belong to segment six

and the point of opening of the salivary duct belongs to this segment and is a definite landmark of this segment. It does not belong to the hypopharynx although it may become involved with this structure.

9. The distribution of segmental nerves to sensory structures and muscles is a positive indication of segmental homologies when all nerves are present. At times nerves may be lost, if the structures which they serve are lost, and at times the clarity of segmental relations may be disturbed by the fusion of nerves.

10. The insertions of muscles are constant, but the origins may shift, even from one segment to another, if the ectodermal areas upon which they primitively originated are lost or displaced.

With these general conclusions in mind it is possible to proceed to the problem of the organization of the Anopluran head.

Of all the species of Anoplura now known, those of the genus *Pediculus* seem to present the least modification of the head. Therefore it is appropriate to begin with the head of *Pediculus*.

The Head Capsule of *Pediculus humanus* Figures 1, 2

In this head the anterior apex is more or less membranous and forms a slightly eversible protuberance, commonly called the haustellum, which surrounds the apparent mouth opening and is beset with small hooks. In this membrane, on the dorsal side, there is a small, sclerotized plate which is by all criteria the labrum. Posterior to the labrum is a large plate which extends across the head in front of the antennae and is continued somewhat to the ventral side. This plate is clearly the clypeus, since it bears the origins of the cibarial muscles and the place of origin of these muscles is constant in all insects that have been examined. This plate is separated by a broad suture from the next plate, which makes up the greater part of the dorsal wall of the head. The entire posterior portion of the head capsule, dorsally, is composed of the ocular-antennal segment. The antennae are attached to the head at the anterior-lateral angles of this plate and the eyes are placed on each side at about the middle of the lateral border. The plate is divided by a V-shaped suture, the lateral terminations of which are between the eyes and the antennae. The base of the V is connected with the median coronal suture. The portion of the ocular-antennal segment anterior to this V is the frons, while the areas posterior to the suture constitute the ocular lobes or, as they are sometimes called, the parietals.

The dorsal sclerotization of the ocular-antennal segment extends around somewhat to the ventral side of the head. There are no dorsal areas that can be assigned definitely to the gnathal segments.

Except for the reduction of the dorsal elements there is nothing in any way peculiar thus far about this head capsule.

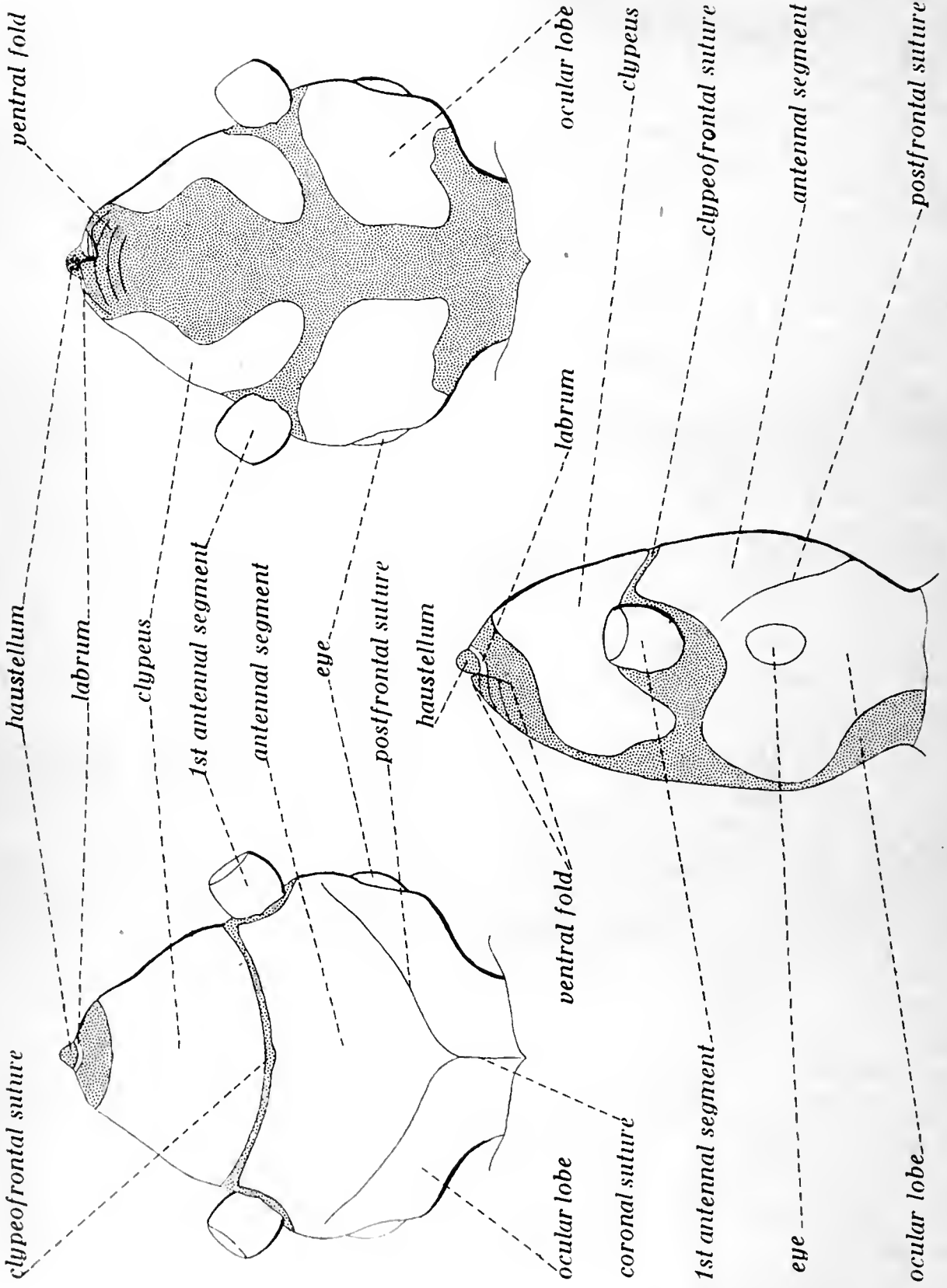
On the ventral side of the head the areas not occupied by the ventral extensions of the dorsal sclerotization are entirely membranous and show no indications of segmentation.

The tentorium, as in all Anoplura, is lacking and there are consequently no tentorial pits.

The mouthparts are entirely retracted within the head and will be considered later.

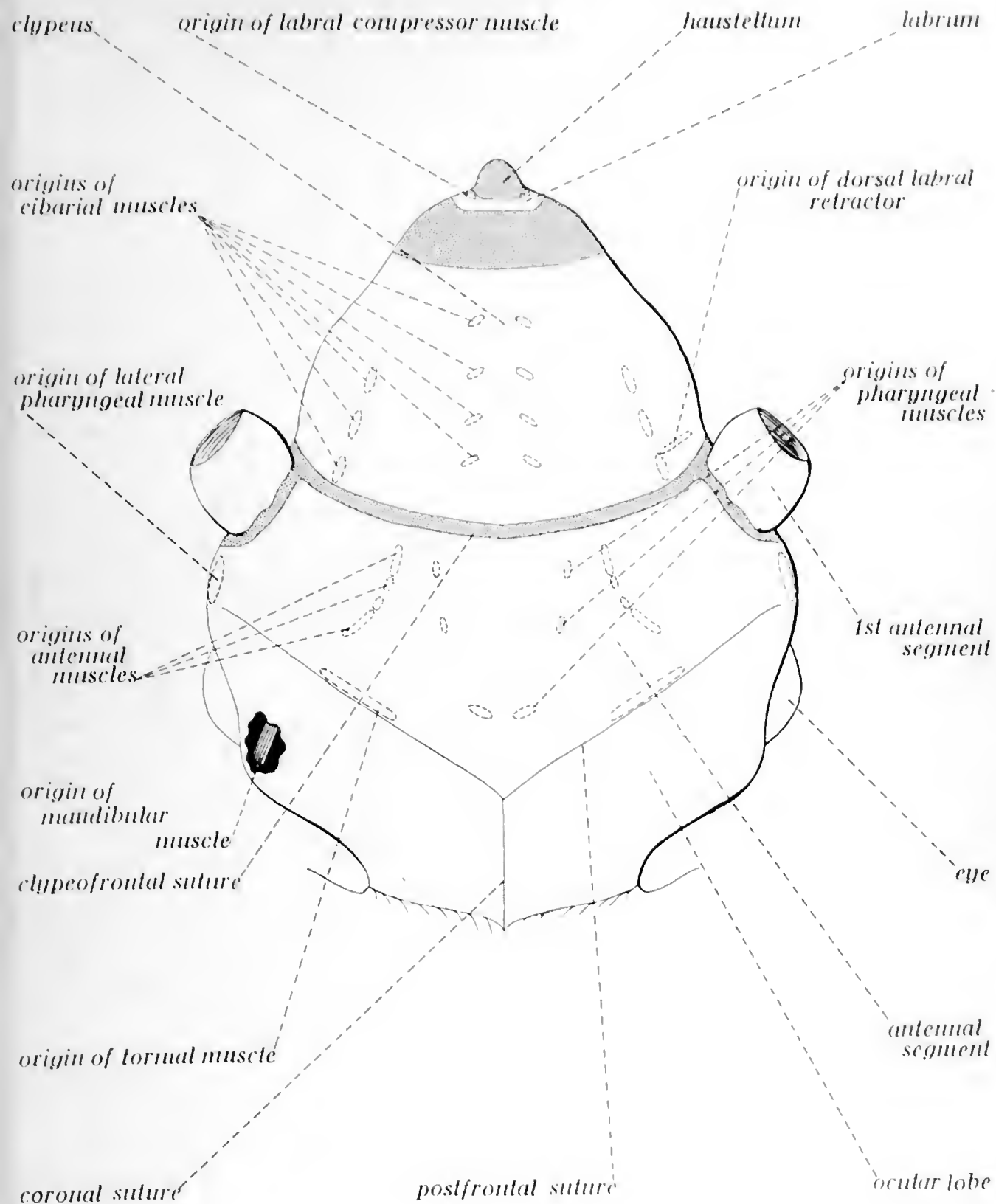
The Head Capsule of *Haematopinus suis* Figure 3

The head capsule of this species is considered because it presents certain features which would not be readily understood on the basis of what



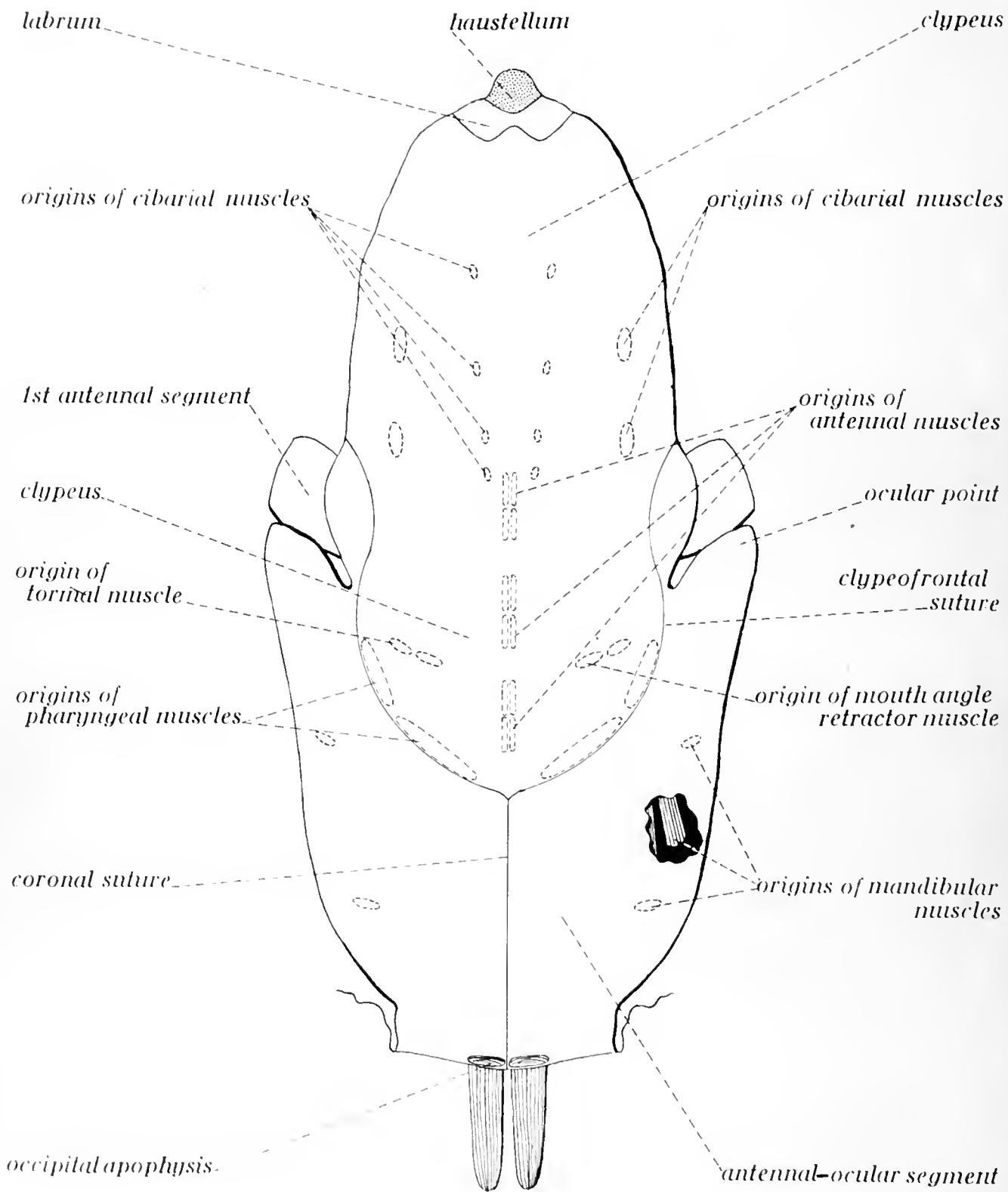
Head structures as shown in *Pediculus humanus* Linnaeus

Figure 1



Origins of muscles in head of *Pediculus humanus* Linnaeus

Figure 2



Structures and origins of muscles in head of *Haematopinus suis* (Linnaeus)

Figure 3

is found in *Pediculus*.

It will be noted that in this head there is no external indication of eyes. However, the ocular nerves are present and end in a small spot, just at the base of the areas designated in the illustration as the ocular points, which are morphologically the eyes. Webb has demonstrated that in some specimens, at least, definite but small lenses can be recognized.

In comparison with the head of *Pediculus* it will be noted that one transverse suture is missing. On the basis of all the available evidence, including the study of other species not here considered, we interpret the conditions as follows. We assume that the clypeus has been produced posteriorly until it has crowded out the frons, and the frontoclypeal and postfrontal sutures have become confluent. Therefore nothing is left of the frons except the small areas at each side which bear the antennae. The transverse, V- or U-shaped suture is therefore morphologically the postfrontal + clypeofrontal suture. This conclusion is supported by the positions of the origins of the cibarial muscles.

One other feature of this head calls for mention.

At the posterior border of the head are two invaginated sclerotizations, the occipital apophyses. To these attach muscles which serve to retract or elevate the head. Evidence derived from the innervation of these muscles indicates that they and the structures upon which they insert belong to the head. To just what segment of the head they belong remains to be determined.

The ventral side of the head is so similar to that of *Pediculus* that it is not here illustrated.

The Head Capsule of Other Anoplura

There are some modifications of the head capsule in other species of Anoplura, but they can all be accounted for on the basis of the two species which have been discussed. Consequently, we need belabor this subject no further.

The Mouthparts and Internal Structures

As has already been noted, the mouthparts of the sucking lice are of a very peculiar type which is not found elsewhere in the insects. Functionally they are to be described as "piercing and sucking," but their mechanism is very different from anything that is to be found in other piercing and sucking forms such as the Hemiptera and the blood-sucking flies. They have been the subject of much controversy and there are still certain details which remain doubtful and which will require embryological work for their final elucidation.

Since, apart from the space occupied by the brain, the internal structures of the head are almost exclusively associated with the mechanism of feeding we may consider all these structures together.

The first necessary step is that of forming a clear picture of the relationship of the piercing structures and the food channel. It must be grasped at the very beginning that the piercing structures do not in any way form the food channel. In order to understand this clearly, reference may be made to Figure 4. In Part A of this figure is shown a longitudinal section through a normal insectan head, with the lateral parts such as mandibles and maxillae omitted. The roof of the oral chamber or cibarium is here formed by a continuation of the ventral wall of the labrum and the floor of the chamber by the hypopharynx and the anterior wall of the labium. Leaving aside any argument as to where the true mouth opening actually is we may for the present consider it to be the opening into the pharynx. Note especially the opening of the salivary duct between the hypopharynx

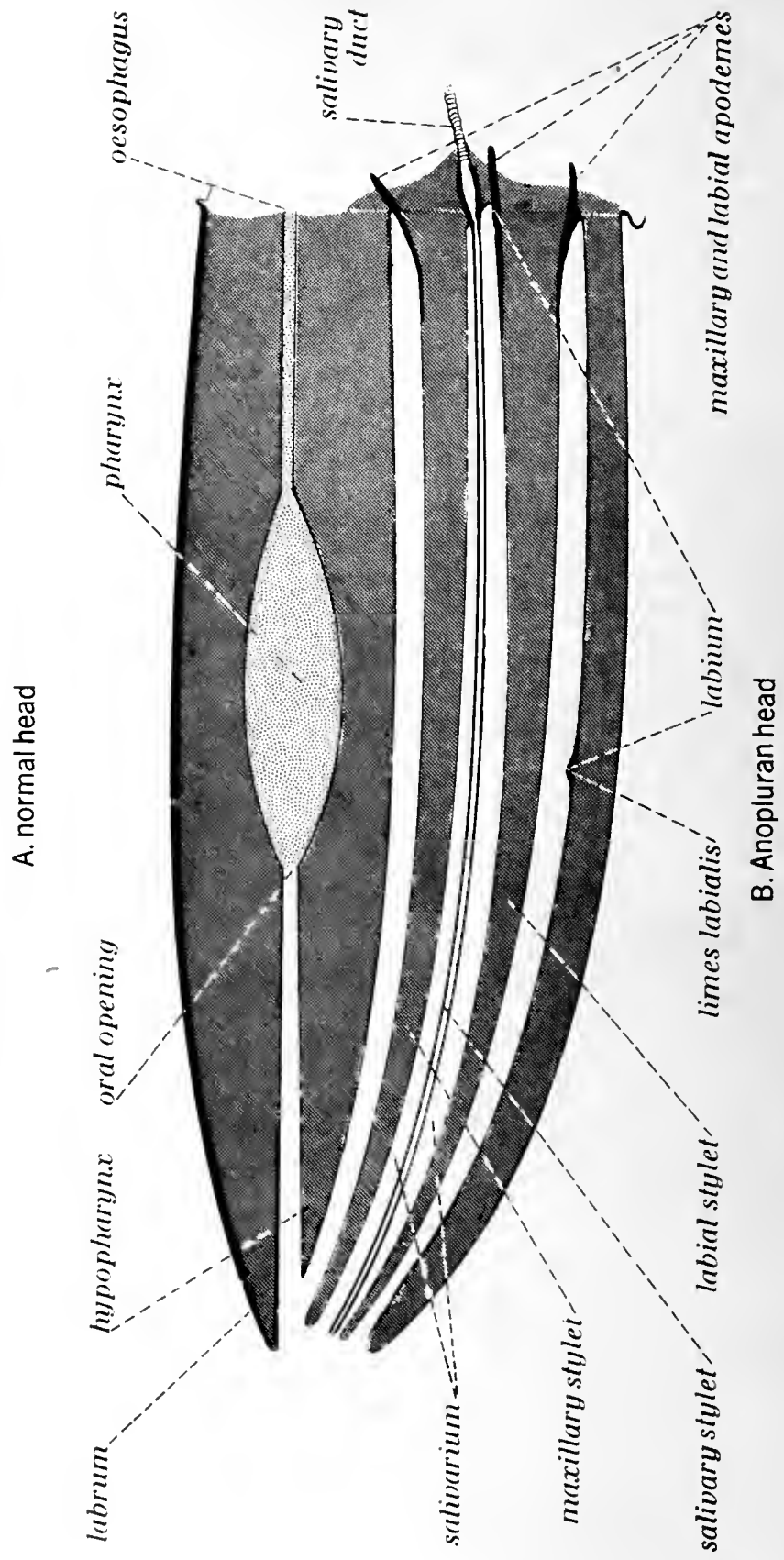
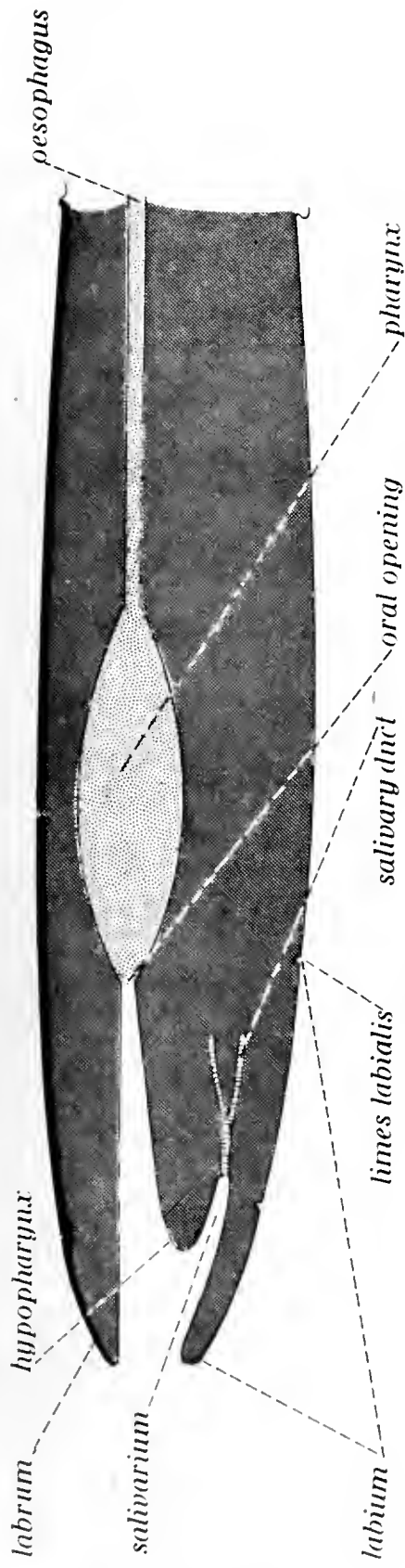


Diagram of mouthparts

Figure 4

and the labium.

In Part B of this figure is shown a similar diagram of the head of a sucking louse. Note that the upper portion of the head remains unchanged and the modifications involved are all in the lower—morphologically the posterior—portion. It is evident that the parts involved in the piercing structures have been pulled back into a sac that lies entirely beneath the mouth. The three needles which form the piercing instrument originate from the base of this sac. When the instrument is brought into action it is extruded through a small opening in the floor of the oral chamber just in from the apex of the head. It is very evident that the blood of the host does not pass into this sac on its way into the alimentary canal. The actual arrangement of the sac and its relation to other parts is shown in less diagrammatic form in Figure 5.

The questions at issue have to do mostly with the homologies of the three stylets which comprise the piercing instrument. In the diagrammatic illustration they are greatly exaggerated in thickness. Actually, they are exceedingly delicate and are closely appressed together. However, the questions concerning these stylets are not all there is to the problem, since there are certain other structures which do not appear in this diagram and which have to be explained.

For our explanation it is necessary to turn to the musculature and the innervations of the muscles.

Perhaps the most favorable subject for study of these problems is the hog louse, *Haematopinus suis*. This is a rather large species and it shows all the structures. It may be noted that all the work on which the accompanying illustrations were based was done by the method of dissection employing powers up to x115 of the binocular dissecting microscope.

In Figure 6 are shown the structures which appear upon removal of the dorsal wall of the head. We may in passing note the muscles of the antennae, which originate upon the dorsal wall. In insects which possess a tentorium they would originate upon that structure, but since the tentorium is here lacking the origins must of necessity shift to another position. In some Anoplura they originate in part upon the lateral wall of the head ventrad of the antennae.

The "brain" is relatively large and is composed of the supraoesophageal and suboesophageal ganglia which are connected by the very short circumoesophageal connectives that pass around the oesophagus (see Figure 25). One landmark to be especially noted is the frontal ganglion, which in all insects lies in front of the brain and between the cibarial and pharyngeal muscle bundles. Just posterior to this frontal ganglion the alimentary canal swells into a bulb which is the pharynx and which forms the sucking pump. From the pharynx large bundles of muscles extend to the dorsal wall of the head. It is these muscles which function to dilate the pharynx and cause it to operate as a pump in sucking up the blood of the host. There is nothing in any way unusual about them or their arrangement.

Anterior to the frontal ganglion are several muscle bundles originating upon the clypeus and inserting upon the dorsal wall of the oral chamber. These are the cibarial muscles, as is confirmed by their innervations which will be discussed later.

Anteriorly to these muscle bundles the dorsal wall of the mouth chamber is formed by a sclerotized plate, somewhat in the form of an inverted Y. From the apex of each arm a muscle extends forward to a little, external plate which we have previously identified as the labrum. These muscles may be regarded as the compressors of the labrum and are essentially the same as are to be found in most insects. The plate to which they insert, and which forms the dorsal wall of the chamber, is here called the palatal plate. It is morphologically equivalent to the plates which are to be found in the dorsal wall of the oral chamber, in one form or another, in a wide

variety of insects.

There is nothing here that is in any way unusual or markedly different from what is to be seen in any typical insect.

Disregard for the moment the pair of structures which lie one on each side of the palatal plate. They present one of the most obscure problems involved in the mouthparts of these insects and we shall discuss them later.

Look again at Figure 5 in which the relations of the various structures are shown and note the position of the ventral trophic sac and the point at which it joins the cibarium.

In Figure 8 the ventral wall of the head has been dissected away to reveal the trophic sac and its associated muscles. The piercing stylets are concealed within this sac and only the branching ends of the apodemes upon which the muscles of the stylets insert, and which are formed from the walls of the sac, appear at the posterior extremity.

Note that from these apodemes slender muscles extend forward to attach to a sclerotized transverse band in the ventral wall of the sac at about the midpoint of its length. Also, certain muscles extend from the apodemes and attach to the obturaculum, a structure which will be discussed later, and there is a relatively huge, transverse muscle at the base of the trophic sac, this originating at each of its ends upon the obturaculum. Along the trophic sac are inserted certain slender muscles which originate upon the outer head wall.

In Figure 9 the base of the trophic sac is shown as with the walls cut away to reveal the apodemes of the stylets which are contained within the sac. It must be emphasized that the stylets are outgrowths from the wall of the sac and so are these apodemes, the sac being closed apically. There are no muscles inside the sac. The sac is an invagination of the body wall and anything inside it is morphologically outside the body. We may note in passing that certain illustrations of these structures which have been published show the apodemes as being inside the sac and thus in effect indicate an arrangement that is a morphological impossibility.

Let us now turn our attention to the stylets themselves. There are three of them—a dorsal, a middle, and a ventral. The dorsal and ventral stylets are flattened and relatively broad; the central stylet is cylindrical and very delicate. The three are very closely appressed together and extend forward so far that when at rest their anterior ends lie just within the mouth chamber. They enter the chamber through a slit in its floor. If they are extended to reach a blood vessel the base of the sac must be pushed far forward to lie close to the apex of the head.

The homologies of these stylets have been much disputed.

The nature of the median stylet is, however, quite clear. It carries the extension of the salivary duct and except for the lumen of the duct is solid. There is no reason whatsoever to consider it as anything more than a greatly elongated papilla which arises from about the mouth of the salivary duct and it is here called the salivary stylet. It has been considered to be the hypopharynx, but only because of a complete misunderstanding which has been widely spread among morphologists. The salivary duct does not belong to the hypopharynx and the opening of this duct defines a point that belongs to the labium.

Nor can there be much doubt concerning the ventral stylet. It is unquestionably derived from the labium and its muscles are innervated by nerves that seem clearly to be labial. Presumably the stylet is formed from the terminal portion of the labium, the part generally called the ligula, and there are no labial palpi. To understand the structure one must visualize the entire labium as being pulled back into the head, part of it forming the floor of the consequent invagination and part of it being free and extending forward to form the free stylet. We consider that the floor of the trophic sac is formed from the labium as far forward as the point

indicated as the "limes labialis," or boundary of the labium in Figure 8.

There now remains the question of the identity of the dorsal stylet. In the earlier work upon which this presentation is based this stylet was considered to be the hypopharynx. At that time, however, the innervations had not yet been studied. In the light of further studies we have been forced to conclude that this stylet is actually formed from the fused maxillae. The reasons for this decision will be discussed when we consider the nervous system of the head.

The hypopharynx here, on the basis of evidence presented by the nerves, is represented by the dorsal wall of the trophic sac and the floor of the oral chamber as far posteriorly as the opening into the pharynx. Muscles inserting upon this area are innervated by nerves which can be nothing but nerves of the hypopharynx.

We are left now with the problem of the pair of structures lying inside the head just in from the apex, one on each side of the palatal plate and to which we referred earlier.

In our previous work we considered these structures to be vestiges of the maxillae, but in the light of the information now available this opinion can not be maintained. The maxillae have already been accounted for and there remain but two possibilities in regard to the structures in question. It would seem that they must be either completely new structures with no antecedents in other insects or that they must be derived from some pre-existing movable structure and the only such structures that exist in this part of the head of any insects are either the mandibles or certain developments from the dorsal wall of the cibarium to which the name "premandibles," or the better name "messoros," have been applied. We discard recourse to the first suggestion—that they are completely new structures—as a matter of principle and concentrate upon the thought that they are derived from some pre-existing movable structure provided with muscles and nerves.

First let us describe them as they occur in *Haematopinus* (Figure 10). Here they consist of a pair of somewhat wedge-shaped, sclerotized bodies, lying within the head cavity, one on each side of the palatal plate. Each of them is connected by a strong and undoubtedly chitinous ligament to the head wall just at the margin of the labrum and each is also connected by a slighter ligament to the margin of the palatal plate. Each is provided with one very large muscle that originates far back on the lateral wall of the ocular lobe of the head and inserts upon the doubtful structure by way of a long and strong apodeme. A much smaller muscle originates upon the sclerotized wall of the pharynx. Both these muscles are innervated by branches of a nerve, which is one of the first pair to arise from the suboesophageal ganglion (Figure 25).

In the light of this innervation we are forced to conclude that the structures in question are actually the mandibles. They cannot have been derived from such structures as the messoros, which are developed from the dorsal wall of the cibarium and whose muscles are innervated by branches from the labral nerve.

How these mandibles have become withdrawn into the body and how they have acquired two connections to the body wall are problems which can only be solved by careful and detailed embryological studies that are still to be made. But that no interpretation other than that here presented is consistent with their innervations is clear.

These structures vary somewhat in form and position in different groups of the lice, in some species lying close to the ventral side of the head (Figure 11) and close together, but they seem to retain the same connections to the head wall and to the palatal plate and to retain also the same musculature. It is possible that a minutely detailed study of them would offer some evidence that would have a bearing upon problems of relationships within the group but at the present time this seems impracticable.

Structures Associated With the Mouthparts
Pawlowsky's Glands and Salivary Glands
Figures 5, 6, 7, 9, 10, 11

These are a pair of small, glandular structures each of which opens through a short duct into the trophic sac. Their function is unknown, as are their homologies. They are innervated by branches of what we here consider to be the hypopharyngeal nerves. There exists very little information—and that mostly very vague—concerning glands of the head region other than the salivary glands and at present we can make no statement concerning Pawlowsky's glands other than to record their position and their innervation. We have suspected that they may be homologous with what have been called "pharyngeal glands" in other insects, but an extended study would be necessary to determine whether or not this is the case.

In those lice which have been investigated in regard to the matter there are two pairs of salivary or labial glands. These lie in the thorax, dorsal of the alimentary canal. In *Pediculus humanus* the members of one pair are small and oval or somewhat kidney-shaped, those of the other pair are tubular and folded. From each gland a duct extends forward and unites with the duct from the other type of gland on the same side of the body. These two ducts then unite into the common duct near the point of their entry into the head. This common duct then discharges at the apex of the median, salivary stylet which has been described.

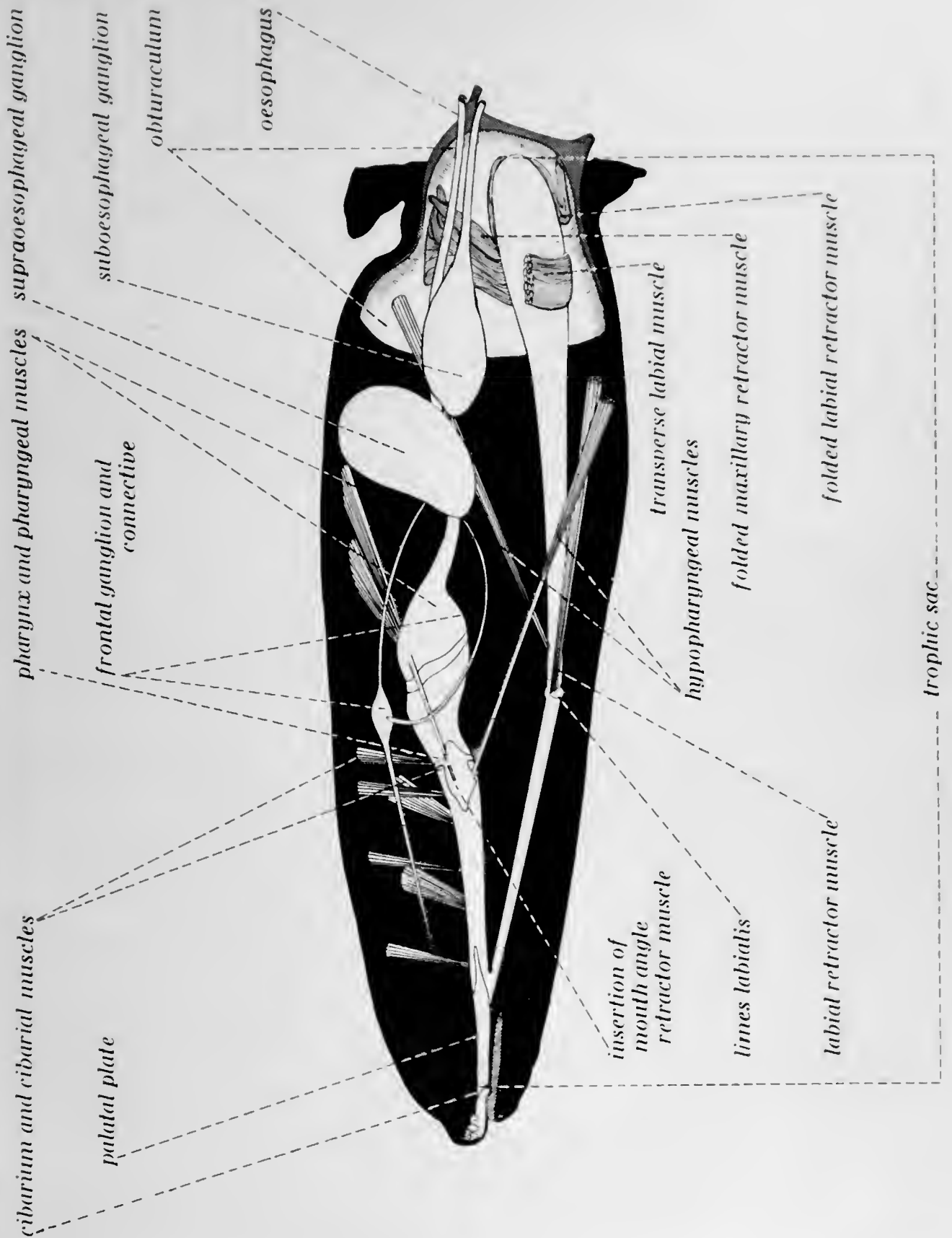
The Obturaculum
Figures 7, 8, 12

The mouthparts themselves are not the only peculiar feature of the head in these insects. We have referred earlier to a structure which we have called the "obturaculum," literally the plug or cork, which represents a most peculiar development that, as far as at present known, occurs only in this Order.

The extreme posterior portion of the head is filled by a mass of tissue which in histological preparations has the appearance of being minutely fibrous and which may be regarded as connective tissue. This tissue forms a plug, or a transverse diaphragm, which fills the occipital foramen and extends into the thorax. There it more or less completely envelopes the ganglia which are concentrated in that region. The anterior end of the plug is concave and cup-like. Through this plug the alimentary canal, the tracheae, the salivary duct, and the tracheae enter the head in the manner of tubes through the cork of a bottle.

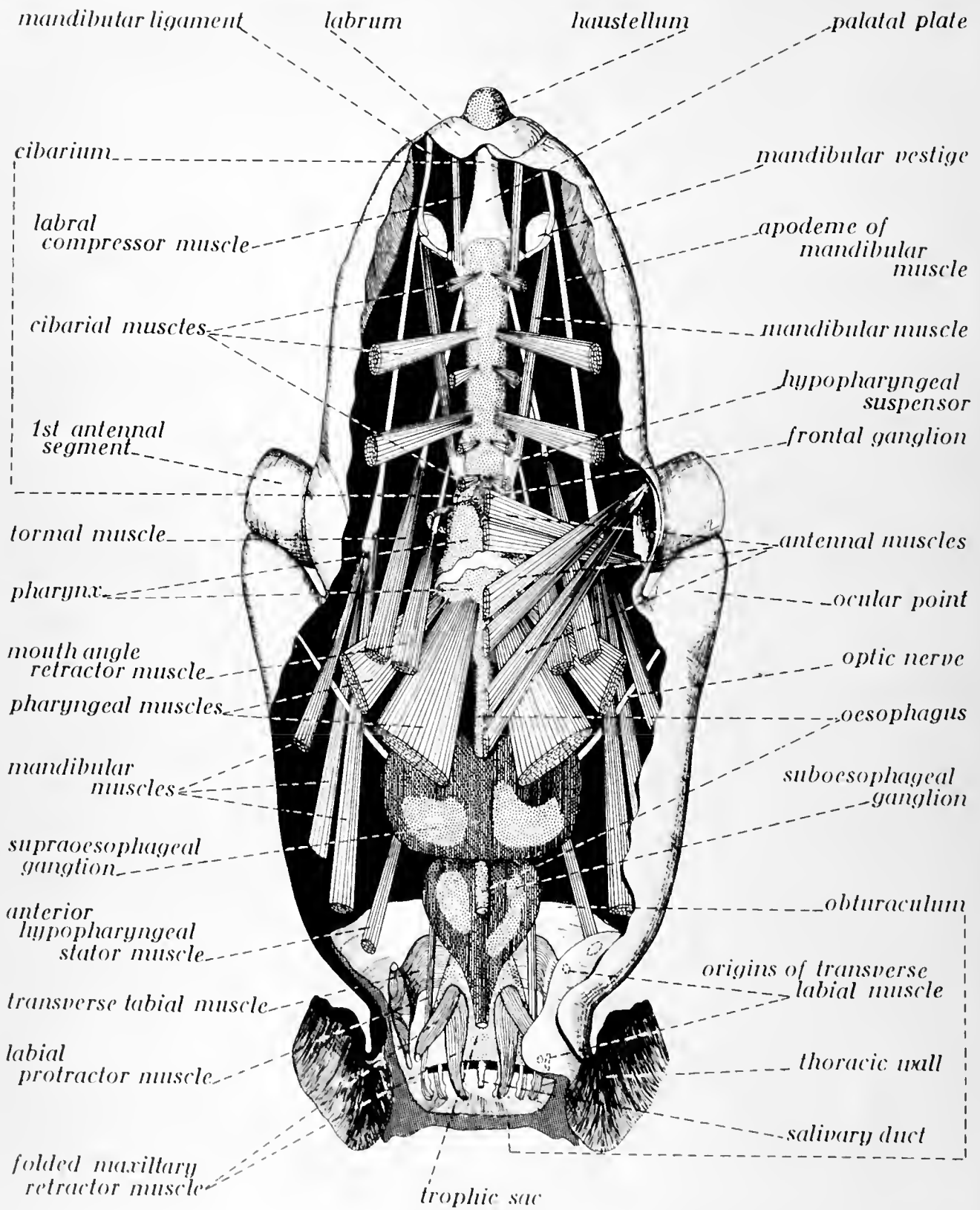
The base of the trophic sac extends into the concavity of the anterior end of the obturaculum and certain of the muscles which have their insertions on the apodemes of the trophic stylets originate upon the walls of the cup. Thus, the large, transverse labial muscle, which inserts upon the ventral surface of the trophic sac, originates in this manner as do the folded maxillary retractors and the labial retractors. The importance of this will be apparent upon reference to the illustration of the head of *Linognathus vituli* (Figure 12). Here it will be seen that the trophic sac extends far back into the thorax. Upon what would its muscles originate if the obturaculum were not present? This mass of connective tissue is evidently a part of the solution of the problem of functioning which is presented by the peculiar trophic mechanism and its significance in connection with this will be discussed later.

The origin and homologies of the obturaculum are at present quite in doubt. It seems evidently to be a mass of connective tissue, but at present there is very little information concerning the occurrence of such tissue in insects. Other work at present in progress has shown that a sheath



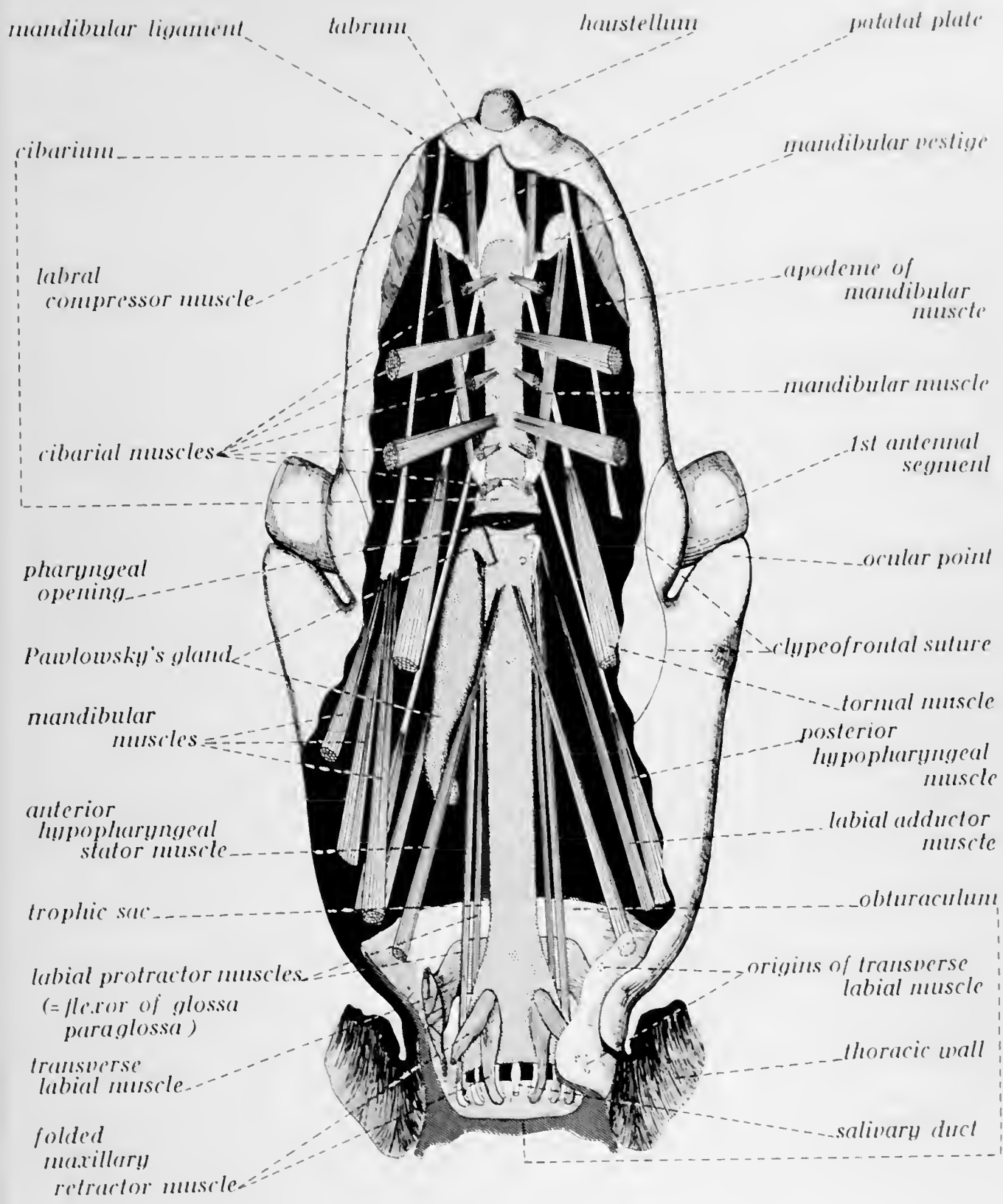
Internal structures of head in *Haematopinus suis*

Figure 5



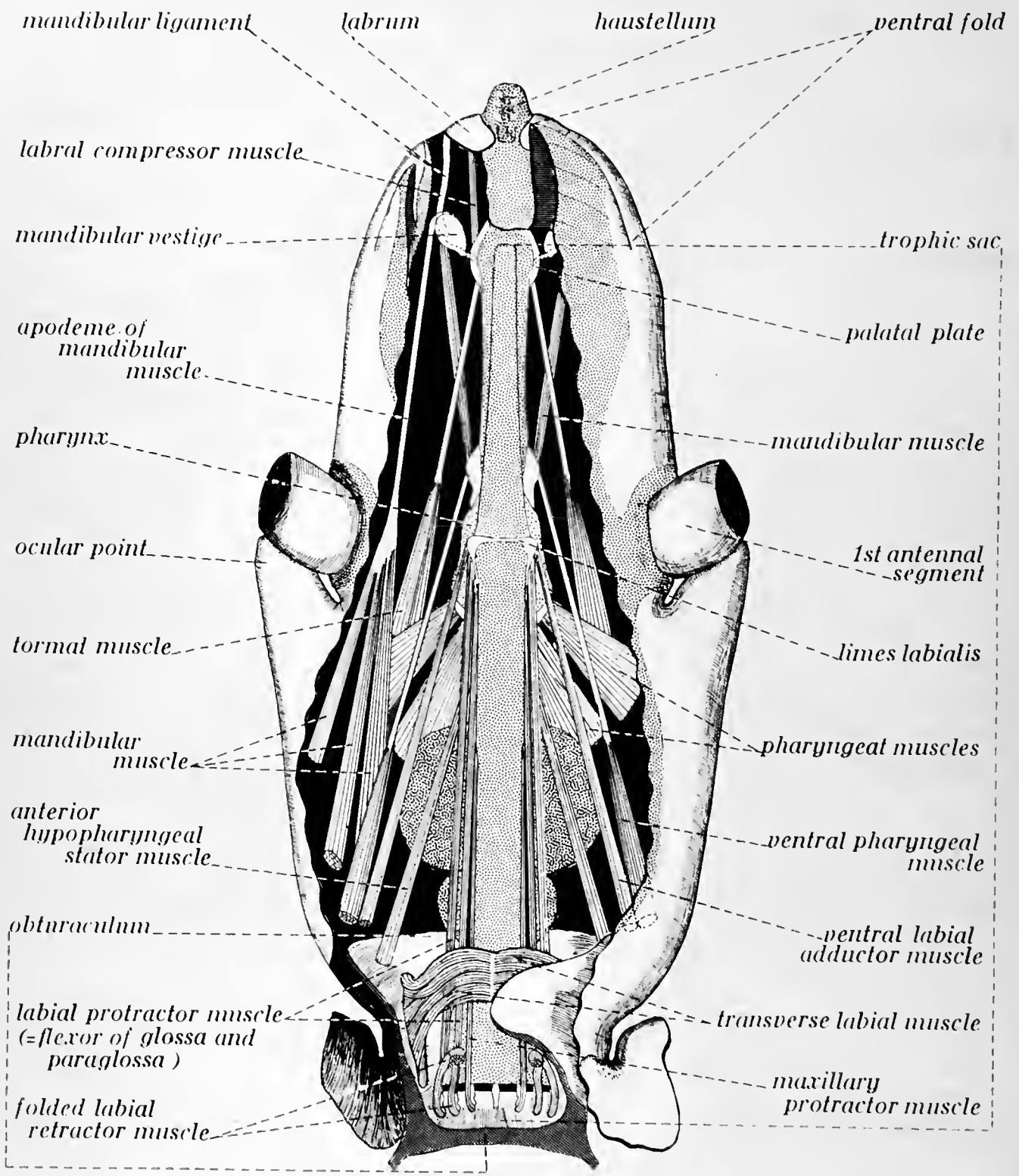
Structures in the head of *Haematopinus suis*, dorsal aspect

Figure 6



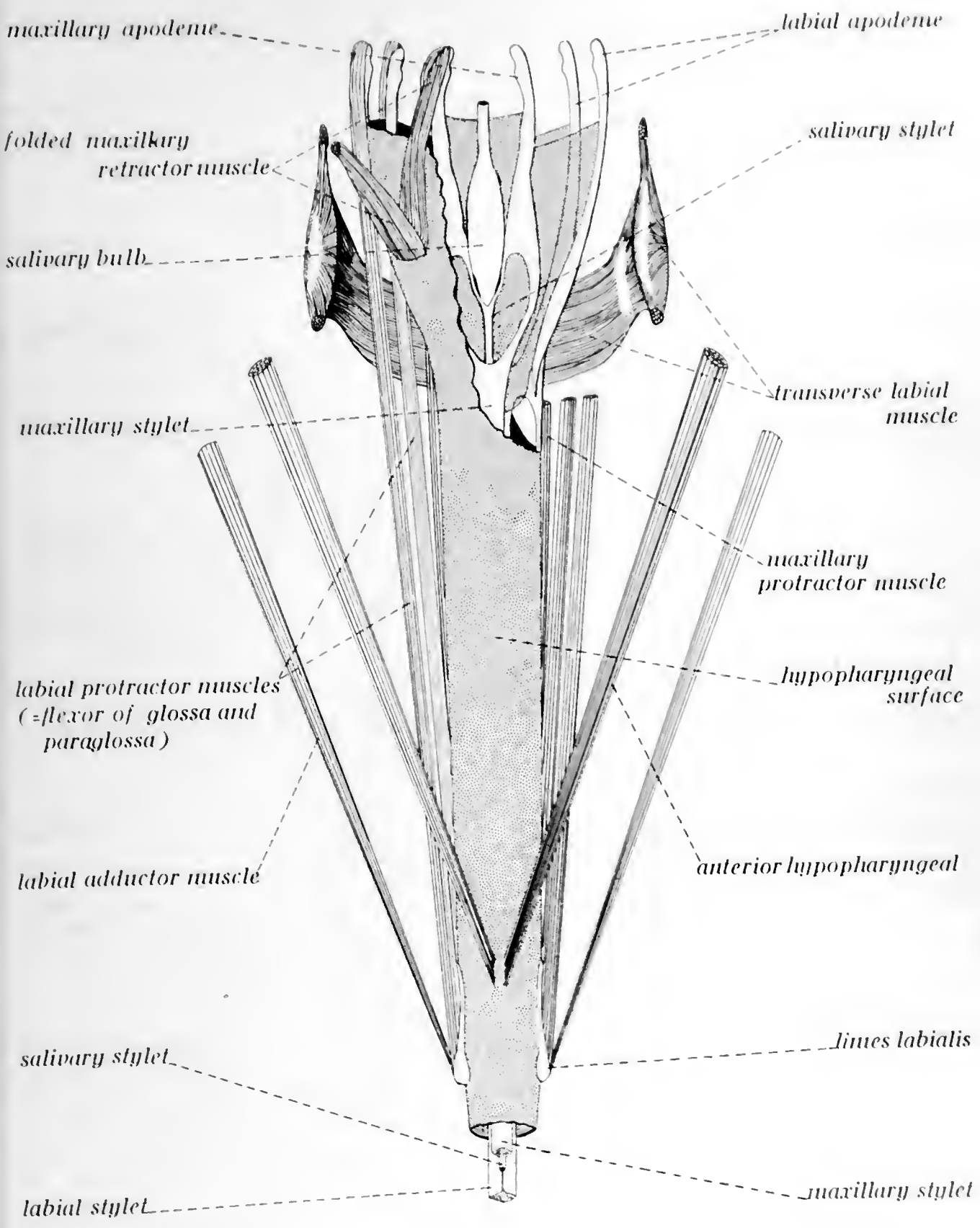
Structures in the head of *Haematopinus suis*, pharynx and brain removed

Figure 7



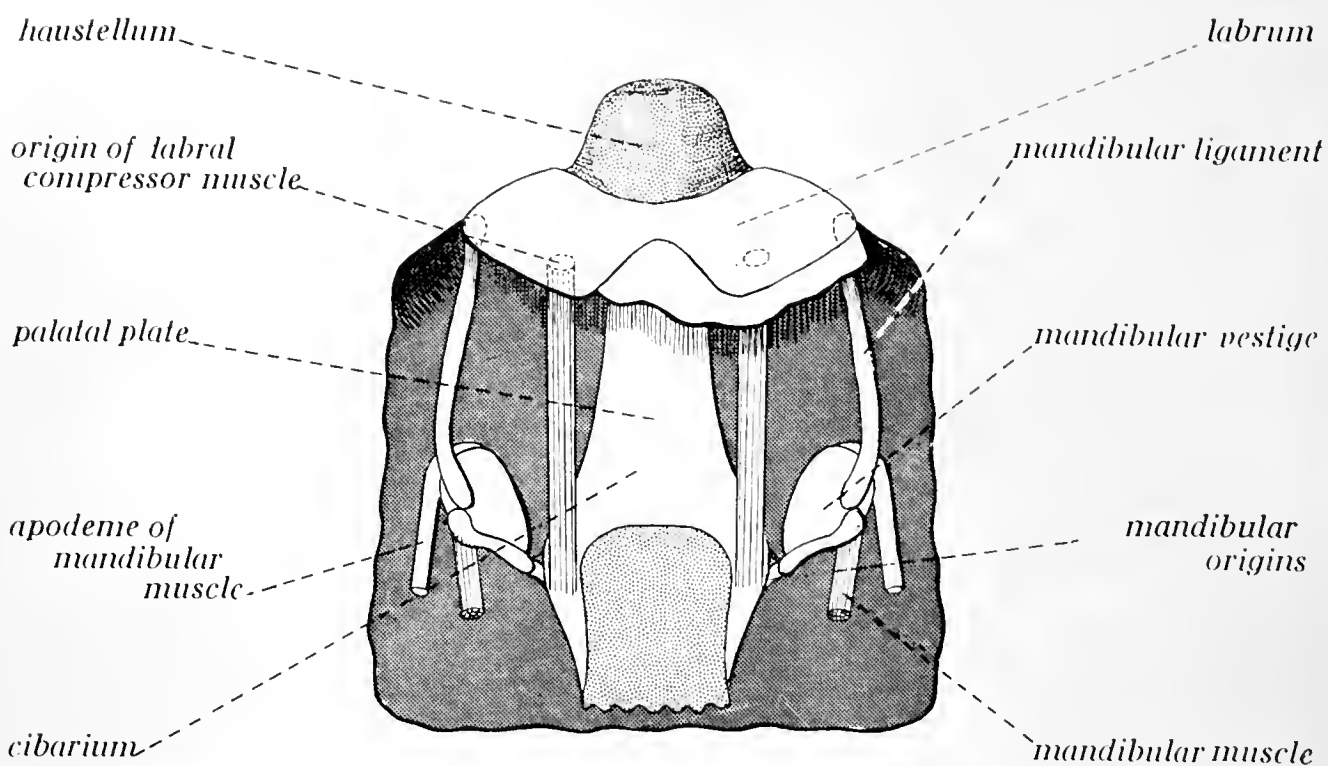
Structures in the head of *Haematopinus suis*, ventral aspect

Figure 8

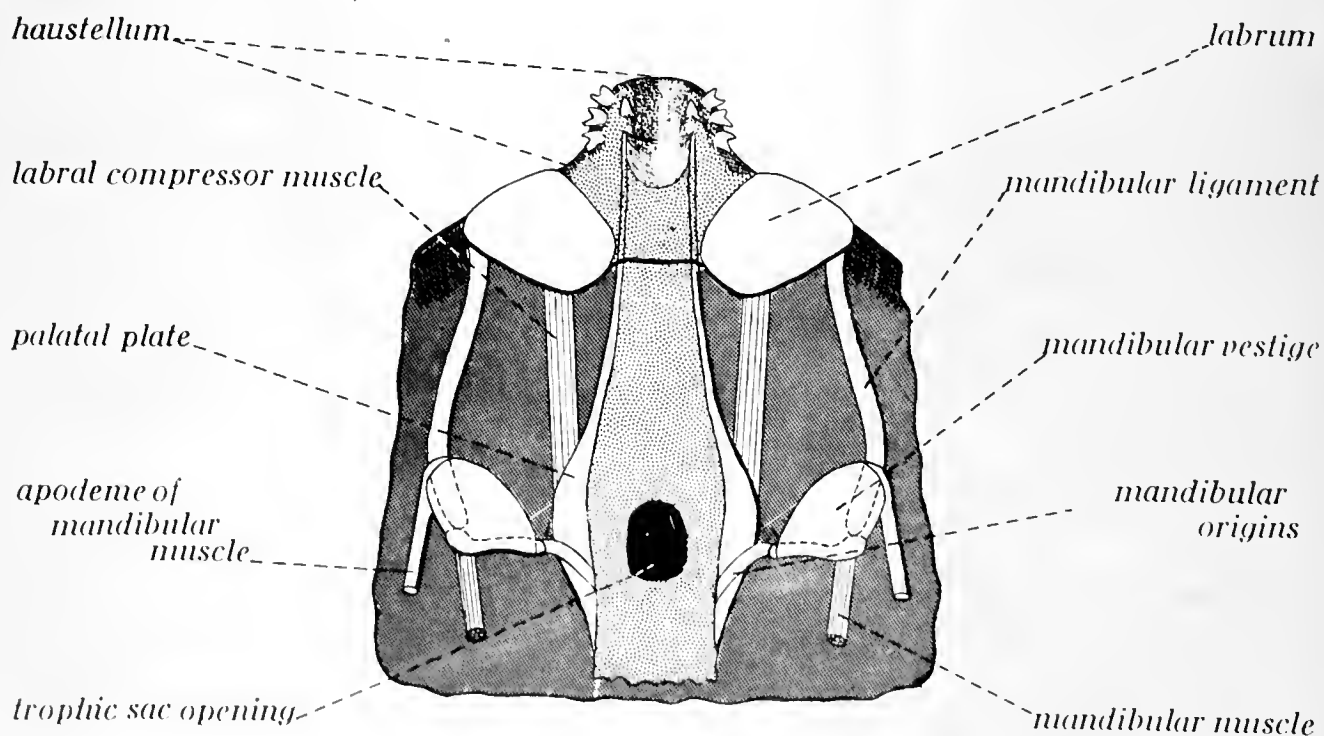


Base of trophic sac in *Haematopinus suis*

Figure 9



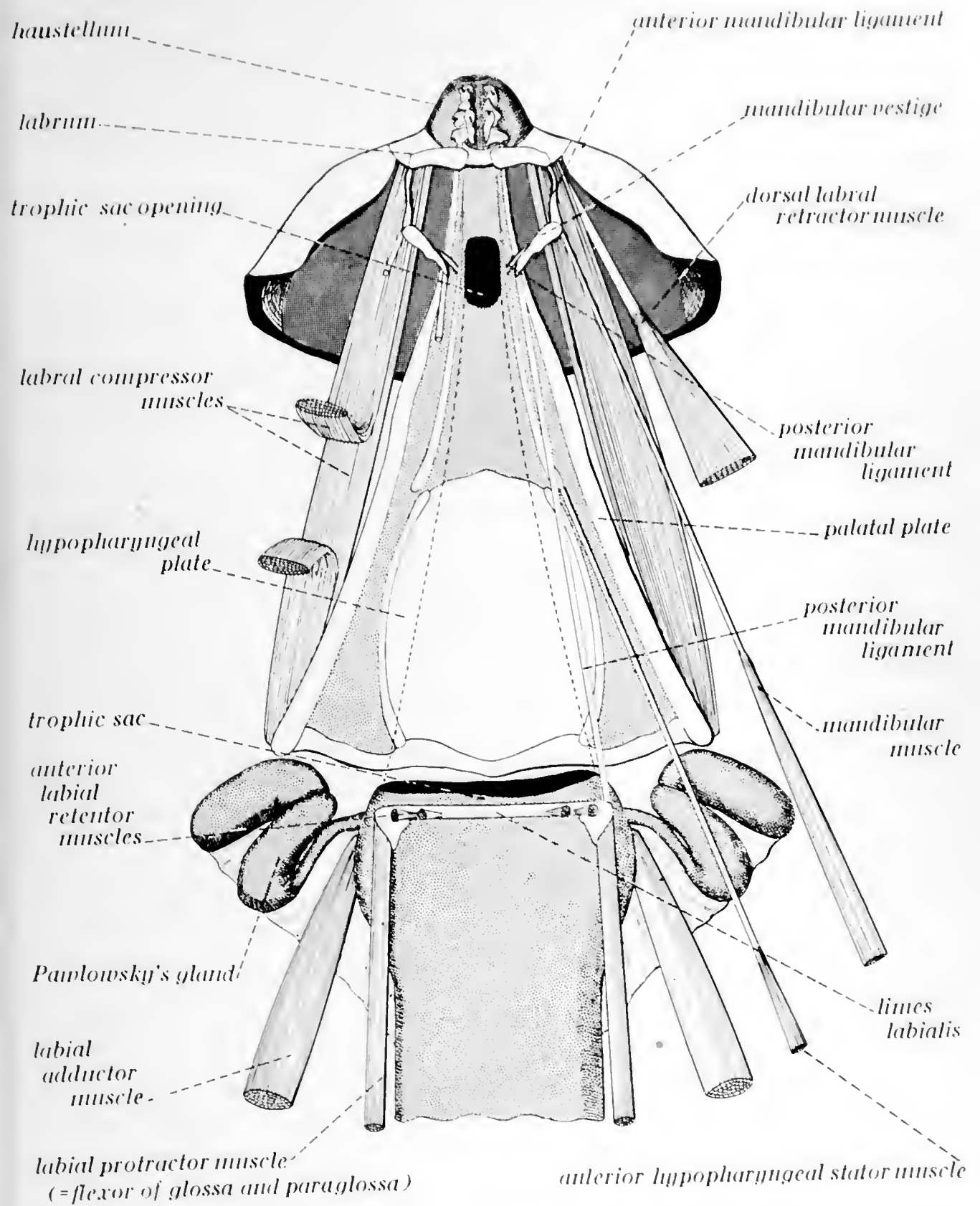
A. dorsal aspect



B. ventral aspect

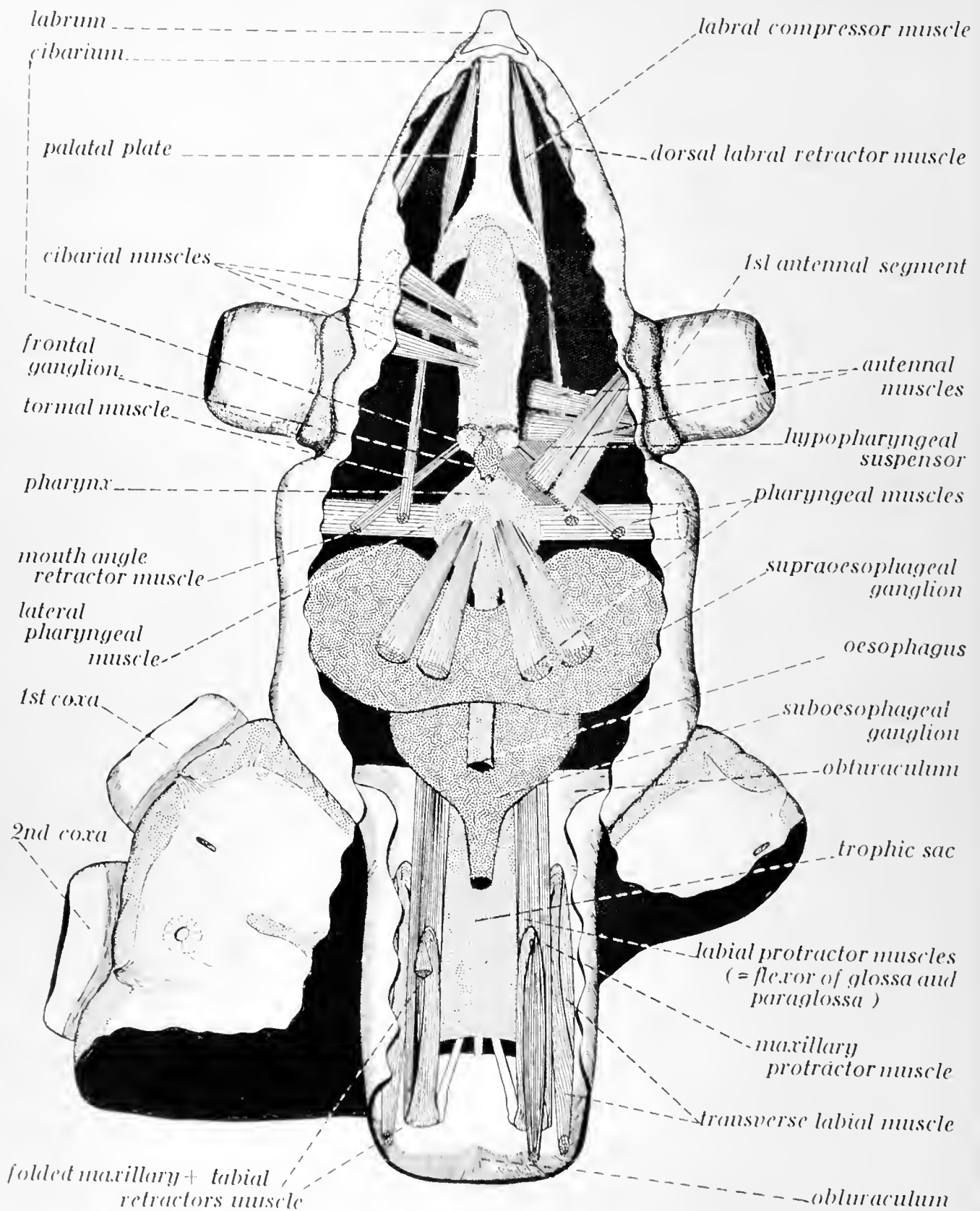
The mandibles in *Haematopinus suis*

Figure 10



Cibarial region in *Pediculus humanus*, trophic sac removed

Figure 11



Structures in the head of *Linognathus vituli* (Linnaeus)

Figure 12

of connective tissue which envelopes the thoracic ganglia and extends into the head occurs in a cockroach and offers the material from which the obturaculum could have been derived.

The Functioning of the Mouthparts

Some idea of how the trophic mechanism may function can be derived from contemplating the arrangements that have been described.

It seems probable, from purely mechanical considerations, that the slender muscles which extend forward from the branches of the maxillary and labial apodemes and attach to the walls of the trophic sac must act to pull the stylets forward, but it seems improbable that they can furnish the entire drive necessary for the complete exertion of the stylets. We may therefore surmise that the action of these muscles is aided by blood pressure. That pressure might very well be developed by the contraction of the powerful dorso-ventral muscles of the abdomen. The pressures thus developed would be transmitted through the obturaculum to the head cavity and thus brought to bear upon the trophic sac.

In any case, however the necessary force is developed, the stylets are pushed out of the trophic sac and forced into the tissues of the host. It is evident from the structure of the stylet bundle that the blood does not pass through any channel formed by the stylets themselves. If it did so it would merely pass into the trophic sac itself and not into the pharynx. We may assume, therefore, that the stylets merely serve to pierce a blood vessel. The membranous area at the apex of the head can be unrolled and appressed closely to the skin of the host. It seems probable that the blood is drawn up around the stylet bundle and into the mouth by the action of the pump formed by the pharynx.

The retraction of the stylets offers some interesting mechanical problems. Presumably the muscles which accomplish this are those indicated in the illustrations as the folded retractors of the labium and maxillae. These muscles when at rest are actually folded upon themselves and raise the question of how such a folded muscle can function. This may possibly be accounted for in the following way.

It seems probable that in forms such as *Linoëgnathus vituli*, where the trophic sac extends far back into the thorax, a rather peculiar muscle would be required to permit of the extreme degree of relaxation and extension that would be necessary when the stylets are fully extended and that this muscle would have to be extremely long. We suspect that when the muscles are extended they are under little or no strain. Note that these muscles originate on the obturaculum which is composed of a tissue that seems to be extremely elastic, as can be seen in dissections of fresh material. We may suppose then that when the stylets are to be withdrawn the retractor muscles give merely an initial pull and that the completion of the retraction of the parts is accomplished by the elasticity of the obturaculum. As the retraction comes to completion the retractor muscles simply fold upon themselves. We see no other way of accounting for the mechanics of such a peculiar arrangement.

The Antennae

The antennae are normally five-segmented and no species of sucking louse is known that has more segments than this. In a few species there is apparently a fusion of the two terminal segments, leading to an apparent four-segmented condition. In one genus, *Haematopinoides*, the antennae are definitely four-segmented. In a few species the three terminal segments are but weakly separated from each other and the antennae have the appearance of being three-segmented.

Each of the two terminal segments usually bears upon its posterior border a ring-like structure that may be regarded as a sensorium, but in some forms these are lacking.

No especially peculiar developments of the antennae are known. In some forms there is a slight sexual dimorphism which involves segment three in the male. This segment may have its apical, preaxial angle somewhat prolonged and this prolongation may terminate in a recurved spine or a short, stout seta or some other modification of setae may occur. In some cases a modified seta may here be present unaccompanied by any other modification. No instance is known where the antennae of the male are developed into such extreme clasping structures as occur at times in the Mallophaga.

The Eyes

Definitely developed and clearly recognizable eyes are present in only a few species of the sucking lice. In these species each eye possesses a single lens, beneath which is a pigment spot. The presence of such eyes has been accepted as a taxonomic character and has been much used in the definition of genera.

Webb* in a recent paper has shown definitely the existence of eye vestiges in *Haematopinus suis*, each eye consisting of a very small and obscure lens, "beneath which there are two or possibly four ovoid crystalline bodies surmounting a cluster of pigmented sensory cells ending in nerve fibres." He has identified—in all probability quite correctly—what he considered to be eye vestiges in a considerable number of species of *Haematopinus*, *Linognathus*, *Solenopotes*, *Ratemia*, *Prolinognathus*, *Hybophthirus*, and *Antarctophthirus*. They are definitely present in *Pediculus*, *Phthirus*, *Pedicinus*, *Microthoracius*, and *Pecaroecus*.

Unfortunately, the great majority of all the species of sucking lice are known only from preparations made from dried specimens and in the course of making these preparations any spots of eye pigment are destroyed and the lenses themselves at times become difficult or even impossible to recognize and to differentiate from any small, clear spot. For this reason the existence of eyes cannot at present definitely be demonstrated in many forms where they may actually exist. For this the study of properly preserved material must be awaited.

It is clear, however, that the presence of recognizable eyes cannot form a sound basis for any system of classification within the Order Anoplura, although in some instances it may offer good key characters for identification.

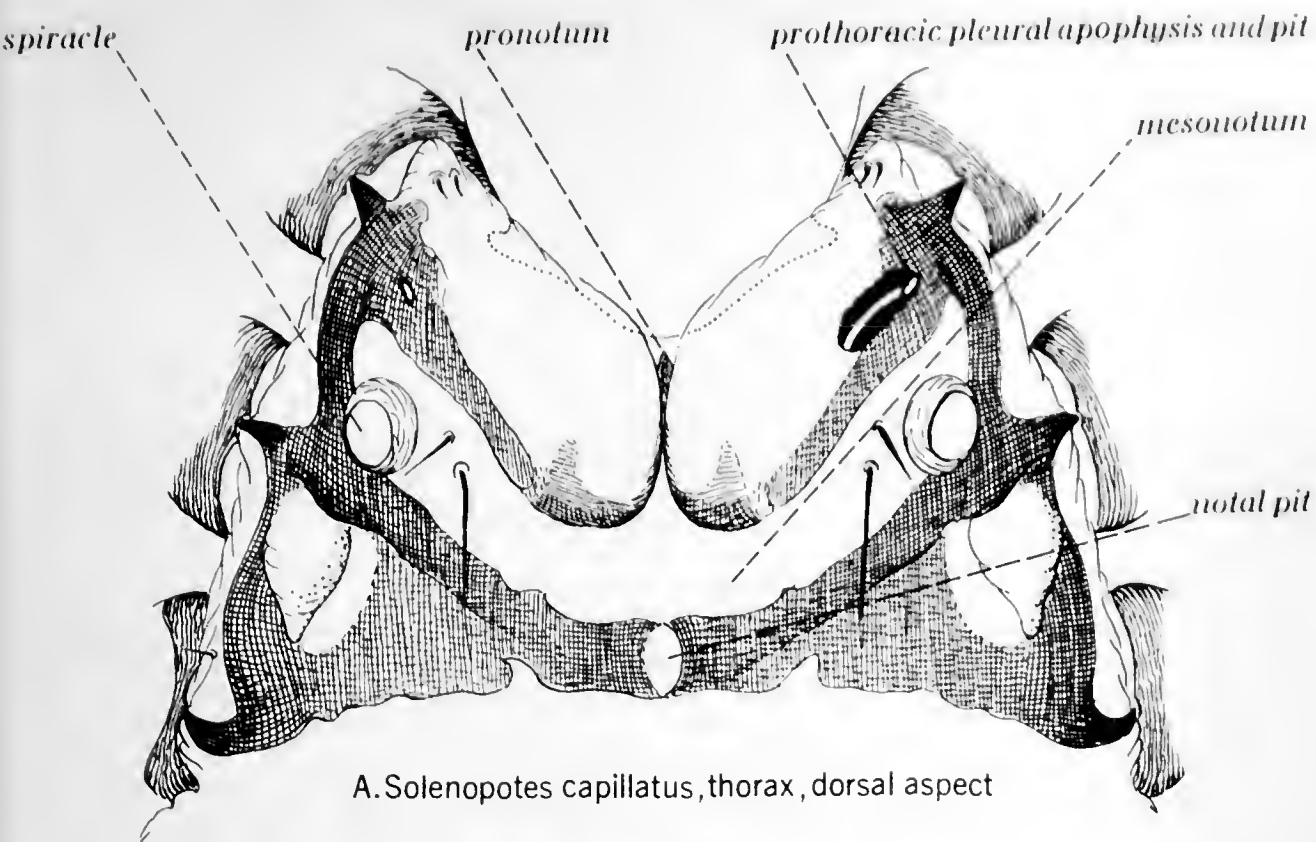
Webb has referred to these eyes as "ocelli," but their position indicates clearly that they are the morphological homologues of the compound eyes of other insects and not of the structures for which the term ocelli is ordinarily employed. Morphologically, they are vestigial compound eyes.

The Thorax Figures 13, 14

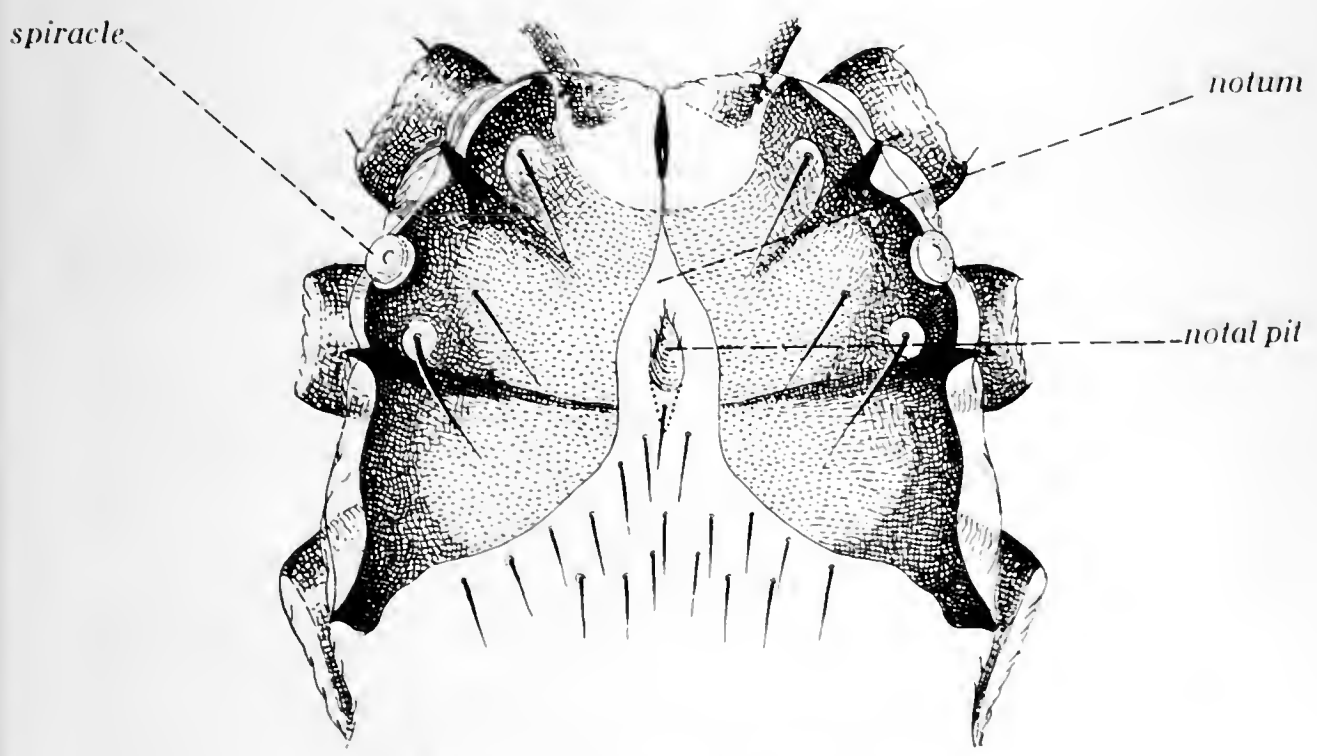
In association with the absence of wings the thorax is very much reduced. While three separate segments are definitely present they are closely fused and certain marked modifications have taken place. The metathorax is the most reduced of the three segments and may be represented only by small lateral elements. Only one pair of spiracles is present, this belonging to the mesothorax.

An understanding of the structure of the thorax in these insects rests upon the recognition of certain landmarks. In the vast majority of insects

* Webb, J. E. 1948. Eyes in the Siphunculata. *Proceedings of the Zoological Society of London*, Volume 118, Part III, Page 575.



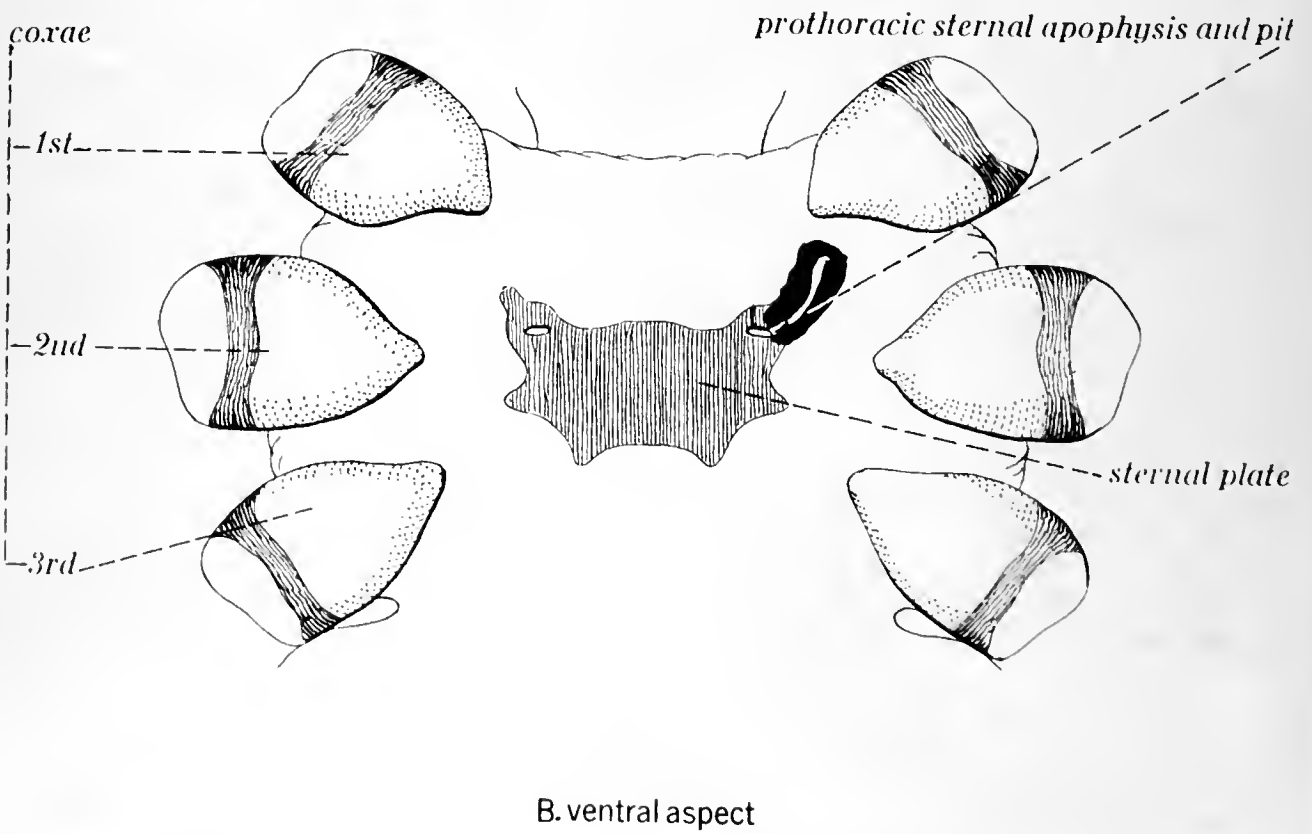
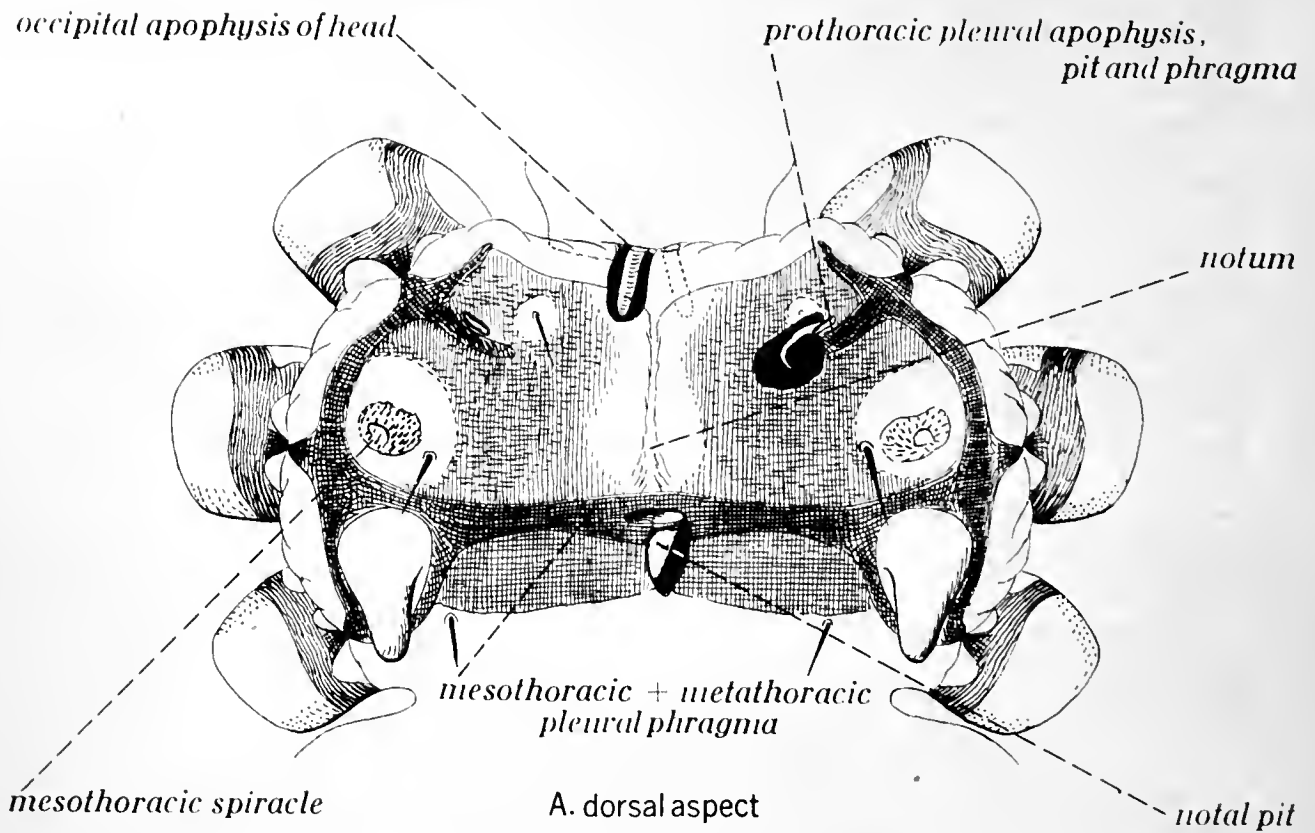
A. *Solenopotes capillatus*, thorax, dorsal aspect



B. *Pediculus humanus*, thorax, dorsal aspect

Structures of the thorax

Figure 13



Structures of the thorax in *Haematopinus suis*

Figure 14

there occurs on each side, on the so-called pleurite of the prothorax, an invaginated tubular internal process called the prothoracic pleural apophysis. The external opening of this apophysis lies in a fold or sclerotized stiffening rib that is known as the pleural fold or pleural ridge. The latter is best characterized as the prothoracic pleural phragma. The point of origin of this apophysis in the body wall is a precise landmark which definitely defines the "pleurite"—morphologically the subcoxa—of this segment. A similar phragma, but without such a definite apophysis, occurs on each of the other two segments. The principal coxal articulation in all insects is with the apex of this phragma.

On the basis of the landmark afforded by the prothoracic pleural apophysis and of other minor indications it is clear that the apparent notum of the thorax in the Anoplura is composed for the most part of the so-called pleurites, morphologically the subcoxae. The true notum, at the very most, includes merely a narrow median area, usually unsclerotized, and a lateral extension of this area on each side which includes the spiracle. In some species the notum is reduced almost completely to a median notal pit, the subcoxae having fused with each other across the mid-line of the dorsum, even to the extent of enveloping and isolating the notal element about the spiracles.

Perhaps the nearest approach to a normal thorax that is to be seen in any sucking louse is that found in the genus *Solenopotes* (Figure 13A). Here the pronotum is reduced merely to a median fold, but the mesonotum is of considerable extent in its anterior portion, although its posterior portion forms merely a median pit which lies in the subcoxal phragma. In *Haematopinus suis* (Figure 14) the notum is reduced to a slight median line throughout, with a very large median pit which is entirely enclosed by the mesothoracic subcoxal phragma, and the spiracles seem to form isolated islands of notal origin. In *Pediculus humanus* (Figure 13B) there is a somewhat broader notal area left, this being membranous and enclosing the notal pit, but the spiracles are even more completely isolated, being surrounded by a sclerotized area of the mesothoracic subcoxa.

Apart from the modifications of the mouthparts this reduction or almost complete obliteration of the notal areas of the thorax is perhaps the most characteristic feature in the morphology of the sucking lice.

The ventral side of the thorax is always quite simple. Nothing at all remains of the primitive ventral arcs of the subcoxae and the whole ventral area normally is membranous except for a single, median, sternal plate, even this not being present in some species. It is not clear whether this plate belongs to any one of the segments or is a fusion product derived from all of them. In a few species, such as in the genus *Haematopinus*, it is clear that the plate belongs at least in part to the prothorax, a pair of sternal apophyses being present which fuse with the prothoracic pleural apophyses in a manner like that found in many other insects. These sternal apophyses are present in only a relatively small number of the sucking lice.

In many Anoplura the sternal plate becomes free from the body around its margins, especially at its posterior end. In some species it is lacking and in a few it is merely an irregular, sclerotized area.

The Legs

The principal modifications of the legs are found in the tibiae and tarsi and are connected with the grasping of the hairs of the host. There is a single tarsal claw on each leg, except in four species. In these four species the anterior tarsus bears a short, somewhat hooked structure which arises at the side of the usual claw. This structure has the appearance of a claw but there is difficulty in being certain about its true nature and the opinion is here held that it is not actually movable.

The tarsus is at the most but weakly two-segmented and even this appearance of segmentation is usually obliterated. In almost all forms the tarsus is closely joined to the tibia and is but doubtfully movable upon the tibia. The tibia is usually more or less produced at its morphologically ventral apical angle, a thumb-like process being formed that opposes the claw and thus participates in grasping the hairs of the host.

Usually the anterior legs are smaller than the others and have a slender claw. In the majority of forms the middle legs are somewhat larger than the first, with stouter claw, and in most species the posterior legs are much broadened and flattened, with a stout claw. There are, however, various combinations of these characters and in a few species the legs are all of essentially the same size and form.

There is never anything that can be called a pulvillus, but frequently there is a small, membranous lobe or blade-like process on the inner margin of the tarsus. In *Haematopinus* there is a peculiar, sclerotized plate in the "palm" at the base of the tarsus.

Certain very peculiar developments found only in the genus *Euhaematopinus* will be discussed in connection with that genus.

The Abdomen

The primitive number of segments in the abdomen of insects is here considered to be eleven. The anus is borne upon the eleventh segment, the gonopore of the female upon the eighth (usually appearing as between the eighth and the ninth) and the gonopore of the male upon the tenth. If the full complement of abdominal spiracles is present there are eight pairs, borne upon segments one to eight. There is a rather general tendency for the number of abdominal segments to be reduced by the reduction or obliteration of segments either at the anterior or posterior ends of the body or at times in both. In order to determine the homologies of segmental structures in any insect it is necessary to rely closely upon established landmarks. Of these landmarks the gonopore in either sex may be regarded as the most useful. In the Anoplura the spiracles are of but little aid since no known species has more than six pairs.

Among the Anoplura the genus *Hoplopleura* seems most nearly to retain evidence of the full complement of abdominal segments. Here the paratergal plates, which will be discussed later, are present on eight segments and the eighth of these segments bears the gonopore in the female and also bears a pair of gonopods. The ninth segment is well developed, but the tenth and eleventh are reduced to mere membranous areas around the anus. The first segment is evidently much reduced, but can still be distinguished. Since in this genus all the evidence is harmonious and consistent we need have no hesitation in accepting it. We may therefore take the position of the vulva in the female, which lies between the gonopods of segment eight, as the initial point for all reckonings of segmentation of the abdomen.

In some forms, such as the genus *Linoëgnathus*, the abdomen is membranous almost throughout except for the tergum of segment nine and certain sclerotized areas on the ventral side in association with the genitalia. In others, such as *Haematopinus*, the derm of the dorsum is slightly sclerotized almost throughout with small plates of denser sclerotization and with sclerotized paratergal areas along the lateral margins. But in the majority of known species, the abdominal segments, both dorsally and ventrally, bear distinct, segmentally arranged, sclerotized plates in addition to the paratergal sclerotizations. These tergal and sternal plates are usually associated each with a row of setae and the arrangement of the plates and rows of setae is to some degree distinctive of the various genera. Thus, in *Polyplax* the female bears two plates and two rows of setae on most of the segments both dorsally and ventrally, while in *Hoplopleura* there are

normally three plates and three rows of setae on most of the segments. There are some species in which the plates are entirely lacking, but the rows of setae remain. There is a certain measure of sexual dimorphism in regard to the numbers of the plates and rows of setae in certain of the genera.

In the majority of known species there is at the lateral margin of each of at least some of the abdominal segments a distinct, sclerotized plate which bears or is at least closely associated with the spiracle, although these plates may be present on segments on which the spiracles are lacking. In earlier literature these plates were characterized as "pleural plates," but since the spiracles may be regarded as belonging morphologically to the dorsum the term "paratergal plates" or the term "laterotergites" is preferable. They are here called paratergites.

The number and form of these plates is of very great importance for the recognition of both genera and species. In some genera, such as *Hoplopleura*, *Schizophthirus*, and *Pterophthirus*, they form an overlapping series along each side of the abdomen, with their posterior margins free from the body and at times extraordinarily prolonged.

The External Genitalia of the Female

As already pointed out, the gonopore of the female belongs to the venter of the eighth abdominal segment. Morphologically, the gonopore and the vulva are not necessarily the same thing, since the gonopore may be retracted into the body with the consequent formation of a genital chamber or vagina into which surrounding elements may be withdrawn, even to the extent of involving the venter of one or more segments. However, in the Anoplura there seem to be no complications involved which disturb the apparently normal segmental arrangements.

The sternal plate of segment eight, lying anteriorly to the transverse fold which forms the vulva, is always or almost always in some degree sclerotized to afford support for muscle origins and this sclerotization at times involves also the venter of segment seven. These sclerotizations, which are usually in some degree united if more than one segment is involved, collectively form what is here called the genital plate.

The gonopods, which represent the primitive paired segmental appendages of segment eight, are practically always indicated at least by the presence of a cluster of setae on each side at the end of the vulvar fold. In the majority of species they are definitely represented by a pair of flattened, apically free lobes which at times are of considerable size. The mesal margin of each gonopod is continued into the fold that forms the lip or anterior margin of the vulva and this lip is at times beset with a fringe of delicate processes or is at other times simple.

Just within the vulva is the vaginal chamber. In some species the dorsal wall of this chamber is slightly sclerotized. Into this dorsal wall opens the duct of the spermatheca, if the spermatheca is present. In some species the spermatheca seems not to be developed, as in *Pediculus* and *Haematopinus*. It is very strongly developed in *Pthirus* and in at least most of the species of *Linognathus* and occasionally in other forms. In some instances where it appears to be lacking this may be occasioned merely by its weak sclerotization or perhaps even by its destruction in the making of the preparation. It is a structure which calls for further investigation.

The spermatheca itself, at its best development, is a swollen, sclerotized structure at the inner end of the sclerotized spermathecal duct (Figure 124) and there seems never to be more than one. Usually, the opening of the duct through the wall of the vagina is surrounded by a small area of dense sclerotization, if the duct is present.

The venter of segment nine bears near each lateral margin a tuft of setae, one or more of which may be enlarged and flattened and is also at times produced at each posterior lateral angle into a distinct lobe. These structures may—and very probably do—represent vestiges of the gonopods of this segment.

The sucking lice are therefore to be characterized as possessing at least vestiges of an ovipositor.

The External Genitalia of the Male Figure 15

In all insects the gonopore of the male belongs to the venter of segment nine of the abdomen. We cannot here enter into the much disputed problem of the homologies of the parts associated with these genitalia and their morphological origins. A study of the general problem, made by Dr. Joel Gustafson,* has been published and the following conclusions are derived from it.

Fundamentally, the structure of the external genitalia of the males of insects is a simple matter. There is the median gonopore itself. There is a pair of the primitive segmental appendages belonging to segment nine which form claspers, each consisting of a coxite and a one-segmented movable piece which is considered to represent the coxal style; and there is another pair of movable appendages, likewise belonging to the ninth segment, and derived morphologically from the primitive eversible sacs of this segment. These are the parameres. This simple basic set of structures may, however, be modified in fearful and wonderful ways.

First of all the gonopore may be borne at the apex of what we may regard as a papilla which may become so greatly enlarged that it forms a sac, here called the genital sac. This sac, when at rest, is usually retracted into the body. The gonopore may be surrounded by a sclerotization of the walls of the sac and a penis is thus formed. Furthermore, other sclerotizations of the walls of the sac may form as supporting structures for the penis and these structures may become extremely complicated. The entire structure included in all this is the aedeagus.

The pair of structures formed from the primitive segmental appendages of segment nine may form elaborate clasping structures for holding on to the female during copulation, or they may be reduced or even lost.

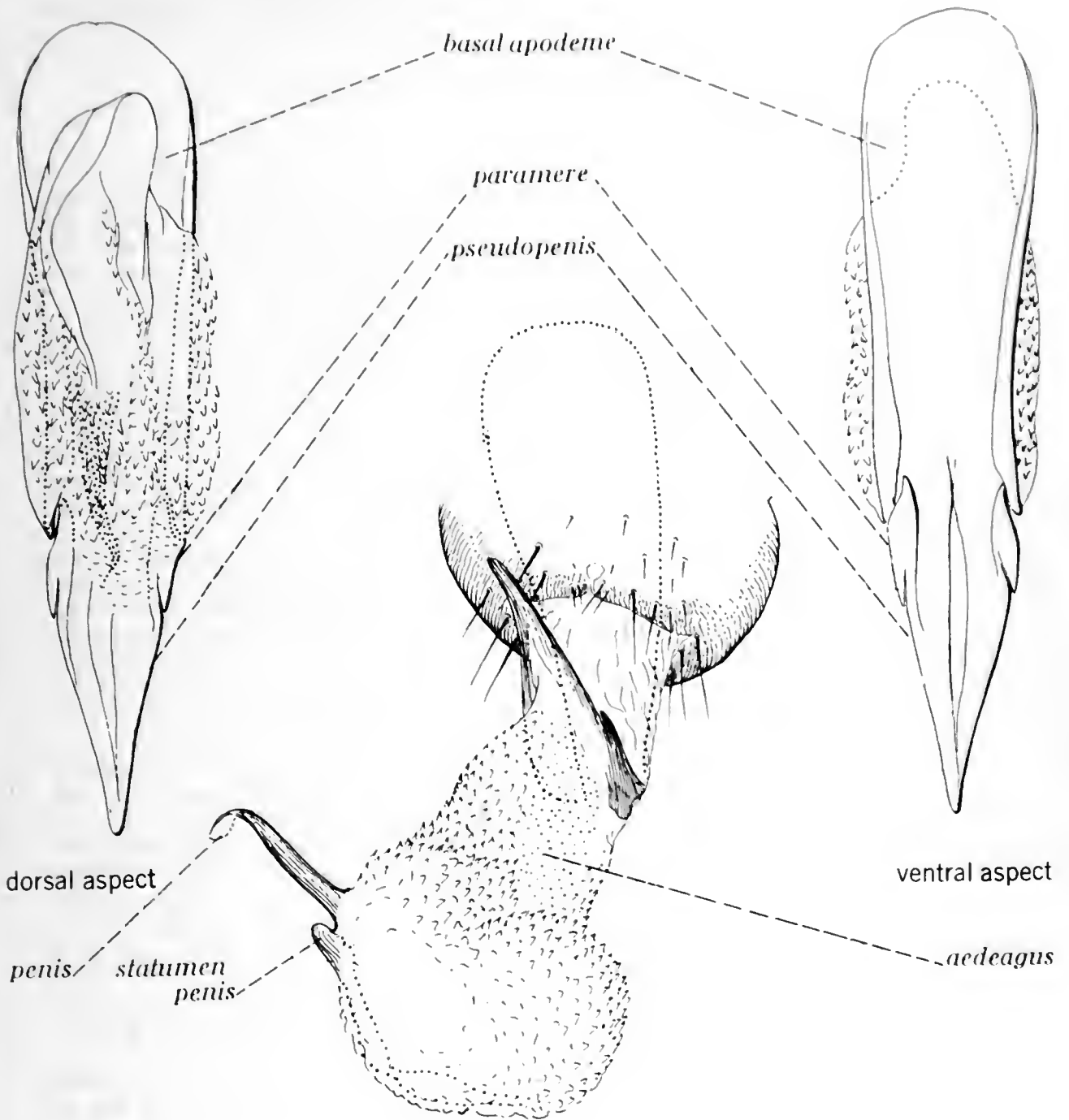
The other pair of movable structures, the parameres, may become very closely associated with the base of the aedeagus or may even seem to become a part of the aedeagus itself. Or they may be lost. Only rarely do both the claspers and the parameres appear clearly developed in the same insect and consequently doubt has at times been expressed—or in fact the definite opinion has been expressed—that two pairs of movable structures do not actually exist. But the fact that both pairs were a part of the primitive genitalic complex is indisputable and there are insects in which both are retained.

Because of these factors of loss of some parts, coincidentally at times with unusual development of other parts, the homologies of the parts are at times much obscured. But if we cling closely to principles and identify the landmarks consistently, genitalia of even the most complicated appearance can be shown to consist merely of modifications of these few basic parts.

Now to apply these ideas to the Anoplura.

The structures appear in a very simple and even somewhat reduced form in the male of *Pediculus* (Figure 15) as shown in their expanded position when engaged in copulation.

* Gustafson, Joel F. 1950. The Origin and Evolution of the Genitalia of the Insecta. *Microentomology* 15: 2.



Genitalia of the male of *Pediculus humanus*

Figure 15

We have here a very large genital sac. Near the apex of the sac is the gonopore, which is borne upon a sclerotized, tubular process, the penis, formed as a continuation of the walls of the sac. Close to this penis is another sclerotization of the walls of the genital sac, for which the term "statumen penis" was employed by Nuttall—and which presumably serves to aid in supporting the penis. Arising from the dorsal wall of the sac, toward its base, is a fold of the wall which is partially sclerotized and forms a quite large, V-shaped structure, the apex of which is free. For this, no better term than "pseudopenis," which in the past has been employed, is available. Partially fused with the base of the pseudopenis there is on each side a short, strongly sclerotized piece which is apically free. These pieces are here interpreted as the parameres, a term that has commonly been employed for similar structures throughout the group and which is in all probability morphologically correct. Articulated to the base of the sac is a long, flat, sclerotized apodeme which extends into the body. This piece has commonly been called the basal plate, but the term genital apodeme would be better.

When the genitalia are at rest they are retracted into the body, with no more than the apex of the pseudopenis extruded. The parts are then necessarily folded upon each other in such a manner that it is difficult to determine their exact relationships and in our systematic work, in which the details of the genitalia of the male are of great importance for the separation of species, we can as a rule do little more than merely to recognize the sclerotized parts as seen in the retracted position.

The changes in the structure of the genitalia are very largely concerned with changes in the details of form of the various sclerotized parts, the parameres, the pseudopenis and the sclerotizations of the genital sac. In some species apparently certain additional structures are formed from the walls of the sac which are not yet completely understood and remain to be elucidated in the future, but this happens in only a few species. In general, if one will recall the simple basic plan of structure, it will not be difficult to understand the illustrations which will be presented in connection with the species which are to be treated in detail.

The Tracheal System Figure 16

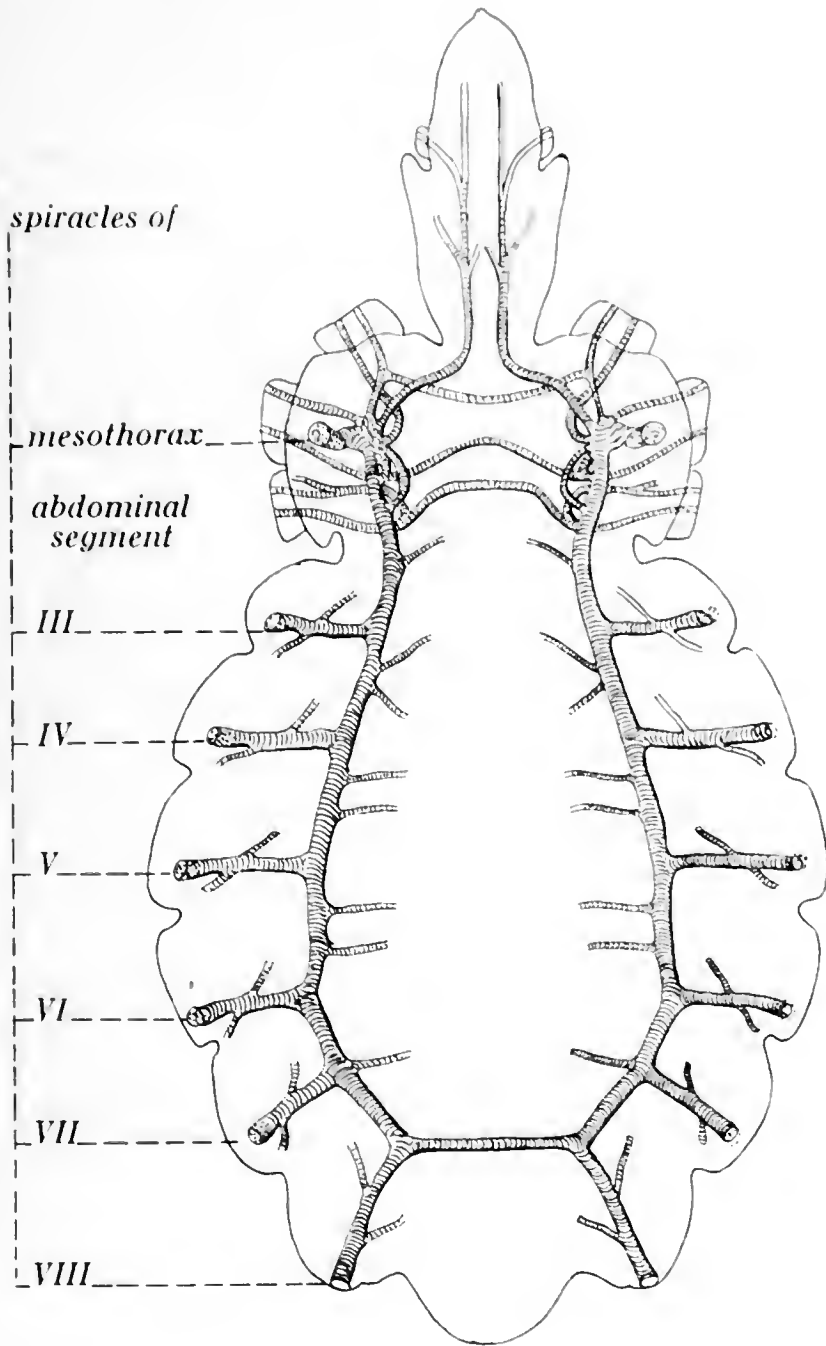
As has already been pointed out the thorax always bears but a single pair of spiracles, these belonging to the mesothorax. They have at times been ascribed to the prothorax, but this is definitely in error, since no insect, with the very dubious exception of some of the Apterygota, possesses prothoracic spiracles. It has at times been claimed that a pair exists on the metathorax in some of the sucking lice, but this too is definitely in error.

No species of Anoplura possesses more than six pairs of abdominal spiracles, these being on the third to eighth segments. In many species the number is less. In one genus, *Neolinothrus*, there is but one pair, this being on the eighth segment.

The tracheal system itself is very simple. There is but one tracheal trunk on each side of the body and there are no tracheal sacs. The accompanying illustration of the tracheal system of *Haematopinus suis* will suffice (Figure 16).

The spiracles, however, present some points of special interest. While they have in the past been illustrated for a few species, the only comprehensive studies of them are those of Webb.* Webb has studied them to some

* Webb, J. E. 1946, *Proceedings of the Zoological Society of London* 116: 49-119; 1947, *Proceedings of the Zoological Society of London* 116: 575-578; 1948, *Proceedings of the Zoological Society of London* 118: 582-587.



Tracheal system of *Haematopinus suis*

Figure 16

extent in histological preparations and also has given an extensive account of them as they appear in such preparations as are used for taxonomic purposes.

It is not possible in a general work such as this to go into this subject in all its details, but since Webb has proposed a partial classification of the Anoplura on the basis of the spiracles they must be considered at some length.

It may be noted at the beginning that the thoracic spiracles usually differ somewhat from those of the abdomen, usually being definitely larger—as is common in almost all insects—and also slightly different in details, although of essentially similar character. They are ordinarily somewhat difficult to study because of the presence of other structures that somewhat obscure them and we shall here concentrate attention upon the abdominal spiracles.

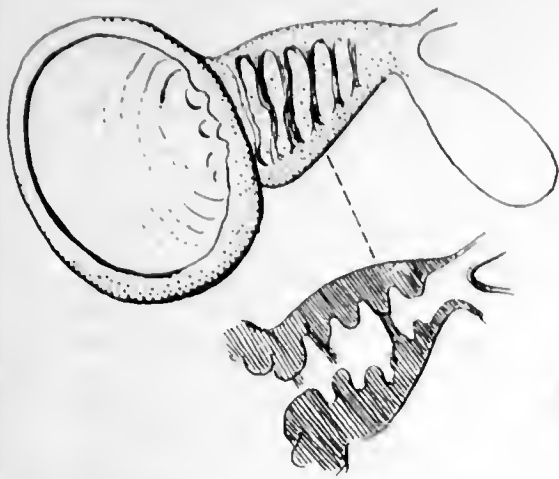
In its simplest form an Anopluran spiracle consists of the following parts. There is an oval or circular opening which leads into a somewhat expanded chamber called the atrium. This chamber possesses quite strongly sclerotized walls and may be subglobular or more or less elongated. On its inner end it is constricted, usually very suddenly, and then continues into a tapering second chamber which finally becomes much attenuated. At the point of greatest attenuation there is usually attached to its wall a minute, sclerotized rod which is the apodeme of the oclucosor muscle. At this point the trachea begins with its usual ctenidial threads.

The oclucosor muscle originates upon the body wall and by contracting seems to bring about a pinching of the attenuated inner end of the atrium, thus closing the spiracle. In some forms the apodeme of the oclucosor muscle seems to be lacking and the muscle inserts directly upon the wall of the atrium.

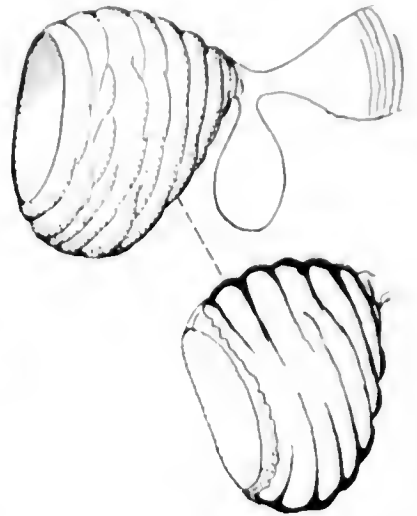
Webb has described a gland which accompanies the atrium and discharges a waxy material that coats the inner walls of the chamber. This gland, however, will not appear in ordinary taxonomic preparations. Webb has indicated that in some cases what he considers to be the duct of this gland has taken over the duty of forming the narrowed air passage into the trachea, while a portion of the attenuated atrium has been left as a side chamber that ends blindly. This side chamber is at its greatest development quite small. On the basis of Webb's own illustrations and upon general morphological grounds, it is here maintained that Webb has misunderstood the situation. The present writer does not believe that any such change as that indicated has occurred. It seems much more probable that the atrium at times is produced on one side somewhat past the internal opening into the spiracle and thus forms a slight diverticulum.

The walls of the atrium may be beset with little points or ledges which project into the chamber on the inner side, as Webb has clearly shown in histological sections. These ledges vary greatly in their size and extent and in the degree and manner in which they may anastomose with each other. Viewing a spiracle from the side they are indicated as dark lines which sometimes form rings about the chamber or form a network. At times they correspond with deep furrows on the wall of the chamber that may result in constrictions, which divide the atrium in ring-like sections as shown in Figure 17.

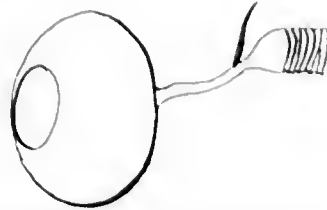
The simplest spiracle which appears in the extensive material at hand is that of *Scipio aulacodi* (Figure 17). Here we have an almost spherical atrium, with apparently no internal ledges. It constricts very abruptly into the slender prolongation that leads to the opening of the trachea. A very similar arrangement is seen in *Haematopinooides squamosus* (Figure 17). In *Eulinoëgnathus aculeatus* (Figure 17) the appearance is the same except that the second chamber is somewhat swollen and has thickened walls. The next step seems to be represented in *Haemodipsus ventricosus* and *Neohaematopinus*



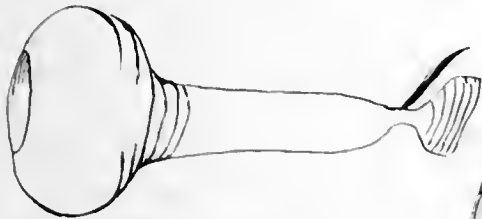
Adroctenes



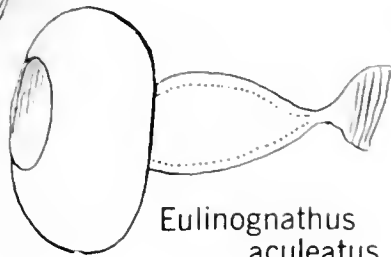
Hesperoctenes



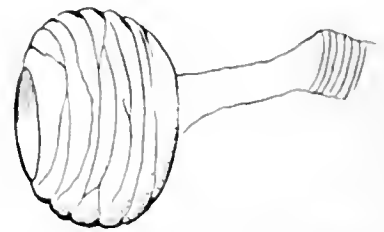
Haematopinoides squamosus



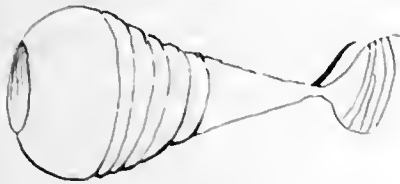
Haemodipsus ventricosus



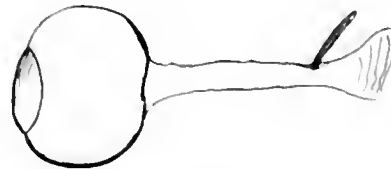
Eulinognathus
aculeatus



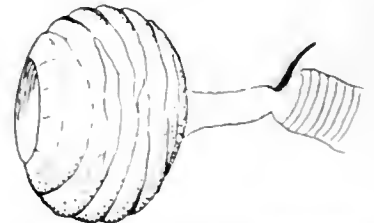
Phthirpediculus propithecii



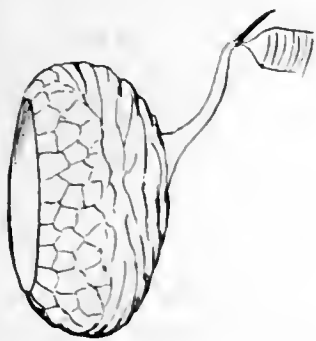
Neohaematopinus sciuropteri



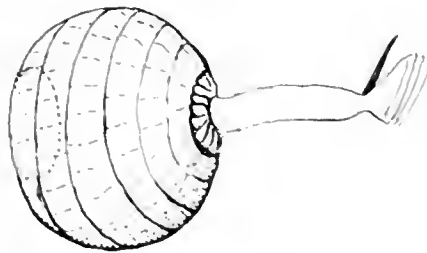
Scipio aulacodi



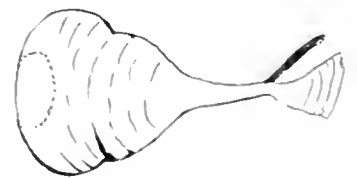
Hoplopleura acanthopus



Neolinognathus praelautus



Polyplax spinulosa



Ctenophthirus cercomydis

Spiracles of Anoplura and Polyctenidae

Figure 17

sciuropteri (Figure 17) where the transition from the atrium to the second chamber is more gradual and shows annular constrictions which appear as slight ledges inside the chamber. In *Phthirpediculus propithecii* (Figure 17) and *Hoplopleura acanthopus* (Figure 17) the walls of the atrial chamber present a number of slight furrows marking the position of internal ledges which anastomose to some degree. In *Enderleinellus longiceps* (Figure 18) the chamber presents deep, annular constrictions which are widely spaced. In some species, such as *Neolinognathus praelautus* (Figure 17) and *Enderleinellus malaysianus* (Figure 18) the lines marking the internal ledges become more or less anastomosed, forming a network which marks out cell-like areas on the surface.

In *Microthoracius mazzai* (Figure 18) the lines mark out very distinct cells, but here we have a quite distinctive feature in the fact that at the points of intersection of the internal ledges the ledges form pointed processes projecting into the atrial chamber.

Very beautiful examples of a network and enclosed cell-like areas is furnished by *Linognathus setosus* (Figure 18) and *Linognathus stenopsis* (Figure 18). In these species, what seems to represent the diverticulum formed by the spiracular gland appears as a slight swelling at one side of the base of the second chamber. In *Solenpotes capillatus* (Figure 18) the atrium is elongated and almost cylindrical, with the lines which mark the courses of the internal ledges forming a quite distinctive angular pattern, but in other species of this genus the atrium is more nearly spherical although the pattern of the lines is similar. In this genus also there is a tendency for the spiracle to be borne in a slightly elevated, more or less sclerotic tubercle, but this is at times much reduced or but little evident.

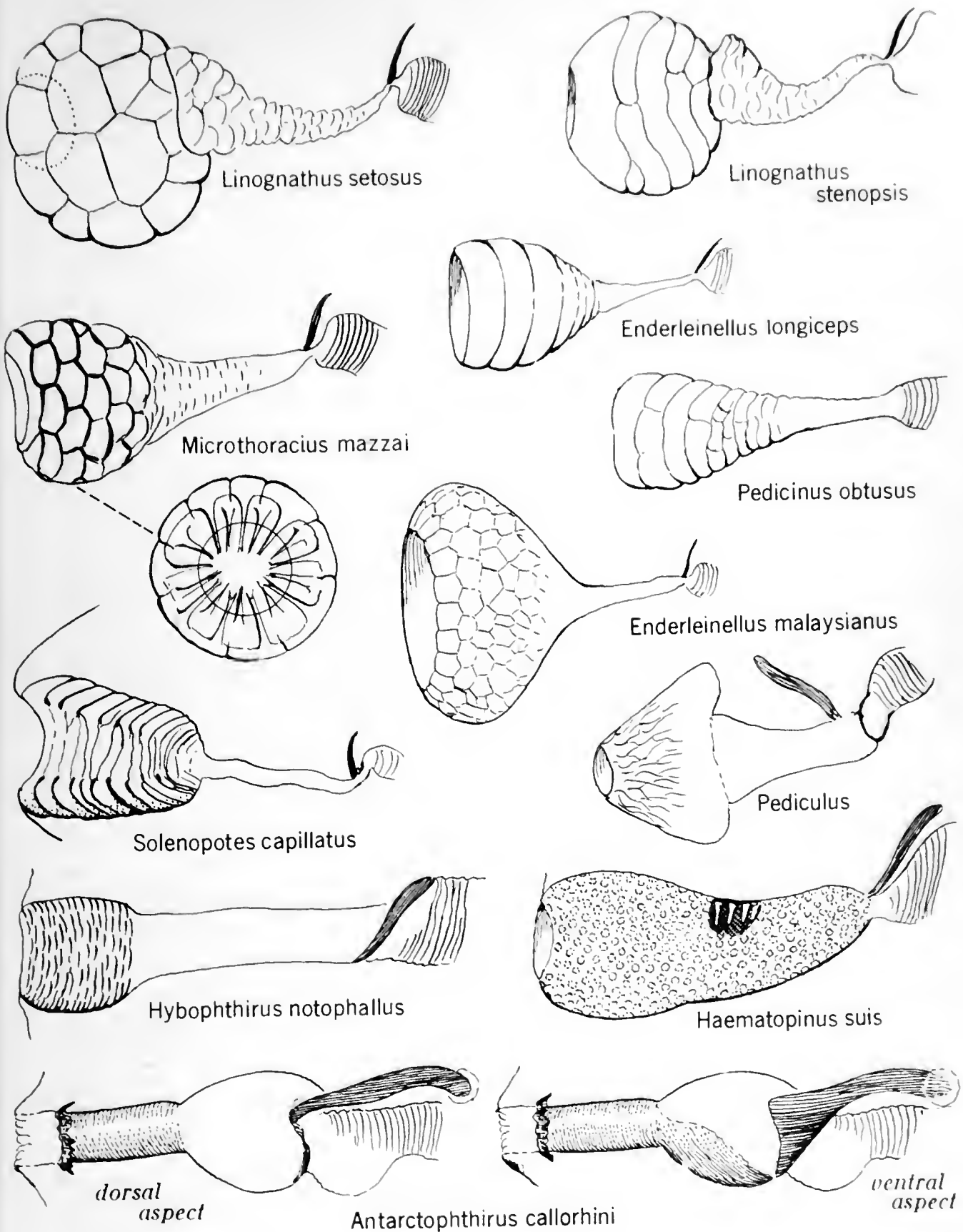
In *Hybophthirus notophallus* (Figure 18) the atrial chamber is short and almost cylindrical, with its walls marked by very short and non-anastomosing lines indicating the presence of short and interrupted internal ledges. The second chamber is but little narrower in diameter than the atrium.

In *Pediculus humanus* (Figure 18) the atrium is more or less conical with the opening at the apex and is marked by longitudinal lines. Inside it is beset with slender points. A quite similar arrangement appears in *Pthirus*.

In *Haematopinus suis* (Figure 18), as in other species of this genus, the atrium is elongated, apparently including the second chamber of the area usually occupied by the second chamber, and is marked throughout by little, circular areas which correspond with multitudinous points which line its inner wall.

The most distinctive spiracles in the Order are those of the lice of marine carnivores. These are here illustrated (Figure 18) as they occur in *Antarctophthirus callorhini*, a species in which the membranous derm permits them to be clearly seen. Here the spiracle opens through a short, membranous papilla. Slightly in from the apex of the papilla is a peculiar, sclerotized collar which marks the beginning of a short, simple, sclerotized tube that constitutes the atrium. The spiracle then expands into the second chamber, which may be membranous or partially sclerotized and forms a sort of bulb. To the wall of this bulb attaches the large apodeme of the occlusor muscle and then the trachea begins. This type of spiracle is very distinctive of the little group of species considered to form the family Echinophthiriidae.

The significance of these structures in the intra-ordinal classification of the Anoplura will be considered in the chapter on classification. As having a possible bearing upon the question of their value for such purposes, there are here presented illustrations (Figure 17) of the spiracles in two genera of the Hemipterous family Polycetenidae, which are ectoparasites occurring on bats. It may be noted that in their general features they quite closely resemble the spiracles of some of the Anoplura. They display the same characteristics of an atrium and a second chamber, with



Spiracles of Anoplura

Figure 18

the walls of the atrium beset internally with ledges. The principal difference lies in the presence of a very well-developed diverticulum which may possibly represent the atrial gland described by Webb for the Anoplura.

We may here call special attention to the spiracles of *Enderleinellus malaysianus* (Figure 18) and *Enderleinellus longiceps* (Figure 18). It may very well be that at some time in the future these two species will be referred to different genera, but with the utmost degree of splitting they will stand as still belonging to closely related genera. Yet the pattern of these spiracles does not suggest any close relationship.

Internal Anatomy

There still remain numerous details of the internal anatomy of the Anoplura which have not been well investigated and which cannot here be considered. This chapter is therefore somewhat incomplete. It will be concerned only with the major features, especially as they may have a bearing upon the understanding of external morphology and thus aid in the problem of taxonomy.

The Head

It was necessary to consider certain aspects of the internal anatomy of the head while we were attempting to explain the homologies and functioning of the mouthparts. What remains to be reviewed consists chiefly of the nervous system.

We have briefly mentioned the musculature of the antennae. In insects which are provided with a tentorium the muscles of the antennae originate upon it. But since there is no tentorium in the Anoplura the muscles originate upon the head wall. There is some variation in the position of their origins, in *Haematopinus* all being upon the dorsal wall, while in some other species a portion of the origins are upon the ventral side.

This is a matter of some general interest, since the claim has been made by one morphologist that the origins of muscles do not shift. There can be no possible question of the fact that they do so in these insects.

Pawlowsky's glands, as previously noted, are a pair of rather large, apparently glandular structures, opening separately through the dorsal wall of the trophic sac (Figure 11). They are innervated by a branch from the hypopharyngeal nerve and thus may definitely be regarded as belonging to the hypopharynx and consequently to the clypeal segment. A general study of the occurrence of glands in this region in other insects will be required before their homologies can be determined.

We may here call attention once more to the peculiar mass of connective tissue which occurs in the posterior portion of the head and which we have called the obturaculum. It extends into the thorax, where it envelopes the thoracic ganglia of the nervous system. It serves as the point of origin of various muscles and in this respect, if in no other, presents a quite unique development. Again, no conclusions concerning this mass of tissue can be drawn until a general study of connective tissue in this region of the body of other insects has been made. The present knowledge of the occurrence of connective tissue in the bodies of insects is exceedingly slight.

The salivary glands have already been noted and described in connection with the morphology of the head and mouthparts.

The muscles found in the head have been considered to some extent in connection with the description of the mouthparts. We shall not here describe them in detail, muscle by muscle, relying rather upon the illustrations which have already been presented, but we shall refer to them again in connection with the nervous system.

The Thorax

Figures 13, 14, 19

It has already been pointed out that the true notum of all of the thoracic segments is much reduced. Apart from the ganglia of the nervous system, which will be considered later, the thorax is occupied mostly by the muscles connected with the legs. We shall here content ourselves with a general description of the disposition of these muscles which will aid to some degree in understanding the external structures.

In Figure 19A the muscles are shown as they appear when the dorsal derm has been removed. In Figure 19B are shown the muscles which are revealed by the removal of the first layer of dorsal muscles.

Note in Figure 14A the prothoracic pleural ridge or phragma. Upon this phragma there originate on each side of the body a little cluster of muscles which insert upon the anterior margin of the sternal plate, these being properly designated as the dorsoventral prothoracic muscles. Just anterior to the phragma a little cluster of muscles originates and these muscles pass forward to insert upon the posterior border of the head near its lateral margin. From each of the two apophyses at the posterior border of the head narrow muscle bands extend posteriorly to the median notal apophysis or pit.

The muscles of all the legs converge to points of origin upon the transverse, sclerotized band which includes the notal pit or apophysis. This band is apparently formed by a continuation and fusion of the pleural ridges or phragmata of both the mesothorax and metathorax.

There are three muscles inserting upon each coxa. Since the muscles of the coxae in other insects—there usually being four of them—have been named according to their functions as promotor, remotor, levator, and depressor muscles and since these various functions seem here to be carried out by but three muscles, it becomes a very dubious procedure to assign specific names to them and no attempt will be made to do so. They are perhaps best called simply anterior, posterior, and dorsal muscles. The dorsal muscle of the anterior coxae sends a small branch to the corresponding pleurosternal apophysis.

From the notal pit bands of muscles radiate posteriorly to attach at the posterior border of the thorax (which may involve an element belonging properly to the abdomen) and presumably function to move the thorax in relation to the abdomen.

Ventrally there are very few muscles (Figure 19B). Attention may be called to a single small muscle strand extending from each coxa to the margin of the sternal plate; to a small strand which passes across between the prothoracic pleurosternal apophyses; to another quite large strand which extends across between the posterior coxae.

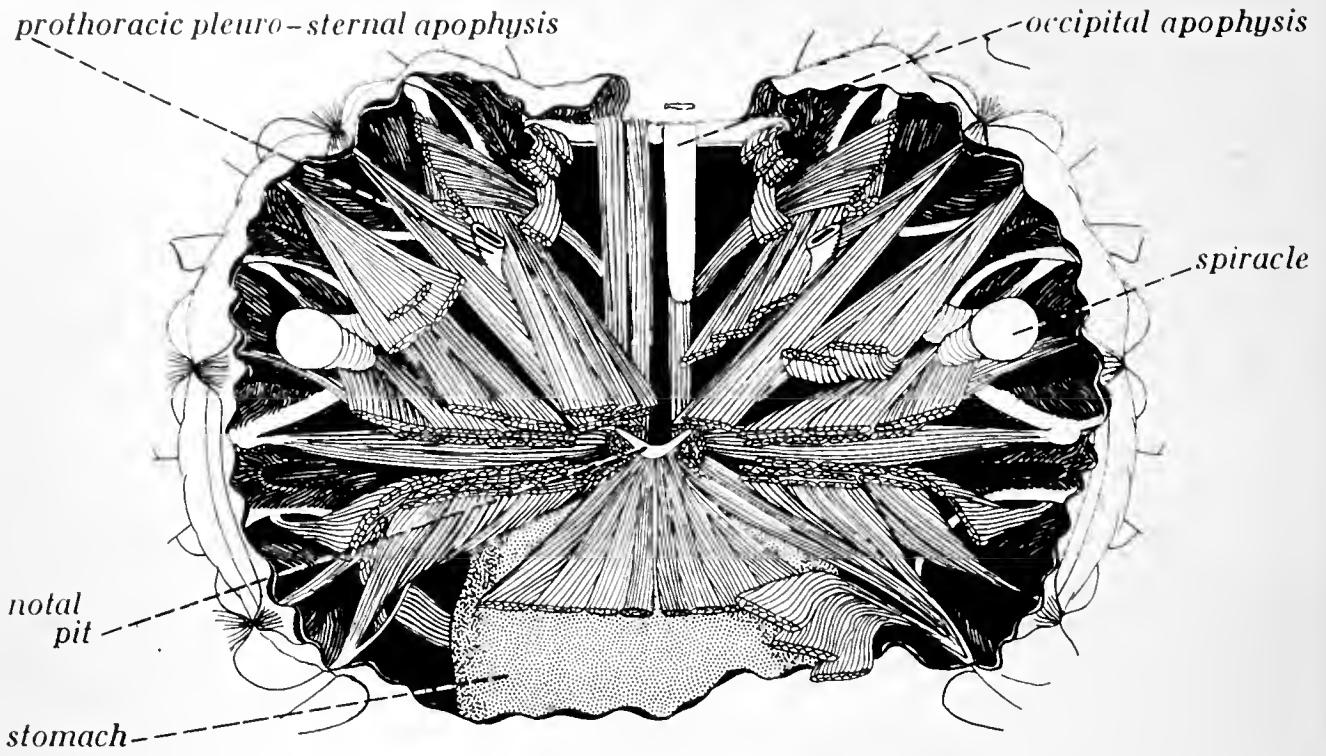
The musculature within the legs themselves shows no especially interesting features and will not be discussed here.

The Abdomen

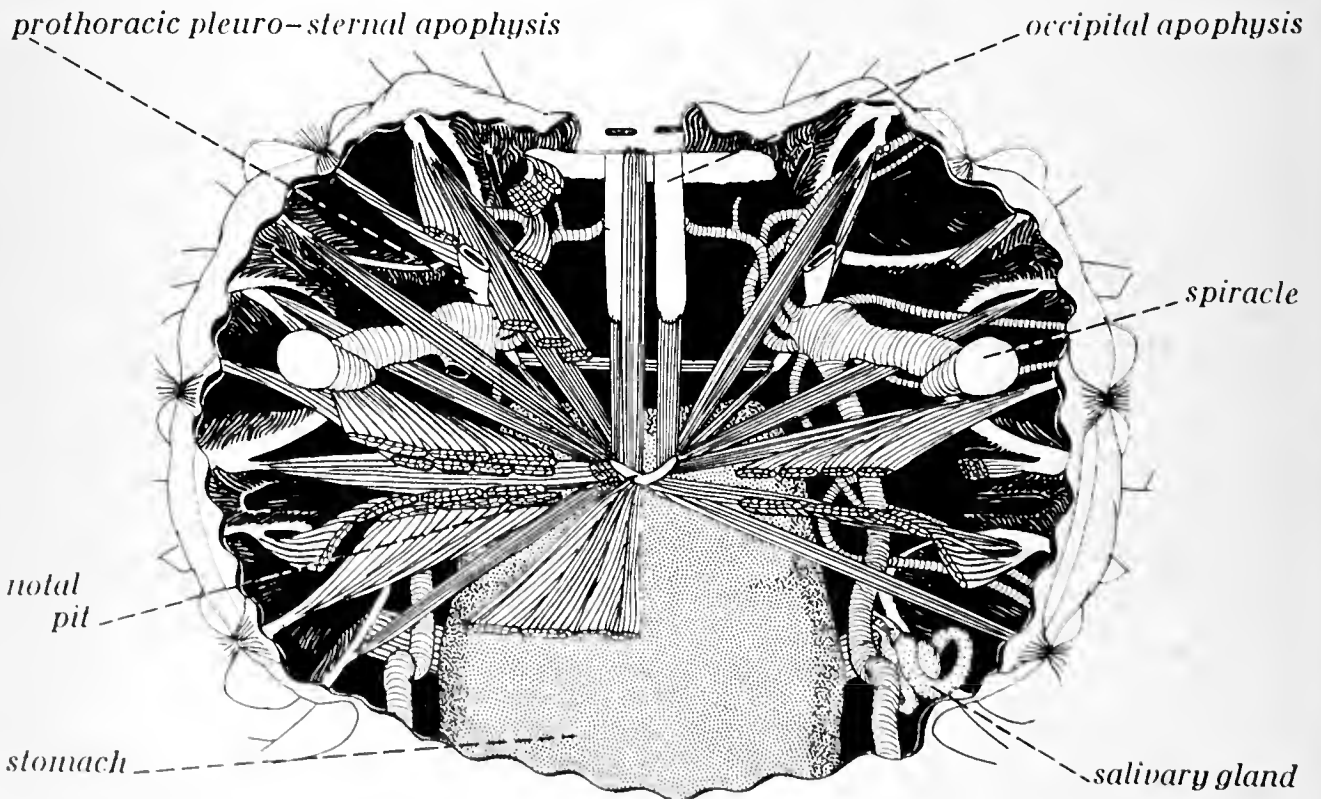
The segmentation of the abdomen has already been discussed.

Apart from the muscles connected with the genital organs the principal muscles of the abdomen are found in the relatively huge dorsoventral bundles arranged in a row on each side of the alimentary canal and extending from the tergite to the sternite of each segment. It may very well be that upon these muscles depends to a large degree the compression of the abdomen which sets up internal pressures in the body fluids by which various movements—such as perhaps the extrusion of the trophic stylets—are at least in part accomplished.

The muscles of the reproductive structures will be considered in connection with the account of these structures.



A. thoracic musculature, dorsal muscles in place



B. thoracic musculature, dorsal muscles removed, and tracheal system

Musculature of thorax of *Haematopinus suis*

Figure 19

The Alimentary Canal Figures 20, 22

The very slender oesophagus passes through the obturaculum and then expands abruptly into the relatively huge mid-gut. Keilin and Nuttall* indicate the presence of caeca at the anterior end of the mid-gut, but these do not appear in *Haematopinus suis*. This large intestine then passes directly through the body without any convolutions until it becomes the small intestine. The small intestine is somewhat convoluted and variously swollen, these swellings perhaps depending upon the contents. It passes finally into a swollen, bulbous structure, the rectal sac, then narrows again to the anus. Upon the rectal sac are four or more pad-like or plate-like structures which are the rectal "glands" or rectal pads as found in other insects.

The Organs of Excretion

There appear to be but four Malpighian tubules in *Haematopinus suis* and four are recorded by Keilin and Nuttall* for *Pediculus humanus*. These discharge into the alimentary canal near the anterior end of the small intestine. Keilin and Nuttall have indicated that excretory products may be stored in certain "nephrocytes" or cells of the fat body, but this is questioned by Wigglesworth.

The Heart Figure 20

The dorsal vessel is of a peculiar form in the sucking lice. It consists mostly of the very long and slender aorta which continues posteriorly almost to the end of the abdomen and then forms a bulbous swelling, from which muscles extend apparently to the body wall.

The Reproductive Organs of the Female Figure 21

Each ovary consists in *Haematopinus suis* of five ovarioles and the same number is recorded by Keilin and Nuttall for *Pediculus humanus*. Apparently at any moment only one of these tubules will contain an egg ready for deposition. The ovarioles are distributed along an oviduct which leads to the uterus from each ovary. Opening into each oviduct there are in *Haematopinus suis* apparently three quite large accessory glands.

The common oviduct or uterus is a very large structure with apparently muscular walls. The duct from each ovary opens into the uterus far back toward the posterior end of the latter.

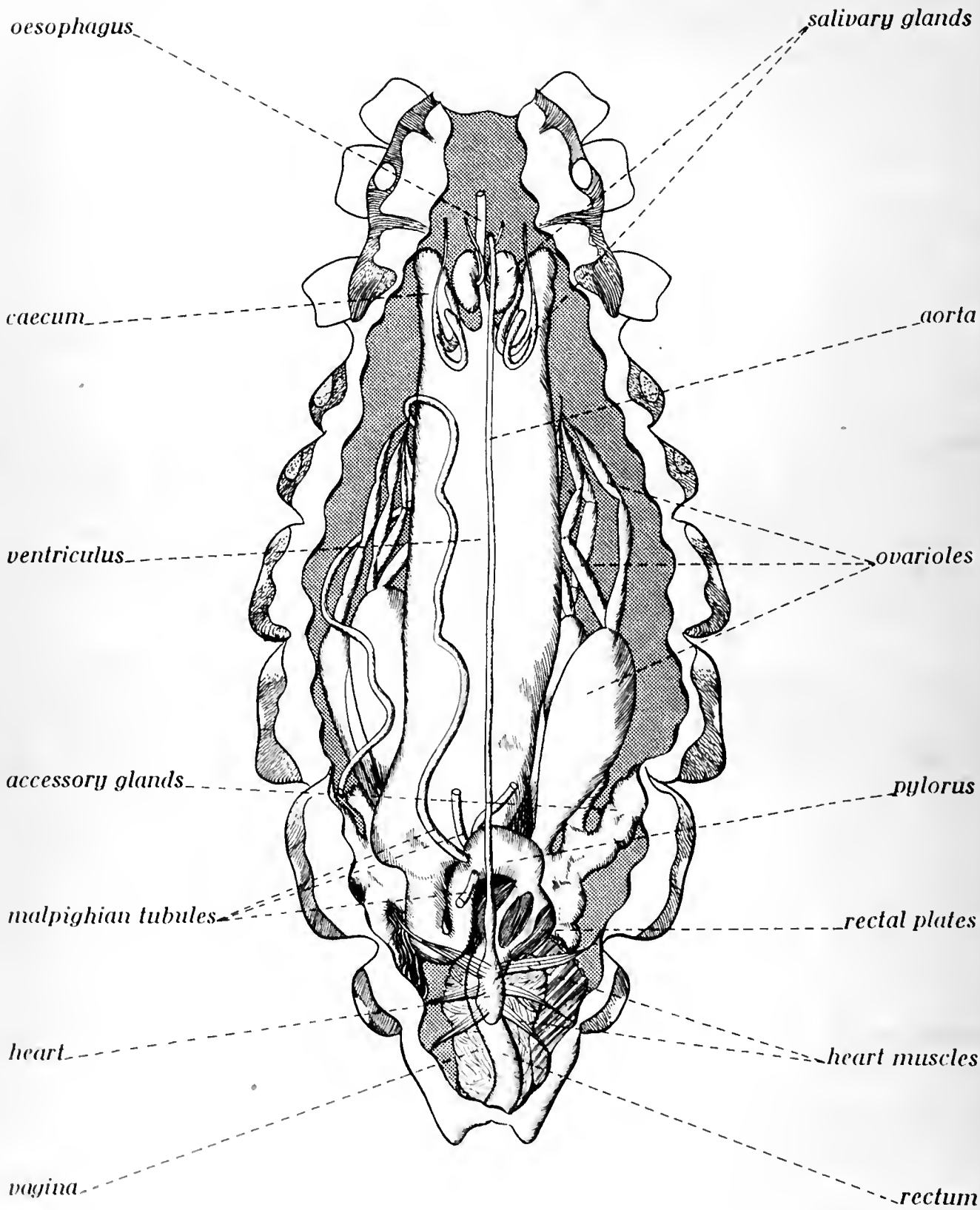
At its posterior end the uterus opens into the vagina and from the vagina various small muscles pass to the body wall.

The spermatheca has already been described. It apparently does not occur in all species of the Anoplura and the details of its histological structure remain still to be studied.

The Spermatheca

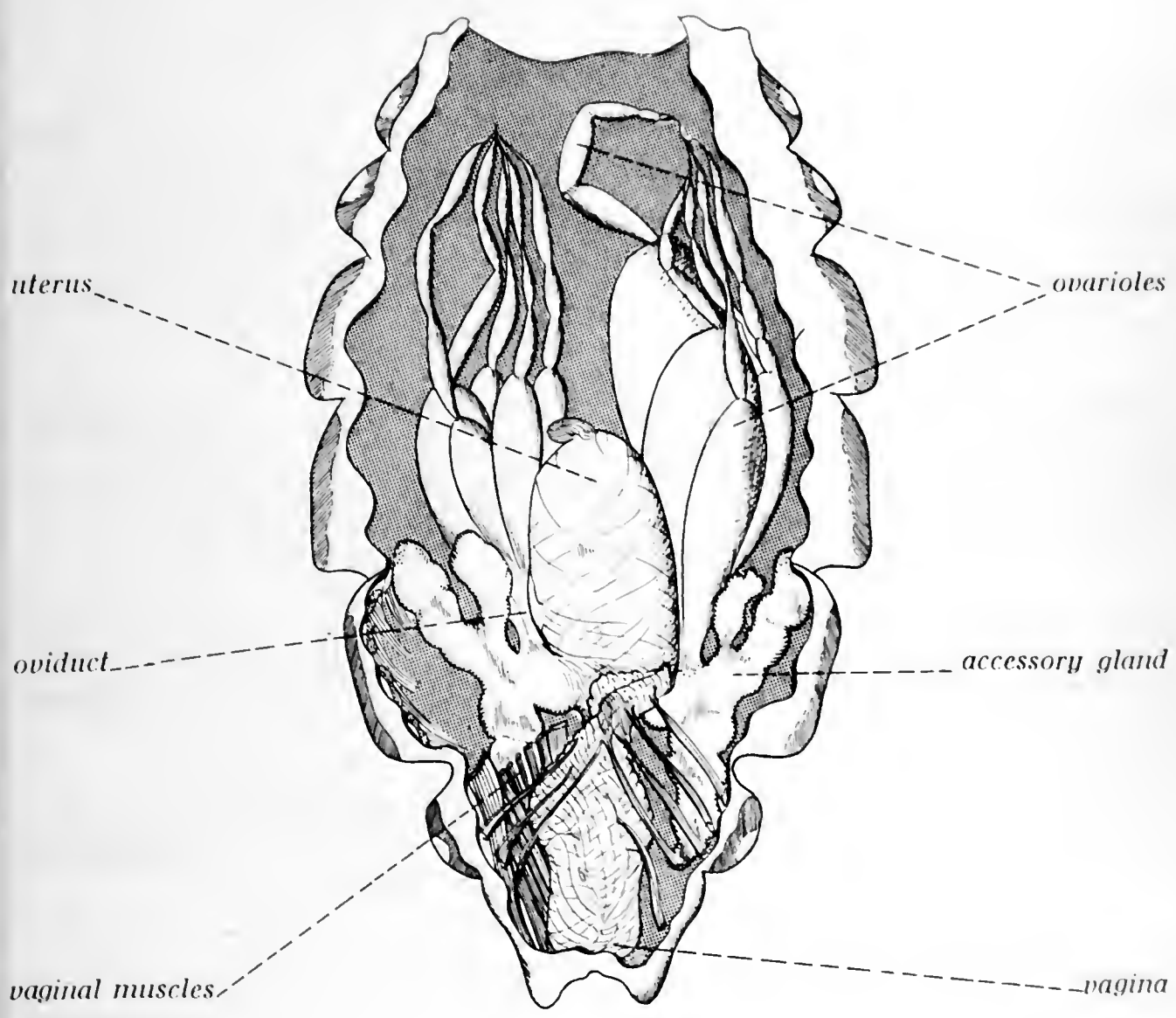
A single spermatheca is present in the female of so many species of Anoplura that it seems justifiable to regard this structure as a part of the basic structure of the group, although in some species it seems to have been lost. Thus, it appears to be lacking in *Pediculus*, *Haematopinus*, and some other genera.

* Keilin, D., and G. H. F. Nuttall. 1930. *Parasitology* 22: Plate XI.



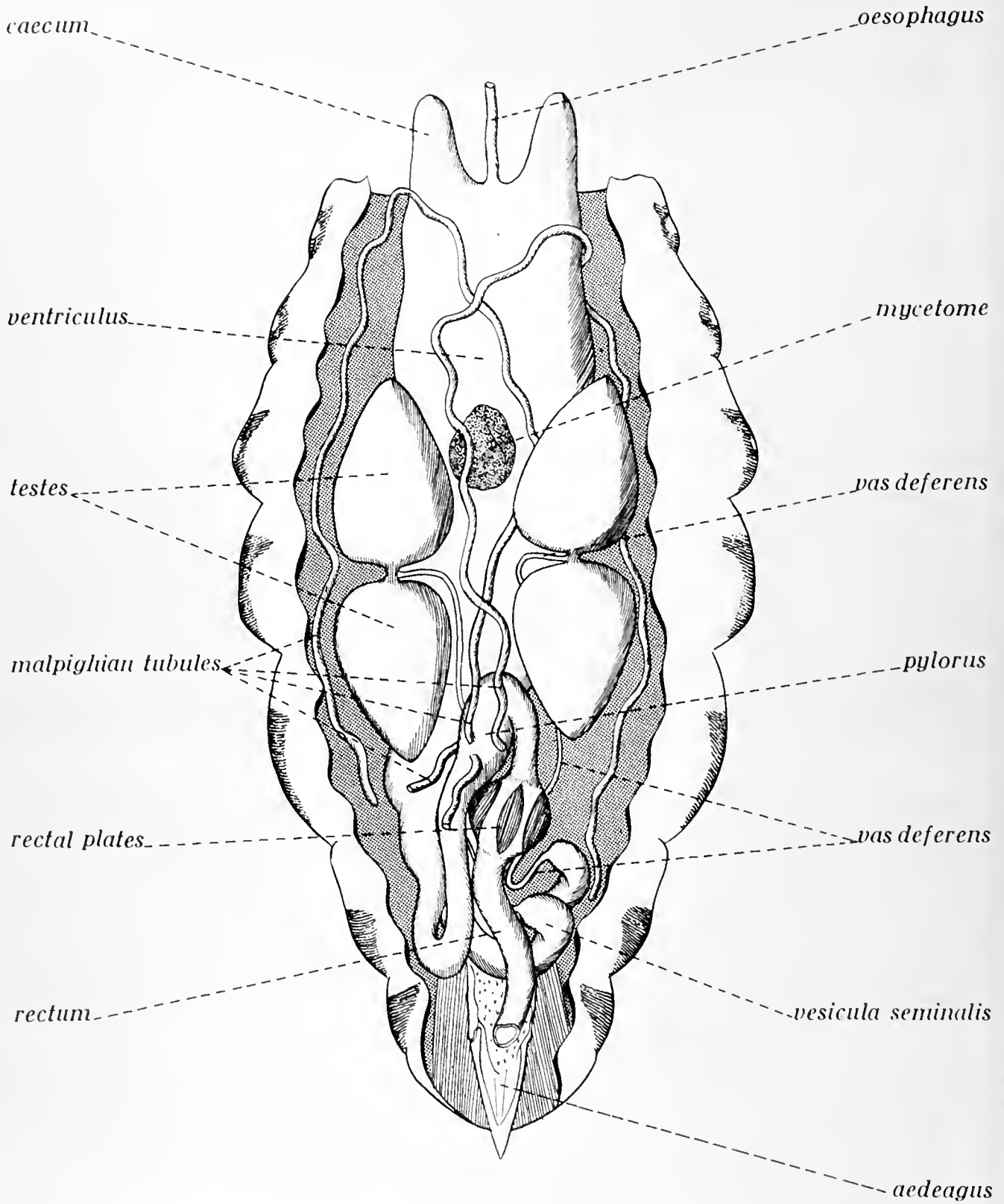
Internal abdominal structures of female of *Pediculus humanus*

Figure 20



Reproductive organs of female of *Pediculus humanus*

Figure 21



Internal abdominal structures of the male of *Pediculus humanus*

Figure 22

In appearance it consists of a delicate, weakly sclerotized tube which extends from the dorsal wall of the vagina for a short distance and terminates in a membranous or more or less sclerotized bulb. The opening into the vagina is commonly surrounded by a crescentic or circular ring of strong sclerotization and this ring is at times almost the sole evidence of the presence of the spermatheca.

The bulb is commonly extremely delicate and subject to distortion in preparations and even to loss. Because of these circumstances it is generally of somewhat dubious taxonomic value. In one group, however, that of certain species of the genus *Enderleinellus*, it is extremely helpful, its variations presenting the only apparent means of separating the females of certain of the species. It merits an extended study, throughout the Anoplura, which is scarcely practicable in a work of the present type.

For an example of a well-developed spermatheca the reader is referred to the illustration of the genitalia of the female of *Pthirus pubis* (Figure 124).

The Reproductive Organs of the Male Figures 22, 23

The number of testes can be interpreted either as four with the members of each pair connected together by a short and slender tube, from which the vas deferens issues, or as two, each of which is much constricted to form a dumbbell-shaped structure, with the vas deferens issuing from the constricted portion. Each vas deferens proceeds for some distance as a slender tube and then expands to form a thick tube which has been considered by various authors to represent the vesicula seminalis. The two vesiculae lie close together, appressed against the ventral side of the alimentary canal, and are twice convoluted, the convolutions extending forward almost to the anterior border of the abdomen. Posteriorly, the vesicles unite into a common tube which forms the ejaculatory duct.

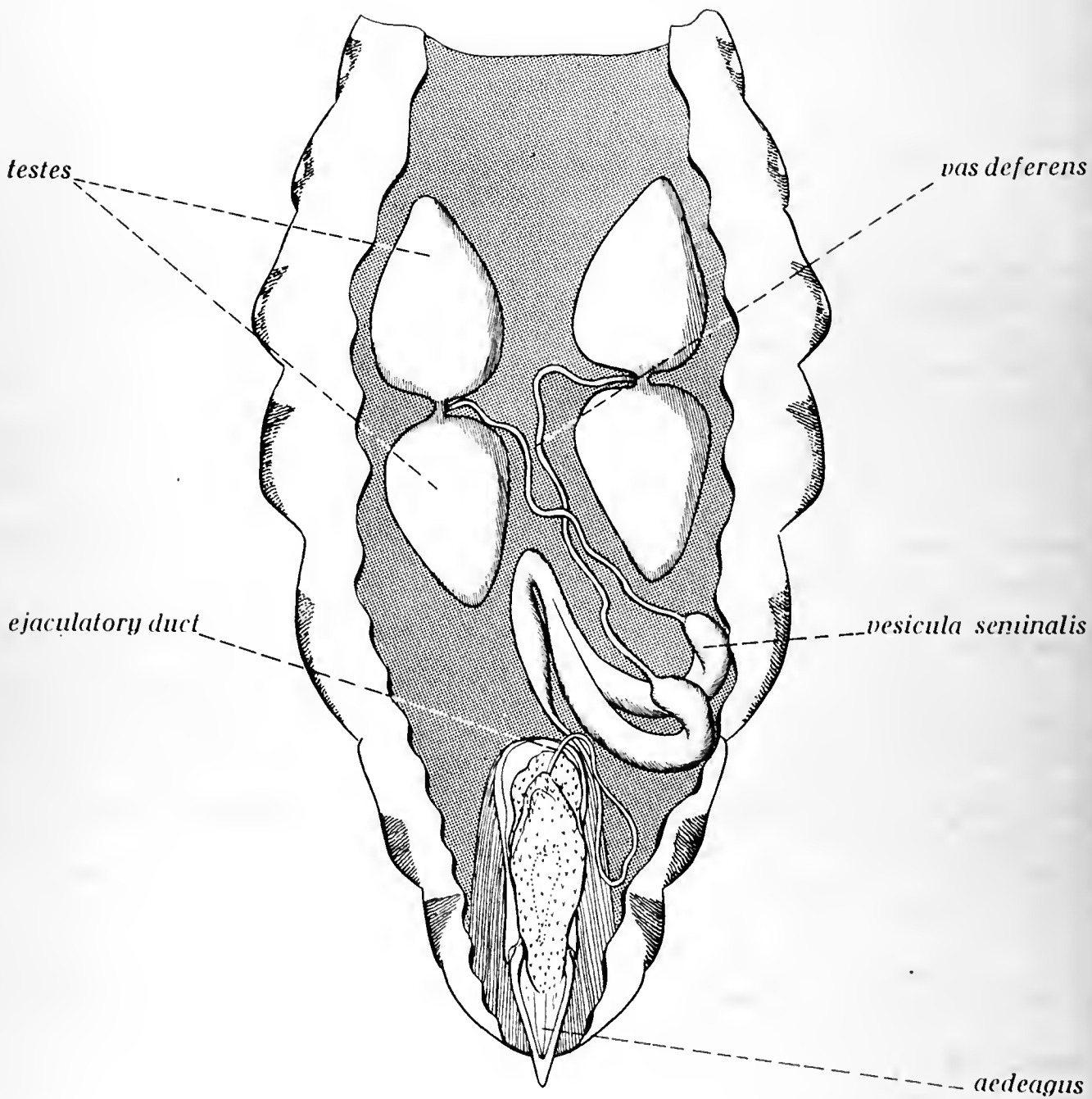
The ejaculatory duct terminates at the apex of the sclerotized penis, so that when the genitalia are extruded as in copulation it must traverse the length of the aedeagus.

The musculature of the genitalic parts has been studied in connection with this work only in *Haematopinus suis* (Figure 24) and here only sufficiently to give a general idea of the mode of operation. It is probable that other species will show some departure from the arrangements here illustrated.

A relatively massive muscle inserts upon the base of the basal apodeme ventrally and originates upon the terminal sternite of the abdomen. Apparently this muscle, probably with the aid of blood pressure, serves to extrude the genitalia. From the dorsal side of the basal apodeme arises a mass of muscle bundles which curve toward the mid-line where those from the two halves unite and finally insert upon the base of the genital sac. These are undoubtedly concerned with the retraction of the sac. From each side of the sac a series of muscle bundles extends to the ventral body wall, where the bundles originate upon the genital plate. These apparently also serve as retractors. Another small muscle inserts on each side near the apex of the sclerotization of the genital sac and inserts on the terminal sternite of the abdomen close to the apex of the body. The function of this is not entirely clear, but it is evidently concerned with the retraction of the complex.

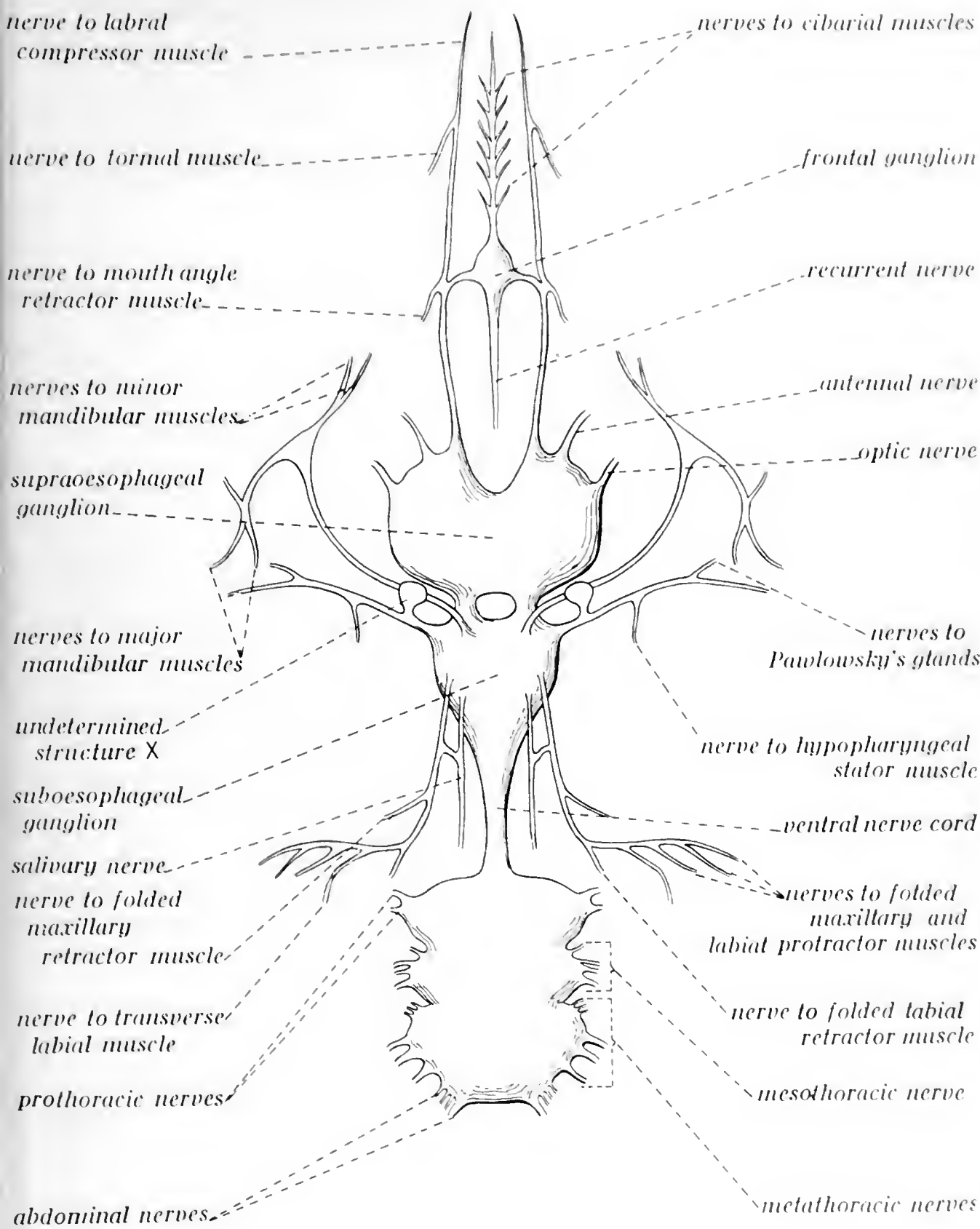
The Nervous System Figure 24

For an understanding of the elements of the nervous system as related to



Structure of male reproductive organs of *Pediculus humanus*

Figure 23



Nervous system of *Haematopinus suis*

Figure 24

the segmentation of the head the reader is referred to a series of papers by Laura M. Henry* in which the significance of the innervations is discussed in detail. The conclusions there presented are here adopted without reservation and have been employed as the basis for an understanding of the head and mouthparts of these lice.

Some description of the arrangement of the nervous elements in the head has already been given in connection with the consideration of the mouthparts, but we may review this again in connection with the nervous system as a whole.

From the supraoesophageal ganglion there originate three pairs of nerves. Of these, one pair innervates the eyes and one the antennae. Those of the third pair are the nerves of the labrum and the stomodaeum and innervate all muscles which insert upon these parts. All muscles which they innervate are therefore to be identified as inserting upon structures that belong morphologically to the labral segment, which is segment one of the body. These nerves pass forward and branch. A mesal branch from each leads to the frontal ganglion and close to the point of origin of this branch is a lateral branch which passes to the muscle which we identify as the mouthangle retractor. The main nerves continue forward and give off laterally a branch which innervates what we consider to be the tormal muscle, a muscle that inserts upon the posterior-lateral angle of the palatal plate. Continuing, the main nerves innervate the muscle that we consider to be the compressor of the labrum.

From the frontal ganglion a single median nerve extends posteriorly, this being the recurrent nerve which cares for the innervations of the anterior portion of the alimentary canal, that is to say of all those portions derived from the stomodaeum. We have not followed it in complete detail, but Florence** has indicated that it forms a small ganglion which may be identified as the occipital ganglion, and then branches.

The circumoesophageal connectives are very short and the opening enclosed by them for the passage of the oesophagus and other structures is extremely small.

Arising from the suboesophageal ganglion, somewhat toward the meson, is a pair of nerves which through branches supplies the two pairs of muscles that we identify as belonging to the mandibles.

Next comes a pair of nerves which arise from near the side of the suboesophageal ganglion and which, through branches, innervate all the structures that we identify as belonging to the hypopharynx, these including Pawlowsky's gland and certain muscles. From each of these main nerves, near its base, there arises a short stalk that terminates in a little, knob-like structure, indicated in Figure 25 as X. We have no evidence as to what this structure is.

There follows a pair of nerves which we consider to be formed by a fusion of the maxillary and labial nerve trunks and which innervate the muscles assigned to the maxilla and labium. The last pair innervate the salivary glands and are connected by a small cross-nerve to the labial-maxillary trunk.

Following the suboesophageal ganglion the ventral nerve cord is very slender for a short distance and then expands into the huge mass of fused ganglia in the thorax. This ganglion mass is very evidently composed of the three thoracic ganglia and includes also all the abdominal ganglia. From its posterior-lateral angles there arise on each side four nerves which supply the structures of the abdomen. We have not traced these nerves beyond the point of determining that the last nerve of the series, which is

* Henry, Laura M. 1947, *Microentomology* 12: 3: 85-82; figs. 23-29; 1947, *Microentomology* 12: 4: 83-110; figs. 30-45; 1948, *Microentomology* 13: 1: 1-26; figs. 1-9; 1948, *Microentomology* 13: 2: 27-48; figs. 10-16.

** Florence, Laura. 1921. *Cornell University Agricultural Experiment Station, Ithaca, New York, Memoir 51*, pages 642-743.

the largest, cares for all the reproductive system. There is evidently a considerable degree of fusion of the nerves to the various segments and this remains still to be worked out.

We have not traced the innervation of the heart. It is therefore evident that there is more work still to be done before all the details of the nervous system are finally established.

The Mycetome
Figure 22

The structure called the mycetome has been noted by several authors in various species of Anoplura and knowledge concerning it has been summed up by Steinhaus in his book "Insect Microbiology" (1946). The entire subject of the mycetome is a rather complicated one and will not be reviewed here. It will suffice for our purposes to note it as a visible disk of cells lying on the mid-gut in the larvae and in the adult male. In the adult female the enclosed symbionts leave the region of the stomach and migrate into the ovaries. The mycetome has been observed in *Pediculus humanus*, *Pthirus pubis*, a species of *Pedicinus*, *Haematopinus suis*, *eurysternus*, and *asini*, *Linognathus vituli* and *setosus*, and in *Polyplax spinulosa*. The position of the mycetome appears generally to be essentially as is indicated for the male of *Pediculus humanus* in Figure 22.

CHAPTER III

Growth and Development

The Egg Figures 25, 26

As far as is known the sucking lice, with one single exception, always attach their eggs to the hairs of the host. This single exception is a louse of man which will attach eggs to the clothing. Even here the method is essentially the same as in other forms, the eggs being attached to projecting fibers whenever possible. The attachment is by means of a drop of cement which surrounds a single hair, or in some instances several hairs, and encloses one end of the egg itself. Florence (1921) has indicated that the cement originates in the collateral or accessory glands illustrated in Figure 21.

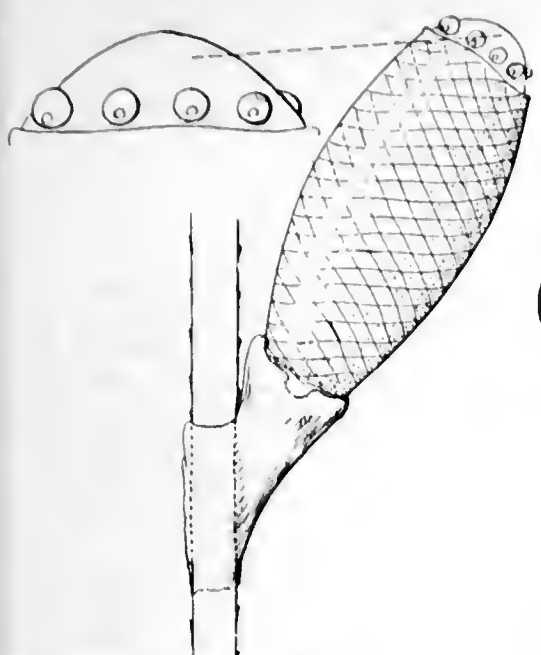
The free end of the egg is always provided with an operculum that breaks away to permit the exit of the larva and, as far as observations go, the egg is always oriented with this end away from the base of the hair upon which the egg is attached. The eggs are always arranged singly along the hair, although at times they may be placed in a very closely spaced series.

The total amount of information concerning the eggs of the Anoplura is relatively small. The eggs of a number of species have been illustrated from time to time but these illustrations are usually but little detailed and the structures of the egg shell have only rarely been studied in detail. Such information as there is has been derived mostly from the egg of *Pediculus humanus*.

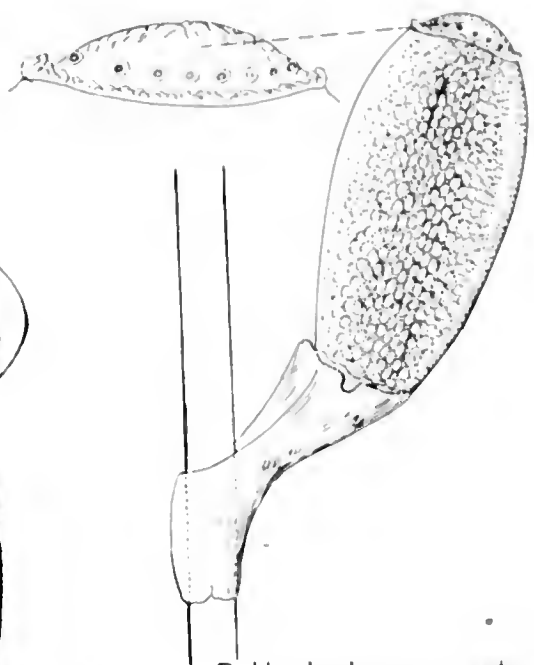
In many forms, such as *Pediculus humanus*, the operculum is beset with small, knob-like tubercles, each of which carries a minute external opening. This pore communicates with a somewhat expanded chamber, which in turn communicates with the interior of the egg by a pore. However, this arrangement is by no means present, at least in such form, in the eggs of all species.

Unfortunately, the total amount of material available in connection with the present work has been quite small and the eggs of only a few species can be illustrated. These are sufficient, however, to show that there is considerable variation in details and to suggest that an extended study would be worth while and might throw some light on the problems of general classification. It may be remarked that eggs can be obtained with no difficulty from the skins of mammals in museum collections, even if remains of the lice themselves are not present. However, this presents difficulties, since as many as three species of lice may occur upon a single host and consequently doubt will arise in many instances as to the ascription of the eggs to the proper species. Also, there is the difficulty that a large percentage of the eggs will have hatched and consequently the operculum will be lacking. In such examples the most distinctive characters of the eggs will have been lost.

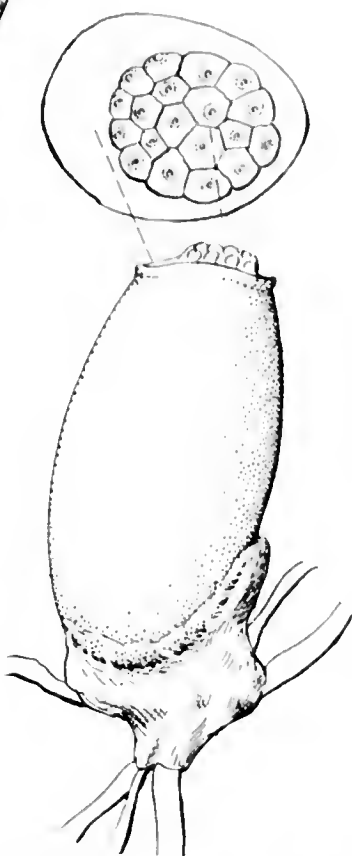
On the basis of the material that is available the following notes are offered. In Figure 25C is shown the egg of *Pediculus humanus corporis* as attached by an irregular drop of cement to a cluster of fibers of the clothing of the host. The operculum is shown as detached and flattened. It will be noted that there are 15-20 of the little air cells or cellulae, these being arranged in an eccentrically placed group. In eggs of what is here for the moment called *Pediculus chapini* (Figure 26D) the number of cells is fewer, but material has not been available to permit the dissecting away of an operculum in such a manner as to reveal the exact number.



A. *Hoplopleura oenomydis*



B. *Hoplopleura crypt*



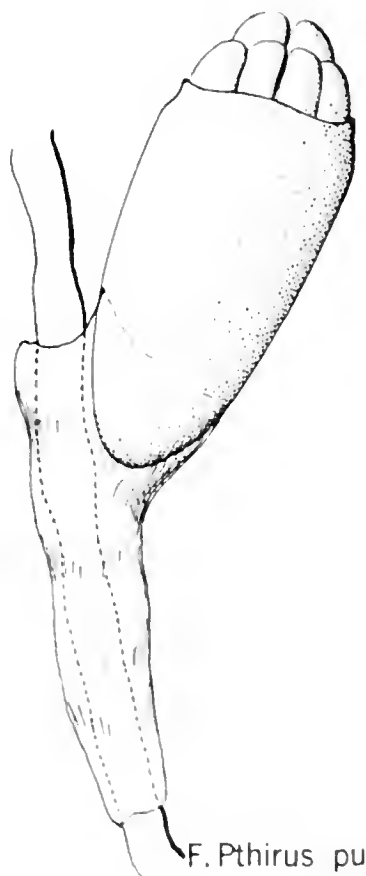
C. *Pediculus humanus corporis*



D. *Pediculus mjobergi*



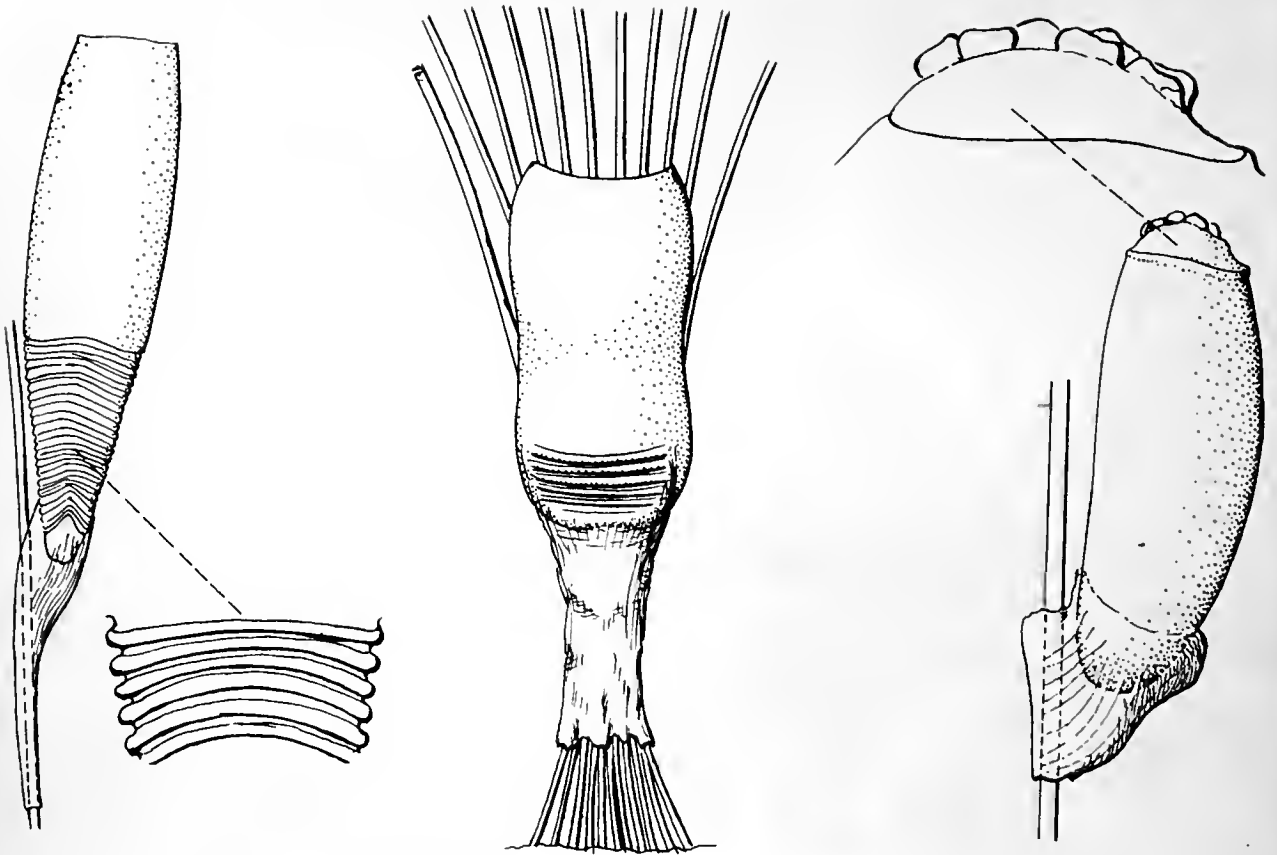
E. *Enderleinellus osborni*



F. *Pthirus pubis*

Eggs of Anoplura

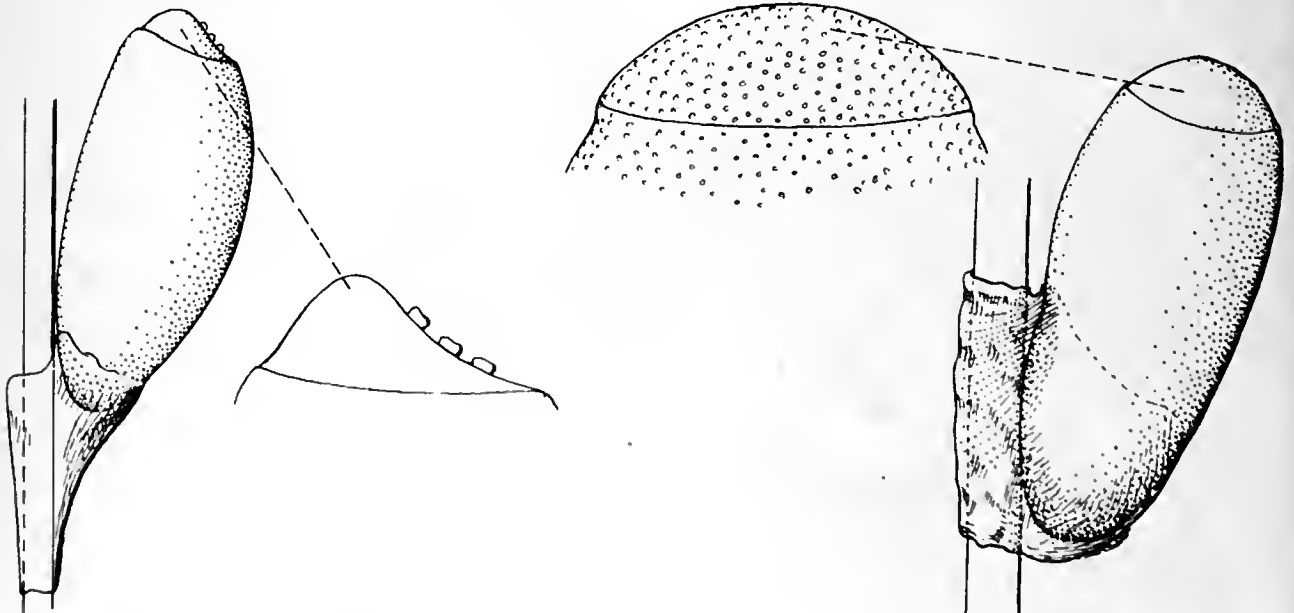
Figure 25



A. *Neohaematopinus sciuropteri*

B. *Haematopinooides squamosus*

C. *Linognathus breviceps*



D. *Fahrenholzia microcephala*

E. *Haematopinus suis*

Eggs of Anoplura

Figure 26

In *Pthirus pubis* (Figure 25F) the cellulae seem to occupy practically the entire area of the opercular surface and are large and elongated. In *Hoplopleura oenomydis* (Figure 25A) the cellulae are moderately large and are arranged in a single row extending around the operculum close to the margin. In *Hoplopleura cryptica* (Figure 25B) the cellulae are very small, being scarcely larger than the enclosed pore and there seem to be about 16 of them. In *Fahrenholzia microcephala* (Figure 26D) there seem to be only 3 or 4 cellulae and these are very small and are displaced toward one side. In *Lino gnathus breviceps* (Figure 26C) there are perhaps 10 cellulae, these occupying the central area. In *Enderleinellus osborni* (Figure 25E) there are no cellulae and no evident pores. In *Haematopinus suis* (Figure 26E) there are no evident cellulae.

The egg shell appears sculptured in some species. Thus, in the egg of *Hoplopleura oenomydis* (Figure 25A) it is marked by two sets of diagonal crosslines which divide the surface into little, lozenge-shaped areas that can be seen only in favorable specimens and by proper adjustment of the light in the microscope. In *Haematopinus suis* the entire shell, including the operculum, is marked with minute, clear, cellular areas. In *Hoplopleura cryptica* the shell bears somewhat irregular, cellular areas. In other species here illustrated there seem to be no markings of any kind. In the egg of *Neohaematopinus sciuropteri* (Figure 26A)—or at least on the basis of circumstantial evidence an egg presumed to belong to that species—the available specimens have lost the operculum, but the base of the egg is very distinctly marked by transverse folds or ridges.

The form of the cement pedicel varies. Its attachment to the hair may be very short or may be much extended. It may be rough and irregular or smooth. The attachment to the egg may be strictly apical or may extend up one side of the egg. In the egg of *Haematopinoides squamosus* (Figure 26B), which seems usually to be attached to a cluster of hairs of the host, the cement itself is transversely wrinkled on the side away from the attachment.

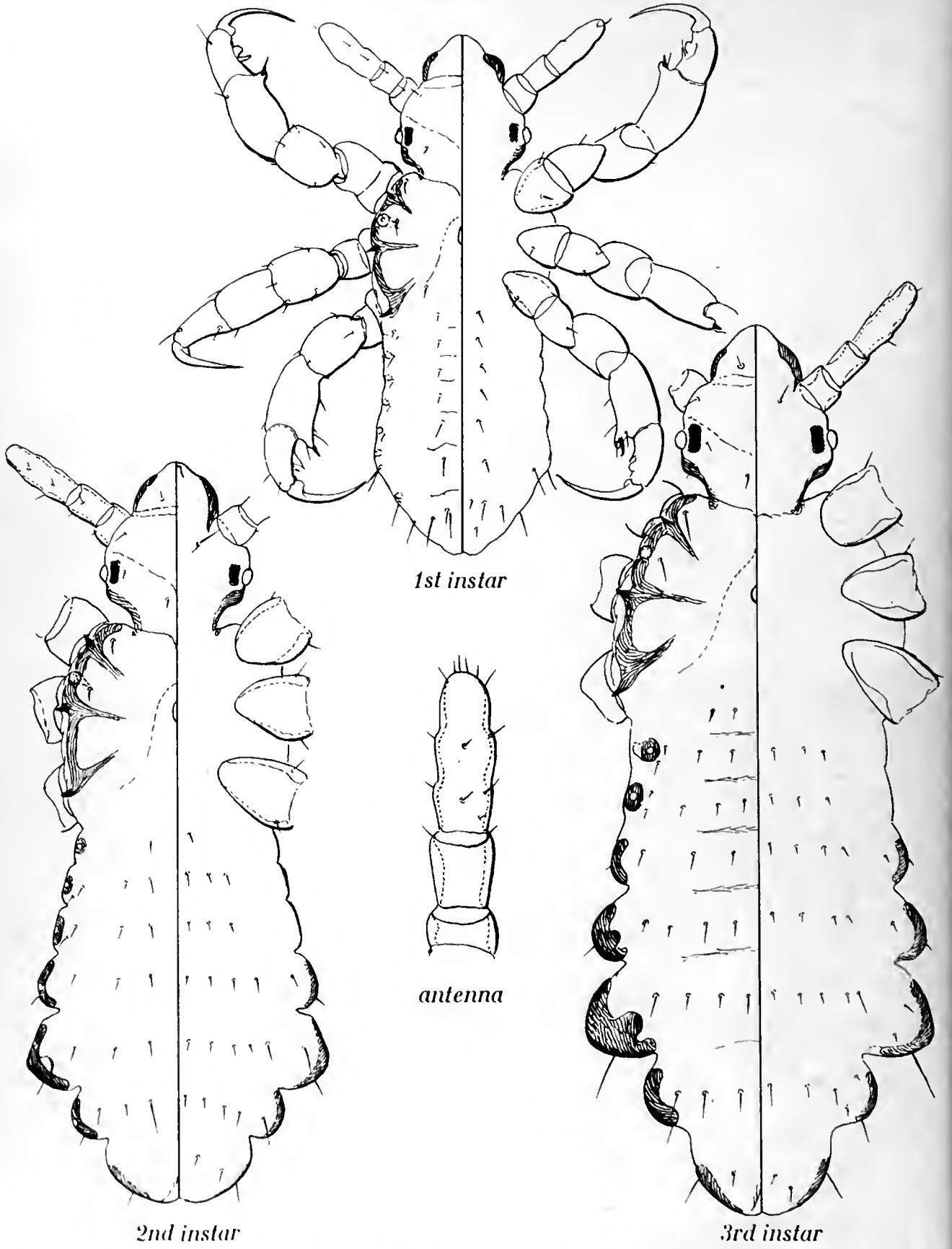
The number of hairs enclosed within the cement seems frequently to be variable. In general, it appears on the basis of the small amount of available material that ordinarily a single hair is involved. There seems to be no special choice as to the size of the hairs. Thus, eggs are at hand of *Fahrenholzia microcephala*, taken from the same host individual, some of which are attached to small, slender hairs and others to large, spiny hairs. In the latter case the cement is spread very thinly around the hair.

In the form of the eggs there seems in general to be nothing especially distinctive, although certainly in some species this is not true. The egg of *Haematopinoides squamosus* in the material at hand is somewhat constricted medially. The egg of *Pediculus chapini* is quite pointed basally. The egg of *Neohaematopinus sciuropteri* is noticeably long and slender. In most of the species here illustrated the actual form of the egg is probably more slender than is indicated, since dried eggs usually collapse with consequent apparent broadening.

Developmental Stages Figures 27, 28, 29, 30

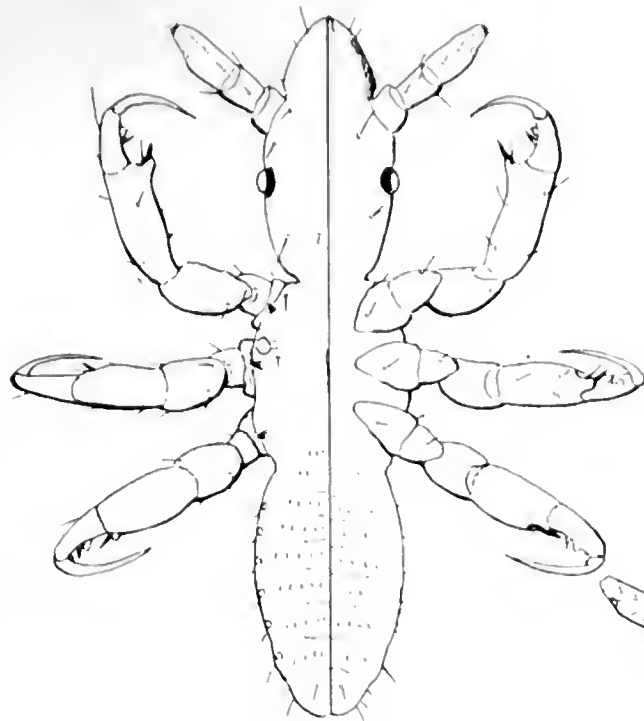
The existing knowledge of the immature stages of the Anoplura is quite scanty, there being probably not more than a half-dozen species of which all the stages are known. The only species at hand of which all stages are represented are *Pediculus humanus*, *Pediculus mjöbergi* (Figure 27) and *Pedicinus obtusus* (Figure 28).

There seem to be a total of four instars. It will be noted that in these species the principal changes which occur, apart from the development of the genitalic structures and alteration of proportions, are associated with the development of the paratergites. In *Pediculus mjöbergi* these are

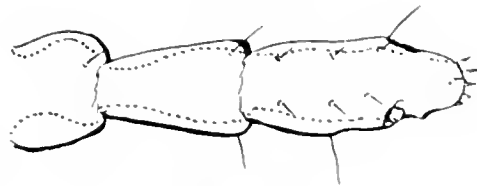


Nymphal stages of *Pediculus mjobergi* Ferris

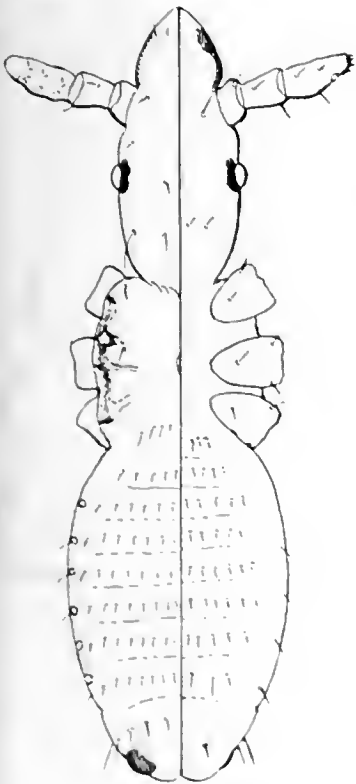
Figure 27



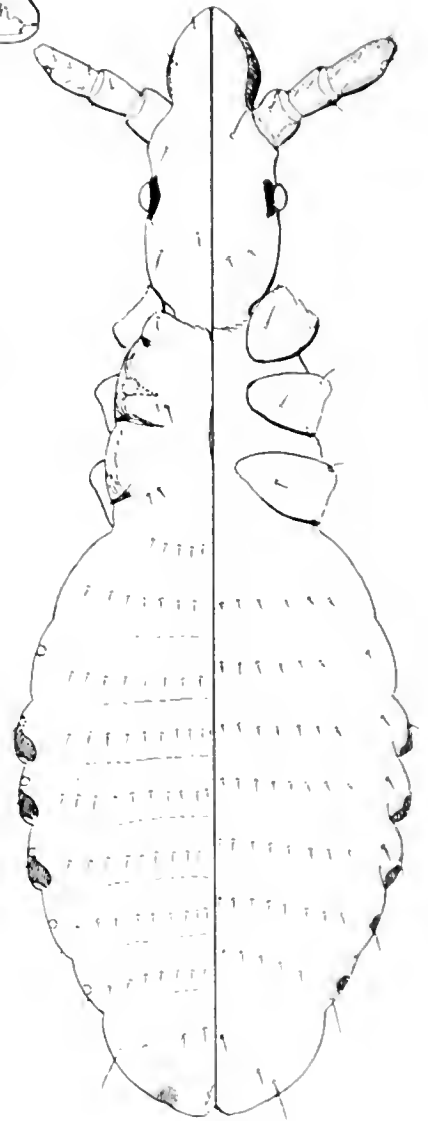
1st instar



antenna



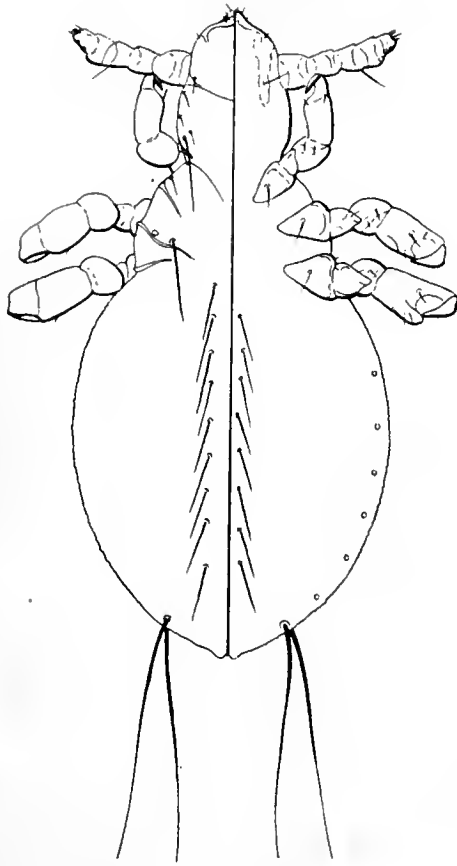
2nd instar



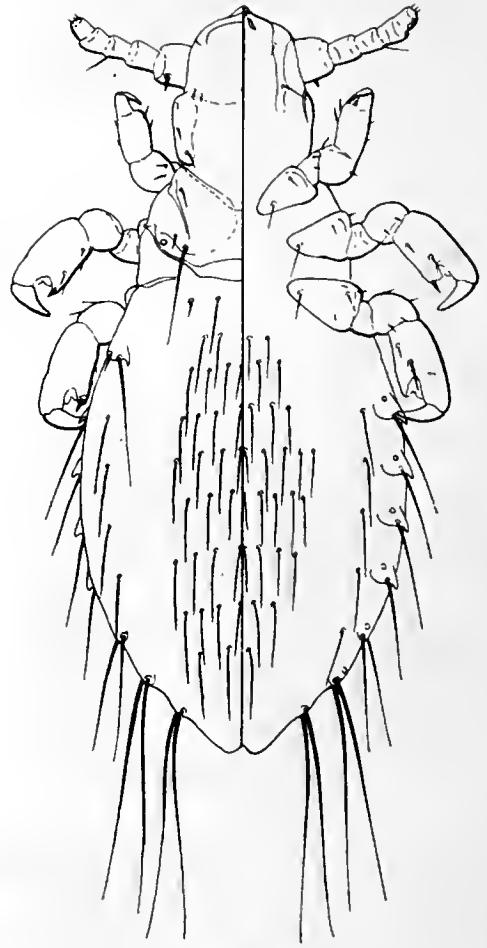
3rd instar

Nymphal stages of *Pedicinus obtusus* (Rudow)

Figure 28



1st instar



2nd instar?

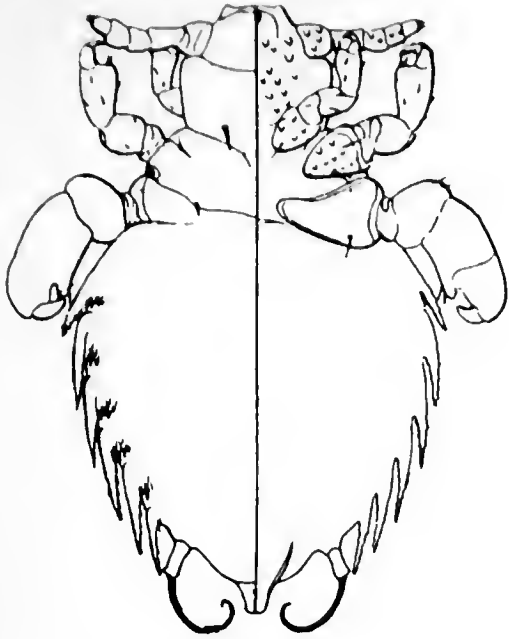
Nymphal stages of *Polyplax spinulosa* (Burmeister)

Figure 29

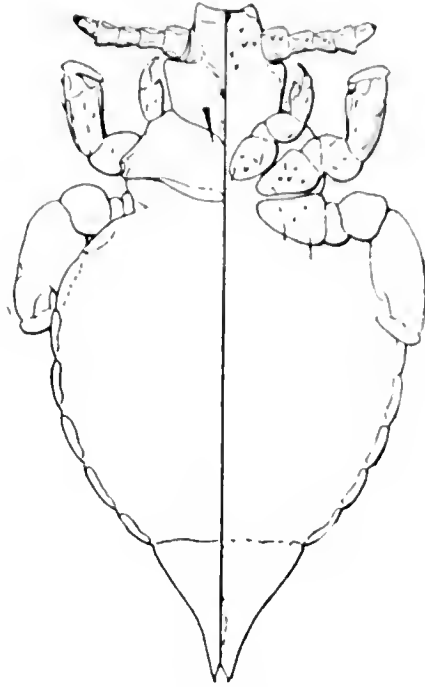
recognizable in the second instar, while in *Pedicinus obtusus* they do not appear until the third instar. Also, in these species there are certain changes in the antennae, the last three segments being scarcely or not at all indicated in the first three instars. This is not generally true, the first stage usually having five antennal segments as does the adult.

Of other species, there are at hand only a few immature individuals, no complete developmental series being represented. Consequently, it is difficult to assign these specimens to their proper instars. On the basis of present indications, however, it appears that the only species in which the immature stages present any especially peculiar developments are those of the genus *Hoplopleura*. In this genus there seems to be a general tendency toward the development of sclerotized tubercles on the antennae and on the ventral side of the head and also of unusual setae on the abdominal margins. It is not clear in which stage the paratergites appear in these forms.

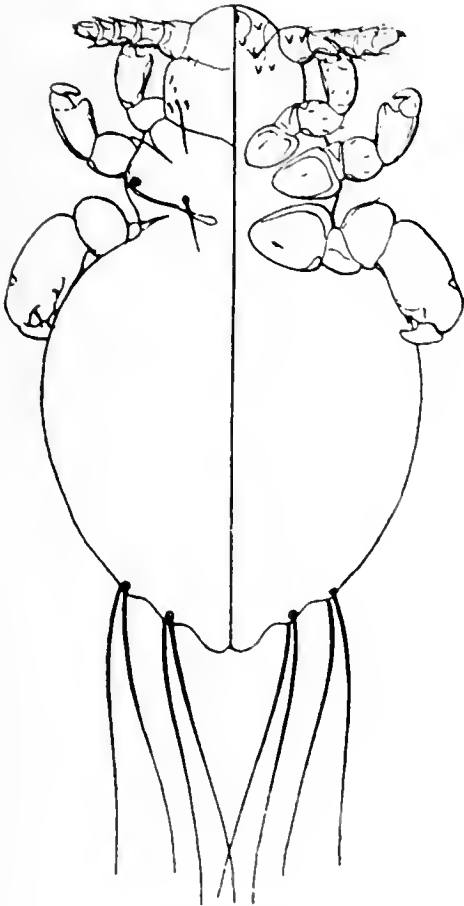
The appearance of the immature stages in the genus *Hoplopleura* is such that an incautious worker might very well be led to suspect the presence of more than one species. Illustrations of some of these stages of this genus are herewith presented.



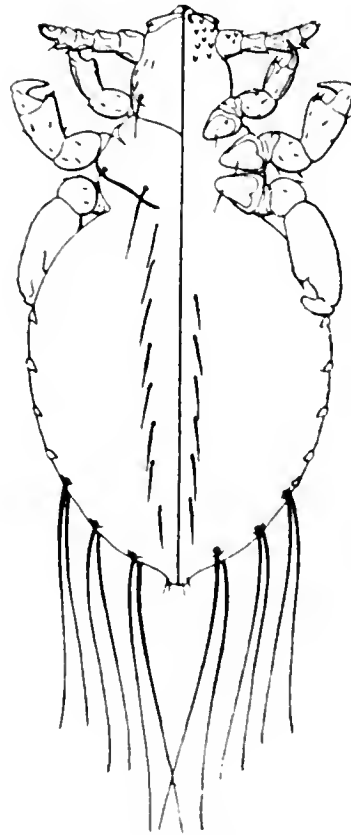
intermedia



pelomydis



acanthopus



arboricola

First stage of species of Hoplopleura

Figure 30

CHAPTER IV

The Taxonomic Status of the Sucking Lice

Historical Review

The sucking lice are for the most part very small forms and require special methods of preparation for study under the microscope. Such methods were scarcely available until comparatively recent times and in fact have reached a satisfactory degree of development only within the last thirty-five years; even yet very few entomologists have become fully aware of them or have become proficient in their use. Moreover, the members of this group of ectoparasites were long regarded as merely "disgusting parasites" and therefore scarcely worthy of the attention of anyone possessed of esthetic feelings. And still beyond that, it requires a special effort to secure material of any large representation of the group, since the collector must first obtain specimens of the mammals upon which they occur. For all of these reasons they have until relatively recent years received but little attention from entomologists. Their taxonomic history represents a series of stumbling attempts to assign them to some generally acceptable position in the scheme of classification of the insects and to devise a system of classification within the group itself. Even yet there is no absolute agreement in regard to either of these aspects of their classification.

Fahrenholz,* in a paper published in 1936, gave a detailed review of the taxonomic history of the group, which has been utilized in preparing the following summary. This has been supplemented from other sources and brought up to date, especially with the aid of a work on the history of the development of insect classification published in 1937.**

We need not concern ourselves with anything that may have been done prior to the appearance of the tenth edition of Linnaeus' "Systema Naturae" of 1758, upon which our present system of classification and nomenclature is grounded. In this work Linnaeus adopted the ancient Latin name *Pediculus* for a genus into which he threw almost everything that could conceivably be called a "louse," placing this genus in the insect Order Apterata along with the mites, fleas, and the primitively wingless group now called the Thysanura. The genus contained a weird assortment of forms, including biting lice, sucking lice, Corrodentia, a beetle triungulinid and a Hippoboscid fly.

In 1775, Fabricius, in his "Systema Entomologiae", included the genus with essentially the same composition in his Order Antliata, placing in it a miscellaneous assortment of forms that included mites and some flies, and this system was followed in his "Systema Antliatorum" which was published in 1805.

In 1806, Latreille recognized the Order Parasita, which was composed of the two groups of lice—the biting lice being placed in the genus *Ricinus* and the sucking lice in the genus *Pediculus*.

Also in 1806, Lamarck, in his "Histoire Naturelle des Animaux sans Vertebres," placed these genera in the Order Arachnides Antennistes, in the strange company of the centipedes, the myriopods, and certain insects now generally referred to the Order Thysanura.

In 1815, Leach, in the "Edinburgh Encyclopaedia," placed the lice in the

*Fahrenholz, H. *Zeitschrift für Parasitenkunde*, Volume 9, Part 1, pages 50-57. 1936.

** Wilson, H. F., and M. H. Doner. *The Historical Development of Insect Classification*. 1937.

new Order Anoplura, this including two genera of sucking lice, *Pediculus* and *Haematopinus*; and one genus of biting lice, *Nirmus*. This arrangement was adopted also by him in "Zoological Miscellany" in 1817, where he placed the sucking lice in the family Pediculidae and the biting lice in the family Nirmidae.

In 1818, Nitzsch, in a paper entitled "Darstellung der Familien und Gattungen der Thierinsekten," published in Volume III of Germar's Magazin für die Entomologie, recognized these two groups but placed the sucking lice in the Hemiptera Epizoica and the biting lice in the Orthoptera Epizoica.

In 1823, Dumeril, in his "Considerations generales sur le classe des insectes," placed the sucking lice in the group Rhinaptera along with the fleas and at least some mites.

In 1825, Latreille, in his "Families naturelles du regne animal," retained the Order Parasita and divided it into two groups, Siphunculata for the sucking lice and Mandibulata for the biting lice.

In 1826, Kirby and Spence, in Volume IV of their "Introduction to Entomology," placed all the lice together in the Order Aptera, still along with the Thysanura, the myriopods and various arachnids.

At some time between 1835 and 1840, Burmeister, in his "Handbuch der Entomologie," which was published in five volumes during these years, placed the sucking lice under the Order Rhynchota and the biting lice in the Order Mallophaga, this apparently being the first use of the latter name.

In 1842, Denny, in his "Monographia Anoplurorum Britanniae," restored the Order Anoplura, dividing it into two suborders. For the sucking lice he employed the subordinal names Rhynchota or Haustellata and for the biting lice the names Mallophaga or Mandibulata, in each case apparently as alternatives.

In 1874, Giebel, in his great work "Insecta Epizoa," placed the sucking lice as the family Pediculina in the Order Hemiptera, calling the group Hemiptera Epizoa.

In 1880, Piaget, in his monumental "Les Pediculines," very frankly avoided the use of any ordinal names, but regarded the sucking lice as constituting a single family, the Pediculidae, and the biting lice as two families, Liotheidae and Philopteridae, the three families being considered as of equal rank.

In 1896(?), Haeckel referred the two groups of lice to the Order Phthiraptera and this name has recently been taken up by Weber and by Eichler, these authors using it to include the suborders Anoplura, Mallophaga and Rhynchophthirina, the last name being that which was proposed by Ferris for the reception of the genus *Haematomyzus*.

At some time during the latter part of the nineteenth century the idea became established in the minds of entomologists that the sucking lice are related to the Hemiptera. Thus in the earlier editions of Comstock's "Manual for the Study of Insects," and in fact in an edition as late as 1913, they are placed as the Suborder Parasita under the Hemiptera. In Kellogg's "American Insects" (1908) they are thus placed. On the other hand, the Mallophaga were recognized by Comstock as a separate Order as early as 1895.

In 1903, Cholodkovsky, in "Zoologischer Anzeiger," Volume 27, recognized the sucking lice as an independent Order and proposed the name Pseudorhynchota for them.

In this same journal and volume Shipley proposed the ordinal name Ellipoptera for them in an attempt to establish a uniform system of endings for the names of the insect Orders.

Also in this same journal and volume Börner, in a projected classification of the insects, recognized the sucking lice as the Order Siphunculata, crediting the name erroneously to Meinert.

In 1908, Handlirsch, who probably had a broader understanding of insect

classification than any other man who has ever lived, recognized the sucking lice under the ordinal name Siphunculata and he adopted this assignment in a section of Schroeder's "Handbuch der Entomologie," which was published in 1923.

In 1908, Dalle Torre, in Wyttsmann's "Genera Insectorum," published a catalogue of the sucking lice, calling them the Order Anoplura.

In 1910, Mjöberg, in a work entitled "Studien über Mallophagen und Anopluren," which appeared in Volume 6 of "Arkiv för Zoologi," reverted to the opinion that these two groups constitute a single Order, for which he apparently used the name Siphunculata, while employing the subordinal names Anoplura for the sucking lice and Mallophaga for the biting lice.

In 1916, Lancelot Harrison, in a paper published in Volume 18 of the "Proceedings of the Cambridge Philosophical Society," also supported this view.

Apparently as a result of the conclusions of these last two authors, the writers of various textbooks—notably Imms in his "General Textbook of Entomology"—have adopted this opinion and have united the two groups, Imms employing the ordinal name Anoplura for both.

Ferris, in his series of papers entitled "Contributions Toward a Monograph of the Sucking Lice"—published in the Stanford University Publications, Biological Sciences Series, over a period from 1919 to 1934—considered the sucking lice to belong by themselves in the Order Anoplura.

Fahrenholz, in a paper published in 1936 in "Zeitschrift für Parasitenkunde," Volume 9, followed this procedure, but included in the sucking lice the peculiar genus *Haematomyzus*, which has but one species, the louse of the elephants. Ferris had shown earlier that this insect is not a sucking louse, being an insect with biting mouthparts and probably more closely related to the Mallophaga, to which Order he assigned it. Fahrenholz retained it in the sucking lice purely on the grounds that functionally it is a sucking form. He divided the Anoplura into two Suborders—Rhynchophthirina, a name previously proposed by Ferris as a Suborder of the Mallophaga for inclusion of *Haematomyzus*; and the new name Inrostrata, for the true sucking lice.

In 1939, Weber, in "Biologisches Zentralblatt," Volume 59, took up Hæckel's name Phthiraptera, as already noted, placing under it as suborders the three groups Anoplura, Mallophaga, and Rhynchophthirina, the last named including only the louse of elephants. In 1946, Eichler, in "Archiv für Naturgeschichte," Neue Folge, Volume 10, Heft 3, also adopted this arrangement.

In 1946, Webb, in "Proceedings of the Zoological Society of London," Volume 116, adopted the opinion that the lice constitute a single Order, to which he applied the name Anoplura.

In 1949, Hopkins, in Volume 119 of the same journal, followed Weber's procedure of placing all the lice in the Order Phthiraptera.

Throughout all this time the authors of various textbooks of entomology and parasitology, none of whom had any personal acquaintance with the insects involved, have adopted one or another of the various arrangements and one or another of the various names. It would be useless to consider these textbooks, since they contribute nothing original.

The problem of the name to be used for the sucking lice involves two aspects, one being purely nomenclatorial, the other zoological.

The problem of nomenclature being the simpler may be disposed of first. To the question of what name should be employed for the sucking lice there is no absolute answer. The International Rules do not cover situations of this kind, since they do not extend to the names of groups above the superfamily and even here are not definite. The only rule that can be followed is some rule of reason. The subject is subjudice at the moment, to be settled, perhaps, at Copenhagen in 1953.

Apparently the first ordinal name employed for all the lice was *Parasiti*, proposed by Latreille in 1796. If priority holds, this name would have to be maintained either for all the lice together as combined in a single Order, or for one of the groups if the Order be divided. But priority does not necessarily hold in such circumstances and there is the objection to this name that it is entirely too broad in its connotations. Furthermore, the name *Parasitidae* has been employed also for a family of mites.

The second available name seems to be *Anoplura*, proposed by Leach in 1815. This name has come into quite general use and conveys no suggestion of applicability to any group other than the lice. The opinion here held is that there is no reason why it should be replaced by any of the names which were later proposed.

Now, since this name was originally proposed for the biting and the sucking lice as combined in a single group, the question arises as to which group should inherit it if the Order is divided. The opinion is here maintained that since the biting lice were very early removed as the Order *Mallophaga* and were thus supplied with a name that has long been employed, the reasonable procedure is to retain the name *Anoplura* for the sucking lice if they be recognized as an independent Order.

We come now to the zoological question involved, that of whether the two groups should be recognized as separate Orders or merged in a single Order.

This problem has no objective solution, whatever answer is adopted being merely one of opinion. The two groups exist, but the rank to be assigned to them depends solely upon the mental processes of the protagonists of either opinion and upon subjective ideas concerning philosophical questions involved in the general process of classification. The groups are nearly enough alike to justify union, or they are sufficiently different to justify separation, either step being dependent upon the weight assigned to similarities of habit on the one hand or to differences in morphology on the other.

The author, being a morphologist, claims the greater weight for morphology. And from the point of view here adopted this argues for ordinal separation.

The principal distinction between the sucking lice and the biting lice (the latter including the *Rhynchophthirina*) lies in the mouthparts. The feeding mechanism of the sucking lice, which will be described in detail in a later section, differs very greatly from the mechanism found in the biting lice and there are no known transitional forms between the two groups. Nor is this all. The arrangement of the thoracic elements is quite different in the two groups.

As a matter of fact, the idea that the biting lice and the sucking lice are related finds but little actual morphological support, although there is a suggestion of some sort of remote relationship. The feeling of relationship seems to arise chiefly from the fact that the biting lice offer the only known source from which the sucking lice could have been derived. The writer is not impressed by Webb's insistence upon the evidence afforded by the tracheal system, in the light of the very profound differences in the feeding mechanism.

The opinion is here maintained, therefore, that the sucking lice should be recognized as the Order *Anoplura*.

The Characteristics of the Order *Anoplura*

An insect Order the members of which are, as far as known, ectoparasites exclusively upon mammals, living in the hair, feeding upon the blood of the host throughout their entire life cycle, and attaching their eggs to the hairs of the host. Metamorphosis of the type commonly called hemimetabolic, consisting chiefly of changes in size or proportions of parts, in the degree of sclerotization and in the development of the sexual apparatus.

Antennae normally five-segmented, although at times apparently only three-segmented or four-segmented.

Mouthparts highly modified, being formed of three stylets which are retracted into a trophic sac, lying beneath the pharynx, these stylets being protrusible.

Thorax with the three segments closely fused but recognizable, the true notum being reduced in all segments to a narrow, median, membranous area or at times to a median pit and slight lateral extensions which surround the spiracles. The apparent thoracic nota formed almost entirely of subcoxal (=pleural) elements and these at times fused entirely across the notum, thus almost completely obliterating the true notal plates. Never more than one pair of thoracic spiracles, these belonging to the mesothorax.

Ovipositor of the female present, but reduced to at most a pair of flattened lobes which represent the gonopods of segment eight and a pair of small, sclerotized areas or mere tufts of setae which probably represent the gonopods of segment nine. Male never retaining the gonopods of segment nine and consequently without claspers, but usually retaining the parameres, the genital structures being retracted into the body when at rest.

Legs modified as clasping organs by having the distal, ventral angle of the tibia prolonged into a thumb which opposes the claw. Tarsus normally one-segmented and at most only obscurely two-segmented. Tarsal claws always single except in a few instances where a very doubtful second, claw-like structure is present on the anterior legs.

NOTES. The extraordinary mouthparts, which are among the most highly modified that are to be found in the Insecta, are the principal basis for the recognition of the Order as distinct from the Mallophaga. No transition between such mouthparts and those of the Mallophaga is known to exist. However, other distinctive characters are to be found in the thorax. In the Mallophaga the prothorax is always definitely separated from and movable independently of the other segments and the dorsa of at least the prothorax and the metathorax seem always to be composed of the true notal plates. In the Anoplura the prothorax is always fused with the mesothorax in such a manner that it cannot be independently movable, and the thoracic dorsum throughout is composed primarily of the pleural (=subcoxal) elements. While it is highly probable that the two groups go back to some common ancestry, that ancestry is entirely hypothetical and even if definitely known would still not preclude their being considered as separate Orders.

The feeling that the two groups should be united into a single Order seems to rest chiefly upon the similarities of habit and metamorphosis. Thus, the members of both groups attach their eggs to the hairs of their host, but exactly the same procedure is adopted by certain mites and by flies of the family Oestridae. Webb has considered the two groups to be closely related because of resemblances in their spiracles and tracheal systems. No comparative study of the spiracles through various Orders was made. Thus spiracles in some respects very similar to those both of Anoplura and Mallophaga appear in members of the families Polycetenidae and Cimicidae of the Order Hemiptera. We have here a situation very similar to that of the presence of "combs" of setae, such as those on the fleas, which occur in various ectoparasitic groups but which are also found in other forms that are not parasitic when once those forms are examined by the same methods which are employed in the case of the ectoparasites.

It is quite true that no other group than the Mallophaga is known to which the sucking lice may be closely related, but this in itself is no argument for combining the two groups into a single Order.

Concerning the general relationships of the sucking lice, it may simply be noted that if there is in fact some connection with the Mallophaga then the Anoplura are probably remotely related to the Corrodentia, since the Mallophaga seem thus to be connected.

CHAPTER V

The Classification Within the Order Anoplura

For many years after the formal naming of the genus *Pediculus* by Linnaeus all the known species of lice, both biting and sucking, were referred to this genus. It was not until 1806 that the biting lice were removed and placed in the genus *Ricinus*. It was then not until 1815 that the sucking lice remaining in *Pediculus* were in part transferred to two new genera, *Haematopinus* and *Pthirus*. The next genus of sucking lice, *Pedicinus*, was not named until 1844 and the next, *Echinophthirius*, not until 1871. As late as 1880 Piaget recognized only these genera, most of the species being referred by him to *Haematopinus*. In 1891 Osborn named the genus *Haematopinoides* and in 1896 the genus *Euhaematopinus*, which is definitely a synonym of *Haematopinoides*. During all this time—perhaps fortunately—no attempts were made to develop a higher classification, Giebel, in 1874, placing all the species in the family Pediculina and Piaget, in 1880, using the same arrangement with the alteration of the family name to Pediculidae.

As late as 1904 but seven genera had been named as belonging to the sucking lice, and of these one was a synonym and one, *Haematomyzus*, is now known not to be a sucking louse.

In 1904, Enderlein began the publication of a series of papers which represent the first really intelligent work done on the group. He recognized the superficial character of the genus *Haematopinus* and began the process of dismembering it. He named a total of eight new genera, of which six were removed directly from *Haematopinus* and two were based upon new species. At the time when Enderlein began his work there were, according to a count later made by Fahrenholz, but 65 known species, one of which was later shown not to belong to the Anoplura, and nearly 60 were referred to the genus *Haematopinus*. Up to this time there was no need for a system of classification above the generic level. Enderlein essayed the beginnings of such a system and this was later followed by Dalla Torre and by Ferris.

Eliminating the genus *Haematomyzus*, the sole member of the family Haematomyzidae established by Enderlein, which we now know is not a sucking louse, Enderlein's system was as follows:

FAMILY Pediculidae Leach

Subfamilies

Pediculinae Enderlein

Pedicininae Enderlein

FAMILY Echinophthiriidae Enderlein

FAMILY Haematopinidae Enderlein

Subfamilies

Haematopininae Enderlein

Linognathinae Enderlein

Euhaematopininae Enderlein

In 1909, Enderlein, in a paper on the lice of marine mammals published in the report of the Deutsche Südpolar Expedition, Volume X, divided the Echinophthiriidae into two subfamilies, Echinophthiriinae and Antarctophthiriinae.

In 1908, Dalla Torre published a catalogue of the Anoplura in Wytzman's "Genera Insectorum." This work, while useful as a first attempt at a catalogue, was an entirely mechanical bit of bibliography involving no knowledge of the insects on the part of the author and represented a none-too-thorough search of the literature. Only 65 species were listed. The classification adopted by Enderlein was followed.

In 1916, Ferris published a "Catalogue and Host List of the Anoplura" in the "Proceedings of the California Academy of Sciences," (Fourth Series), Volume VI. The system proposed by Enderlein was here followed. Some names were overlooked and there was some false synonymy, but the number of known

species at this time must have been quite close to the 120 listed.

In 1929, Ewing, in a book entitled "A Manual of External Parasites," proposed an extended classification. This still included *Haematomyzus* and the family Haematomyzidae. Excluding the Haematomyzidae the system was as follows:

FAMILY Haematopinidae Enderlein
Subfamilies

Enderleinellinae Ewing
Hybophthiriinae Ewing
Hoplopleurinae Ewing
Linognathinae Enderlein
Neolinognathinae Ewing
Haematopininae Enderlein

FAMILY Haematopinoididae Ewing
Subfamilies

Haematopinoidinae Ewing
Hamophthiriinae Ewing

FAMILY Pediculidae Piaget
Subfamilies

Pediculinae Enderlein
Pedicininae Enderlein
Phthirpediculinae Ewing

FAMILY Phthiriidae Ewing

Contains but one genus Phthirus

FAMILY Echinophthiriidae Enderlein
Subfamilies

Echinophthiriinae Enderlein
Antarctophthiriinae Enderlein
Lepidophthiriinae Ewing

In 1931, Ferris, in an extended paper in "Parasitology," Volume XXIII, showed that *Haematomyzus* does not belong to the sucking lice. He transferred this genus doubtfully to the Mallophaga and proposed for it the subordinal name Rhynchophthirina.

In 1932, Bedford, in a check list of the parasites of birds and mammals of South Africa, published in the "18th Report of the Director of Veterinary Services of the Union of South Africa," considered the biting lice and the sucking lice together to constitute the Order Anoplura, with three Suborders, Mallophaga, Rhynchophthirina, and Siphunculata. Under the Siphunculata he adopted the system proposed by Ewing.

In 1936, Fahrenholz, in a paper in "Zeitschrift für Parasitenkunde," Volume IX, Heft 1, proposed a classification in which he considered the sucking lice to constitute the Suborder Inrostrata of the Order Anoplura. Under this Suborder he proposed the following arrangement:

FAMILY Echinophthiriidae Enderlein
Subfamilies

Echinophthiriinae Enderlein
Antarctophthiriinae Enderlein

FAMILY Haematopinidae Enderlein
Subfamilies

Haematopininae Enderlein
Linognathinae Enderlein
Polyplacinae Fahrenholz

Haematopinoidinae Ewing
Lemurphthirinae Fahrenholz
Hamophthirinae Ewing

FAMILY Neolinognathidae Fahrenholz
Containing the single genus
Neolinognathus

FAMILY Pediculidae Leach
Subfamilies

Pedicininae Enderlein
Pediculinae Enderlein

In 1946, Eichler, in "Archiv für Naturgeschichte," Neue Folge, Volume X, Heft 3, adopted the name Phthiraptera of Haeckel, for an Order which included the three Suborders Mallophaga, Anoplura, and Rhynchophthirina. Under the Suborder Anoplura he proposed the following arrangement. If we substitute the term "superfamily" for his "family series" we shall be more nearly in accord with usual entomological practice.

FAMILY Echinophthiriidae Enderlein
Subfamilies

Echinophthiriinae Enderlein
Antarctophthiriinae Enderlein

FAMILY SERIES Pediculiformia Eichler

FAMILY Haematopinidae Enderlein
Subfamilies

Haematopininae Enderlein
Linognathinae Enderlein

Polyplacinae Fahrenholz
Lemurphthirinae Fahrenholz
Hamophthirinae Ewing

FAMILY Pediculidae Leach

Subfamilies

Pedicininae Enderlein
Pediculinae Enderlein
Phthirinae Ewing

In 1946, Webb, in a paper in the "Proceedings of the Zoological Society of London," Volume 116, Part 1, proposed a partial system of classification of the sucking lice "based solely on differences in spiracle structure..." as he himself said, but influenced to a considerable degree by considerations based on the distribution of the lice according to hosts. The system as there presented was only partial, since some genera were not placed in it. Webb's system, as far as it has been carried at the time of the present writing, is as follows: The biting lice and sucking lice are united in the Order Anoplura and are regarded as Suborders, the names Mallophaga and Siphunculata being employed for them. The Siphunculata, so far as treated, are divided into six families—Docophthiriidae, Pediculidae, Eulinognathidae, Linognathidae, Haematopinidae, and Echinophthiriidae. No subfamilies are named.

In the opinion here held this classification is in part correct. But in part it also rests upon some very peculiar concepts of taxonomy. Thus the louse of elephants, *Haematomyzus elephantis*, is not only regarded as a sucking louse but is even placed in the family Haematopinidae on the basis of spiracle structure alone!

In 1949, Hopkins, in the "Proceedings of the Zoological Society of London," Volume 119, recognized the biting and sucking lice together as constituting an Order Phthiraptera with the three Suborders Anoplura, Mallophaga, and Rhynchophthirina. Under the Anoplura he recognized but three families—Pediculidae, Haematopinidae, and Neolinognathidae.

In attempting to develop an intraordinal classification of the sucking lice, here considered to be the Order Anoplura, consideration has been given only to morphology. It is here held that the problems associated with the distribution of the lice on their various hosts should be approached only after conclusions have first been reached by way of morphological studies. It may be very agreeable in the end to find that the conclusions drawn from the lice themselves are in accord with those drawn from their hosts and if the two sets of conclusions serve to confirm each other we may be justified in feeling that some approach to truth has been achieved. But to use A to develop B and then to turn about and use B to develop A is a process that presents certain illogical aspects. This is especially true if *a priori* ideas concerning A and B have been employed. On the other hand, if A has been competently and logically developed and then B is found to agree closely with A there may very well be situations where, a point in A being doubtful, B may at least be used as a tentative aid in testing A or in supplementing it.

Thus in developing a classification of the sucking lice, if on morphological grounds a certain set of relationships is clearly indicated and then a definite correlation with the distribution of the lice according to hosts appears in harmony with these indications, we may be justified in employing the evidence of distribution to supplement the evidence or morphology where the latter is inadequate or confused. But we are certainly not justified in employing the evidence from distribution if it completely denies or is otherwise not in harmony with clear evidence from morphology. Especially is this true when the evidence from distribution is itself based upon questionable concepts.

For example, the genus *Polyplax* is a large group which is confined to rodents of the family Muridae, except for one or two species which occur on shrews. To say that since the shrews and the Muridae are not closely related to each other lice of the genus *Polyplax* should not occur on shrews and that therefore these lice actually from shrews do not belong to the genus *Polyplax*, despite the morphological evidence, is an utterly illogical procedure. To say that such genera as *Schizophthirus* and *Ancistroplax* cannot be related to the genus *Hoplopleura* because of the wide differences in the assumed relationships of the hosts would be to deny the plain evidence

of morphology.

But in the case of the Enderleinellinae we have a different situation. The genus *Enderleinellus*, which is of considerable size, is known only from Sciuridae. There are two peculiar genera, *Microphthirus* and *Werneckia*, which in certain respects are like *Enderleinellus* but which depart from that genus in the lack of a certain structure that we are inclined to accept as of morphological significance. But in certain other respects these two genera are like *Enderleinellus* and all three genera are as far as known confined to the squirrels. The totality of the evidence thus indicates that the absence of the structure in question is probably not sufficient to indicate that the two genera which lack it should be excluded from the Enderleinellinae. We are not here denying the evidence from morphology, we are merely supplementing it where it is weak, for experience in other fields of taxonomy indicates that the loss of a structure in the course of evolution may occur without disturbing or invalidating the evidence of relationship that is derived from other sources. What it does disturb is really nothing more than the ease with which keys for identification may be developed.

In attempting to develop a classification of the sucking lice certain considerations should be kept in mind.

1. This group is probably something of a remnant of what it once may have been. The living mammals represent but a very small part of all the species of mammals that have existed in the past. Let us reflect upon the number of proboscideans that are known only as fossils. What were their parasites? The single louse-like parasite of the elephants is all that is left to accompany the dwindling line of its hosts. The same situation may very well hold in regard to other lice.

2. Being a very small, very specialized, and perhaps remnant group, we have left but few or none of the connecting links that one may hope to find in the Orders of insects that still contain thousands of species.

3. There has evidently been a very large amount of evolution by loss among the Anoplura and this leaves us with a rather small complement of structures with which to work.

4. We still know probably not more than half of the species of sucking lice that exist in the world.

5. Under these conditions we have but limited bases for judgment as to the relationships of such forms as *Hybophthirus notophallus*, the louse of the aardvark; *Haematopinoides squamosus*, the louse of certain moles; the two known species of *Neolinognathus* from elephant shrews; as well as some other peculiar forms. Each of these genera contains the solitary or almost solitary representative of some ancient line and we have no basis for judgment as to whether its peculiarities are merely those of an individual species or were common to the members of what may once have been a much larger group.

Actually, whatever basis for classification we may adopt, the grouping of the genera of the sucking lice is not at all clear. Certainly no satisfactory arrangement can be obtained by focusing attention upon a single set of characters. We must take into consideration the totality of the characters which are available.

The opinion is here held that in the light of our present knowledge of the Anoplura any system of classification within the Order which elaborately divides it into superfamilies, families, subfamilies, tribes, subtribes, genera, and subgenera, can be nothing more than pretentious nonsense. Such minute subdivision can very well wait until a substantially larger proportion of the species is known.

In the light of these considerations the system here adopted will be rather conservative, only families, subfamilies and genera being employed. It is presented with a full realization of the possibility that it may very well be inadequate and at some points may actually be wrong. However, there

is the thought that the number of species concerning which error is most likely to exist constitutes only a small part of the whole. Thus, there may be question concerning the seven species referred to the Pediciniinae and to certain isolated species. But the great mass of the species and genera fall into clearly recognizable groups.

The genera of Anoplura are reasonably clear and uncomplicated, except as they may be complicated subjectively by workers who see a new genus in every slight departure from the normal form. These genera to a considerable degree fall into groups, the central pattern of which is rather evident, but which becomes clouded as we pass out from it. In fact, around their peripheries these groups become so misty that no very definite outlines can be detected and it is here that the principal difficulties arise. To name families that cannot be defined is to create difficulties for all future workers, to overemphasize the differences that exist and exaggerate the boundaries among these differences.

At an earlier time, when little or nothing was known about the morphology of these insects, certain ideas concerning their classification seemed valid which now appear at least dubious. Thus it was assumed that the presence of a distinct lens marking each compound eye separated the Pediculidae from all the other lice and defined a family. We now know that such lenses are present in various other forms which seem not to be closely related to *Pediculus* and this once apparently beautifully defined family becomes extremely difficult to define. Evolution by loss has occurred so extensively in the Anoplura that the persistence of a structure may indicate only the retention of what was once a widespread character in all the ancestors of the group. It is therefore difficult to properly evaluate the remnants that are left.

One other quite secondary, but nevertheless important, problem arises. This has to do with the names which should be employed for the families and subfamilies that are recognized. This is a problem which is inherently difficult and which, probably because of this difficulty, is not even touched upon by the "International Rules of Zoological Nomenclature."

Should priority rule? If so, what constitutes priority? Does it date from the first recognition of the existence of a group in any status whatsoever or from the first unequivocal employment of a group name with a particular ending? Are family and subfamily or any lower category names such as tribes and subtribes to be regarded as nomenclatorially equivalent, in the manner in which generic and subgeneric names are equivalent? What determines the type of any category? Should it be the oldest genus referred to the category—as some maintain—or should it be the genus upon which the category name was first based—as others maintain?

And who is to be cited as the author of a group name—if this recognition must willy-nilly be accorded to someone? Shall it be the person who first recognized the group and employed a group name of any rank? Or shall it be the person who used the name which is now employed? Thus, is the author of a subfamily name to be regarded as the author of the name if it is elevated to family rank, or shall it be the person who first used the name to characterize a family? If a subfamily is raised to family rank and then reduced again to a subfamily of some other family, who is the author of the name? Or should we refuse to bother about the name of the author of a group?

There are no fixed answers to these problems and in the absence of answers one is left very much to follow whatever course seems reasonable.

The writer of these lines has puzzled long over all these questions and has come to no answers to any of them that are entirely satisfactory to himself. As far as classification is concerned, there is on the one hand the undesirability of obscuring facts by too comprehensive groupings or on the other hand of going beyond all reasonable limits by the indiscriminate

naming of groups that cannot be supported by any cogent reasons.

As to nomenclature, the stand here adopted is in part based upon priority in actual recognition of a group, whatever category may have been assigned to it, and in some degree upon arbitrary action in refusing to recognize a group—such as the Haematopinoididae—which would assign a family name to a large group on the basis of a very aberrant member.

As to authors' names, it is here held that the matter is too unimportant to bother with, or above all to argue very much about one way or another. The names of authors are indicated in accompanying discussions but not conjoined with the names of the groups in section headings.

THE SYSTEM HERE EMPLOYED Family Echinophthiriidae

This family, which was established as such by Enderlein in 1904, is retained. It was united with the Haematopinidae by Hopkins but this step is regarded as erroneous on morphological grounds. Two subfamilies—Echinophthiriinae and Antarctophthiriinae—were recognized by Enderlein and accepted by most later workers, but are here rejected since it does not appear that anything is gained by recognizing them.

Family Haematopinidae

First established by Enderlein to contain the vast majority of the sucking lice and later accepted by all workers with various restrictions. It is here accepted for two genera, *Haematopinus* and *Pecarocetus*.

Family Hoplopleuridae

This family contains within it the genus *Haematopinoides* which, under the synonymic name *Euhaematopinus*, was placed by itself in the subfamily *Euhaematopininae* of the family Haematopinidae by Enderlein and later, under its correct name *Haematopinoides*, placed by Ewing in the family Haematopinoididae. This family is rejected as zoologically unjustified and referred to the Hoplopleuridae. It may very well be argued, and perhaps correctly, that the family name Haematopinoididae should be employed for the family Hoplopleuridae, to which it is here referred, but it is a very aberrant form which is quite unsuited to be used as the type of the family.

The group of which *Hoplopleura* is here taken as the type was recognized by Ewing in 1929 as the subfamily Hoplopleurinae of the family Haematopinidae. Since at the same time Ewing recognized the subfamily Enderleinellinae, it is necessary to make a choice between these two names for the family here considered to include the two groups. *Hoplopleura* is chosen as being more nearly central than is *Enderleinellus*.

Subfamily Enderleinellinae Ewing

Established by Ewing in 1929 as a subfamily of the Haematopinidae. Here accepted as a subfamily of the Hoplopleuridae, to contain three genera.

Subfamily Hybophthirinae Ewing

This group was named by Ewing in 1929 as a subfamily of the Haematopinidae. Webb has considered the members of this group to be closely related to *Haematopinus* and has placed them in the family Haematopinidae, but since he also placed in this family the genus *Haematomyzus*—which is not even an Anopluran—the importance of the spiracular characters which he employed may be somewhat discounted.

The three genera here placed in the Hybophthiriinae are, in their free paratergal plates of the abdomen, much more closely similar to the members of the Hoplopleuridae than to any other group. They agree among themselves in the possession of a claw-like structure arising beside the claw on the anterior legs and in this appear to be related most closely to each other.

Subfamily Pedicininae Enderlein

It is concerning this group that there will probably be the greatest difference of opinion and the writer does not expect agreement with the point of view here adopted.

The group was first recognized by Enderlein as a subfamily of the family Pediculidae, which was restricted to *Pediculus*, *Pthirus*, and *Pedicinus*. The genus *Pedicinus* has, ever since, been placed as a subfamily of the Pediculidae because of two factors. One of these factors is undoubtedly that of the feeling that anything occurring on the Primates should be related to *Pediculus*. The other factor is that of the common possession of eyes by *Pediculus* and *Pedicinus* and this character was employed as the distinguishing mark of the Pediculidae. But in the light of what is now known it does not appear that this character by itself is especially significant, since it is known that genera such as *Pecaroecus* and *Microthoracius*—which certainly do not belong with *Pediculus*—have eyes and they can even be demonstrated in *Haematopinus* although they are not there so evident.

In fact, present evidence indicates merely that the presence of eyes represents merely the retention of a primitive character, once common to all the sucking lice and their ancestors.

If we remove the eyes from consideration, the remainder of the body in *Pedicinus* contraindicates any association with *Pediculus*. In fact, with the eyes removed all the characteristics of the body seem much closer to what is found in the Hoplopleuridae. The free paratergal plates and the absence or great reduction of the gonopods of segment nine in the female are more nearly in harmony with what appears in this family.

We might raise *Pedicinus* to family rank, but this is merely to increase the number of families by emphasizing the difference in one structure.

With these thoughts in mind the author has decided to "take the bull by the horns" and remove the genus *Pedicinus* from close association with *Pediculus*, assigning it to the family with which it shares the majority of its features, regardless of whether or not it ought to be related to the Pediculidae.

Subfamily Polyplacinae

Established by Fahrenholz in 1936 as a subfamily of the Haematopinidae. It is here considered to contain the genus *Hamophthirus*, which was employed by Ewing in 1929 as type of his subfamily Hamophthirinae of the family Haematopinoididae and thus on grounds of priority it might be argued that the name Hamophthiriidae should be employed for it. However, the genus *Hamophthirus* is very badly described and quite unsuitable to stand as the type of any group.

It contains also the genus *Lemurphthirus* which was employed by Fahrenholz in 1936 as type of the subfamily Lemurphthirinae of the family Haematopinidae. This subfamily is here rejected.

Family Linognathidae

First recognized by Enderlein as the subfamily Linognathinae of the family Haematopinidae and retained in this position by later workers. It is here elevated to family rank.

Family Neolinognathidae

This group was first recognized by Ewing as the subfamily Neolinognathinae of the family Haematopinidae and later raised to family rank by Fahrenholz.

Family Pediculidae

This family was apparently established under a family name, with the family ending as now employed, by Piaget in 1880, although it had earlier been recognized by Giebel under the name Pediculina. It is here utilized for two genera only, the genus *Pedicinus*—which has usually been assigned to the Pediculidae—here being regarded as belonging rather to the Hoplopleuridae.

CHAPTER VI

Review of the Families, Subfamilies, Genera and Species of the Anoplura

Family ECHINOPHTHIRIIDAE Enderlein

1904. Enderlein, Zoologischer Anzeiger 28:136. (Names the family.)
1909. Enderlein, Deutsche Südpolar Expedition 10:506. (Divides the family into two subfamilies, Echinophthiriinae and Antarctophthiriinae.)
1910. Mjöberg, Arkiv för Zoologi 6:177. (Names the family Lepidophthiriidae.)
1916. Ferris, Proceedings of the California Academy of Sciences (Series 4) 6:180. (Rejects the family Lepidophthiriidae as a synonym of Echinophthiriidae.)
1928. Freund, Die Tierwelt der Nord-und Ostsee, Teil XI d₁. (Reviews the family and accepts the two subfamilies Echinophthiriinae and Lepidophthiriinae.)
1929. Ewing, A Manual of External Parasites, page 148. (Recognizes three subfamilies, Echinophthiriinae, Antarctophthiriinae, and Lepidophthiriinae.)
1936. Fahrenholz, Zeitschrift für Parasitenkunde 9:56. (Recognizes the two subfamilies Echinophthiriinae and Antarctophthiriinae.)
1946. Eichler, Archiv für Naturgeschichte, Neue Folge, 10:345-398. (Recognizes the family with two subfamilies, Echinophthiriinae and Antarctophthiriinae and places the family in the "Family Series Echinophthiriformia.")

DESCRIPTION OF THE FAMILY. Anoplura which occur exclusively upon marine mammals of the Suborder Pinnipedia of the Order Carnivora. Eyes not externally evident. Antennae four- or five-segmented. Body more or less thickly beset with setae which are in some species modified into scales, in others only somewhat flattened and in at least one species normally cylindrical. Abdomen never with sclerotized tergal, paratergal, or sternal plates, membranous or leathery. Abdominal spiracles of a distinctive type, with a long, slender, and more or less membranous atrial chamber, the walls of which do not bear transverse markings. Female with the gonopods of segment eight never forming free lobes. Males with the genital sac forming a flattened, median plate, alongside which lie the flattened parameres. Thorax never with a sternal plate which is apically or marginally free, although at times with an irregular sternal sclerotization. Middle and posterior legs always with a very stout tibiotarsus, in which the tibiotarsal division is scarcely or not at all evident. Anterior legs usually small and slender, with the tibiotarsal division evident, but in at least one species similar to the others.

NOTES. Nothing is to be gained by dividing this family into two subfamilies, and still less by dividing it into three as has been proposed. Division on the basis of the presence or absence of scales is contraindicated by the fact that *Proechinophthirius fluctus* (Ferris), which lacks scales, is in other respects very similar to *Antarctophthirus callorhini* (Osborn) in which the vestiture of scales is less than that to be found in other members of the latter genus. A division on the basis of number of antennal segments also is contraindicated, since such a division would cut directly across any division on the basis of the presence or absence of scales. Nor is anything to be gained by division on the basis of the distribution of the species for, upon whatever basis such division may be made, it does not follow the relationships of the hosts.

Key to the Genera of ECHINOPHTHIRIIDAE

1. Antennae 5-segmented.....ANTARCTOPHTHIRUS
 Antennae 4-segmented.....2
2. Abdomen with scales.....LEPIDOPHTHIRUS
 Abdomen without scales.....3
3. Legs all of same size and shape, with stout tibiotarsus and claw.....
 ECHINOPHTHIRUS
 Anterior legs much smaller than the others and with small, slender claw
 PROECHINOPHTHIRUS

Genus ANTARCTOPHTHIRUS Enderlein

1906. *Antarctophthirus* Enderlein, Zoologischer Anzeiger 29:661.
 1910. *Arctophthirus* Mjöberg, Arkiv för Zoologi 13:177.
 1934. *Antarctophthirus*, Ferris, Contributions Toward a Monograph of the
 Sucking Lice, Part 7:484.
 1941. *Achimella* Eichler, Archiv für Naturgeschichte, Neue Folge, 10:375.

GENERIC TYPE. The type of *Antarctophthirus*, by original designation, is *Antarctophthirus oëmorhini* Enderlein. The type of *Arctophthirus* Mjöberg is, by original designation, *Haematopinus trichechi* Bohemann. The type of *Achimella* is, by original designation, *Haematopinus callorhini* Osborn.

CHARACTERS. Echinophthiriidae with five-segmented antennae. Anterior legs small and with slender claw; middle and posterior legs very large and stout and with stout claw. Body more or less beset with flattened, scale-like setae.

NOTES. There is no justification for the recognition of the genus *Arctophthirus* Mjöberg. There is perhaps some justification for the recognition of *Achimella*, but that evidence is not considered sufficient.

Key to Species of ANTARCTOPHTHIRUS

1. Thoracic sternum beset only with slender setae; scales on the abdomen very few, arranged more or less in patches on the dorsum of the abdomen and on the posterior portion of the venter; occurring on the Alaska fur seal.....CALLORHINI
 Thoracic sternum bearing scales; scales very abundant on the abdomen..2
2. Thoracic sternum with a few long setae on its posterior border.....3
 Thoracic sternum without long setae along its posterior border.....4
3. Scales of the abdominal dorsum all very uniform in size and shape, ovoid, the apex slightly pointed; occurring on *Phocarctos*, *Eumetopias*, and *Zalophus*.....MICROCHIR
 Scales of the abdomen (according to Enderlein) elongated-oval and of various sizes; occurring on *Lobodon*.....LOBODONTIS
4. Ventral side of the head beset with small, flattened, oval setae in addition to scales; occurring on *Oëmorhinus*.....OËMORHINI
 Ventral side of the head with long hairs or with minute hairs only....5
5. Ventral side of the head with many long hairs posteriorly.....TRICHECHI
 Ventral side of the head with only 3-4 minute hairs posteriorly MAWSONI

Antarctophthirus callorhini (Osborn)

1899. *Haematopinus callorhini* Osborn, In The Fur Seals and the Fur-Seal Islands of the North Pacific Ocean 3:553; figure 1.
 1915. *Antarctophthirus monachus* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications (no volume number), page 49; text figures 17A and 18; Plate III, figure 4.

1934. *Antarctophthirus callorhini* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:495; figures 289, 290.

1941. *Achimella callorhini* (Osborn), Eichler, Archiv für Naturgeschichte, Neue Folge, 10:275.

HOSTS AND DISTRIBUTION. The types of Osborn's *Haematoptinus callorhini* were from *Callorhinus alaskanus* from the Pribilof Islands. The specimens upon which the name *monachus* were based came from Osborn as a loan but bore no data other than as from "seal," but they were in all probability from the type lot. Since that time a few more specimens have come to hand from the type host on St. Paul and Pribilof Islands in the Bering Sea.

Antarctophthirus lobodontis Enderlein

1909. *Antarctophthirus lobodontis* Enderlein, Deutsche Südpolar Expedition 10:510; Figures KK, NN.

HOSTS AND DISTRIBUTION. Known only from the original record from *Lobodon carcinophagus*, Booth Wandel Island in the Antarctic.

Antarctophthirus mawsoni Harrison

1937. *Antarctophthirus mawsoni* Harrison, Australasian Antarctic Expedition, 1911-1914, Scientific Reports, Series C-Zoology and Botany 2:1:11; figure 1.

HOSTS AND DISTRIBUTION. From *Ommatophoca rossi*, King George V Land in the Antarctic.

Antarctophthirus microchir (Trouessart and Neumann)

1888. *Echinophthirus microchir* Trouessart and Neumann, Le Naturaliste 10:80; figures.

1906. *Antarctophthirus microchir* (Trouessart and Neumann), Enderlein, Zoologischer Anzeiger 29:663; figures 3, 4.

1934. *Antarctophthirus microchir* (Trouessart and Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:489; figures 285, 286.

1939. *Antarctophthirus microchir californianus* Fahrenholz, Mitteilungen aus dem entomologischen Verein Bremen, page 42.

HOSTS AND DISTRIBUTION. Types from *Phocarctos hookeri*, Auckland Island. Recorded also from *Zalophus californianus* and *Eumetopias jubata* from the coast of California.

NOTES. The supposed variety *californianus* was named by Fahrenholz purely upon the basis of differences in the illustrations presented by Enderlein and Ferris. These differences are of an order inevitably associated with differences in the preparation of specimens and involve no actual morphological characters. Actually the agreement between specimens from California and the beautiful illustrations given by Enderlein is extremely close. The supposed variety is here rejected.

Antarctophthirus oömorhini Enderlein

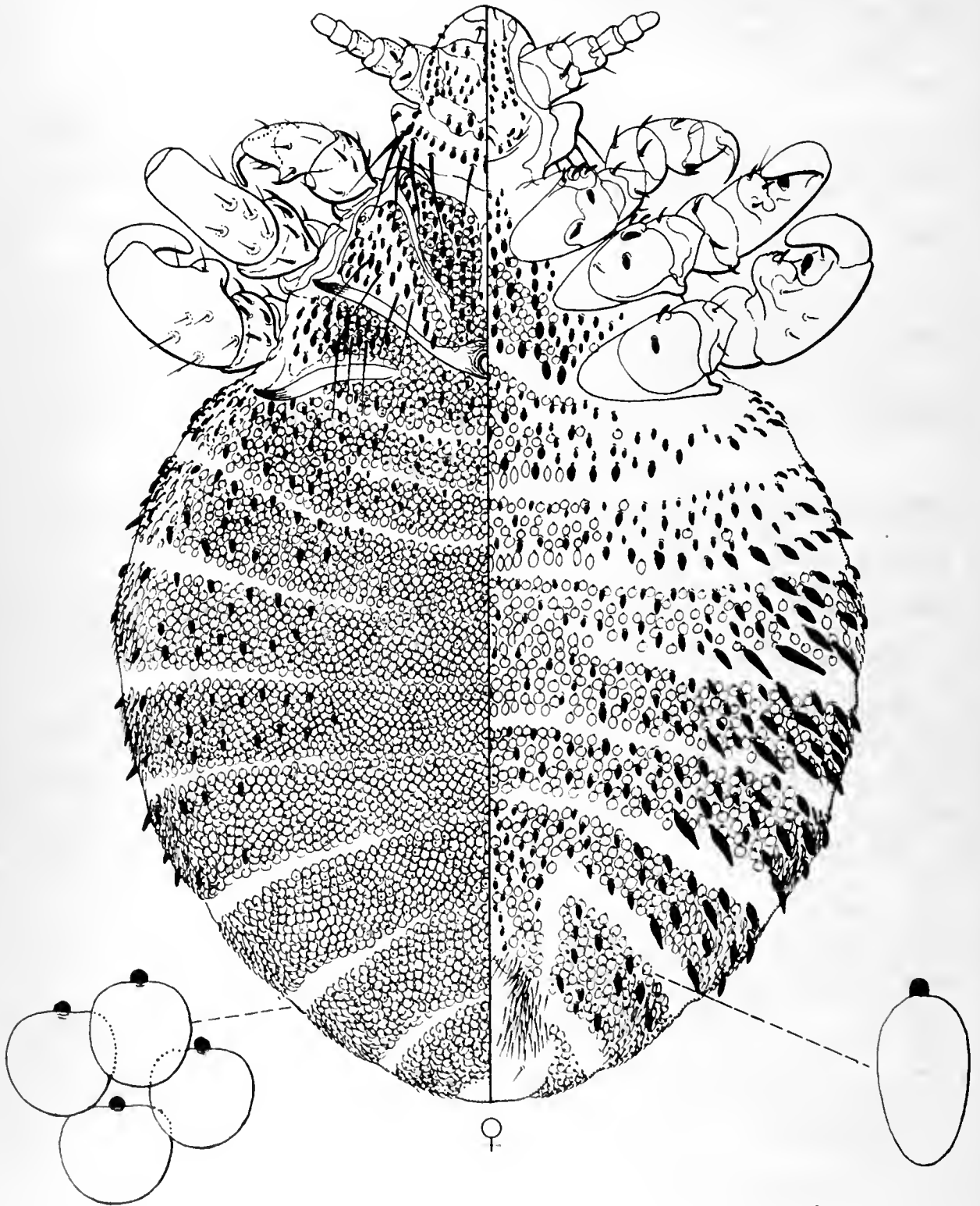
Figure 31

1902. *Echinophthirus setosus* (Burmeister), Rothschild, Report of the Southern Cross Expedition, page 224. (Misidentification)

1906. *Antarctophthirus oömorhini* Enderlein, Zoologischer Anzeiger 29:662; text figures.

1909. *Antarctophthirus oömorhini* Enderlein, Enderlein, Deutsche Südpolar Expedition 10:509; figures 174, 175, 181, 182.

1934. *Antarctophthirus oömorhini* Enderlein, Ferris, Contributions Toward a



Antarctophthirus ogmorhini (Enderlein)

Figure 31

Monograph of the Sucking Lice, Part 7:486; figures 282, 283.

1937. *Antarctophthirus oëmorhini* Enderlein, Harrison, Australasian Antarctic Expedition, 1911-1914, Scientific Reports, Series C, Zoology and Botany 2:1:11.

HOSTS AND DISTRIBUTION. Described as from *Oëmorhinus leptonyx*, Victoria Land and Booth Wandel Island in the Antarctic. This is apparently now placed in the genus *Hydrurga*.

NOTES. The accompanying illustration was made from the types in the British Museum.

Antarctophthirus trichechi (Bohemann)

1865. *Haematopinus trichechi* Bohemann, Vetenskaps Akademie Forhandlingar, Kobnhaven 22:557; Plate 35, figure 2.

1909. *Antarctophthirus trichechi* (Bohemann), Enderlein, Deutsche Südpolar Expedition 10:512; figures 172, 173, 185-188.

1910. *Arctophthirus trichechi* (Bohemann), Mjoberg, Arkiv für Zoologi 10:13:178; figures 90-92.

1934. *Antarctophthirus trichechi* (Bohemann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:492; figures 287, 288.

HOSTS AND DISTRIBUTION. Recorded by various authors from the walrus, *Odobenus rosmarus* and *Odobenus obesus*, from various places in the Arctic.

Genus ECHINOPHTHIRIUS Giebel

1871. *Echinophthirus* Giebel, Zeitschrift für die gesamten Naturwissenschaften 37:177.

1934. *Echinophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:475.

1946. *Echinophthirus*, Hopkins, Annals and Magazine of Natural History, Series 11, 12:566. (Bears date of 1945, but published May, 1946)

GENERIC TYPE. *Pediculus phocae* Lucas, which is considered to be a synonym of *Pediculus horridus* von Olfers.

CHARACTERS. With four-segmented antennae. Legs all of essentially the same size and form, stout and with stout claw. Abdomen thickly beset with stout, flattened, but not scale-like, setae.

HOSTS. Occurring as far as known only on seals of the genera *Halichoerus* and *Phoca*, of the family Phocidae.

NOTES. Ferris (1934) reviewed a considerable amount of material and concluded that this genus contains but one species. Hopkins (1946) suggested, although apparently not on the basis of an examination of specimens, that "analogy with other genera suggests the possibility that it may prove necessary to divide the genus again into several species or subspecies." After reviewing such material as is available, the opinion is here still held that the genus contains but one species, as far as morphological evidence goes, although at present nothing certain can be said concerning the supposed subspecies from seals in Lake Baikal.

Echinophthirus horridus (von Olfers)

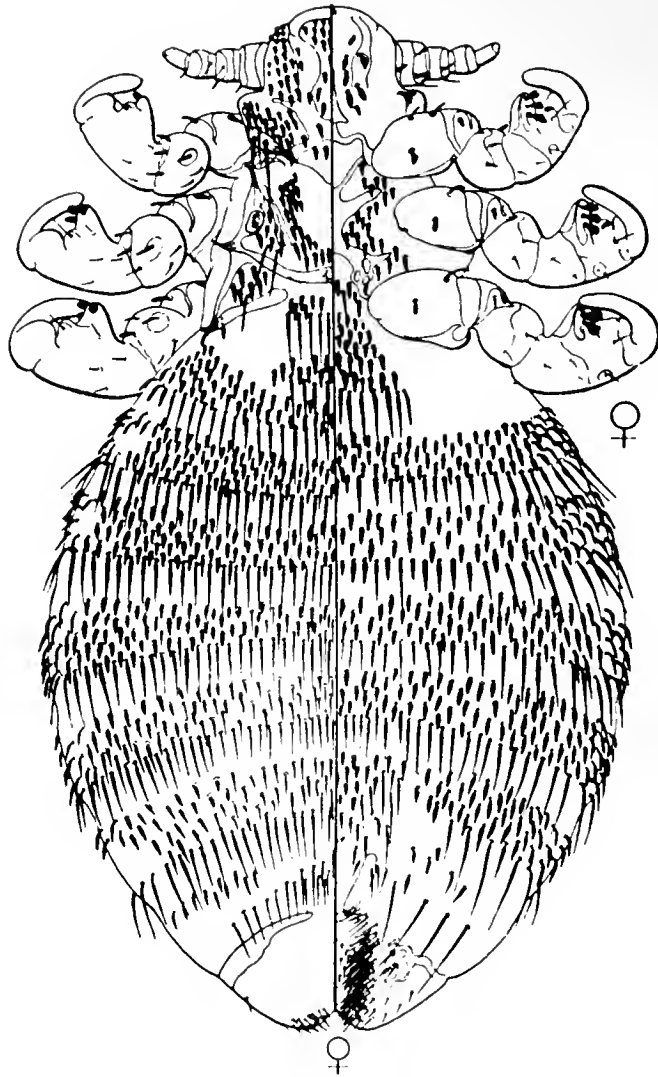
Figures 32, 33

1816. *Pediculus horridus* von Olfers, De vegetativis et animatis corporibus animatis reperiundis commentarius, Part 1, page 84. (Fide Fahrenholz)

1834. *Pediculus phocae* Lucas, Guerin's Magazin de Zoologie 4:Classe IX: Plate 121.

1838. *Pediculus setosus* Burmeister, Genera Insectorum, Species 12.

1857. *Pediculus annulatus* Schilling, Gurlt, Archiv für Naturgeschichte 23: 281.



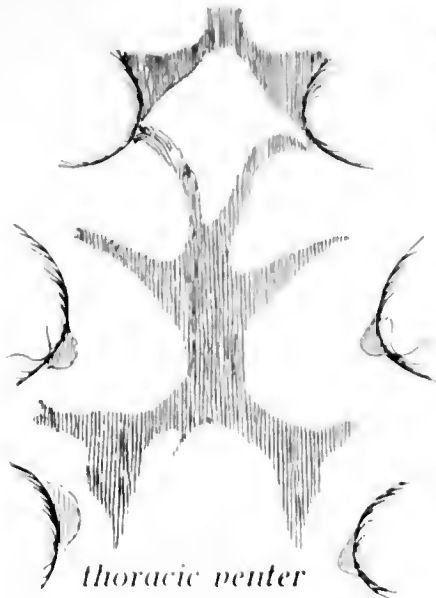
Echinophthirius horridus (von Olfers)

Figure 32

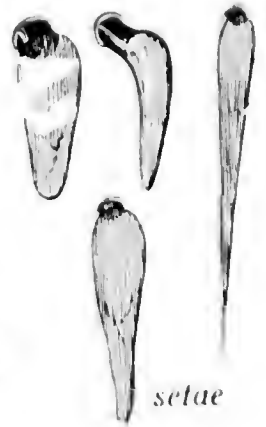
1874. *Echinophthirius setosus* (Denny) (sic), Giebel, *Insecta Epizoa*, page 42.
1880. *Echinophthirius setosus* (Lucas), Piaget, *Les Pediculines*, page 656; Plate 54, figure 1.
1886. *Echinophthirius groenlandicus* Becher, *In Die Internationale Polarforschung 1882-1883*, Beobachtungs Ergebnisse 3:60; Plate 5, fig. 1.
1897. *Echinophthirius sericans* Meinert, *Vetenskabelige Meddelser Kjobenhavn* 58:177.
1919. *Echinophthirius horridus* (von Olfers), Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover* 5-10:22.
1928. *Echinophthirius horridus* (von Olfers), Freund, *In Die Tierwelt der Nord- und Ostsee*, Teil XI d₁:6; figures 1, 2.
1934. *Echinophthirius horridus* (von Olfers), Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 7:475; figures 277, 278.
1935. *Echinophthirius horridus baikalensis* Ass, *Travaux de la station limnologique de Lac Baikal* 6:21:25-29; 5 figures.
1946. *Echinophthirius horridus* (von Olfers), Hopkins, *Annals and Magazine of Natural History*, Series 11, 12:566. (Bears date of 1945, but published May, 1946)



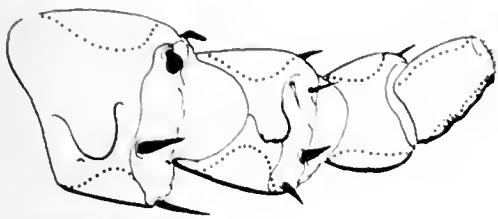
thoracic dorsum



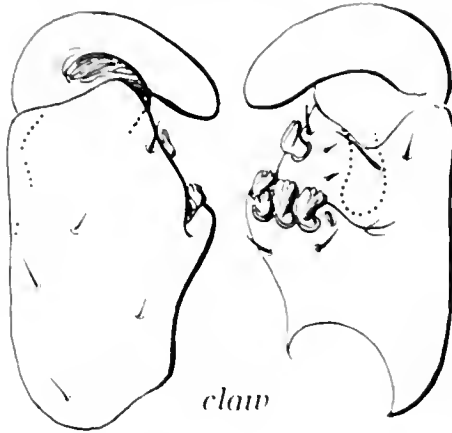
thoracic venter



setae



antenna



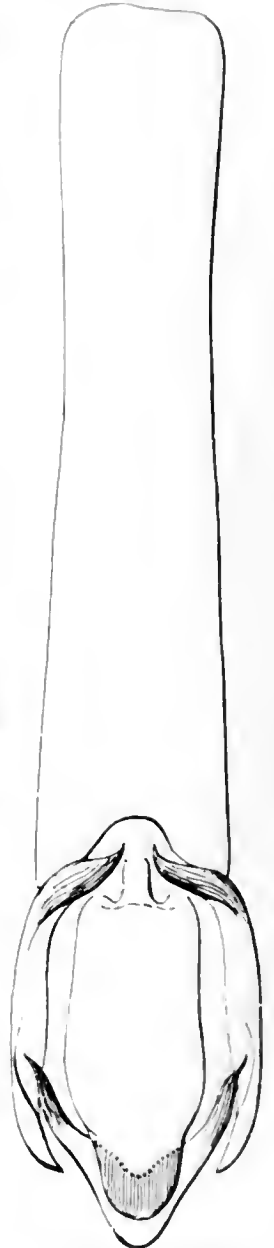
claw



female genitalia



male genital plate



male genitalia

Echinophthirius horridus (von Olfers)

Figure 33

HOSTS AND DISTRIBUTION. Described by von Olfers as from *Phoca vitulina*. The type of *phocae* Lucas was said to have been taken from the same host species in a zoological garden in Paris. The type of *sericans* Meinert was from *Phoca groenlandica* and the type of *groenlandicus* Becher was ascribed to the same host. The species was recorded by Ferris from *Phoca vitulina* from the Shetland Islands, from Scotland, and from specimens taken at the Hamburg Zoological Garden; from *Phoca hispida* in the Beaufort Sea off Alaska; from *Phoca richardii* at Pacific Grove, California. The species has been recorded on various occasions from *Phoca vitulina*, *Phoca variegata*, and *Halichoerus gryphus* from the North Atlantic. Freund recorded specimens from *Phoca baikalensis* from Lake Baikal.

NOTES. Hopkins has reviewed the literature and has pointed out that the name *annulata* is a *nomen nudum* and that Burmeister's name *setosus* was proposed merely as a substitute for *phocae* Lucas.

The status of the supposed species *groenlandicus* is somewhat obscure. Ferris has examined specimens from "Greenland seal," but it is possible that this label meant nothing more than "a seal from Greenland." Mjöberg recorded specimens from *Phoca groenlandica* which he considered to be *horridus*. Freund, who reviewed the whole subject, considered it very questionable that a distinct species occurs on this host. It is here held that the evidence is all against the distinctness of the species *Echinophthirius groenlandicus* Becher.

Freund examined specimens from *Phoca baikalensis* which he considered to belong to *horridus*, this being anterior to the description of the supposed subspecies *baikalensis* from this host. We may therefore consider this supposed subspecies to be a synonym of *horridus*.

As already pointed out in connection with the discussion of the genus, the opinion is here held that there is no evidence to justify the naming of more than one species of this genus.

Genus LEPIDOPHTHIRUS Enderlein

1904. *Lepidophthirus* Enderlein, Zoologischer Anzeiger 28:44.
1934. *Lepidophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:498.

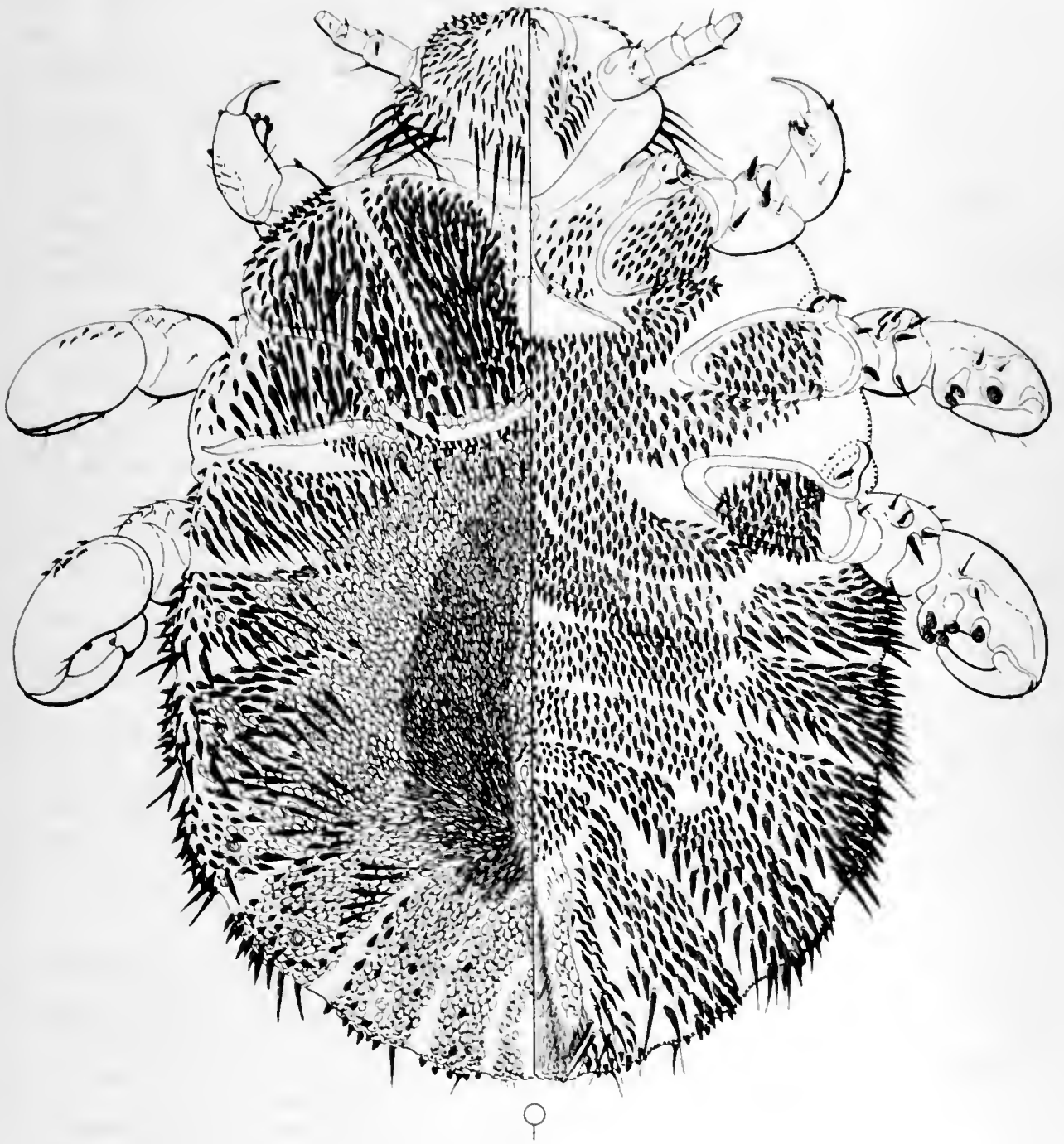
GENERIC TYPE. *Lepidophthirus macrorhini* Enderlein, the only included species.

CHARACTERS. Echinophthiriidae with four-segmented antennae. Anterior legs much smaller than the others and with slender claw; middle and posterior legs very large and stout, with stout claw. Body very thickly beset with setae of various sizes and shapes, these mostly more or less flattened and the dorsum of the abdomen also very thickly beset with scales.

Lepidophthirus macrorhini Enderlein Figures 34, 35

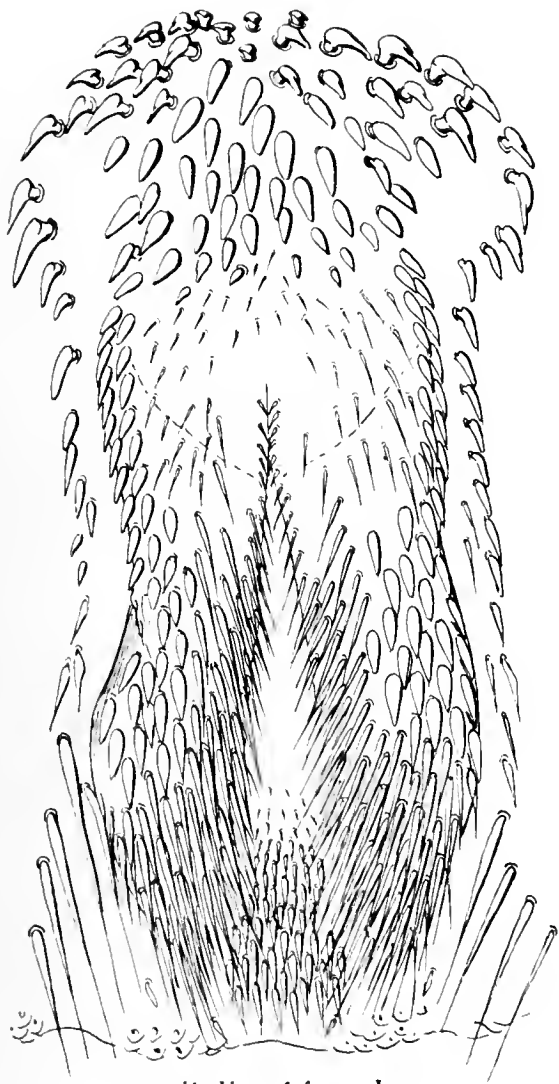
1904. *Lepidophthirus macrorhini* Enderlein, Zoologischer Anzeiger 28:46; figures 1-5.
1929. *Lepidophthirus macrorhini* Enderlein, Bedford, Director of Veterinary Services, Union of South Africa, Report 15:507.
1934. *Lepidophthirus macrorhini* Enderlein, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:499; figures 291, 292.
1937. *Lepidophthirus macrorhini* Enderlein, Harrison, Australasian Antarctic Expedition, 1911-1914, Scientific Reports, Series C-Zoology and Botany 2:Part 1:13.

HOSTS AND DISTRIBUTION. Known only from the southern sea elephant or elephant seal, from Kerguelen Island and also from near Cape Town, South Africa, and from Macquarie Island.



Lepidophthirus macrorhini Enderlein

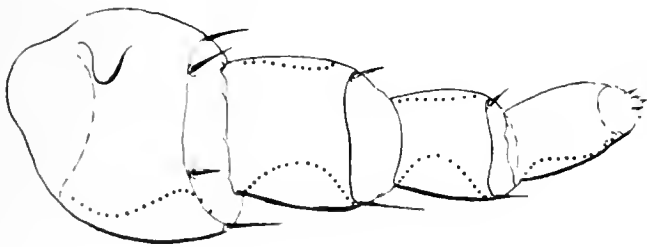
Figure 34



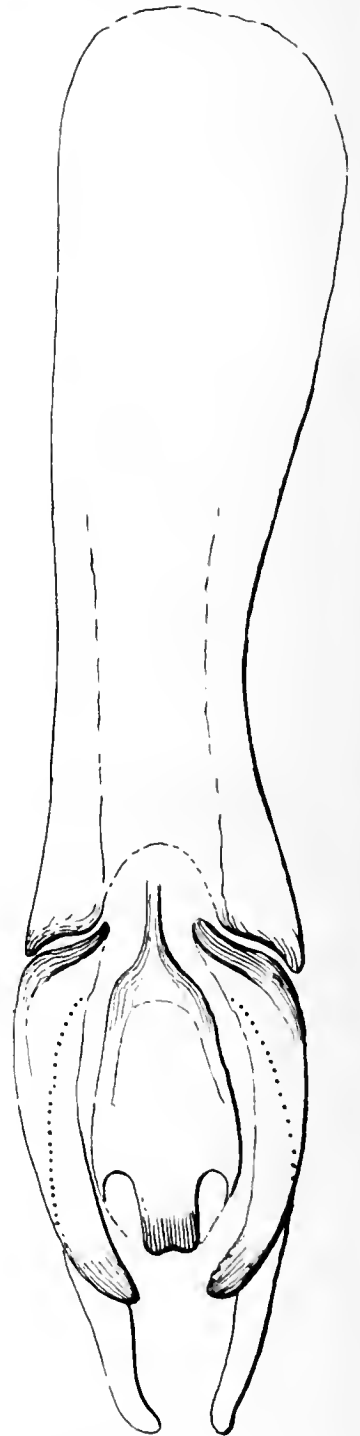
genitalia of female



scales



antenna



genitalia of male

Genus PROECHINOPHTHIRIUS Ewing

1923. *Proechinophthirus* Ewing, Journal of the Washington Academy of Sciences 13:149.
1934. *Proechinophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:480.

GENERIC TYPE. *Echinophthirus fluctus* Ferris, the only included species.

CHARACTERS. Echinophthiriidae with four-segmented antennae. Thorax with no sclerotized sternal areas. Abdomen beset with setae of various shapes and sizes, but none flattened and none being scale-like. Anterior legs small and with weak, slender claw; middle and posterior legs large and stout, with stout claw.

Proechinophthirus fluctus (Ferris)

Figure 36

1916. *Echinophthirus fluctus* Ferris, Entomological News 27:366; figure.
1923. *Proechinophthirus fluctus* (Ferris), Ewing, Journal of the Washington Academy of Sciences 13:149.
1934. *Proechinophthirus fluctus* (Ferris), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:481; figures 279, 280, 281.

HOSTS AND DISTRIBUTION. The types of the species were taken from the stuffed skin of an Otariid pup in the collection of Stanford University, this bearing no data. The pup was identified as being that of a Stellar's sea lion, *Eumetopias jubata*, but this may have been an error. The species has since been taken from the Alaskan fur seal, *Callorhinus alaskanus*, on St. Paul Island and on the Pribilof Islands in Bering Sea.

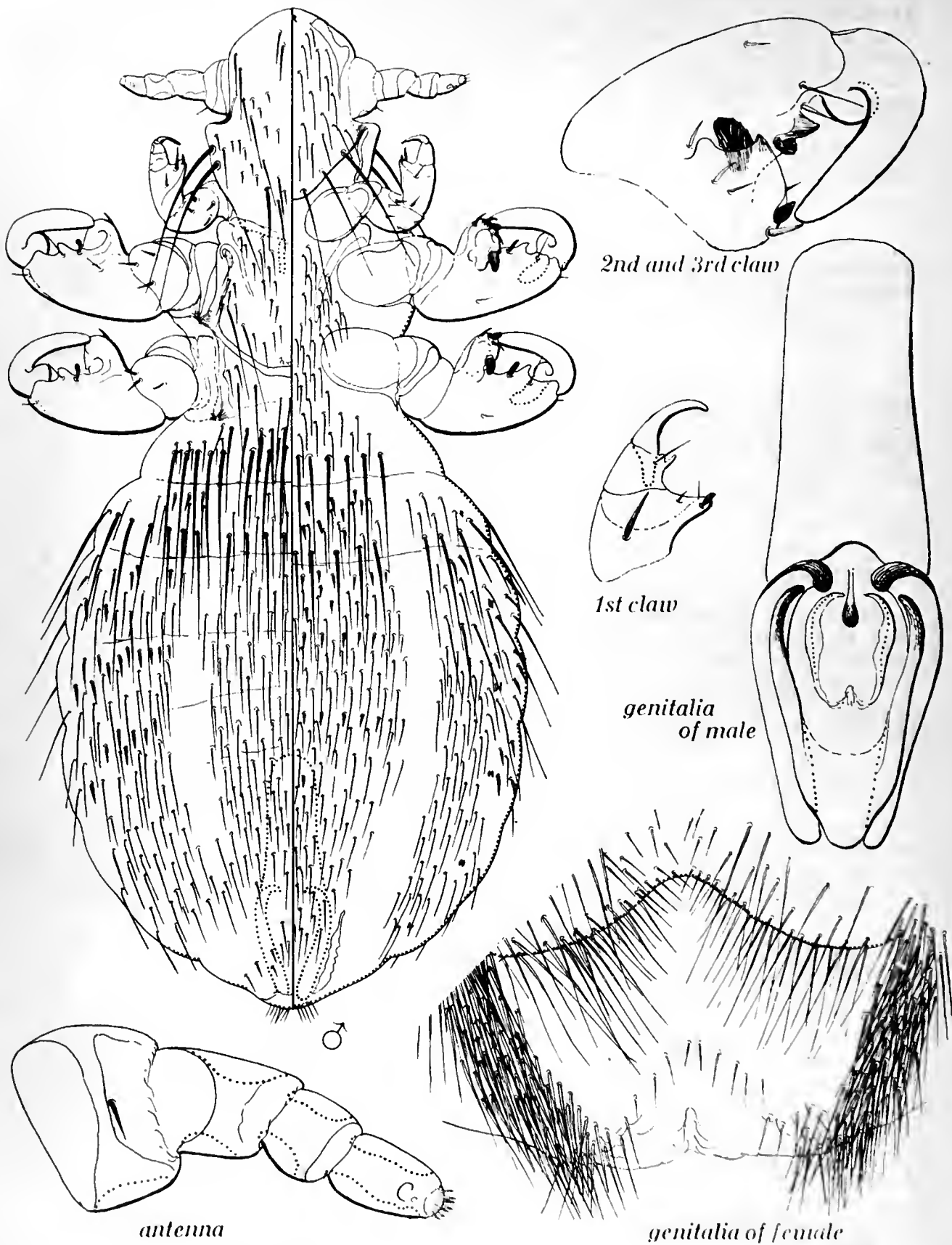
Family HAEMATOPINIDAE Enderlein

1904. Enderlein, Zoologischer Anzeiger 28:136.

DESCRIPTION OF THE FAMILY. Anoplura in which the paratergites of the abdominal segments are strongly sclerotized and form lateral lobes or prominences but are never marginally free from the body wall. Spiracles with the atrium beset internally with numerous points. Legs all of substantially the same size and with claws of the same size and shape. Clearly defined eyes present or absent, if absent the head with pronounced ocular points just posterior to the antennae. Thorax always with a well-defined notal pit and with a pair of sternal, apophyseal pits. Abdomen usually with the derm of the dorsum at least very finely wrinkled, at times slightly sclerotic, and with sclerotized areas, which, while somewhat more sclerotized than the surrounding derm, are defined more by the absence of this minute wrinkling. Gonopods of segment eight of the female always well developed. Genitalia of the male never with free parameres. Female apparently without spermatheca.

NOTES. At one time this family was considered to include the great majority of all the sucking lice, but it has been progressively reduced until here it is considered to contain but two genera, *Haematopinus* and *Pecaroecus*, the latter having but one species. Webb (1936) considered it to include four genera—*Haematopinus*, *Haematomyzus*, *Hybophthirus*, and *Scipio*—and possibly also the genus *Microthoracius*. *Haematomyzus*, as has already been and cannot too strongly be—emphasized, does not belong in this Order and the present writer is unable to see any special affinity between *Haematopinus* and the two genera *Hybophthirus* and *Scipio*. There has been some temptation to include *Microthoracius* in the family, but this has finally been resisted.

Actually the family is very difficult to define, unless it be restricted to the single genus *Haematopinus*. In the past, when the presence of defin-



Proechinophthirus fluctus (Ferris)

Figure 36

ite eyes was recognized only in *Pediculus*, *Pthirus*, and *Pedicinus*, the problem was not difficult, but now that well-defined eyes with a distinct lens are known to occur in *Pecarocoeus* and morphologically true—although externally scarcely recognizable—eyes have been established in *Haematopinus*, there remains little by which the Pediculidae and the Haematopinidae can be separated. Perhaps even yet it has not been possible to free our thinking from the presupposition that the classification of the lice should follow the phylogeny of the hosts. This matter will be considered further in connection with the discussion of the Pediculidae.

Key to the Genera of Haematopinidae

Head with pronounced ocular points posterior to the antennae...HAEMATOPINUS
 Head without ocular points.....PECAROCOCUS

Genus HAEMATOPINUS Leach

- 1815. *Haematopinus* Leach, Edinburgh Encyclopaedia, Supplement 1:24.
- 1842. *Haematopinus*, Denny, Monographia Anoplurorum Britanniae, page 24.
- 1880. *Haematopinus*, Piaget, Les Pediculines, page 633.
- 1904. *Haematopinus*, Enderlein, Zoologischer Anzeiger 28:138.
- 1933. *Haematopinus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:419.
- 1942. *Haematopinus*, Webb, Proceedings of the Zoological Society of London 118:578.

GENERIC TYPE. *Pediculus suis* Linnaeus.

CHARACTERS. Haematopinidae in which the head is produced into distinct ocular points posterior to the antennae, but with distinct eyes lacking. Legs with a prominent, apically free, and more or less sclerotized process on the ventral side between tibia and tarsus.

NOTES. The members of this genus occur on hosts of the families Suidae, Bovidae, and Cervidae of the Order Artiodactyla and the family Equidae of the Order Perissodactyla.

Key to Species of HAEMATOPINUS

The species *breviculus* is omitted from this key because of the inadequate description.

- 1. Female with the gonopods of segment eight slender, apically acute, curved and almost sickle-shaped; known from *Equus burchelli* in Africa ACUTICEPS
- Otherwise.....2
- 2. Female with the gonopods of segment eight elongate and narrow, their mesal margins straight and divergent; occurring on *Cervus unicolor* in India.....LONGUS
- Otherwise.....3
- 3. Genitalia of the male with the penis strongly asymmetrical, strongly sclerotized at one side, this sclerotization much swollen and forming a large knob or hook at its base.....4
- Genitalia of the male with the penis otherwise formed, V- or Y-shaped if present.....7
- 4. Female with a deeply pigmented, somewhat W-shaped spot in the wall of the vagina just anterior to the vulva; occurring on *Taurotragus* and *Strepsiceros*.....TAUROTRAGI
- Female without such a spot.....5
- 5. With 5-8 slender setae in a cluster on the posterior side of each of the lateral lobes of the abdomen; occurring on *Bos bubalus* normally and apparently also on camels.....TUBERCULATUS

- With not more than 2-3 setae in this position on any segment.....6
6. Head very short and broad, the length only slightly greater than the breadth; occurring on domestic cattle throughout the world.....EURYSTERNUS
Head elongate, from 2-2.5 times as long as wide; occurring on Equidae.. ASINI
7. An elongate, slender species in which the paratergal plates of the abdomen form prominent, acutely conical points; occurring on *Syncerus caffer*.....BUFALI
Stout-bodied species, the paratergal plates forming rounded prominences.....8
8. Head very short and broad, the width of the hindhead more than half as great as the length of the head.....9
Head relatively slender, the width of the hindhead normally definitely less than half the length of the head.....10
9. Margin of the vulva with a pair of marginally serrate lobes between the bases of the gonopods; occurring on *Phacochoerus*.....PHACOCHOERI
Margin of the vulva with an undivided and simple median lobe between the bases of the gonopods; occurring on *Poramochoerus*.....LATUS
10. A stout-bodied form with well-developed, broad, paratergal plates and with the dorsum of the abdomen normally with sclerotized areas; occurring on domestic pigs.....SUIS
A more slender-bodied form with very weakly developed paratergal plates and with the dorsum of the abdomen membranous; occurring on the wild boar of Europe.....APRI

Haematopinus acuticeps Ferris

1933. *Haematopinus acuticeps* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:467; figure 275.
1948. *Haematopinus acuticeps* Ferris, Webb, Proceedings of the Zoological Society of London 118:581; Plate I, figure G.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Hippotigris* (=Equus) *burchelli*, Mpwapwa, Tanganyika Territory, East Africa. This host is later cited by Webb as *Equus burchelli muansae*.

NOTES. Whatever may be the status of the two supposed subspecies *burchellis* and *elegans* of *Haematopinus asini* which actually or presumptively occur on this same host, there can be no question of the status of *acuticeps*. The form of the gonopods of the female is alone sufficient to distinguish it.

Haematopinus aprì Goureau

1866. *Haematopinus aprì* Goureau, Bulletin de la Société des Sciences Historiques et Naturelles de l'Yonne, Auxerre 20:205.
1870. *Haematopinus urius* (Nitzsch), Giebel, Insecta Epizoa, page 45; Plate 2, figure 2.
1880. *Haematopinus urius* (Nitzsch), Piaget, Les Pediculines, page 654; Plate 48, figure 4.
1933. *Haematopinus aperis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:431; figures 252B, 253B, 255A-D, 256F, G, M, N.
1939. *Haematopinus suis* (Linnaeus), Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitare Krankheiten und Hygiene der Haustiere 55: 2:138; figures 1-5.

HOSTS AND DISTRIBUTION. From *Sus scrofa*, the wild swine of western Europe.

NOTES. The confusion of this species with *Haematopinus suis* (Linnaeus) will be discussed in more detail in connection with the latter species. It is sufficient here merely to remark that the lice of *Sus scrofa*, the wild

boar of western Europe, seem clearly to be distinct from the lice of the domesticated swine of the present day, which are thought to have been derived from pigs of eastern Asia that have been imported into Europe.

The purely nomenclatorial problem concerning the proper name for this species presents some difficult points. In pre-Linnaean times the name *Pediculus urius* was used very evidently for lice from the pigs of Europe which were derived from the wild swine of Europe, but Linnaeus did not employ this name. It was revived by Nitzsch in 1818 and used by him, clearly as a substitute for the name *suis* employed by Linnaeus, since *suis* is placed as a synonym of *urius*.

In 1870 Giebel used the name *urius* for lice of domestic and wild swine. His illustration was said by him to have been prepared by Nitzsch in 1805. In the writer's opinion it clearly represents the lice of wild swine. A case might, therefore, be made out for the use of the name *urius* since the type of the name *urius* as employed by Nitzsch would fix the application of the name if *suis* be regarded as a separate species.

In 1880 Piaget used the name *urius*. The writer has examined Piaget's material and used his specimens as the types for the name *aperis*, which was published in 1933.

However, according to Fahrenholz, the name *Haematopinus apri* Goureau was proposed in 1866 for the lice of wild swine of Europe. The present writer has not seen this work and accepts the name on Fahrenholz' word. In any case this name certainly reduced *aperis* to synonymy.

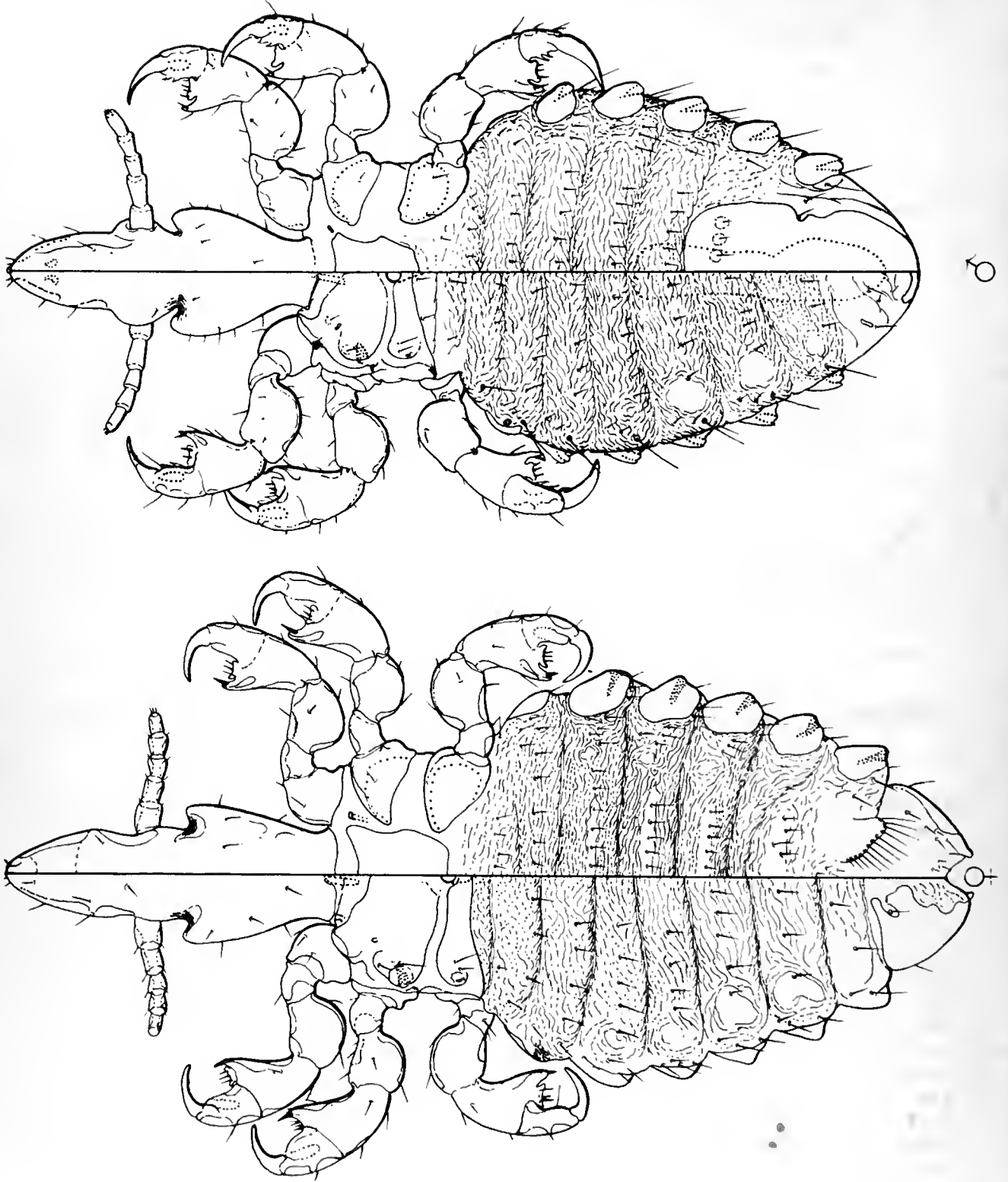
Hopkins has expressed the opinion that this form should be regarded as a subspecies of *suis*, but the writer cannot concur in this.

Haematopinus asini (Linnaeus) Figures 37, 38

1758. *Pediculus asini* Linnaeus, Systema Naturae, Edition X, page 612.
1829. *Pediculus asini* (Linnaeus). Stephens, Catalogue of British Insects 2:329.
1838. *Pediculus macrocephalus* Burmeister, Genera Insectorum, Rhynchota, Species 18.
1916. *Haematopinus elegans* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:22; figure 8.
1916. *Haematopinus minor* Fahrenholz, Zoologischer Anzeiger 48:90.
1933. *Haematopinus asini* (Linnaeus), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:464; figures 273, 274, 275C.
1948. *Haematopinus asini asini* (Linnaeus), Webb, Proceedings of the Zoological Society of London 118:578.
1948. *Haematopinus asini macrocephalus* (Burmeister), Webb, Proceedings of the Zoological Society of London 118:578.
1948. *Haematopinus asini minor* Fahrenholz, Webb, Proceedings of the Zoological Society of London 118:580; figures g-i; Plate I, figure D.
1948. *Haematopinus asini burchellii* Webb, Proceedings of the Zoological Society of London 118:580; figures d-f; Plate I, figures A, B, E.
1948. *Haematopinus asini elegans* Fahrenholz, Webb, Proceedings of the Zoological Society of London 118:580.

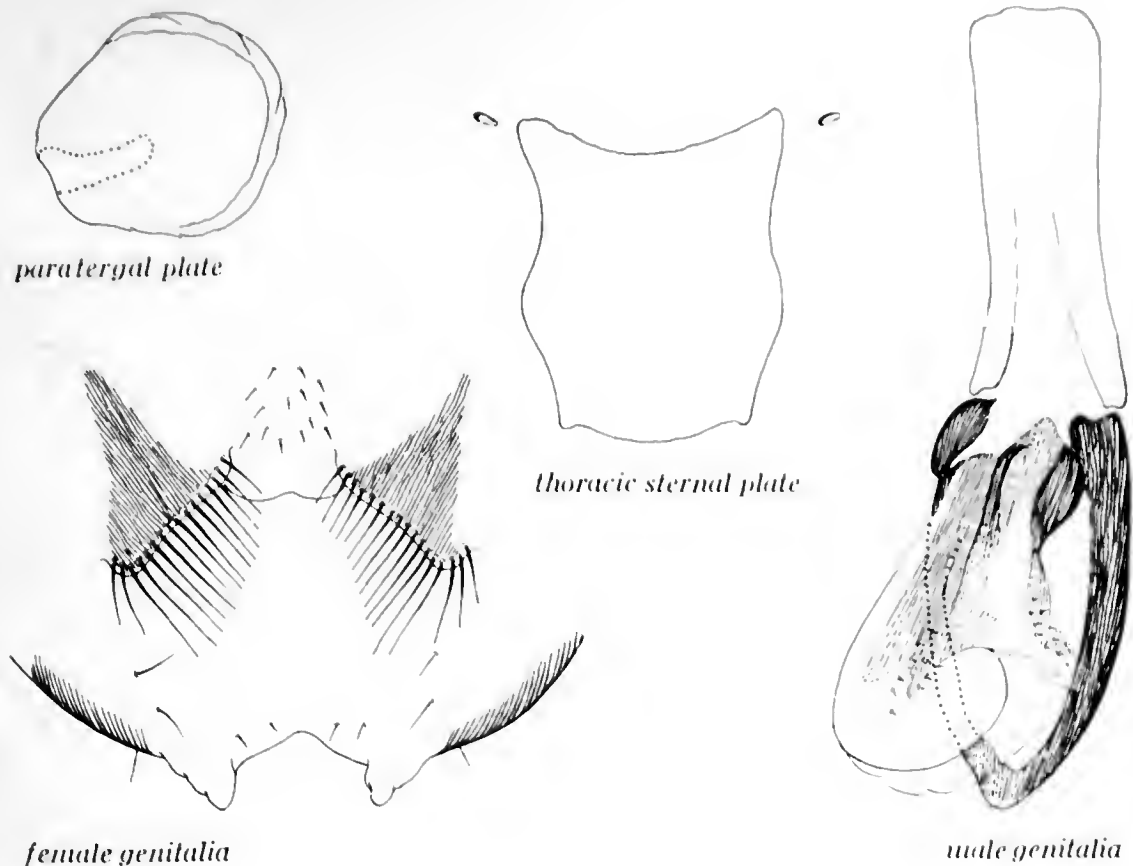
HOSTS AND DISTRIBUTION. The type host is *Equus asinus*. Recorded also from domestic horses in various parts of the world and, in the opinion here adopted, apparently occurring normally on zebras. The type host of *macrocephalus* apparently was the domestic horse. That of *minor* was *Equus burchelli*, and it is recorded also from *Equus burchelli granti*. The type host of *burchellii* is *Equus burchelli granti*. The type of *elegans* was not specified, being recorded merely as from Gobabis, Southwest Africa.

NOTES. In these species from the genus *Equus* we have a most extraordinary situation. Webb (1948) has reviewed the group and adopted the point



Haematopinus asini (Linnaeus)

Figure 37



Haematopinus asini (Linnaeus), details

Figure 38

of view that we have to do with a series of "subspecies," some of which occur upon the same host. They are described by him as differing only in the form of the head. It may be noted that *Haematopinus acuticeps* Ferris occurs also on *Equus burchelli*, but this species is very evidently distinct in every respect, including the genitalia of the female.

The point of view adopted by the present writer toward the establishment of subspecies in this group will be considered elsewhere in this paper. It is the opinion here adopted that in the case of these supposed subspecies the evidence for their separation from *asini* is not convincing except in the case of the form identified by Webb as *minor*. The present writer examined the types of this species in connection with his earlier work and noticed no difference which would justify the recognition of this form in any way, but the illustration given by Webb (his Plate I, figure D) suggests that it may merit some recognition, although it is not evident that the form illustrated by him is the same as that to which the name was applied by Fahrenholz.

Haematopinus breviculus Fahrenholz

1939. *Haematopinus breviculus* Fahrenholz, Mitteilungen aus dem entomologischen Verein Bremen, page 32: figures 1-3.

HOSTS AND DISTRIBUTION. Based upon a single female, without indication of host or origin. Said by Fahrenholz to be very close to *curysternus*.

Haematopinus bufali (de Geer)

1778. *Pediculus bufali* de Geer, Memoires pour servir a l'histoire naturelle des insectes apteres 7:68; Plate I, figures 11, 12.
1781. *Pediculus bufali-capensis* Fabricius, Species Insectorum, Volume 2.
1816. *Pediculus papillosus* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, page 85.
1844. *Pediculus phthiriosis* Gervais, In Walckenaer, Histoire naturelle des insectes apteres 3:306.
1915. *Haematopinus neumanni* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:8.
1935. *Haematopinus bufali* (de Geer), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:460; figures 270-272.

HOSTS AND DISTRIBUTION. Originally described as from "le Buffle d'Afrique," from the Cape of Good Hope. Later recorded from *Buffelus caffer* and "buffalo" in Nyasaland and the Congo Free State. Mr. G. H. E. Hopkins has kindly supplied specimens from *Buffelus* (or *Syncerus*) *caffer radcliffi* on the shores of Lake Edward.

Haematopinus eurysternus (Nitzsch)
Figures 39, 40

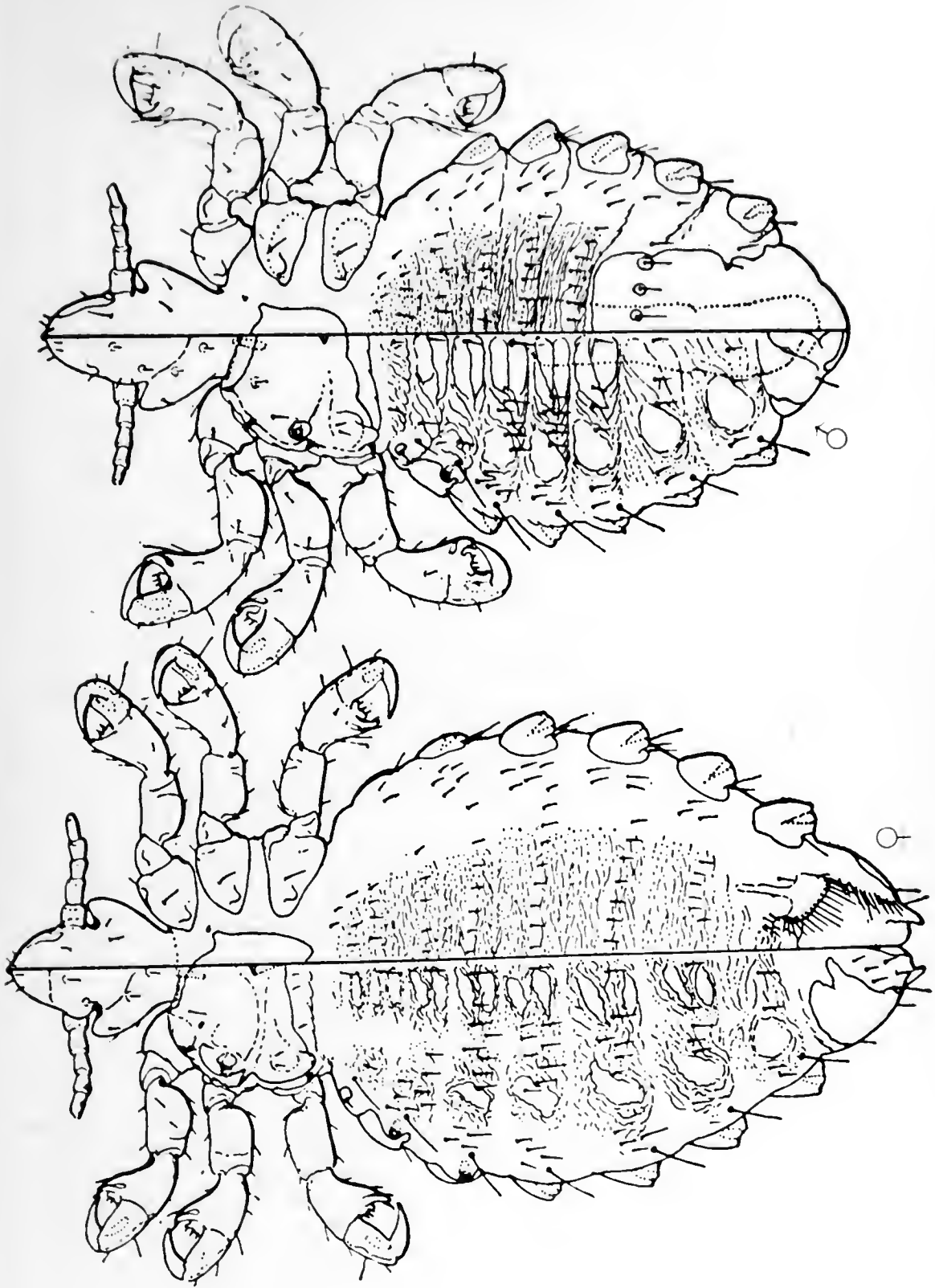
1818. *Pediculus eurysternus* Nitzsch, German's Magazin für die Entomologie 3:305.
1829. *Haematopinus eurysternus* (Nitzsch), Stephens, Catalogue of British Insects 2:329.
1916. *Haematopinus quadripertusus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:19; figures 15-17.
1916. *Haematopinus parviprocursus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:21.
1933. *Haematopinus eurysternus* (Nitzsch), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:448; figures 263, 264.
1950. *Haematopinus quadripertusus* Fahrenholz, Muesebeck, Journal of Economic Entomology 43:119, 133.

HOSTS AND DISTRIBUTION. Originally described from domestic cattle in Europe and known from these hosts from many parts of the world.

NOTES. *Haematopinus quadripertusus* was described from males only, from cattle at Banjo, in the Cameroons. *Haematopinus parviprocursus* was described from females only from unknown host from the then German Southwest Africa. The types of both these supposed species were examined by Ferris, who came to the conclusion that they represent the same species and that this species is to be identified as *Haematopinus eurysternus*.

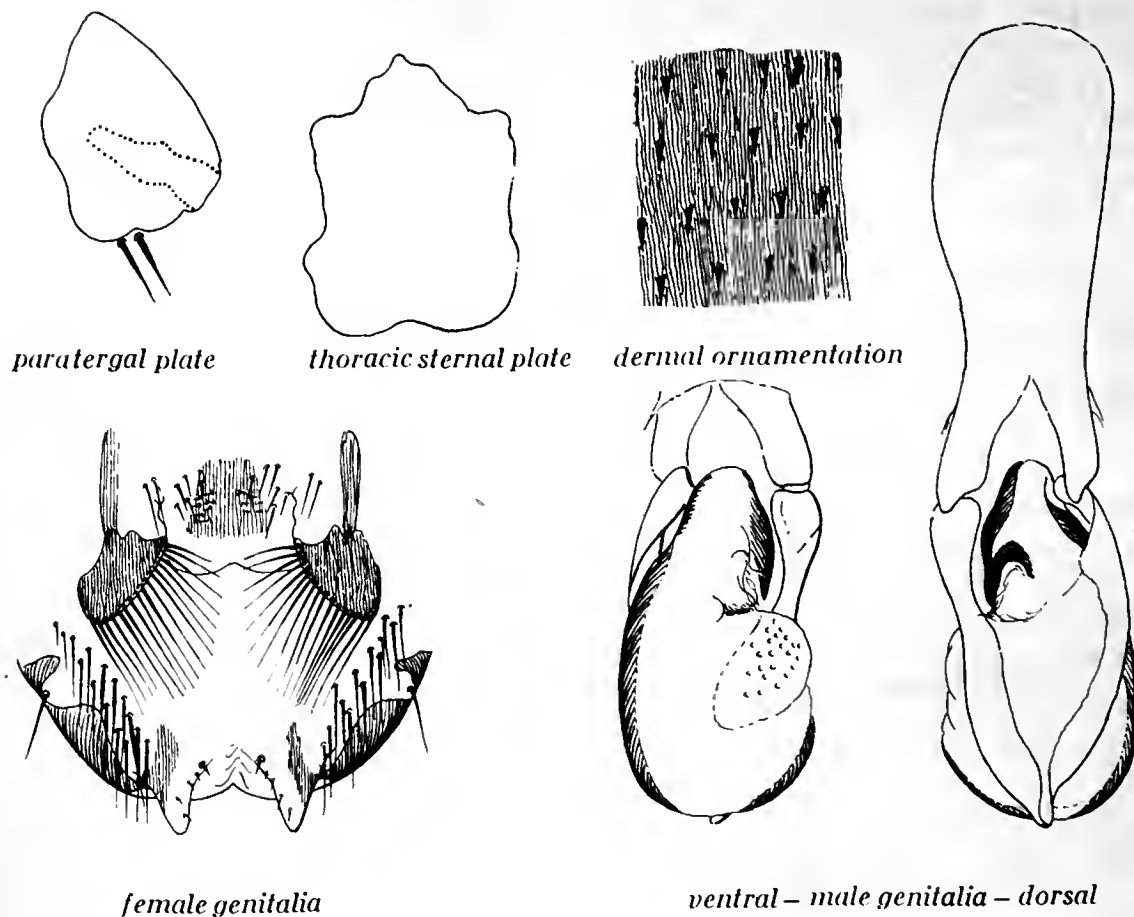
This question has been reviewed again in connection with the present work and the opinion previously expressed is still maintained. It was pointed out by Ferris (1933) that specimens from cattle in tropical countries seem to be much larger and of deeper pigmentation than those from northern areas, although no morphological differences could be detected. The only basis then for the separation of the cattle lice into two or more species is that of size. It must be noted, however, that the cattle of many tropical areas, such as Asia and Africa, are derived apparently from a different source from the cattle of Europe and North America, the former apparently having come largely from the "hump-backed" type and there may be an association with these differences of host origins.

Specimens of the large form have been collected in Florida in the United States. These were sent to the writer by Dr. C. F. W. Muesebeck of the United States Department of Agriculture and the information noted above was imparted to him. He elected to regard these specimens as representing a species different from that usually found in the United States and has pub-



Haematopinus eurysternus (Nitzsch)

Figure 39



Haematopinus eurysternus (Nitzsch), details

Figure 40

lished the record, using the common name "Cattle tail louse," for this form.

The question of the specific name to be used for this form, if it be recognized, arises. It would appear that the name *quadripertusus* Fahrenholz is available. However, this form is not here accepted as distinct.

Haematopinus latus Neumann

1909. *Haematopinus latus* Neumann, Archives de Parasitologie 13:595; figures 6-9.
1911. *Haematopinus peristictus* Kellogg and Paine, Bulletin of Entomological Research 2:145. (In part)
1912. *Haematopinus incisus* Harms, Zoologischer Anzeiger 40:293.
1933. *Haematopinus latus* Neumann, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:477: figures 260C, 262.
1939. *Haematopinus latus* Neumann, Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere 55: 151; Plate 4, figures 9-11.
1939. *Haematopinus latus latissimus* Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere 55: 152; Plate 4, figure 12.

HOSTS AND DISTRIBUTION. The types of *latus* were recorded as from *Potomochoerus africanus* at Kaporo, Nyasaland. The types of the supposed variety *latissimus* are the specimens recorded by Ferris from *Potomochoerus choeropotamus*, Luangwa Valley, northeastern Rhodesia. Recorded from the same host from Zululand and South Africa and also from *Potomochoerus affinis* from the former German East Africa.

NOTES. This species has at times been confused with *Haematopinus phacochoeri* Enderlein, but is clearly distinct.

The writer sees no excuse for the naming of the supposed variety *latis-simus*. Among the specimens at hand are some of evidently very early adult females and others of fully adult individuals. There is enough difference among these specimens to suggest the presence of two forms and this seems to be the only basis for Fahrenholz' supposed variety.

Haematopinus longus Neumann

1912. *Haematopinus longus* Neumann, Bulletin de la Société Zoologique de France 37:141; figure 1.
1933. *Haematopinus longus* Neumann, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:469; figure 276.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Cervus unicolor*, at Kota, Nepal, India.

Haematopinus phacochoeri Enderlein

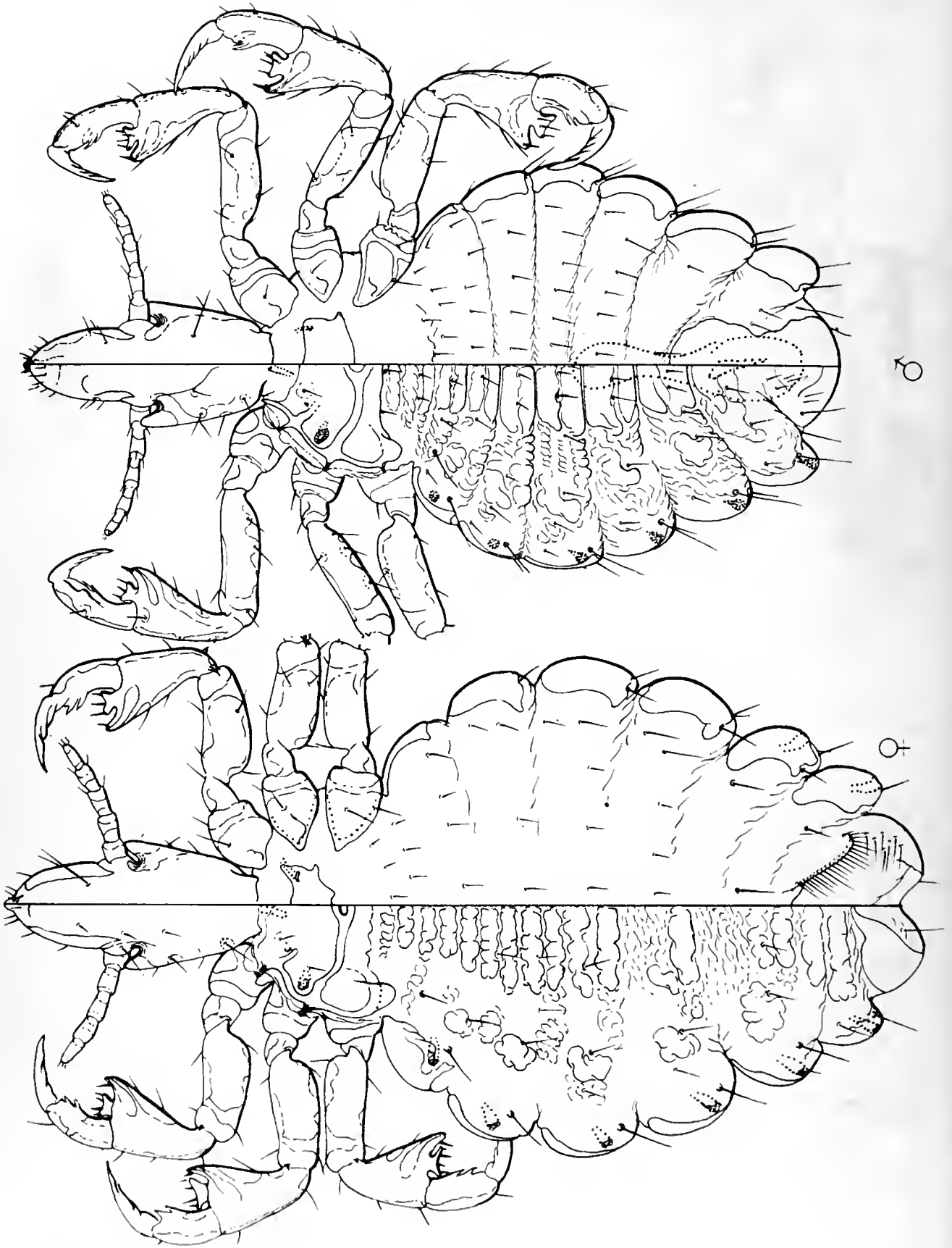
1908. *Haematopinus phacochoeri* Enderlein, Wissenschaftliche Ergebnisse der Schwedische Expedition nach dem Kilimandjaro, dem Meru, und dem umgebenden Massaische Steppen 11:7; figure.
1911. *Haematopinus peristictus* Kellogg and Paine, Bulletin of Entomological Research 2:145; Plate 4, figures 3-6 (in part).
1933. *Haematopinus phacochoeri* Enderlein, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:444; figures 260, 261.
1939. *Haematopinus phacochoeri* Enderlein, Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere 55:149; figures 9a, 9b.
1939. *Haematopinus phacochoeri peristictus* Kellogg and Paine, Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere 55:150.

HOSTS AND DISTRIBUTION. The types of *phacochoeri* were from *Phacochoerus aeliani massaicus* in the region of Mt. Kilimanjaro and those of *peristictus* from *Phacochoerus aethiopicus*, at Akamanga, North Nyasa, Africa. The species has been recorded from *Phacochoerus* sp. in the former German East Africa, and from *Phacochoerus sundevali* in Zululand. In addition, there are records given as merely from "wart hog," in East Africa, northeastern Rhodesia and southern Rhodesia. Certain records from "buffalo," in Kenya are open to doubt.

NOTES. There has in the past been some confusion of this species with *Haematopinus latus* Neumann, but it appears that these two species are characteristic of different host genera. Fahrenholz has attempted to resurrect the name *peristictus* as a variety, but the types of this name are at hand and offer no justification for this procedure.

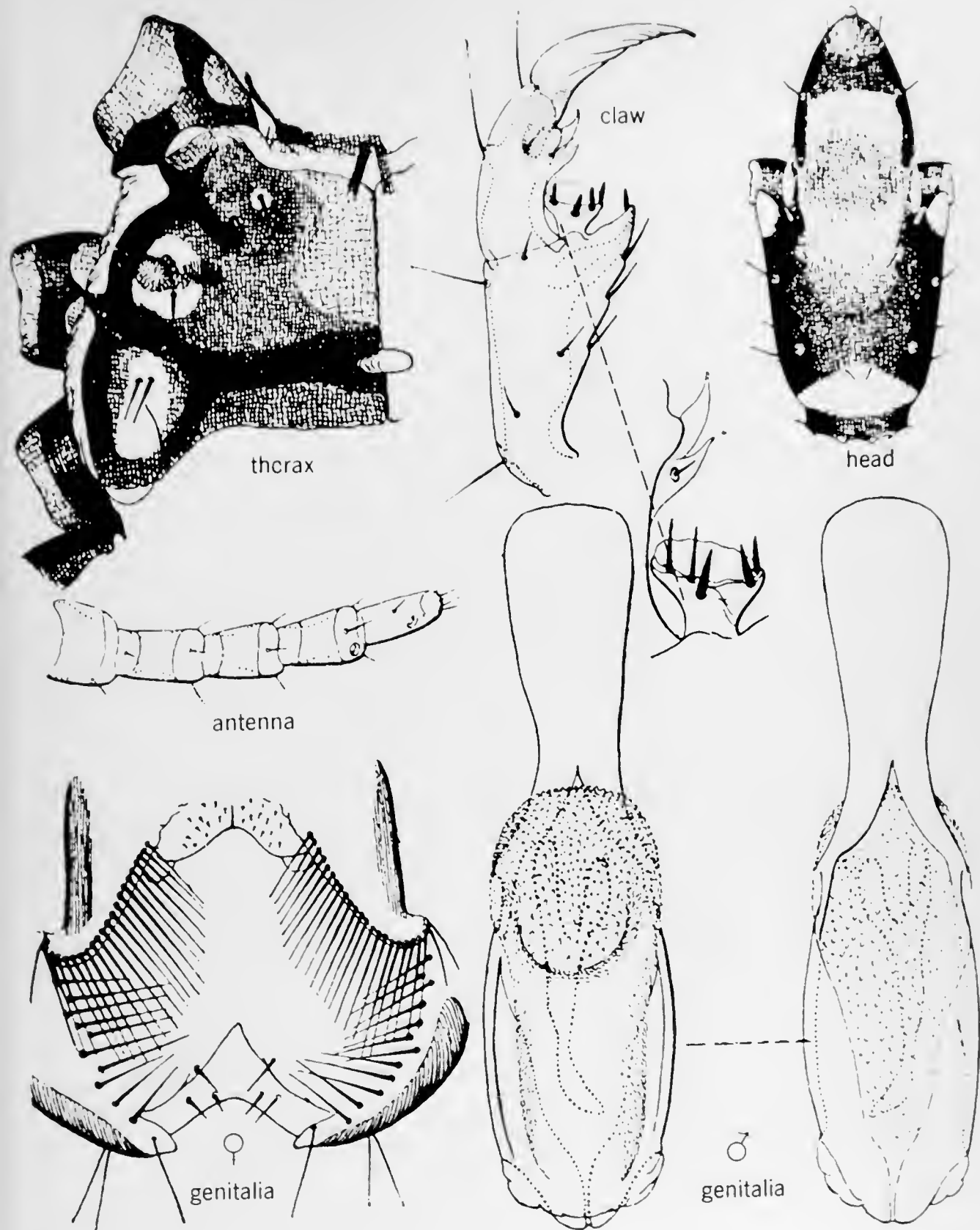
Haematopinus suis (Linnaeus) Figures 41, 42

1758. *Pediculus suis* Linnaeus, Systema Naturae, Edition X, page 611.
1810. *Haematopinus suis* (Linnaeus), Leach, Encyclopaedia Britannica, Supplement 1, page 24.
1818. *Pediculus urius* Nitzsch, Germar's Magazin der Entomologie 3:305.
1903. *Haematopinus irritans* Law, Textbook of Veterinary Medicine 5:13.
1911. *Haematopinus suis adventicius* Neumann, Archives de Parasitologie 14:406; figure 8.
1916. *Haematopinus suis chinensis* Fahrenholz, Fahrenholz, Zoologischer Anzeiger 48:90.



Haematopinus suis (Linnaeus)

Figure 41



Haematopinus suis (Linnaeus), details

Figure 42

1916. *Haematopinus suis germanus* (misprint for *germanicus*) Fahrenholz, Zoologischer Anzeiger 48:90.
1917. *Haematopinus suis sardiniensis* Fahrenholz, Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten 34:Beiheft 2:10.
1933. *Haematopinus suis* (Linnaeus), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:425; figures 252A, 253A, 254.
1934. *Haematopinus adventicius* Fahrenholz, Ewing, Proceedings of the Helminthological Society of Washington, page 76.
1939. *Haematopinus chinensis* Fahrenholz, Fahrenholz, Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere 55:Heft 2:138; Plate 3, figures 1-3.

HOSTS AND DISTRIBUTION. The name *Pediculus suis* was applied specifically by Linnaeus to the lice of domestic swine, presumably those of Sweden. Since that time it has been used for the lice of domestic swine, as recorded from almost all parts of the world. The only records from undomesticated swine seem to be those given by Ferris (1933) from *Sus cristatus*, from Tanjong Badak, Tenasserim and from Dinapore, India.

NOTES. Concerning this species we have a problem that is compounded of both nomenclatorial and zoological questions, for none of which is there at present a satisfactory answer. The story is long and complicated and nothing more than a mere abstract of it can here be presented.

The reasons for the complications rest largely upon the fact that the domesticated swine population of Europe has changed within relatively recent times. The domesticated swine of western Europe, throughout most of historic times, were presumably derived from the wild swine of that area. Early in the eighteenth century domesticated swine from eastern Asia were introduced into Europe and swine of this type have now become the common domesticated animals of almost all the world.

Because of these facts, references to the lice of swine in European literature, certainly prior to such a date as 1758, undoubtedly concerned the lice of the wild boar of Europe, *Sus scrofa*. Even at that date, 1758, the population of domestic swine in Europe was changing.

Now, if the native swine of Europe originally had upon them a louse of a species different from that of the domesticated swine of eastern Asia—as seems to be true—to which of these species should the name *suis* apply? There are two indirect approaches to the problem. One of these rests upon pre-Linnaean history and the other upon post-Linnaean history. On the basis of pre-Linnaean history it is clear that the name *suis* should apply to lice from the wild swine of Europe. But on the basis of post-Linnaean history the name has been used for almost 200 years to apply to lice derived from the swine of eastern Asia, which even at the time of Linnaeus were beginning to replace the other type.

No one knows what Linnaeus actually had in hand when he named the species *Pediculus suis*. The probabilities certainly are that he used the name for lice of swine of the older European race, although it must be noted that the Asiatic swine had been introduced into Sweden a few years before the appearance of the tenth edition of the *Systema Naturae* and it is possible—since they undoubtedly attracted a considerable amount of attention—lice may have been taken from them and come to Linnaeus' notice.

From the point of view of the present writer the reasonable procedure is to accept the name *suis* for the lice of domestic swine as we now find them and to consider that as used by Linnaeus the name covered a compound species. We may legitimately argue that the general usage of the last 150 years or more constitutes a de facto restriction of this name to the form for which it has commonly been used and that to change this at the present date is unnecessary and confusing.

Furthermore, it should be noted that as early as 1818 Nitzsch revived the old, pre-Linnaean name *urinus* as a substitute for *suis*, and that later

evidence has indicated that he actually had at hand the lice of the wild swine. This name might be considered thereby to have become established. In any case, in 1866 these lice were definitely given the name *Haematopinus aprī* Goureaux.

Fahrenholz and Ewing have opposed the point of view here held and have maintained that the name *suis* should be transferred to the lice of the wild swine of Europe, thus leaving it to be determined what name should be used for those from the present-day domesticated swine. Fahrenholz has maintained that the proper name to be used is *Haematopinus chinensis* Fahrenholz, while Ewing has supported *Haematopinus adventicius* Neumann. Both overlooked the earlier name *Haematopinus irritans* Law.

The problem can in the end be settled only by a ruling of the International Commission on Zoological Nomenclature, and for the present the writer refuses to disturb the long-established nomenclature.

So much for the nomenclatorial problem. The zoological problem is also involved and complicated.

To begin with, it appears that the lice of the wild swine of Europe differ to such a degree from those of domesticated swine that they may justifiably be called a distinct species. After we have eliminated the lice of the wild swine of Europe from consideration, there remains the question of the forms to be found among the lice of domesticated swine. Among these there is present a considerable variety of size, form, pigmentation, and of some morphological characters. At least three of the forms have been first named as varieties and then elevated to the rank of species by Fahrenholz.

Ferris (1933), on the basis of an examination of specimens from numerous parts of the world, gave an extended account of the variations to be found among them. Here and there appeared individual collections which, if taken by themselves alone, might justify some nomenclatorial recognition. But after these specimens are removed we are left with a residue of material which presents almost every possible combination of the characters seen in the others, indicating a completely interlinked genetic chain which conforms to the concept of species here adopted and previously discussed. In the end the problem can be settled—if at all—only by genetic studies. For the present the single name *Haematopinus suis* (Linnaeus) will here be used to cover this complex of forms.

Haematopinus taurotragi Cummings

1914. *Haematopinus taurotragi* Cummings, Bulletin of Entomological Research 5:155; figures.

1933. *Haematopinus taurotragi* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:453; figures 265, 266.

HOSTS AND DISTRIBUTION. Type from *Taurotragus oryx* (= *Boselaphus oreās*), from a menagerie in England. Later recorded by Bedford from the same host at various places in South Africa and also from *Strepsiceros kudu* in South Africa.

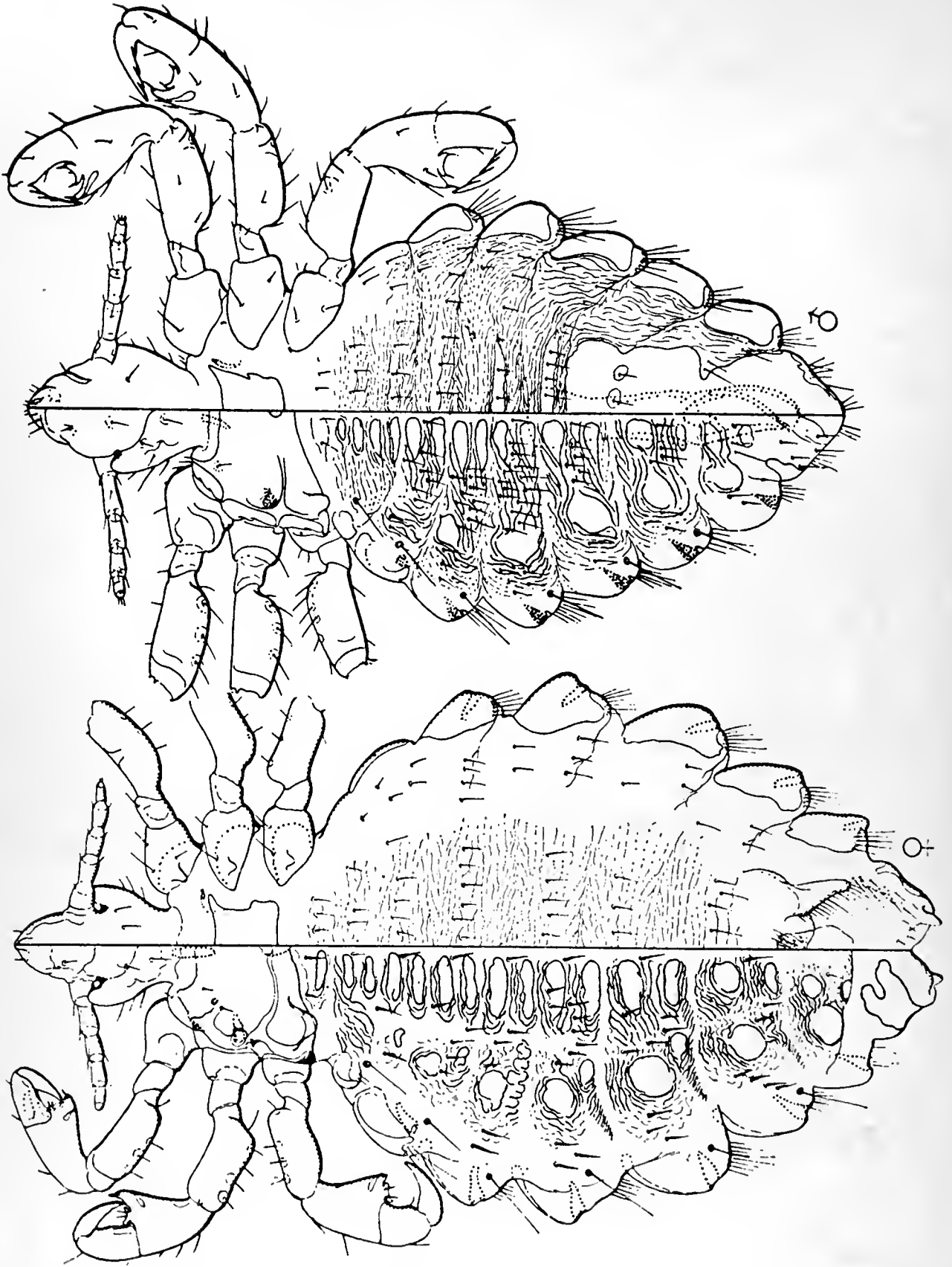
Haematopinus tuberculatus (Burmeister) Figures 43, 44

1800. *Pediculus bufali-europaei* Latreille, Histoire naturelle et particulière des crustacés et des insectes 8:96 (nomen dubium).

1839. *Pediculus tuberculatus* Burmeister, Genera Insectorum, Rhynchota, Species 20.

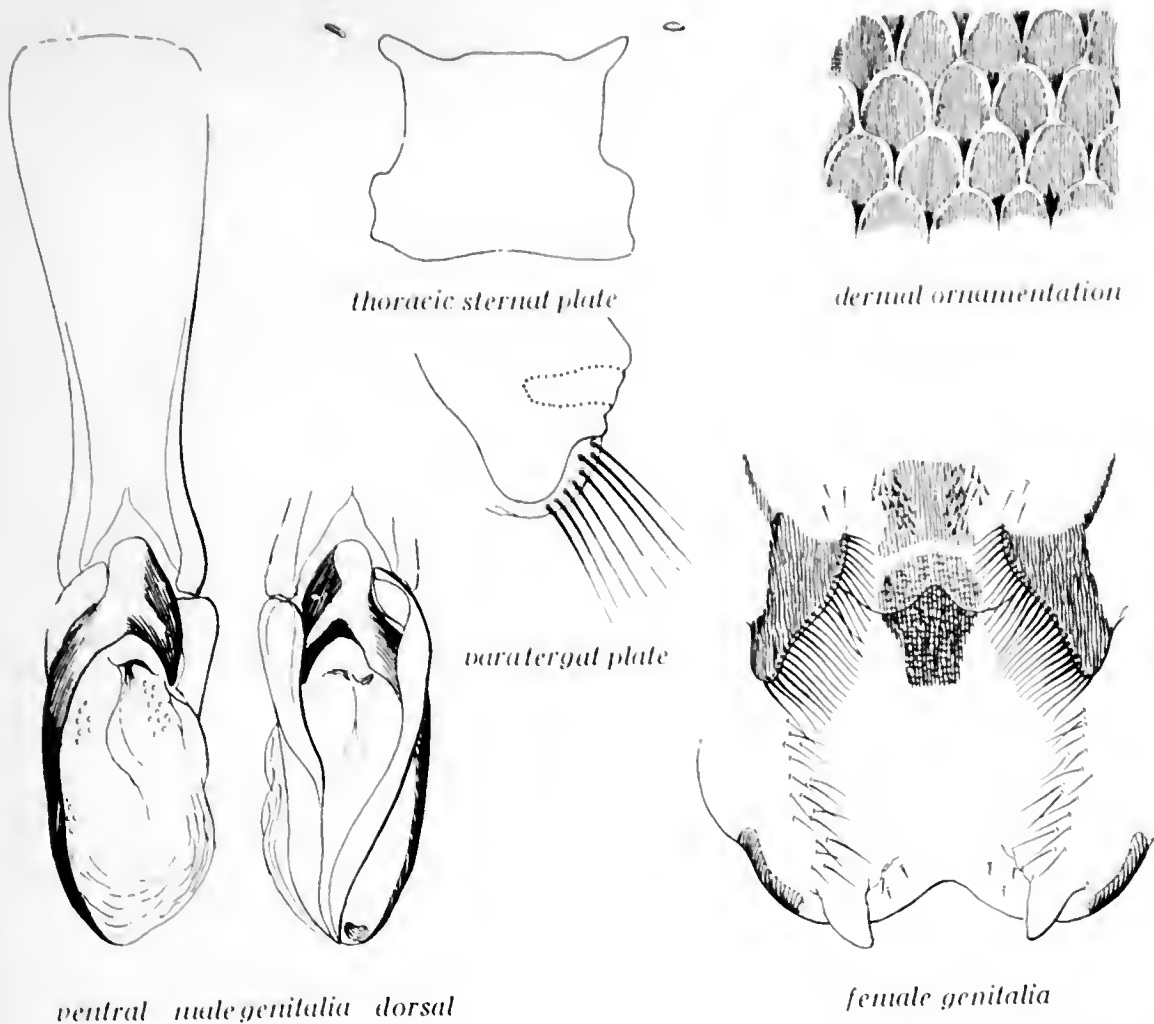
1852. *Haematopinus tuberculatus* (Burmeister), Lucas, Annales de la Société Entomologique de France (series 2) 10:529; Plate 11, number 2.

1869. *Haematopinus punctatus* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:167.



Haematopinus tuberculatus (Burmeister)

Figure 43



Haematopinus tuberculatus (Burmeister), details

Figure 44

1919. *Haematopinus bufali-europaei* (Latreille), Fahrenholz, Zeitschrift für angewandte Entomologie 6:154.

1933. *Haematopinus tuberculatus* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 6:455; figures 267-269.

HOSTS AND DISTRIBUTION. Burmeister's name was based upon specimens from the "common buffalo or buffalo of India," presumably *Bos bubalus*, and there are many records of the species from this host in India, China, the Philippine Islands and Guam. In addition, there are records of the species from the yak, *Bos grunniens*, and from camel in Australia and Africa. Latreille's specimens were recorded as from buffalo from Italy.

NOTES. There is a strong probability that the species named by Latreille (1800) is the same as that named by Burmeister in 1839, but the writer has in the past declined, and still declines, to accept the synonymy involved. A very considerable literature has grown up under the name *tuberculatus*, while under the clumsy name *bufali-europaei* there have been but occasional passing references since it was first proposed.

Specimens from camel have been examined by the writer. They seem to differ from the typical form only in smaller size.

Genus PECAROECUS Babcock and Ewing

1939. *Pecaroecus* Babcock and Ewing, Proceedings of the Entomological Society of Washington 40:197.

GENERIC TYPE. *Pecaroecus javalii* Babcock and Ewing.

CHARACTERS. Haematopinidae with distinct eyes, these being represented by a facet and a pigment spot just posterior to each antenna. Legs without a sclerotized plate in the "palm" of the tibia. Thorax without a sclerotized sternal plate. Abdomen with small, sclerotized, tubercle-like paratergites present.

NOTES. The single known species of this genus is a strange form which seems rather definitely to be related to *Haematopinus*.

Pecaroecus javalii Babcock and Ewing
Figures 45, 46

1938. *Pecaroecus javalii* Babcock and Ewing, Proceedings of the Entomological Society of Washington 40:199; figures 103.

HOSTS AND DISTRIBUTION. Known from a single record, from *Pecari angulatus*, between Juno and the Pecos River, State of Texas, United States.

NOTES. Specimens from the type lot have been made available through the kindness of Mr. Babcock and the accompanying illustrations are based upon these.

Family HOPLOPLEURIDAE Ferris, new family

DESCRIPTION OF THE FAMILY. Anoplura in most of which there is no external indication of eyes, lenses being present in only one genus. Abdomen, in all but one species, with paratergal plates on at least one segment, these plates always at least in part with an apical portion which is free from the body and not forming a mere cap over the apex of lateral lobes of the abdomen. Thoracic sternal plate usually developed, commonly with its posterior apex free, but at times weakly sclerotized and at times lacking. Ventral prothoracic apophyseal pits lacking. Abdominal tergal and sternal plates very commonly present and well developed. Antennae normally five-segmented, in one species described as three-segmented, at times with the terminal three segments tending to be more or less fused together, frequently sexually dimorphic, the male having either the apical preaxial angle of segment three more or less produced and bearing one or more short, stout, retrorse setae dorsally, or having such a seta on the dorsal side of each of the last three segments. Female with the gonopods of the ninth segment usually short and not strongly developed, never elongated and leaf-like.

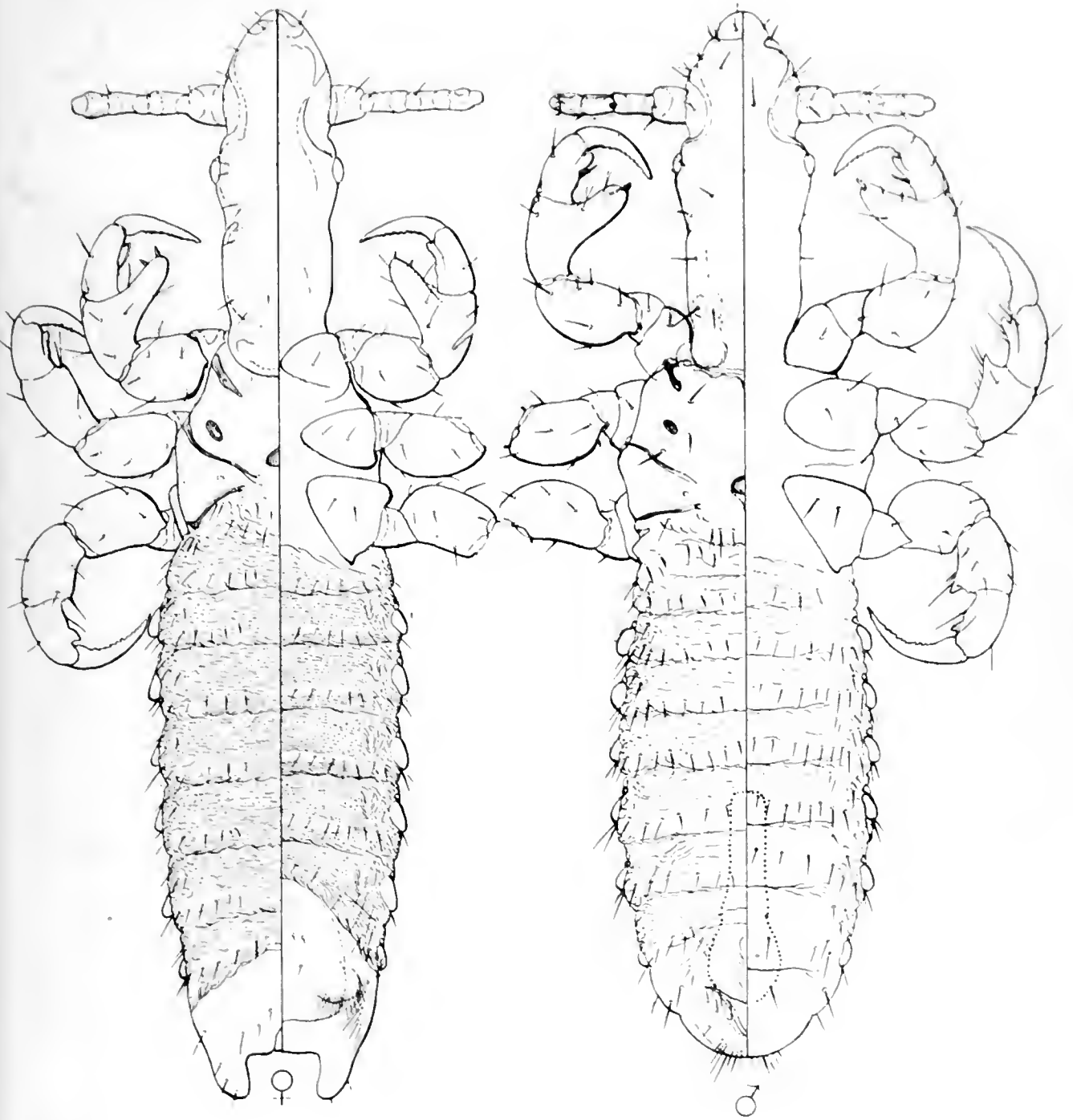
NOTES. As here understood this is the largest family of the Order, most of its members occurring on rodents, but a few on Insectivora and Primates, and one on Ungulata.

The principal objection that may be urged against this family is the inclusion in it of the genus *Pedicinus*, which has long been associated with the Pediculidae. This matter will be discussed at length under the subfamily Pedicininae and it may here simply be noted that in the writer's opinion the genus is more closely related to the Hoplopleuridae than it is to *Pediculus*.

The general pattern of the Hoplopleuridae is reasonably consistent, being marked especially by the development of the paratergal plates of the abdomen, which always have at least an apical point free from the body wall.

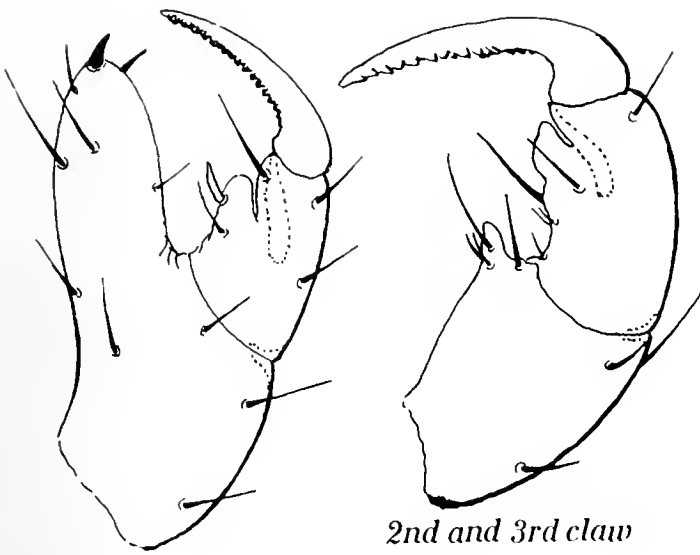
The family name is chosen from a genus which is large and in which the characters of the family are especially well developed.

The family is here divided into five subfamilies, which may be separated by the following key.



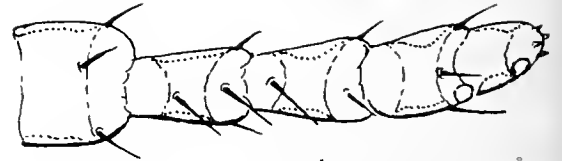
Pecaroecus javalii Babcock and Ewing

Figure 45

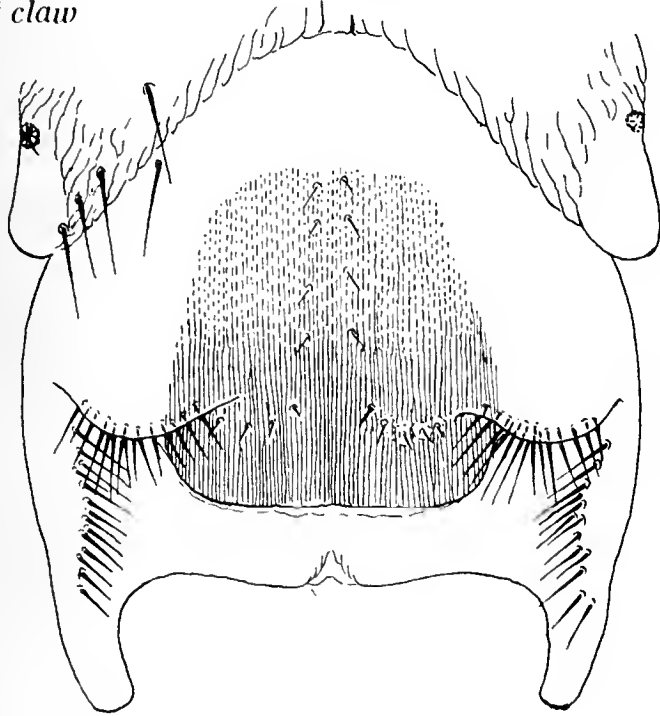


1st claw

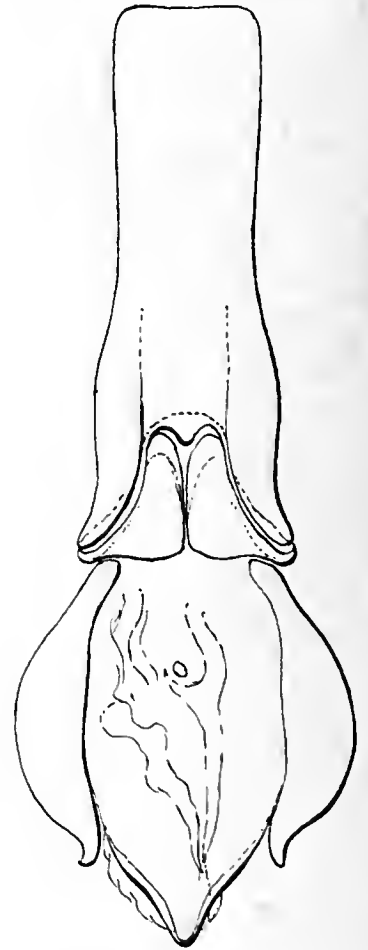
2nd and 3rd claw



antenna



genitalia of female



genitalia of male

Pecaroecus javalii Babcock and Ewing,

Figure 46

Key to the Subfamilies of Hoplopleuridae

1. Eyes present externally as a pair of distinct lenses; occurring on Old World monkeys of the superfamily Cercopithecoidea.....PEDICININAE
Without any external indication of eyes.....2
2. With a small, claw-like process alongside the true claw on the anterior legs.....HYBOPHTHIRINAE
Without such a claw-like process on the anterior legs.....3
3. Anterior and middle legs of the same size and form, both small and slender, with slender claw; venter side of the abdomen in all species except three, with a pair of small, sclerotized, detached plates on the venter of abdominal segment two; restricted to Sciuridae.....
.....ENDERLEINELLINAE
Anterior legs the smallest of the three pairs, the second pair at least somewhat larger than the first and with stouter claw; venter of abdominal segment two without such a pair of detached plates, except as the paratergal plates of this segment may be longitudinally divided into a dorsal and a ventral piece.....4
4. Second abdominal segment with its sternal plate extended laterally on each side to articulate with the corresponding paratergal plate.....
.....HOLOPLEURINAE
Second abdominal segment with its sternal plate never thus extended laterally.....POLYPLACINAE

Subfamily ENDERLEINELLINAE Ewing

1929. Ewing, A Manual of External Parasites, page 132.

DESCRIPTION OF THE SUBFAMILY. Hoplopleuridae with the two anterior pairs of legs slender and with slender claw, the two pairs being of the same size and shape, the third pair stout and with stout claw. All but three of the included species provided with a pair of small, highly sclerotized plates on the ventral side of the second abdominal segment, each of these plates bearing a strongly sclerotized, flat projection. Usually very small species. All the known species occurring on the rodent family Sciuridae.

NOTES. The members of this subfamily are among the smallest of the Anoplura, some of them attaining a length of scarcely more than .35 mm. The peculiar plates on the venter of the second abdominal segment are at present of undetermined homology. In some species each plate articulates laterally with the corresponding paratergite. It may be either a detached portion of the paratergite arising from some such phenomenon as the ventral portion of the longitudinally divided paratergites of this segment—such as appears especially clearly in the genus *Fahrenholzia*—or it may be an extreme development of the divided sternal plate of the second segment which appears in such genera as *Schizophthirus* and *Haematopinoides* and is at times indicated in *Hoplopleura* itself. In any case the development seen in *Enderleinellus* is quite distinctive.

Two genera—*Microphthirus* and *Werneckia*—totaling three species, which are here assigned to the Enderleinellinae, lack these plates but in other respects seem properly to be associated with *Enderleinellus*, both on the basis of general structure and host relationships.

Key to the Genera of Enderleinellinae

1. The pair of plates on the venter of abdominal segment two present.....
.....ENDERLEINELLUS
2. These plates lacking.....2
Paratergal plates of abdominal segments three to six each connected ventrally with the corresponding sternite by a narrow, sclerotized

bridge; paratergal plates with their posterior margin not free from the body wall; occurring on American flying squirrels...MICROPHTHIRUS
Paratergal plates of the abdominal segments not thus connected with the sternites, their apices free from the body wall; occurring on African squirrels.....WERNECKIA

Genus ENDERLEINELLUS Fahrenholz

1912. *Enderleinellus* Fahrenholz, Zoologischer Anzeiger 39:56.
1919. *Enderleinellus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:7.
1929. *Cyclophthirus* Ewing, A Manual of External Parasites, page 195.
1929. *Euenderleinellus* Ewing, A Manual of External Parasites, page 197.
1929. *Hoplophthirus* Ewing, A Manual of External Parasites, page 194.
1929. *Rhinophthirus* Ewing, A Manual of External Parasites, page 196.

GENERIC TYPE. *Pediculus sphaerocephalus* Nitzsch = *Enderleinellus nitzschi* Fahrenholz.

GENERIC SYNONYMS. *Cyclophthirus* Ewing, type *Haematopinus suturalis* Osborn. *Euenderleinellus* Ewing, type *Enderleinellus larisci* Ferris. *Hoplophthirus* Ewing, type *Enderleinellus euxeri* Ferris. *Rhinophthirus* Ewing, type *Enderleinellus heliosciuri* Ferris.

CHARACTERS. *Enderleinellinae* in which a pair of small, sclerotized plates is present on the venter of abdominal segment three, these plates bearing a flattened point which is apically free from the body. All the known members of the genus occur on hosts of the rodent family Sciuridae.

NOTES. In 1929 Ewing proposed to divide this genus, forming from it a total of five genera. Actually, if one wishes to overlook the basic similarities which exist throughout the group and to seize upon the peculiarities of individual species, this number of genera could be doubled with no special effort. It may very well be that when the numerous species that must still remain to be discovered have been incorporated into the system some division will be justified and at least a part of the names proposed by Ewing will deserve to be accepted. For the present nothing much seems to be gained by such division and all the species are here retained in *Enderleinellus*.

Certain very troublesome problems arise in connection with some of the groups of species within the genus. These can be illustrated especially by referring to the group which occurs on New World members of the genus *Sciurus*. A very considerable amount of material representing this group has been assembled, but there remain many host species from which nothing has yet been collected. Within this material it is possible to recognize a wide variety of form in the genitalia of the males, although all the differences represent merely modifications of a single pattern. Some specimens are so different from others that it would appear nonsensical to refer them to the same species, but there are numerous instances of intermediate forms differing only in some small detail. We have on the one hand the constantly pressing temptation to name a new species or "variety" for each of these slightly different forms, or on the other hand to throw all these variants into a few species. Either method produces results which are undesirable and which may equally effectually obscure any approximation to truth. At the time when the section on this genus was prepared by Ferris for his "Contributions Toward a Monograph of the Sucking Lice," he was but an inexperienced student of the systematics of insects. Disgusted by the results of unrestrained "species mongering" he revolted against the practices of certain other workers and went to the other extreme. It now appears that this conservatism was in its turn unsupportable and certainly some of the so-called species recognized by Ferris are actually species groups.

Dr. Fabio Werneck, of the Instituto Oswaldo Cruz, of Rio de Janeiro, Brasil, in the course of a few months spent at Stanford University, independently worked over the extensive collection of *Enderleinellus* there available. He detected some of the errors, not only of judgment but of observation, on the part of Ferris and named certain new species from the collection. However, a considerable amount of material was left by him as still doubtful and remains for further study to elucidate it.

With the addition of the species recognized by Werneck the number of species now assigned to the genus is 29, which we may suspect represents scarcely more than half the species that exist. Ellender, in his review of the rodents, recognizes 44 genera in the Sciuridae, these containing approximately 1300 named forms. The vast majority of these forms are listed as subspecies and as there appears to be an average of about five subspecies for each species it may be assumed that about 300 actual species exist in the family. Of these only about 50 have as yet yielded species of *Enderleinellus*, although the evidence indicates that every Sciurid possesses a member of this genus. It therefore seems probable that the total number of species of the genus in existence will probably be between 50 and 60. When the majority of these are known we shall be in a much better position than at present to develop a classification of the group.

Key to Species of ENDERLEINELLUS

1. Paired ventral plates of abdominal segment 2 each produced laterally to meet the corresponding paratergal plate.....2
 Paired ventral plates of abdominal segment 2 circular, not thus produced laterally and completely detached from the paratergites.....4
- 2 (1). Abdominal segments 4-8 each with a pair of very long setae on the paratergal plates or at the lateral margins of the body, the lateral margins thus fringed with pairs of long setae; occurring on *Marmota* in North America.....MARMOTAE
 Such long setae present only on the paratergal plates.....3
- 3 (2). Female with 2-4 very long setae on the dorsum of abdominal segment 4, these setae reaching to the apex of the body; known from *Citellus beecheyi*, *Citellus variegatus*, and *Citellus tereticaudus* in southwestern and extreme western United States.....OSBORNII
 Female without such long dorsal setae; known from many species of *Citellus* from Siberia throughout North America.....SUTURALIS
- 4 (1). Paratergal plates present only on segments 2-4.....5
 Paratergal plates present on segments 2-5 or 2-6.....9
- 5 (4). Spiracles present only on segments 3-4.....6
 Spiracles present on at least segments 3-5 and at times on 3-7....7
- 6 (5). Both sexes with abdominal setae, both dorsally and ventrally, large, flattened, elongate-cuneiform; known from *Funambulus palmarum* in Ceylon.....PLATYSPICATUS
 Both sexes with the abdominal setae, both dorsally and ventrally, all slender; known from *Paraxerus* in Africa.....ZONATUS
- 7 (6). Dorsum of the abdomen very sparsely haired, the female with not more than 4-5 setae on each half anterior to segment, these all very long; the male with not more than 3-4 such setae and with a median series of pairs of very small setae: known from *Heliosciurus* in Africa.....HELIOSCIURI
 Dorsum, in both sexes, with setae more numerous and none much longer than the length of its segment.....8
- 8 (7). Dorsum of the abdomen with numerous setae, there being as many as 14-20 in an almost continuous row across segments 4-6 in both sexes; known from *Lariscus* in Borneo.....LARISCI
 Dorsum of the abdomen with not more than 8-10 setae in any row in

- the female and less on the male; known from *Menetes* in Siam.....
.....MENETENSIS
- 9 (4). Paratergal plates present on abdominal segments 2-6.....10
Paratergal plates present on abdominal segments 2-5.....12
- 10 (9). Thoracic sternal plate with a slender, median, anterior prolongation which extends forward between the anterior coxae; occurring on the European *Sciurus vulgaris*.....NITZSCHI
Thoracic sternal plate without such anterior prolongation.....11
- 11 (10). Paratergal plates of abdominal segment 3 bearing a seta which is as long as the abdomen itself; known from *Xerus erythropus* in Africa.....EUXERI
No seta on any paratergal plate longer than the plate itself; known from *Dremomys pernyi* in China.....DREMOMYDIS
- 12 (9). Thoracic sternal plate with a narrow, median, anterior prolongation extending forward between the anterior coxae.....15
Thoracic sternal plate without such median anterior prolongation.....13
- 13 (12). All spiracles extremely large, their outside diameter equaling almost half the width of the plates which bear them; known from members of the genus *Callosciurus* in the Malayan Region.....MALAYSIANUS
Spiracles small, equaling only a small fraction of the width of the plates which bear them.....14
- 14 (13). Paratergal plates of segment 4 with 1 of their 2 setae equaling 2-3 times the length of the plate that bears it; attributed (possibly erroneously) to the North American *Tamias striatus*.....TAMIASIS
Paratergal plates of segment 4 with the setae much shorter than the length of the plates; known from *Nannosciurus* in Java.....NANNOSCIURI
- 15 (12). Thoracic sternal plate divided longitudinally into 2 oval, strongly sclerotized pieces which are separated from each other by a more or less membranous median area; occurring on New World squirrels of the genus *Sciurus* and closely related genera (see special key); the group of.....LONGICEPS
Thoracic sternal plate without such division; known from *Sciurotamias* in China.....SCIUROTAMIASIS

The Longiceps Group

The members of this group constitute an extraordinary complex of evidently closely related forms which occur on New World members of the genera *Sciurus* and *Microsciurus*, the latter being a little genus that is confined to Central America and northern South America. While a considerable amount of material is available, it represents only a small portion of the forms that probably exist. The development of an understanding of this complex has only begun and consequently uncertainty concerning the species which should be recognized must remain for a long time to come. All that has been accomplished thus far is to segregate a few of the forms that are clearly recognizable, while there are left on hand numerous specimens that cannot be assigned to one species or another.

In his treatment of the genus *Enderleinellus* in Part 1 of his "Contributions Toward a Monograph of the Sucking Lice," Ferris called attention to the existence of numerous variants of the males of the four species of this group which he recognized. Later, Werneck worked over this same material and from it and other specimens available to him later named six more species, bringing to ten the total number of species recognized in the group. Neither Ferris nor Werneck was able to point out characters by

which the females could be differentiated and the species were based almost entirely upon characteristics of the genitalia of the males.

A renewed study of the group in connection with the present work has revealed certain minute characters which serve to make at least some of the species identifiable in the female also, but even yet there remain some which can be associated with their males only by being found in company with them.

The males present what is probably the most unusual complex of structures that is to be found in this sex in any of the sucking lice. Material upon which to base the much-needed dissections to explain these structures has not been available in connection with this work and such a study must be left to the future. All that can be done at present is simply arbitrarily to identify the same structure throughout the series without attempting to discuss its morphological nature.

In the material at hand and among the species which have been named there are males with genitalic structures so different that there is nothing to be done other than to regard them as distinct species. But between these extremes there exist many intermediate forms with which nothing can be done at present. These must either be left unnamed or referred tentatively to the nearest recognized species.

Because of these facts separate keys are provided for males and females, that for the males being the most nearly complete.

Key to Males

1. Arms of the basal plate bent laterally at the posterior end, but not expanded at the apex nor with apical lobes or with any subapical spur or expansion.....2
- Arms of the basal plate expanded apically, or divided apically into two lobes or with a subapical, mesal spur or expansion.....3
2. Piece X elongate, widened posteriorly; known only from *Sciurus griseus* in California.....KELLOGGI
- Piece X very short, transverse; typical of *Sciurus niger*.....LONGICEPS
3. Arms of the basal plate with a distinct little subapical spur which is set well in from the acute and simple apex; type from *Sciurus boothiae*.....HONDURENSIS
- Arms of the basal plate without such subapical spur.....4
4. Arms of the basal plate with the two very small apical lobes containing the articulation of the corresponding arm of the pseudopenis and with a marked subapical, mesal expansion set well in from the apex; type from *Urosциurus* in South America.....UROSCIURI
- Otherwise.....5
5. Arms of the basal plate with a quite shallow apical emargination.....6
- Arms of the basal plate with a deeply V- or U-shaped emargination.....7
6. Arms of the basal plate with the mesal apical lobe larger than the other and rounded at the apex; type from *Sciurus aestuans* in Brasil..
.....BRASILIENSIS
- Arms of the basal plate with the outer lobe larger than the mesal lobe and with both lobes apically acute; type from *Sciurus nesaeus* in Venezuela.....INSULARIS
7. Median complex of the aedeagus with a pair of minute, recurved hooks at the mid-line, just posterior to the gonopore; type from *Sciurus truei* in Mexico.....MEXICANUS
- Median complex of the aedeagus without such hooks.....8
8. Arms of the basal plate with the mesal apical lobe shorter than the other; pseudopenis with its apical stem at least half as long as its arms; type from *Sciurus arizonensis*.....ARIZONENSIS
- Arms of the basal plate with the two apical lobes equal in length;

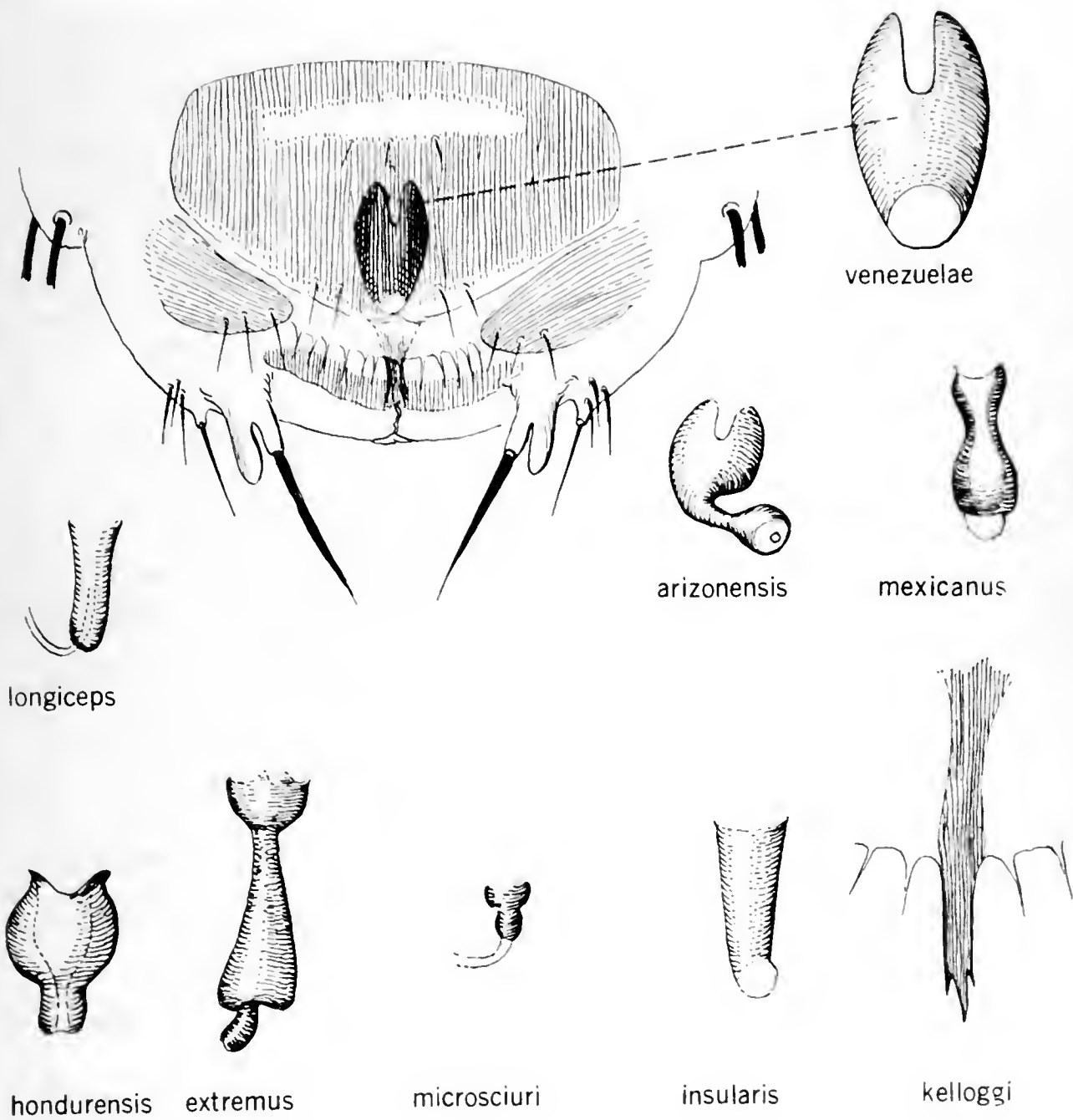
- stem of the pseudopenis less than half as long as the arms, at times forming merely a short projection.....9
9. Arms of the basal plate with the apical lobes short and narrow, not expanded basally; from *Microsciurus* in Colombia.....MICROSCIURI
Arms of the basal plate with the apical lobes very large and broadened basally.....10
10. Arms of the basal plate with the mesal lobe definitely broader at the base than is the outer lobe; type from *Sciurus socialis* in Guatemala.....EXTREMUS
Arms of the basal plate with the apical lobes of the same width at the base; type from *Sciurus griseogena* in Venezuela.....VENEZUELAE

The distinctive characters in the females are to be found in connection with the genitalia. The anterior margin of the vulva is beset with small fimbriae, medially forming a relatively stout and somewhat sclerotized point. Just anterior to this median point is to be seen a sclerotized structure which is presumably the spermatheca. Its exact relation to the surrounding parts remains to be determined from fresh material and here nothing more can be done than to describe and illustrate its appearance. In one species of the group (*kelloggi*) it appears to be lacking. In other species its form is quite distinctive and it ranges in size from a large, oval body as seen in *venezuelae* (Figure 41) to a very minute structure as in *microsciuri* (Figure 41). This structure maintains its characteristic shape throughout all the specimens available from the type host and is here illustrated for nine of the eleven species. A careful special study of the entire group is needed.

Key to Females
Figure 47

Two species, *brasiliensis* and *urosciuri*, are omitted from this key because of lack of material.

1. Spermatheca apparently lacking; median tooth of the vulvar fimbriation strongly sclerotized, this sclerotization extending forward until it merges with the sclerotization of the genital plate.....KELLOGGI
Spermatheca definitely present.....2
2. Spermatheca forming a relatively very large, oval body.....VENEZUELAE
Otherwise.....3
3. Spermatheca strongly bent, its ends expanded, the expansion of the anterior end being larger than that of the posterior end...ARIZONENSIS
Not so.....4
4. Spermatheca forming a relatively straight, simple, tapering tube.....5
Not so.....6
5. Spermatheca with a slender, tubular, posterior prolongation...LONGICEPS
Spermatheca larger and stouter, without such posterior prolongation...
.....INSULARIS
6. Spermatheca forming an elongate body which is anteriorly swollen, then reducing by an abrupt constriction to expand again gradually toward the posterior end, then becoming terminally truncate with a small, strongly sclerotized terminal appendix.....EXTREMUS
Not so.....7
7. Spermatheca forming an elongate body which is more or less constricted about the middle.....MEXICANUS
Not so.....8
8. Spermatheca extremely minute, short, anteriorly swollen, and then constricting, its posterior end prolonged into delicate tube MICROSCIURI
Spermatheca similar in form but much larger and apparently without the slender prolongation.....HONDURENSIS



Details of genitalia of females of the *Enderleinellus longiceps* group

Figure 47

Enderleinellus arizonensis Werneck

1948. *Enderleinellus arizonensis* Werneck, *Memorias do Instituto Oswaldo Cruz* 45:288; figures 13-15.

HOSTS AND DISTRIBUTION. Type from *Sciurus arizonensis* from the Huachuca Mountains in Arizona. Also recorded by Werneck from *Sciurus apache* from Colonia Garcia, Chihuahua, Mexico; *Sciurus alleni* from the Sierra Guadalupe. and *Sciurus nayaritensis* from the Sierra Madre, Zacatecas, Mexico.

NOTES. This species was included by Ferris in *Enderleinellus extremus* Ferris.

Enderleinellus brasiliensis Werneck

1937. *Enderleinellus brasiliensis* Werneck, *Memorias do Instituto Oswaldo Cruz* 32:399; figure 11.

HOSTS AND DISTRIBUTION. From *Sciurus aestuans* at Abaete, state of Para, Brasil.

Enderleinellus dremomydis Ferris

1919. *Enderleinellus dremomydis* Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1:29; figure 16.

HOSTS AND DISTRIBUTION. From *Dremomys pernyi*, West Szechuan, China.

Enderleinellus euxeri Ferris

1919. *Enderleinellus euxeri* Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1:37; figures 22, 23.

1929. *Hoplophthirus euxeri* (Ferris), Ewing, *A Manual of External Parasites*, page 194.

HOSTS AND DISTRIBUTION. Described as from *Euxerus microdon*, which is a synonym of *Xerus erythropus*, from Wambugu and Oni, British East Africa.

Enderleinellus extremus Ferris

1919. *Enderleinellus extremus* Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1:24; figure 12.

HOSTS AND DISTRIBUTION. Type from *Sciurus socialis* at Nenton, Guatemala. Also recorded from *Sciurus aureogaster* from the states of Vera Cruz and Oaxaca; from *Sciurus deppii* from the state of Tabasco; from *Sciurus griseo-flavus*, state of Chiapas; from *Sciurus negligens*, state of Tamaulipas; from *Sciurus polioopus*, state of Oaxaca; all these being from Mexico. All of these specimens are left in *extremus* by Werneck.

Enderleinellus heliosciuri Ferris

1919. *Enderleinellus heliosciuri* Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1:40; figures 24, 25.

HOSTS AND DISTRIBUTION. Type from *Heliosciurus gambianus* (as *undulatus*) from British East Africa and from the same host (as *rufobrachiatus* and *multicolor*) from Uganda; from *Heliosciurus ruwenzorii*, Mt. Ruwenzori, British East Africa; from *Protoxerus stangeri*, British East Africa.

Enderleinellus hondurensis Werneck

1948. *Enderleinellus hondurensis* Werneck, *Memorias do Instituto Oswaldo Cruz* 45:286; figures 7-9.

HOSTS AND DISTRIBUTION. Type from *Sciurus boothiae* from San Pedro Sula, Honduras. Also from *Sciurus melania* at Boqueron, Colombia, and from *Sciurus variegatoides* (as *goldmani*) from the state of Chiapas, Mexico.

NOTES. This species, with the above records, was included by Ferris in *Enderleinellus kelloggi*.

Enderleinellus insularis Werneck

1948. *Enderleinellus insularis* Werneck, *Memorias do Instituto Oswaldo Cruz* 45: 293; figures 25-27.

HOSTS AND DISTRIBUTION. Type from *Sciurus nesaeus* from Margarita Island, Venezuela.

NOTES. This species was included by Ferris under *Enderleinellus extremus*.

Enderleinellus kelloggi Ferris

1916. *Enderleinellus kelloggi* Ferris, *Psyche* 23: 105.

1919. *Enderleinellus kelloggi* Ferris, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1: 22; figure 11.

HOSTS AND DISTRIBUTION. From *Sciurus griseus*, Stanford University, California.

NOTES. Specimens erroneously recorded as *kelloggi* are here placed under *hondurensis*.

Enderleinellus larisci Ferris

1919. *Enderleinellus larisci* Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1: 17; figures 7, 8.

1929. *Euenderleinellus larisci* (Ferris), Ewing, *A Manual of External Parasites*, page 197.

HOSTS AND DISTRIBUTION. From *Lariscus insignis* (as *diversus*), from Lanchut, southwest Borneo.

NOTES. This species was designated as type of the genus *Euenderleinellus* Ewing.

Enderleinellus longiceps Kellogg and Ferris

1915. *Enderleinellus longiceps* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Anoplura Publications, University Series (no volume number), page 44; Plate 2, figure 5; Plate 4, figure 12; Plate 6, figure 2.

1919. *Enderleinellus longiceps* Kellogg and Ferris, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 1: 19; figures 9, 10.

1948. *Enderleinellus longiceps* Kellogg and Ferris, Werneck, *Memorias do Instituto Oswaldo Cruz* 45: 284; figures 1-3.

HOSTS AND DISTRIBUTION. Type from *Sciurus niger* or *Sciurus carolinensis*, at Lincoln, Nebraska. Recorded from *Sciurus niger* at Valentine, Nebraska, and Waterloo, Indiana; from *Sciurus carolinensis* at Bayou Saint Louis, Mississippi; from *Sciurus kaibabensis* from the Kaibab National Forest, Arizona; from *Sciurus aberti* at Estes Park, Colorado; from *Sciurus alleni*, Colonia Garcia, Chihuahua, Mexico; from *Sciurus oculatus*, state of Vera Cruz, Mexico.

NOTES. The records given above are those of Ferris, which have been accepted by Werneck. Specimens from *Sciurus apache* in Chihuahua, Mexico, referred by Ferris to *longiceps* have been placed by Werneck in *Enderleinellus arizonensis* as have specimens from *Sciurus arizonensis* in Arizona and from *Sciurus nayaritensis*, state of Zacatecas, Mexico.

Enderleinellus malaysianus Ferris

1919. *Enderleinellus malaysianus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:12; figures 3, 4.

HOSTS AND DISTRIBUTION. Type from *Callosciurus caniceps* (as *Sciurus lucas*) from Saint Lukes Island, Mergui Archipelago, Malaysia. Also recorded from the same host (as *Sciurus bentinckanus*) from Bentinck Island in the same archipelago, (as *Sciurus domelensis*) from Domel Island in the same archipelago, (as *Sciurus lancavensis*) from Pulo Teratau, and (as *Sciurus davisoni*) from Trong, lower Siam; and from *Callosciurus prevosti* (as *Sciurus borneoensis*) at Pulo Kanchut, Borneo.

Enderleinellus marmotae Ferris

1919. *Enderleinellus marmotae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:47; figure 30.

HOSTS AND DISTRIBUTION. Type from *Marmota monax* from Grafton, South Dakota; also recorded from the same host at Elk River, Minnesota, and Marble Cave, Missouri, at Sandy Springs, Maryland, and Washington, District of Columbia.

Enderleinellus menetensis Ferris

1919. *Enderleinellus menetensis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:14; figures 5, 6.

HOSTS AND DISTRIBUTION. From *Menetes berdmorei*, Koh Kut Island, south-east Siam.

Enderleinellus mexicanus Werneck

1947. *Enderleinellus mexicanus* Werneck, Memorias do Instituto Oswaldo Cruz 45:289; figures 16-18.

HOSTS AND DISTRIBUTION. Type from *Sciurus truei* at Chacala, Mexico. Also recorded from *Sciurus nelsoni* from the state of Morelos, and from *Sciurus colliae*, state of Nayarit, Mexico.

NOTES. The specimens recorded above were recorded by Ferris under *Enderleinellus extremus*.

Enderleinellus microsciuri Werneck

1947. *Enderleinellus microsciuri* Werneck, Memorias do Instituto Oswaldo Cruz 45:287; figures 10-12.

HOSTS AND DISTRIBUTION. From *Microsciurus mimulus* from unspecified locality in Colombia.

NOTES. The specimens upon which this species was based were previously recorded by Ferris as *Enderleinellus kelloggii*.

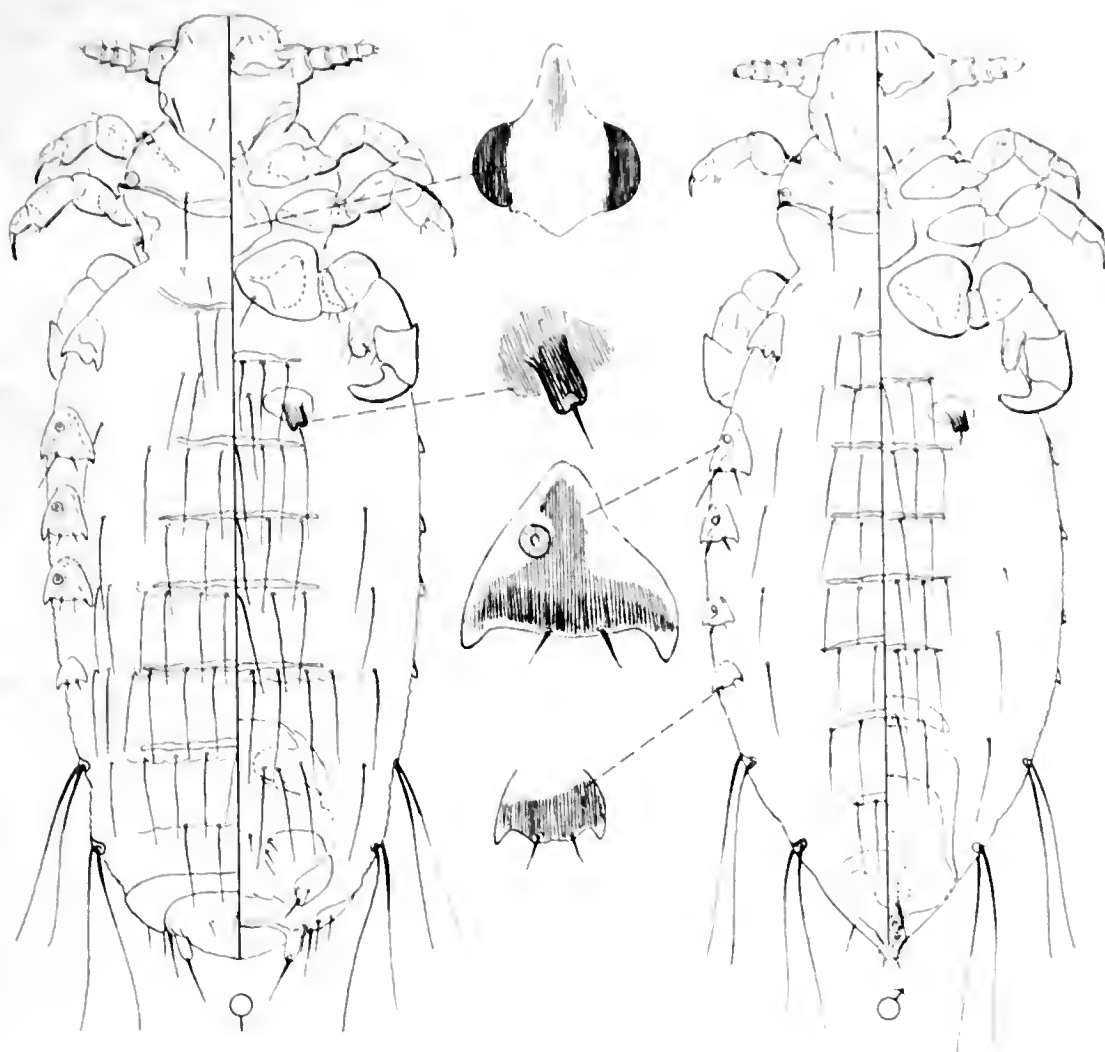
Enderleinellus nannosciuri Ferris

1919. *Enderleinellus nannosciuri* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:30; figure 17.

HOSTS AND DISTRIBUTION. From *Nannosciurus melanotis* from Batavia, Java.

Enderleinellus nitzschi Fahrenholz
Figures 48, 49

1818. *Pediculus sphaerocephalus* Nitzsch, German's und Zincken's Magazin für die Entomologie 3:305. (Not *Pediculus sphaerocephalus* von Olfers)



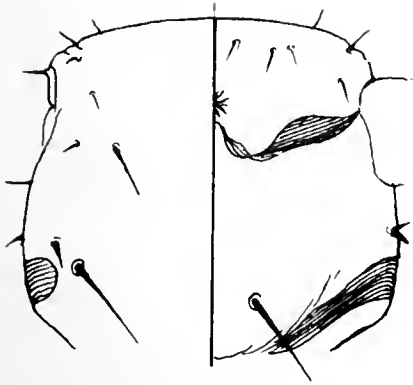
Enderleinellus nitzschi Fahrenholz

Figure 48

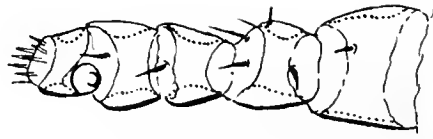
1912. *Enderleinellus sphaerocephalus* (Nitzsch), Fahrenholz, Jahresbericht des niedersächsischen Zoologischen Vereins zu Hannover 2-4:52; text figures 22, 23; Plate 2, figures 5-7.
1916. *Enderleinellus nitzschi* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:29.
1919. *Enderleinellus nitzschi* Fahrenholz, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:8; figures 1, 2.

HOSTS AND DISTRIBUTION. Originally described from *Sciurus vulgaris* in Europe and recorded numerous times from this host. Recorded also from *Sciurus anomalus* (as *syriacus*) from Syria; from *Sciurus hudsonicus* from Alaska; from *Sciurus douglasii* from western United States; from *Sciurus fremonti* from Colorado.

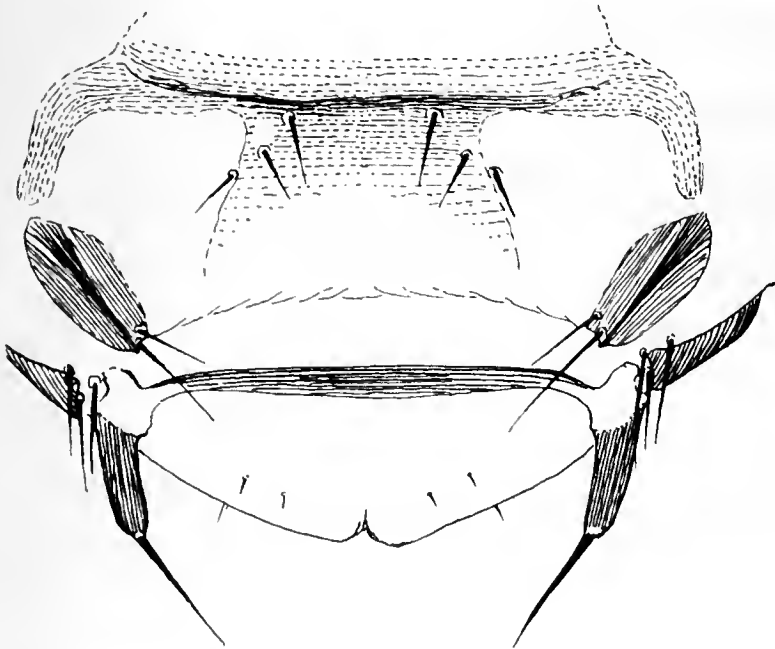
NOTES. Werneck, who examined all the material recorded above, has agreed that no specific differences exist among the specimens from the different hosts.



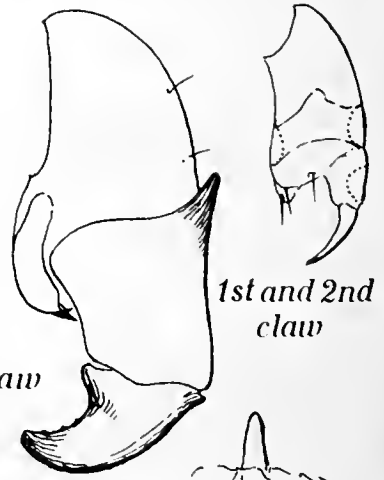
head



antenna

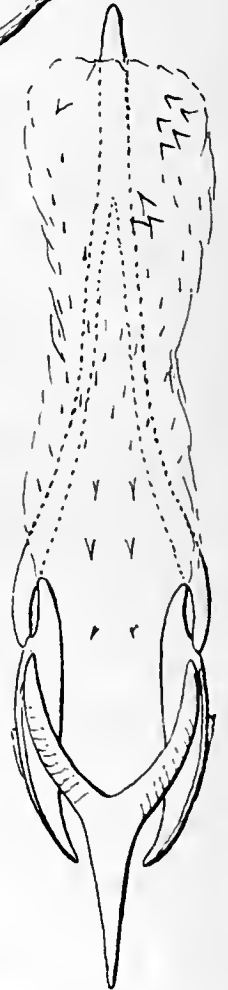


female genitalia



3rd claw

*1st and 2nd
claw*



male genitalia

Enderleinellus nitzschi Fahrenholz, details

Figure 49

Enderleinellus osborni Kellogg and Ferris

1915. *Enderleinellus osborni* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 43; text figure 15; Plate 4; figure 11; Plate 6, figure 6.
1919. *Enderleinellus osborni* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:46; figure 29.

HOSTS AND DISTRIBUTION. Type from *Citellus beecheyi* (as *douglasi*) at Covelo, Mendocino County, California, and recorded from this host species at various localities in California. Also from *Citellus variegatus* (as *buckleyi*) in Texas and (as *grammurus*) in Arizona. From *Citellus* (as *Xerospermophilus*) *tereticaudus*, Imperial County, California.

Enderleinellus platyspicatus Ferris

1919. *Enderleinellus platyspicatus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:26; figures 14, 15.

HOSTS AND DISTRIBUTION. From *Funambulus palmarum* (as *tristriatus*) in Ceylon.

Enderleinellus replicatus Redikorzev

1937. *Enderleinellus replicatus* Redikorzev, Parasitology 29:4; figure.

HOSTS AND DISTRIBUTION. From *Sciuropterus volans*, Tartar Republic, without closer indication of locality.

NOTES. Members of this genus very commonly in dying contract in such a manner that the head is drawn back over the body as the result of opisthotonos, and in preparing specimens for study they must be unfolded. Unfortunately, in describing this species its author made his illustrations from a specimen that was thus contracted and consequently his illustration is entirely useless. It is impossible to determine what the species is actually like and to include it in the key.

Enderleinellus sciurotamiasis Ferris

1919. *Enderleinellus sciurotamiasis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:45; figures 20, 21.

HOSTS AND DISTRIBUTION. From *Sciurotamias davidianus*, Shensi Province, China.

Enderleinellus suturalis (Osborn)

1891. *Haematopinus suturalis* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:27; fig. 15.
1915. *Enderleinellus suturalis* (Osborn), Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 40; Plate 4, figure 9.
1916. *Enderleinellus suturalis occidentalis* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 42; Plate 2, figure 3; Plate 4, figure 10; Plate 5, figure 17.
1919. *Enderleinellus suturalis* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:42; figures 26, 27, 28.
1929. *Cyclophthirus suturalis* (Osborn), Ewing, A Manual of External Parasites, page 196.

HOSTS AND DISTRIBUTION. Originally described as from *Citellus tridecim-*

lineatus and *Citellus franklini* (as *Spermophilus*) at Ames, Iowa. The first of these has been designated by Kellogg and Ferris as the type host. Ferris has recorded the species from a long series of species of *Citellus* as follows: *eversmanni*, Altai, Siberia; *mongolicus*, Kansu, China; *beldingi*, California; *elegans*, Colorado; *franklini*, North Dakota; *mollis*, Nevada; *osgoodi*, near Circle, Alaska; *townsendi*, state of Washington; *tridecimlineatus*, Kansas and Oklahoma; *madrensis* (as *Callopermophilus*), Chihuahua, Mexico; *nelsoni* (as *Ammospermophilus*), California; *Cynomys gunnisoni*, Colorado; *Cynomys leucurus*, Colorado and Wyoming.

NOTES. In the rather extensive material at hand there is a quite wide range of variation in various details, but a study of the material by Dr. Edwin Cook has shown no clear basis for recognizing more than one species. The two species, *osborni* and *marmotae*, which have in the past been separated from *suturalis* are the only ones in which the situation seems reasonably clear. Studies are continuing with an accompanying attempt to secure additional material and it is hoped eventually to publish a detailed report upon the group.

Enderleinellus tamiasis Fahrenholz

1916. *Enderleinellus tamiasis* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:27; text figure 22.

1919. *Enderleinellus tamiasis* Fahrenholz, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:288; figure 176.

HOSTS AND DISTRIBUTION. Known only from the original record from *Tamias striatus* in the Berlin Zoological Garden.

NOTES. It is entirely possible that *Tamias striatus*, which is a native of eastern and central United States, is not the normal host of this species, no species of *Enderleinellus* having yet been recovered from this host under natural conditions.

Enderleinellus urosciuri Werneck

1937. *Enderleinellus urosciuri* Werneck, Memorias do Instituto Oswaldo Cruz 32:400; figure 12.

HOSTS AND DISTRIBUTION. Recorded from *Sciurus* (as *Urosciurus*) *igniventris* from Acajutuba, Rio Negro, state of Amazonas, Brasil.

Enderleinellus venezuelae Ferris

1919. *Enderleinellus venezuelae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:25; figure 13.

1948. *Enderleinellus venezuelae* Ferris, Werneck, Memorias do Instituto Oswaldo Cruz 45:292; figures 22-24.

HOSTS AND DISTRIBUTION. Type from *Sciurus griseogena* from Macuto, Venezuela. Also recorded from the same host (as *meridensis*) from Merida, Venezuela, and from *Sciurus gerrardi* (as *versicolor*) from Rio Aurare, Venezuela.

Enderleinellus zonatus Ferris

1919. *Enderleinellus zonatus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:32; figures 18, 19. (In part)

1948. *Enderleinellus zonatus* Ferris, Werneck, Memorias do Instituto Oswaldo Cruz 45:295; figure 28.

HOSTS AND DISTRIBUTION. Type from *Paraxerus ochraceus* (as *jacksoni*), Kijabe, British East Africa.

NOTES. Werneck has pointed out that two distinct species were included in the material recorded by Ferris.

Genus MICROPHTHIRUS Ferris

1919. *Microphthirus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:49.

GENERIC TYPE. *Enderleinellus uncinatus* Ferris.

CHARACTERS. Enderleinellinae in which the pair of little, sclerotized plates on the venter of the second abdominal segment is lacking. Paratergal plates of segments 3-6 each continuous with the corresponding sternal plate, being connected with it by a narrow, sclerotized bridge. Paratergal plates not free from the body at any point. Antennae with the proximal, postaxial angle of segments 2-3 produced into a sclerotized hook.

NOTES. As known at present this genus contains but a single species. This is a very peculiar form, known only from North American flying squirrels of the genus *Glaucomys*. The assignment of the genus to the Enderleinellae is based entirely upon the character of the legs, since there is little else to connect it with any other group of the Anoplura. The host association supports this assignment and in this particular case has been taken into consideration in placing the genus.

Microphthirus uncinatus (Ferris)
Figures 50, 51

1916. *Enderleinellus uncinatus* Ferris, Psyche 23:108; figures 6, 7.

1919. *Microphthirus uncinatus* (Ferris), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 1:49; figures 31-32.

HOSTS AND DISTRIBUTION. Known only from the original record from *Glaucomys sabrinus* at Yosemite National Park, California. The host is a member of the rodent family Sciuridae.

NOTES. This is one of the very smallest of all sucking lice, the male attaining a length of only about .35 mm. The insects are so small that as seen upon their host they are very likely to be mistaken for young of one of the other species which occur on these squirrels.

Genus WERNECKIA Ferris, new genus

GENERIC TYPE. *Enderleinellus minutus* Werneck. One other species, *Enderleinellus paraxeri* Werneck, is here included.

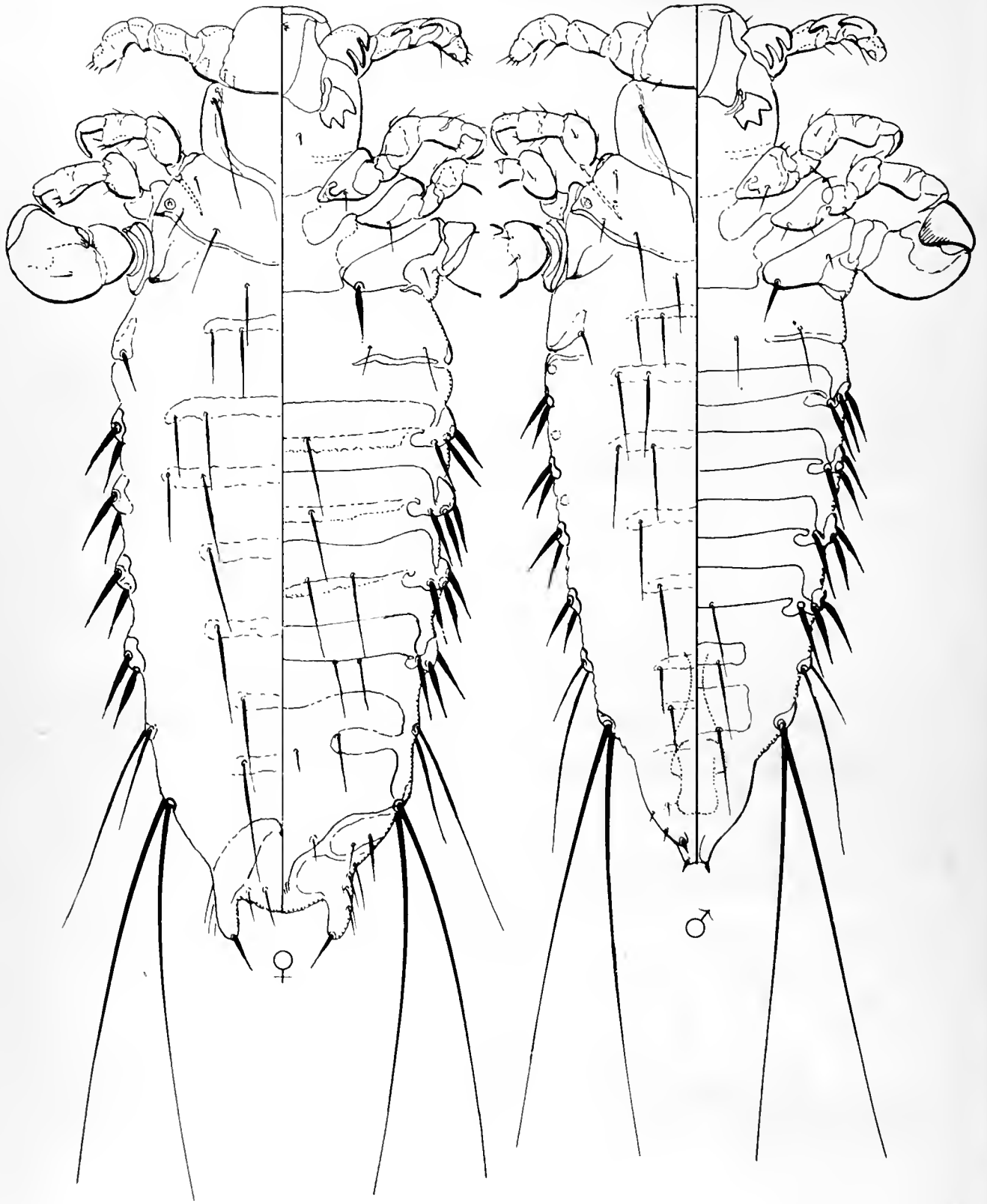
CHARACTERS. Enderleinellinae in which the paired sclerotizations of the second abdominal sternum are lacking. Differing from *Microphthirus* in which this also is true, in not having the paratergal plates connected with the sternites by sclerotizations.

Occurring on African squirrels of the genus *Paraxerus*.

NOTES. Since each of the two included species is known from but a single male very little can be said about the group. It is by no means certain that these two species should be placed in the same genus, since they differ materially in various respects and it appears possible that they are independent derivatives from species of *Enderleinellus* that also occur on their hosts.

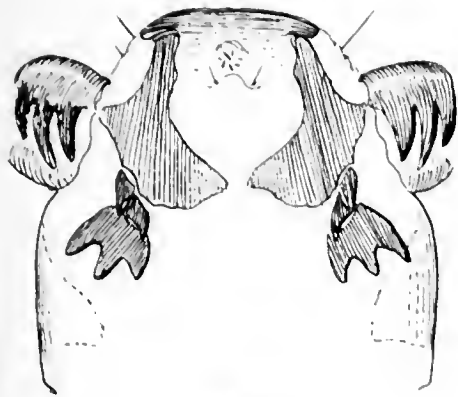
Key to Species of WERNECKIA

- Genitalia of the male with all parts of the terminal complex slender..... PARAXERI
-
- Genitalia of the male with the parts of the terminal complex short, the parameres broadened..... MINUTA



Microphthirus uncinatus (Ferris)

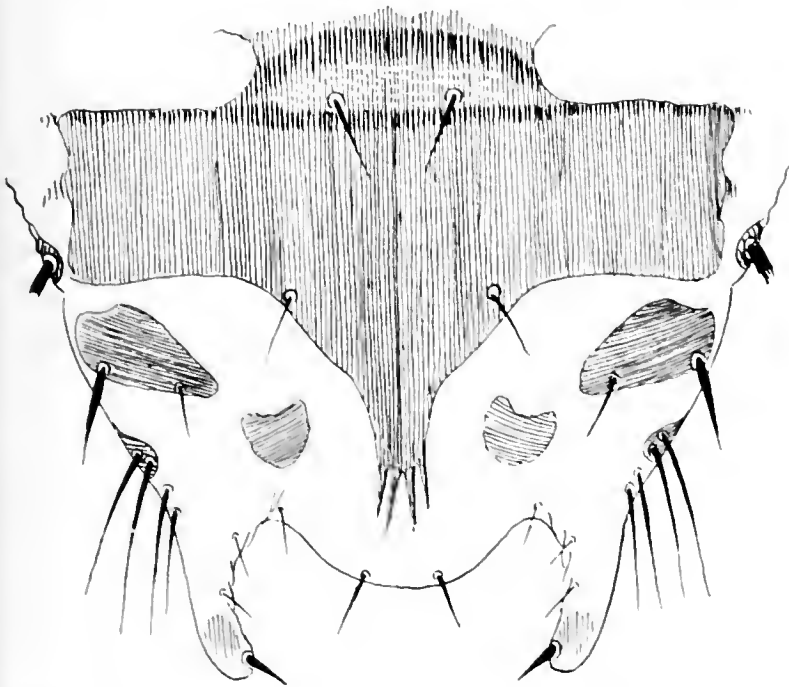
Figure 50



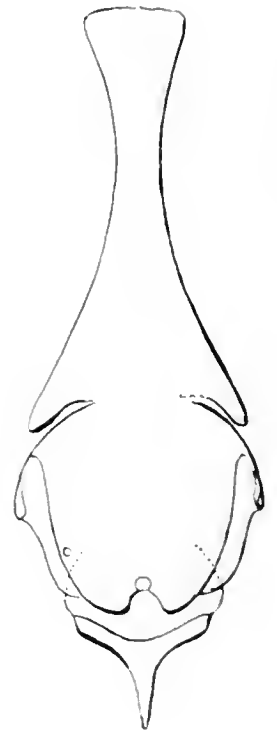
head



antenna



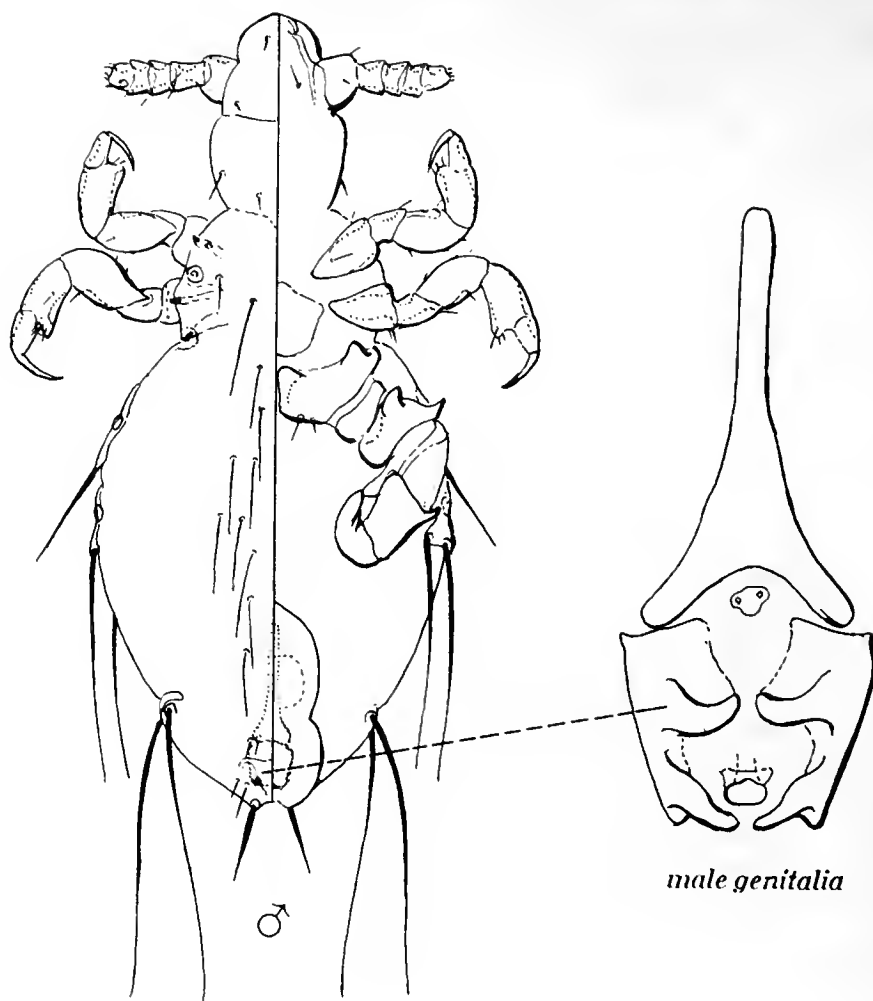
female genitalia



male genitalia

Microphthirus uncinatus (Ferris), details

Figure 51



Werneckia minuta (Werneck)

Figure 52

Werneckia minuta (Werneck)
Figure 52

1947. *Enderleinellus minutus* Werneck, Memorias do Instituto Oswaldo Cruz 45:296; figure 30.

HOSTS AND DISTRIBUTION. Known from but a single male, from *Paraxerus jacksoni* (=ochraceus), from Kijabe, British East Africa.

NOTES. The single male representing this species was discovered by Werneck among the type material of *Enderleinellus zonatus* Ferris and described by Werneck who, however, did not note the absence of the paired ventral plates of the second abdominal segment.

Werneckia paraxeri (Werneck)

1947. *Enderleinellus paraxeri* Werneck, Memorias do Instituto Oswaldo Cruz 45:295; figure 29.

HOSTS AND DISTRIBUTION. Known from but a single female, from *Paraxerus palliatus*, from British East Africa.

NOTES. The circumstances surrounding this species are the same as those connected with *minuta*.

Subfamily HOPOPLEURINAE Ferris, new subfamily

DESCRIPTION OF THE SUBFAMILY. Hoplopleuridae in which there is no evidence of eyes. Paratergal plates reaching an extreme degree of development, those of abdominal segments 4-6 enclosing the sides of the abdomen and each to some extent overlapping that of the segment next succeeding. Sternal plates of abdominal segment two prolonged laterally on each side to articulate with the corresponding paratergal plate and at times divided mesally by a membranous area into two plates which may be much expanded. Anterior legs always small, with slender claw, the middle legs larger with stouter claw, the posterior legs still larger, generally flattened and with very broad claw. Antennae 4-5 segmented, never sexually dimorphic.

NOTES. In its basic pattern this group is quite homogeneous, although some of its species present some extraordinary specializations. The group is as a whole probably the most specialized of the Anoplura.

The five included genera may be separated by the following key.

Key to the Genera of HOPOPLEURINAE

1. Antennae clearly 5-segmented.....2
 Antennae 4-segmented.....4
2. Paratergal plates of abdominal segment 2 each prolonged into a blade-like process which projects from the body wall.....PTEROPHTHIRUS
 Not so.....3
3. Sternal plate of abdominal segment 2 divided longitudinally into 2 much expanded plates.....SCHIZOPHTHIRUS
 Not so.....HOPOPLEURA
4. Posterior legs with a membranous, bladder-like expansion on the coxa and on the tibio-tarsus.....HAEMATOPINOIDES
 Not so.....ANCISTROPLAX

Genus ANCISTROPLAX Waterston

1929. *Ancistroplax* Waterston, Parasitology 21:161.

1932. *Ancistroplax*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:38.

GENERIC TYPE. *Ancistroplax crocidurae* Waterston.

CHARACTERS. Hoplopleurinae in which the antennae are four-segmented. Paratergal plates of abdominal segments 3-7 each having the appearance of being divided into two equal parts by a longitudinal line of weak sclerotization. Tergal and sternal plates of the abdomen strongly developed in both sexes, the female having three plates and three rows of setae, both dorsally and ventrally, on segments 3-6; the male having but one plate, either dorsally or ventrally, on any segment, but this on segments 4-6, both dorsally and ventrally having two rows of setae and presenting an appearance which suggests that it is composed of two transverse plates which have partially fused. Tergal plate of segment six of the male having its posterior angles each produced into a free process which is bent apically toward the mid-line of the body. Posterior legs strongly expanded and flattened, with broad claw. Sternal plate of abdominal segment two divided longitudinally into two expanded plates. First sternal plate of segment three not produced laterally to articulate with the corresponding paratergites.

NOTES. The affinities of this genus seem to be most closely with *Schizophtirus*. It seems also to be more or less closely related to the genus *Haematopinooides*.

Ancistroplax crocidurae Waterston
Figures 53, 54

1929. *Ancistroplax crocidurae* Waterston, Parasitology 21:161; figures.
1932. *Ancistroplax crocidurae* Waterston, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:308; figures 188, 189.

HOSTS AND DISTRIBUTION. There is but a single record of this species which attributes it to a shrew, *Crocidura horsfieldi*, in Ceylon.

Genus HAEMATOPINOIDES Osborn

1891. *Haematopinoides* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:28.
1896. *Euhaematopinus* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (new series) 5:186.
1929. *Haematopinoides*, Ewing, A Manual of External Parasites, page 140.
1932. *Haematopinoides*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:289.

GENERIC TYPE. *Haematopinoides squamosus* Osborn. The genus *Euhaematopinus* Osborn, with *Euhaematopinus abnormis* Osborn as type, is synonymous, its type species being synonymous with *squamosus*.

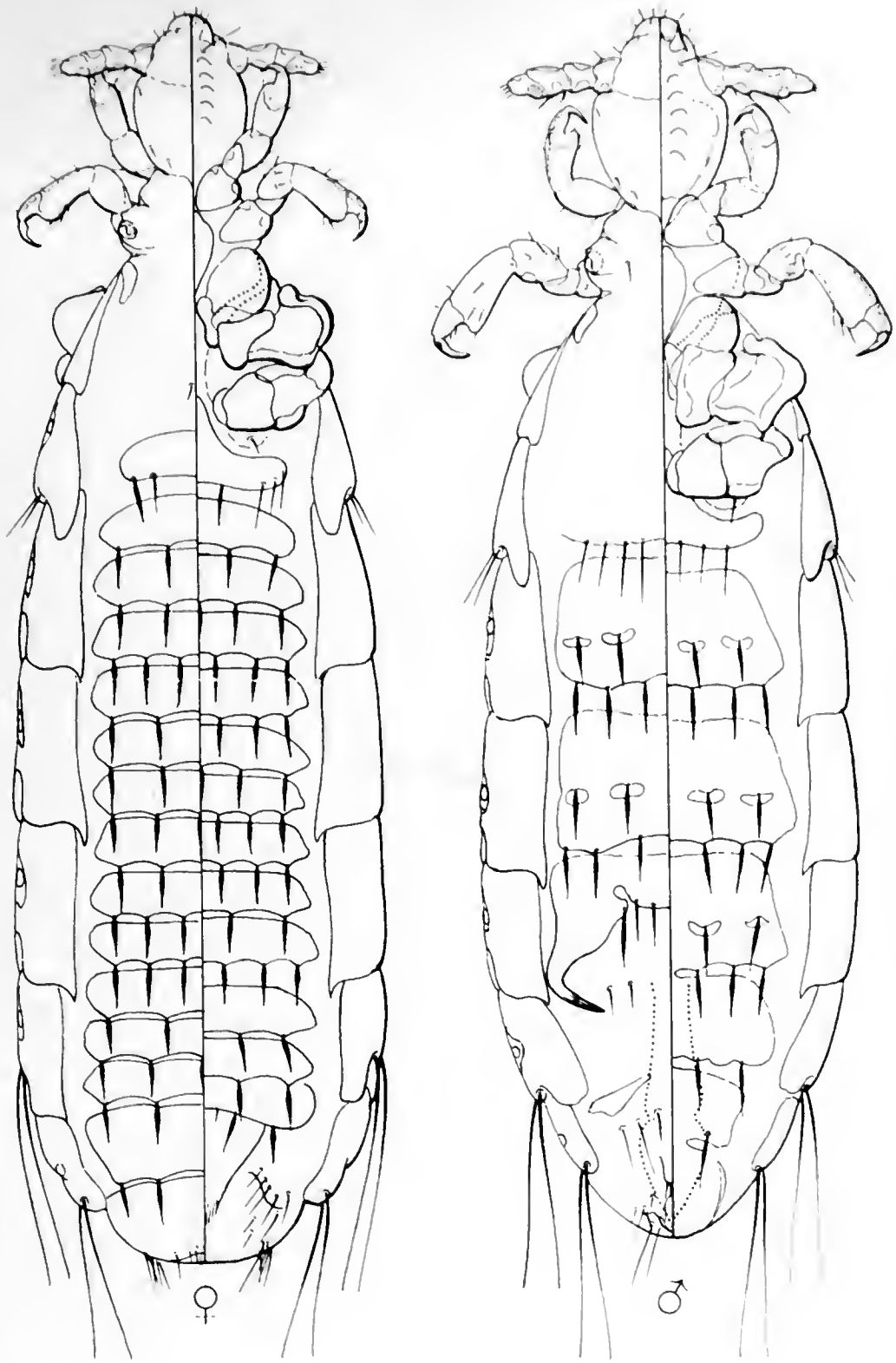
CHARACTERS. Hoplopleurinae in which the antennae are 4-segmented. Posterior legs with a membranous, bladder-like expansion arising from the anterior margin of the coxae and a similar structure on the anterior wall of the tibia. Apart from the usual sclerotizations of the terminal and genitalic segments, tergal plates are developed only on segments 1-3 and sternal plates on segments 2-3 in the female, while they are present on all segments except the first in the male. Female with two rows of setae both dorsally and ventrally on most of the abdominal segments, the male with but one. Sternite of the second abdominal segment divided longitudinally into two expanded plates each of which articulates by a lateral extension with the corresponding paratergal plate. First plate of abdominal segment three not produced laterally.

NOTES. This genus (as *Euhaematopinus*) was employed by Enderlein in 1904 as type of the subfamily *Euhaematopininae* of the family *Haematopinidae* and in 1929 this was elevated to the rank of a family, under the name *Haematopinoididae*, by Ewing. Actually, the genus is very closely related to *Hoplopleura*. The membranous expansions on the posterior legs are unique structures but do not in any way justify the assignment of the genus to an isolated position.

Haematopinoides squamosus (Osborn)
Figures 55, 56

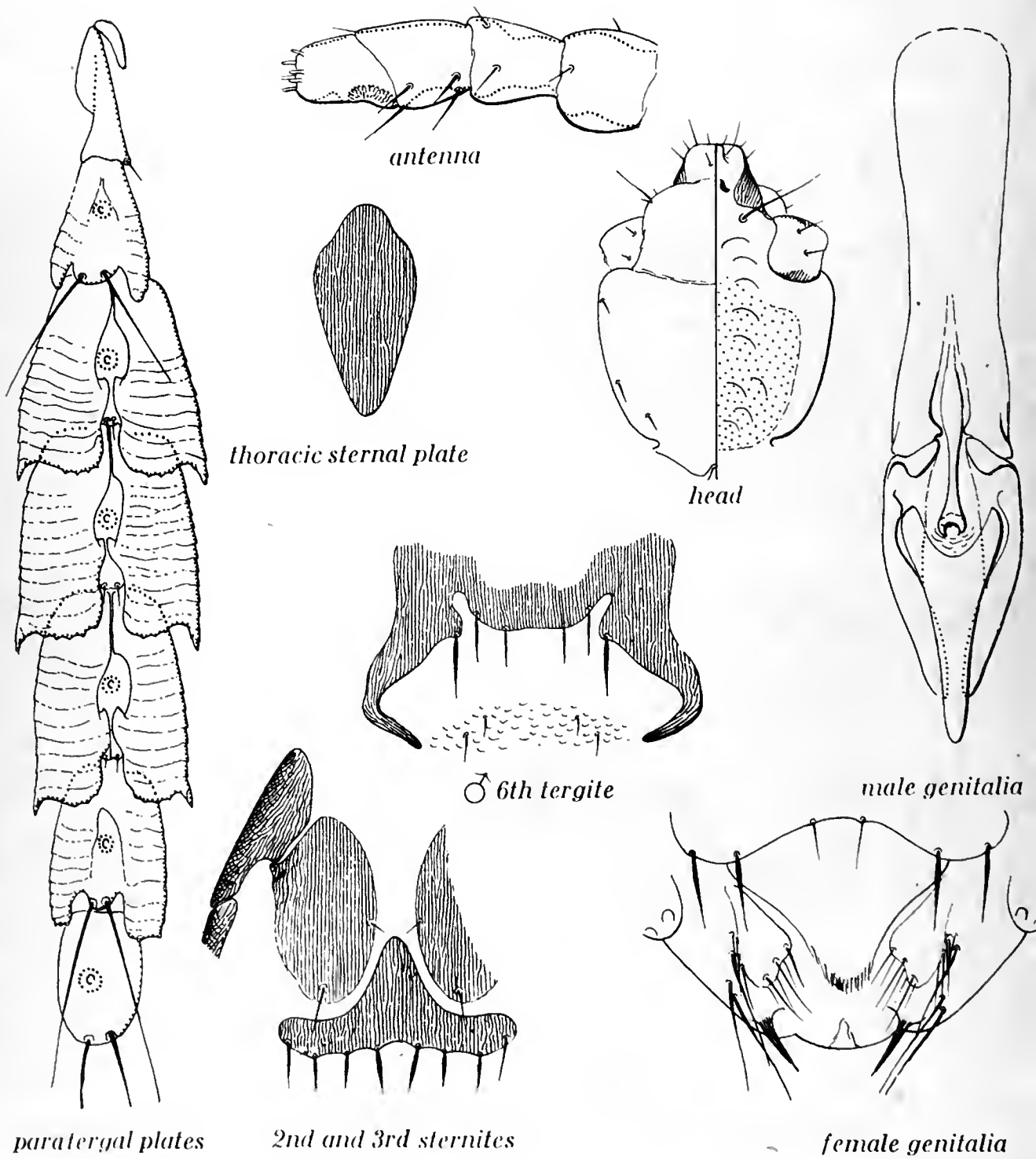
1891. *Haematopinoides squamosus* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:28; figure 16.
1896. *Euhaematopinus abnormis* Osborn, United States Department of Agriculture, Division of Entomology (new series) 5:187; figure.
1922. *Euhaematopinus abnormis* Osborn, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:150; figures 98, 99.
1929. *Haematopinoides squamosus* Osborn, Ewing, A Manual of External Parasites, page 140.

HOSTS AND DISTRIBUTION. First recorded, undoubtedly quite erroneously, from a rodent of the family Geomyidae in Iowa. Later described again as a new genus and species from its true host, a mole, *Scalopus aquaticus*, at Ames, Iowa, United States. It has since been recorded from this host from localities in Kansas, Illinois, and New York. Also specimens are at hand



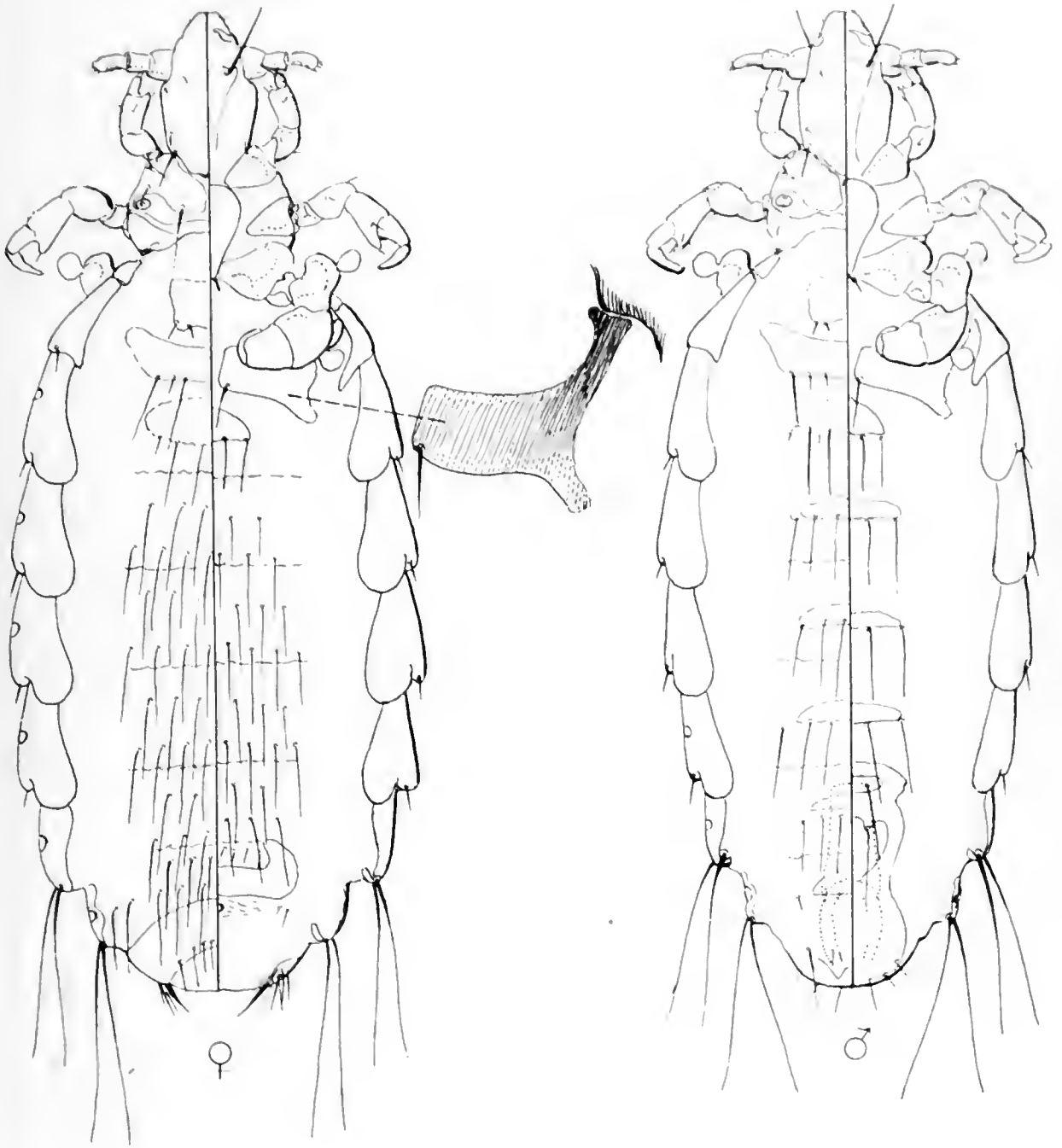
Ancistroplax crocidurae Waterston

Figure 53



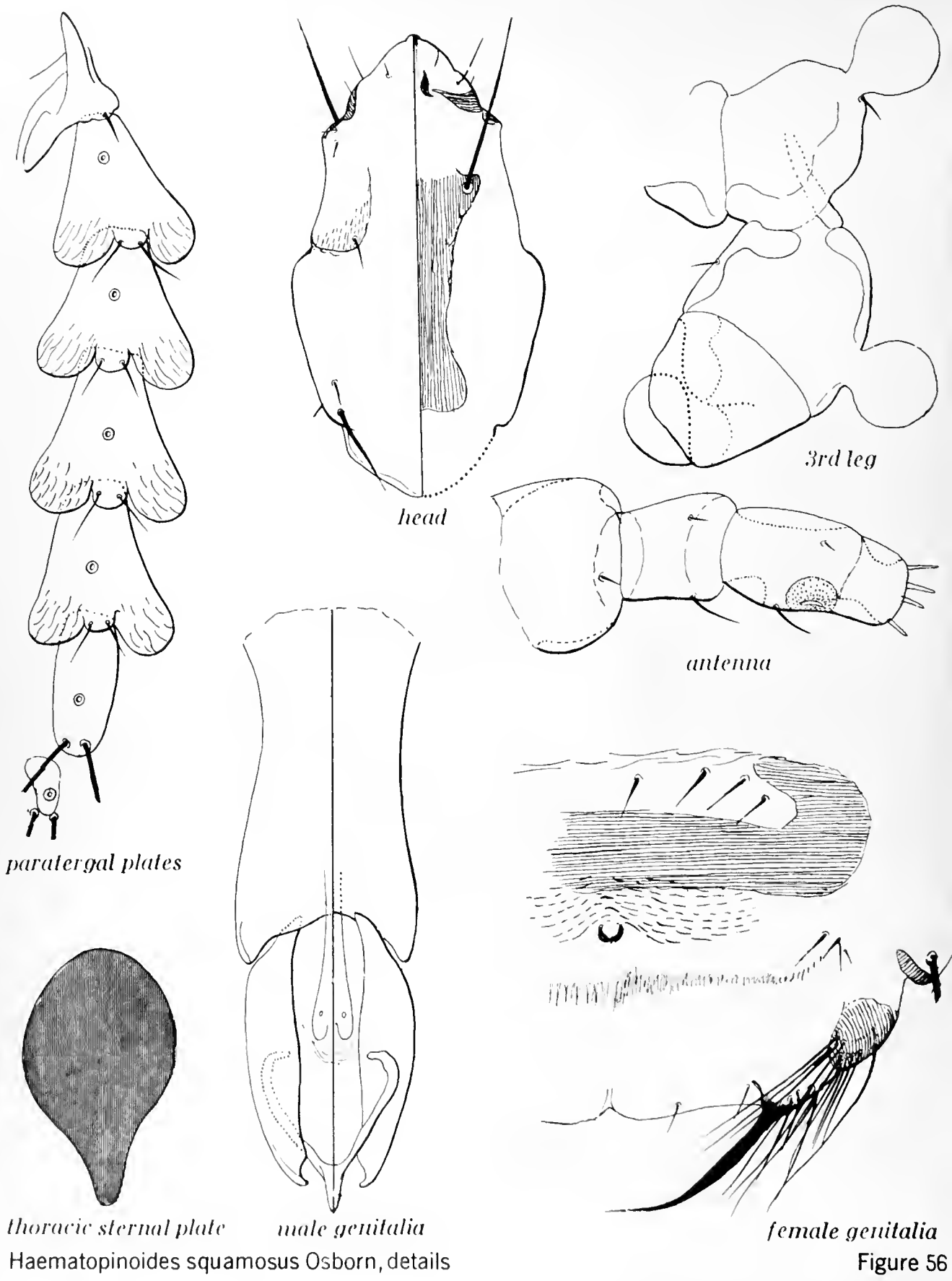
Ancistroplax crocidurae Waterston, details

Figure 54



Haematopinoides squamosus Osborn

Figure 55



paratergal plates

head

3rd leg

antenna

thoracic sternal plate

male genitalia

female genitalia

Haematopinoides squamosus Osborn, details

Figure 56

from another mole, *Parascalops breweri*, from eastern United States.

NOTES. Ewing has recorded finding the types of *Haematopinoides squamosus*, which had presumably been lost, and has confirmed the suspicion, previously expressed by Ferris, to the effect that *Euhaematopinus abnormis* is the same species. Apparently Osborn was misled into naming two genera simply by differences in the nature of the preparations then at hand.

Genus HOPLOPLEURA Enderlein

1904. *Hoplopleura* Enderlein, *Zoologischer Anzeiger* 28:221.
1921. *Hoplopleura*, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 2:59.
1929. *Ctenura* Ewing, *A Manual of External Parasites*, page 199.
1929. *Euhoplopleura* Ewing, *A Manual of External Parasites*, page 198.
1929. *Ctenopleura* Ewing, *A Manual of External Parasites*, page 199.
1929. *Ferrisella* Ewing, *A Manual of External Parasites*, page 199.

GENERIC TYPE. *Pediculus acanthopus* Burmeister.

GENERIC SYNONYMS. *Ctenopleura* Ewing, type *Hoplopleura cryptica* Ferris; *Ctenura* Ewing, type *Hoplopleura pectinata* Cummings; *Euhoplopleura* Ewing, type *Hoplopleura trispinosa* Kellogg and Ferris; *Ferrisella* Ewing, type *Hoplopleura ochotonae* Ferris.

CHARACTERS. Hoplopleurinae in which the sternal plate of abdominal segment two is always, and the first sternal plate is usually, extended laterally to articulate with the corresponding paratergites, these two plates always being narrowly transverse. First sternal plate of segment three usually with two or three enlarged, stout setae in two groups, rarely these not developed. Paratergites of the abdominal segments never showing any indication of a partial longitudinal division into dorsal and ventral parts. Antennae clearly five-segmented. Posterior legs with no bladder-like, membranous expansions. Paratergites of abdominal segment two not produced into a long, blade-like extension.

NOTES. This genus, as here understood, forms a very homogeneous group. In two or three species the first sternal plate of abdominal segment 3 does not attain the paratergal plate of the segment but any attempt to separate these species into a different genus on this basis seems to gain nothing and would result only in the formation of an evidently unnatural grouping.

The four genera named by Ewing and listed above do not, in the opinion here held, merit recognition, but the genus *Pterophthirus*, named by Ewing, is here accepted.

Key to Species of Hoplopleura

1. First sternal plate of abdominal segment 3 extended laterally to approximate or articulate with the corresponding paratergal plates....5
First sternal plate of abdominal segment 3 not extended laterally.....2
- 2 (1). Paratergal plates of abdominal segments 4-6 in the female and of at least segment 4 in the male with a pair of short, stout, apically flattened and truncate setae; known from *Octodontomys* in Bolivia.
.....DISCRETA
- Not so, all setae of the paratergal plates apically acute.....3
- 3 (2). Paratergal plates of abdominal segment 6 with the dorsal apical angle prolonged into a thumb-like process, the ventral angle rounded; known from *Octodon* in Chile.....CHILENSIS
- Otherwise.....4
- 4 (3). Paratergal plates of abdominal segments 4-5 with the posterior margin almost straight, the posterior angles each forming but a slight tooth; known from the squirrel genus *Sciurotamias* in China
.....EMARGINATA

- Paratergal plates of abdominal segments 4-5 with the posterior margin presenting a deep, median emargination between the two broad lateral lobes; known from *Hydromys* in Australia.....BIDENTATA
- 5 (1). Paratergal plates of abdominal segment 8 in both sexes with each posterior angle prolonged into a tapering apically acute lobe..6
Paratergal plates of abdominal segment 8 never with more than one apical lobe or process, usually with none.....7
- 6 (5). Paratergal plates of abdominal segment 2 with each posterior angle prolonged into a tapering, apically acute point; known from undetermined rodent in Brasil.....BRASILIENSIS
Paratergal plates of abdominal segment 2 with the posterior margin truncate, the angles not at all prolonged into points; female with the apex of the abdomen bearing a comb of stout setae; known from *Rattus surifer* in the Malayan region.....PECTINATA
- 7 (5). First sternal plate of abdominal segment 3 with two groups of definitely enlarged setae.....8
First sternal plate of abdominal segment 3 without such pairs of enlarged setae; occurring on *Ochotona* in Asia.....OCHOTONAE
- 8 (7). Enlarged setae of the first sternal plate of abdominal segment 3 arranged in two groups of 3 setae each.....9
Enlarged setae of this plate arranged in two groups of 2 setae each.....11
- 9 (8). Paratergal plates of abdominal segments 3-6 each with the posterior border bearing 4 prominent, almost equal points or processes...10
Paratergal plates of these segments with merely the apical angles prolonged into points; occurring on North American flying squirrels of the genus *Glaucomys*.....TRISPINOSA
- 10 (9). Paratergal plates of abdominal segments 2-6 each borne upon a distinct prominence; tergal and sternal setae of the abdomen extremely numerous and heavy; known from *Tatera liodon* in Africa..
.....CRYPTICA
Paratergal plates of abdominal segments 2-6 not thus borne upon prominences; setae of abdominal tergites and sternites slender and of normal number; known from *Tatera boehmi* in Africa.....VEPRECULA
- 11 (8). Paratergal plates of abdominal segment 8 with 1 apical angle produced into an elongated, apically free process.....12
Paratergal plates of abdominal segment 8 entirely devoid of any apical process or with only a very slight lobe.....14
- 12 (11). Paratergal plates of abdominal segments 3-6 each with the posterior margin divided into 4 slender processes of which the dorsal process is longer than the plate itself; probably normal to *Lemniscomys* in Africa.....PELOMYDIS
Paratergal plates of abdominal segments 3-6, if divided into lobes, having the dorsal lobe no longer than the others.....13
- 13 (12). Paratergal plates of abdominal segment 7 with the posterior margin divided into 2 equal major lobes, each of which is divided into 2 equal minor lobes; known from *Arvicanthis* in Africa.....
.....LATICEPS
Paratergal plates of segment 7 with the posterior margin divided into 2 lobes of which one is apically acute and the other apically truncate or slightly emarginate; known from various hosts in Africa.....INTERMEDIA
- 14 (11). Paratergal plates of abdominal segment 7 with at least one of the apical angles produced into a lobe which is in some instances as long as the body of the plate.....15
Paratergal plates of segment 7 with neither of its apical angles thus produced.....27

- 15 (14). Paratergal plates of abdominal segment 7 with but one of its apical angles produced into a lobe or point.....16
 Paratergal plates of abdominal segment 7 with each of its apical angles produced into a lobe or point.....23
- 16 (15). Paratergal plates of segments 3-5 each with the posterior margin divided into 4 slender lobes or processes which equal at least half the length of the body of the plate.....17
 Paratergal plates of abdominal segments 3-5 with the posterior margin divided into 2 major lobes, each of which may be apically more or less emarginate or deeply divided into 2 minor lobes.....18
- 17 (16). Dorsal apical process of the paratergal plates of abdominal segments 3-7 very long, longer than the body of the plate; known from *Lemniscomys* in Africa.....ENORMIS
 Dorsal apical process on no paratergal plate longer than the body of the plate or longer than the other processes.....NEUMANNI
- 18 (16). Ventral lobe of paratergal plates of abdominal segment 3 divided into 2 apically rounded, equal lobes; from species of *Oryzomys* in the New World.....19
 Ventral lobe of paratergal plates of abdominal segment 3 otherwise.....20
- 19 (18). Ventral lobe of abdominal segment 6 divided into 2 equal lobules; known from *Oryzomys* in southeastern United States....ORYZOMYDIS
 Ventral lobe of abdominal segment 6 forming a single, acute point; known from species of *Oryzomys* in South America...NESORYZOMYDIS
- 20 (18). Ventral lobe of paratergal plates of abdominal segment 3 acute...AFFLINIS
 Ventral lobe of paratergal plates of abdominal segment 3 broadly truncate or apically emarginate.....21
- 21 (20). Ventral lobe of paratergal plates of abdominal segment 6 acute; known from the genus *Apomys* in the Philippine Islands..APOMYDIS
 Ventral lobe of paratergal plates of segment 6 truncate or emarginate.....22
- 22 (21). Ventral lobe of paratergal plates of abdominal segment 6 deeply emarginate; known from *Dasymys yelucus* in Africa.....SOMERENI
 Ventral lobe of paratergal plates of abdominal segment 6 truncate; known from various rodents in South America.....TRAVASSOSI
- 23 (15). Both dorsal and ventral apical lobes of paratergal plates of abdominal segment 7 apically acute.....24
 At least one of the lobes of the paratergal plates of abdominal segment 7 apically acute.....26
- 24 (23). Paratergal plates of abdominal segments 3-6 with the posterior margin divided into 4 nearly equal, apically rounded lobes; occurring on the genera *Nectomys* and *Oryzomys* in South America...QUADRIDENTATA
 Paratergal plates of abdominal segments 3-6 with the posterior margin divided into 2 apically truncate or slightly emarginate lobes.....25
- 25 (24). Paratergal plates of abdominal segments 4-6 with the setae of the posterior margin extremely minute; occurring characteristically on members of the New World genera *Peromyscus* and *Onychomys*, but recorded also from *Mus musculus* in North America and Eurasia.....HESPEROMYDIS
 Paratergal plates of abdominal segments 4-6 with the setae of their posterior margin almost equaling in length the depth of the median emargination in which they are placed; occurring as far as known on the genus *Cricetulus* in China.....CRICETULI

- 26 (23). Dorsal lobe of the paratergal plates of abdominal segment 7 definitely truncate, the ventral lobe acute; from members of the New World genus *Reithrodontomys*.....REITHRODONTOMYDIS
Both dorsal and ventral apical lobes of the paratergites of abdominal segment 7 narrowly rounded apically; known from *Mus triton* in Africa.....RUKENYAE
- 27 (14). Female with 3 rows of setae dorsally and ventrally on most of the abdominal segments.....28
Female with but 2 rows of setae both dorsally and ventrally on most of the abdominal segments; probably normal to species of *Tatera* in Africa.....BISERIATA
- 28 (27). Paratergal plates of abdominal segment 6 with the posterior angles not produced into points.....29
Paratergal plates of abdominal segment 6 with at least one of the posterior angles produced into a definite point or lobe.....30
- 29 (28). Sternal plate of the thorax broadly triangular, occurring on the North American squirrel genus *Tamias*.....ERRATICA
Sternal plate of the thorax narrowly produced posteriorly; known from the Asiatic genus *Phaiomys*.....PHAIOMYDIS
- 30 (28). Both dorsal and ventral basal angles of the paratergal plates of abdominal segments 4-5 with a process which projects toward the mid-line of the body.....31
Basal angles of these paratergal plates without such processes.....32
- 31 (30). Outer seta of the pairs of enlarged setae on the first sternite of abdominal segment 3 longer than the other and distinctly bent; known from the squirrel genus *Callosciurus* in China.....DISTORTA
Outer seta of these pairs not longer than the other and not bent; known from the squirrel genus *Callosciurus* in the Malayan area.....ERISMATA
- 32 (30). Paratergal plates of abdominal segment 6 with 4 almost equal, slender processes on its posterior border; known from *Nydomys cunninghami* in Africa.....MYLOMYDIS
Paratergal plates of abdominal segment 6 without such processes.....33
- 33 (32). Paratergal plates of abdominal segments 4-6 without setae, even of the most minute size.....34
Paratergal plates of abdominal segments 4-6 definitely with setae, even if small, on the posterior margin.....36
- 34 (33). Both dorsal and ventral lobes of the paratergal plates of abdominal segment 3 broadly truncate; occurring on *Micromys* in Europe.....LONGULA
Both dorsal and ventral lobes of the paratergal plates of abdominal segment 3 apically acute.....35
- 35 (34). Dorsal apical lobe of the paratergal plates of abdominal segments 4-5 apically broad and emarginate; known from *Oxymycterus judex* in South America.....FONSECAI
Ventral apical lobe of the paratergal plates of abdominal segments 3-6 acute; from *Oxymycterus* in Peru.....OXYMYCTERI
- 36 (33). Apical lobes of paratergal plates of abdominal segment 6 both acute.....37
Apical lobes of paratergal plates of abdominal segment 6 otherwise.....42
- 37 (36). Apical lobes of the paratergal plates of abdominal segment 3 with the dorsal lobe apically acute, the ventral lobe broad and slightly emarginate; occurring on various members of the subfamily Microtinae of the Muridae in Europe, North America, and certainly Asia.....ACANTHOPUS

- Apical lobes of the paratergal plates of abdominal segment 3 otherwise.....38
- 38 (37). Paratergal plates of abdominal segments 4-5 with a deep, rectangular, median emargination in the posterior border, this dividing the plate into two broad, apical lobes; known from *Reithrodon* in Argentina.....ARGENTINA
- Paratergal plates of abdominal segments 4-5 without such emargination of the posterior border.....39
- 39 (38). With but 1 or occasionally 2 setae between the ends of the tergal and sternal plates of the abdomen and the corresponding paratergal plates; known from the squirrel genus *Funambulus* in Asia.....MANICULATA
- With not less than 2 and usually more setae between the ends of the tergal and sternal plates of the abdomen and the corresponding paratergal plates.....40
- 40 (39). Paratergal plates of abdominal segments 4-6 with the apical angles strongly produced and acute, the posterior border of the plate arcuately and quite deeply emarginate.....41
- Paratergal plates of abdominal segments 4-6 with the margin between the toothed apical angles almost straight, not at all emarginate; occurring on the genus *Sigmodon* in North America....
-HIRSUTA
- 41 (40). Parameres of the male apically notched; occurring on the genus *Neotamias* (better known as *Eutamias*) in North America.....
-ARBORICOLA
- Parameres of the male apically entire; known from the genus *Sciurus* in North America.....SCIURICOLA
- 42 (36). Paratergal plates of abdominal segment 6 with the dorsal apical angle forming a slight tooth, the ventral angle without a tooth; known from *Phyllotis* in South America.....REDUCTA
- Paratergal plates of abdominal segment 6 with both apical angles produced into points or lobes.....43
- 43 (42). Ventral apical lobe of paratergal plates of abdominal segment 6 acute, the dorsal lobe more or less truncate.....44
- Dorsal and ventral apical lobes of paratergal plates of abdominal segment 6 essentially similar, truncate or apically serrate or emarginate.....46
- 44 (43). Paratergal plates of segments 3-5 each with 1 very minute and 1 longer seta on the posterior margin; known from various hosts, including domestic rats, in various parts of the world.....
-OENOMYDIS
- Paratergal plates of abdominal segments 3-5 each with 2 setae which are as long as or longer than the depth of the emargination in which they are placed.....45
- 45 (44). Ventral apical lobe of the paratergal plates of segments 3-5 acutely pointed; known from the genus *Chrotomys* in the Philippine Islands.....CHROTOMYDIS
- Ventral apical lobe of paratergal plates of abdominal segments 3-5 narrowly rounded or truncate apically; known from *Rattus sabanus* in the Malayan area.....MALAYSIANA
- 46 (43). Paratergal plates of abdominal segments 4-6 each with 1 very minute seta and 1 seta which is about as long as the depth of the emargination in which it is placed; known from *Rhipidomys* in South America.....ANGULATA
- Paratergal plates of abdominal segments 4-6 each with 2 setae of nearly equal length, these as long as or longer than the depth of the emargination in which they are placed; known from *Meriones* in China.....MERIONIDIS

Hoplopleura acanthopus (Burmeister)
Figures 57, 58

1839. *Pediculus acanthopus* Burmeister, Genera Insectorum, Rhynchota, Number 5; Plate 1, figure 2.
1842. *Haematopinus acanthopus* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 25; Plate 24, figure 3.
1880. *Haematopinus acanthopus* (Burmeister), Piaget, Les Pediculines, page 638; Plate 52, figure 4.
1904. *Polyplax acanthopus* (Burmeister), Enderlein, Zoologischer Anzeiger 28:142.
1904. *Hoplopleura acanthopus* (Burmeister), Enderlein, Zoologischer Anzeiger 28:221; figures 1, 2.
1915. *Hoplopleura acanthopus*, variety *americanus* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 16; text figure 3; Plate 4, figure 2; Plate 5, figure 8.
1916. *Hoplopleura acanthopus*, variety *aequidentis* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:26; figure 21b.
1921. *Hoplopleura acanthopus* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:63; figures 34, 35.

HOSTS AND DISTRIBUTION. First described from *Microtus* (as *Arvicola*) *arvalis*, somewhere in Europe. It has since been recorded from *Microtus agrestis* and *Microtus nivalis* in Europe; from *Microtus constrictus*, *Microtus californicus*, *Microtus intermedius*, and *Microtus ochrogaster* in various parts of the United States; from *Lemmus alaskensis* in Alaska; from *Synaptomys borealis* at Athabasca Landing in Canada; from *Pitymys pinetorum* in eastern United States. It has also been recorded from *Mus musculus* in Rumania and *Mus spicilegus* in Sweden, these records very probably being due to contamination or straggling.

NOTES. An examination of the abundant material at hand offers no excuse for the naming of the supposed variety *americanus*. Furthermore, on the basis of such evidence as was given by its describer there is no apparent reason for the supposed variety *aequidentis*.

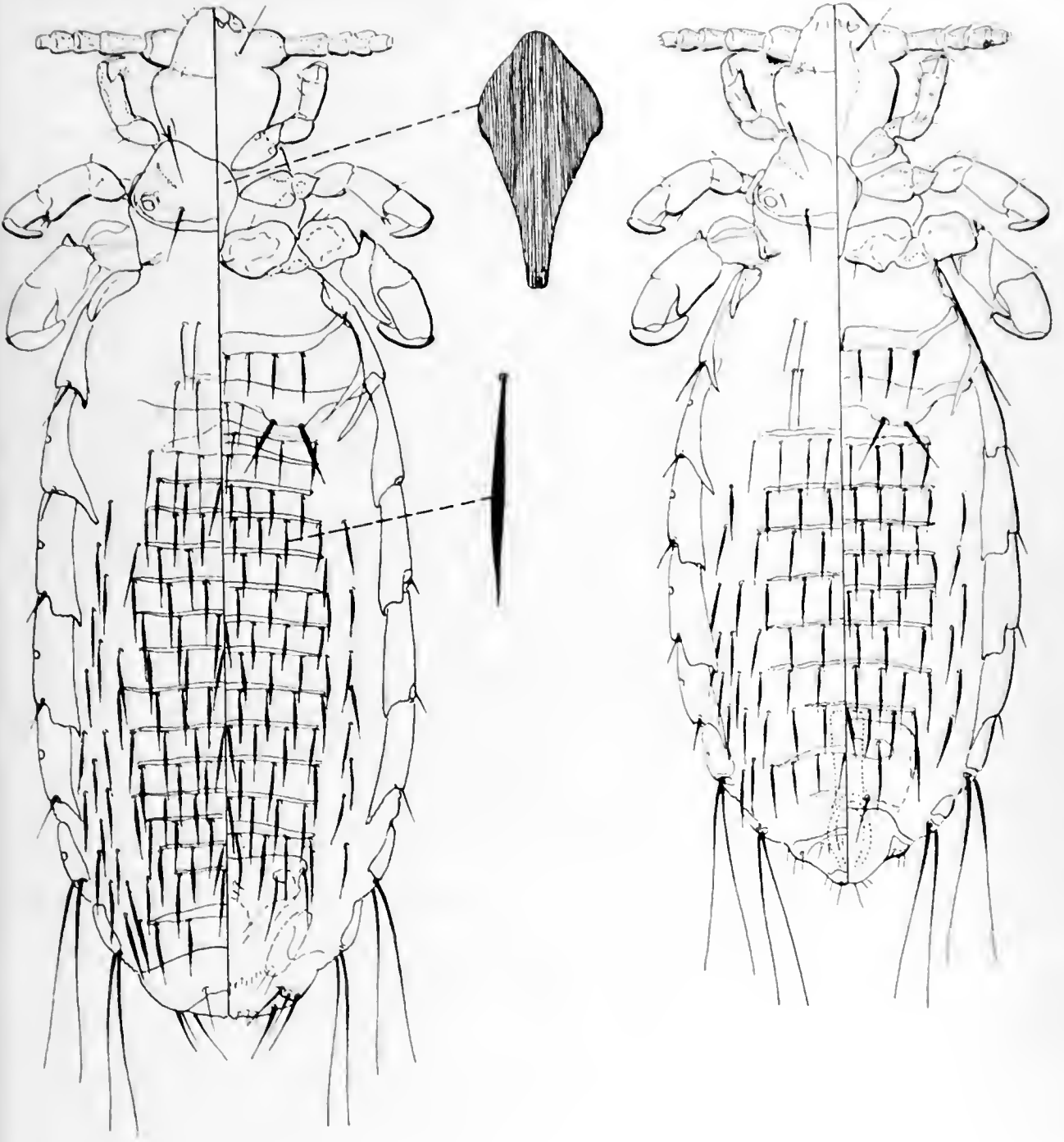
Hoplopleura affinis (Burmeister)

1839. *Pediculus affinis* Burmeister, Genera Insectorum, Rhynchota, No. 10.
1842. *Haematopinus affinis* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 36.
1904. *Polyplax affinis* (Burmeister), Enderlein, Zoologischer Anzeiger 28:142.
1921. *Hoplopleura affinis* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:75; figures 42, 43.

HOSTS AND DISTRIBUTION. First recorded from *Apodemus agrarius* and *Apodemus sylvaticus* in Europe. Later recorded by Ferris from both these hosts, from *agrarius* in Germany and from *sylvaticus* in Manchuria and Siberia. In addition, Ferris has recorded the species from a number of South American mammals, including *Akodon mollis* in Peru; *Akodon arviculoides* in Paraguay; *Akodon amnicola* in Argentina; *Phyllotis pictus* (as *Euneomys* sp.) in Peru; *Phyllotis micropus* in Argentina. Certain other records by Ferris from South American mammals are here transferred to other species as will be noted below.

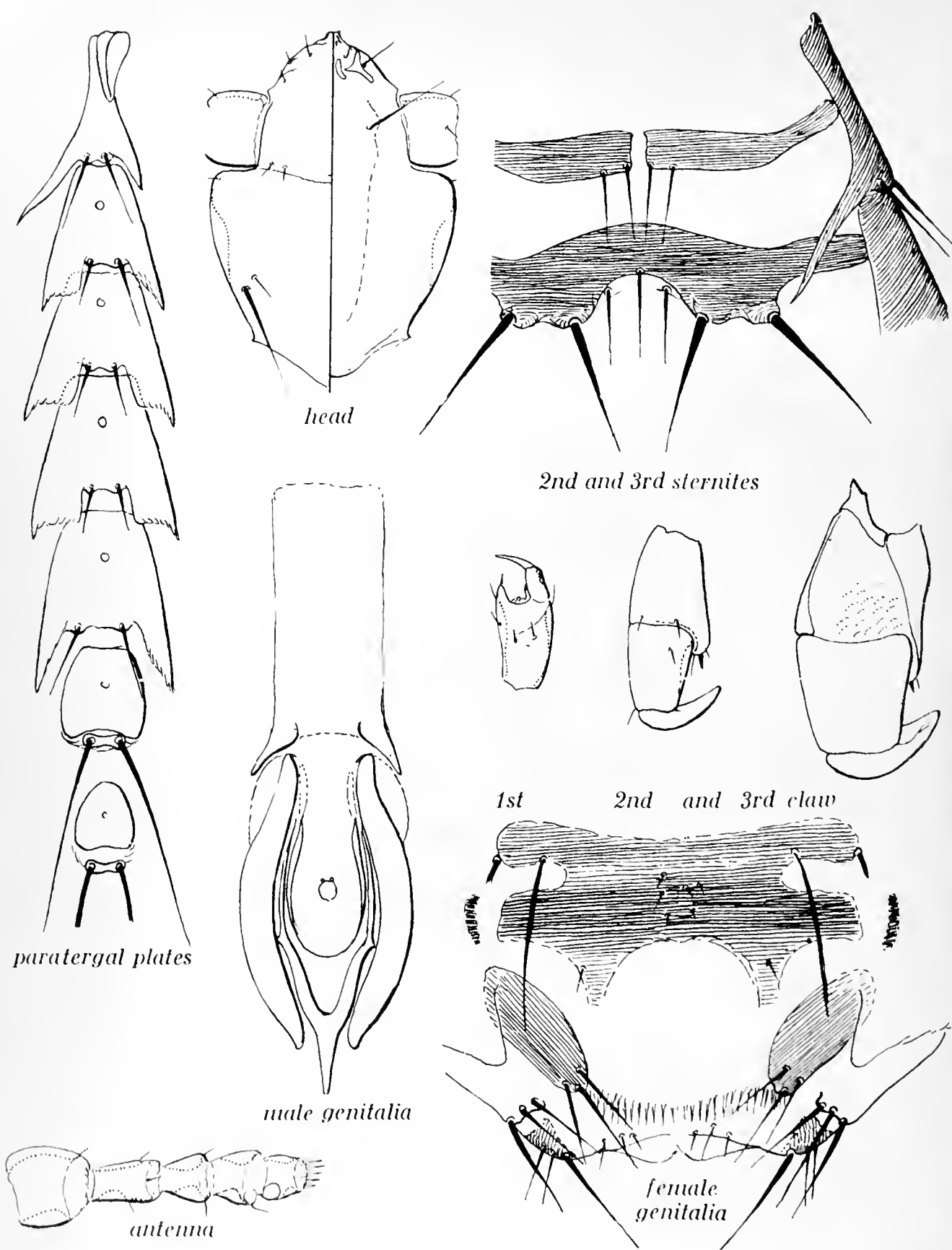
NOTES. Specimens from *Cricetulus incanus* from China, previously referred to *affinis* are here described as *Hoplopleura cricetuli* new species, and specimens from *Reithrodon hatcheri* from Patagonia, are referred to *Hoplopleura argentina* Werneck.

The records of *affinis* from other South American hosts appear to be ut-



Hoplopleura acanthopus (Burmeister)

Figure 57



Hoplopleura acanthopus (Burmeister), details

Figure 58

terly unreasonable, but a re-examination of the material at hand offers no basis for their separation. It would seem very probable that biologically more than one species is involved, but nothing morphological appears that will justify a separation.

Hoplopleura angulata Ferris

1921. *Hoplopleura angulata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:73; figures 40, 41.

HOSTS AND DISTRIBUTION. Type from *Rhipidomys venezuelae*, somewhere in Venezuela. Also recorded by Ferris from *Rhipidomys* sp. (ascertained by Hopkins to be *Rhipidomys leucodactylus*), from the Rio San Miguel, Peru; from *Rhipidomys venustus*, Merida, Venezuela; and from *Thomasomys cinereus*, Balsas, Peru.

Hoplopleura apomydis Ferris

1921. *Hoplopleura apomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:84; figures 49, 50.

HOSTS AND DISTRIBUTION. Described as from *Apomys bardus*, which is *Apomys insignis*, from Malingdang Peak, Mindanao, Philippine Islands.

Hoplopleura arboricola Kellogg and Ferris

1915. *Hoplopleura arboricola* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 19; text figures 6, 7; Plate 4, figure 8. (Part)

1921. *Hoplopleura erratica arboricola* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:109.

HOSTS AND DISTRIBUTION. This species occurs on members of the genus *Neotamias*, which has usually been referred to in North American literature as *Eutamias*, under which generic name the host records have in the past been placed. Type from *Neotamias hindsi*, Inverness, Marin County, California. Recorded from various other species of this genus in California.

Hoplopleura argentina Werneck

1921. *Hoplopleura affinis* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:75. (Part; misidentification)

1837. *Hoplopleura affinis argentina* Werneck, Memorias do Instituto Oswaldo Cruz 32:404.

HOSTS AND DISTRIBUTION. Type from *Reithrodon* sp. from the Republic of Argentina. Specimens recorded by Ferris from *Reithrodon hatcheri* from Cordilleras, Patagonia, as *Hoplopleura affinis*, seem definitely to be this.

NOTES. The differences between this form and *Hoplopleura affinis* are very slight, as indicated in the key to species, but in accord with the practice here adopted of not recognizing any form below the species, it is here regarded as a species.

Hoplopleura bidentata (Neumann)

1909. *Haematopinus (Polyplax) bidentata* Neumann, Archives de Parasitologie 13:515; figure 18.

1916. *Hoplopleura bidentata* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:129; figures 86, 87.

HOSTS AND DISTRIBUTION. Originally described as from *Rattus rattus* at Lake Torrens, Australia, this undoubtedly an error in host attribution. It

has since been recorded from what seems undoubtedly to be its normal host, *Hydromys chryso-gaster*, from Sydney and an undetermined locality in New South Wales, Australia.

Hoplopleura biseriata Ferris

1921. *Hoplopleura biseriata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:103; figure 64A.

1949. *Hoplopleura biseriata* Ferris, Hopkins, Proceedings of the Zoological Society of London 119:477.

HOSTS AND DISTRIBUTION. Originally described as from *Malacothrix typicus* at Bothaville, Orange Free State, Africa. Hopkins has pointed out that this record was undoubtedly due to contamination and has recorded the species from *Tatera brantsi*, *Tatera lobengulæ*, *Tatera joanae*, and *Tatera angolæ* from unspecified localities in Africa.

Hoplopleura brasiliensis Werneck

1932. *Hoplopleura brasiliensis* Werneck, Comptes rendus de séances de la Société de Biologie de Rio de Janeiro 119:754; figure.

1932. *Hoplopleura brasiliensis* Werneck, Werneck, Memórias do Instituto Oswaldo Cruz 26:235; Plate 45.

HOSTS AND DISTRIBUTION. From an undetermined rodent from the state of Goyaz, Brasil.

Hoplopleura chilensis Werneck

1937. *Hoplopleura disgrega*, variety *chilensis* Werneck, Memórias do Instituto Oswaldo Cruz 32:406; figures 15, 16.

HOSTS AND DISTRIBUTION. From *Octodon degus* from Chile, without closer indication of locality.

NOTES. On the basis of the very clear illustrations given by Werneck this appears certainly to be a distinct species and not merely a "variety" of *disgrega*.

Hoplopleura chrotomydis Ferris

1921. *Hoplopleura chrotomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:81; figure 46.

HOSTS AND DISTRIBUTION. Known only from the original record from a skin of *Chrotomys whiteheadi* at Irisan, Benguet, Benguet, Philippine Islands.

Hoplopleura cricetuli Ferris, new species

1921. *Hoplopleura affinis* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:75. (Misidentification)

HOSTS AND DISTRIBUTION. Several specimens, both male and female, from *Cricetulus incanus*, Shensi, China; from skin number 172,550 in the United States National Museum.

CHARACTERS. In all respects practically identical with *Hoplopleura affinis*, as that species is described by Ferris (1921), differing significantly only in the form of the paratergites of abdominal segment seven. In *affinis* the paratergites of this segment have the dorsal, posterior angle produced into an elongated point which is free from the body for most of its length and the posterior margin of the plate is straight or but slightly emarginate. In *cricetuli*, the dorsal lobe—while of the same shape as in *affinis*—is free from the body only at its apex and the posterior margin of the plate is deeply emarginate, this emargination forming a ventral lobe

which is only slightly shorter than the dorsal lobe but is not free from the body.

Holotype and paratypes deposited in the collections of Stanford University. Paratypes deposited in the United States National Museum.

NOTES. Complete illustrations and an extended description of this species will be presented elsewhere. Enough is presented in the above description and in the accompanying key to permit the identification of the species.

Hoplopleura cryptica Ferris

1921. *Hoplopleura cryptica* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:104; figures 65, 66B, D, E, G.

1929. *Ctenura cryptica* (Ferris), Ewing, A Manual of External Parasites, page 199.

HOSTS AND DISTRIBUTION. From *Tatera liodon* at Kikindu, Uganda.

Hoplopleura disgrega Ferris

1921. *Hoplopleura disgrega* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:132; figures 88, 89.

HOSTS AND DISTRIBUTION. From *Octodontomys simonsi*, which is placed by Hopkins as *Octodontomys gliroides*, at Orura, Bolivia.

Hoplopleura distorta Ferris

1921. *Hoplopleura distorta* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:115; figures 72C, H.

HOSTS AND DISTRIBUTION. Recorded as from *Rhinosciurus* sp. Hopkins, who has investigated the matter, states that the host is actually *Callosciurus vestitus*.

Hoplopleura edentulus Fahrenholz

1916. *Hoplopleura acanthopus*, variety *edentulus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:26; figure 21c.

HOSTS AND DISTRIBUTION. Described as from *Evotomys rutilus* "aus Siebenburgen, Kronstadt." From the description and the accompanying figure it seems probable that this is nothing more than a slight variant of *Hoplopleura acanthopus*.

Hoplopleura emarginata Ferris

1922. *Hoplopleura emarginata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:130; figures 90, 91.

HOSTS AND DISTRIBUTION. Described as from *Sciurotamias davidianus*, a skin from Shensi, China.

NOTES. This is a peculiar form which in some respects more closely resembles members of the genus *Neohaematopinus* than it does *Hoplopleura*. It is retained in *Hoplopleura* because of the character of the sternal plate of the second abdominal segment. Future authors may possibly wish either to remove it to *Neohaematopinus* or to name a new genus for it.

Hoplopleura enormis Kellogg and Ferris

1915. *Hoplopleura enormis* Kellogg and Ferris, Annals of the Durban Museum 1:155; Plate 16, figures 4, 4c.

1921. *Hoplopleura enormis enormis* Kellogg and Ferris, Ferris, Contribu-

tions Toward a Monograph of the Sucking Lice, Part 2:94; figures 57, 58B, C, 59B.

HOSTS AND DISTRIBUTION. Described as from *Arvicanthis dorsalis* from Mfongosi, Zululand, for which the name *Lemniscomys griseldais* is now employed. Later recorded by Ferris from *Lemniscomys barbarus* from Gondokoro, Africa.

NOTES. The supposed subspecies of *enormis* named by Ferris are here regarded as species.

Hoplopleura erismata Ferris

1921. *Hoplopleura erismata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:113; figures 72B, E, F.

HOSTS AND DISTRIBUTION. From *Sciurus ferrugineus* from Southeast Siam. This host belongs to the genus *Callosciurus*. Recorded also from *Callosciurus caniceps* (as *Sciurus davisoni*) from Lower Siam and from *Callosciurus maclellandi* (as *Tamiops* sp.) from Tenasserim.

Hoplopleura erratica (Osborn)

1896. *Haematopinus erraticus* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (new series) 5:186.

1921. *Hoplopleura erratica erratica* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:106; figures 67, 68.

HOSTS AND DISTRIBUTION. Type recorded as taken from a gull in Iowa, but this very evidently in error. The host is clearly *Tamias striatus*, from which the species has been recorded by Ferris from Indiana, Tennessee, New York, and the District of Columbia; all in the United States.

NOTES. The supposed subspecies recognized by Ferris are here considered to be species.

Hoplopleura fonsecai Werneck

1934. *Hoplopleura fonsecai* Werneck, Memorias do Instituto Oswaldo Cruz 27: 412; figures 7-12.

HOSTS AND DISTRIBUTION. Type from *Oxymycterus judex* at Humboldt, state of Santa Catharina, Brasil.

Hoplopleura hesperomydis (Osborn)

1891. *Haematopinus hesperomydis* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:26; figure 14.

1915. *Hoplopleura hesperomydis* (Osborn), Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 17; text figures 4, 5; Plate 1, figure 3; Plate 4, figure 2. (The name *Hoplopleura hesperomydis occidentalis*, appearing in the legend of Plate 4, figure 2, is due to an error.)

1921. *Hoplopleura hesperomydis* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:70; figures 38, 39.

HOSTS AND DISTRIBUTION. Originally described as from *Peromyscus* (= *Hesperomys*) *leucopus* at Ames, Iowa. Recorded by Kellogg and Ferris and by Ferris from *Peromyscus boyleti* and *Peromyscus maniculatus* in California. Recorded by Ferris from *Onychomys torridus* in California and *Onychomys leucogaster* in Colorado. All these localities are in the United States. Recorded by Ferris from *Oryzomys fulvescens* at Orizaba, Mexico; from *Oryzomys chaparensis* at Santos, Bolivia; and from *Eligmodontia collisae* (which Hopkins has determined to be *Hesperomys callosus*) at Goya, Argentina.

Ferris has also recorded it from *Mus musculus* in Virginia, U. S. A., and Russian Turkestan; from *Mus gansus*, which is apparently a synonym of *Mus musculus*, from China; from *Mus wagneri*, which is also a synonym of *Mus musculus*, from China.

NOTES. The material recorded above has been examined in connection with this work and still appears to be *Hoplopleura hesperomydis*. The normal hosts of this species seem quite definitely to be species of *Peromyscus* and the closely related genus *Onychomys*. Some of the other records may be due to contamination. The occurrence of the species on *Mus musculus* in the United States may possibly be due to an actual transfer from the normal hosts, but its occurrence on this host in Asia is very strange.

Certain specimens from hosts of the genus *Reithrodontomys*, which have previously been referred to *hesperomydis*, are here transferred to a new species, *Hoplopleura reithrodontomydis*.

Hoplopleura hirsuta Ferris

1916. *Hoplopleura hirsuta* Ferris, Psyche 23:112; figures 8, 9A, 10, 11B.
1921. *Hoplopleura hirsuta* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:117; figures 75, 76.

HOSTS AND DISTRIBUTION. Type from *Sigmodon hispidus*, Raleigh, North Carolina. There are various records from this host throughout southern United States, as far west as Yuma, Arizona. Ferris has recorded it from *Sigmodon ocoznathus* from the state of Chihuahua, and from *Sigmodon peruanus* from Peru. Two records by Ferris, each of a single specimen, from skins of *Rhipidomys venustus* in Venezuela and *Xenomys nelsoni* in Mexico, are most probably due to contamination.

Hoplopleura hispida (Grube)

1851. *Pediculus hispidus* Grube, In Middendorff's Reise, Parasiten, page 497; Plate 2, figure 2.
1921. *Hoplopleura hispida* (Grube), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:67.

HOSTS AND DISTRIBUTION. Recorded as from *Lemmus obensis* "am Taimyrsee," in Siberia.

NOTES. On the basis of the illustration accompanying the original description this species seems to be a *Hoplopleura* and should be identifiable if taken from the type host.

Hoplopleura intermedia Kellogg and Ferris

1915. *Hoplopleura intermedia* Kellogg and Ferris, Annals of the Durban Museum 1:153; Plate 16, figures 5, 5a-d.
1921. *Hoplopleura intermedia* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:90; figures 54, 55B, C, 56B.

HOSTS AND DISTRIBUTION. Type from *Rattus coucha*, Mfongosi, Zululand, South Africa. Also recorded from *Rattus tullbergi* and *Rattus* (as *Zelotomys*) *hildegardae*, British East Africa and from *Dendromus insignis* from British East Africa, this last record probably due to contamination.

Hoplopleura laticeps Ferris

1921. *Hoplopleura laticeps* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:92; figures 55A, 56A.

HOSTS AND DISTRIBUTION. Known only from the original record from *Hybomys* (as *Arvicanthis*) *univittatus* from Benito River, West Africa.

Hoplopleura longula (Neumann)

1909. *Haematopinus (Polyplax) longula* Neumann, Archives de Parasitologie 13:513; figures 15, 17.
1910. *Hoplopleura lineata* Fahrenholz, Zoologischer Anzeiger 35:715.
1921. *Hoplopleura longula* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:68; figures 36, 37.

HOSTS AND DISTRIBUTION. Described by Neumann from *Micromys minutus* at Colchester, Essex, England, and by Fahrenholz from the same host, presumably from Germany.

Hoplopleura maniculata (Neumann)

1909. *Haematopinus (Polyplax) maniculatus* Neumann, Archives de Parasitologie 13:521; figures 21, 22.
1921. *Hoplopleura maniculata* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:112; figures 71, 72A, D, G.

HOSTS AND DISTRIBUTION. Described from *Funambulus* (as *Sciurus*) *palmarum*, Rajkote, Rajkote, India, and at the same time erroneously attributed to a bat. Later recorded by Ferris from the type host from Navapour, India, and from Ceylon.

Hoplopleura malaysiana Ferris

1921. *Hoplopleura malaysiana* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:79; figures 44, 45.

HOSTS AND DISTRIBUTION. Recorded as from *Rattus vociferans lancavenis*, which is apparently *Rattus sabanus*, from Lankavi Island, Malay Straits.

Hoplopleura merionidis Ferris

1921. *Hoplopleura merionidis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:98; figure 60.

HOSTS AND DISTRIBUTION. Recorded from *Meriones psammophilus* from Shansi, China, this apparently being identical with *Mertones meridianus*.

Hoplopleura mylomydis Ferris

1921. *Hoplopleura enormis mylomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:97; figure 59C.

HOSTS AND DISTRIBUTION. Known only from the original description from *Mylomys roosevelti*, which is apparently a synonym of *Mylomys cunninghami*, British East Africa.

Hoplopleura nesoryzomydis Ferris

1921. *Hoplopleura nesoryzomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:90; figure 53A.

HOSTS AND DISTRIBUTION. Recorded as from *Nesoryzomys narboroughi* and *Nesoryzomys defessus* in the Galapagos Islands. According to Ellender, *Nesoryzomys* is merely a subgenus of *Oryzomys* and evidently *defessus* is an error for *indefessus*.

Hoplopleura neumanni Fahrenholz

1901. *Haematopinus praectus* Neumann, Archives de Parasitologie 5:600. (In part: error for *praectus*)
1902. *Haematopinus praectus* Neumann, Archives de Parasitologie 6:144. (In part)

1919. *Hoplopleura neumanni* Fahrenholz, Jahresbericht des niedersächsischen Zoologischen Vereins zu Hannover 2-4:26.

1921. *Hoplopleura neumanni* Fahrenholz, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:101; figure 63.

HOSTS AND DISTRIBUTION. Based upon specimens recorded merely as "gros rats," from Abyssinia. Ferris has recorded the species from *Tatera nigricauda* from British East Africa. Hopkins has noted that this species occurs in Abyssinia and it is probable that it was the type host.

Hoplopleura ochotonae Ferris

1922. *Hoplopleura ochotonae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:142; figure 92.

HOSTS AND DISTRIBUTION. Described as from *Ochotona cansus*, which is a synonym of *Ochotona thibetana*, from Taochao, China. Recorded also from *Ochotona danurica*, Tabool, Mongolia, and from *Ochotona roylei* without indication of locality.

Hoplopleura oenomydis Ferris Figures 59, 60

1921. *Hoplopleura oenomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:82; figures 47, 48.

1924. *Hoplopleura pacifica* Ewing, Bishop Museum Bulletin 14:9; figure 1b, e.

1932. *Hoplopleura oenomydis* Ferris, Ferris, Bishop Museum Bulletin 98:121; figures 37a-i, 38a-k, 39.

1947. *Hoplopleura oenomydis* Ferris, Pritchard, The Journal of Parasitology 35:374.

HOSTS AND DISTRIBUTION. Type from *Oenomys hypoxanthus* at Molo, British East Africa. Also recorded from *Dasymys incomtus* and *Grammomys* (as *Thamnomys*) *surdaster* from British East Africa; from *Rattus exulans* (as *calcis*) and *Rattus mearnsi* from the Philippine Islands. Described by Ewing as *Hoplopleura pacifica* from *Rattus exulans* (as *hawaiiensis*) from the Hawaiian Islands, and recorded from this same host from the Marquesas Islands. It has recently been shown to be the most common louse on *Rattus norvegicus* in southeastern United States.

NOTES. Hopkins has recently expressed doubt concerning the synonymy indicated above, considering it to be "extremely improbable" that all the published records can refer to *Hoplopleura oenomydis*. A re-examination of all the available material reveals no reason for altering the opinions previously expressed by Ferris in regard to the matter, whatever the "improbabilities" may be.

Hoplopleura oryzomydis Pratt and Lane

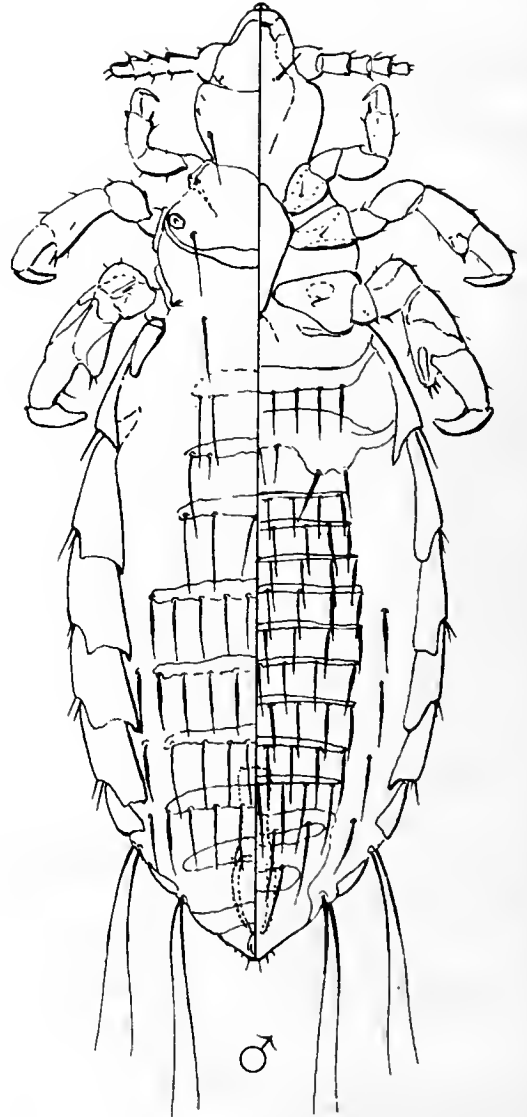
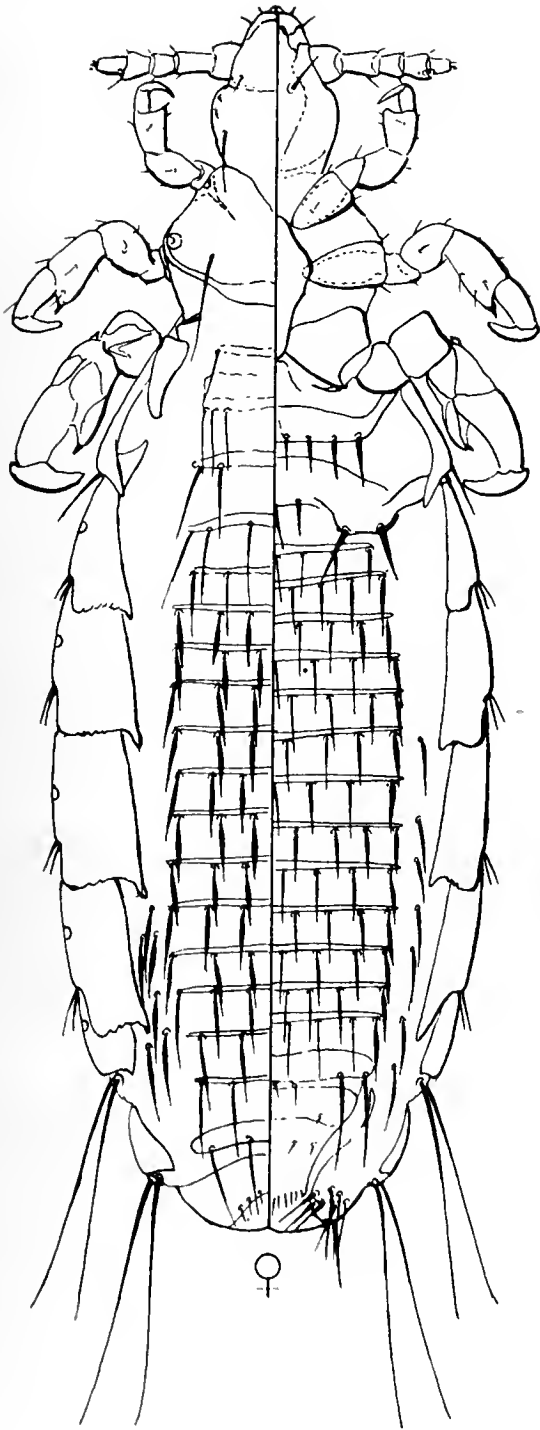
1951. *Hoplopleura oryzomydis* Pratt and Lane, Journal of Parasitology 37:141; figures 1-3, 5.

HOSTS AND DISTRIBUTION. Type from *Oryzomys palustris*, Oatland Island, Chatham County, Georgia, and other specimens from the same host species in Delaware, South Carolina, and Florida, United States.

Hoplopleura oxymycteri Ferris

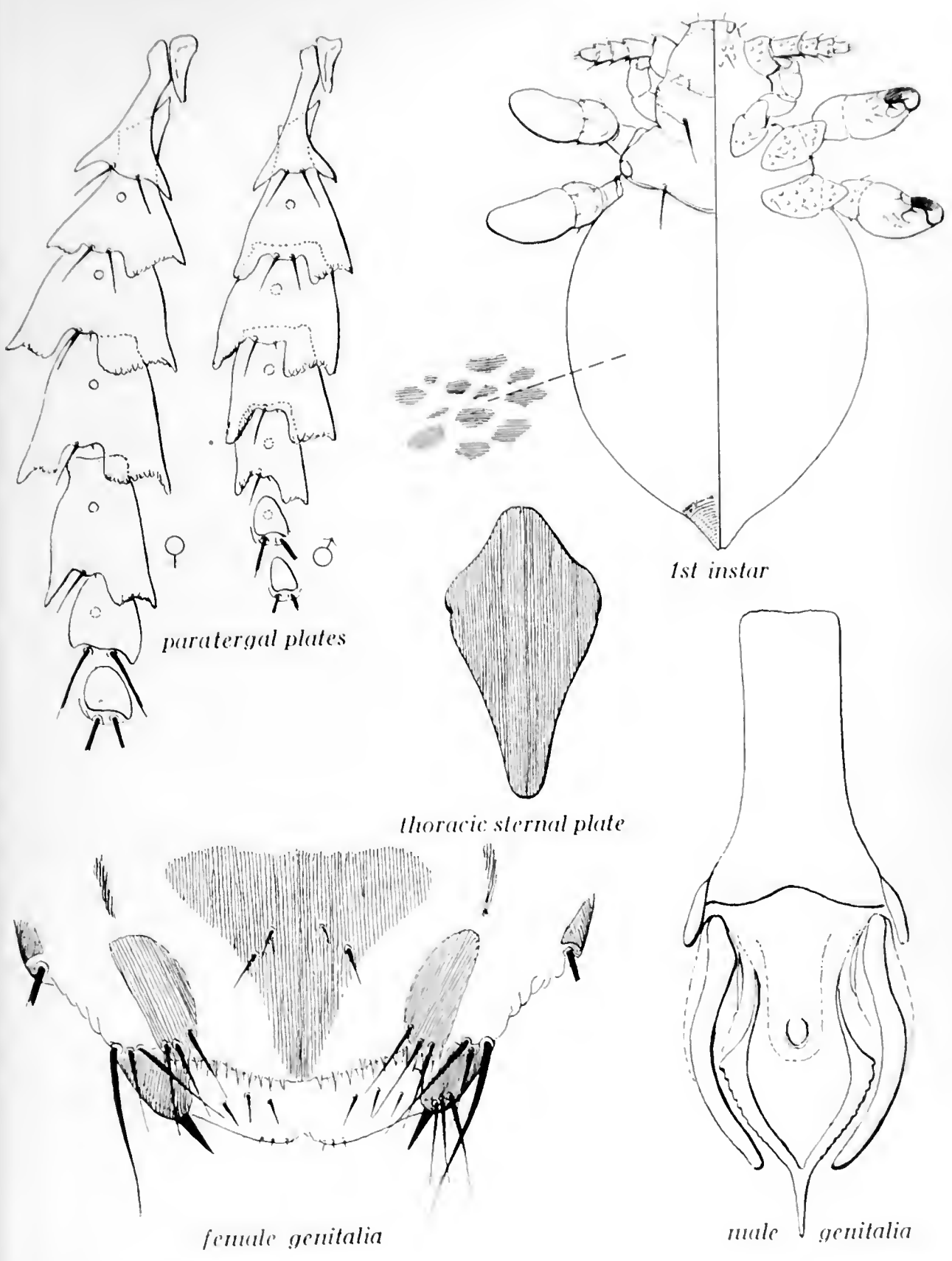
1921. *Hoplopleura oxymycteri* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:122; figures 79, 80.

HOSTS AND DISTRIBUTION. From *Oxymycterus paramensis* at Occabamba Pass, Peru.



Hoplopleura oenomydis Ferris

Figure 59



Hoplopleura oenomydis Ferris, details

Figure 60

Hoplopleura pectinata Cummings

1913. *Hoplopleura pectinata* Cummings, Bulletin of Entomological Research 4:35.
1921. *Hoplopleura pectinata* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:99; figures 61, 62.
1929. *Ctenura pectinata* (Cummings), Ewing, A Manual of External Parasites, page 199.
1932. *Hoplopleura pectinata* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:282.

HOSTS AND DISTRIBUTION. Described from *Rattus* (as *Epimys*) *surifer* at Biserat, Jalor, Malay Peninsula, and later recorded from the same host from Trong, lower Siam.

NOTES. This species has been designated as type of the genus *Ctenura*, a genus which is here rejected.

Hoplopleura pelomydis Ferris

1921. *Hoplopleura enormis pelomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:96; figures 58A, 59A.

HOSTS AND DISTRIBUTION. Described as from *Pelomys fallax*, Summit Sagalla, British East Africa. Also recorded from *Lemniscomys striatus* (in part as *pulchellus*) from the Cameroons and from British East Africa. It is probable that the species of *Lemniscomys* are the true hosts.

Hoplopleura phaiomydis Ferris

1921. *Hoplopleura phaiomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:120; figures 77, 78.

HOSTS AND DISTRIBUTION. Recorded as from an undetermined species of *Phaiomys* from East Ladak, Kashmir. Hopkins has ascertained that the host species was *Phaiomys blythi*, which Ellender considers to be a synonym of *Phaiomys leucurus*.

Hoplopleura quadridentata (Neumann)

1909. *Haematopinus (Polyplax) quadridentatus* (Neumann), Archives de Parasitologie 13:5:3-15; figures 13-14.
1921. *Hoplopleura quadridentata* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:87; figures 52, 53B, C, E.

HOSTS AND DISTRIBUTION. Recorded by Neumann from *Holochilus squamipes*, which apparently is *Nectomys squamipes*, from Haut Peru. Later recorded by Ferris from this same host at Sapucay, Paraguay, and from *Nectomys palmipes*, which is perhaps the same as *squamipes*, from the island of Trinidad; from *Orizomys fulvescens* from Orizaba, Mexico; and from *Oryzomys rostratus* from Alta Mira, Tamaulipas, Mexico.

Hoplopleura reducta Ferris

1921. *Hoplopleura reducta* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:124; figure 81.
1935. *Hoplopleura reducta* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:615.

HOSTS AND DISTRIBUTION. Described as from *Phyllotis micropus* from Todos Santos, Guatemala. Later recorded from an undetermined host from unspecified locality in South America.

Hoplopleura reithrodontomydis Ferris, new species

HOSTS AND DISTRIBUTION. Type from a female *Reithrodontomys dorsalis*, Todos Santos, Guatemala, U.S.N.M. skin number 76917. Paratypes from *Reithrodontomys australis*, Volcan de Irazu, Costa Rica, U.S.N.M. skin number 116623, and *Reithrodontomys chrysopsis*, Ajusco, near Mexico City, Mexico.

CHARACTERS. Female in all respects identical with *Hoplopleura hesperomydis*, except for the shape of the paratergites of abdominal segment seven, which in *hesperomydis* have both dorsal and ventral lobes definitely acute apically, while in *reithrodontomydis* the dorsal lobe is broad and apically truncate or slightly emarginate. All of the rather numerous specimens at hand from the three host species and three localities agree very closely. An extended description and illustrations of the species will be presented elsewhere.

Hoplopleura rukenyae Ferris

1921. *Hoplopleura sukenyae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:86; figure 51. (Misspelling)

HOSTS AND DISTRIBUTION. Known from a single male from *Mus triton*, Mount Rukenya, British East Africa.

NOTES. Mr. G. H. E. Hopkins has called attention to the fact that the type locality of this species is more commonly, and perhaps more correctly, spelled Rukenya rather than Sukenya. It is probable that an error in reading a label was committed and under these circumstances it seems justifiable to change the spelling of the specific name to *rukenyae*.

Hoplopleura sciuricola Ferris

1921. *Hoplopleura sciuricola* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:110; figures 69, 70.

HOSTS AND DISTRIBUTION. Type from *Sciurus carolinensis* at Bayou St. Louis, Mississippi. Also recorded from other species of *Sciurus* as follows: *hudsonicus* in Alaska, *douglasi* in California, *ignitus* in Peru, *nesaeus* in Venezuela, *variabilis* in Colombia, and undetermined species in Bolivia and Peru.

Hoplopleura somereni Waterston

1923. *Hoplopleura somereni* Waterston, Bulletin of Entomological Research 14:99; figure 1b, c, d; figure 2c, d.

HOSTS AND DISTRIBUTION. From *Dasymys helukus* at Wamia, Okedi Camp, Kenya.

Hoplopleura travassosi Werneck

1932. *Hoplopleura travassosi* Werneck, Revista Medico-Cirurgica do Brasil, anno 40:345; figure.

1934. *Hoplopleura travassosi* Werneck, Memorias do Instituto Oswaldo Cruz 27:409; figures 1-6.

HOSTS AND DISTRIBUTION. Type from *Orizomys flavescens* at Angra dos Reis, state of Rio de Janeiro, Brasil. Also recorded from *Kannabateomys amblyonyx* and *Oxymycterus judex* at the same locality.

Hoplopleura trispinosa Kellogg and Ferris

1915. *Hoplopleura trispinosa* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications. University Series (no volume number), page 22; text figure 8; Plate 4, figure 3.

1921. *Hoplopleura trispinosa* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:115; figures 73, 74.
 1929. *Euhoplopleura trispinosa* (Kellogg and Ferris), Ewing, A Manual of External Parasites, pages 135, 199.

HOSTS AND DISTRIBUTION. Type from *Glaucomys sabrinus*, Brownsville, Oregon. Also recorded from the same host at Yosemite National Park, California, and from *Glaucomys volans* from Maryland.

NOTES. This species has been designated as type of the genus *Euhoplopleura*, which is here rejected.

Hoplopleura veprecula Ferris

1921. *Hoplopleura veprecula* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:105; figures 64B, 66A, C, F.

HOSTS AND DISTRIBUTION. From *Tatera boehmi* at South Guaso Nyiro, British East Africa.

Genus PTEROPHTHIRUS Ewing

1923. *Pterophthirus* Ewing, Journal of the Washington Academy of Sciences 13:147.

1932. *Pterophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:280.

GENERIC TYPE. *Hoplopleura alata* Ferris. Three other species are here referred to the genus.

CHARACTERS. Hoplopleurinae with five-segmented antennae. Paratergal plates of abdominal segment two produced into a long, tapering, blade-like process which projects from the body. First sternal plate of abdominal segment three not produced laterally to articulate with the corresponding paratergal plates. Otherwise essentially as in *Hoplopleura*.

NOTES. This genus is very close to *Hoplopleura*, differing from the latter only in the form of the paratergal plates of abdominal segment two. Even here it appears from the illustrations presented in connection with the description of *Pterophthirus imitans* Werneck that this species is somewhat of an intermediate between the two genera. As known at present the genus is confined to South American rodents.

The four known species may be separated by the following key.

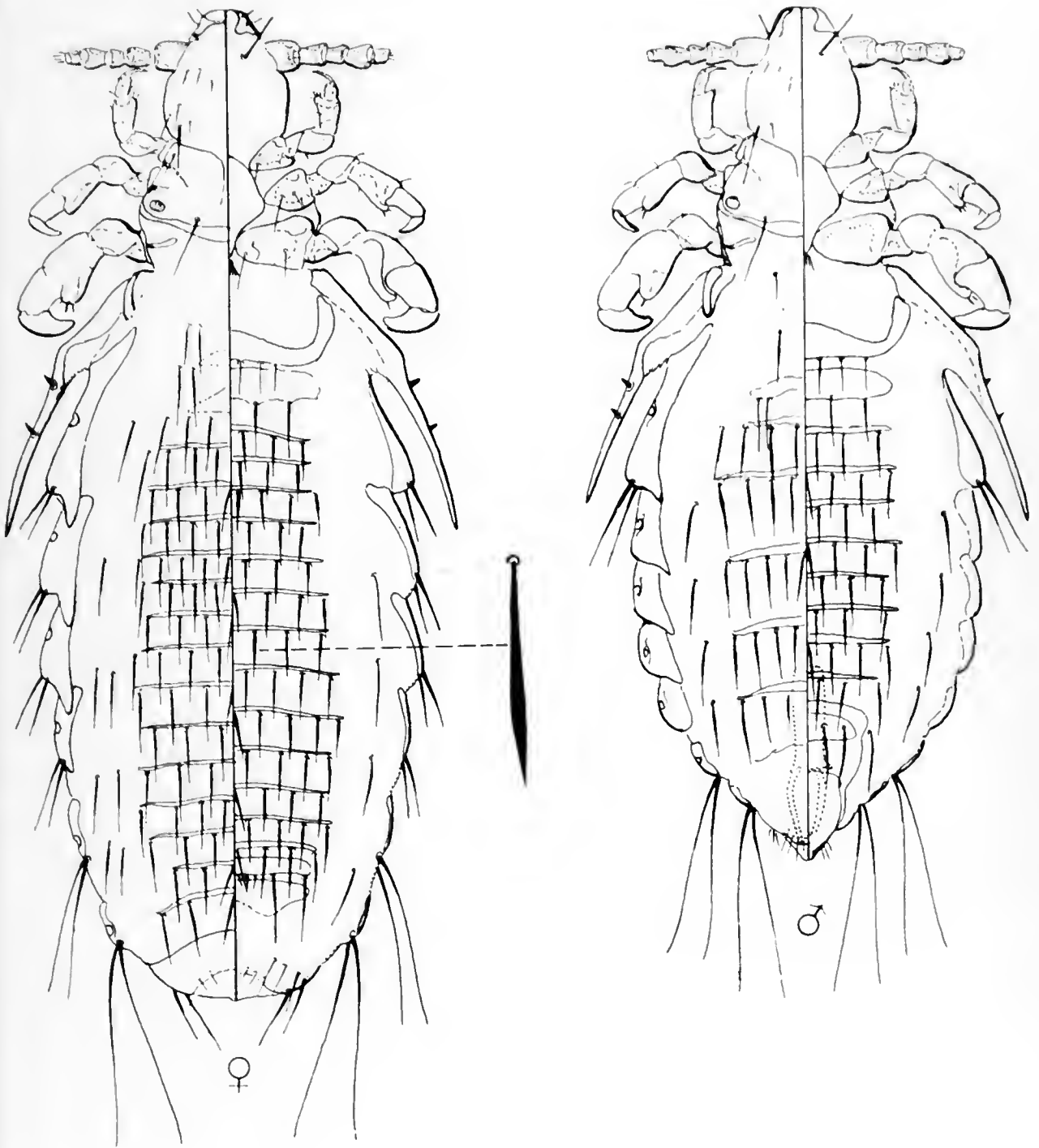
Key to Species of PTEROPHTHIRUS

1. Paratergal plates of abdominal segments 3-4 each with the ventral, apical angle produced into an acute point.....2
 Paratergal plates of abdominal segments 3-4 with the ventral apical angle not at all produced.....3
2. Paratergal plates of segments 3-5 with both dorsal and ventral, apical angles produced into an acute point.....IMITANS
 Paratergal plates of segments 3-5 with the ventral, apical angle produced into an acute point, the dorsal angle broadly truncate.WERNECKI
3. Paratergal plates of segments 3-4 with the dorsal, apical angle produced into a point.....ALATA
 Paratergal plates of segments 3-4 with the dorsal, apical lobe broadly truncate.....AUDAX

Pterophthirus alata (Ferris)

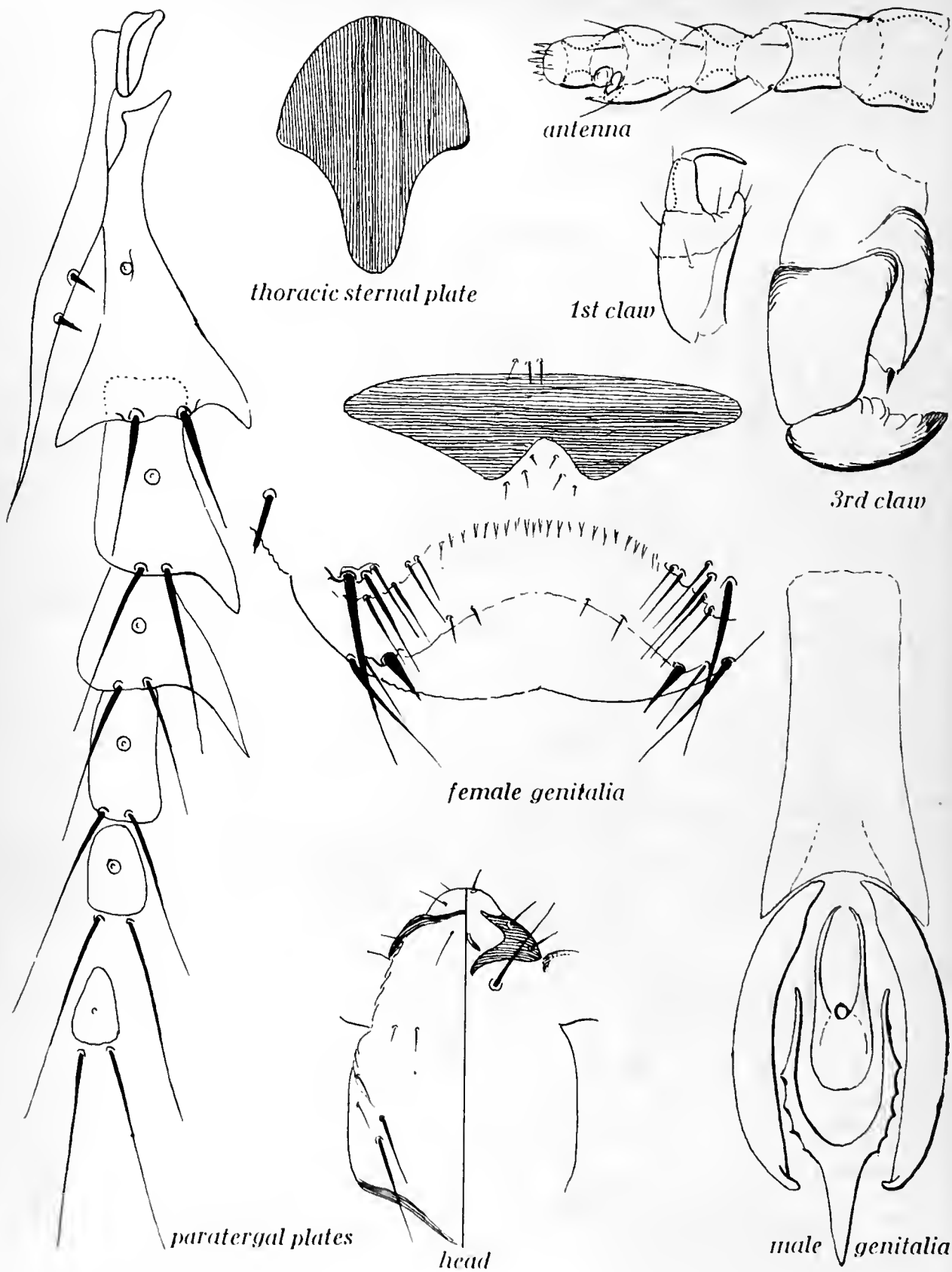
Figures 61, 62

1921. *Hoplopleura alata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:127; figures 84, 85.



Pterophthirus alata (Ferris)

Figure 61



Pterophthirus alata (Ferris), details

Figure 62

1923. *Pterophthirus alata* (Ferris), Ewing, Journal of the Washington Academy of Sciences 13:147.

1942. *Pterophthirus alata* (Ferris), Werneck, Revista Brasileira de Biologia 2(3):317.

HOSTS AND DISTRIBUTION. Recorded by Ferris from *Microcavia* (as *Kerodon*) *australis* from the Upper Rio Chico, Patagonia, Argentina, and later recorded by Werneck from the same host (as *Caviella*) from the provinces of Jujuy and Catamarca, in Argentina.

Pterophthirus audax (Ferris)

1921. *Hoplopleura audax* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 2:125; figures 82, 83.

1923. *Pterophthirus audax* (Ferris), Ewing, Journal of the Washington Academy of Sciences 13:148.

1923. *Pterophthirus audax* (Ferris), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:281.

1942. *Pterophthirus audax* (Ferris), Werneck, Revista Brasileira de Biologia 2(3):317.

HOSTS AND DISTRIBUTION. Types from *Proechimys semispinosus* and other specimens from *Proechimys* (as *Nelomys*) *mincae* at San Javier, North Ecuador. Recorded by Werneck from *Proechimys oris* at Abiete, Para, Brasil.

Pterophthirus imitans Werneck

1942. *Pterophthirus imitans* Werneck, Revista Brasileira de Biologia 2(3):317; figures.

HOSTS AND DISTRIBUTION. From *Cavia aperea*, Santo Amaro, state of São Paulo, Brasil.

Pterophthirus wernecki Guimarães

1950. *Pterophthirus wernecki* Guimarães, Papeis Avulsos do Departamento de Zoologia, Secretaria da Agricultura, São Paulo, Brasil 9:8:83; figures.

HOSTS AND DISTRIBUTION. From *Proechimys iheringi* at Boraceia, state of São Paulo, Brasil.

Genus SCHIZOPHTHIRUS Ferris

1922. *Schizophthirus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:143.

1932. *Hasellus* Jancke, Zeitschrift für Parasitenkunde 4:532.

GENERIC TYPE. *Pediculus pleurophaeus* Burmeister, by original designation. One other species is included in the genus.

GENERIC SYNONYM. *Hasellus* Jancke, by community of type.

CHARACTERS. Hoplopleurinae with five-segmented antennae. Abdominal segments, exclusive of the usual terminal and genital segments, without tergal or sternal plates in the female except for plates belonging apparently to segments one to three. Male with such plates on all segments. Female with three rows of setae on most of the segments both dorsally and ventrally, the male with one row on each segment both dorsally and ventrally. Sternal plate of segment two divided longitudinally into two much expanded plates, each of which articulates by means of a process with the corresponding paratergal plate and each of which bears on its posterior border 2-3 stout, thorn-like setae.

The members of this genus occur on rodents of the family Gliridae.

Key to Species of SCHIZOPHTHIRUS

Dorsal and ventral lobes of the paratergal plates of abdominal segments 3-6 deeply divided into 2 very unequal lobes, the dorsal lobe being much narrower than the ventral lobe; known from the European genera *Muscardinus* and *Eliomys*.....PLEUROPHAEUS
Paratergal plates of these abdominal segments not thus deeply divided, and with the lobes equal; known from the genus *Graphiurus* in Africa. GRAPHIURI

Schizophthirus graphiuri Ferris

1922. *Schizophthirus graphiuri* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:147; figures 93A, 96, 97.

HOSTS AND DISTRIBUTION. Type from *Graphiurus murinus* from British East Africa and recorded also as from *Graphiurus murinus* (as *raptor*) from the same region; from *Graphiurus nanus* from Natal, South Africa; from *Graphiurus alticola*, locality not specified in available reference.

Schizophthirus pleurophaeus (Burmeister) Figures 63, 64

1839. *Pediculus pleurophaeus* Burmeister, Genera Insectorum, Rhynchota, Number 7.

1922. *Schizophthirus pleurophaeus* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:145; figures 94, 95.

HOSTS AND DISTRIBUTION. Type from *Dryomys nitedula* (as *Myoxys nitella*) from somewhere in Europe. Also recorded from *Eliomys quercinus* (as *pallidus*) from Italy and from *Muscardinus avellanarius* from Germany.

Subfamily HYBOPHTHIRINAE Ferris, new subfamily

DESCRIPTION OF THE SUBFAMILY. Hoplopleuridae in which there is no external indication of eyes. The most distinctive character is the presence of a short, claw-like structure which arises beside the true claw on the anterior legs. Paratergal plates present on abdominal segments 2-8 or 3-8, with at least one of the posterior apical angles forming a lobe or point which is free from the body wall. Abdomen with but a single row of setae on any segment, both dorsally and ventrally, in either sex and without sclerotized tergal and sternal plates other than those normally present on the terminal and genitalic segments, except at times in the male. Antennae five-segmented, sexually dimorphic only to the extent that the male may bear a single enlarged seta near its apex.

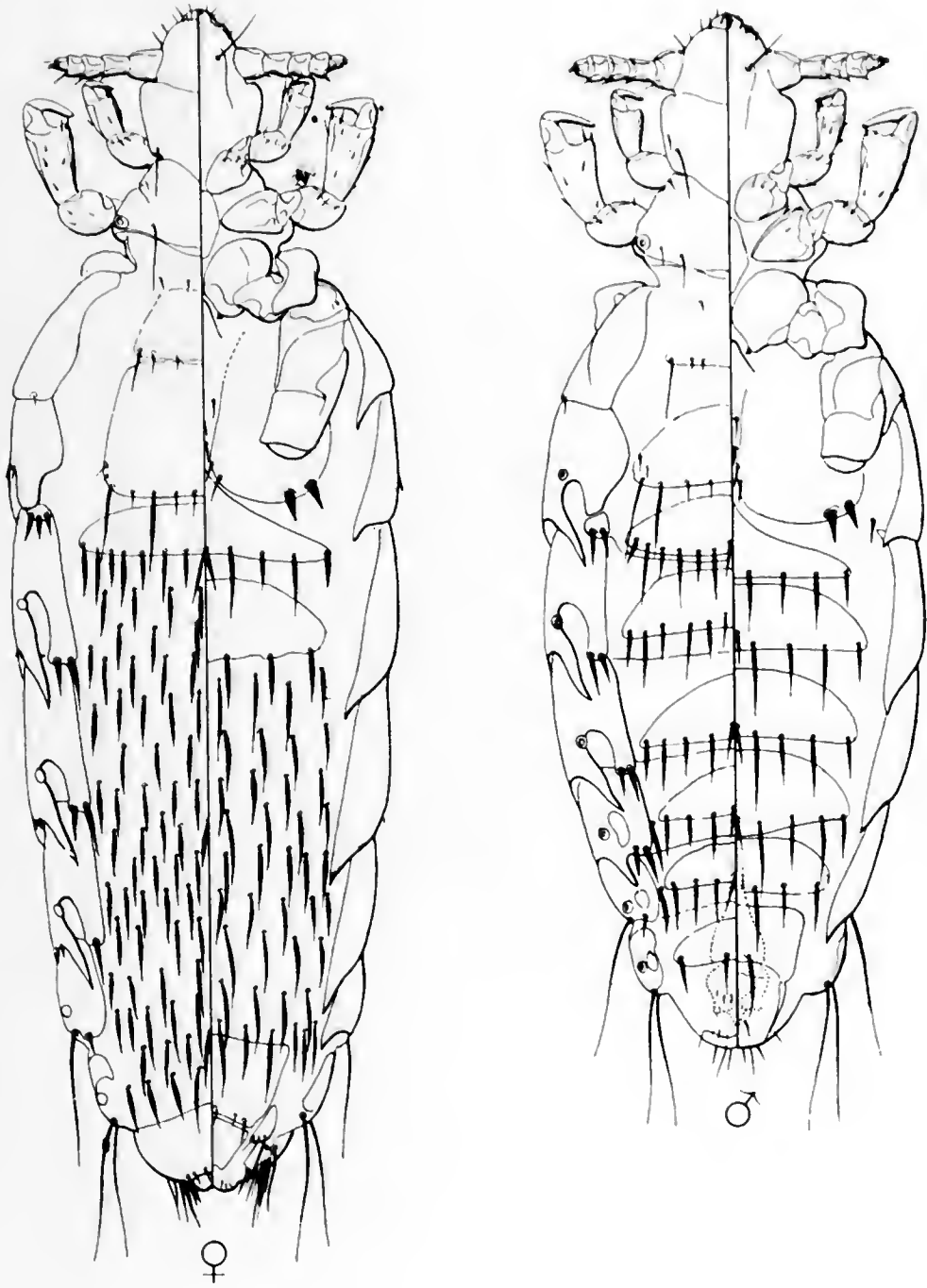
Occurring on African mammals of the rodent family Echimyidae, subfamilies Thryonomyinae and Petromyinae, and the family Orycteropodidae of the Order Tubulidentata.

NOTES. A considerable amount of doubt is felt concerning the validity of this subfamily. The presence of the peculiar claw-like structure alongside the true claw on the front tarsi seems to link the included species and there are no other characters which specifically deny such an association.

Webb referred the two included genera to the Haematopinidae, but the present writer is quite unable to agree with this assignment.

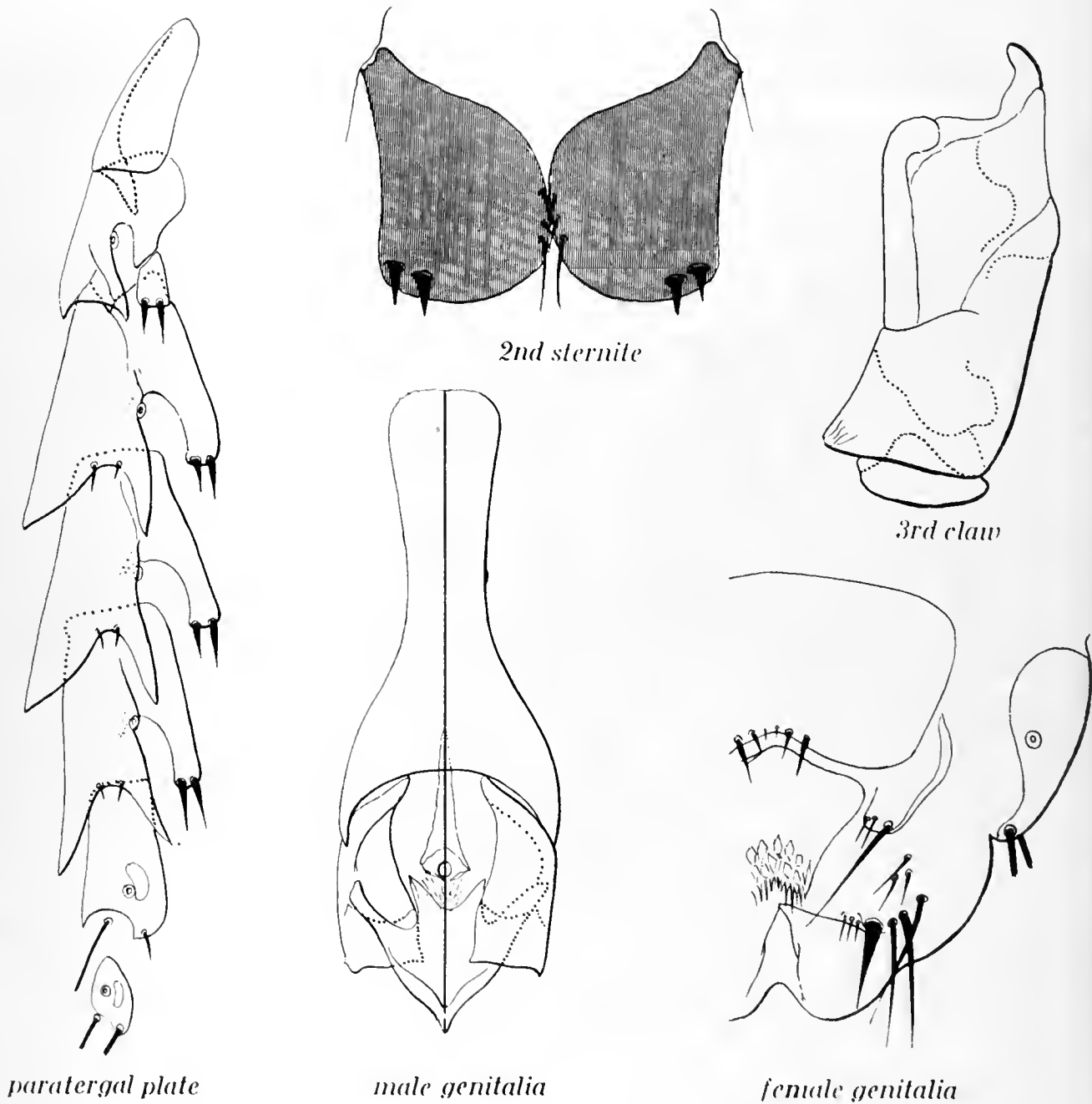
Key to the Genera of HYBOPHTHIRINAE

Hindhead almost triangular, the lateral margins strongly convergent; occurring on the genus *Orycteropus* of the Order Tubulidentata.....HYBOPHTHIRUS
Hindhead with the lateral margins approximately parallel; occurring on rodents of the family Echimyidae..... SCIPPIO



Schizophthirus pleurophaeus (Burmeister)

Figure 63



Schizophthirus pleurophaeus (Burmeister), details

Figure 64

Genus HYBOPHTHIRUS Enderlein

1909. *Hybophthirus* Enderlein, Kenkschrift der medicinischen-naturwissenschaft-lichen Gesellschaft zu Jena 14:79.
1922. *Hybophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:175.

GENERIC TYPE. *Hybophthirus orycteropodi* Enderlein, which is a synonym of the earlier described *Haematopinus notophallus* Neumann.

CHARACTERS. Hybophthirinae in which the head is short and broad, sharply expanded posterior to the antennae and then constricting sharply, the hindhead being almost triangular. Thorax without any sternal plate; prothoracic sternal apophyses present, forming a pair of pits on the ventral side; with the metanotum forming a distinct, apically free lobe at each posterior angle. First pair of legs slender, with slender claw; second and third legs equal to each other, large and stout, with stout claw. Abdomen with paratergal plates present on segments 2-8, each with the posterior, dorsal angle prolonged into an apically rounded, free lobe. Abdomen with but one row of small setae across each segment, both dorsally and ventrally, in both sexes.

Hybophthirus notophallus (Neumann)
Figures 65, 66

1909. *Haematopinus notophallus* Neumann, Jahresbericht des Nassauische Vereins für Naturkunde in Wiesbaden, page 2.
1909. *Hybophthirus notophallus* Enderlein, Denkschrift der medicinischen-naturwissenschaft-lichen Gesellschaft zu Jena 14:79-80; Plate 8, figures 1-3.
1922. *Hybophthirus notophallus* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:176; figures 117-118.

HOSTS AND DISTRIBUTION. Neumann's types were from *Orycteropus afer* (= *capensis*), the "Cape ant bear," at "Gochas, Afrique occidentale allemande," and Enderlein's types were from the same host in "Klein-Namaland, Umgebung von Steinkopf." The species has later been recorded from the same host in South Africa.

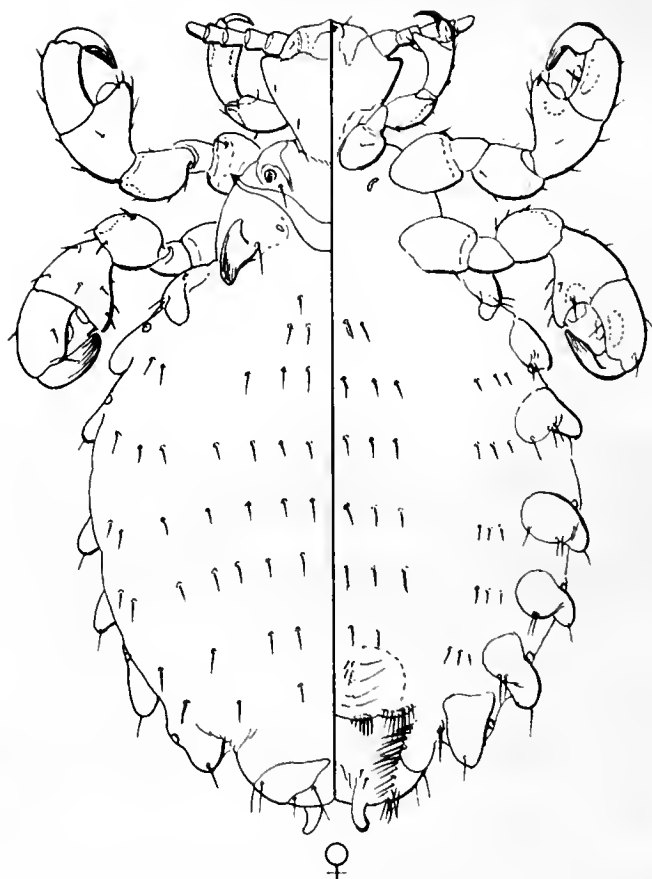
NOTES. The priority of Neumann's specific name over that applied by Enderlein has been pointed out by Cummings. The accompanying illustrations are from specimens from the type host in the Zoological Garden at Pretoria, South Africa.

Genus SCIPIO Cummings

1913. *Scipio* Cummings, Bulletin of Entomological Research 3:393.
1916. *Neumannellus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:31.
1922. *Scipio*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:170.
1936. *Bedfordia* Fahrenholz, Zeitschrift für Parasitenkunde 9:55.

GENERIC TYPE. *Haematopinus aulacodi* Neumann, the only included species at the time of the naming of the genus. *Neumannellus* Fahrenholz has the same type. *Bedfordia* Fahrenholz, type *Scipio tripedatus* Ferris, is here considered to be a synonym.

CHARACTERS. Head with the posterior lateral margins more or less nearly parallel. Antennae of the male with the third segment somewhat modified by the presence of a stout, subapical, dorsal seta. Thorax at the most with a very small sternal plate which is not apically or marginally free. Posterior-lateral angle of the metathorax dorsally with a pronounced lobe, except that this is weakly developed in one species. Abdomen with definite



Hybophthirus notophallus (Neumann)

Figure 65

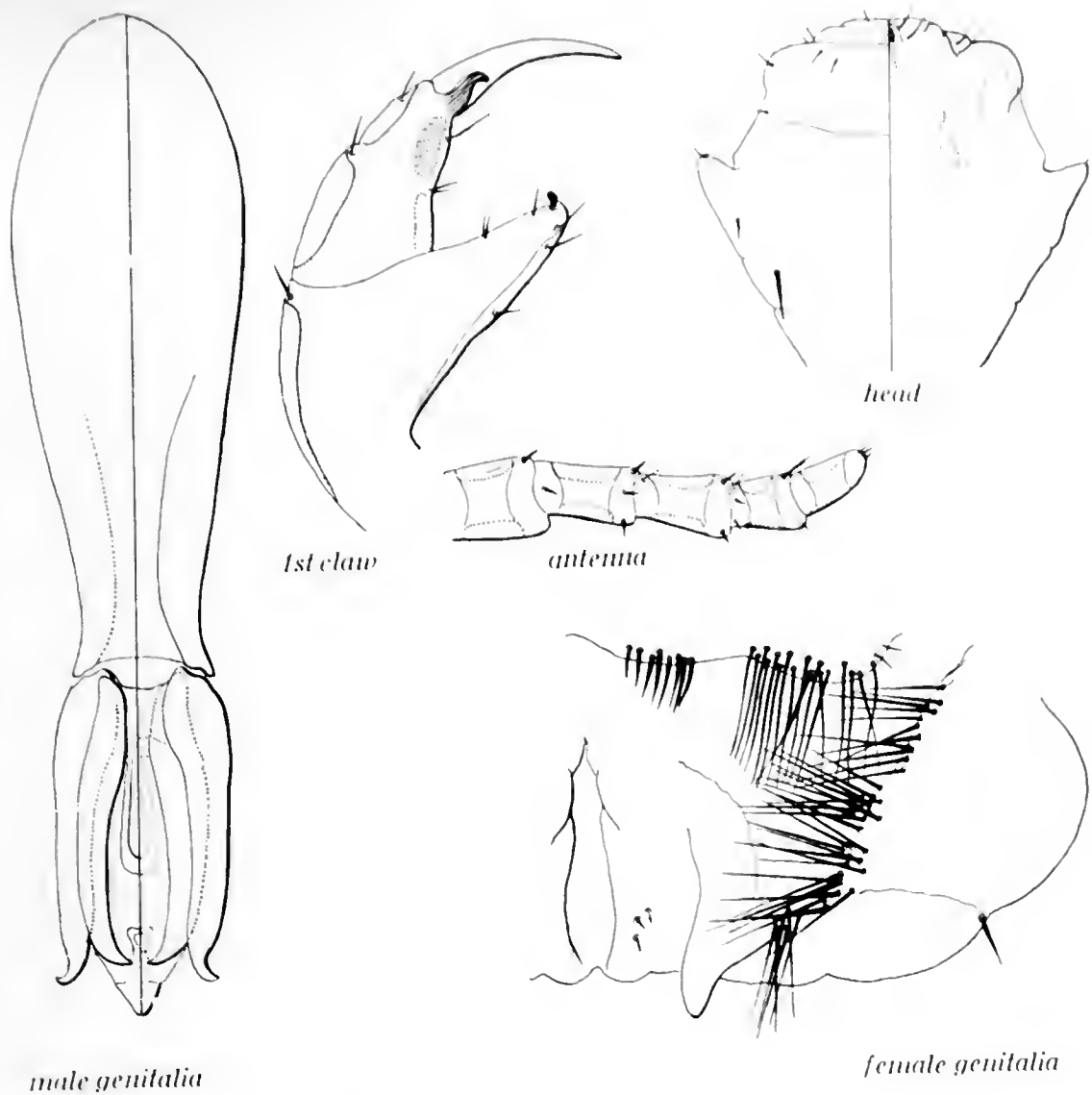
paratergal plates on segments 3-8. Female in all the species with the abdomen membranous except for the usual ninth tergite and the genital plate; male in two species with a single, very small, tergal plate on each of most of the segments. Anterior legs small and with slender claw with a short, claw-like process arising beside it. Middle and posterior legs enlarged and with stout claw or middle legs larger and stouter than the posterior pair.

NOTES. Four species, one probably invalid, are here referred to this genus. Of these, one—*Scipio tripedatus* Ferris—is a rather peculiar form, having the middle legs enlarged and with stout claw, but the posterior legs definitely smaller and with slender claw. Fahrenholz has considered this sufficient to justify the erection of a new genus, *Bedfordia*, but this is not accepted here, as the relationships of the species seem very definitely to be with *Scipio*. All the species occur upon hosts of the rodent family Echimyidae.

Key to Species of SCIPIO

One supposed species, *longiceps* Ewing, is omitted from this key.

1. Middle legs larger than posterior legs and with stouter claw. TRIPEDATUS
Middle and posterior legs of approximately equal size.....2
2. Head very noticeably elongate.....AULACODI
Head but slightly longer than broad.....BREVICEPS



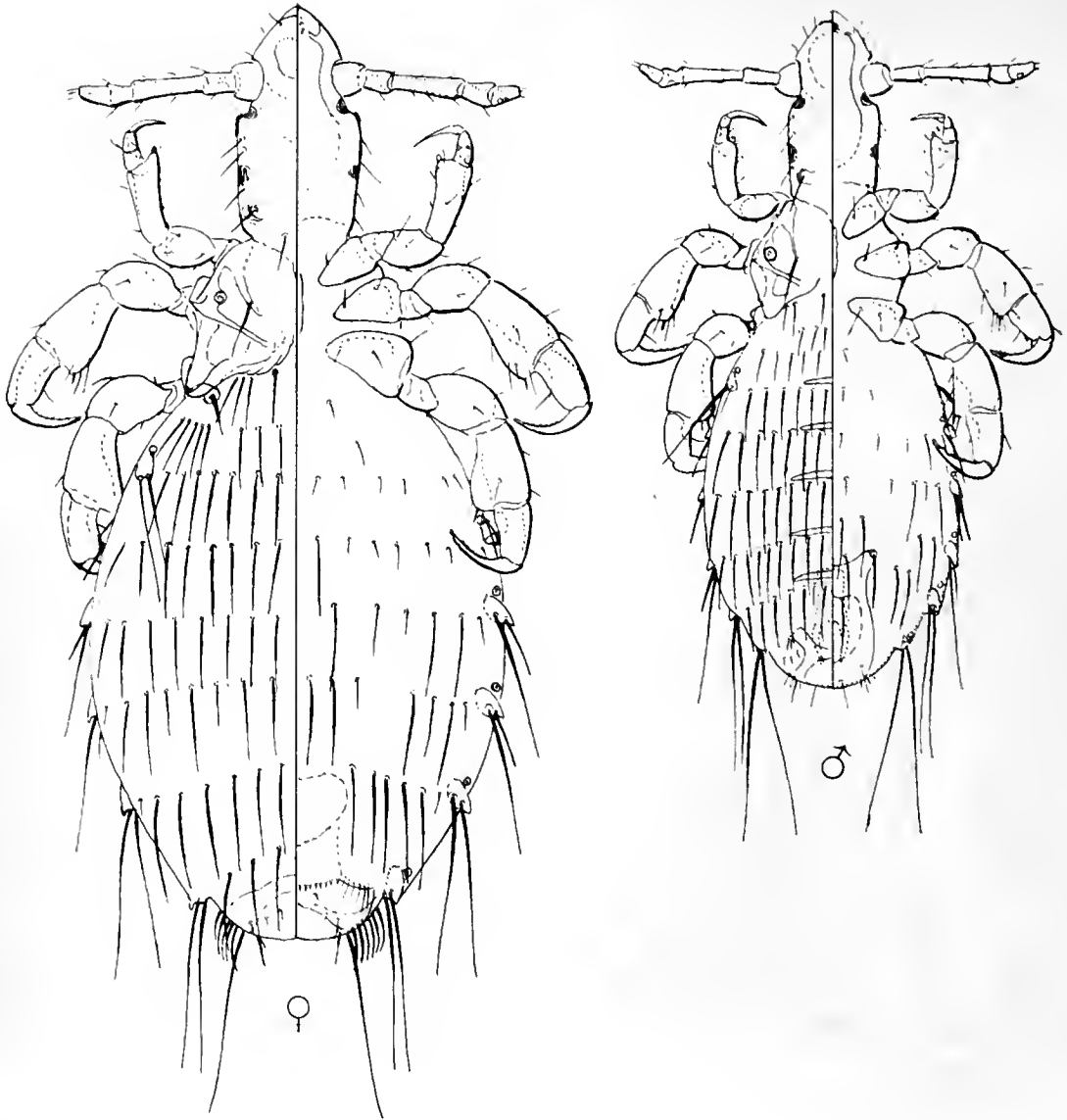
Hybophthirus notophallus (Neumann), details

Figure 66

Scipio aulacodi (Neumann)
 Figures 67, 68

1911. *Haematopinus aulacodi* Neumann, Archives de Parasitologie 14:403; figures 5-7.
 1913. *Scipio aulacodi* (Neumann), Cummings, Bulletin of Entomological Research 3:393.
 1922. *Scipio aulacodi* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:170; figures 113-114.

HOSTS AND DISTRIBUTION. Originally described from *Thryonomys* (= *Aulacodus*) *swinderianus* from Dahomey, Africa. Later recorded from *Thryonomys* sp., Mfongos, Zululand, and from *Thryonomys swinderianus* (*aulacodus*) *variegatus* from Rustenburg, Transvaal District, South Africa. The hosts are members of the rodent family Echimyidae.



Scipio aulacodi (Neumann)

Figure 67

Scipio breviceps Ferris

1922. *Scipio breviceps* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:173; figures 114, 115, 116.

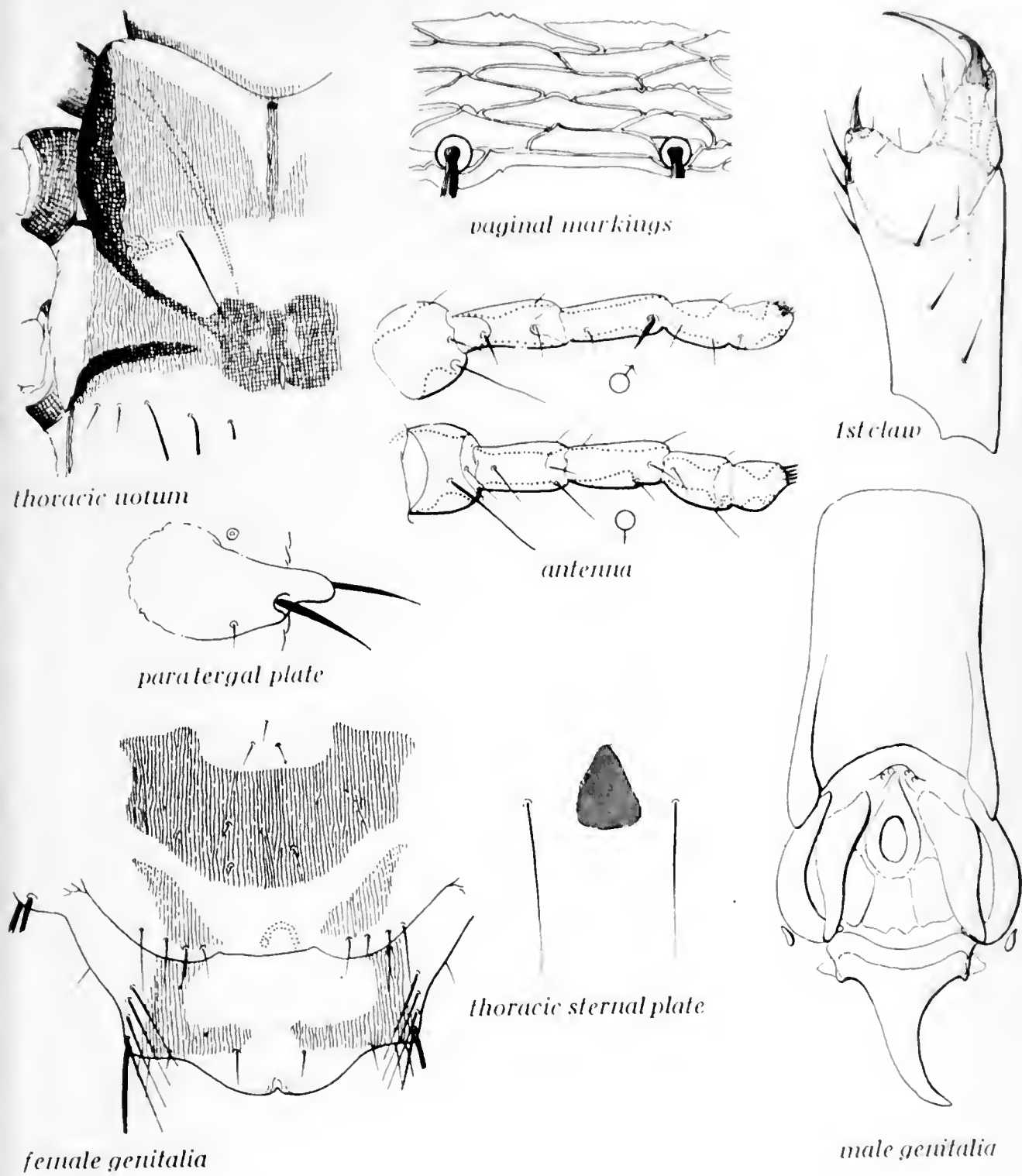
HOSTS AND DISTRIBUTION. Originally described from *Thryonomys* sp., Zululand, and later recorded by Bedford from *Thryonomys swinderianus variegatus*. The hosts are members of the rodent family Echimyidae.

Scipio longiceps Ewing

1937. *Scipio longiceps* Ewing, Proceedings of the Helminthological Society of Washington, page 81; figure 29.

HOSTS AND DISTRIBUTION. From *Thryonomys gregor pusillus* from Majiyagumvi, British East Africa. The host is a member of the rodent family Echimyidae.

NOTES. The description and very inadequate accompanying illustration,



Scipio aulacodi (Neumann), details

Figure 68

both based upon the male alone, offer no convincing evidence that this species is distinct from *Scipio aulacodi*.

Scipio tripedatus Ferris

1932. *Scipio tripedatus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:285; figures 173-175.

1936. *Bedfordia tripedata* (Ferris), Fahrenholz, Zeitschrift für Parasitenkunde 9:55.

HOSTS AND DISTRIBUTION. Type from a "rock rat," one of the species of the genus *Petromus* (= *Petromys*) without locality other than South Africa and also recorded from *Petromus typicus tropicalis*, Windhoek, South Africa, and from *Petromus* sp. at Khan River, Southwest Africa. The hosts are members of the rodent family Echimyidae.

NOTES. This species has been designated as type of the genus *Bedfordia* Fahrenholz, but this genus is here rejected.

Subfamily PEDICININAE Enderlein

1904. Enderlein, Zoologischer Anzeiger 28:136, 138.

DESCRIPTION OF THE SUBFAMILY. Hoplopleuridae in which distinct eyes are present as external lenses accompanied in life by pigment spots. Antennae five-segmented, the last three segments at times more or less fused together; sexually dimorphic, the males having a small, stout seta on the dorsal side of each of the last three segments. Paratergal plates present on abdominal segments 4-6 or 5-6 in the form of distinct plates of which at least one of the apical angles is free from the body. Abdomen otherwise membranous except for the usual terminal and genitalic plates. Spiracles present on abdominal segments 3-8. Legs variable in form, either all more or less similar and relatively slender or the first pair slender and the others larger and stouter. Gonopods of segment eight of the female always obsolete, their position represented only by a row of setae. Gonopods of segment nine likewise represented merely by a row of setae, the apex of the body never with lobes or processes. Genitalia of the male always with parameres which are fused basally to the base of the aedeagus.

Occurring on Old World monkeys of the superfamily Cercopithecoidea.

NOTES. The removal of the genus *Pedicinus* from the family Pediculidae, with which it has long been associated, has been decided upon only after much doubt. The morphological community with the Pediculidae has lain only in the presence of distinct eyes, but it is now known that the eyes are present in various forms and they presumably mean nothing more than the retention of a primitive character which was once common to all the lice. In the remainder of its morphology *Pedicinus* departs as widely from *Pediculus* as do most of the other genera. Even the spiracles, which have been insisted upon by Webb as indices to relationship, have not been claimed by him to have any special resemblance to those of the Pediculidae. In other respects the members of the genus approach quite closely various forms of the Hoplopleuridae and, considering the morphological evidence, there have been but two alternatives apparent. One of these is to name a new family for the genus *Pedicinus*. The other is to regard this genus as constituting a subfamily of the Hoplopleuridae. The second alternative has been chosen.

The removal of *Pedicinus* from the Pediculidae and its assignment to the Hoplopleuridae will doubtless be viewed with horror by those whose ideas of the relationship of the various genera of lice are at least colored—if not determined—by the relationships of the hosts. The genus *Pedicinus*, being from a Primate, ought to be related to *Pediculus*, but the morphological evidence does not support such a relationship. Possibly future workers will see some other solution of the difficulty.

Genus PEDICINUS Gervais

1844. *Pedicinus* Gervais, *In* Walckenaer's *Histoire naturelle des insectes aptères* 3:301.
1912. *Phthirpedicinus* Fahrenholz, *Zoologischer Anzeiger* 39:54.
1916. *Neopedicinus* Fahrenholz, *Archiv für Naturgeschichte, Abteilung A*, 81:11:7.
1934. *Pedicinus*, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 7:502.

GENERIC TYPE. The question of just what name the type of this genus should bear is open to a difference of opinion, the genus having been based upon a misidentified species. The genus was based by Gervais upon specimens which he identified as being the *Pediculus eurygaster* of Burmeister, but which on the basis of his description and illustrations was clearly misidentified. The opinion is here held that the generic name belongs with the species which he actually had before him and upon which he based his generic concept, not with the species which belongs with the name that he mistakenly employed. The question then remains as to what species Gervais actually had.

Ferris has maintained that in all probability it was the species later described by Piaget as *Pedicinus longiceps*. Hopkins, however, has maintained the opinion that *longiceps* should be regarded as a synonym of the earlier name *Haematopinus obtusus* Rudow. This opinion is here reluctantly accepted and the type of the genus *Pedicinus* thus may be given as *Haematopinus obtusus* Rudow.

GENERIC SYNONYMS. *Neopedicinus* Fahrenholz, type *Neopedicinus patas* Fahrenholz; *Phthirpedicinus* Fahrenholz, type *Phthirpedicinus micropilosus* Fahrenholz, which is here considered to be a synonym of *Pedicinus eurygaster* (Burmeister).

CHARACTERS. With the same characters as the subfamily, of which it is the only included genus.

NOTES. In the opinion of the writer there is no justification for the two genera named by Fahrenholz, although the names are available should future workers desire to employ them.

Key to Species of PEDICINUS

1. With but 2 pairs of paratergal plates on the abdomen.....EURYGASTER
With 3 pairs of free paratergal plates on the abdomen.....2
2. All legs of essentially the same size and form.....3
Second and third pairs of legs definitely stouter and with heavier claw than the first pair.....5
3. Legs very long and slender; penis of the male apically acutely pointed.....HAMADRYAS
.....4
Legs not thus long and slender.....4
4. Female with the genital plate trapezoidal and with the posterior margin deeply emarginate; male with the penis apically flattened and produced into two slight points.....ALBIDUS
Female with the genital plate transversely narrow; male with the penis merely slightly swollen at the apex.....OBTUSUS
5. With small paratergal sclerotization on segments 7-8, in addition to the 3 pairs of paratergal plates in both male and female.....PICTUS
Without such sclerotizations in addition to the three pairs of paratergal plates.....6
6. Penis of the male with a tooth on each side just anterior to the apex.....ANCOORATUS
.....PATAS
Penis of the male without such preapical teeth.....PATAS

Pedicinus albidus (Rudow)

1869. *Haematopinus albidus* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:168.
1934. *Pedicinus albidus* (Rudow), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:511; figure 296.

HOSTS AND DISTRIBUTION. Type from the "barbary ape," *Macaca sylvanus*. Ferris has recorded the species from the same host from Morocco and in the London Zoological Garden.

Pedicinus ancoratus Ferris

1934. *Pedicinus ancoratus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:518; figures 299, 300A, F, H, I.

HOSTS AND DISTRIBUTION. Type from *Presbytis pullata*, Pulo Sebang, East Sumatra. Also recorded from *Presbytis cristata* and *Presbytis germani* from the Malayan region, from *Presbytis schistacea* from Kashmir, from *Presbytis rubicunda* from Borneo, doubtfully from *Pygathrix priamus* from Ceylon.

Pedicinus eurygaster (Burmeister)

1838. *Pediculus eurygaster* Burmeister, Genera Insectorum, Rhynchota, Species 21.
1864. *Pediculus microps* Nitzsch, Giebel, Zeitschrift für die gesamten Naturwissenschaften 23:32.
1880. *Pedicinus eurygaster* (Burmeister), Piaget, Les Pediculines, page 630. (In part)
1880. *Pedicinus longiceps* Piaget, Les Pediculines, page 632. (In part)
1880. *Pedicinus breviceps* Piaget, Les Pediculines, page 632. (In part)
1881. *Pedicinus piageti* Stroebelt, Jahresbericht der zoologischen Sektion des Westfälischen provincial-Vereins für Wissenschaft und Kunst 9:82; Plate 1, figure 3.
1912. *Phthirpedicinus micropilosus* Fahrenholz, Zoologischer Anzeiger 39:55.
1932. *Phthirpedicinus microps* (Nitzsch), Werneck, Annales da Academia Brasileira de Ciencias 4:163; figures 1-5.
1934. *Pedicinus eurygaster* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:521; figures 303-305.

HOSTS AND DISTRIBUTION. Recorded by Burmeister from *Innuus sinicus*, without locality data, presumably from a captive animal. Recorded by Piaget under three specific names from *Macacus cynomolgus*, *Cercopithecus cynomolgus*, and *Cercopithecus mona*; by Stroebelt from *Macacus erythraeus*; by Mjöberg from *Macacus silenus*; by Fahrenholz from *Macacus rhesus* and *silenus* and from *Cercopithecus* sp.; and by Ferris from a long series of hosts of the genera *Macacus*, *Pithecus*, and *Rhinopithecus*; from skins of wild animals from Kashmir, the Malayan area, and the Philippine Islands. The full list will be found in the "Host List" at the end of this volume.

NOTES. The original description given by Burmeister fortunately mentions specifically the distinguishing character of this species, which is the presence of but two pairs of abdominal paratergal plates. Since in the long series of specimens examined by Ferris no other species having this character appears, and since the one species that does appear is frequently encountered on captive monkeys, the identification may be accepted as practically certain. Ferris was able to examine the specimens of the three species—*eurygaster*, *breviceps*, and *longiceps*—recorded by Piaget and found all of these to be compounded of *eurygaster* and *obtusus*. It is probable that various published records under the name of *eurygaster* are erroneous, as was the identification employed by Gervais when he founded the genus *Pedicinus*.

This species has been designated as type of the genus *Phthirpedicinus*, which is not here accepted.

Pedicinus hamadryas Mjöberg

1910. *Pedicinus hamadryas* Mjöberg, Arkiv för Zoologi 6:13:172; figs. 86-87.
1934. *Pedicinus hamadryas* Mjöberg, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:513; figures 86, 87.

HOSTS AND DISTRIBUTION. Type recorded as from *Hamadryas* sp. from the Zoological Garden at Hamburg, Germany. Ferris recorded the species from a single specimen from "monkey," bearing no indication of place of origin.

Pedicinus obtusus (Rudow)
Figures 69, 70

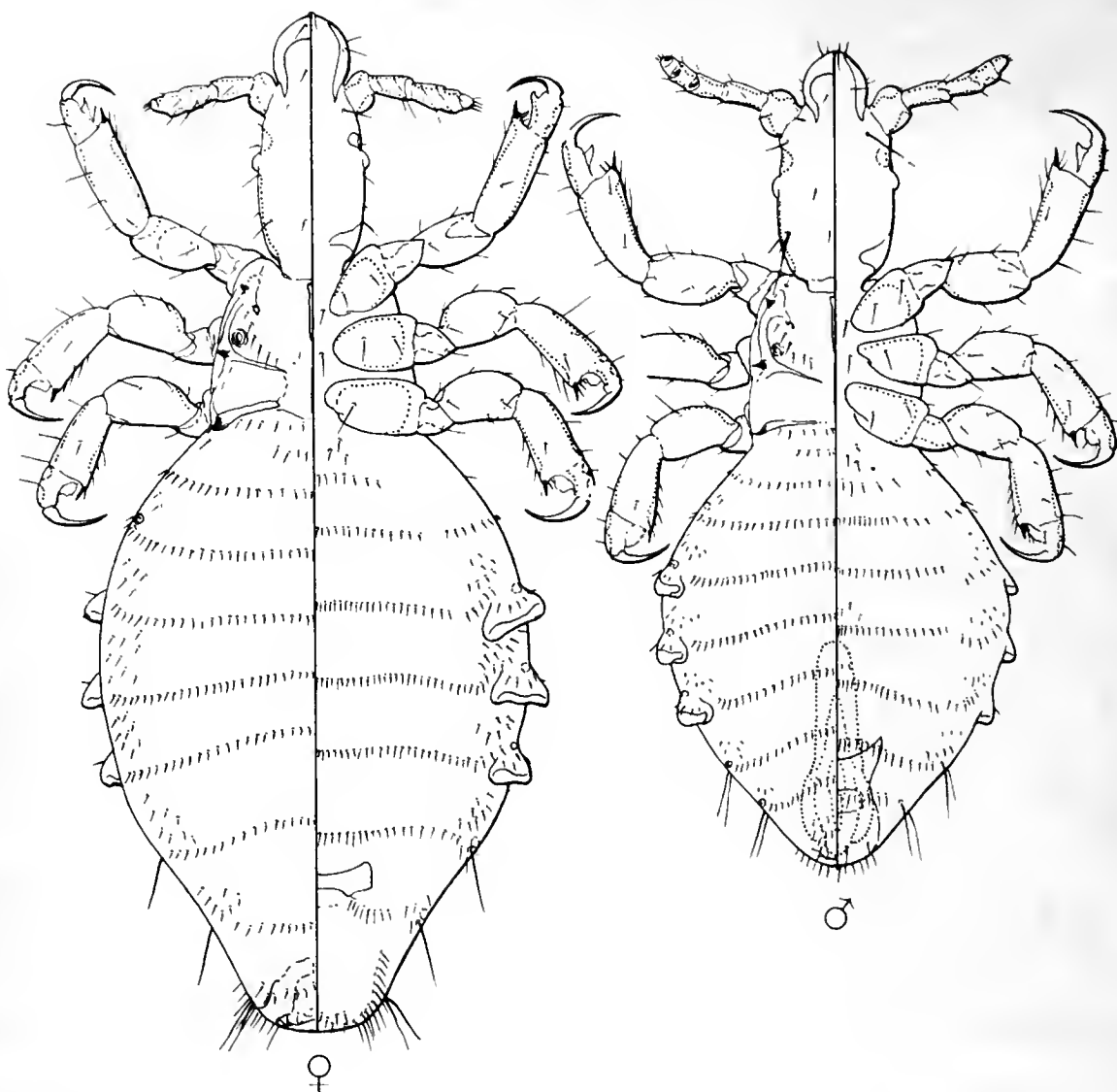
1844. *Pedicinus eurygaster* (Burmeister), Gervais, In Walckenaer's Histoire naturelle des insectes aptères 3:301; Plate 48, figures 1, 1b. (Misidentification)
1869. *Haematopinus obtusus* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:169.
1880. *Pedicinus eurygaster* (Burmeister), Piaget, Les Pediculines, page 630. (Part; misidentification)
1880. *Pedicinus longiceps* Piaget, Les Pediculines, page 632. (In part)
1880. *Pedicinus breviceps* Piaget, Les Pediculines, page 632. (In part)
1885. *Pedicinus graciliceps* Piaget, Les Pediculines, Supplement, page 141.
1910. *Pedicinus paralleliceps* Mjöberg, Arkiv för Zoologi 6:13:174; fig. 88.
1912. *Pedicinus rhesi* Fahrenholz, Zoologischer Anzeiger 39:54.
1916. *Pedicinus vulgaris* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:32.
1917. *Pedicinus paralleliceps*, variety *colobi* Fahrenholz, Jahrbuch der Hamburgischen wissenschaftlichen Anstalten 34:2:3, 8.
1934. *Pedicinus longiceps* Piaget, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:505; figures 293-296D.
1946. *Pedicinus obtusus* (Rudow), Hopkins, Annals and Magazine of Natural History (Series 11) 12:564.

HOSTS AND DISTRIBUTION. The types of *Haematopinus obtusus* Rudow were said to be from *Semnopithecus maurus*, without indication of locality. The lectotype selected from among the material of Piaget is from *Semnopithecus pruinosus*. The types of *Pedicinus graciliceps* Piaget were recorded merely as from monkey. The types of *Pedicinus paralleliceps* Mjöberg were said to be from *Macacus rhesus*. *Pedicinus vulgaris* Fahrenholz was named, on the basis of the literature only, for the specimens recorded by Piaget from *Inuus nemestrinus*, these here being considered actually to represent Piaget's *Pedicinus longiceps*, and therefore being *obtusus*. All of the specimens noted above were apparently taken from captive animals.

The list of hosts, other than as recorded above, is very long and is given in full with all available corrections in the host list at the end of this volume. Some of these records are of specimens taken from captive animals, but others are from wild animals or their skins, and the indications are that the species may occur on almost any Cercopithecoid monkey. It is apparently the species which is most likely to be found on captive animals.

NOTES. Ferris was able to examine the types of the four supposed species recorded by Piaget, of which three were described by Piaget as new. He reports (1934) that there were but two actual species recorded under four names and that in some of the preparations both were included on the same slides. He selected the lectotypes for *longiceps* as indicated above.

In the same work Ferris placed *Haematopinus obtusus* Rudow as unrecognizable other than supposedly as a species of *Pedicinus*, although he recorded

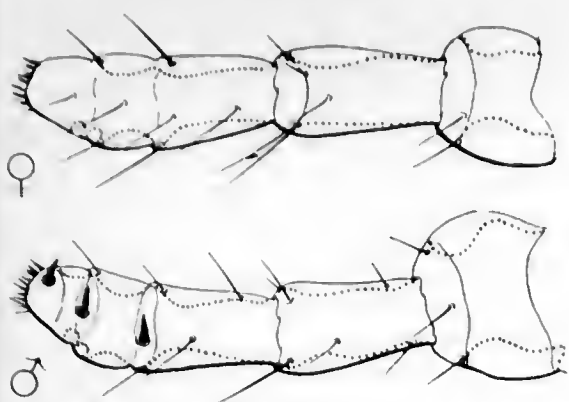


Pedicinus obtusus (Rudow)

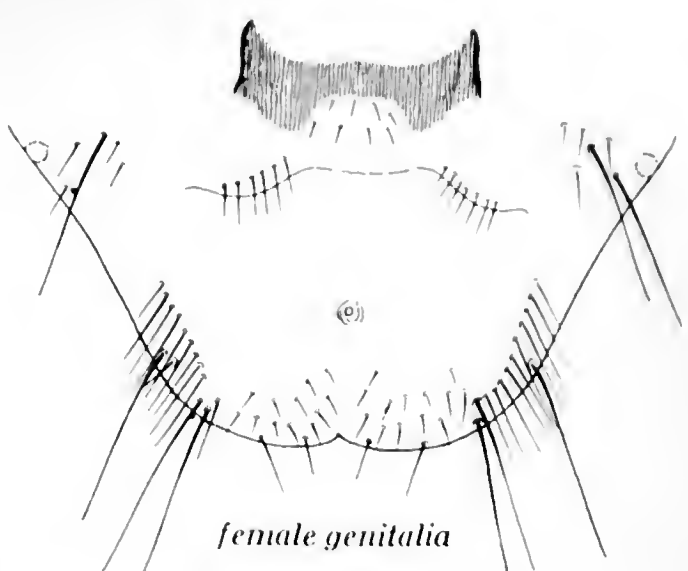
Figure 69

the examination of specimens from the Hamburg Museum which might conceivably contain Rudow's types. Hopkins (1946) has adopted a different point of view, advocating that a neotype be selected from among the specimens in the Hamburg Museum. By doing so no name would be left as belonging to an unrecognizable species and as *obtusus* antedates *longiceps* the latter would become a synonym.

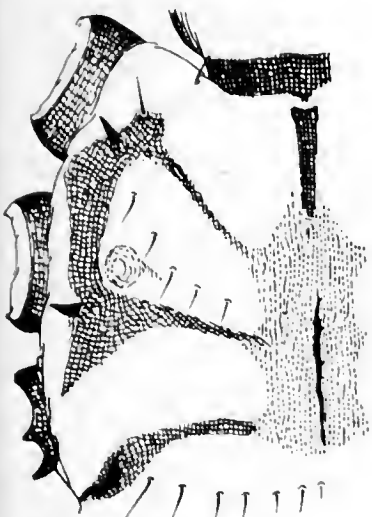
We need not go into all the arguments concerning this matter. In principle the writer is opposed to the replacement of any name, the application of which is certain, by any name which is at all uncertain or clouded. Nor is the opinion here held that every name which has been proposed and of which the type is lost or apparently lost should have a neotype named for it. To adopt such a procedure is to open endless vistas for abuse and nomenclatorial instability. In this particular case, however, there is some legitimate argument for following the suggestion made by Hopkins and for selecting a neotype from among the specimens in the Hamburg Museum, thus getting rid of an unattached name that has been cluttering the literature for more than seventy-five years. The point is here somewhat reluctantly conceded and the name *obtusus* is employed.



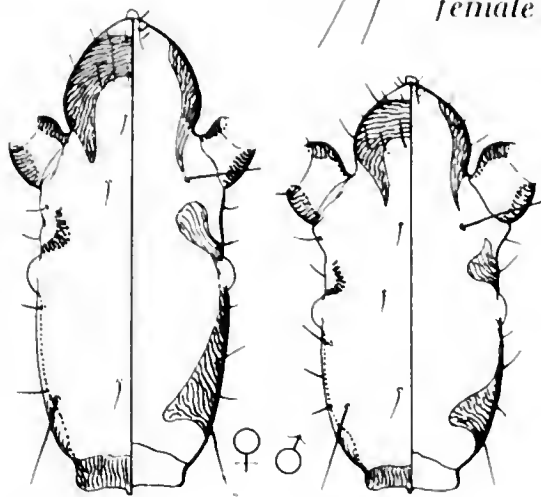
antenna



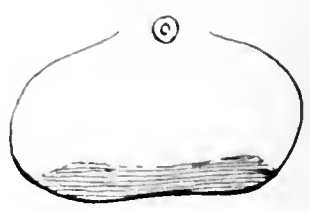
female genitalia



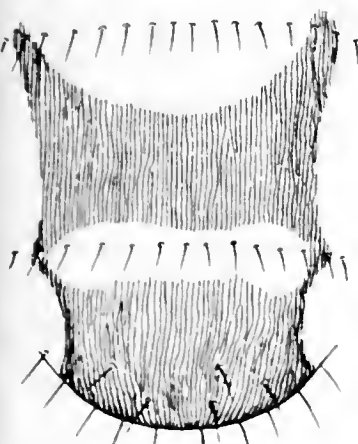
thoracic notum



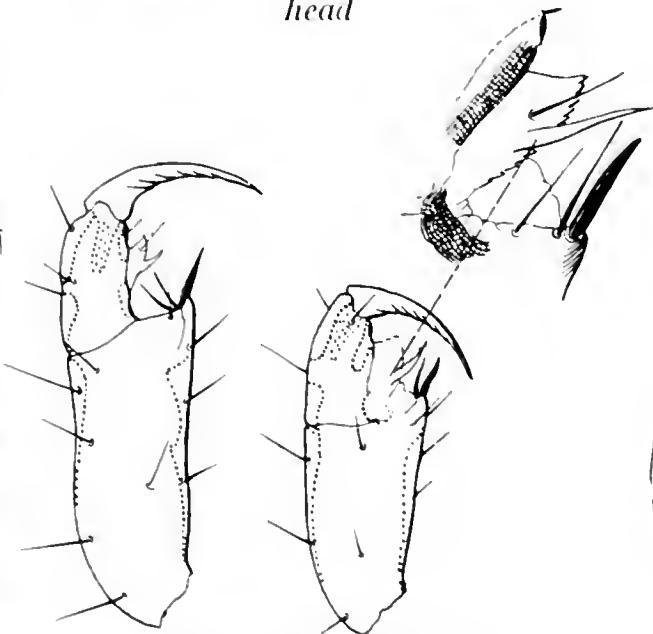
head



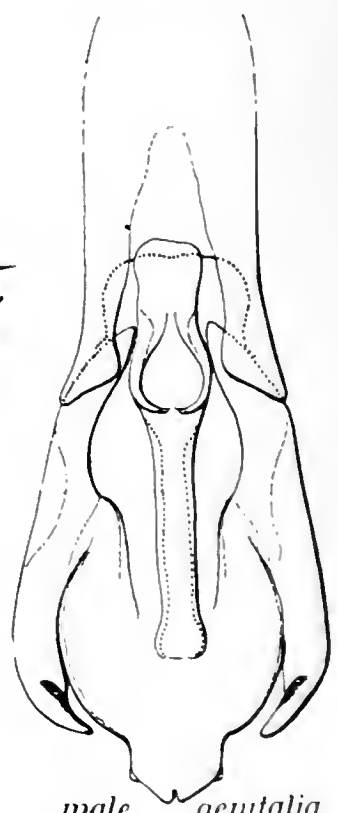
paratergal plate



male genital plate



1st claw 2nd and 3rd



male genitalia

Pedicinus obtusus (Rudow), details

Figure 70

Pedicinus patas (Fahrenholz)

1916. *Neopedicinus patas* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:6; Plate f, figure 2; text figure 7.
1934. *Pedicinus patas* (Fahrenholz), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:515; figure 300G.

HOSTS AND DISTRIBUTION. Type recorded as from *Cercopithecus patas* without indication of locality. Recorded by Ferris from *Erythrocebus whitei*, *Lasiopyga kolbi*, and *Lasiopyga alboangularis* from East Africa.

Pedicinus pictus Ferris

1934. *Pedicinus pictus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 7:518; figures 301, 302.

HOSTS AND DISTRIBUTION. Type from *Colobus caudatus* from Mount Kenya, British East Africa. Also recorded from *Pygathrix entellus* from the London Zoological Garden.

Subfamily POLYPLACINAE Ferris, new subfamily

DESCRIPTION OF THE SUBFAMILY. Hoplopleuridae in which the antennae are always five-segmented (with the exception of one poorly described species in which they are said to be three-segmented) and are very commonly sexually dimorphic, the male having the apical, preaxial angle of segment three more or less prolonged and terminating in a sclerotized point or bearing one or two short, stout, retrorse setae dorsally. Anterior legs (except in one species) small and with slender claw; middle legs larger than the first and with stouter claw; third legs (with the exception of a few species) distinctly larger than the second and with stouter claw, but not flattened. Paratergal plates always present on at least one abdominal segment (with the exception of one species in which they are entirely lacking) and always with at least one of the posterior angles forming a point which is free from the body; never forming the apices of spiracle-bearing abdominal tubercles; never overlapping. Abdomen most commonly with well-developed tergal and sternal plates; although in a few cases without such plates other than on the terminal and genitalic segments. Sternal plate of segment two never extended laterally to articulate with the corresponding paratergites. Thoracic sternal plate well developed, except in a few species in which it is lacking.

NOTES. This subfamily is a bit difficult to define definitely because of the existence of a few species which in one respect or another depart from the normal form. Thus the genus *Lemurphthirus*, with one included species, has paratergal plates only on the second abdominal segment, although in other respects it is a typical member of the group. One species assigned to the genus *Haemodipsus* entirely lacks paratergites and other abdominal plates, although an apparently closely related species has paratergal plates, even though they are very small. In a few species the sternal plate of the thorax is lacking, although in most species it is well developed.

These departures from the normal form, however, are limited to a few species and do not disturb the general homogeneity of the group.

The hosts of the subfamily are found among various groups of the rodents, although a few occur on insectivores and the Lagomorpha, and one doubtful member of the group occurs even upon an ungulate.

Sixteen genera are here recognized as belonging to the subfamily.

Key to the Genera of POLYPLACINAE

1. Antennae described as 3-segmented; ascribed to a lemur in Borneo.....HAMOPHTHIRUS
 Antennae definitely 5-segmented.....2
2. With no trace of paratergal plates on any abdominal segment; from European hare; one species of the genus.....HAEMODIPSUS
 With paratergal plates definitely present on at least one segment of the abdomen.....3
3. Paratergal plates present only on the second abdominal segment; ascribed to a lemuroid in Africa.....LEMURPHTHIRUS
 Paratergal plates present on more than the second abdominal segment...4
4. With the paratergal plates present only on abdominal segments 4-6; ascribed to donkey and zebra from Africa.....RATEMIA
 Paratergal plates present on at least four abdominal segments.....5
5. Paratergal plates of abdominal segments 2-7 consisting merely of narrow, longitudinal, sclerotized strips; ascribed to a South American rodent.....GALEOPHTHIRUS
 Paratergal plates otherwise.....6
6. Paratergal plates of the abdominal segments very small, consisting of a single point which projects from a slight base; ascribed to hares and rabbits in Europe, Africa, and North America.....HAEMODIPSUS
 Otherwise.....7
7. Paratergal plates of abdominal segments 3-6 each with the basal, ventral angle produced, the angle bearing 2 slender setae; ascribed to a lemur in Madagascar.....PHTHIRPEDICULUS
 Paratergal plates of abdominal segments 3-6 otherwise.....8
8. Both sexes with one of the transverse rows of setae on the abdominal tergites and sternites with setae which are flattened and leaf-like or cuneiform; ascribed to a South American rodent.....CTENOPHTHIRUS
 Setae of the abdomen otherwise.....9
9. Paratergal plates of abdominal segment 2 definitely divided longitudinally into 2 plates, one of which lies on the dorsum and one on the venter, the ventral portion with a flat, raised, apically free point; occurring on the New World rodent family Heteromyidae....FAHRENHOLZIA
 Paratergal plates of segment 2 of the abdomen with at the most slight evidence of being thus divided, the ventral part never independent of the dorsal part.....10
10. Abdominal segments with not more than 2 median setae and a single seta on each side near the lateral margin on any segment, either dorsally or ventrally; occurring on the South American genus *Lagidium*.....LAGIODIOPHTHIRUS
 Abdominal segments with more numerous setae.....11
11. Antennae with both basal and distal anterior angles of the basal segment prolonged into a distant hook; known from *Anathana* in India....DOCOPHTHIRUS
 Antennae not thus.....12
12. Paratergal plates of abdominal segment 2 with evidence of a distinct longitudinal division into 2 plates.....13
 Paratergal plates of abdominal segment 2 with no evidence of such longitudinal division.....14
13. Abdomen in both sexes with distinct transverse tergal and sternal plates.....POLYPLAX
 Abdomen in both sexes without such transverse plates, there being merely a small, tubercle-like, sclerotized area about the base of each seta; occurring on African rodents of the genus *Cricetomys*.....PROENDERLEINELLUS
14. Paratergal plates present on a variable number of abdominal segments

- but never on segments 7-8.....EULINOGNATHUS
 Paratergal plates present on abdominal segments 2-8.....15
 15. Second plate of the second abdominal tergite in the male always at least slightly modified, having its posterior border emarginate and with a group of setae set in an aster-like fashion at each end of this emargination; if the tergite is not sclerotized some modification of the row of setae still appears; occurring chiefly on the rodent family Sciuridae.....NEOHAEMATOPINUS
 Second plate of the second abdominal tergite in the male not thus modified; occurring on the Murid genus *Acomys* in Africa.....SYMOCA

Genus CTENOPHTHIRUS Ferris

1922. *Ctenophthirus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:153.

GENERIC TYPE. *Ctenophthirus cercomydis* Ferris, at present the only known species.

CHARACTERS. Hoplopleuridae of the subfamily Polyplacinae in which the antennae are five-segmented and not sexually dimorphic. Paratergal plates present on abdominal segments 2-8; those of segment two very small; those of segments 3-6 narrow and with each posterior angle produced into a pronounced point. Female with a distinct tergal plate on abdominal segment one, two tergal plates which are more or less fused together on segment two and two tergal plates on segment eight, the remaining segments with three tergal plates. The posteriormost plate on segments 3-8 bears a single row of flattened, almost foliate setae. On the ventral side the arrangement of the sternal plates is similar except that segment three bears three plates which are fused together. Male with two tergal plates on segment three, these more or less fused, and two sternal plates on segments 3-7, the posteriormost plate with a row of mingled, simple, and flattened setae. Spiracles present on segments 3-8. Sternal plate of the thorax present.

Ctenophthirus cercomydis Ferris
 Figures 71, 72

1922. *Ctenophthirus cercomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:153; figures 100-101.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Cercomys cunicularis* (recorded as *fosteri*) from Sapucay, Paraguay. The host belongs to the rodent family Echimyidae.

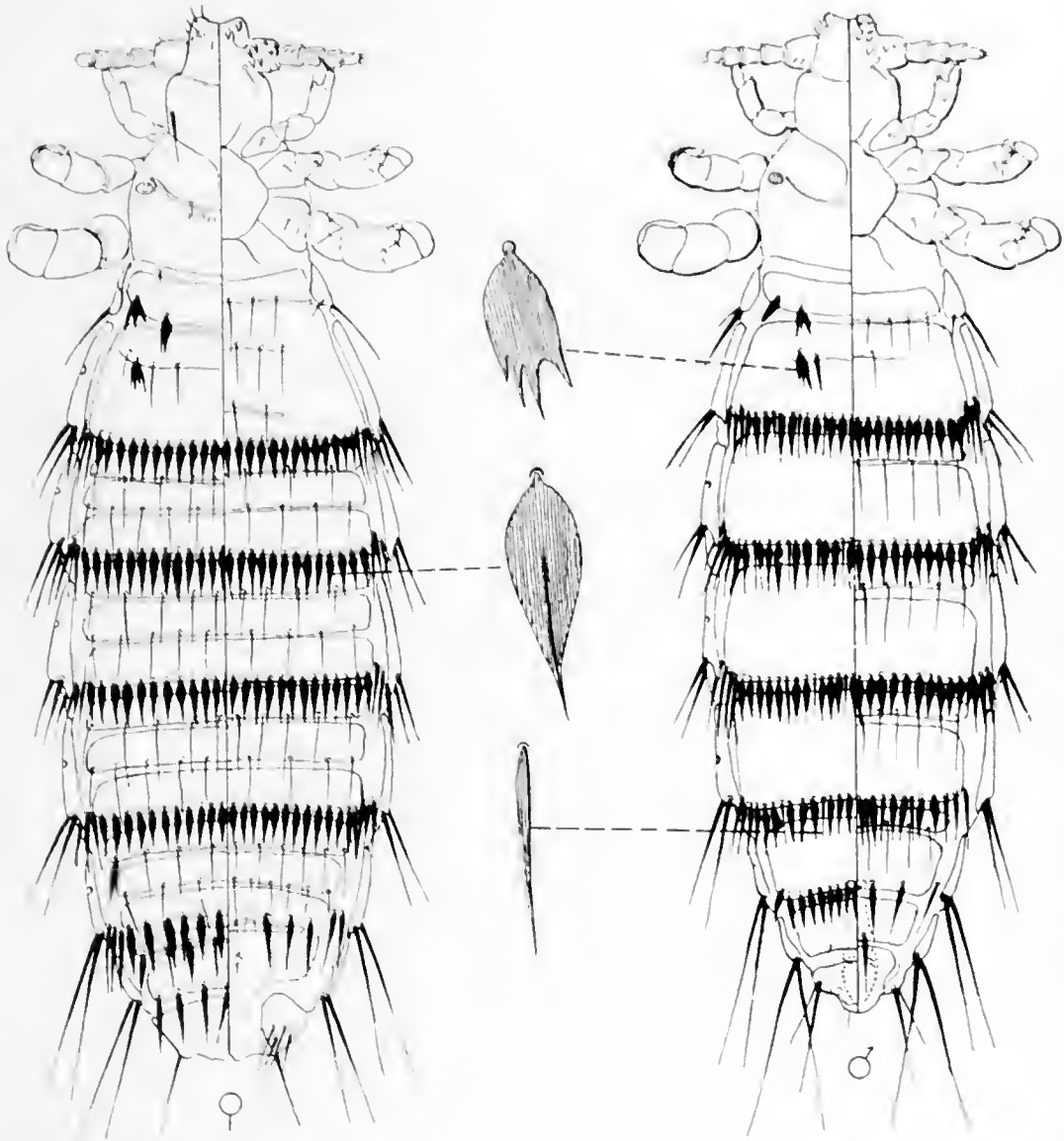
Genus DOCOPHTHIRUS Waterston

1923. *Docophthirus* Waterston, Bulletin of Entomological Research 14:101.

1932. *Docophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:303.

GENERIC TYPE. *Docophthirus acinetus* Waterston, the only known species.

CHARACTERS. Polyplacinae with five-segmented antennae which are not sexually dimorphic; with the first segment having the anterior margin produced basally and ventrally into sclerotized hooks. Second and third legs both enlarged and practically equal in size. Paratergal plates of the abdomen present on at least segments 2-6, those of segment three not longitudinally divided, those of all the segments with each posterior angle produced into a distinct point. Abdomen of the female with two rows of tergal setae on segments 3-7, and one row on segments one and eight, with a small tergal plate present in connection with the anteriormost row of setae on segments 2-7; with two rows of setae on the sternites of segments 2-7, but with a distinct plate present only on segment two. Male with a single row

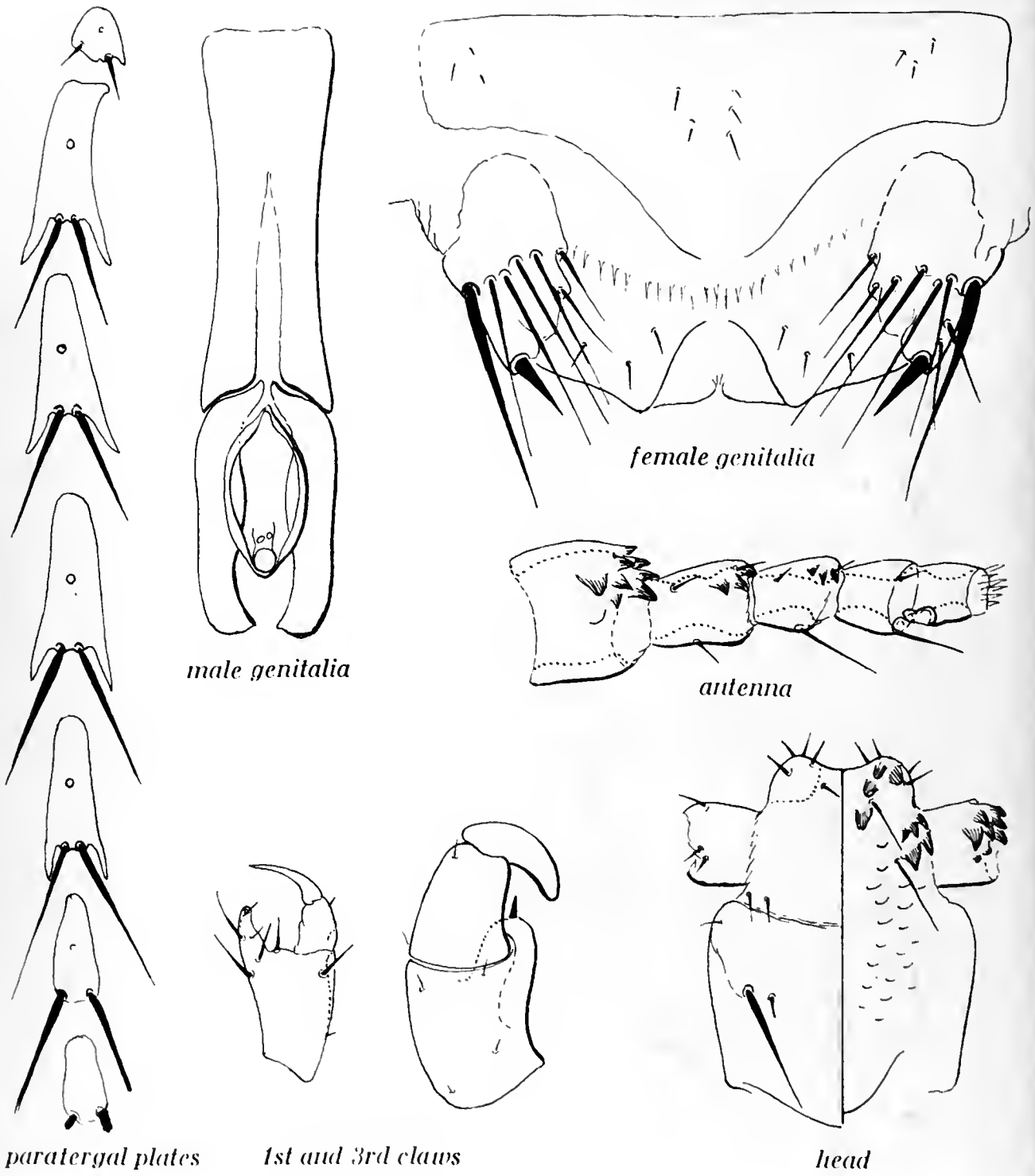


Ctenophthirus cercomydis Ferris

Figure 71

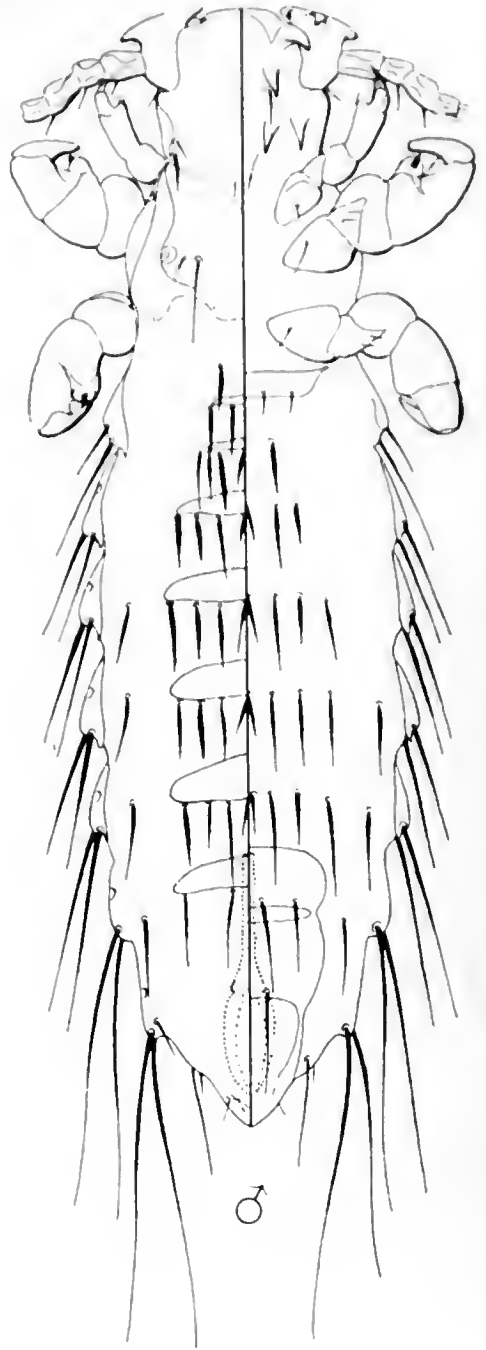
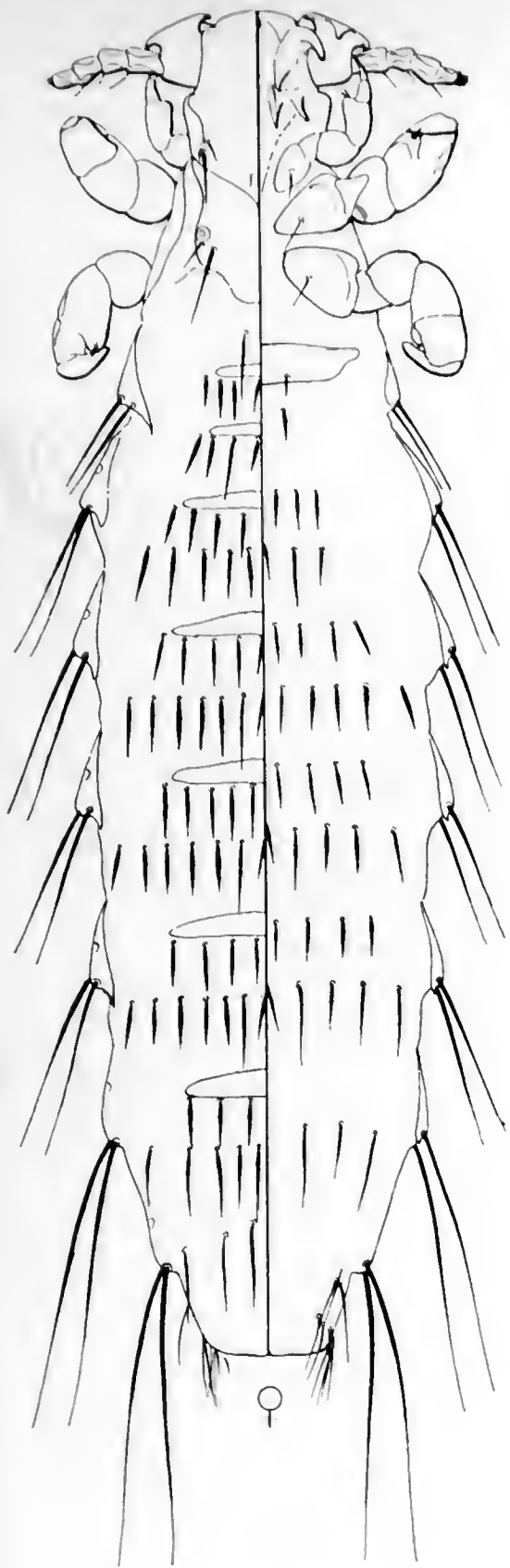
of tergal setae on all tergites except segment two, which has two rows, with one row and one plate on segments one and 4-7 and two plates on segment two; ventrally with but one plate and one row of setae on segment two and with but one row of setae on any other segment and no plates except on segments seven and eight. Spiracles present on segments 2-8. Thoracic sternal plate not developed.

NOTES. None of the known material is in very good condition and possibly the above description will require some modification.



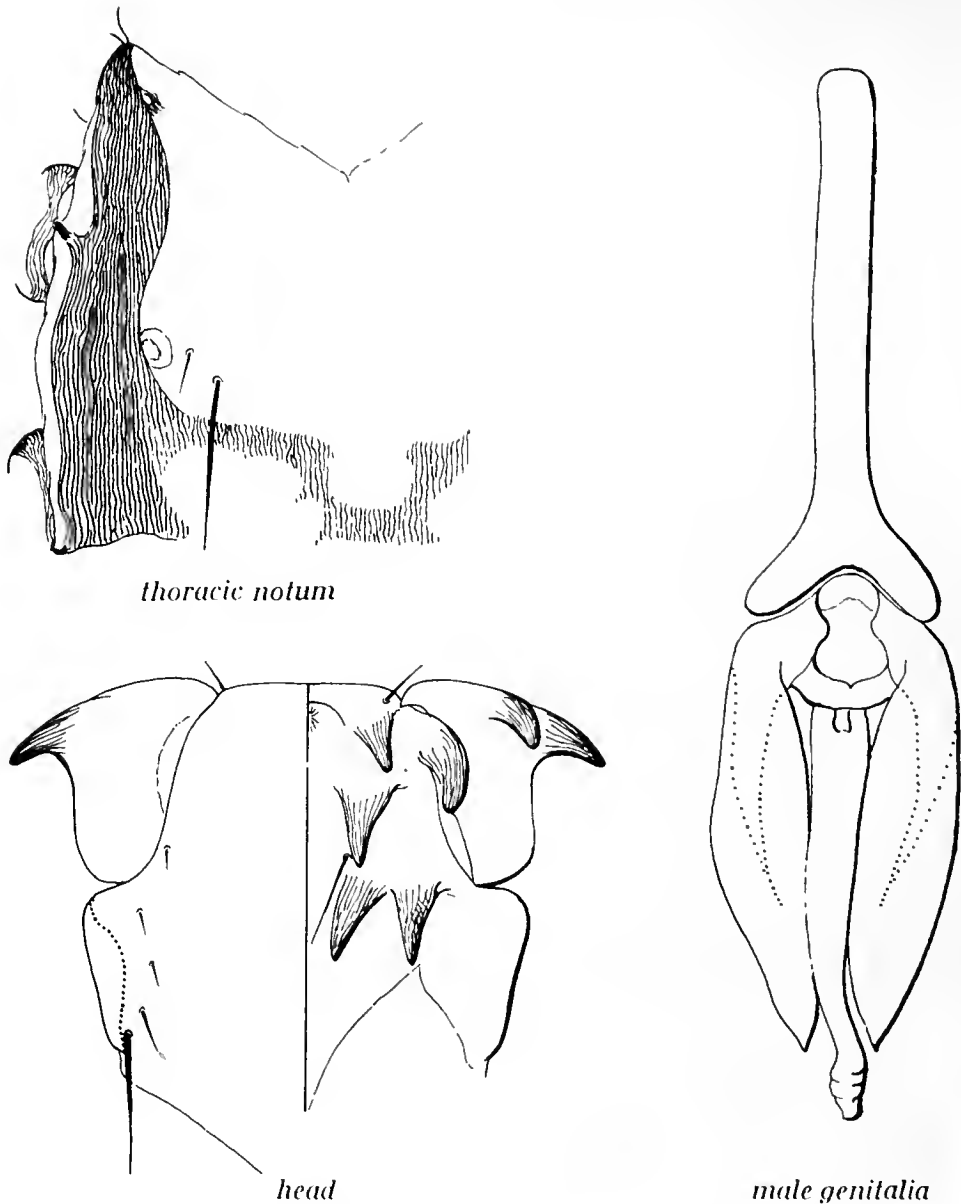
Ctenophthirus cercomydis Ferris, details

Figure 72



Docophthirus acinetus Waterston

Figure 73



thoracic notum

head

male genitalia

Docophthirus acinetus Waterston, details

Figure 74

Docophthirus acinetus Waterston
Figures 73, 74

1923. *Docophthirus acinetus* Waterston, Bulletin of Entomological Research 14:101; figures 21a and 21b.

1932. *Docophthirus acinetus* Waterston, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:304; figures 185, 186.

HOSTS AND DISTRIBUTION. Known only from the original record in which it was ascribed to *Anathana ellioti*, which belongs to the family Tupaiidae, the tree shrews.

Genus EULINOGNATHUS Cummings

1916. *Eulinognathus* Cummings, Annals and Magazine of Natural History (series 8) 17:90.
 1929. *Bathyerģicola* Bedford, Annual Report of the Director of Veterinary Services, Union of South Africa 15:505.
 1932. *Bathyerģicola*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:311.
 1932. *Eulinognathus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:318.

SYNONYM. *Bathyerģicola* Bedford.

GENERIC TYPE. *Eulinognathus denticulatus* Cummings, by original designation. The type of *Bathyerģicola* is *Bathyerģicola hilli* Bedford, by original designation.

CHARACTERS. Polyplacinae with five-segmented antennae which are not sexually dimorphic. Anterior legs small, with slender claw. Middle legs larger than the first, with stouter claw and at times as large as the posterior legs. Paratergal plates present on abdominal segments 2-6 at least, except that they are lacking on segment two in one species. Abdomen always membranous throughout except for the ninth tergite and the usual genital plates. Abdominal segments with either one or two transverse rows of setae on most of the segments, both dorsally and ventrally, in the female and always with but one row in the male. Spiracles present on segments 3-7 or 3-8.

NOTES. A most unsatisfactory situation exists in regard to this genus. Ferris (1932) recognized *Eulinognathus* and *Bathyerģicola* as distinct genera, although it was indicated that neither of these genera was entirely homogeneous or sharply defined. A re-study of the question in connection with the present work does not support the separation there accepted. In 1932, it was indicated that the two genera could be separated by the number of abdominal spiracles, *Eulinognathus* having spiracles only on segments 3-7 while *Bathyerģicola* has them also on segment eight. But this seems to separate species which are actually more or less alike on the basis of other characters. A separation on the basis of the rows of setae on the abdominal segments of the female will not permit a separation of the males. A separation of one species called *Bathyerģicola lawrensis* Bedford, on the basis of the absence of paratergal plates on segment two of the abdomen would remove this species from association with others which resemble it in other respects. A separation of the species which have tubercles on the head brings together certain forms which seem to be connected by host associations, but is not supported by other characters. A separation on the basis of the presence or absence of the thoracic sternal plate leads to an evidently artificial grouping. Any arrangement that may be made seems to receive no support from host or geographical distribution, yet all the species seem to share a general similarity. The solution of naming several genera suggests itself but seems to offer no especially sensible arrangement, although this may be the eventual solution.

This solution is in part here accepted by recognizing the two genera *Laģidiophthirus* and *Galeophthirus* which have previously been named for species referred to *Eulinognathus*.

Key to Species of EULINOGNATHUS

1. Head with at least 1-2 stout, sclerotized, hook-like processes or tubercles on the ventral side near the bases of the antennae.....2
 Head without such hooks or tubercles.....4
2. Head with both dorsal and ventral hooks or tubercles.....DENTICULATUS
 Head with hooks or tubercles only on the ventral side.....3
3. Ventral side of first antennal segment with hooks.....ACULEATUS

- Ventral side of first antennal segment without such hooks.....BIUNCATUS
4. Paratergal plates present only on segments 3-6.....LAWRENSIS
- Paratergal plates present on at least segments 2-6.....5
5. Abdominal segment 7 with distinct, apically free paratergal plates.....LOPHIOMYDIS
- Abdominal segment 7 without distinct, apically free paratergal plates 6
6. Sternal plate of thorax well developed.....AMERICANUS
- Sternal plate of thorax not at all developed.....HILLI

Eulinognathus aculeatus (Neumann)

1912. *Haematopinus aculeatus* Neumann, Bulletin de la Société Zoologique de France 37:143; figures 5, 6.
1916. *Eulinognathus aculeatus* (Neumann), Ferris, Proceedings of the California Academy of Sciences (Series 4) 6:168.
1932. *Eulinognathus aculeatus* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:321; figures 196, 197.

HOSTS AND DISTRIBUTION. Originally recorded from "*Dipus* sp.," at Djjerba, Tunis. According to Ellerman's list this is probably a species of *Jaculus*. Recorded by Ferris from *Allactaga mongolica* which, according to Ellerman, is *Allactaga siberica*. These hosts are members of the family Dipodidae.

NOTES. There is a possibility of a misidentification in the record by Ferris, since the types of the species were not seen.

Eulinognathus americanus Ewing

1923. *Eulinognathus americanus* Ewing, Journal of the Washington Academy of Sciences 13:148.
1932. *Eulinognathus americanus* Ewing, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:325; figure 200.

HOSTS AND DISTRIBUTION. Type from *Ctenomys brasiliensis* on the Salade River, Paraguay. Recorded by Ferris from *Ctenomys sericus* from the Upper Rio Chico, Paraguay. The hosts belong to the family Echimyidae.

NOTES. The curiously modified setae on the paratergal plates of segments 3-5 offer a basis for the generic separation of this species if this should prove desirable. It is at present known only from the female.

Eulinognathus biuncatus Ferris

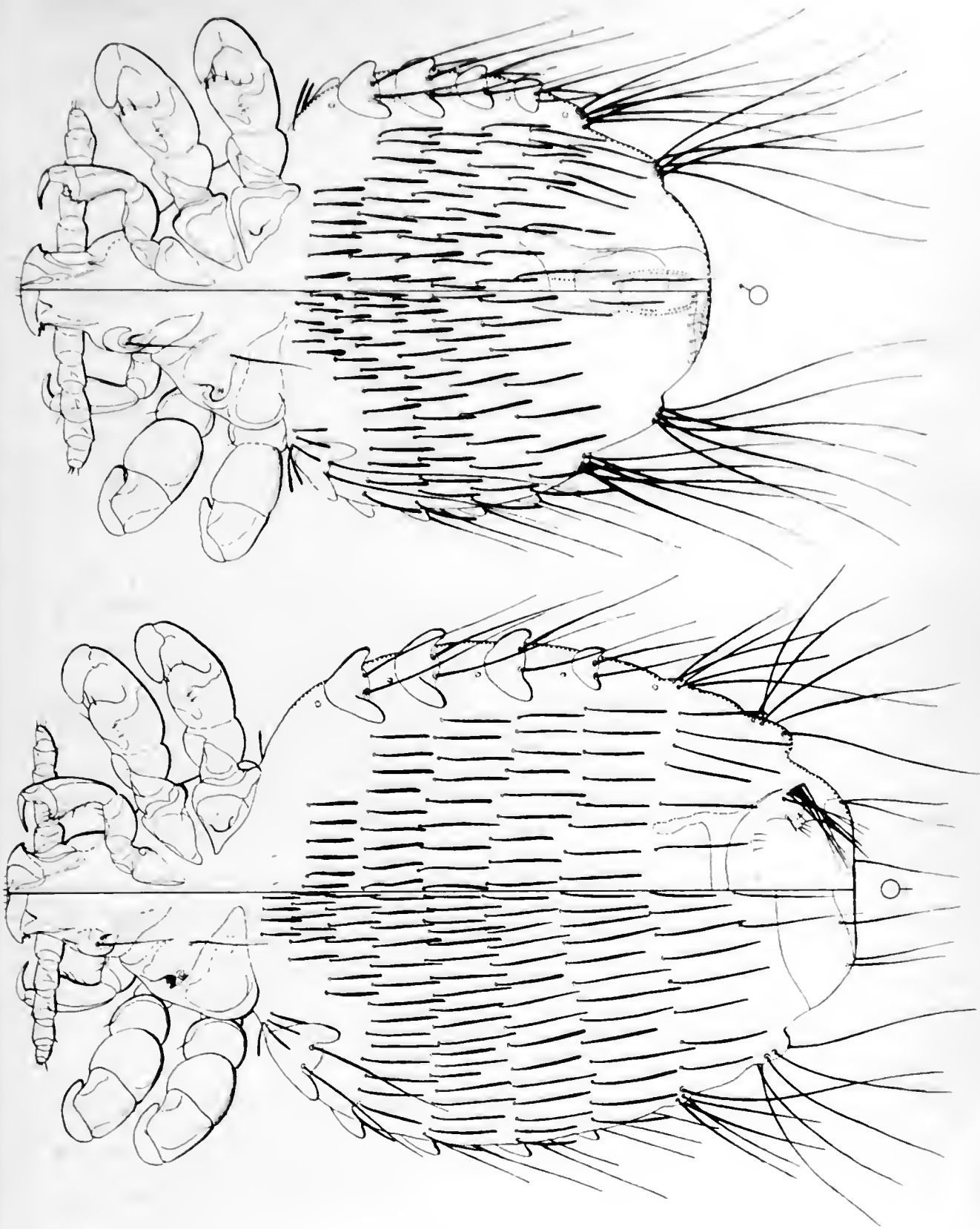
1932. *Eulinognathus biuncatus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:324; figures 198, 199.

HOSTS AND DISTRIBUTION. From *Dipodipus sowerbyi* in Shensi, China. According to Ellender this is *Dipus sagitta*.

Eulinognathus denticulatus Cummings
 Figures 75, 76

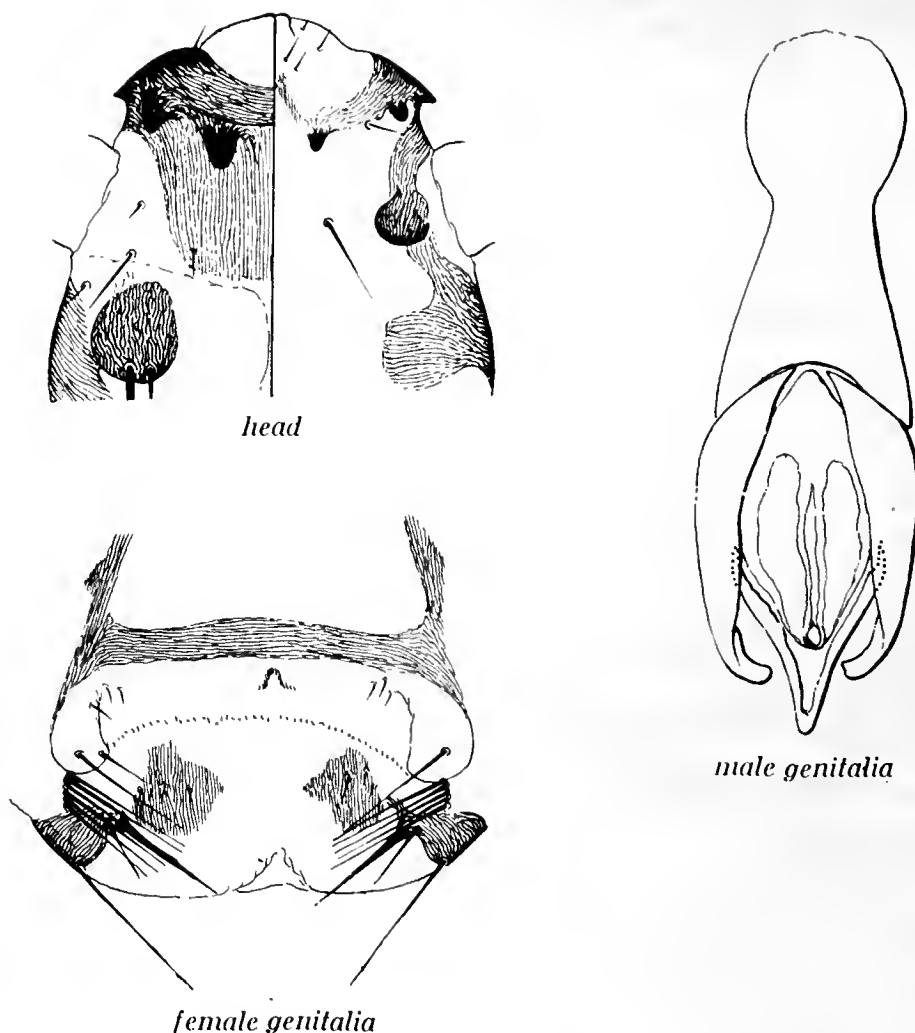
1916. *Eulinognathus denticulatus* Cummings, Annals and Magazine of Natural History (Series 8) 17:90; figure.
1932. *Eulinognathus denticulatus* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:319; figures 194-195.
1940. *Eulinognathus denticulatus surdasteri* Werneck, Revista de Entomologia 11:724; figure.

HOSTS AND DISTRIBUTION. Recorded by Cummings from *Pedetes caffer* without indication of locality, and by Bedford from the same host in South Africa. Ferris has recorded it from *Pedetes larvalis* and *Pedetes* sp. at Nairobi and Machakos, British East Africa, and from *Nastomys coucha* and *Rattus rattus* at Nairobi. Werneck has described the supposed subspecies or



Eulinognathus denticulatus Cummings

Figure 75



Eulinognathus denticulatus Cummings, details

Figure 76

variety *surdasteri* from *Pedetes surdaster larvalis* at Nairobi, basing it upon slight differences in the form of the pseudopenis of the male. Males at hand from the type host at Nairobi show definitely that the supposed difference depends merely upon whether or not the pseudopenis happens to be turned upward. The subspecies *surdasteri* is consequently rejected. According to Ellerman's list there are but two species of *Pedetes*, these being *caffer* and *surdaster*, *larvalis* being a subspecies of the latter. The hosts belong to the rodent family Pedetidae.

Eulinognathus hilli (Bedford)

- 1929. *Bathyrhagica hilli* Bedford, Report of the Director of Veterinary Services, Union of South Africa, 15:506; figures 6, 7, 7a, 8.
- 1932. *Bathyrhagica hilli* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:312; figures 190, 191.
- 1932. *Proenderleinellus hilli* (Bedford), Bedford, Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, 18:401.

HOSTS AND DISTRIBUTION. Described from *Georhynchus hottentotus* at Pietermaritzburg, Natal, South Africa, and recorded only from this host and locality. According to Ellender the generic name of the host is *Cryptomys*. It belongs to the family Bathyergidae.

Eulinognathus lawrensis (Bedford)

1929. *Bathyergicola lawrensis* Bedford, Annual Report of the Director of Veterinary Services, Union of South Africa, 15:506; figs. 7b, 9, 10.
1932. *Bathyergicola lawrensis* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:314; figure 192.
1932. *Proenderleinellus lawrensis* (Bedford), Bedford, Annual Report of the Director of Veterinary Services and Animal Industry, Union of South Africa, 18:401.

HOSTS AND DISTRIBUTION. Described from *Bathyergus suillus* (=maritimus) from unspecified locality in Cape Colony, South Africa. The host belongs to the family Bathyergidae.

Eulinognathus lophiomydis (Ferris)

1932. *Bathyergicola lophiomydis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:315; figure 193.
1940. *Bathyergicola lophiomydis* Ferris, Werneck, Revista de Entomologia 11:728; figures.

HOSTS AND DISTRIBUTION. Type, the female, described as from *Lophiomyces thomasi* from Mount Garguez, and recorded also from *Lophiomyces ibeanus* at Nakroru, British East Africa. The male was described by Werneck from *Lophiomyces* sp., "probably *testudo*," from Kenya, British East Africa. According to Ellender all these names represent subspecies of *Lophiomyces imhausi*. The host genus belongs to the family Lophiomyidae.

Genus FAHRENHOLZIA Kellogg and Ferris

1915. *Fahrenholzia* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 32.
1922. *Fahrenholzia*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:158.

GENERIC TYPE. *Fahrenholzia pinnata* Kellogg and Ferris.

CHARACTERS. Polyplacinae with five-segmented antennae which are not sexually dimorphic. Anterior legs small, with slender claw. Middle and posterior legs equal in size, with very large tibiotarsus and stout claw, the tarsus with a sclerotized, retrorse point at the outer basal angle. Paratergal plates of the abdomen present on a variable number of segments, always, however, with at least three pairs present. The paratergal plates of what is apparently segment two consist each of two plates, one lying on the dorsum, the other on the venter, distinctly separated from each other, the ventral piece provided with a flat, apically free process which arises somewhat anterior to the apex of the plate. It is possible that we have to do with the paratergal plates of segments one and two, one or the other of which has been somewhat displaced posteriorly. Following these plates there are always plates on segments three and four, these having the apical angles free from the body. Plates which do not have the apex thus free may occur as far posteriorly as segment eight. Abdomen entirely membranous except for the usual dorsal and ventral plates of the terminal and genital segments, each segment with but a single row of setae, both dorsally and ventrally, these setae strikingly stout. Spiracles present on segments 3-8. Thoracic sternal plate strongly developed.

The members of this genus occur exclusively on members of the rodent family Heteromyidae, which occurs in North America and northern South America.

NOTES. The status of some of the species included in this genus is not clear. The author has in the past named certain "subspecies," a practice which he would not now approve, for some of these forms. These are here considered as species. It is probable that a considerable number of forms remain still to be discovered and until more is known about the group it is hopeless to talk about subspecies.

Key to Species of FAHRENHOLZIA

1. Paratergal plates present only on abdominal segments 2-4.....2
Paratergal plates present on more than these segments.....4
2. Paratergal plates of segment 3 with both apical lobes acute.....3
Paratergal plates of segment 3 with the dorsal lobe apically broad and truncate or slightly emarginate.....MICROCEPHALA
3. Paratergal plates very small and slight; male with free, elongated parameres and with a distinct pseudopenis.....REDUCTA
Paratergal plates well developed; parameres of the male broadly expanded; with no distinct pseudopenis.....PINNATA
4. Paratergal plates of segment 3 with but a single lobe.....TRIBULOSA
Paratergal plates of segment 3 bilobed.....ZACATECAE

Fahrenholzia microcephala Ferris

1922. *Fahrenholzia microcephala* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:161; figures 106, 107.

HOSTS AND DISTRIBUTION. Holotype recorded as from *Heteromys pictus* at San Carlos, Vera Cruz, Mexico, which, according to Ellender, belongs to the genus *Liomys*. Also recorded from *Heteromys goldmani* at Achotal, state of Vera Cruz, Mexico, and from *Liomys irroratus* in Texas and Mexico.

Fahrenholzia pinnata Kellogg and Ferris Figures 77, 78

1915. *Fahrenholzia pinnata* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 32; text figure 13; Plate 3, figure 2; Plate 5, figure 5; Plate 6, figure 10.

1922. *Fahrenholzia pinnata* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:159; figures 104, 105.

HOSTS AND DISTRIBUTION. Type from *Dipodomys californicus* at Covelo, Mendocino County, California. Recorded also from *Dipodomys merriami* at Independence, California, and *Dipodomys deserti* at Mecca, California; from *Dipodomys ornatus* at Valparaiso, state of Zacatecas, and *Dipodomys phillipsii* at Amecameca, Mexico; from *Perodipus* sp. at Coulterville, California; from *Peroğnathus parvus* in the Pine Forest Mountains, Nevada.

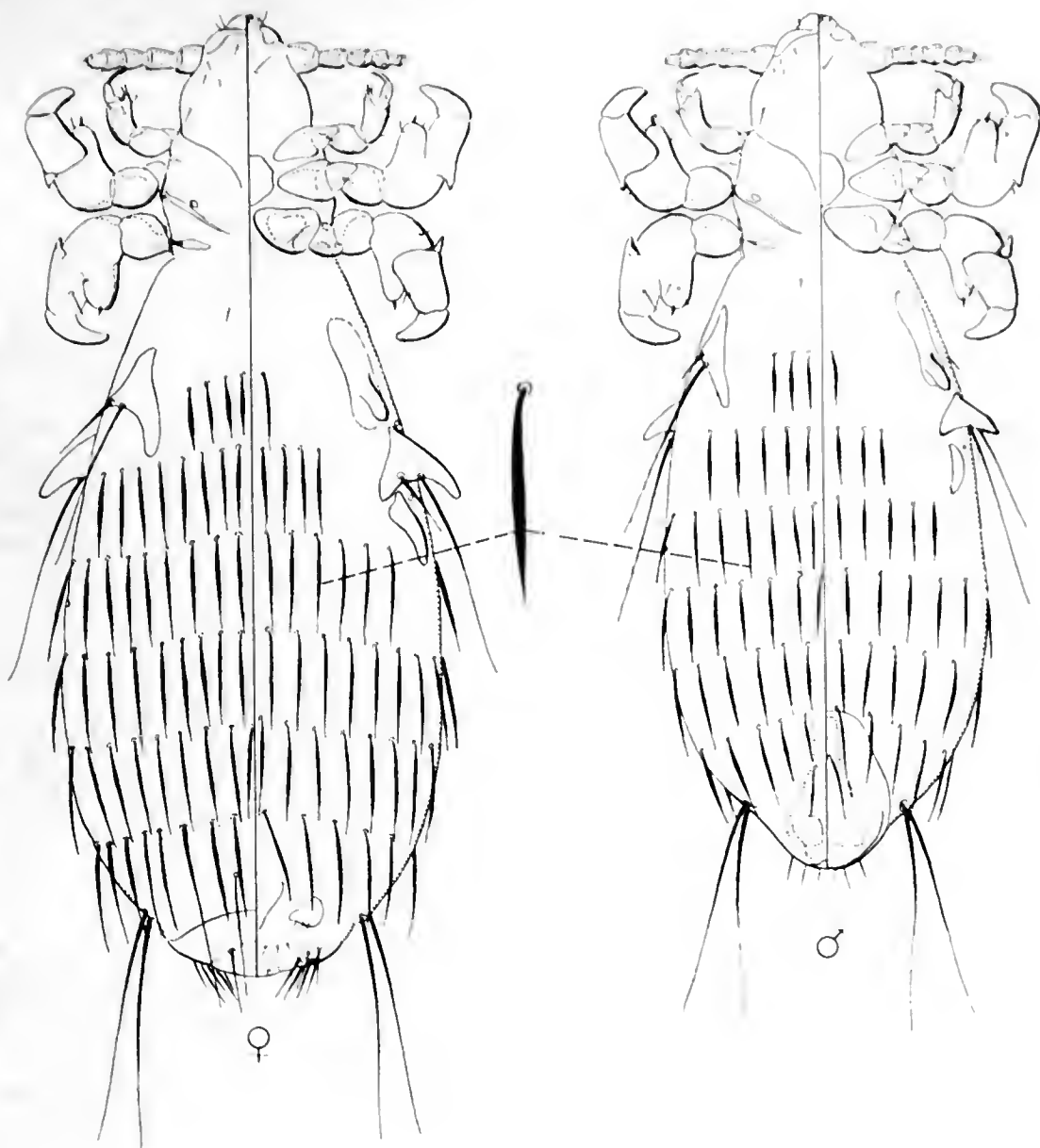
Fahrenholzia reducta Ferris

1922. *Fahrenholzia tribulosa reducta* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:165; figure 109B.

HOSTS AND DISTRIBUTION. Recorded only from *Peroğnathus formosus* at Victorville, California.

Fahrenholzia tribulosa Ferris

1922. *Fahrenholzia tribulosa tribulosa* Ferris, Contributions Toward a Mon-



Fahrenholzia pinnata Kellogg and Ferris

Figure 77

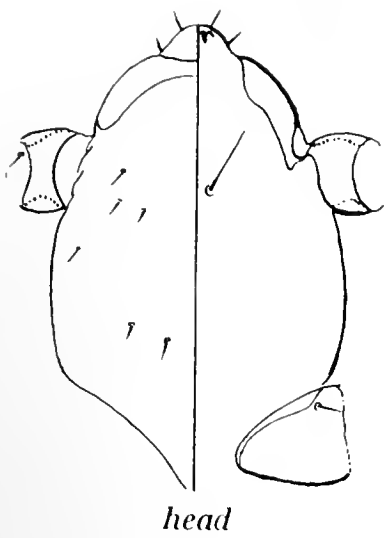
ograph of the Sucking Lice, Part 3:163, figures 108, 109A, D. E.

HOSTS AND DISTRIBUTION. Known only from *Peroñathus californicus* at Pleasant Valley, Merced County, California.

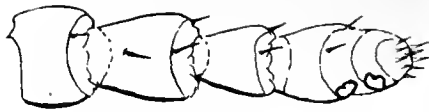
Fahrenholzia zacatecae Ferris

1922. *Fahrenholzia tribulosa zacatecae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:166; figure 109C.

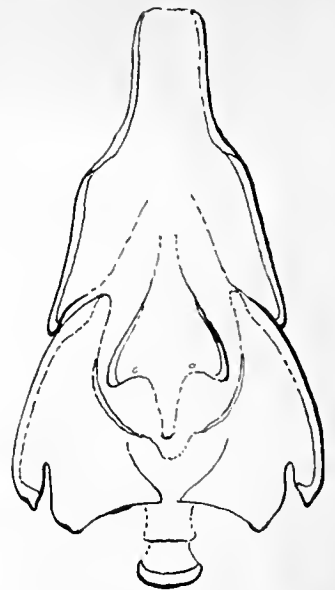
HOSTS AND DISTRIBUTION. Type from *Peroñathus hispidus* at Valparaiso, state of Zacatecas, Mexico. Specimens are at hand from the same host species in Savala County and at Somerset, Atasco County, Texas.



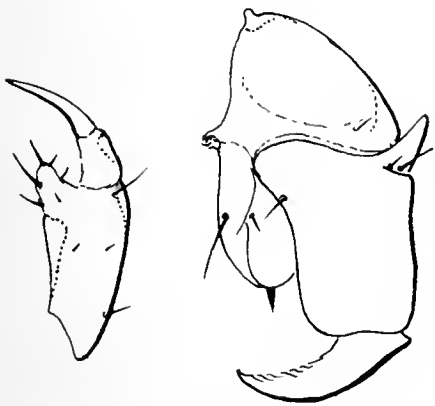
head



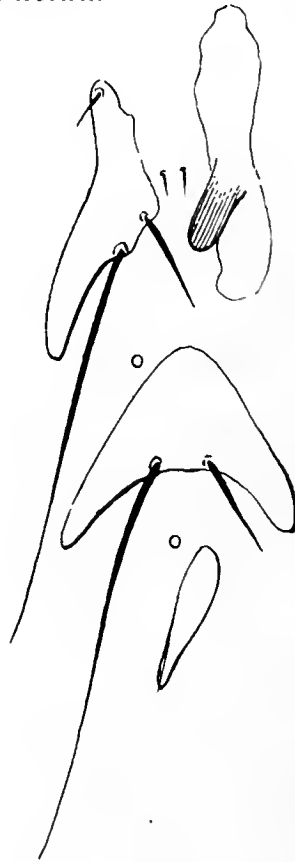
antenna



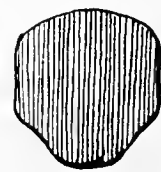
male genitalia



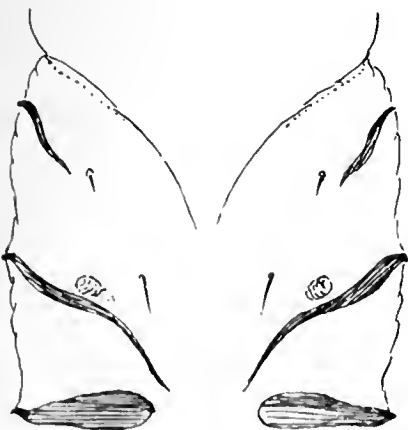
1st and 3rd claws



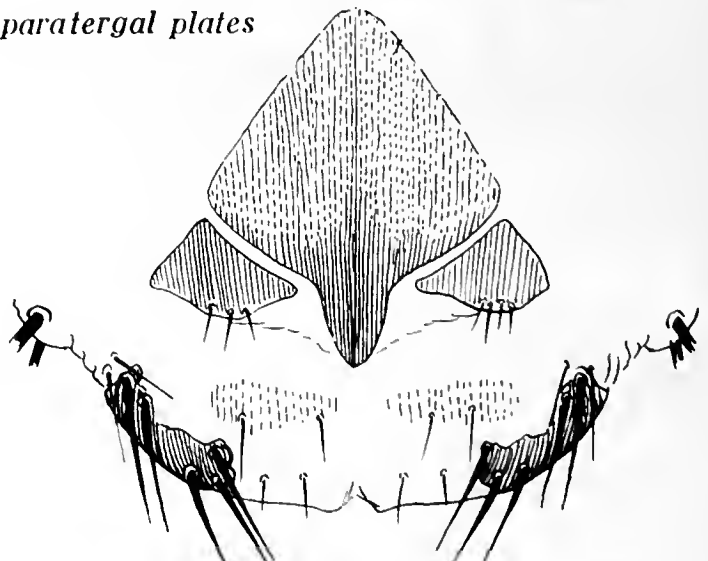
paratergal plates



thoracic sternal plate



thoracic dorsum



female genitalia

Fahrenholzia pinnata Kellogg and Ferris, details

Figure 78

Genus GALEOPHTHIRUS Eichler

1950. *Galeophthirus* Eichler, Bolletino della Societa Entomologica Italiana 79:12.

GENERIC TYPE. *Eulino gnathus caviae* Werneck, the only included species.

CHARACTERS. Antennae five-segmented, not sexually dimorphic. First legs small and weak, with slender claw. Second and third legs about equal to each other, large and stout, with stout claw. Paratergal plates present on abdominal segments 3-7, each consisting of an elongated, narrow, sclerotized area which bears two long setae at the apex, the apex not free from the body wall. Abdomen membranous throughout in both sexes except for the usual sclerotizations of the terminal and genital segments. Female with two rows or partial rows of setae on each of most of the segments, the male with but one row. Abdominal spiracles present on segments 3-8. Thoracic sternal plate present.

NOTES. About the only basis for recognizing this genus appears in the form of the paratergal plates. The writer is somewhat dubious concerning it, but it is here accepted.

Galeophthirus caviae Werneck
Figure 79

1934. *Eulino gnathus caviae* Werneck, Memorias do Instituto Oswaldo Cruz 29: 183; figures 6-11.

1950. *Galeophthirus caviae* (Werneck). Eichler, Bolletino della Societa Entomologica Italiana 79:12.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Galea leucoblephara*, which, according to Ellender, is a subspecies of *Galea musteloides* at Jujuy, Republic of Argentina. The host belongs to the family Caviidae.

Genus HAEMODIPSUS Enderlein

1904. *Haemodipsus* Enderlein, Zoologischer Anzeiger 28:139, 143.

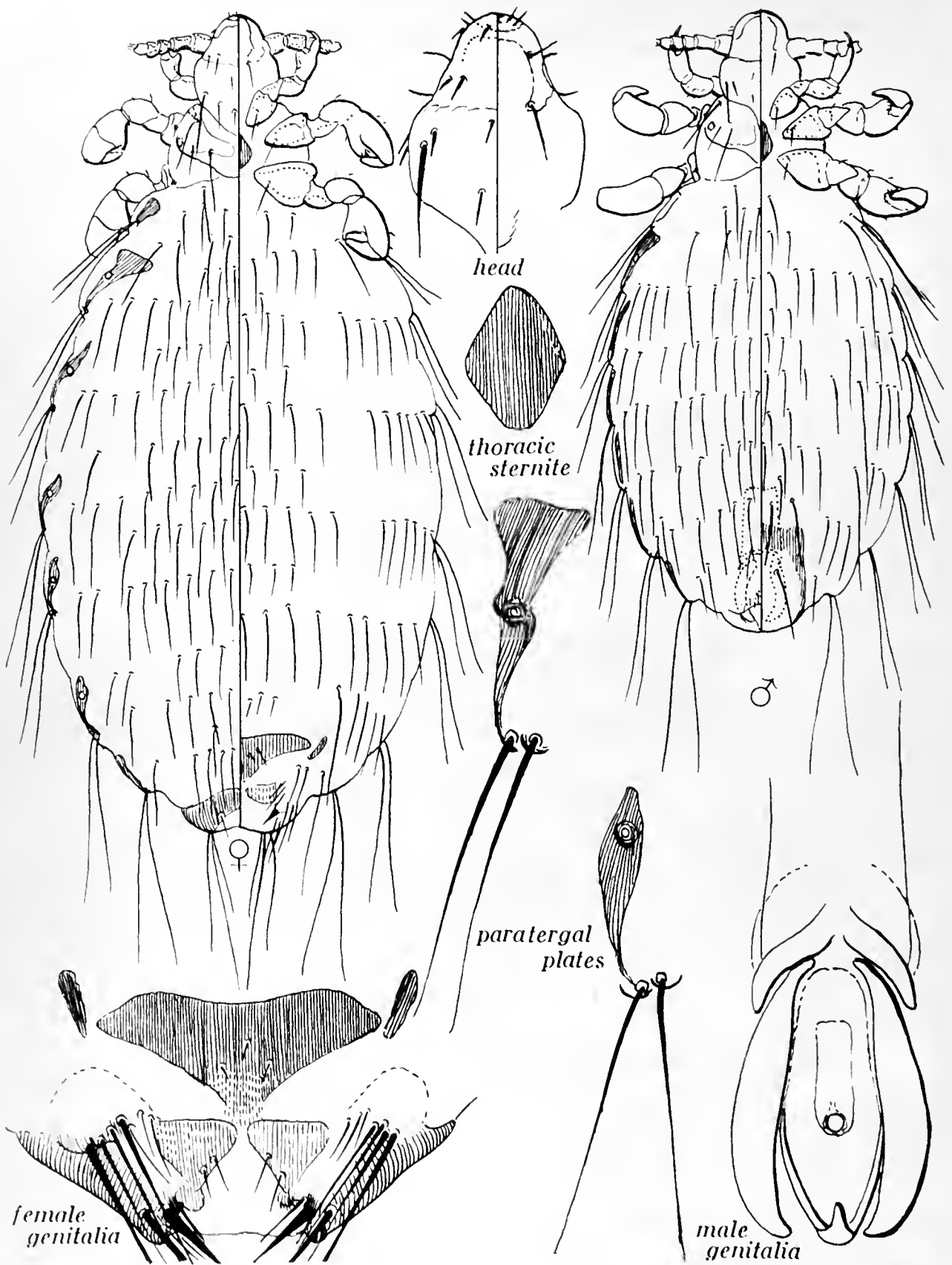
1932. *Haemodipsus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:59.

GENERIC TYPE. *Pediculus lyriocephalus* Burmeister. Two other species are included in this genus.

CHARACTERS. Anoplura referable to the Polyplacinae. Antennae five-segmented, not sexually dimorphic. First pair of legs small and with slender claw; second and third legs moderately stout and with stout claw, about equal to each other. Type species with the abdomen membranous throughout and without trace of paratergal plates; in other species of the genus with small paratergal plates on segments 3-6, these being merely a slight, sclerotized point which projects from the body wall and is supported by a slight, expanded sclerotization at the base. Abdominal segments in both sexes with a single row of setae on each, both dorsally and ventrally. Thoracic sternal plate present, but very weakly developed and at no point free from the body. Spiracles present on abdominal segments 3-8.

The members of this genus occur on hares and rabbits of the family Leporidae of the Order Lagomorpha.

NOTES. The situation concerning this genus is very unsatisfactory. The type species is unfortunately but little known and the information concerning it quite incomplete. It is possible that the other species which are referred to this genus are so placed chiefly because of their hosts. As based upon the type species the genus can scarcely be referred to the Hoplopleuridae, but the other species seem to belong to this family and to the subfamily Polyplacinae. A thorough redescription of both sexes of the type species is much needed.



Galeophthirus caviae (Werneck)

Figure 79

Key to Species of HAEMODIPSUS

1. Paratergal plates of the abdomen entirely lacking.....LYRIOCEPHALUS
Paratergal plates present on the abdomen.....2
2. Head slender.....AFRICANUS
Head strongly widened posterior to the antennae.....3
3. Sternal plate of the thorax forming a rather narrow, transverse bar....
.....VENTRICOSUS
Sternal plate of the thorax filling the space among the coxae and more
or less hexagonal.....SETONI

Haemodipsus africanus Bedford

1934. *Haemodipsus africanus* Bedford, Onderstepoort Journal of Veterinary Science and Animal Industry 2:48; figure 10.

HOSTS AND DISTRIBUTION. Recorded from *Lepus zuluensis* at Jericho, Transvaal, South Africa.

Haemodipsus lyriocephalus (Burmeister)

Figure 80

1839. *Pediculus lyriocephalus* Burmeister, Genera Insectorum, Rhynchota, Species 11.

1842. *Haematopinus lyriocephalus* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 27; Plate 24, figure 4.

1904. *Haemodipsus lyriocephalus* (Burmeister), Enderlein, Zoologischer Anzeiger 28:143.

1932. *Haemodipsus lyriocephalus* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:330; figures 202, 203.

1935. *Haemodipsus lyriocephalus* (Burmeister), Freund, Die Tierwelt Mitteleuropas, Band 4, Lieferung 3:20; figures 87-89.

HOSTS AND DISTRIBUTION. Described from *Lepus timidus* in Europe. Ferris has recorded it from *Lepus glacialis* without further data. Hopkins records it from *Lepus europaeus* in Europe.

Haemodipsus setoni Ewing

1924. *Haemodipsus setoni* Ewing, American Journal of Tropical Medicine 3:548.

1932. *Haemodipsus setoni* Ewing, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:335; figures 205B, E.

HOSTS AND DISTRIBUTION. Described from *Lepus californicus* at Wichita, Kansas, and recorded from the same host at San Diego, California. Recorded by Kellogg and Ferris from the same host in California and Arizona. Specimens from an undetermined species of "cotton tail rabbit," presumably a species of *Sylvilagus*, are at hand from the state of Montana.

Haemodipsus ventricosus (Denny)

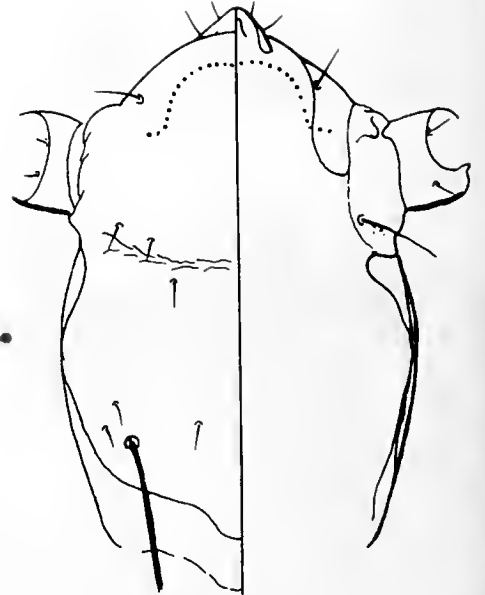
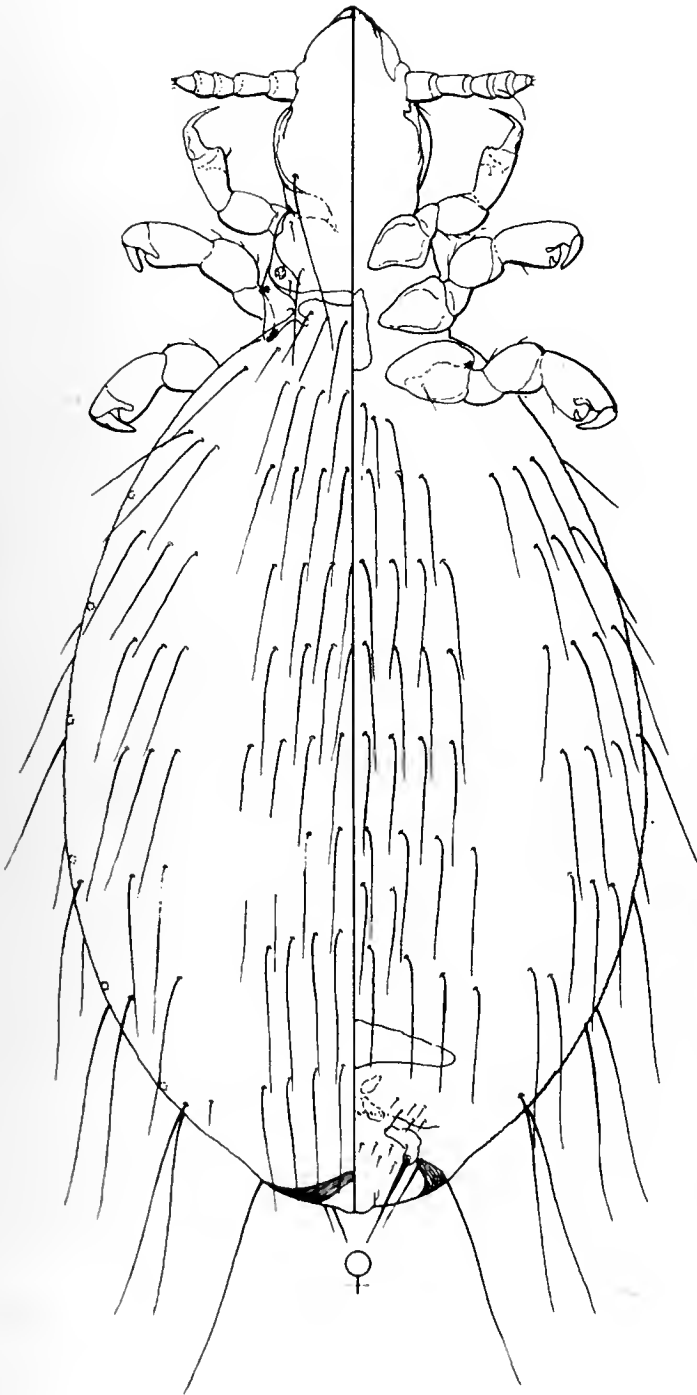
Figures 81, 82

1842. *Haematopinus ventricosus* Denny, Monographia Anoplurorum Britanniae, page 30; Plate 25, figure 6.

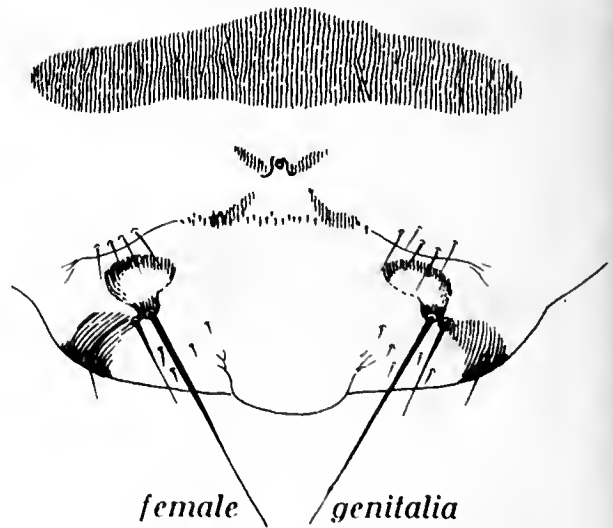
1904. *Haemodipsus ventricosus* (Denny), Enderlein, Zoologischer Anzeiger 28:143.

1932. *Haemodipsus ventricosus* (Denny), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:332; figures 204, 205.

HOSTS AND DISTRIBUTION. Described from the European rabbit, *Oryctolagus (=Lepus) cuniculus*, from England and many times recorded from this host and from domestic rabbits which are supposed to have been derived from this species in many parts of the world.



head

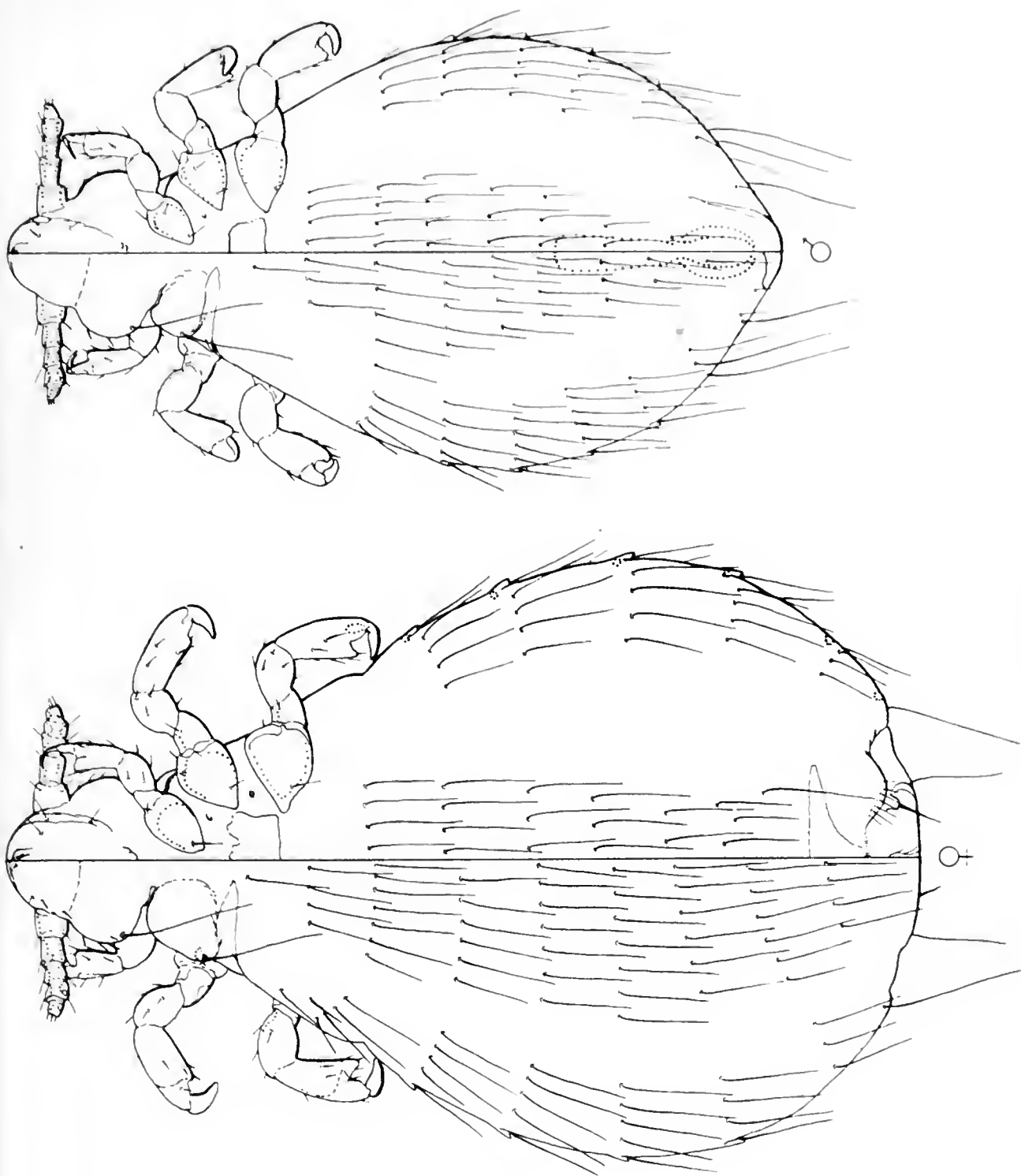


female

genitalia

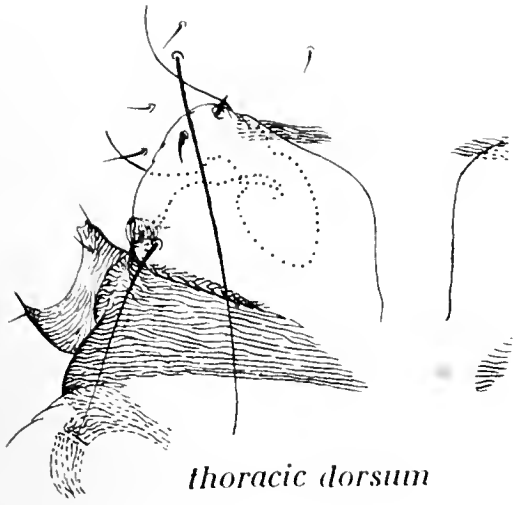
Haemodipsus lyriocephalus (Burmeister)

Figure 80

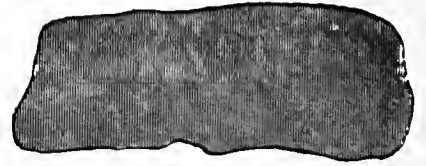


Haemodipsus ventricosus (Denny)

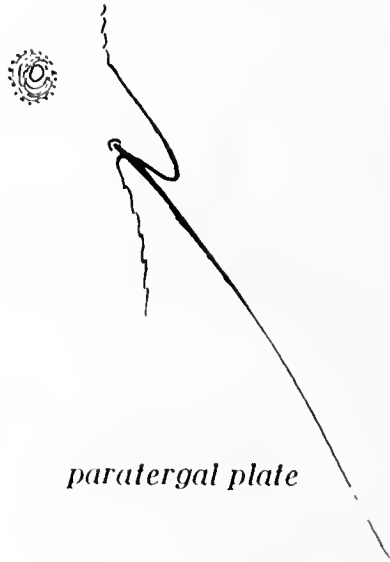
Figure 81



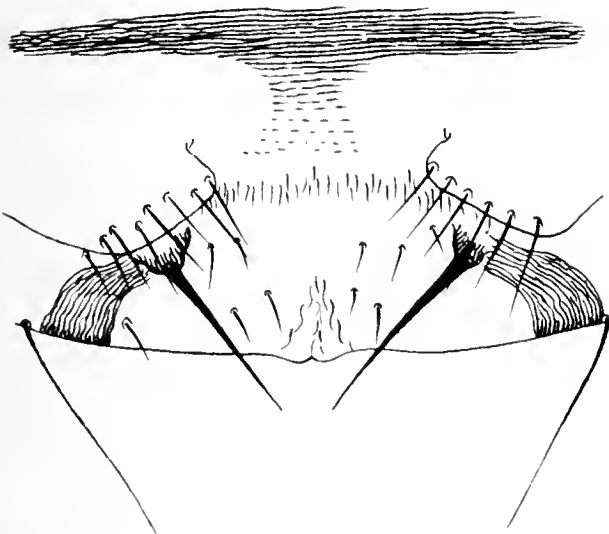
thoracic dorsum



thoracic sternal plate



paratergal plate



female genitalia



male genitalia

Genus HAMOPHTHIRUS Mjöberg

1925. *Hamophthirus* Mjöberg, Psyche 32:283.

1932. *Hamophthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:306.

GENERIC TYPE. *Hamophthirus galeopitheci* Mjöberg, the only included species.

CHARACTERS. Unfortunately this genus is known only from the original, very inadequate description and the accompanying crude figures. The following abstract of the important characters which can be gained from these is given.

Polyplacinae with three-segmented antennae, the basal segment much enlarged and with an apical hook at the anterior distal angle. Head very broad, its posterior angles produced each into a prominent point. Paratergal plates present on abdominal segments 3-7. Legs said to be "fairly equally developed."

There is in this description and the accompanying figures a suggestion that this genus is rather closely related to *Docophthirus*, although the three-segmented antennae would immediately suffice to separate it from all the other members of the subfamily.

Hamophthirus galeopitheci Mjöberg

1925. *Hamophthirus galeopitheci* Mjöberg, Psyche 32:283; figure.

1932. *Hamophthirus galeopitheci* Mjöberg, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:307; figure 187.

HOSTS AND DISTRIBUTION. From a Dermopteran, *Galeopithecus* sp., at Fes-seltan, British North Borneo. This is a *Cynocephalus variegatus*.

NOTES. In spite of the inadequate description and poor illustrations it should be possible to recognize this species if it is recovered. Ferris (1932) merely reproduces the description and figures given by Mjöberg.

Genus LAGIDIOPHTHIRUS Eichler

1950. *Lagidiophthirus* Eichler, Bolletino della Societa Entomologica Italiana 79:12.

GENERIC TYPE. *Haemodipsus parvus* Kellogg and Ferris, the only included species.

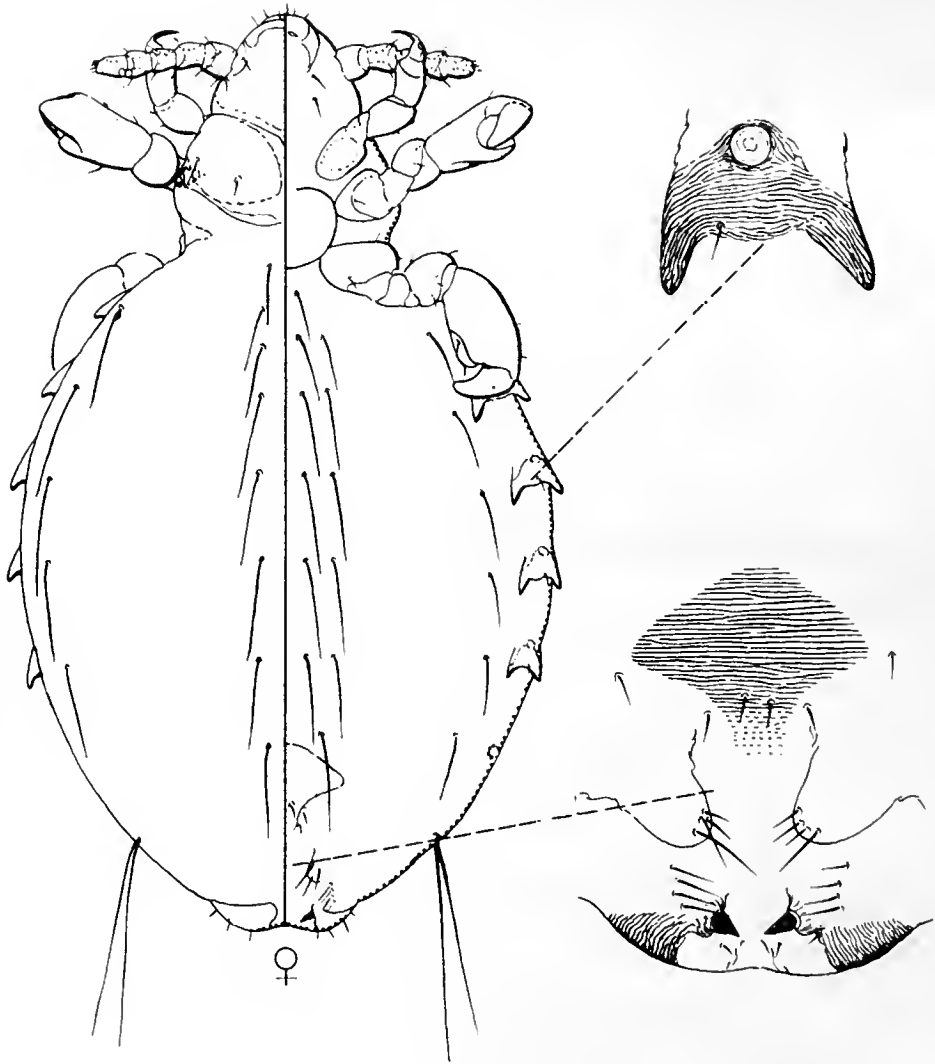
CHARACTERS. Polyplacinae with five-segmented antennae, which are not sexually dimorphic. Anterior legs small and weak; second and third legs large and stout, about equal to each other. Paratergal plates of the abdomen present on segments 2-6, these quite small and with each posterior angle produced into a strong point. Abdomen otherwise membranous except for the usual plates of the terminal and genitalic segments. Body setae very few, there being a single row, both dorsally and ventrally, on each abdominal segment, each row having a median group of 2-4 setae and there being a single seta, both dorsally and ventrally, close to the lateral margin. Spiracles present only on abdominal segments 3-7. Prothoracic sternal plate well developed.

NOTES. Recognizing a new genus for the single species included in this genus is the only way of escaping from the problems which it presents in regard to its generic assignment, in spite of the weakness of the characters on which the genus is based.

Lagidiophthirus parvus (Kellogg and Ferris)

Figure 83

1915. *Haemodipsus parvus* Kellogg and Ferris, Anoplura and Mallophaga of



Lagidiophthirus parvus (Kellogg and Ferris)

Figure 83

North American Mammals, Stanford University Publications, University Series (no volume number), page 30; text figure 12; Plate 2, figure 4; Plate 4, figure 6.

1932. *Eulinoëgnathus parvus* (Kellogg and Ferris), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:327; figure 201.
 1940. *Eulinoëgnathus parvus* (Kellogg and Ferris), Werneck, Revista de Entomologia 11:726; figure.
 1950. *Lagidiophthirus parvus* (Kellogg and Ferris), Eichler, Bolletino della Societa Entomologica Italiana 79:12.

HOSTS AND DISTRIBUTION. Type from *Lagidium peruanum* from an unspecified locality in Peru. Werneck has recorded the species from *Lagidium inca-*
which, according to Ellender, is the same as *peruanum*—from the Cordillera Songo, Province of Murillo, Department of La Paz, Bolivia.

NOTES. This species was originally described from the female alone but Werneck has described the male. It is possible here to illustrate only the female.

Genus LEMURPHTHRUS Bedford

1927. *Lemurphthirus* Bedford, Parasitology 19:263.

1932. *Lemurphthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:299.

GENERIC TYPE. *Lemurphthirus galaḡus* Bedford.

CHARACTERS. Polyplacinae with five-segmented antennae which are sexually dimorphic, the male having the distal, preaxial angle of the third segment strongly produced and curved posteriorly and bearing two short, stout setae. Anterior legs small and weak, with weak claw; middle and posterior legs definitely larger, but not greatly so, about equal to each other. Paratergal plates present only on the second abdominal segment, consisting of a simple, flat, somewhat cuneiform, sclerotized piece, the extreme apex of which is free from the body. Abdomen, in both sexes, with a single plate and a single row of hairs on each segment, both dorsally and ventrally, except that the female appears to have two plates and two rows of setae on segment two. Thorax unusually elongate, with a very large, marginally free, sternal plate. Spiracles present on abdominal segments 3-8.

NOTES. The head and thorax of the species of this genus might very well belong to a species of *Neohaematopinus*, but the abdomen is quite different. The genus contains two known species.

Key to Species of LEMURPHTHRUS

Sternal plate of the thorax with a slender, median, anterior prolongation..
.....VERRUCULOSUS
Sternal plate of the thorax without such anterior prolongation.....GALAGUS

Lemurphthirus galaḡus Bedford Figures 84, 85

1927. *Lemurphthirus galaḡus* Bedford, Parasitology 19:263; figures.

1932. *Lemurphthirus galaḡus* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:300; figures 183, 184.

HOSTS AND DISTRIBUTION. Type from *Galaḡus moholi* (which, according to Hopkins, is *senegalensis*), a Lemuroid, from Onderstepoort, Transvaal, South Africa and recorded at the same time from Southwest Africa. Ferris has recorded the species from the same host, without data, in the British Museum. Hopkins records it without locality from *Galaḡo demidovii*.

Lemurphthirus verruculosus Ward

1951. *Lemurphthirus verruculosus* Ward, Entomological News 62:190; figures.

HOSTS AND DISTRIBUTION. Known only from "mouse lemur" from Bemangidy, Fort Dauphin District, Tuléar Province, Madagascar. Presumably this refers to some species of the genus *Cheiroḡaleus*.

Genus NEOHAEMATOPINUS Mjöberg

1910. *Neohaematopinus* Mjöberg, Arkiv för Zoologi 6:13: 160.

1910. *Acanthopinus* Mjöberg, Arkiv för Zoologi 6:13: 160.

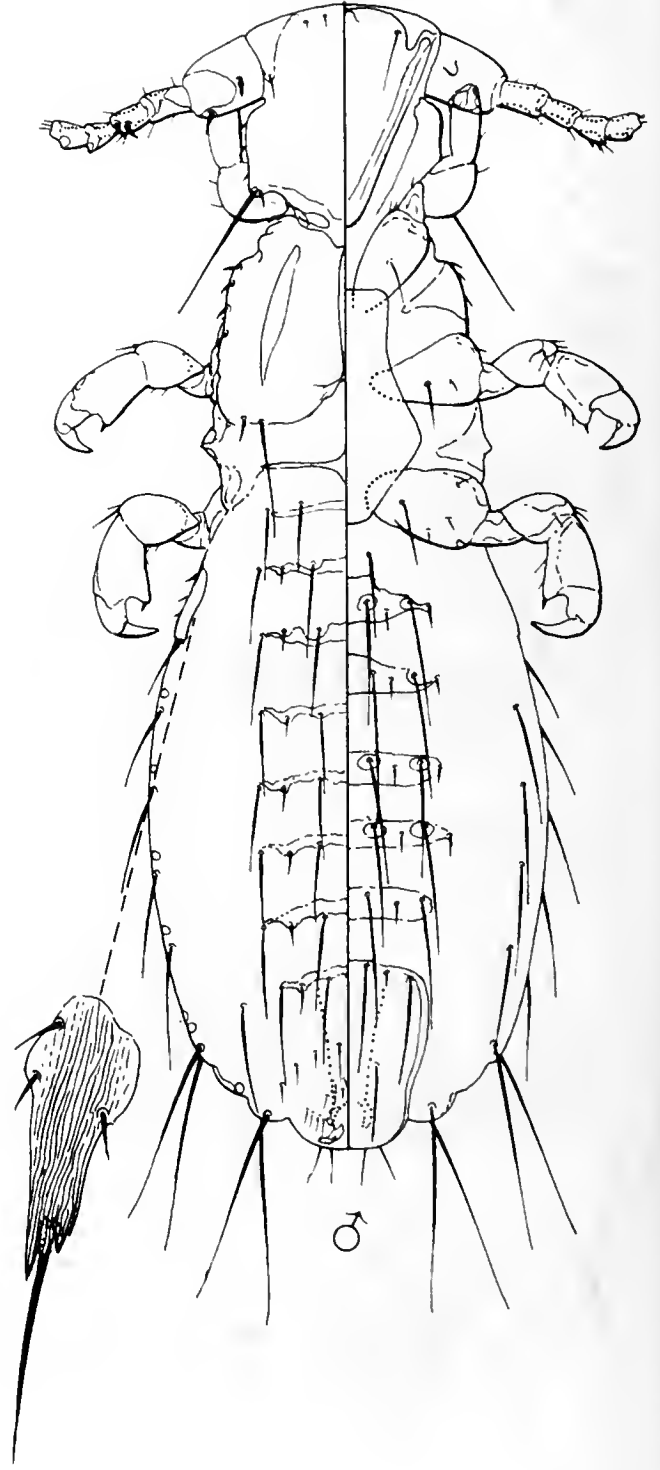
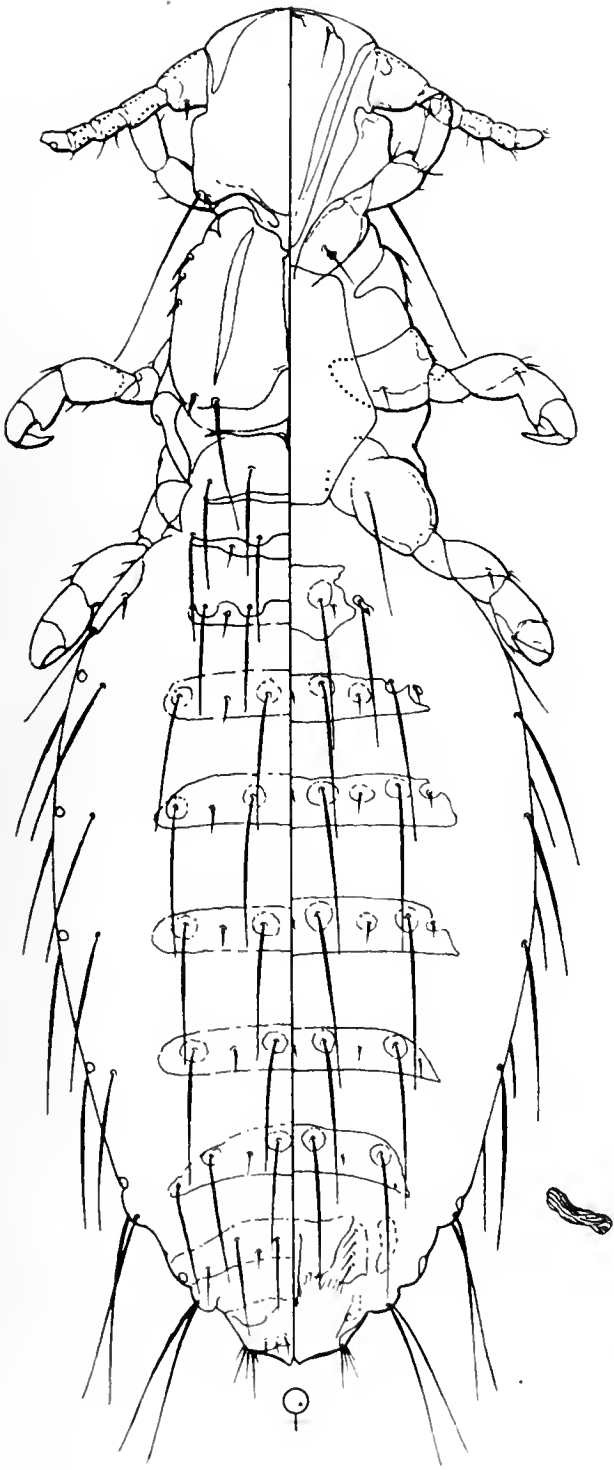
1914. *Linoḡnathoides* Cummings, Bulletin of Entomological Research 3:393.

1916. *Luteḡus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, S1:11:31.

1923. *Neohaematopinus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:237.

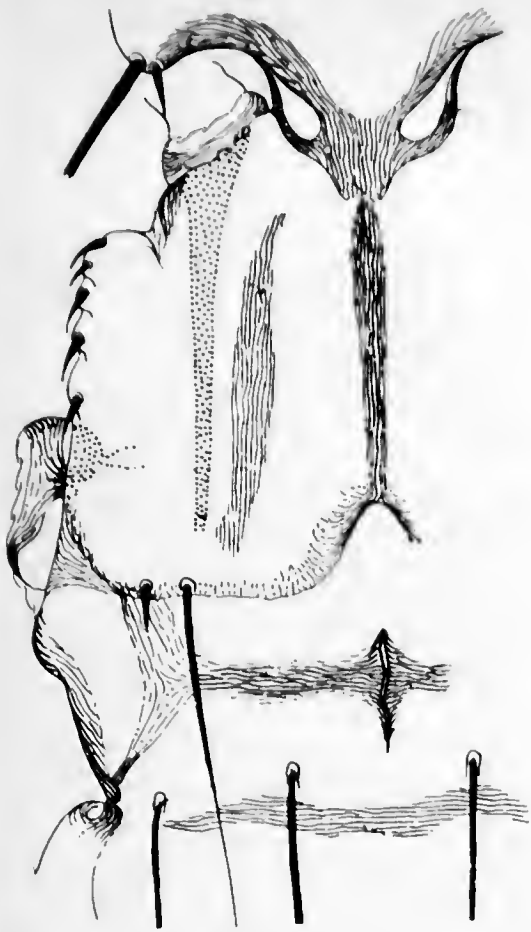
1929. *Ahaematopinus* Ewing, A Manual of External Parasites, page 197.

1949. *Petauristophthirus* Eichler, Bolletino della Societa Entomologica Italiana 79:12.

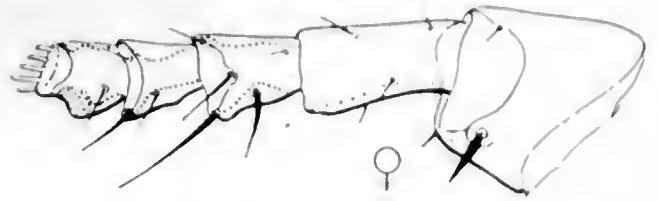


Lemurphthirus galagus Bedford

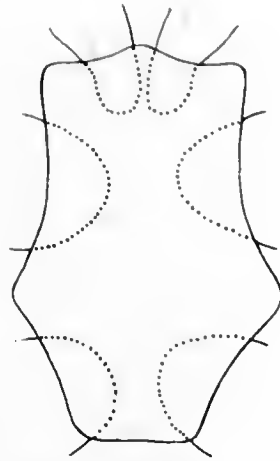
Figure 84



thoracic dorsum



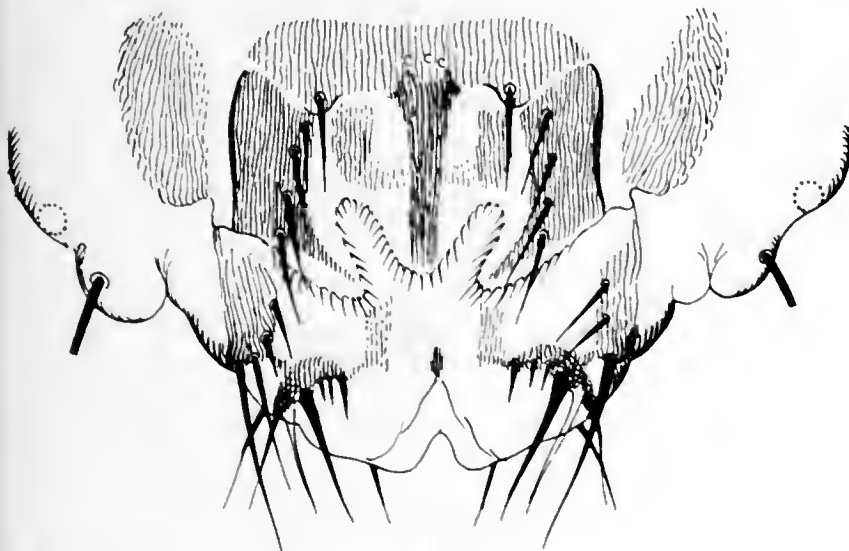
antenna



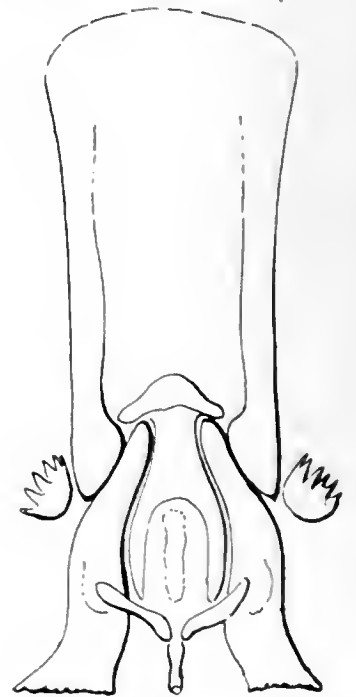
thoracic sternal plate



2nd or 3rd claw



female genitalia



male genitalia

Lemurphthirus galagus Bedford, details

Figure 85

GENERIC TYPE. *Haematopinus sciuropteri* Osborn.

GENERIC SYNONYMS. *Acanthopinus* Mjöberg, type *Haematopinus antennatus* Osborn; this specific name being preoccupied was later changed to *Acanthopinus sciurinus* Mjöberg. *Linoğnathoides* Cummings, type *Linoğnathoides citelli* Cummings. *Lutegus* Fahrenholz, type *Haematopinus (Polyplax) pectinifer* Neumann. *Ahaematopinus* Ewing, type *Neohaematopinus inornatus* Kellogg and Ferris. *Petauristophthirus* Eichler, type *Neohaematopinus petauristae* Ferris.

CHARACTERS. Polyplacinae in which the antennae are usually at least slightly sexually dimorphic, the third segment in the male having the distal preaxial angle slightly prolonged and bearing dorsally 1-2 small, stout, recurved setae. Head usually abruptly broadened posterior to the antennae. Legs with the first pair small and with slender claw; second and third pairs larger and with stout claw, usually almost equal but the third pair at times larger than the second, although never flattened and expanded. Thoracic sternal plate usually well developed, although lacking in one species. Abdomen always with paratergal plates on segments 3-8, and occasionally with a vestige of such plates on segment one, the plates of segment two never divided longitudinally. Abdomen always with some development of tergal plates in the male and usually so in the female, but in some species with the plates very weakly developed or present only on segment two or 2-3. Female normally with two transverse rows of setae on segments 2-7 dorsally and segments 3-6 ventrally, but in a few species with three rows on these segments. Male normally with but one row of setae on any segment dorsally, except that segment two has two rows; normally with two rows of setae on segments 2-6 ventrally. In all known species the row of dorsal setae which is probably the second row of segment two is associated with an at least slightly developed tergal plate which is posteriorly emarginate, with some of the setae at the lateral ends of the plate somewhat differentiated in size or form from the others and more or less radiately arranged. In some species this character is weakly developed but in all it is to some degree indicated.

NOTES. In spite of some departures by certain species from the characteristic pattern of the genus this group, as here understood, seems to be quite natural and relatively homogeneous. The group of species for which the name *Linoğnathoides* might be employed departs most widely from the typical form, especially in its type species, but it would be very difficult to advance any very cogent reason for its separation. The genus *Lutegus* would, in any event, be a synonym of *Linoğnathoides*. The genus *Ahaematopinus* is utterly without justification and there is no satisfactory reason for the naming of the genus *Petauristophthirus*.

The genus *Neohaematopinus* is characteristically associated with members of the rodent family Sciuridae, but two species occur on North American species of the genus *Neotoma* and perhaps some other closely related genera, these being members of the Murid subfamily Cricetinae. One species recorded from a South American rodent of the family Octodontidae probably does not belong to *Neohaematopinus*.

Key to Species of NEOHAEMATOPINUS

- 1. Sternal plate of the thorax entirely lacking; known from *Spermophilus leptodactylus* in the Caspian Sea area in Asia.....CITELLI
- Sternal plate of the thorax present and sclerotized.....2
- 2 (1). Thoracic sternal plate always with the posterior angles each produced into a distinct point.....3
- Thoracic sternal plate not with its posterior angles thus produced.....13
- 3 (2). Paratergites of abdominal segments 4-6 with not more than 2 setae

- on the posterior border.....4
- Paratergal plates of segments 4-6 each with 3 or more setae.....9
- 4 (3). With an enlarged thorn-like seta at the extreme apex of the postaxial angle of the first antennal segment.....5
- Without such a seta, or if an enlarged, thorn-like seta is developed it is not at the apex of the postaxial distal angle, being more or less removed therefrom.....6
- 5 (4). Abdomen of the female with a definitely developed tergal plate associated with the anterior row of setae on segments 3-7; attributed to many species of squirrels.....SCIURINUS
- Abdomen of the female with no tergal plate on segments 3-7; known only from *Sciurus griseus* in western United States....GRISEICOLUS
- 6 (4). Head very broad, definitely broader than long; known from North American flying squirrels of the genus *Glaucomys*.....SCIUKOPTERI
- Head definitely longer than broad.....7
- 7 (6). Known from *Sciurus vulgaris* in Europe (see notes under species)....SCIURI
- Known from New World Cricetinae of the genus *Neotoma* and closely related genera.....8
- 8 (7). Female with no trace of abdominal tergal and sternal plates other than those normally present on the terminal and genital segments and extremely small tergal plates on abdominal segment 2; known from *Neotoma cinerea* in western United States.....INORNATUS
- Female with definitely developed tergal and sternal plates associated with the first row of setae on each abdominal segment; known from *Neotoma albigula*, *Neotoma fuscipes*, and *Neotoma micropus* in southwestern United States and *Hodomys alleni* in Mexico..NEOTOMAE
- 9 (3). Paratergal plates of abdominal segments 3-6 each with 3 setae on the posterior margin.....10
- Paratergal plates of abdominal segments 3-6 each with 5-6 setae on the posterior margin.....11
- 10 (9). First antennal segment with a stout, thorn-like seta borne at the apex of the distal postaxial angle; known from members of the genus *Neotamias* in North America.....PACIFICUS
- First antennal segment with no trace of such a seta; known from *Citellus tereticaudus* in southwestern United States...CITELLINUS
- 11 (9). Paratergal plates of abdominal segments 3-6 each with 6 setae on the posterior border, these arranged in 2 groups of 3 setae each; known from *Sciurus anomalus* in Syria.....SYRIACUS
- Paratergal plates with the setae otherwise arranged.....12
- 12 (11). Paratergal plates of abdominal segments 3-6 each with 5 setae which are arranged with a single seta near the ventral angle and a group of 4 near the dorsal angle; known from *Funambulus* in Ceylon.....CEYLONICUS
- Paratergal plates of abdominal segments 4-5 each with their setae arranged in 2 groups, the dorsal group with 4 and the ventral group with 3; known from *Funambulus palmarum* in India ECHINATUS
- 13 (2). Paratergal plates of abdominal segments 3-6 each with one or both of their posterior angles produced into a short, slender, somewhat finger-like process; known from *Abrocoma cinerea* (a Cricetine) in Peru.....LONGUS
- Paratergal plates not so.....14
- 14 (13). Female with 3 rows of tergal setae on abdominal segments 3-6...15
- Female with 2 rows of setae on these segments.....18
- 15 (14). Abdomen of the female with sclerotized tergal and sternal plates present only on the terminal and genital segments; male with the pseudopenis joined to the apices of the parameres; known from *Atlantoxerus getulus* in Africa.....PECTINIFER

- Abdomen of the female with well developed tergal and sternal plates in both sexes; male with the pseudopenis enclosed between the parameres; a group of species from African squirrels of the genera *Heliosciurus* and *Paraxerus*.....16
- 16 (15). Antennae with the distal postaxial angle somewhat produced and bearing a stout, apically blunt seta at its extreme apex.....
.....HELIOSCIURI
- Antennae with the distal postaxial angle not at all produced and if it bears a seta this is small and apically acute.....17
- 17 (16). Genitalia of the male with the parameres having their lateral margin strongly arcuate.....SUAHELICUS
- Genitalia of the male with the outer margin almost straight.....
.....KENYAE
- 18 (14). Thoracic sternal plate in the shape of a 7-sided polygon, all the sides of which are almost straight.....19
- Thoracic sternal plate otherwise shaped.....20
- 19 (18). Tergal and sternal plates in both sexes entirely lacking except for those present on the terminal and genital segments; paratergal plates extremely small; known from *Petaurista petaurista* in the Malayan area.....BATUANAE
- Tergal and sternal plates definitely developed on all abdominal segments in both sexes; paratergal plates strongly developed; known from *Petaurista inornatus* in Kashmir.....PETAURISTAE
- 20 (18). Thoracic sternal plate longer than wide, relatively narrow, somewhat irregular in shape; known from *Xerus inauris* in Africa....
.....FAUREI
- Thoracic sternal plate as wide as long or wider, usually more or less transversely oval; a group of forms occurring on the *Marmota* section of the Sciuridae (see notes under *laeviusculus*).21
- 21 (20). Thoracic spiracles notably large, their diameter equaling about one-half the length of the second coxae; known from *Marmota* and perhaps occurring on some species of *Citellus* in North America.
.....MARMOTAE
- Thoracic spiracles smaller, scarcely exceeding one-fourth the length of the second coxae and usually smaller.....22
- 22 (21). Rows of tergal and sternal setae on the abdomen continuous across each segment, not interrupted by bare areas.....23
- Rows of tergal and sternal setae across the abdomen interrupted by bare areas which divide them into lateral and median groups
.....MATHESONI
- 23 (22). Setae of the ventral rows of segments all noticeably stout (according to the original description); described as occurring on *Citellus adocetus* in Mexico.....TRAUBI
- Setae of all the ventral rows slender; 2 described species of which one, PATIKI, is probably a synonym of.....LAEVIUSCULUS

Neohaematopinus batuanae Ferris

1923. *Neohaematopinus batuanae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:261; figure 167B.

HOSTS AND DISTRIBUTION. From *Petaurista batuana* from the Batu Islands, Malaysia.

Neohaematopinus ceylonicus Ferris, new species

1922. *Neohaematopinus echinatus* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:250; figure 161. (Misidentification)

HOSTS AND DISTRIBUTION. Type a male, upon which the illustration cited was based, from *Funambulus palmarum* at Colombo, Ceylon. Allotype and paratypes from the same species at Kandesanturai, Ceylon, received through the kindness of Mr. Gordon B. Thompson.

CHARACTERS. Male as described and illustrated in the reference cited. Female about 2mm. long. As in the male the paratergites of abdominal segments 3-6 each bear four stout setae of varying length on the dorsal half and a single seta on the ventral half, this being well separated from the others.

NOTES. It was indicated by Ferris that the single specimen upon which his description was based did not agree entirely with the description given by Neumann and it is now clear that it does not represent Neumann's species, since specimens of the latter are now available which agree with the types. It is undoubtedly close to the true *echinatus*.

Neohaematopinus citelli (Cummings)

1914. *Linoëgnathoides spermophili* Cummings, Bulletin of Entomological Research 5:160; figure 3. (Specific name preoccupied)

1916. *Linoëgnathoides citelli* Cummings, Annals and Magazine of Natural History (Series 8) 17:107.

1923. *Neohaematopinus citelli* (Cummings), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:261; figures 168, 169.

HOSTS AND DISTRIBUTION. Originally recorded from *Citellus leptodactylus* and from *Cricetulus phaeus* from Transcaspia. The record from *Cricetulus* is almost certainly an error and can probably safely be disregarded. The probable true host is now known as *Spermophilopsis leptodactylus*.

Neohaematopinus citellinus Ferris

1942. *Neohaematopinus citellinus* Ferris, Microentomology 7:85; figure 41.

HOSTS AND DISTRIBUTION. Type from *Citellus tereticaudus* at Tucson, Arizona, and other specimens attributed to *Ammospermophilus harrissi* from the Santa Rita Mountains, Arizona, United States.

Neohaematopinus echinatus (Neumann)

1909. *Haematopinus (Polyplax) echinatus* Neumann, Archives de Parasitologie 13:517; figures 19, 20.

1912. *Neohaematopinus echinatus* (Neumann), Cummings, Bulletin of Entomological Research 3:393.

HOSTS AND DISTRIBUTION. Recorded from *Funambulus palmarum* from Rajkote, India, this being some other species of the genus. Specimens are at hand from the same host genus at Agra, India, which agree with the original description, these received through the kindness of Mr. Gordon B. Thompson.

NOTES. The specimens at hand from Agra indicate clearly that this species was misidentified by Ferris. The species attributed by him to *echinatus* is here described as *Neohaematopinus ceylonicus*.

Neohaematopinus faurei (Bedford)

1920. *Linoëgnathoides faurei* Bedford, Report of the Director of Veterinary Research, Union of South Africa 7-9:710; Plate 1, figure 2; Plate 7, figure 3.

1932. *Neohaematopinus faurei* (Bedford), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:292; figures 178, 179.

HOSTS AND DISTRIBUTION. Recorded by Bedford from *Geosciurus capensis*, which is now known as *Xerus inauris*, Bloemfontein, Orange Free State. It

was later recorded by Bedford from this host in other localities in South Africa, and from *Tatera* and *Rattus coucha*. Specimens at hand received from Bedford are indicated as being from Mongoose. It is practically certain that the true host is the species of *Xerus*.

NOTES. This is an extreme member of the genus, even of the section to which the name *Linoğnathoides* has been applied. The male has no sclerotized tergites and the characteristic form of tergite two, with its associated grouping of setae, is here represented only by a slight irregularity.

Neohaematopinus griseicolus Ferris

1923. *Neohaematopinus sciurinus griseicolus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:248.

HOSTS AND DISTRIBUTION. Type from *Sciurus griseus* at Inverness, Marin County, California, U. S. A. Also recorded from the same host at other localities in California.

NOTES. It is perhaps inconsistent to recognize this form as a species, in view of the wide range of forms retained in *sciurinus*, but all the specimens at hand agree in the almost complete absence of abdominal tergal and sternal plates in the female, while in all other specimens included in *sciurinus* no such departure occurs.

Neohaematopinus heliosciuri Cummings

1913. *Neohaematopinus heliosciuri* Cummings, Bulletin of Entomological Research 3:393; figure 1.

1923. *Neohaematopinus heliosciuri* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:255; figures 164, 165A, C, E, H.

HOSTS AND DISTRIBUTION. Type from *Paraxerus* (as *Heliosciurus*) *palliatu*s from Uchweni Forest, Witu, British East Africa. Also recorded from *Paraxerus ochraceus* (as *Paraxerus jacksoni* and as *Parasciurus animosus*) from various localities in British East Africa.

Neohaematopinus inornatus (Kellogg and Ferris)

1915. *Linoğnathoides inornatus* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 25; text figure 10; Plate 4, figure 7; Plate 5, figure 5; Plate 6, figure 3.

1923. *Neohaematopinus inornatus* (Kellogg and Ferris), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:252; figures 162, 163.

1929. *Ahaematopinus inornatus* (Kellogg and Ferris), Ewing, A Manual of External Parasites, page 198.

1942. *Neohaematopinus inornatus* (Kellogg and Ferris), Ferris, Microentomology 7:84; figure 39.

HOSTS AND DISTRIBUTION. Type from *Neotoma cinerea*, South Yolla Bolly Mountain, Tehama County, California. Recorded also from the same host from Yosemite Valley, California, and from "mountain rat," which was almost certainly the same host, from Colorado.

NOTES. This species has been designated as type of the genus *Ahaematopinus* Ewing, a genus for which there is, in the opinion here held, no excuse whatsoever.

*Neohaematopinus kenya*e Ferris

1923. *Neohaematopinus kenya*e Ferris, Contributions Toward a Monograph of

the Sucking Lice, Part 4:258; figures 165B, F, G.

HOSTS AND DISTRIBUTION. From *Heliosciurus gambianus* (as *keniae*), Mount Kenya, British East Africa.

Neohaematopinus laeviusculus (Grube)

1851. *Pediculus laeviusculus* Grube, In Middendorff's Reise 2:498; Plate 32, figure 7. (Figure labelled *spermophili*)
1896. *Haematopinus montanus* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (new series) 5:184; fig. 107.
1900. *Haematopinus columbianus* Osborn, Canadian Entomologist 32:215.
1904. *Polyplax laeviuscula* (Grube), Enderlein, Zoologischer Anzeiger 28:142.
1923. *Neohaematopinus laeviusculus* (Grube), Ferris, Contributions Toward a

Monograph of the Sucking Lice, Part 4:264; figs. 170, 171A, B, D, G.
HOSTS AND DISTRIBUTION. Described from *Citellus* (as *Spermophilus*) *eversmanni*, Jakutsk, Siberia. Later recorded from this host from Altai, Siberia, and from a long list of other species of *Citellus* from North America ranging from Point Barrow through western United States into Mexico, and from *Cynomys leucurus* from Colorado in the United States.

NOTES. A re-examination of all the available material shows no satisfactory basis for breaking this species up, although a considerable degree of variation exists. Rubin has named three species of this group, which will here be listed as distinct although the opinion is held that they cannot be definitely recognized. Even the species *marmotae*, which is probably the most definitely differentiated form in the group, presents no very precise limits and some specimens have been seen which are dubiously referable either to this or to *laeviusculus*.

The prayer may be voiced that future students will attempt to learn something about the group before engaging in the indiscriminate naming of new species.

Neohaematopinus longus Werneck

1948. *Neohaematopinus longus* Werneck, Revista brasileira de Biologia (8) 2: 175; figure.

HOSTS AND DISTRIBUTION. Recorded from *Abrocoma cinerea* at Caccachara near Llave, Peru. The host is a member of the subfamily Abrocominae of the family Echimyidae.

NOTES. This species is known from but a single female which was evidently very imperfectly prepared for study. It is highly probable that it does not belong to this genus.

Neohaematopinus marmotae Ferris

1923. *Neohaematopinus marmotae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:268; figures 171C, E, F.

HOSTS AND DISTRIBUTION. Type from *Marmota flaviventris*, Yosemite National Park, California. Recorded also from *Marmota* species at Florence, Montana. Specimens which agree very closely with the type are at hand from unspecified *Marmota* at Bannock, Idaho, and from La Manga Pass, Colorado. Ferris has previously doubtfully referred a specimen from *Marmota aurea* from Pamir, Asia, to this species.

NOTES. While in its typical form this species seems clearly to be separable from *laeviusculus*, specimens have been examined from *Marmota* and from species of *Citellus* which raise some question as to the validity of the species, or at least as to its limits and definition. The study of more material will be required for any satisfactory solution of the problem.

Neohaematopinus mathesoni Rubin

1946. *Neohaematopinus mathesoni* Rubin, Proceedings of the Entomological Society of Washington 48:121; figure 1.

HOSTS AND DISTRIBUTION. Described from "*Citellus v. couchi*," which is presumably *Citellus variegatus couchi* from the state of Nuevo Leon, Mexico.

NOTES. A specimen from the type lot of this and other specimens from the same host species (as subspecies *grammurus*) are at hand from Arizona. It is very doubtful that the species can be distinguished from *laeviusculus*.

Neohaematopinus neotomae Ferris

1942. *Neohaematopinus neotomae* Ferris, Microentomology 7:84; figure 40.

HOSTS AND DISTRIBUTION. Type from *Neotoma albigula* at Tucson, Arizona, and other specimens from the same host near Tucson. Also recorded from *Neotoma streator* from the Hastings Reservation near Monterey, California, and from *Hodomys alleni* from Manzanillo, Mexico. Specimens from *Neotoma micropus* from White Sands, New Mexico, have been somewhat doubtfully referred to the species.

Neohaematopinus pacificus Kellogg and Ferris

1915. *Neohaematopinus pacificus* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 38; text figure 14C, D; Plate 5, figures 3, 7a, b.

1923. *Neohaematopinus pacificus* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:249; figure 160A-D.

HOSTS AND DISTRIBUTION. Type from *Neotamias townsendii* at Freestone, Sonoma County, California. Recorded also from *Neotamias hindsi*, *merriami*, *alpinus*, and *speciosus* (as *Eutamias*) from various localities in California, U. S. A.

Neohaematopinus patiki Rubin

1946. *Neohaematopinus patiki* Rubin, Proceedings of the Entomological Society of Washington 48:121; figures 2, 5.

HOSTS AND DISTRIBUTION. Recorded as from an undetermined species of the subgenus *Ammospermophilus* of the genus *Citellus* at Delta, Utah.

NOTES. Unfortunately no material from any species of *Ammospermophilus* is available and consequently it is not possible to offer any observations in regard to this supposed species of *Neohaematopinus*, other than to express extreme doubt that it can be recognized.

Neohaematopinus pectinifer (Neumann)

1885. *Haematopinus setosus* Piaget, Les Pediculines, Supplement, page 143; Plate 15, figure 6 (preoccupied).

1909. *Haematopinus (Polyplax) pectinifer* Neumann, Archives de Parasitologie 15:528; figures 28, 29.

1914. *Linoëgnathoides pectinifer* (Neumann), Cummings, Bulletin of Entomological Research 5:160.

1916. *Luteëus pectinifer* (Neumann), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:31.

1923. *Neohaematopinus pectinifer* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:268; figure 172. (Description of male)

1932. *Neohaematopinus pectinifer* (Neumann), Ferris, Contributions Toward a

Monograph of the Sucking Lice, Part 5:291; figure 177. (Description of female)

HOSTS AND DISTRIBUTION. Recorded from *Xerus getulus* (Now referred to *Atlantoxerus*) in South Africa.

Neohaematopinus petauristae Ferris

1923. *Neohaematopinus petauristae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:258; figures 166, 167A, C, E.
1949. *Petauristophthirus petauristae* (Ferris), Eichler, Bolletino della Società Entomologica Italiana 79:12.

HOSTS AND DISTRIBUTION. From *Petaurista inornata* in Kashmir.

NOTES. This species has been designated as type of the genus *Petauristophthirus* Eichler, a genus for which no very cogent reason can be offered.

Neohaematopinus sciuri Jancke

1931. *Neohaematopinus sciuri* Jancke, Zeitschrift für Parasitenkunde 4:241; figures.

HOSTS AND DISTRIBUTION. Described from *Sciurus vulgaris* in Germany and later recorded from the same host in that country. North American and Asiatic material that might be referred to this species is as follows: from *Sciurus aberti* in Arizona, *Sciurus carolinensis* from Mississippi, *Sciurus poliopterus* from Oaxaca, Mexico—all these from North America; from "Malayan squirrel" in the Zoological Gardens of London, from *Callosciurus finlaysoni*, *caniceps*, and *procerus* in the Malayan area. Other specimens approach the condition seen in these with various degrees of closeness.

See notes under *Neohaematopinus sciurinus*.

Neohaematopinus sciurinus Mjöberg

1891. *Haematopinus antennatus* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:25; figure 13. (Not *Haematopinus antennatus* Piaget)
1910. *Acanthopinus antennatus* (Osborn), Mjöberg, Arkiv för Zoologi 6:161.
1910. *Acanthopinus sciurinus* Mjöberg, Arkiv för Zoologi 6:161.
1915. *Neohaematopinus antennatus* (Osborn), Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 36; text figure 14A, B; Plate 5, figure 10; Plate 6, figure 5.
1916. *Neohaematopinus antennatus semifasciatus* Ferris, Psyche 23:100.
1919. *Neohaematopinus macrospinosus* Fahrenholz, Jahresbericht des niedersächsischen zoologischen Vereins zu Hannover 5-10:24.
1923. *Neohaematopinus sciurinus* (Mjöberg), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:243; figures 155, 158, 159.

HOSTS AND DISTRIBUTION. The types of Osborn's *Haematopinus antennatus* were from *Sciurus niger rufiventris* at Ames, Iowa. The types of Mjöberg's *Acanthopinus sciurinus* were recorded as from *Sciurus vulpinus*, which is a synonym of *niger*, in the Hamburg Zoological Garden, Germany. Later recorded by Ferris from a long list of species of *Sciurus* and related genera from North America, Central America and South America and from the Malayan Region. The list will not here be repeated, since it will be necessary for future workers to reconsider the entire situation in any case before the problem of the extent of the species can be settled. This is considered in the following notes.

NOTES. The very considerable amount of material at hand has been carefully reviewed in connection with this work, with results but little more satisfactory than those recorded by Ferris in 1923. Within this material

the only character that seems to offer any basis for a separation into species is that of the enlarged seta on the first antennal segment. In typical *sciurinus* this seta is quite large and is borne upon a prolongation of the posterior apical angle of the segment, the whole structure forming a pronounced hook. Every degree of variation in this structure is present in the material at hand, down to specimens in which the seta is scarcely present at all. Attempts at arranging this material in groups according to hosts and according to geography have revealed no logical pattern. Thus, specimens from squirrels of the genus *Callosciurus* in the Malayan area are practically identical with specimens from *Sciurus aberti* from Arizona in the United States.

Certain of the material at hand would apparently be referable to *Neohaematopinus sciuri* Jancke, described from the European *Sciurus vulgaris*, on the basis of the development of this seta on the first antennal segment. But if we attempt to group specimens on this basis, again no logical pattern appears. While the species *sciuri* is here listed, this is done solely in order not to prejudice any development of later studies and for the present all other material of this type is referred to *sciurinus*.

The problem must be left to future workers who may be able to accumulate a great mass of material from a long series of squirrel species.

Neohaematopinus sciuropteri (Osborn)
Figures 86, 87

1891. *Haematopinus sciuropteri* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (old series) 7:23; figure 12.

1910. *Neohaematopinus sciuropteri* (Osborn), Mjöberg, Arkiv för Zoologi 6: 160; figure 79.

1923. *Neohaematopinus sciuropteri* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:241; figures 156, 157.

HOSTS AND DISTRIBUTION. Described as from *Sciuropterus volucella*, which is a synonym of *Glaucomyz volans*, at Ames, Iowa. Later recorded from *Glaucomyz sabrinus* at Yosemite National Park, California.

Neohaematopinus suahelicus Ferris

1923. *Neohaematopinus suahelicus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:258; figures 165B, F, G.

HOSTS AND DISTRIBUTION. Described as from *Paraxerus palliatus* from British East Africa, and recorded from *Paraxerus ochraceus* (as *jacksoni* and as *Parasciurus animosus*) from the same area.

Neohaematopinus syriacus Ferris

1923. *Neohaematopinus syriacus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:250; figure 160E.

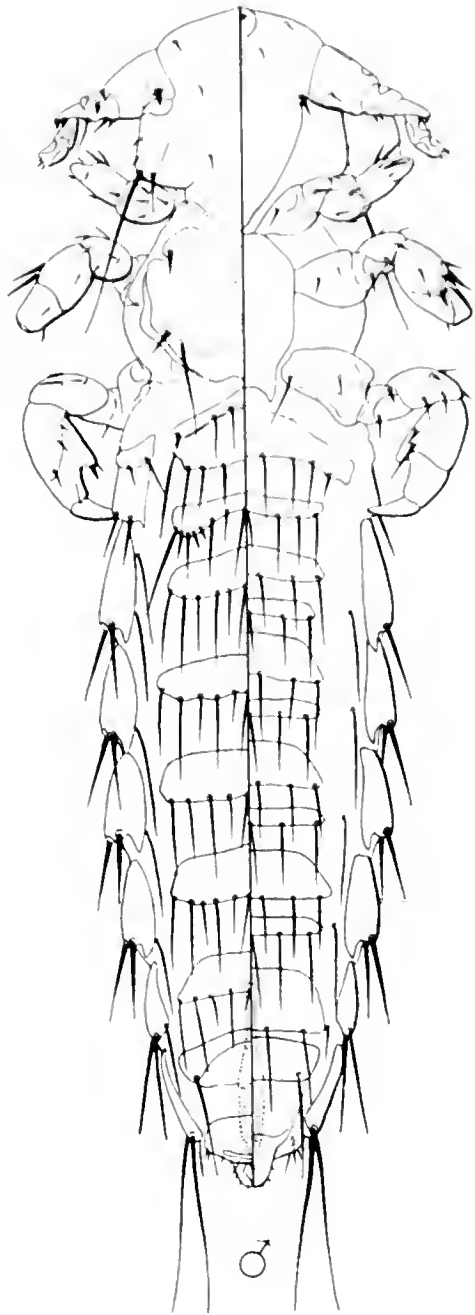
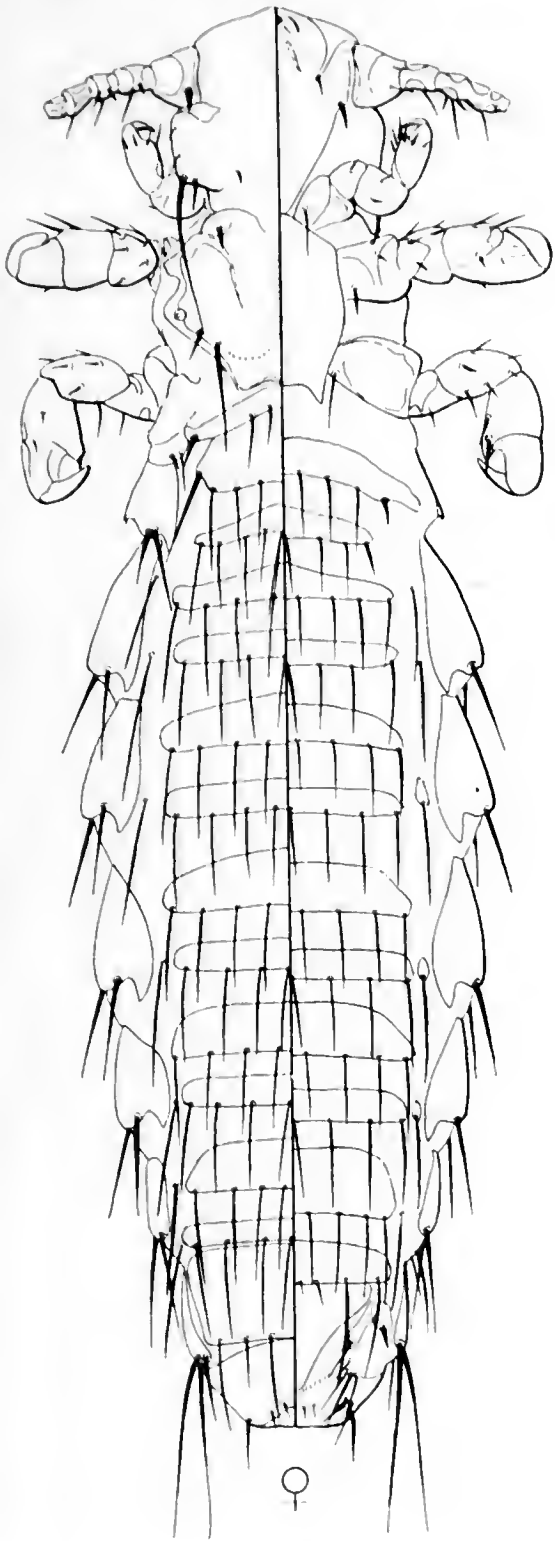
HOSTS AND DISTRIBUTION. From *Sciurus anomalus* (as *syriacus*) from Syria.

Neohaematopinus traubi Rubin

1946. *Neohaematopinus traubi* Rubin, Proceedings of the Entomological Society of Washington 48:120; figures 3, 4.

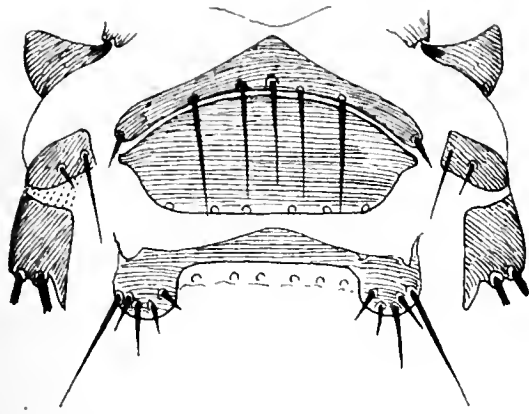
HOSTS AND DISTRIBUTION. Described as from *Citellus adocetus* from the state of Michoacan, Mexico.

NOTES. This species is supposed to be separable from *laeviusculus* and other members of that group by having the abdomen with three rows of setae on each "typical segment." However, the accompanying illustration does not

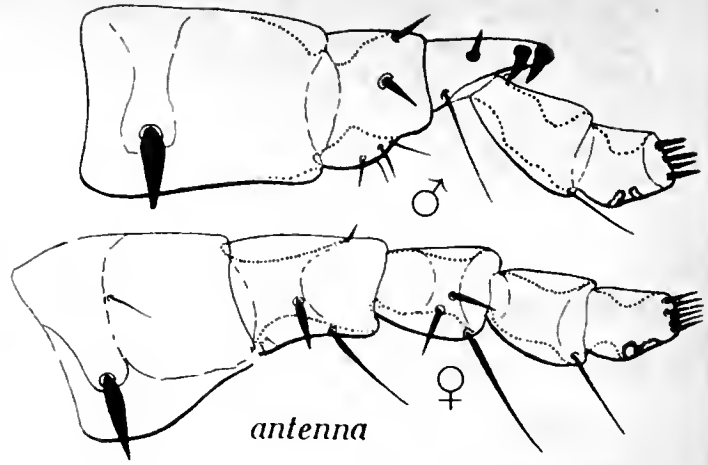


Neohaematopinus sciuropteri (Osborn)

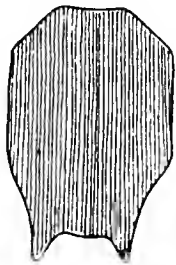
Figure 86



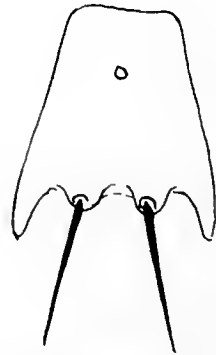
basal abdominal tergites



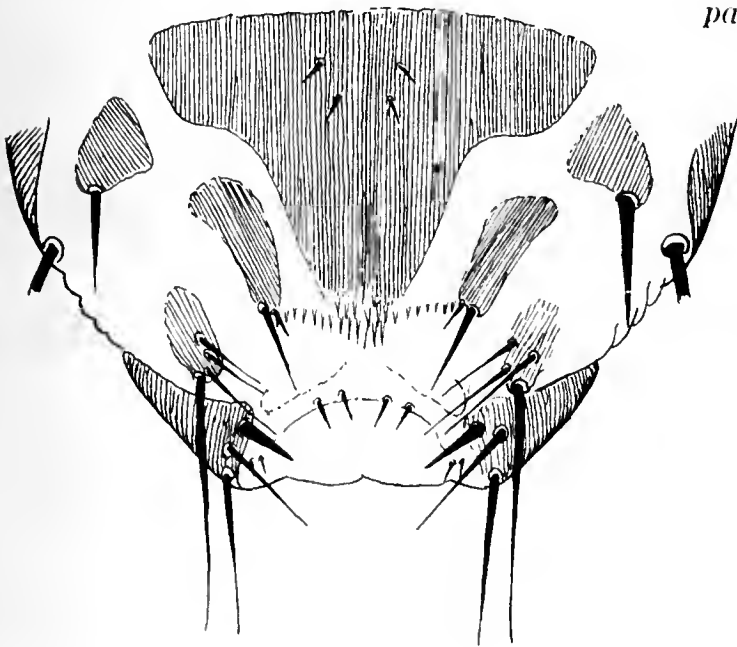
antenna



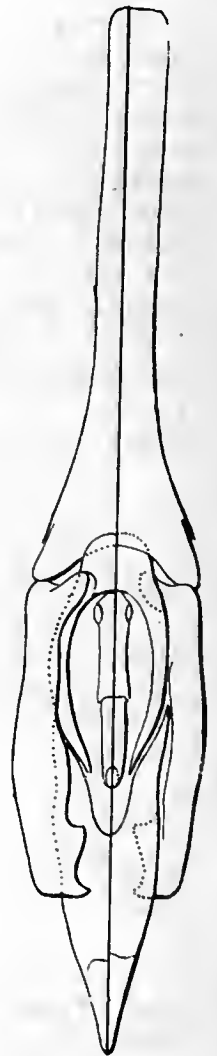
thoracic sternal plate



paratergal plate



female genitalia



male genitalia

Neohaematopinus sciuropteri (Osborn), details

Figure 87

agree with the description. It provides only fourteen rows of setae to be distributed among six segments, this allowing but two rows per segment with two left over, which does not indicate that a "typical segment" can have three rows. The discrepancy is probably due to an error in counting and the surmise may be hazarded that the species is not distinguished as its author supposed. However, according to the illustration given, the stoutness of the ventral setae may possibly afford a basis for its recognition.

Genus PHTHIRPEDICULUS Ewing

1922. *Phthirpediculus* Ewing, Journal of the Washington Academy of Sciences 13:148.

1932. *Phthirpediculus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:295.

GENERIC TYPE. *Phthirpediculus propitheci* Ewing, the only included species.

CHARACTERS. Polyplacinae with five-segmented antennae which are sexually dimorphic, the male having the distal, preaxial angle of the third segment produced and bearing dorsally two, stout, retrorse setae. Anterior legs small, with weak claw; middle and posterior legs about equal to each other, enlarged and stout, with stout claw. Paratergal plates present on abdominal segments 3-6, distinctly developed and with free apical angles; marked by having the basal, mesal angle produced into a distinct sclerotization which extends somewhat toward the mid-line of the body and bears two slender setae. Otherwise the abdomen in both sexes is membranous except for the usual terminal and genitalic plates. Each abdominal segment, both dorsally and ventrally, with one row of setae except that in the female the dorsum of segment two apparently has two rows. Abdominal spiracles present on segments 3-8. Prothoracic sternal plate distinctly developed, of a peculiar type, being divided longitudinally into two plates, each of which bears a pair of slender setae at its posterior end.

Phthirpediculus propitheci Ewing Figures 88, 89

1922. *Phthirpediculus propitheci* Ewing, Journal of the Washington Academy of Sciences 13:149.

1932. *Phthirpediculus propitheci* Ewing, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:296; figures 180, 181.

HOSTS AND DISTRIBUTION. From *Propithecus edwardsii*, a lemur, from Madagascar.

Genus POLYPLAX Enderlein

1904. *Polyplax* Enderlein, Zoologischer Anzeiger 28:142, 223.

1907. *Eremophthirius* Glinkiewicz, Sitzungsberichte der mathematisch-naturwissenschaftlichen Class der kaiserlichen Akademie der Wissenschaften zu Wien 116:381.

1909. *Haematopinus* (*Polyplax*), Neumann, Archives de Parasitologie 13:529.

1923. *Polyplax*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:184.

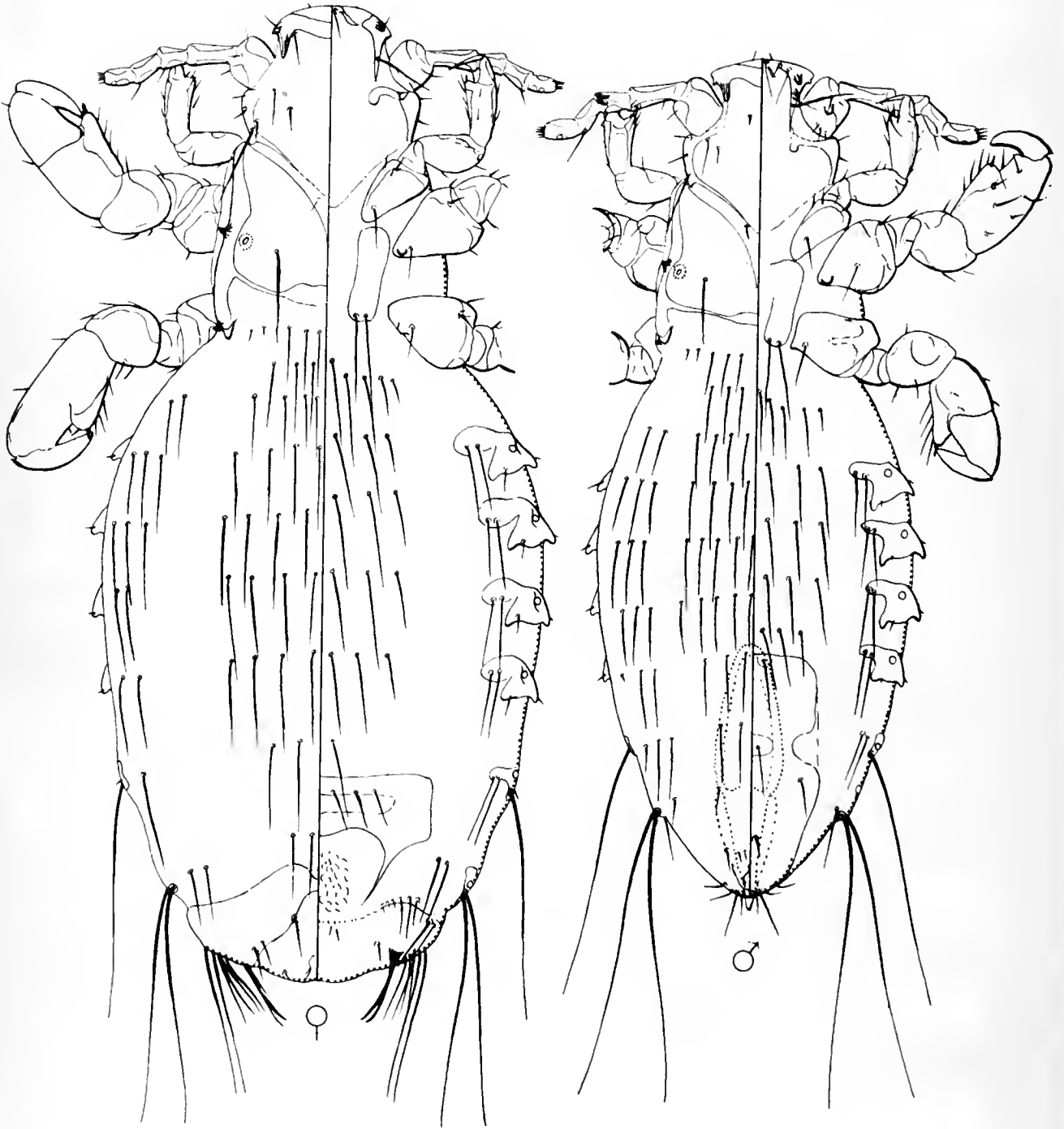
1929. *Polyplax*, Ewing, A Manual of External Parasites, page 137.

1935. *Polyplax*, Ewing, Proceedings of the Biological Society of Washington 48:201.

1935. *Eremophthirius*, Ewing, Proceedings of the Biological Society of Washington 48:201.

1838. *Polyplax*, Fahrenholz, Zeitschrift für Parasitenkunde 10:239.

1938. *Eremophthirius*, Fahrenholz, Zeitschrift für Parasitenkunde 10:242.

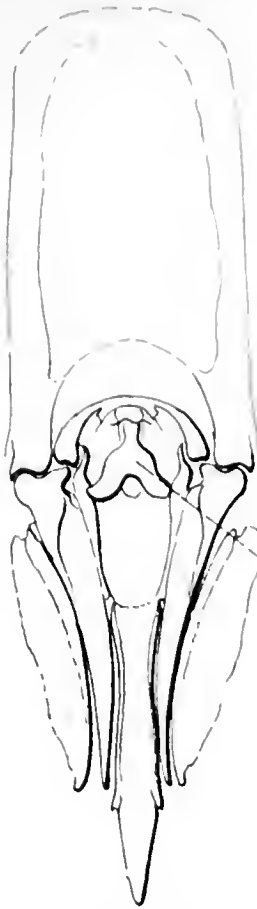


Phthirpediculus propithecii Ewing

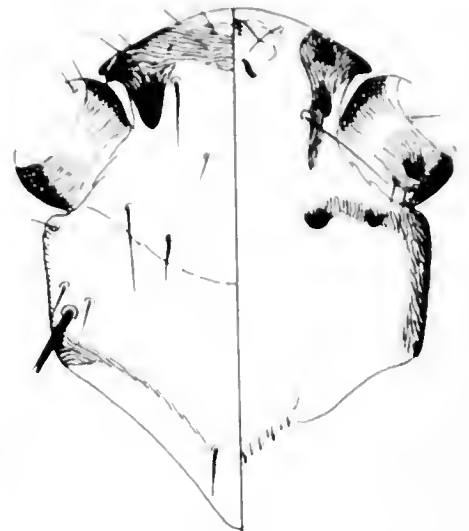
Figure 88



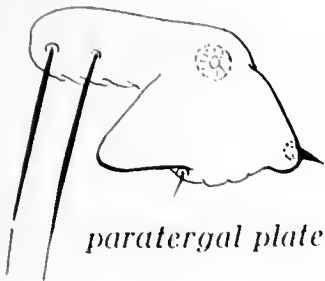
thoracic dorsum



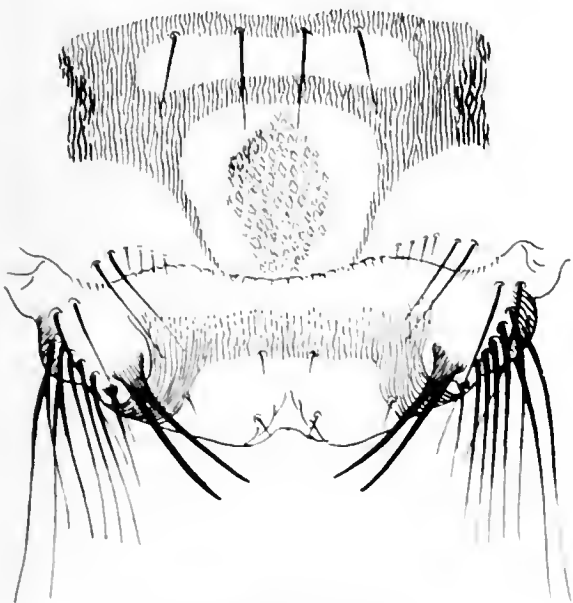
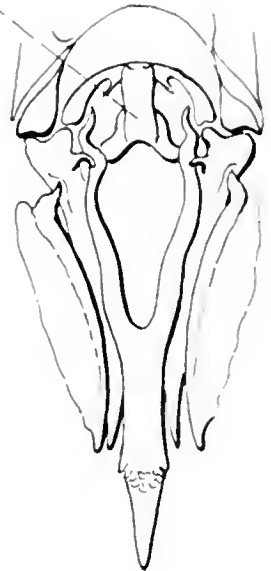
male genitalia



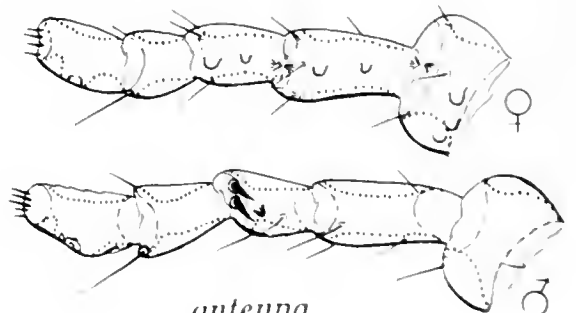
head



paratergal plate



female genitalia



antenna

Phthirpediculus propitheci Ewing

Figure 89

GENERIC TYPE. *Pediculus spinulosus* Burmeister.

GENERIC SYNONYM. *Eremophthirius* Glinkiewicz, of which the type by monotypy is *Eremophthirius werneri* Glinkiewicz.

CHARACTERS. Polyplacidae with five-segmented antennae which are usually at least slightly dimorphic, the males commonly having the distal, preaxial angle of the third segment somewhat produced and bearing at its apex a recurved spine or short, recurved, stout seta. Head usually abruptly widened behind the antennae, but not always so. Thorax usually with a well developed sternal plate which around its margins is free from the body wall. Anterior legs small and weak, with slender claw. Middle legs definitely somewhat larger, with stouter claw. Posterior legs similar to the second but still larger, with stouter claw, but never strongly flattened or expanded. Abdomen with paratergal plates always developed on segments 2-8, the plates rarely if ever overlapping each other in an expanded specimen; the plates of segment two having the appearance of being divided longitudinally into two pieces, one of which lies upon the dorsum. It is possible that this dorsal piece actually represents the paratergite of segment one, although occasionally the plates of segment three are similarly divided. Paratergites of segments 4-6 usually with each posterior angle produced into a slight point, or occasionally into a slender process, the posterior margin between these points being entire; at times with only the ventral angle produced. Tergal and sternal plates always developed and sclerotized, the female having two plates and two rows of setae on segments 4-7 dorsally and on segments 3-7 ventrally; the male with not more than one plate and one row of setae on any segment dorsally and with either one or two plates on the abdominal segments ventrally. The ventral plates on segments 2-3 are never produced laterally to articulate with or approximate the paratergal plates of these segments.

NOTES. The opinion previously expressed by Ferris that *Eremophthirius* should not be separated from *Polyplax* is here still maintained. Fahrenholz has attempted to revive *Eremophthirius* on the basis of the presence in the male of but one ventral plate on any abdominal segment, but any such division results merely in quite meaningless groupings of the species.

The members of the genus *Polyplax* occur almost exclusively upon members of the rodent family Muridae, although at least one species seems to occur normally upon members of the insectivore family Soricidae.

Key to Species of POLYPLAX

A very considerable degree of difficulty has been encountered in preparing a key to the species of this genus. The characters separating some of the species are clear enough when specimens are compared directly, but are not sufficiently trenchant to be of much use in a key, or are of such a nature that they cannot be expressed with the conciseness which is desirable in a key. Furthermore, of some species only one sex is known. In some other instances the male only may present especially distinctive characters. Because of these facts the presentation of separate keys to the sexes is no more practicable than it is to include both in the same key. This introduces serious difficulties, but at the present time there seems to be no way to avoid them.

It should be remembered, also, that some of the species are known from but very few specimens and consequently the possible range of variation is unknown. Under these circumstances the key must be used with caution.

The following species, known only from their original descriptions, are omitted from the key: *dentaticornis* Ewing, *ertopepti* (Ewing), *spinigera* (Burmeister).

1. Posterior legs with a distinct, sclerotized, retrorse tooth at the outer basal angle of the tibia; known from *Rattus sabanus* in the Malayan area.....INSULSA
Posterior legs without such a tooth.....2
- 2 (1). Head with a long seta at or close to the apex of the lateral, posterior angle.....3
Head with this seta borne on a small, apically free, ear-like lobe which is somewhat removed from the apex of the posterior lateral angle; occurring on New World species of the genera *Peromyscus*, *Onychomys*, and *Reithrodontomys*.....AURICULARIS
- 3 (2). Abdomen with tergal and sternal plates undeveloped in the female, except for those associated with the genital segments and one or two very small tergal plates at the base of the abdomen; known from various hosts in India.....ASIATICA
Abdomen of the female always with distinct, even if attenuated, tergal and sternal plates on all segments.....4
- 4 (3). Thoracic sternal plate with a distinct, narrow, handle-like prolongation extending forward between the anterior coxa, this prolongation being one-fourth as long as the plate itself or longer...5
Thoracic sternal plate at the most with nothing more than a slight median, anterior point.....12
- 5 (4). With a pair of long setae on each abdominal paratergite, these setae longer than the plate which bears them.....6
With not more than 1 seta on any paratergal plate which is longer than the plate which bears it, and such setae not present at all paratergites.....7
- 6 (5). Lateral margins of the hindhead in the female short and almost semi-circularly convex (known only from the female); from undetermined rodents from Abyssinia.....PRAECISA
Lateral margins of the hindhead straight and almost parallel in both sexes; known from *Tatera indica* in India.....STEPHENSII
- 7 (5). Male with a row of very short, almost thorn-like, setae on the tergal plates of segments 4-7, in addition to the usual slender setae; known from *Tatera böhmi* in Africa.....BISERIATA
Male with only the usual row of slender setae on any abdominal tergite.....8
- 8 (7). Setae on paratergites of segments 3-6 almost or quite equaling in length the plate that bears them except for one longer seta on segment 3; known from *Tatera vicina* in Africa.....TATERAE
Setae on paratergites of segments 3-6 shorter than the plate which bears them except for 1 long seta on segment 3 or segments 3-4..9
- 9 (8). Paratergal plates of segment 3 only with 1 long seta which is much longer than the plate that bears it.....OTOMYDIS
Paratergal plates of segments 3-4 each with 1 long seta which is much longer than the plate that bears it.....10
- 10 (9). Ventral apical angle of paratergites of abdominal segments 3-6 forming a process that is about twice as wide at its base and twice as long as the tooth at the dorsal angle; known from *Gerbillus pyramidum* in Egypt.....GERBILLI
Ventral apical angle of paratergites of segments 3-6 forming merely a slight tooth which is not larger than that of the dorsal angle.....11
- 11 (10). Lateral margins of the hindhead in the male (female unknown) strongly convergent; occurring on *Pachyuromys* in Egypt.....WERNERI
Lateral margins of the hindhead in the male divergent or practically parallel; from *Meriones aiceps* in China.....CHINENSIS
- 12 (4). Paratergites of abdominal segments 2-6 with both posterior angles produced into a slender, apically acute process which is beset

- with minute squamations.....WATERSTONI
 Paratergites not so.....13
- 13 (12). Paratergial plates of abdominal segments 3-6 posteriorly emarginate, the setae borne close to the apices of the points formed by this emargination.....14
- 14 (13). Paratergites of abdominal segments 3-6 only shallowly emarginate; tergal plates of abdominal segments 3-6 occupying scarcely more than half the width of their respective segments; occurring on *Arvicanthis* in Africa.....1
- Paratergites of segments 3-6 deeply emarginate; tergal plates of segments 3-6 occupying at least three-fourths of the width of their respective segments; occurring on *Arvicanthis* in Africa.....ARVICANTHIS
- 15 (13). Tergal plates of abdominal segments 3-6 each with the ventral posterior angle only forming a tooth and each with a pair of setae which are about as long as the plate which bears them.....16
- Tergal plates of abdominal segments 3-6 not presenting this combination of characters; if the setae are as long as the plates each angle forms a tooth, if one angle does not form a tooth the setae are short.....17
- 16 (15). Head truncate anteriorly immediately in front of the antennae; occurring on *Lophuromys* in Africa.....PHTHISICA
- 17 (15). Head acutely pointed in front of the antennae;.....OXYRRHYNCHUS
- Genitalia of the male with the pseudopenis entirely enclosed within the apices of the parameres; tergal plates in the female all of almost uniform length in the longitudinal axis of the body; occurring on *Saccostomus* in Africa.....JONESI
- Genitalia of the male with the pseudopenis articulating to the apices of the parameres; anterior tergal plate of abdominal segments 4-7 in the female distinctly longer in the longitudinal axis of the body than the posterior plate of the same segment.....18
- 18 (17). Paratergites of abdominal segments 4-6 each with 1 seta which is as long as or longer than the plate which bears it, the other seta somewhat variable but never so short as to appear thorn-like.....19
- Paratergites of abdominal segments 4-6 with seta otherwise.....20
- 19 (18). Paratergites of abdominal segments 3-6 with well developed points at the posterior angles, these points set somewhat anterior to the posterior margin of their plate, this posterior margin projecting posteriorly beyond the points; spiracles noticeably large; two supposed species which are probably identical; occurring on shrews in Europe, Africa, and Asia.....RECLINATA and DELTOIDES
- Paratergites of abdominal segments 3-6 with the points at their posterior angles very small, or perhaps at times lacking; posterior margin of these paratergites not produced; spiracles extremely small and obscure; occurring on *Rattus apoensis* in the Philippine Islands.....TARSOMYDIS
- 20 (18). Dorsal seta of paratergites of segment 4 about as long as the plate itself, the other seta of these plates and of the plates of segments 2, 3, 5, and 6 being much shorter than the plate; a slender-bodied species which, as far as known, occurs on the house mouse and other closely related species of *Mus* and on members of the genus *Apodemus* in Europe and Asia.....SERRATA
- Otherwise.....21

- 21 (20). First abdominal sternite in both sexes quite strongly arcuate and with its lateral angles somewhat prolonged; occurring on *Microtus* and related forms in northern Europe and northern North AmericaALASKENSIS
 First abdominal sternite in both sexes not thus; its posterior margin almost straight and the lateral angles not prolonged..22
- 22 (21). Dorsal lobe of the pseudopenis very short, scarcely one-fourth the length of the ventral lobe; parameres well developed, extending forward between the posterior arms of the basal plate; occurring especially on species of *Rattus* throughout the world.SPINULOSA
 Dorsal lobe of the pseudopenis equaling about half the length of the ventral lobe; parameres quite weakly developed and extending forward only slightly past the apex of the arms of the basal plate; occurring on species of *Microtus* and related genera in North America.....ABSCISA

Polyplax abscisa Fahrenholz

1925. *Polyplax spinulosa* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:187. (In part; misidentification)
1938. *Polyplax abscisa* Fahrenholz, Zeitschrift für Parasitenkunde 10:257; figures 13, 14.

1942. *Polyplax abscisa* Fahrenholz, Ferris, Microentomology 7:86; figure 42.

HOSTS AND DISTRIBUTION. Described as from "*Arvicola* spec., Californien." This was in all probability a species of *Microtus*, much less probably of *Phenacomys*. The species has been recorded by Ferris, under the name of *Polyplax spinulosa*, from *Microtus californicus* and *Microtus* sp. in California, from *Microtus intermedius* from Nevada, from *Microtus pennsylvanicus* from New York, United States.

NOTES. This species is exceedingly close to *Polyplax spinulosa*, apparently differing only in certain details of the genitalia of the male as indicated in the accompanying key.

Polyplax abyssinica Ferris

1923. *Polyplax abyssinica* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:230; figure 150.

1940. *Polyplax abyssinica* Ferris, Werneck, Revista de Entomologica 11:722; figure 1.

HOSTS AND DISTRIBUTION. Type from *Arvicanthus abyssinicus* at Bugondo Teso, Uganda, and recorded by Ferris from the same host from other localities in Uganda. Recorded by Ferris from *Otomys tropicalis* and *Oenomys bacchante* in Uganda. Recorded by Werneck from a subspecies of the type host at various localities in Uganda; from *Arvicanthus* sp., and from *Mastomys coucha* from the West Nile District in Uganda.

NOTES. It is probable that the normal hosts of this species are species of the genus *Arvicanthus*. Ferris described only the female. The male has been described by Werneck.

Polyplax alaskensis Ewing

1927. *Polyplax alaskensis* Ewing, Proceedings of the Entomological Society of Washington 29:118.

1933. *Polyplax borealis* Ferris, Parasitology 25:127; figures 1, 2.

1935. *Polyplax alaskensis* Ewing, Ewing, Proceedings of the Biological Society of Washington 29:118.

HOSTS AND DISTRIBUTION. Described by Ewing from *Microtus* sp. from unspecified locality in Alaska. Described by Ferris from *Evotomys* sp. (*rufocanus*?) from Beskenjarrga, Finmark, Norway. This host is *Clethrionomys rufocanus*.

NOTES. It is here accepted that *borealis* is a synonym of *alaskensis*.

Polyplax arvicanthis Bedford

1919. *Polyplax arvicanthis* Bedford, Report of the Division of Veterinary Research, Department of Agriculture, Union of South Africa 5-6:716; Plate 1, figures.

1923. *Polyplax arvicanthis* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:227; figures 148, 149.

HOSTS AND DISTRIBUTION. Described as from *Arvicanthis pumilio* at Onderstepoort, Pretoria, South Africa, and later recorded from a subspecies of this host from Mount Kenya, British East Africa. The correct name for this host is *Rhabdomys pumilio*.

Polyplax asiatica Ferris

1923. *Polyplax asiatica* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:233; figure 152D.

HOSTS AND DISTRIBUTION. Type from *Crocidura caerulea* (a shrew) from Rangoon, Burma. Also recorded from *Nesokia hardwickii* from Quetta, Baluchistan. Material not previously recorded is at hand from *Bandicota bengalensis* at Akyab, Burma, and from *Rattus concolor* at Bellary, Madras, India.

NOTES. The additional material now at hand tends to substantiate the suspicion, previously expressed by Ferris and by Hopkins, that this species is normal to a rodent and not to shrews.

Polyplax auricularis Kellogg and Ferris

1915. *Polyplax auricularis* Kellogg and Ferris, Anoplura and Mallophaga of North American Mammals, Stanford University Publications, University Series (no volume number), page 13; Plate 1, figure 4; Plate 4, figure 8.

1923. *Polyplax auricularis* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:218; figures 140, 141.

1933. *Polyplax auricularis*, variety *californiae* Fahrenholz, Zeitschrift für Parasitenkunde 10:270; figures 19, 21.

1938. *Polyplax painei* Fahrenholz, Zeitschrift für Parasitenkunde 10:270; figures 20, 22.

HOSTS AND DISTRIBUTION. Type from *Peromyscus maniculatus* at Inverness, Marin County, California, and recorded from the same host at Yosemite National Park, California. Also recorded from *Peromyscus sitchensis* from Forrester Island, Alaska, from *Onychomys torridus* at Victorville, California, from *Onychomys leucogaster* at Colorado Springs, Colorado, and at Liberal, Kansas. All these records are from within the United States. Also recorded from *Reithrodontomys mexicanus* at "Tehontepec, Chiapas," which is probably Tehuantepec, in Oaxaca, and from *Neotomodon allstoni* near Mexico City, Mexico.

NOTES. Fahrenholz has described the supposed variety *californiae* as from *Perodipus streatori*, which is a member of the family Heteromyidae. If it came actually from this host there must have been contamination, since there is very good evidence that the members of this family harbor only lice of the genus *Fahrenholzia*. There is a *Peromyscus maniculatus streatori* and Hopkins suggests that there may have been an error in reading a label. No reason appears for naming the supposed variety.

Fahrenholz has also named the species *Polyplax painei* from *Peromyscus californicus* from San Mateo County, California, but in the light of the available material there seems to be no reason for recognizing this species.

Polyplax biseriata Ferris

1923. *Polyplax biseriata* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:199; figures 125A, 126.

1938. *Eremophthirius biseriatus* (Ferris), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. From *Tatera böhmi* at South Guaso Nyiro, British East Africa, and from *Tatera lobengulæ* at Bothaville, Orange Free State, South Africa.

Polyplax chinensis Ferris

1923. *Polyplax chinensis* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:209; figures 132, 133.

HOSTS AND DISTRIBUTION. But one record, from *Meriones aiceps*, Shensi, China. According to Ellerman this is listed as a subspecies of *Meriones meridianus*.

Polyplax deltoides Fahrenholz

1923. *Polyplax reclinata* (Nitzsch), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:192; figures 120C, 120G. (Misidentification?)

1938. *Polyplax deltoides* Fahrenholz, Zeitschrift für Parasitenkunde 10:256; figure 12.

HOSTS AND DISTRIBUTION. This species was based by Fahrenholz upon the specimens recorded by Ferris as from *Crocidura coerulea* at Rangoon, Burma; from *Crocidura* sp. at Atchebal, Valley of Kashmir; *Pachyura luzonensis* at Manila, Philippine Islands, and from *Scutisorex* sp. at "Medjie," this place name being without other data and perhaps being a misspelling.

NOTES. Since this species name was based entirely upon the records published by Ferris, the type must be selected from among the material recorded by Ferris. The type is therefore designated as a female from *Pachyura luzonensis* at Manila, Philippine Islands, which is in the Stanford University collection.

As far as any evidence given by Fahrenholz is concerned, no good reason appears for regarding this species as anything more than *Polyplax reclinata*. But since specimens from the type host of the latter are not available the name is here accepted.

Polyplax dentaticornis Ewing

1935. *Polyplax dentaticornis* Ewing, Proceedings of the Biological Society of Washington 48:207; figure 2c.

HOSTS AND DISTRIBUTION. Recorded, on the basis of a single male, from *Cricetulus andersoni*, Shensi, China.

Polyplax eriopepli Ewing

1935. *Eremophthirius eriopepli* Ewing, Proceedings of the Biological Society of Washington 48:209.

HOSTS AND DISTRIBUTION. From *Eriopeplus incanus* from Celebes. This host is *Cricetulus longicaudatus*.

Polyplax gerbilli Ferris

1923. *Polyplax gerbilli* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:203; figures 128, 129.

1938. *Eremophthirius gerbilli* Ferris, Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. From *Gerbillus pyramidum* at Khartoum, Egypt.

Polyplax gracilis Fahrenholz

1910. *Polyplax gracilis* Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 2-4:42; text figures 16, 17; Plate 1, figures 10, 11.

1923. *Polyplax gracilis* Fahrenholz, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:234.

1938. *Polyplax gracilis* Fahrenholz, Zeitschrift für Parasitenkunde 10:263; figure 231.

HOSTS AND DISTRIBUTION. Recorded from *Mus minutus*, presumably in Germany. The host is now known as *Micromys minutus*.

Polyplax insulsa Ferris

1923. *Polyplax insulsa* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:231; figures 151, 152A, C.

1929. *Ahaematopinus insulsus* (Ferris), Ewing, A Manual of External Parasites, page 198.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Epimys* (*-Rattus*) *sabanus* from Bunguran, Natuna Islands, Malaysia.

Polyplax jonesi Kellogg and Ferris

1915. *Polyplax jonesi* Kellogg and Ferris, Annals of the Durban Museum 1: 151; Plate 15, figures 3-3e.

1923. *Polyplax jonesi* Kellogg and Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:216; figures 138, 139.

HOSTS AND DISTRIBUTION. Known only from the original record, from *Saccostomus campestris*, at Mfongosi, Zululand, South Africa.

Polyplax otomydis Cummings

1912. *Polyplax otomydis* Cummings, Bulletin of Entomological Research 3: 395-7; figures.

1916. *Polyplax gracilis* Fahrenholz, Ferris, Annals of the Durban Museum 1: 240; figures 23C, 24. (Misidentification)

1916. *Polyplax cummingsi* Ferris, Annals of the Durban Museum 1:240; figures 25, 26A.

1923. *Polyplax otomydis* Cummings, Contributions Toward a Monograph of the Sucking Lice, Part 4:211; figures 134, 135.

1923. *Polyplax cummingsi* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:213; figures 136, 137.

HOSTS AND DISTRIBUTION. Described by Cummings from *Otomys irroratus* from Mount Kenya, British East Africa. Also recorded from this host from Onderstepoort, Pretoria, and from Mfongosi, Zululand, South Africa. Recorded from *Otomys angoniensis* from Naivasha, British East Africa, and from *Otomys brantsi* without indication of locality, this last host now being referred to *Parotomys*. Recorded by Ferris as *Polyplax cummingsi* from *Dasymys incomtus* from Mfongosi, Zululand, and from Kaimosi, British East Africa, and from *Rattus* (now known as *Aethomys*) *chrysophilus* from Mfongosi, Zululand.

NOTES. A re-examination of the material at hand reveals no sound basis for the recognition of the species *cummingsi*, the characters given by Ferris for the separation of the latter species now appearing to have been quite illusory.

Polyplax oxysrhynchus Cummings

1915. *Polyplax oxysrhynchus* Cummings, Proceedings of the Zoological Society of London, page 251; text figures 4-6, 8, 9, 11, 13.
1923. *Polyplax oxysrhynchus* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:225; figures 146, 147.
1938. *Polyplax oxysrhynchus*, variety *hystrellae* Fahrenholz, Zeitschrift für Parasitenkunde 10:275.

HOSTS AND DISTRIBUTION. Type from *Acomys cahirinus* at Assiut, Egypt. Recorded by Ferris from *Acomys hystrella* from Numule, Uganda, and from *Acomys percivali*, British East Africa.

NOTES. Fahrenholz, apparently without seeing any specimens and working merely from the illustrations accompanying the original description of this species and the later record by Ferris, assumed to establish the supposed "variety" *hystrellae* for the specimens illustrated by Ferris. The type of this name will therefore be among these specimens. The differences cited by Fahrenholz for his "variety" are merely such as are inevitable in illustrations made by different persons from specimens which were differently prepared and this supposed variety is here reduced to synonymy.

Polyplax phthisica Ferris

1923. *Polyplax phthisica* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:223; figures 144, 145.

HOSTS AND DISTRIBUTION. Type from *Lophuromys aquilus* from Ngani Narok River, and from the same host species (recorded as *zena*) from Molo, British East Africa; from *Lophuromys sikapusi*, Rhino Camp, Uganda; from *Lophuromys* sp. from Nyasaland. A record from *Thamnomys tbeanus*, British East Africa, is probably due to contamination.

Polyplax praecisa (Neumann)

1901. *Haematopinus praecitus* Neumann, Archives de Parasitologie 5:600. (In part; also typographical error for *praecisus*, later corrected by Neumann)
1902. *Haematopinus praecisus* Neumann, Archives de Parasitologie 6:144; fig.
1904. *Polyplax praecisa* (Neumann), Enderlein, Zoologischer Anzeiger 28:143 (part).
1919. *Polyplax praecisa* (Neumann), Fahrenholz, Jahresbericht des Niedersächsischen Zoologischen Vereins zu Hannover 5-10:25.
1923. *Polyplax praecisa* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:196; figure 123.
1938. *Eremophthirtus praecisus* (Neumann), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. Recorded as from "gros rats," in Abyssinia. Hopkins notes that *Tatera nigricauda* occurs in Abyssinia and assumes the species to have been from this host.

NOTES. Neumann included two distinct species in his *praecisus*. This was recognized by Fahrenholz, who in 1919 named one of the two as *Hoplopleura neumanni* and thus restricted the name to the other, which is a *Polyplax*. Ferris saw the type specimens and confirmed this procedure. *Polyplax praecisa* is still known only from the female and without precise host designation.

Polyplax reclinata (Nitzsch)

1864. *Pediculus reclinatus* Nitzsch, Zeitschrift für den gesamten Naturwissenschaften 25:23.
1874. *Haematopinus reclinatus* (Nitzsch), Giebel, Insecta Epizoa, page 37.
1904. *Polyplax reclinata* (Nitzsch), Enderlein, Zoologischer Anzeiger 28:142.
1910. *Haematopinus (Polyplax) reclinatus* (Nitzsch), Neumann, Archives de Parasitologie 13:524; text figure 24.
1912. *Polyplax reclinata* (Nitzsch), Fahrenholz, Jahresbericht des niedersächsischen zoologischen Vereins zu Hannover 2-4:37; text figures 11, 12; Plate 1, figures 12, 13; Plate 2, figures 2, 4; Plate 3, figure 7.
1923. *Polyplax reclinata* (Nitzsch), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:192. (In part)
1932. *Polyplax reclinata*, variety *leucodontis* Jancke, Zeitschrift für Parasitenkunde 4:525; figure 2.
1938. *Polyplax reclinata* (Nitzsch), Fahrenholz, Zeitschrift für Parasitenkunde 10:254; figures 9, 10, 11.

HOSTS AND DISTRIBUTION. Originally recorded from the European shrew, *Sorex araneus*, and since recorded a few times from this host. Also recorded, as variety *leucodontis*, from another European shrew, *Crocidura leucodon*.

NOTES. Ferris has previously referred to this species specimens from various Asiatic shrews, but Fahrenholz has considered these to represent a distinct species to which he has applied the name *deltoides*. Also Jancke has recorded material from a European shrew, *Crocidura leucodon*, as a variety of *reclinata*. In the absence of specimens from the type host it is not here possible to come to any definite decision regarding this variety. On the basis of the published notes and descriptions by Jancke and Fahrenholz, the present writer still believes all these to represent a single species for which the name *reclinata* is correct. The supposed "variety" *leucodontis* is here placed in synonymy with *reclinata*, but the species name *deltoides* is admitted, in the absence of the material which is necessary before it is definitely reduced to synonymy.

Polyplax serrata (Burmeister)

1839. *Pediculus serratus* Burmeister, Genera Insectorum, Rhynchota, No. 6.
1842. *Haematopinus serratus* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 36.
1904. *Polyplax serrata* (Burmeister), Enderlein, Zoologischer Anzeiger 28:142.
1912. *Polyplax affinis* (Burmeister), Fahrenholz, Jahresbericht des niedersächsischen zoologischen Vereins zu Hannover 2-4:39; figures 13-15. (Misidentification)
1923. *Polyplax serrata* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:191; figure 120B, E.
1932. *Polyplax serrata* (Burmeister), Jancke, Zeitschrift für Parasitenkunde 4:252.
1938. *Polyplax affinis* Fahrenholz, Zeitschrift für Parasitenkunde 10:261. (As a new species)

HOSTS AND DISTRIBUTION. Originally described from the house mouse, *Mus musculus*, in Europe. Later recorded as *Polyplax affinis* (Burmeister) from *Apodemus sylvaticus* in Europe. Ferris has recorded it from this host from Switzerland, Bohemia, and England; from *Apodemus agrarius* from Manchuria and China; from *Apodemus spectosus* from China; from *Mus spicilegus*, which is merely a subspecies of *musculus*, from Spain; and from *Mus musculus* from Scotland and England.

NOTES. The species described as *Pediculus affinis* by Burmeister was at one time placed in *Polyplax* but is now regarded by both Fahrenholz and Ferris as being a *Hoplopleura*. A species of *Polyplax* which has been misidentified as *affinis* is considered by Ferris to be the same as *Polyplax serrata*. Fahrenholz (1938), however, has maintained that this species is distinct and has described it as new, giving *affinis* as a new name for it. Under the revised Rules (Bulletin of Zoological Nomenclature 4:97-125, 1950) this name is available, since at the time of its proposal (1938) it was a nonconcurrent secondary homonym.

In connection with the present work the material at hand from *Mus musculus* and the various species of *Apodemus* has been carefully re-examined. The opinion is here maintained that there is absolutely nothing in these specimens which will justify a specific separation. *Polyplax affinis* Fahrenholz is therefore placed as a synonym of *Polyplax serrata* (Burmeister).

Polyplax spinigera (Burmeister)

1839. *Pediculus spiniger* Burmeister, Genera Insectorum, Rhynchota, No. 9.
1909. *Haematopinus (Polyplax) spiniger* (Burmeister), Neumann, Archives de Parasitologie 13:524; figure 24.

HOSTS AND DISTRIBUTION. Described from a rodent cited by the older authors as *Hypudaeus amphibius*, which is now referred to the genus *Arvicola*.

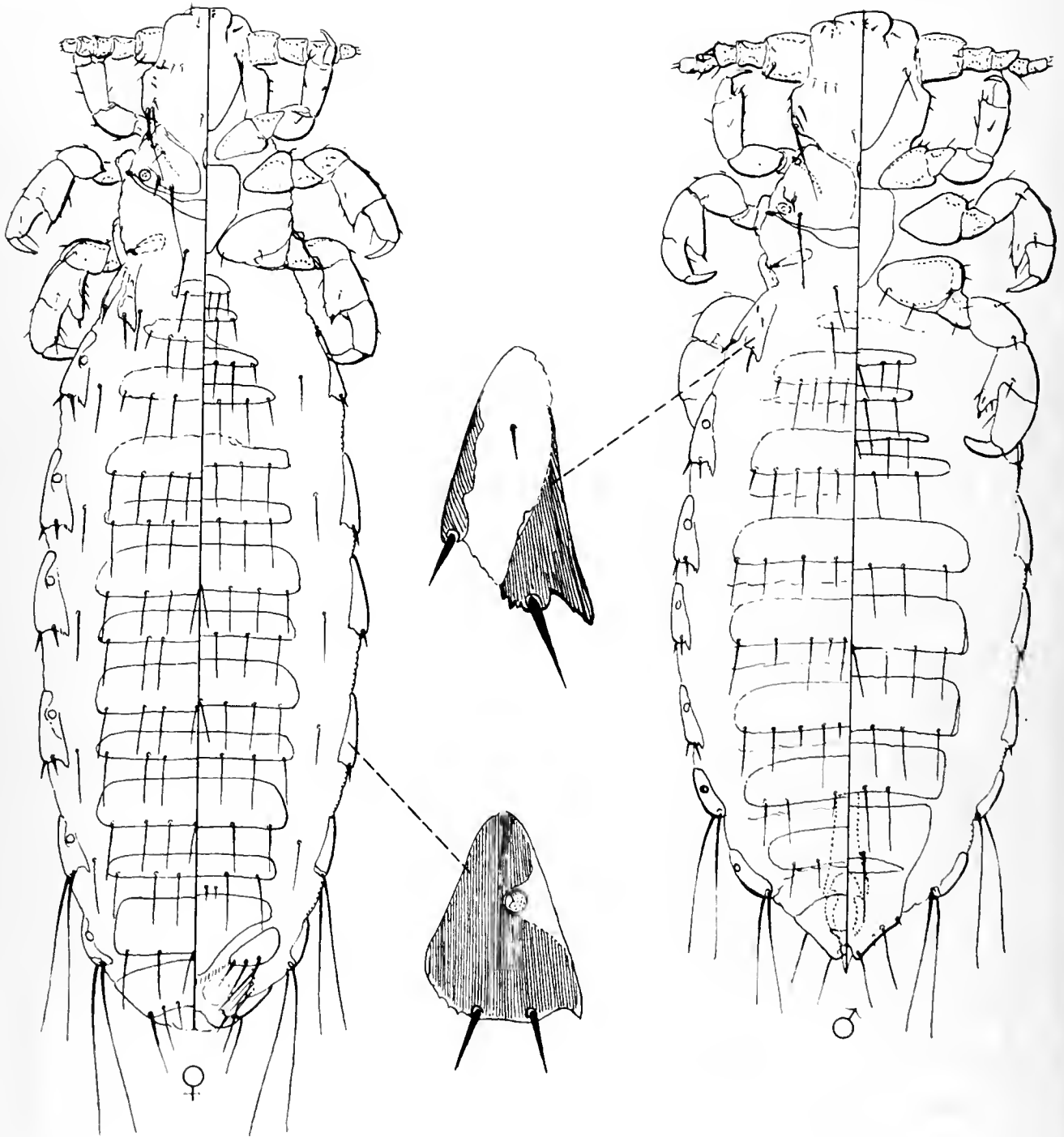
NOTES. Since its original description only one author, Neumann, has seen specimens from this host and the species cannot be definitely identified from his notes and figures. It is apparently distinct from *Polyplax spinulosa* and the suggestion that it is the same as, and therefore antedates, either *Polyplax alaskensis* Ewing or *Polyplax abscisa* Fahrenholz will need to be explored when specimens are obtained from its type host.

Polyplax spinulosa (Burmeister) Figures 90, 91

1839. *Pediculus spinulosus* Burmeister, Genera Insectorum, Rhynchota, No. 8.
1842. *Haematopinus spinulosus* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 26; Plate 24, figure 5.
1864. *Pediculus denticulatus* Nitzsch, Zeitschrift für den gesamten Naturwissenschaften 23:24.
1905. *Polyplax spinulosa* (Burmeister), Enderlein, Zoologischer Anzeiger 28:142.
1923. *Polyplax spinulosa* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:187; figures 119, 120A, D, F, H.
1929. *Polyplax praomydis* Bedford, Annual Report of the Director of Veterinary Services, Union of South Africa 15:503; figures 2-5.
1938. *Polyplax spinulosa* (Burmeister), Fahrenholz, Zeitschrift für Parasitenkunde 10:249; figures 1-8, 23c.
1945. *Polyplax campylopteri* Zavaleta, Anales del Instituto de Biología (Mexico) 11:431; figure.

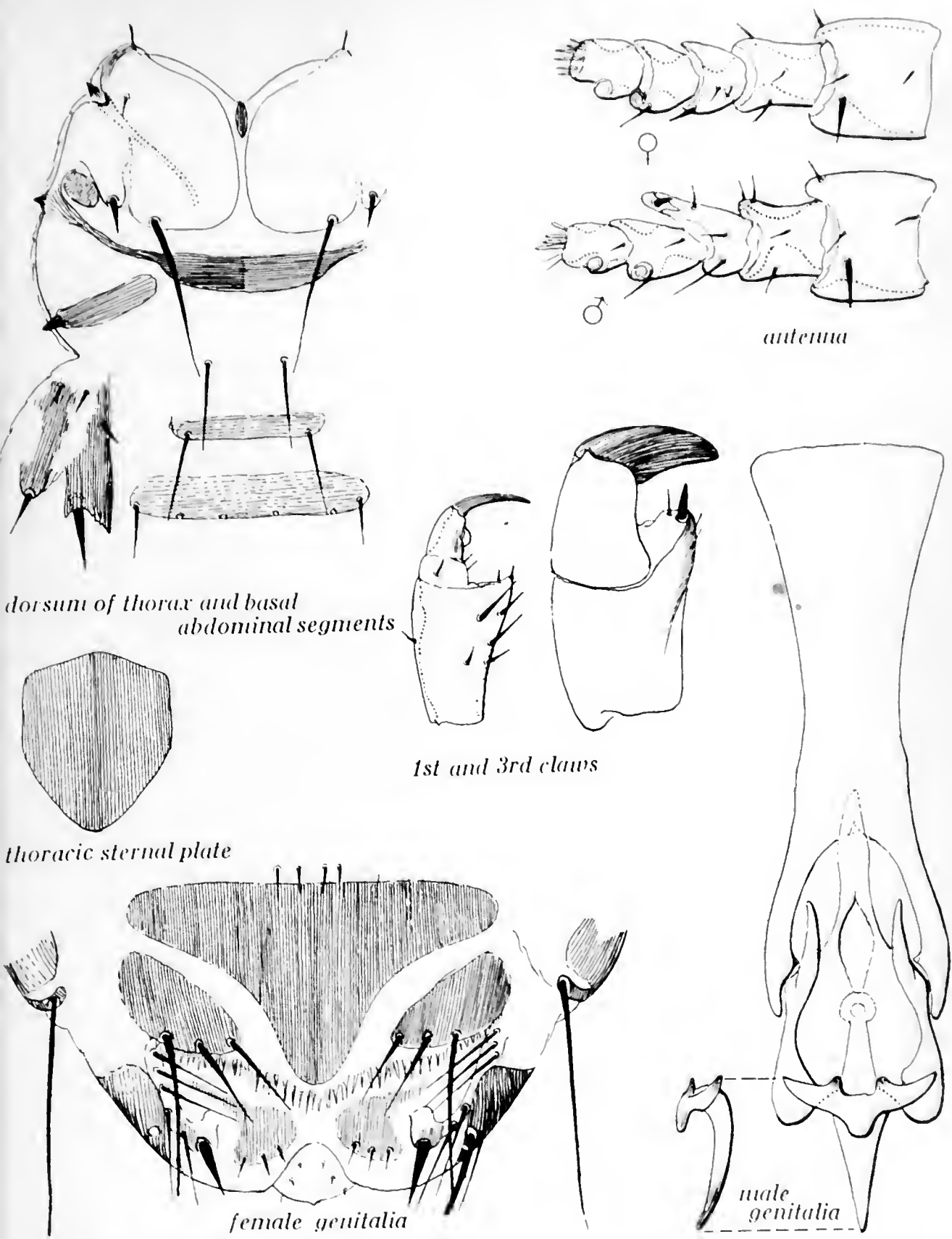
HOSTS AND DISTRIBUTION. Originally described from the brown rat, *Rattus (=Mus=Epimys) norvegicus*, in Europe. Later many times recorded from this host and from *Rattus rattus* and some of its subspecies in many parts of the world. It has been recorded by Ferris from *Rattus calcis*, which is considered to be *exulans*, in the Philippine Islands and *Rattus stridens* in the Malay Peninsula and from *Bandicota* (as *Gunomys*) *bengalensis* in Burma. Described by Bedford as *Polyplax praomydis* from *Praomys* (now called *Thallomys*) *namaquensis* at Onderstepoort, South Africa.

Records by Ferris of the occurrence of this species upon various species of *Microtus*, *Synaptomys*, and *Phenacomys* are erroneous and are here transferred to *Polyplax abscisa* Fahrenholz.



Polyplax spinulosa (Burmeister)

Figure 90



Polyplax spinulosa (Burmeister), details

Figure 91

NOTES. A male from the type lot of *Polyplax praomydis* Bedford is available and is very precisely *spinulosa*. *Polyplax campyloptera* Zavaleta, described as from a bird, is, on the basis of illustrations presented by its author, very obviously nothing more than *spinulosa*.

Polyplax stephensi (Christophers and Newstead)

1906. *Haematopinus stephensi* Christophers and Newstead, Thompson, Yates and Johnston Laboratories Report (new series) 7:3; Plate 1.
1923. *Polyplax stephensi* (Christophers and Newstead), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:206; figures 130, 131.
1938. *Eremophthirius stephensi* (Christophers and Newstead), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. First described from *Gerbillus* (= *Tatera*) *indica* from India, without precise indication of locality. Cotype specimens are labeled as from Madras. Later recorded by Ferris from the same host from various localities in India.

Polyplax tarsomydis Ewing

1935. *Polyplax tarsomydis* Ewing, Proceedings of the Biological Society of Washington 48:206.
1938. *Eremophthirius tarsomydis* (Ewing), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. Described by Ewing as from *Tarsomys* (a subgenus of *Rattus*) *apoensis* from the island of Mindanao, Philippine Islands. One male taken from a skin in the United States National Museum. Two females which may be considered to belong to this species are at hand from the same host, taken from a skin, United States National Museum Number 144616, from the summit of Mount Bliss, on the island of Mindanao.

NOTES. This species was described from a single male. It is not practicable here to describe the female except as it is included in the key to the species.

Polyplax taterae Ferris

1923. *Polyplax taterae* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:198; figures 124, 125D.
1936. *Polyplax subtaterae* Bedford, Onderstepoort Journal of Veterinary Science and Animal Industry 7:63; figure 7.
1938. *Eremophthirius taterae* (Ferris), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.
1938. *Eremophthirius subtaterae* (Bedford), Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. Type of *taterae* from *Tatera vicina* from Mount Rukenya, British East Africa. Type of *subtaterae* from *Tatera liodon* at Kampala, Uganda.

NOTES. Specimens of *subtaterae* are at hand, through the kindness of the late G. A. H. Bedford, and it is upon these that the above synonymy is based.

Polyplax waterstoni Bedford

1919. *Polyplax waterstoni* Bedford, Report of the Division of Veterinary Research, Department of Agriculture, Union of South Africa 6-7: 715; Plate 1, figures 1, 2, 4, 5.
1923. *Polyplax waterstoni* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:193; figures 121, 122.

1938. *Polyplax emnatus* Fahrenholz, Zeitschrift für Parasitenkunde 10:265; figures 16, 17.

HOSTS AND DISTRIBUTION. First described as from "several rats," at Onderstepoort, Pretoria, South Africa. Recorded by Ferris from *Eptmys peromyscus*, for which the proper name is apparently *Rattus tullbergi*, at Molo, British East Africa. Described as *Polyplax emnatus* by Fahrenholz from "*Paderoryctes gadat*," from East Africa. No such host name appears in any available lists. Hopkins has hazarded the guess that this is a corruption of *Tachyoryctes audax*, but this is purely a surmise unsupported by any special evidence.

NOTES. On the basis of the description and illustrations given by Fahrenholz, there is not the slightest justification for the separation of *Polyplax emnatus* from *waterstoni*.

Polyplax werneri (Glinkiewicz)

1907. *Eremophthirus werneri* Glinkiewicz, Sitzungsberichte der mathematisch-naturwissenschaftlichen Classe der kaiserliche Akademie der Wissenschaften zu Wien 116:381; figures.

1923. *Polyplax werneri* (Glinkiewicz), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:202; figure 127.

1938. *Eremophthirus werneri* Glinkiewicz, Fahrenholz, Zeitschrift für Parasitenkunde 10:243.

HOSTS AND DISTRIBUTION. Described from *Pachyuromys duprasi*, Natron Valley, Egypt, and recorded by Ferris from the same host and locality.

NOTES. This species is the type of the genus *Eremophthirus*.

Genus PROENDERLEINELLUS Ewing

1923. *Proenderleinellus* Ewing, Journal of the Washington Academy of Sciences 13:147.

1938. *Waterstonia* Fahrenholz, Zeitschrift für Parasitenkunde 10:244. (Pre-occupied)

1939. *Symysadus* Fahrenholz, Mitteilungen aus dem entomologischen Verein Bremen (no volume number), page 44.

GENERIC TYPE. The genus was based upon *Proenderleinellus africanus* Ewing, which is a synonym of *Polyplax calva* Waterston. The generic names proposed by Fahrenholz were based upon *Polyplax calva* Waterston. This is the only included species.

CHARACTERS. Polyplacinae in which the antennae are five-segmented, not sexually dimorphic. Anterior legs moderately large, but with slender claw; middle legs but slightly larger than the first and with slender claw; third legs much larger than the others and with stout claw. Paratergal plates of the abdomen present on segments 2-8, those of segment two divided longitudinally into two pieces. Abdomen entirely membranous in both sexes except for the usual sclerotizations of the terminal and genitalic segments and even these are much reduced. Abdominal segments of the female, both dorsally and ventrally, with for the most part two rows of setae, these setae borne each on a small, sclerotized plate or tubercle which surrounds its base. Abdomen of the male with one row of such setae on all segments dorsally except perhaps the second, which has two, and with two rows on most of the segments ventrally. Sternal plate of the thorax well developed. Abdominal spiracles present on segments 3-8.

NOTES. The writer, suspecting that *Proenderleinellus africanus* Ewing might be a synonym of the earlier *Polyplax calva* Waterston, enlisted the aid of Mr. C. F. W. Muesebeck, who examined the single male type of the former and agreed.

Proenderleinellus calva (Waterston)

Figures 92, 93

1917. *Polyplax calva* Waterston, Parasitology 9:199; figures.
1923. *Polyplax calva* Waterston, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:234; figures 153, 154.
1923. *Proenderleinellus africanus* Ewing, Journal of the Washington Academy of Sciences 13:147.
1938. *Waterstonia calva* (Waterston), Fahrenholz, Zeitschrift für Parasitenkunde 10:244.
1938. *Waterstonia calva zanzibariensis* Fahrenholz, Zeitschrift für Parasitenkunde 10:244.
1939. *Symysadus calva* (Waterston), Fahrenholz, Mitteilungen aus dem entomologischen Verein Bremen (no volume number), page 44.

HOSTS AND DISTRIBUTION. Described by Waterston from *Cricetomys gambianus* at Accra, French West Africa, and also recorded from *Cricetomys* sp. from Zanzibar. The supposed subspecies *zanzibariensis* was based solely upon the illustration given by Waterston of the male, this male having come from Zanzibar. The supposed species *africanus* of Ewing was based upon a single male which had been taken from a skin of *Thryonomys gregorianus* which had come from British East Africa. There are at hand specimens from the type host at Accra and also from *Cricetomys* from Zanzibar.

NOTES. The specimens at hand deny the slight differences offered by Fahrenholz as a basis for the naming of his supposed form *zanzibariensis*.

Genus RATEMIA Fahrenholz

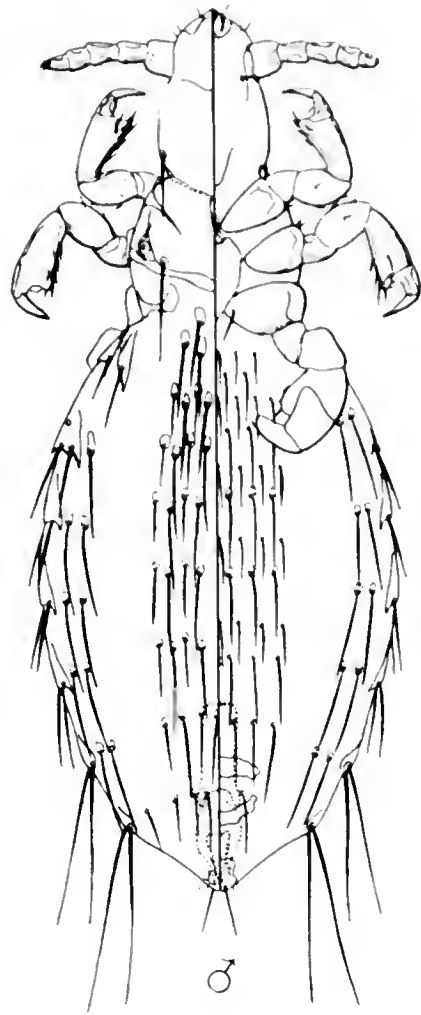
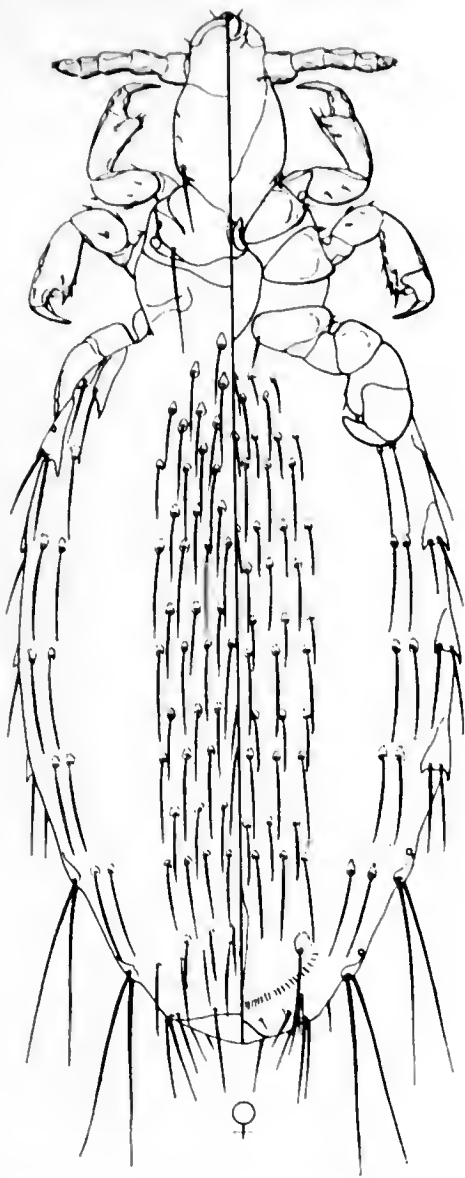
1916. *Ratemia* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:31.
1922. *Ratemia*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:156.
1949. *Ratemia*, Webb, Proceedings of the Zoological Society of London 119:164.

GENERIC TYPE. *Haematopinus (Linoëgnathus) squamulatus* Neumann, the only included species.

CHARACTERS. Polyplacinae with five-segmented antennae which are not sexually dimorphic. Anterior legs relatively small, with slender claw; middle and posterior legs about equal to each other, larger than the first and with somewhat stouter claw. Paratergal plates of the abdomen occurring on segments 3-6. Abdomen otherwise membranous in both sexes except for the usual terminal and genital areas. Abdominal segments in both male and female, both dorsally and ventrally, with a single transverse row of setae which along the mid-line of the body becomes merged with a median cluster of two or three rows of setae. Spiracles present on abdominal segments 3-9. Thoracic sternal plate well developed.

The type species of the genus apparently occurs normally on hosts of the Perissodactylous family Equidae.

NOTES. Because of the hosts of the type species it is difficult to shake off a prejudice that this genus should not be assigned to the Hoplopleuridae, which are primarily parasites of the rodents, and there is a pressure to find some excuse for placing it in the Haematopinidae or the Linoëgnathidae. However, no morphological reason for either of these latter assignments appears and it is here placed in the Hoplopleuridae. Webb (1949) has assumed the genus to be related to *Linoëgnathus* because of similarities of the spiracles, but the present writer remains unimpressed by this supposed resemblance, especially in the face of other morphological features.

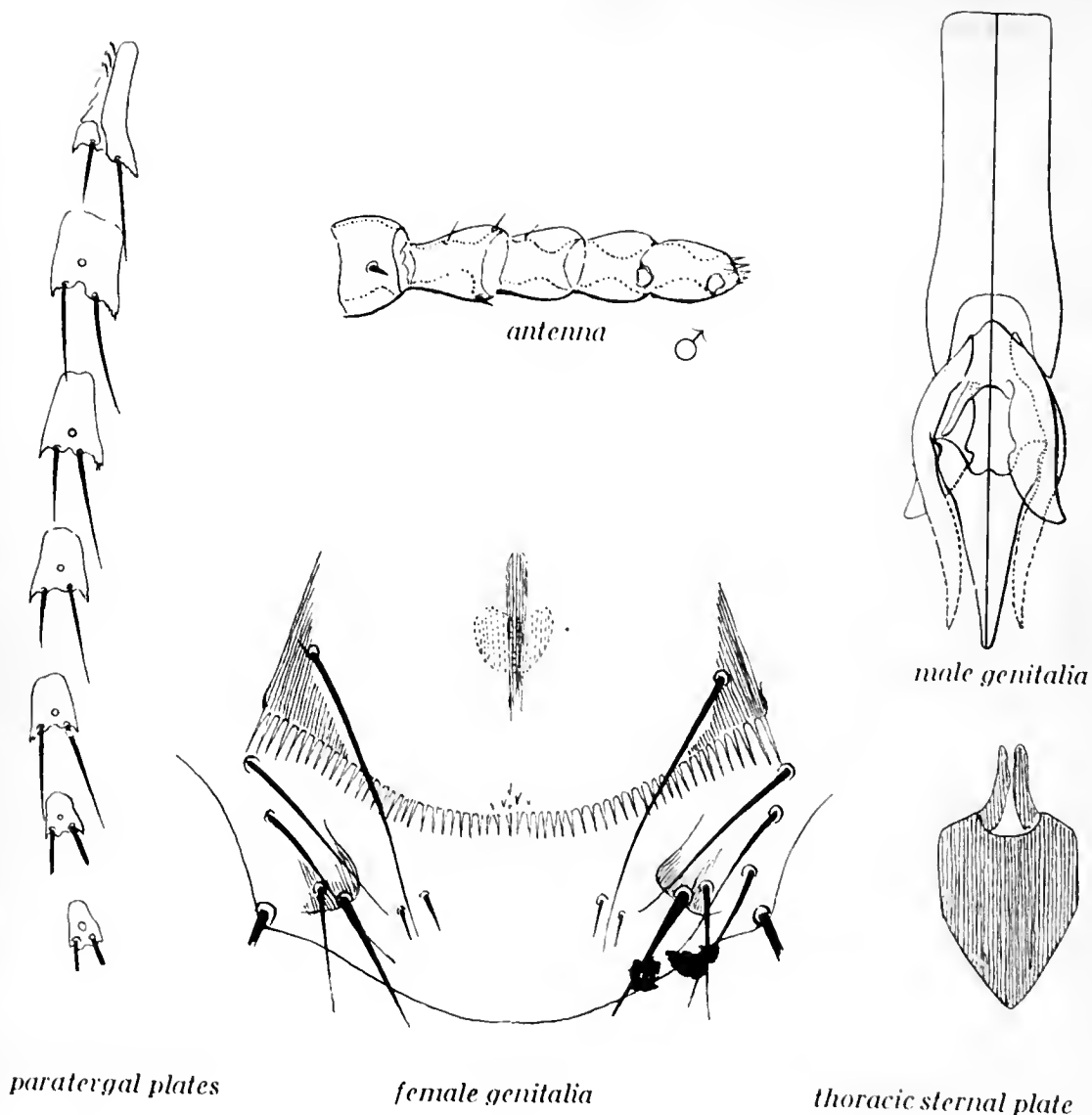


Proenderleinellus calva (Waterston)

Figure 92

Ratemia squamulata (Neumann)
Figure 94

1911. *Haematopinus (Linoëgnathus) squamulatus* Neumann, Archives de Parasitologie 14:401; figures.
 1916. *Ratemia squamulata* (Neumann), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:31.
 1922. *Ratemia squamulata* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:157: figure 103.
 1946. *Ratemia squamulata* (Neumann), Hopkins, Annals and Magazine of Natural History (Series 11) 12:565. (Dated August, 1945, but available copy bears the notation that it was published in May, 1946)



paratergal plates

female genitalia

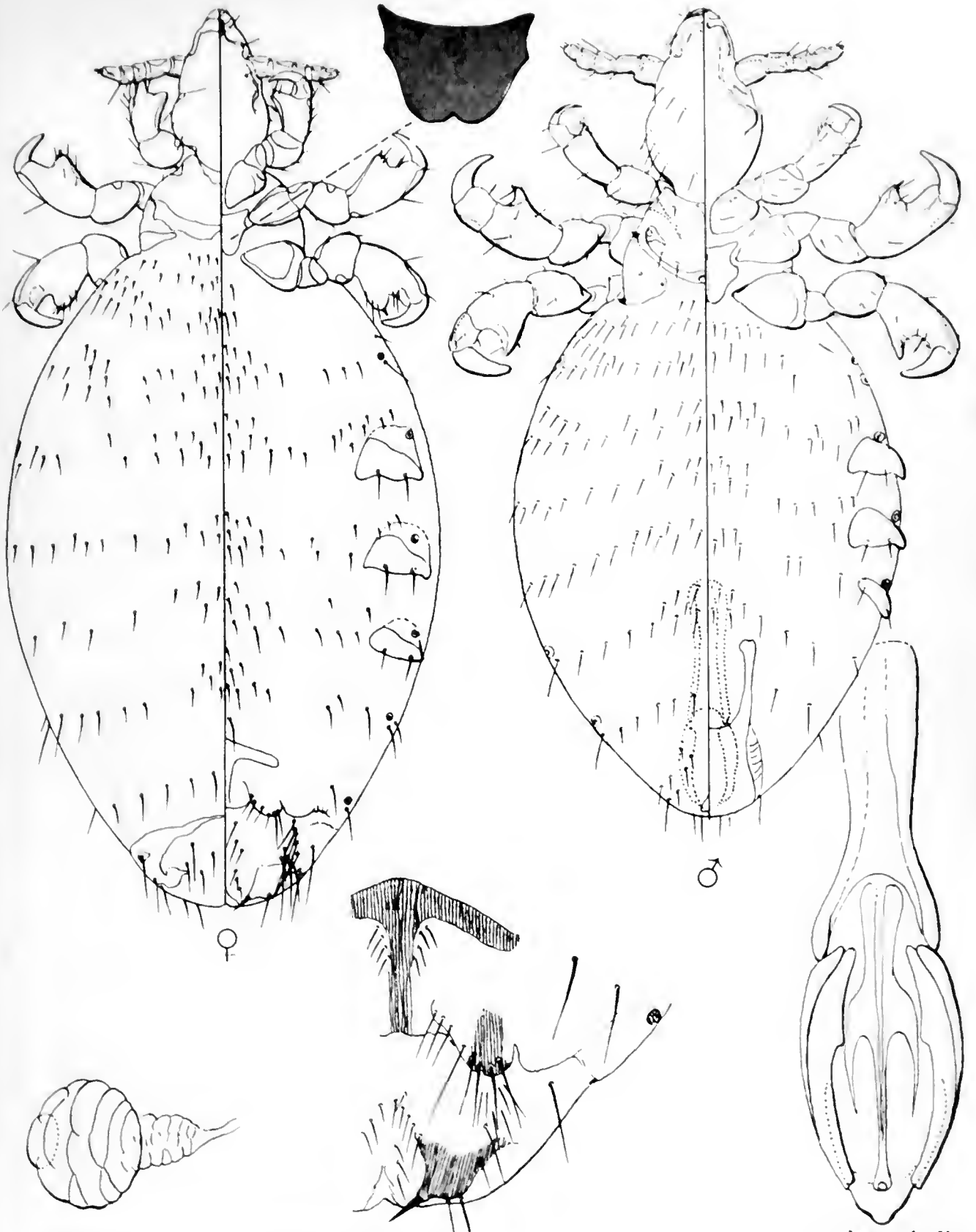
thoracic sternal plate

Proenderleinellus calva (Waterston), details

Figure 93

HOSTS AND DISTRIBUTION. Originally described from an undetermined host at Dire-Daoua, Abyssinia. Since that time Hopkins has recorded the species from domestic donkey at Liro, Lango District, Uganda, and from Burchell's zebra, *Equus (Hippotigris) burchelli*, taken on the Athi Plains near Nairobi, Kenya, thus apparently establishing the normality of the species to members of the Perissodactylous family Equidae. It should, therefore, enter into any list of the parasites of domestic animals.

NOTES. Through the kindness of Mr. Hopkins it has been possible to see specimens from both the hosts recorded by him. In the accompanying illustrations, that of the female is from a specimen in the original type lot; that of the male is from a specimen from *Equus burchelli*, which was received as a loan from Mr. Hopkins.



spiracle
Ratemia squamulata (Neumann)

female genitalia

male genitalia

Figure 94

Genus SYMOCA Fahrenholz

1938. *Symoca* Fahrenholz, Zeitschrift für Parasitenkunde 10:245.

GENERIC TYPE. *Polyplax brachyrrhynchus* Cummings, the only included species.

CHARACTERS. Polyplacidae with five-segmented antennae which are sexually dimorphic, those of the male having the distal, preaxial angle of the third segment slightly prolonged and bearing a stout, recurved seta at its apex. Head with the basal segment of the antennae set very close to the truncate anterior margin. Thorax narrow and somewhat elongate, with no distinct sternal plate. Anterior legs small and weak and with slender claw; middle legs distinctly larger and with somewhat larger claw; posterior legs with the tibio-tarsus much enlarged and with a stout, heavy claw. Abdomen with paratergal plates present on segments 2-8, the plates on segment two apparently not divided longitudinally. Female with abdominal segments 4-7 each with two plates and two transverse rows of setae both dorsally and ventrally. Male with but one row of setae on any segment both dorsally and ventrally, except for the sternum of segment three which apparently has two rows. Sternal plates not developed in the male.

NOTES. While the relationships of this genus are certainly with *Polyplax* and the bases for a generic separation are not especially convincing, the genus is here accepted.

Symoca brachyrrhyncha (Cummings) Figures 95, 96

1915. *Polyplax brachyrrhynchus* Cummings, Proceedings of the Zoological Society of London, page 246; figures 13, 14.

1923. *Polyplax brachyrrhynchus* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 4:220; figures 142, 143.

1938. *Symoca brachyrrhyncha* (Cummings), Fahrenholz. Zeitschrift für Parasitenkunde 10:245.

1939. *Symoca brachyrrhyncha*, variety *minor* Fahrenholz, Mitteilungen aus dem entomologischen Verein Bremen, page 32.

HOSTS AND DISTRIBUTION. Described as from *Acomys cahirinus* at Assiut, Egypt. Recorded by Ferris from *Acomys hystrella* in Uganda and from *Acomys percivali* in British East Africa.

NOTES. Fahrenholz based the supposed variety *minor* entirely upon a comparison of the description and illustrations given by Cummings with those given by Ferris, although Ferris had compared his specimens with the types. The differences cited by Fahrenholz are merely such as may readily appear in the work of two individuals, even utilizing the same material.

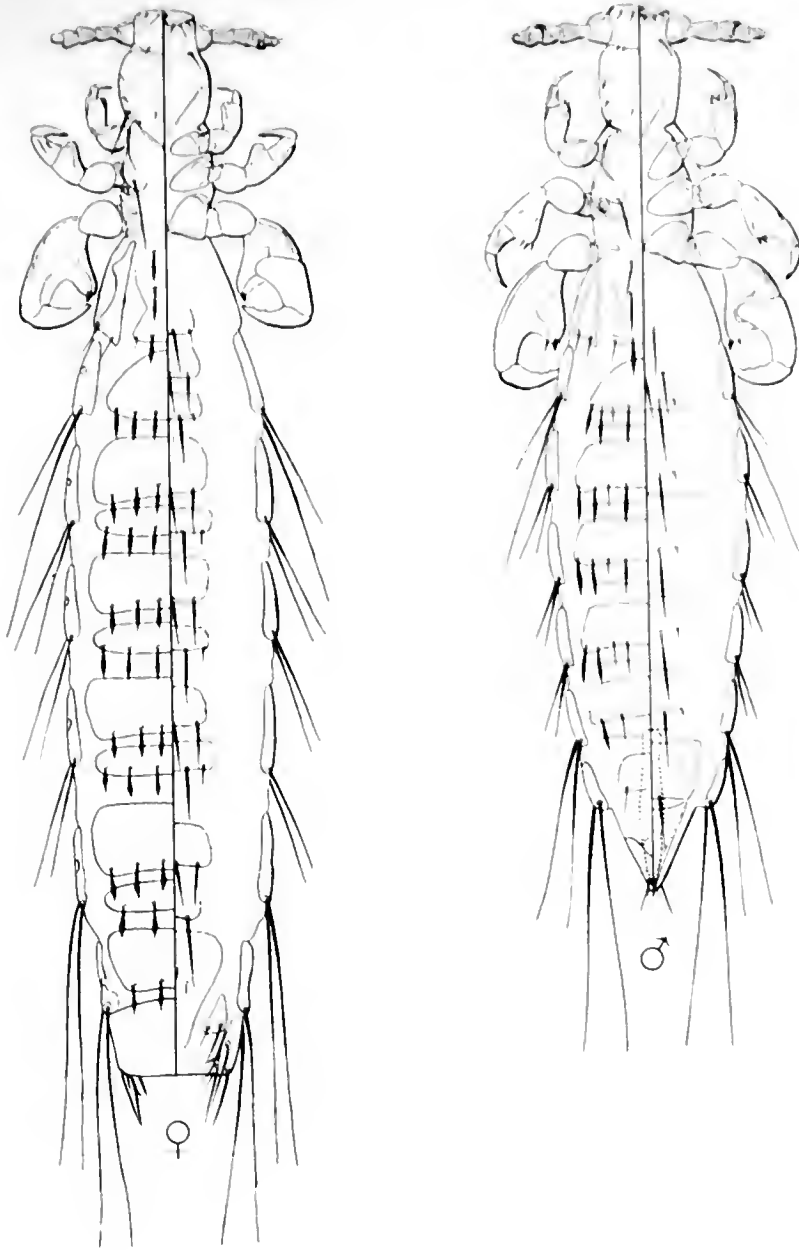
Family LINOGNATHIDAE Webb

1904. *Trichaulinae* Enderlein, Zoologischer Anzeiger 28:138.

1905. *Lino gnathinae* Enderlein, Zoologischer Anzeiger 29:194.

1946. *Lino gnathidae* Webb, Proceedings of the Zoological Society of London 116:107.

DESCRIPTION OF THE FAMILY. Anoplura in which external evidence of eyes may or may not be present. Abdomen entirely membranous in both sexes except for plates associated with the terminal and genital segments and rarely (one species) tergal plates in the male. Abdominal segments each with at least one row of hairs both dorsally and ventrally, usually much haired. Second and third legs almost always equal to each other and much larger than the first pair. Thorax usually without any trace of a sternal plate but if present always without the apex free from the body. Spiracles, as



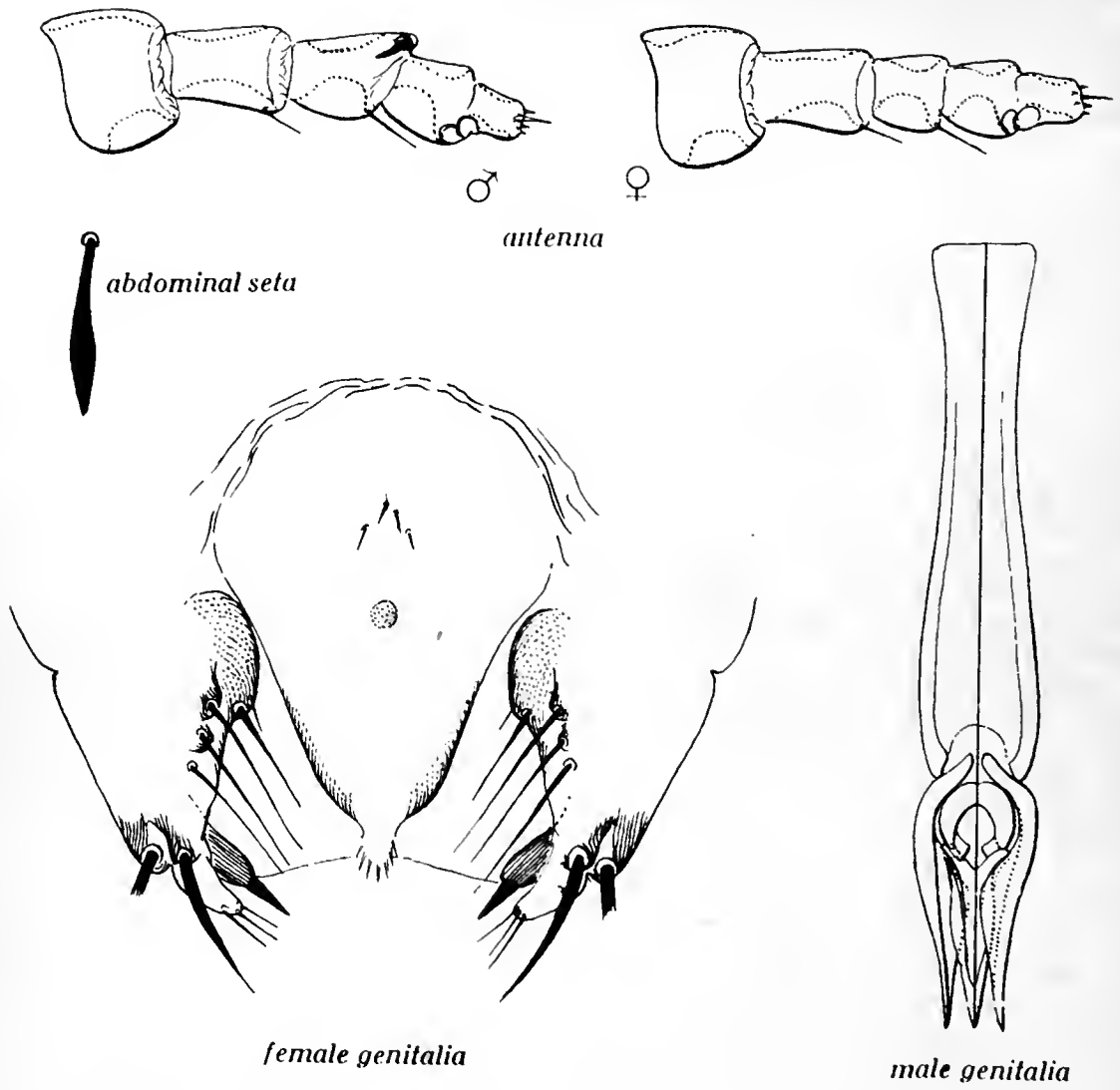
Symoca brachyrrhyncha (Cummings)

Figure 95

far as known, with distinct internal ledges which show externally as rings, or with the ledges forming internal points.

The members of the family are restricted to members of the Orders Artiodactyla and Hyracoidea, except for two species from Carnivora.

NOTES. To this family there are here assigned four genera—*Linoğnathus*, *Microthoracius*, *Solenopotes*, and *Prolinoğnathus*. A certain amount of doubt is felt concerning the genus *Microthoracius* since an argument can be made for its assignment to the Haematopinidae. One other question, that of the genus *Haemodipsus*, is troublesome. The type of this genus is unfortunately an imperfectly known species and, because of its relation to certain other species which are assigned to the genus, it is here placed in the Hoplopleuridae. Taken by itself it might very properly be assigned to the Linoğnathidae and eventually it may be necessary to break up the genus *Haemodipsus*, assigning its type species to a position near *Linoğnathus*.



Symoca brachyrrhyncha (Cummings), details

Figure 96

Key to the Genera of **LINOGNATHIDAE**

1. Eyes indicated externally by a definite lens; occurring on *Camelidae*...
**MICROTHORACIUS**
 No external trace of eyes.....2
2. Abdominal spiracles borne in a slightly sclerotized tubercle which projects at least slightly from the body; occurring chiefly on *Cervidae*, but 1 species known from domestic cattle.....**SOLENOPTES**
 Spiracles not thus borne in sclerotized tubercles.....3
3. Setae of abdomen greatly reduced in number, there being normally but 2 setae in each median group, both dorsally and ventrally, on any abdominal segment, these in a single row; spiracles extremely small; occurring as far as known only on members of the Order *Hyracoidea*....
**PROLINOGNATHUS**
 Setae of abdomen more numerous, usually abundant, and in 2 or more rows on each segment; spiracles not minute; occurring for the most part on members of the Order *Artiodactyla*, but represented on the family *Canidae* of the Order *Carnivora*.....**LINOGNATHUS**

Genus *LINOGNATHUS* Enderlein

1904. *Trichaulus* Enderlein, Zoologischer Anzeiger 28:139, 141. (Preoccupied)
1905. *Linoëgnathus* Enderlein, Zoologischer Anzeiger 29:194.
1909. *Linoëgnathus* (*Haematopinus*), Neumann, Archives de Parasitologie 13:529.
1932. *Linoëgnathus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:336.
1949. *Stobbella* Eichler, Bolletino della Societa Entomologica Italiana 79:13.

GENERIC TYPE. *Pediculus piliferus* Burmeister, which is considered to be a synonym of *Pediculus setosus* von Olfers.

GENERIC SYNONYMS. *Stobbella* Eichler, type *Linoëgnathodes pithodes* Cummings.

CHARACTERS. Linoëgnathidae in which there is no external evidence of eyes. Antennae five-segmented, the fourth and fifth segments not fused. Spiracles of the abdomen usually more or less spherical, the internal ledges of the atrium appearing externally as partial rings; never elongated and never borne in a sclerotized tubercle. Thoracic sternal plate lacking, or if present very weakly developed and divided longitudinally into two small plates. Abdominal segments usually much haired both dorsally and ventrally, with the hairs in at least two rows. Abdomen terminally with a pair of ventral lobes, but these never produced into flat processes. Genitalia of the male always with parameres well developed and enclosing the oedeagus.

NOTES. This is a genus of considerable size, 26 species now being known. These are confined to the families Bovidae and Giraffidae of the Order Artiodactyla, except for two species which occur on carnivores of the family Canidae.

Eichler has recently named the genus *Stobbella*, with *Linoëgnathus pithodes* as its type, but this genus is here rejected.

Key to Species of *LINOGNATHUS*

1. Abdomen beset with short, stout, more or less fusiform setae.....2
 - Abdomen with no such fusiform setae.....5
- 2 (1). Anterior legs of same form as the others and almost as large; abdomen very thickly and uniformly beset with fusiform setae; on *Gorgon taurinus* in Africa.....SPICATUS
 - Anterior legs definitely smaller than the others and with slender claw; fusiform setae more or less numerous, but leaving bare areas.....3
- 3 (2). Gonopods of female well separated mesally from each other; on *Antilope cervicapra* in India.....PITHODES
 - Gonopods of female very broad and leaf-like, meeting each other mesally at the apex at least.....4
- 4 (3). Median genital plate of female expanded at its posterior end; on *Gazella thomsoni* in British East Africa.....LEWISI
 - Median genital plate of female not broadened at its posterior extremity; on *Antidorcas marsupialis* in South Africa.....BEDFORDI
- 5 (1). Female with no trace of a sclerotized, median, genital plate.....6
 - Female with at least a small, median, genital plate.....11
- 6 (5). Gonopods of the female apically truncate, emarginate or serrate...7
 - Gonopods of the female apically rounded or acute.....9
- 7 (6). Gonopods of the female with the posterior border somewhat emarginate and bearing a sclerotized hook at the mesal angle; forehead elongate and apically acute, hindhead longer than wide, almost rectangular; occurring on domestic cattle throughout the world...
 -VITULI

- Not with this combination of characters.....8
- 8 (7). Head long and slender, the forehead acute, the hindhead with the lateral margins slightly convex; gonopods of female with a slight tooth close to the posterior border near the mesal angle; occurring especially on domestic goats, but also at times on sheep and recorded from the European *Capra ibex* and *Caprella rupicapra*.....STENOPSIS
- Head very small and short, not prolonged in front of the antennae; gonopods of the female with the posterior margin irregularly serrate; widely distributed on domestic sheep.....PEDALIS
- 9 (6). Head elongate and slender; dorsum of metathorax with an apically free lobe close to the margin just above the posterior coxal condyle; occurring on *Cervicapra* in Africa.....FAHRENHOLZI
- Head short and broad, the anterior margin broadly rounded, the forehead not at all prolonged anteriorly.....10
- 10 (9). Abdomen in both sexes with very few elongate setae, there being a median pair and a single seta near the margin, both dorsally and ventrally, in either sex, with a few extremely minute setae between the median and lateral setae; occurring on *Gorgon taurinus* in Africa.....HOLOGASTRUS
- Abdomen with numerous slender setae both dorsally and ventrally in both sexes; occurring on *Canis brasiliensis* in South America.....TAENIOTRICHUS
- 11 (5). Genital plate of the female oval, triangular, or lozenge-shaped, and never with a slender median, stalk-like prolongation connecting with the lip of the vulva.....12
- Genital plate of the female with various configurations, but not as above.....16
- 12 (11). Genital plate relatively very large and definitely lozenge-shaped; head unusually elongate and narrow; occurring on "North African antelope".....PETASMATUS
- Not with this combination of characters.13
- 13 (12). Female with the genital plate transversely oval and with a slight median, posterior point; gonopods elongate, apically somewhat spatulate; male with the terminal sternite produced and with a flattened, sclerotized lobe on each side; occurring on *Connochaetes* and *Gorgon* in Africa.....GNU
- Not with this combination of characters.....14
- 14 (13). Head elongate and slender, anteriorly acute; genital plate of the female forming an almost equilateral triangle; occurring on *Hippotragus* in Africa.....HIPPOTRAGI
- Head broad throughout, genital plate of the female forming merely a small, slightly elongate, oval area.....15
- 15 (14). Head very short and broad, scarcely longer than wide; occurring on domestic dogs and on foxes; occasionally taken from other carnivores.....SETOSUS
- Head broad, but fully twice as long as wide; on domestic sheep in various parts of the world.....OVILLUS
- 16 (11). Female with a pair of small, hook-like processes on the lip of the vulva between the gonopods; male with a deeply pigmented, transverse plate just in front of the anus; occurring on *Taurotragus* in Africa.....TAUROTRAGUS
- Not with these characters.....17
- 17 (16). Female with the genital plate definitely spatulate (not merely slightly expanded anteriorly) and with a slender, stalk-like posterior prolongation nearly or quite connecting with the lip of the vulva.....18
- Female with the genital plate not thus spatulate.....21

- 18 (17). Genital plate of the female described as more or less T-shaped, the arms of the T quite short; occurring on *Peleus capreolus* in Africa.....PELEUS
Genital plate of the female otherwise.....19
- 19 (18). Gonopods of the female curved, their apices directed toward the mid-line of the body and with setae extending from the lateral margin around the apex and well up the mesal margin; head rather smoothly fusiform; occurring on *Cephalophus maxwelli*, an African species.....ANGULATUS
Gonopods of the female almost straight and parallel, their setae confined to the mesal margin.....20
- 20 (19). Gonopods with mesal margin from apex to junction with body straight; occurring on *Aepyceros melampus* in Africa.....AEPYCERUS
Gonopods with mesal margin from apex to junction with body convex; occurring on giraffe.....BREVICORNIS
- 21 (17). Gonopods of female with setae confined to the apex.....22
Gonopods of female with setae extending well up the mesal margin from the apex.....24
- 22 (21). Gonopods of the female apically convergent; genitalia of male with definite pseudopenis and with parameres not basally swollen..23
Gonopods of female described as parallel; genitalia of male described as having the parameres basally swollen and as lacking pseudopenis; occurring on *Antilope cervicapra*, an Indian species.....CERVICAPRAE
- 23 (22). Gonopods of female extremely small, strongly convergent throughout their length; occurring on *Antilope euchore* and various other species of *Antilope* in Africa.....TIBIALIS
Gonopods of female with sclerotization elongate and strongly curved at the extreme apex; occurring on domestic sheep, widely distributed, and perhaps on *Oreotragus saltator* in Africa.....AFRICANUS
- 24 (21). Forehead slender and apically acute; lateral margins of the hind-head smoothly convex; gonopods of the female short and quite broad; genital plate of the female elongate, somewhat expanded anteriorly but scarcely to be described as spatulate; occurring on *Tragelaphus sylvaticus* in Africa.....FRACTUS
Forehead truncate or at the most broadly rounded.....25
- 25 (24). Gonopods of the female with their mesal margins straight, parallel and only these margins bearing setae; genital plate of the female shoe sole-shaped, projecting slightly from the vulva apically; known from *Tragelaphus gratus* in Africa.....LIMNOTRAGI
Otherwise, occurring especially on species of *Cephalophus*.....BREVICEPS

Linognathus aepycerus Bedford

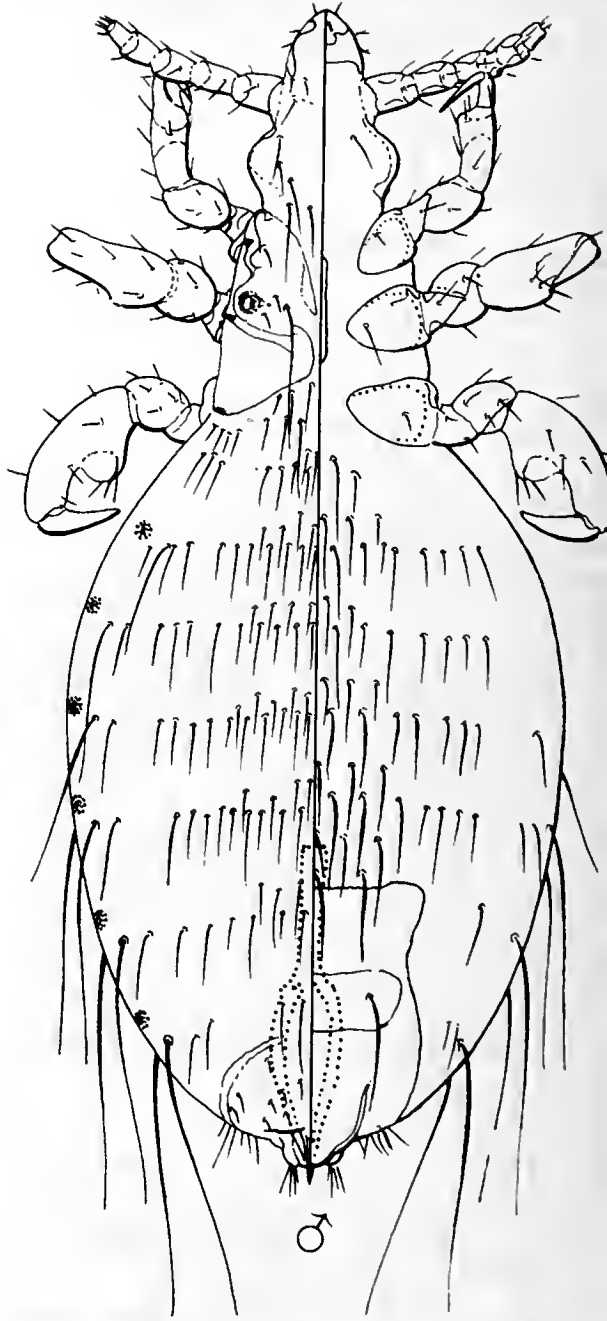
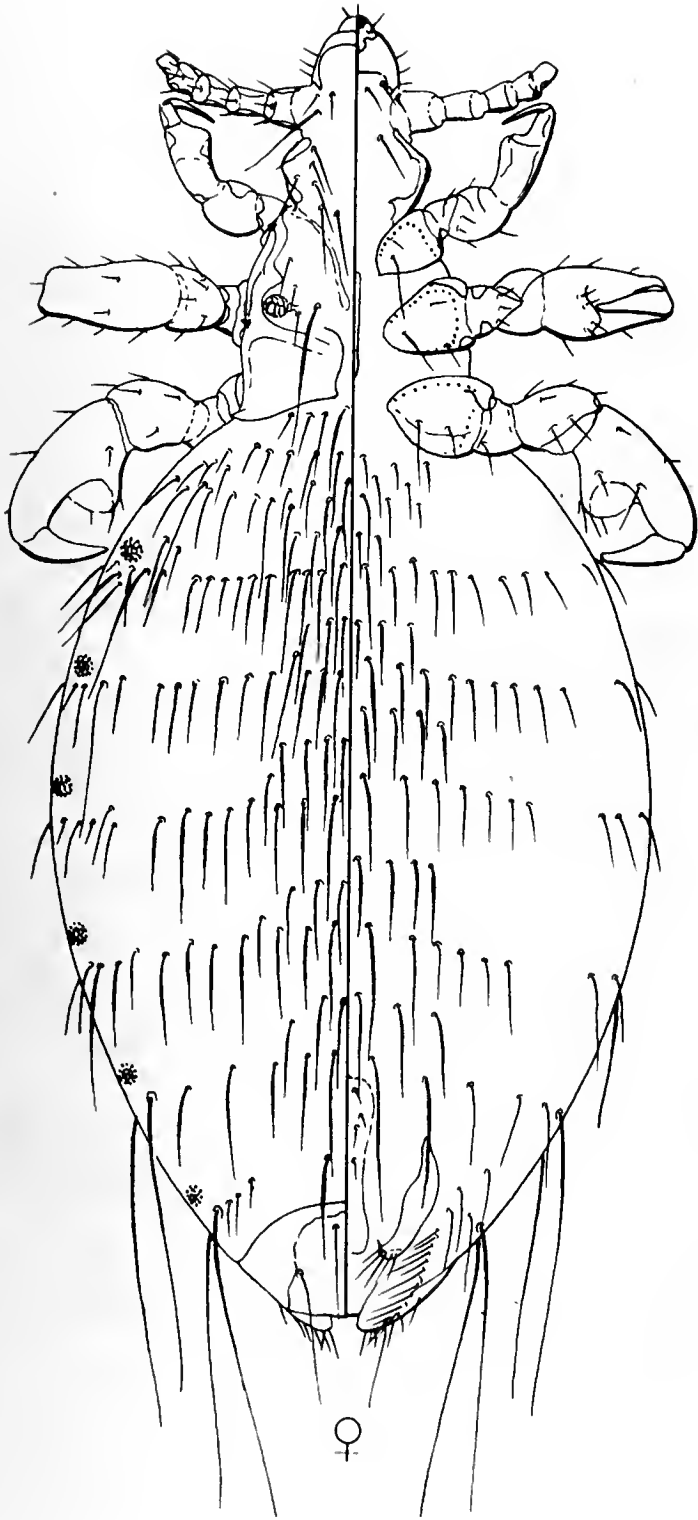
1936. *Linognathus aepycerus* Bedford, Onderstepoort Journal of Veterinary Science and Animal Industry 7:62; figures 5, 6.

HOSTS AND DISTRIBUTION. From *Aepyceros melampus*, commonly called impala, between Pretoria and Johannesburg, South Africa.

Linognathus africanus Kellogg and Paine
Figures 97, 98

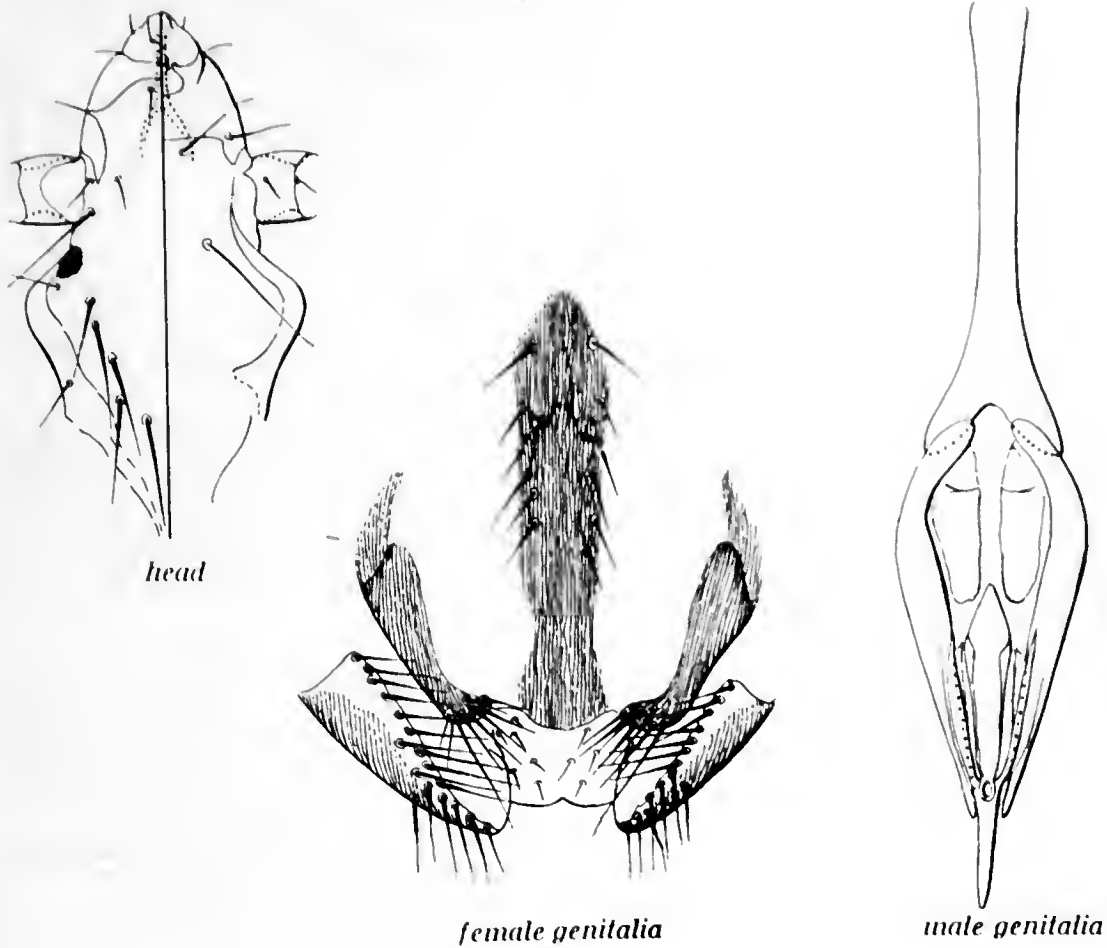
1911. *Linognathus africanus* Kellogg and Paine, Bulletin of Entomological Research 2:146; Plate 4, figures 1, 5.

1916. *Linognathus stenopsis* (Burmeister), Ferris, Proceedings of the California Academy of Sciences (Series 4) 6:155. (Part: misidentification)



Linognathus africanus Kellogg and Paine

Figure 97



Linognathus africanus Kellogg and Paine, details

Figure 98

1927. *Linognathus stenopsis* (Burmeister), Bedford, Report of the Director of Veterinary Education and Research, Union of South Africa 11-12: 737. (Part; misidentification)
1932. *Linognathus africanus* Kellogg and Paine, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:83; figures 212B, G, E, 213.
1932. *Linognathus africanus* Kellogg and Paine, Bedford, Report of the Director of Veterinary Services and Animal Industry, Union of South Africa 18:408.
1939. *Linognathus africanus* Kellogg and Paine, Fahrenholz, Mitteilungen aus dem entomologischen Verein, Bremen, page 35.

HOSTS AND DISTRIBUTION. Type from "sheep," Abeokuta, southern Nigeria, Africa. Later recorded from domestic sheep and domestic goats from various localities in South Africa, Abyssinia, India, and the United States. Recorded by Fahrenholz from *Ovis longipes* from Algeria, North Africa.

NOTES. There are apparently four species of *Linognathus*—namely, *ovillus*, *pedalis*, *stenopsis*, and *africanus*—which may be encountered on domestic sheep and goats. They are quite distinct species and the probability is that here has been some interchange of hosts.

Linognathus angulatus (Piaget)

1885. *Haematopinus unguatus* Piaget, Les Pediculines, Supplement, page 144; Plate 15, figure 7. (A misprint for *angulatus*, since that name appears on the plate and on the label of the type specimens.)
1932. *Linognathus angulatus* (Piaget), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:380; figures 231D, 232G, 233.

HOSTS AND DISTRIBUTION. Type from *Cephalophus nigrifrons* without indication of locality.

NOTES. Since this species was described from the same host genus as was *breviceps*, it might be suspected that synonymy is involved, but apparently the two species are distinct. There may have been some mixing of material or some misidentification involved. Actually the species *aepycerus* approaches it very closely.

Fahrenholz has maintained that the spelling *ungulatus* should be preserved, but it seems clear that this was a typographical error, the spelling *angulatus* being used in connection with the plate accompanying the original description and on the label of the type specimens.

Linognathus bedfordi Ferris

1932. *Linognathus bedfordi* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:387; figures 236, 238B, C, H, I, and 239A, D.

HOSTS AND DISTRIBUTION. From *Antidorcas marsupialis* at Anderstepoort, Union of South Africa.

Linognathus breviceps (Piaget)

1885. *Haematopinus breviceps* Piaget, Les Pediculines, Supplement, page 142; Plate 15, figure 5.
1910. *Linognathus gazella* Mjöberg, Arkiv för Zoologi 6:157; figure 78.
1910. *Linognathus gilvus* Fahrenholz, Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten 34:2:18; figure 5.
1932. *Linognathus breviceps* (Piaget), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:107; figures 216A, 231B, C, E, F, H; 232A.
1932. *Linognathus gazella* Mjöberg, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:111; figures 232B, E, F, 234.

HOSTS AND DISTRIBUTION. First described from *Cephalophus maxwelli* without indication of origin. Described as *Linognathus gazella* Mjöberg from a "gazelle," in the Hamburg Zoological Gardens. Described as *Linognathus gilvus* Fahrenholz from *Cephalophus* sp. from the same Gardens, these having been some of the same specimens, apparently, as the lot that Mjöberg had. Erroneously recorded by Ferris and by Bedford as *Linognathus angulatus* (Piaget) from *Cephalophus natalensis* and *Sylvicapra grimmii* from Zululand and Transvaal.

NOTES. Concerning this species, or perhaps closely related group of species, there is very much of a problem. Ferris, in connection with the reference cited above, was able to examine types of all of them and a considerable range of this material is still at hand. This material has been examined and re-examined in connection with the present work and no consistent basis for the separation of these species has appeared. Perhaps even *Linognathus limnotraei* cannot definitely be separated.

In specimens from the type lot of *gazella* the forehead is almost rectangular, but there is some variation in this and the character does not hold.

Specimens from *Cephalophus grimmii* and *Cephalophus natalensis*—over 30 specimens from the first being available—show enough variation in head form to represent two or three species if these characters can be taken

seriously. Some specimens have the hindhead definitely angulate laterally, while in others it is parallel-sided.

The typical "shoe-sole shaped" genital plate of the female appears in the types of *limnotragi*, but does not hold in other specimens which are at hand from the same host. There is also some range of variation in the form of the gonopods, some being acute and others rounded. However, the species *limnotragi* is here accepted as probably distinct.

The result has been that the species *gazella* and *gilvus* are here placed in synonymy with *breviceps*.

This species has sometimes been placed in synonymy with *Lino gnathus angulatus* (Piaget), which also is attributed to *Cephalophus*, but the two are clearly distinct.

Lino gnathus brevicornis (Giebel)

1874. *Haematopinus brevicornis* Giebel, Insecta Epizoa, page 43.

1932. *Lino gnathus brevicornis* (Giebel), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:365; figures 216D, 219.

HOSTS AND DISTRIBUTION. From *Camelopardalis giraffa* in a zoological garden.

NOTES. The redescription given by Ferris was based upon specimens in the Piaget collection. Whether or not these belonged to the same lot as did Giebel's types is not known.

Lino gnathus cervicaprae (Lucas)

1847. *Haematopinus cervicaprae* Lucas, Annales de la Société entomologique de France (2)5:534; Plate 8, figures II, 1-1h.

1938. *Lino gnathus cervicaprae* (Lucas), Werneck, Libro jubilar do Prof. Travassos, page 527; figures 1-5.

HOSTS AND DISTRIBUTION. Described by Lucas from *Antilope cervicapra*, from a menagerie in Paris. Not seen again until recorded by Werneck from specimens taken from the same host species in the Zoological Garden of London.

NOTES. In 1939 Fahrenholz recorded under this name and described specimens from the Museum d'Histoire Naturelle de Paris which he assumed to have been left by Lucas and therefore possibly to be the types of the species. However, Werneck had already redescribed the species and later published a note in which he indicated that Fahrenholz agreed that these specimens were probably not those recorded by Lucas and accepted the interpretation given by Werneck. The species involved was referred by Werneck to *Lino gnathus tibialis* (Piaget) and the pertinent reference will be found under that name.

Lino gnathus damaliscus Bedford

1936. *Lino gnathus damaliscus* Bedford, Onderstepoort Journal of Veterinary Science and Animal Industry 7:61; figures 3, 4.

HOSTS AND DISTRIBUTION. Type from *Damaliscus albifrons* in the zoological gardens at Johannesburg; also from *Damaliscus dorcas* at Bredasdorp, South Africa.

NOTES. On the basis of the illustrations given by Bedford this appears to be identical with *Lino gnathus taurotragi*, but disposal of it must await a re-examination of its types.

Lino gnathus fahrenheitzi Paine

1911. *Lino gnathus forficulus* Kellogg and Paine, Bulletin of Entomological Research 2:47; Plate 4, figures 2, 4. (Not *Haematopinus forficulus*)

Rudow, which is supposed to be also a *Linognathus*)

1914. *Linognathus fahrenheiti* Paine, Psyche 21:117.

1932. *Linognathus fahrenheiti* Paine, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:370; figures 224, 225.

HOSTS AND DISTRIBUTION. Described as from *Cervicapra arundinarum*, Marimba District, Nyasaland, and later recorded from *Cervicapra fulvorufula* at Mfongosi, Zululand.

Linognathus fractus Ferris

1932. *Linognathus fractus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:366; figures 220, 221.

1932. *Linognathus* sp., Bedford, Report of the Director of Veterinary Services and Animal Industry, Union of South Africa 18:409.

HOSTS AND DISTRIBUTION. From *Tragelaphus sylvaticus* at Onderstepoort, South Africa.

Linognathus gnu Bedford

1927. *Linognathus gnu* Bedford, Transactions of the Royal Society of South Africa 14:349; figures 3, 4.

1927. *Linognathus ferrisi* Bedford, Transactions of the Royal Society of South Africa 14:351; figures 5, 7.

1929. *Linognathus gorgonus* Bedford, Report of the Director of Veterinary Services, Union of South Africa 15:502.

1932. *Linognathus gnu* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:368; figures 222, 223.

HOSTS AND DISTRIBUTION. The type of *Linognathus gnu* was from *Connochaetes gnu* at Clocolan, Orange Free State, and the type of *gorgonus* was from *Gorgon taurinus*, Zoutpansberg District, Northern Transvaal. The species was later recorded from this host at Maastrom, northern Transvaal, and in the Zoological Gardens at Pretoria.

NOTES. This species was described by Bedford as *gnu* and as *ferrisi* because of the fact that he had the two sexes separately from different hosts. The name *ferrisi*, being preoccupied, was later changed by him to *gorgonus*. He later concurred that they represent the same species. Fahrenheit, in 1939, without seeing any specimens, considered the two to be distinct merely on the basis of illustrations given by Bedford and by Ferris. There is no reason to accept this opinion.

Linognathus hippotragi Ferris

1932. *Linognathus hippotragi* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:373; figures 226, 227.

HOSTS AND DISTRIBUTION. From *Hippotragus niger*, in the zoological garden at Johannesburg, South Africa.

Linognathus hologastrus Werneck

1937. *Linognathus hologastrus* Werneck, Memorias do Instituto Oswaldo Cruz 32:397; figures 7-10.

HOSTS AND DISTRIBUTION. From *Gorgon taurinus* at Grootfontein, Southwest Africa.

NOTES. Although this species occurs upon the same host as does *Linognathus gnu*, the two species are very distinct and no confusion between them need arise.

Linognathus lewisi Bedford

1934. *Linognathus lewisi* Bedford, Onderstepoort Journal of Veterinary Science and Animal Industry 2:48; figure 11.

HOSTS AND DISTRIBUTION. From *Gazella thomsoni* at Naivasha, British East Africa.

Linognathus limnotragi Cummings

1913. *Limnognathus limnotragi* Cummings, Bulletin of Entomological Research 4:36; figure.

1932. *Linognathus limnotragi* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:333; figs. 231A, I, J, 232C, D.

HOSTS AND DISTRIBUTION. Types from *Limnotragus* (= *Traegelaphus*) *gratus* in the zoological garden of London. Recorded also from *Traegelaphus sylvaticus* at Onderstepoort, Pretoria, and from *Traegelaphus scriptus* in the zoological garden at London.

NOTES. See the discussion under *Linognathus breviceps*.

Linognathus oviformis (Rudow)

1869. *Haematopinus oviformis* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:170.

1916. *Linognathus oviformis* (Rudow), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:33.

HOSTS AND DISTRIBUTION. Recorded by Rudow from "*Hircus manfricius*," a host name that appears in no available lists. The host was presumably a goat.

NOTES. This is an utterly unrecognizable species that Fahrenholz assigned to *Linognathus* purely as a guess.

Linognathus ovillus (Neumann)

Figures 99, 100

1907. *Haematopinus ovillus* Neumann, Revue veterinaire 32:520; figure.

1932. *Linognathus ovillus* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:346; figures 209, 210A, B, C, E.

HOSTS AND DISTRIBUTION. Described by Neumann as from domestic sheep from New Zealand and Scotland. There have been various records which are dubious because three other species of this genus occur on domestic sheep. The types were examined by Ferris and, on the basis of this, records from domestic sheep in the Falkland Islands and New South Wales are here accepted.

Linognathus pedalis (Osborn)

Figures 101, 102

1896. *Haematopinus pedalis* Osborn, United States Department of Agriculture, Division of Entomology, Bulletin (new series) 5:170; figure 99.

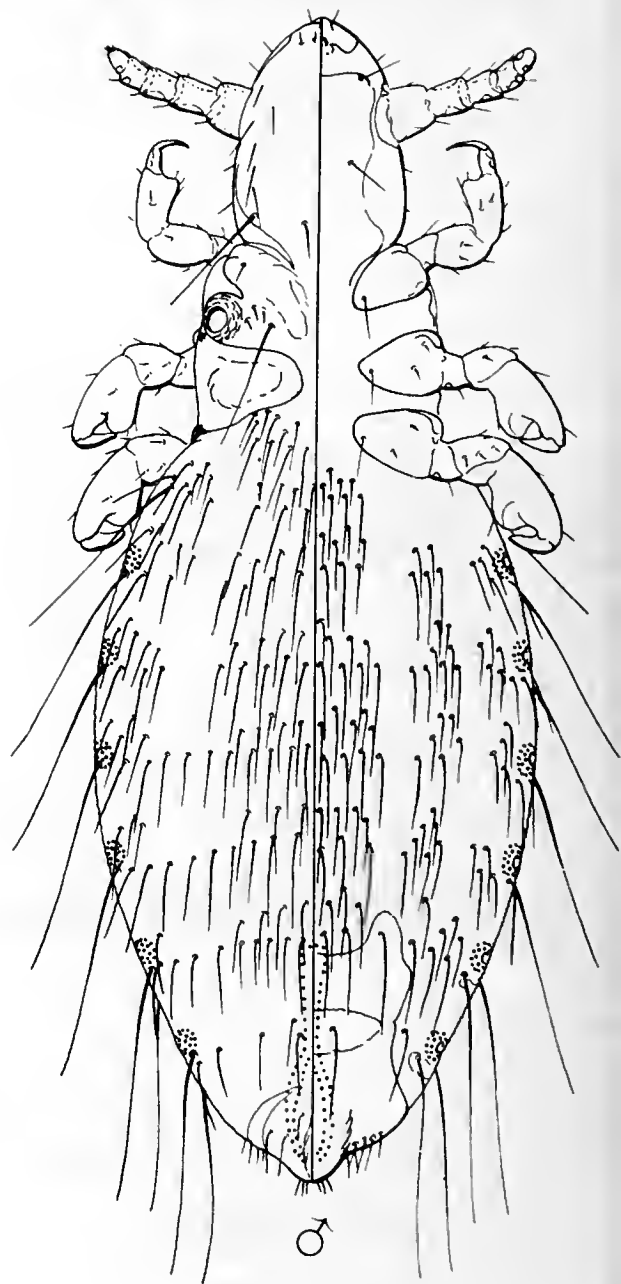
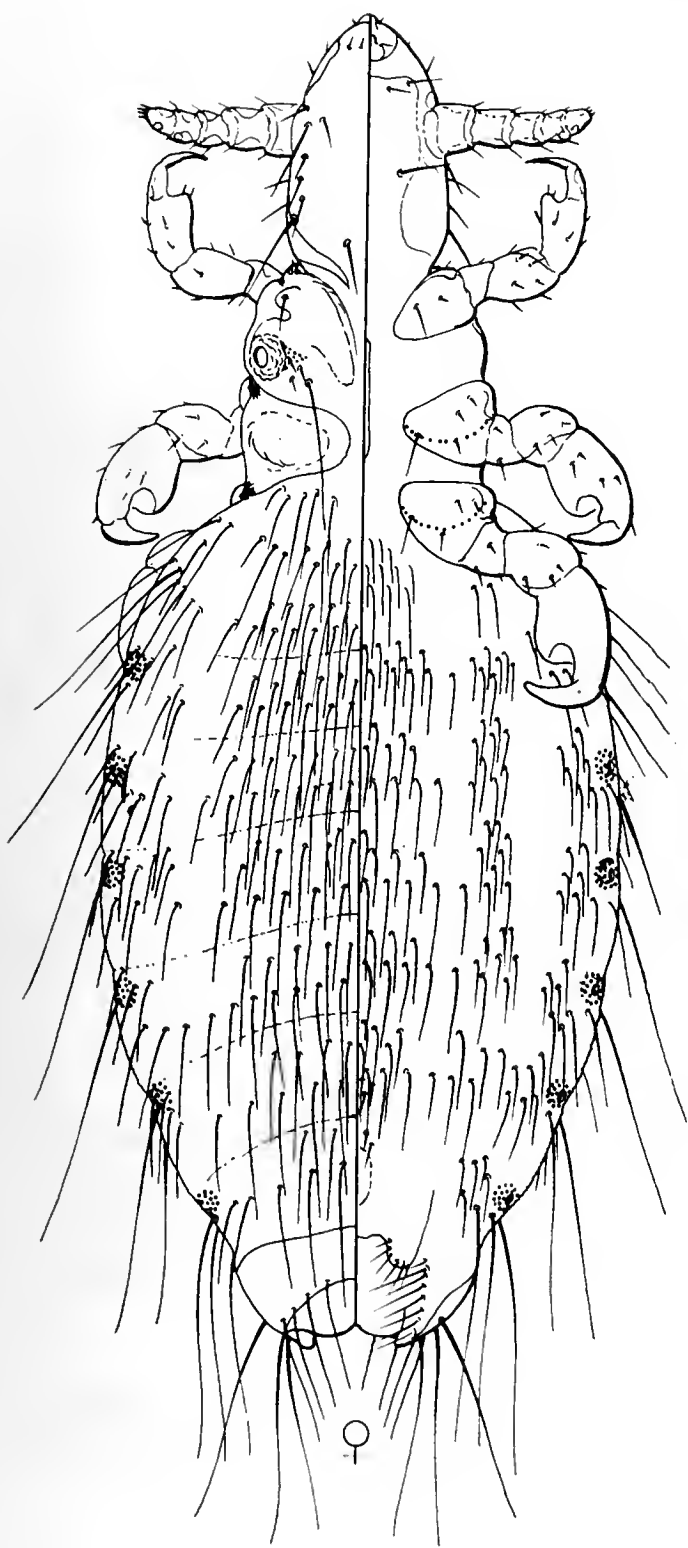
1911. *Haematopinus microcephalus* Garnett, Journal of Comparative Pathology and Therapeutics, page 2; figures 1, 2.

1932. *Linognathus pedalis* (Osborn), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:344; figures 207B, D, E, H, 208.

HOSTS AND DISTRIBUTION. First described from domestic sheep in the United States and recorded from this host in South America, New Zealand, Australia, and South Africa.

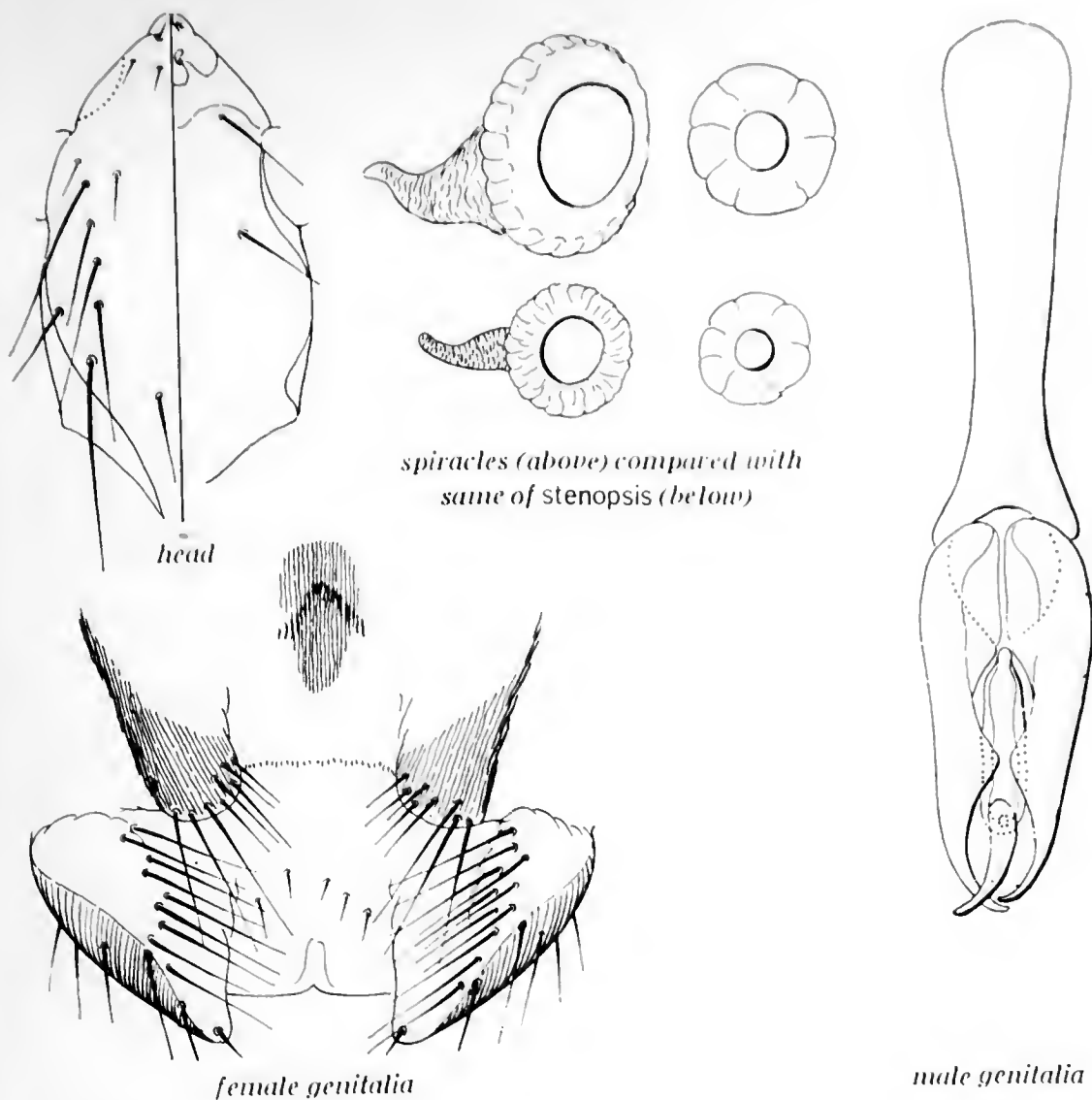
Linognathus peleus Bedford

1936. *Linognathus peleus* Bedford, Onderstepoort Journal of Veterinary Sci-



Linognathus ovillus (Neumann)

Figure 99



Linognathus ovillus (Neumann), details

Figure 100

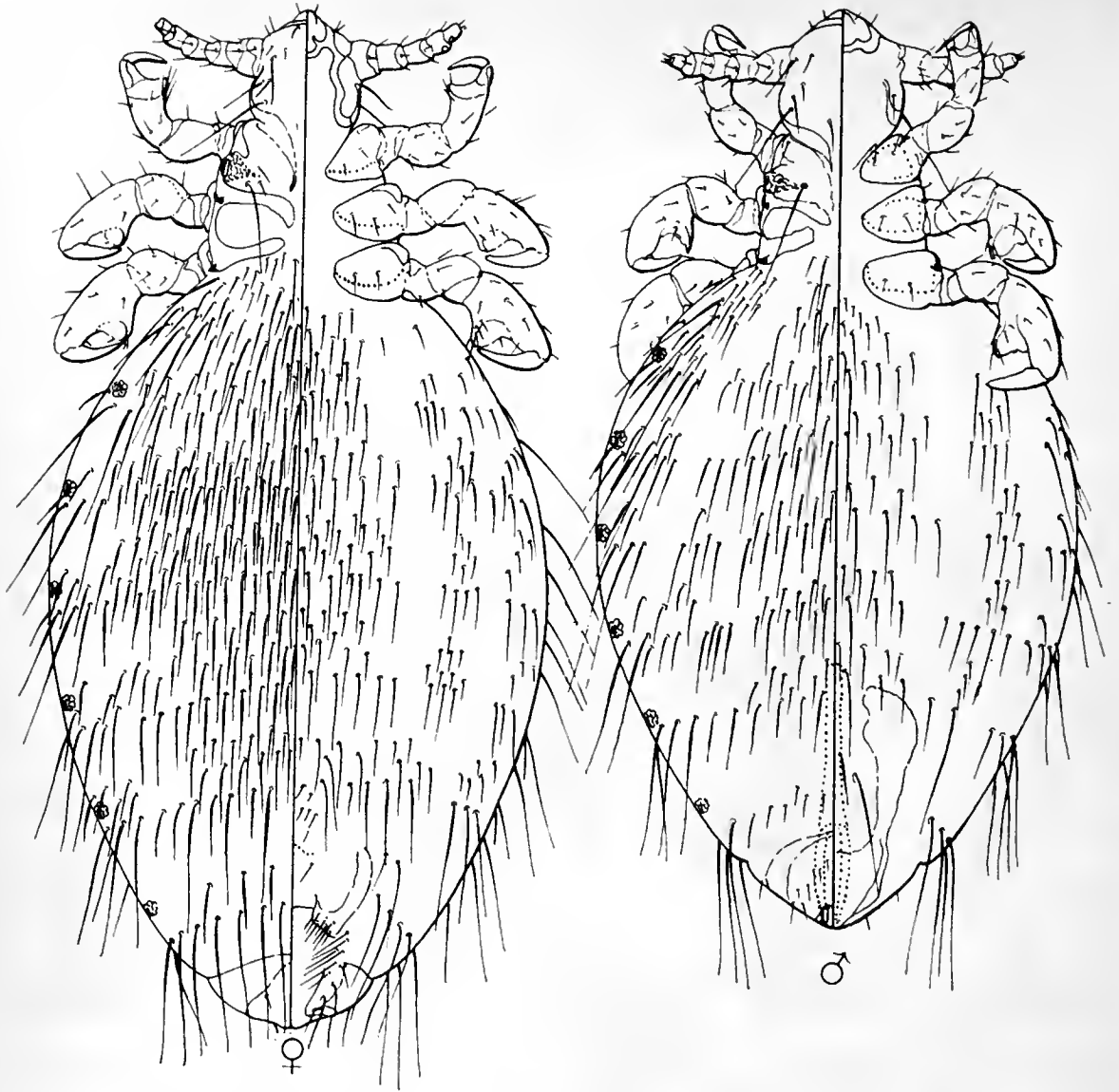
ence and Animal Industry 7:59; figures 1, 2.

HOSTS AND DISTRIBUTION. From *Pelea capreolus* at Onderstepoort, South Africa.

Linognathus petasmatus Ferris, new species

HOSTS AND DISTRIBUTION. Holotype, a female, allotype, and several paratypes, young and eggs, from "North African antelope," presumably from a zoological garden in Manchester, England. Types in the collections of Stanford University, California.

FEMALE. About 2.25 mm. in length. Body form rather slender. Head elongate and relatively slender, very smoothly fusiform, the forehead only slightly shorter than the hindhead and apically acute, the widest point of the hindhead being slightly posterior to the center of this portion. Thorax and legs entirely normal. Abdomen with an uninterrupted row of short setae and a median cluster of similar setae on segments 3-6 both dorsally and ventrally. Median genital plate of the female unusually large, very definitely lozenge-shaped, the anterior extremity slightly prolonged. Gonopods of female slightly convergent posteriorly, narrowly rounded apically and with setae around the apex and slightly up the mesal margin.



Linognathus pedalis (Osborn)

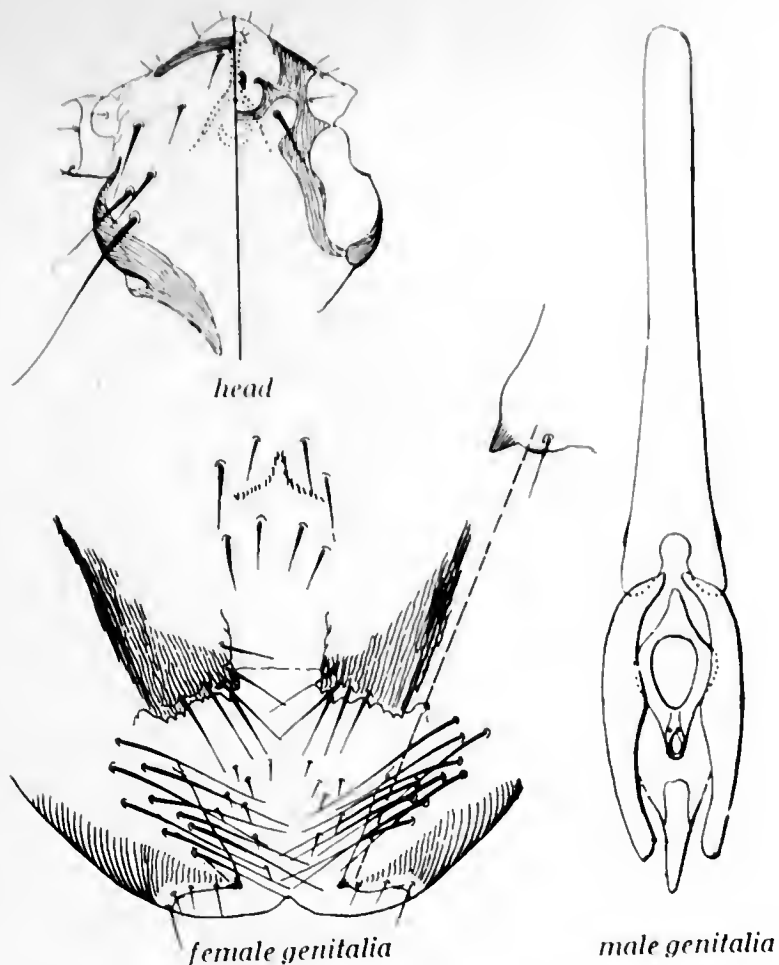
Figure 101

MALE. About 2 mm. long. Genitalia with basal plate long and slender, slightly expanded and slightly bifid at posterior end and somewhat expanded at the anterior end. Parameres apparently strongly curved dorsoventrally; the pseudopenis very short and indistinct, the endomerall piece either lacking or very weakly developed.

NOTES. This species was received some years ago from a correspondent in Birmingham, England, whose name has unfortunately been lost, and it is not clear whether the specimens came directly from North Africa or from an animal in a zoological garden. The species seems to be quite distinct from anything else that has been described.

Linognathus pithodes Cummings

1916. *Linognathus pithodes* Cummings, Proceedings of the Zoological Society of London, page 260; figures 3-5.
 1932. *Linognathus pithodes* Cummings, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:385; figures 235, 238D, 239F, G.



Linognathus pedalis (Osborn), details

Figure 102

1949. *Stobbella pithodes* (Cummings), Eichler, Bolletino della Societa Entomologica Italiana 79:13.

HOSTS AND DISTRIBUTION. From *Antilope cervicapra* from India, in the zoological garden at London.

NOTES. Eichler has designated this species as type of the genus *Stobbella*, which is not here accepted.

Linognathus saccatus (Gervais)

1845. *Haematopinus saccatus* Gervais, In Walckenaer, Histoire Naturelle des Insectes Apteres 3:307.

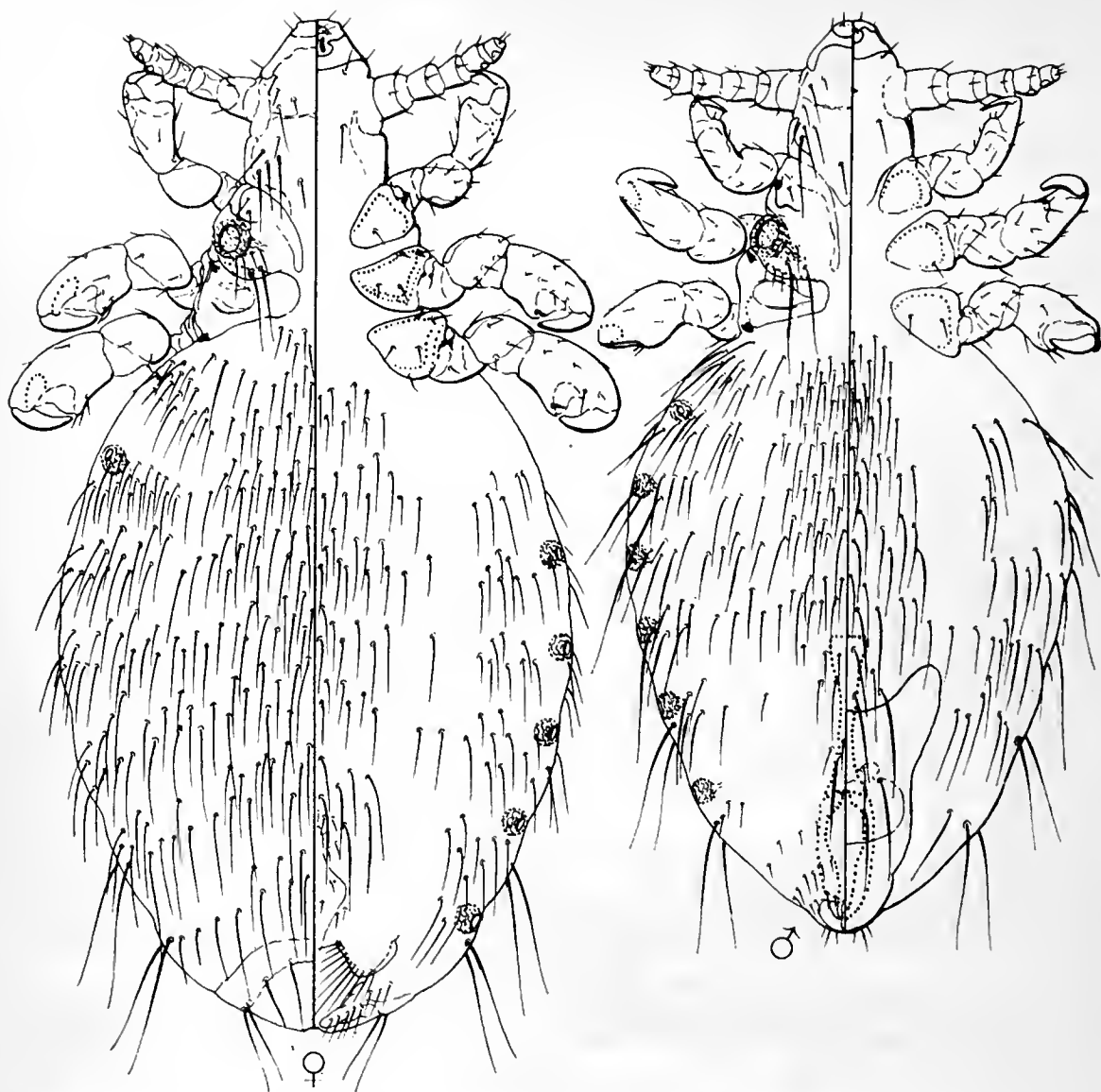
1905. *Linognathus saccatus* (Gervais), Enderlein, Zoologischer Anzeiger 29:194.

HOSTS AND DISTRIBUTION. Known only from the original record from "un Bouc d'Egypte." An utterly unrecognizable species which has been placed in *Linognathus* purely as a guess.

Linognathus setosus (von Olfers)

Figures 103, 104

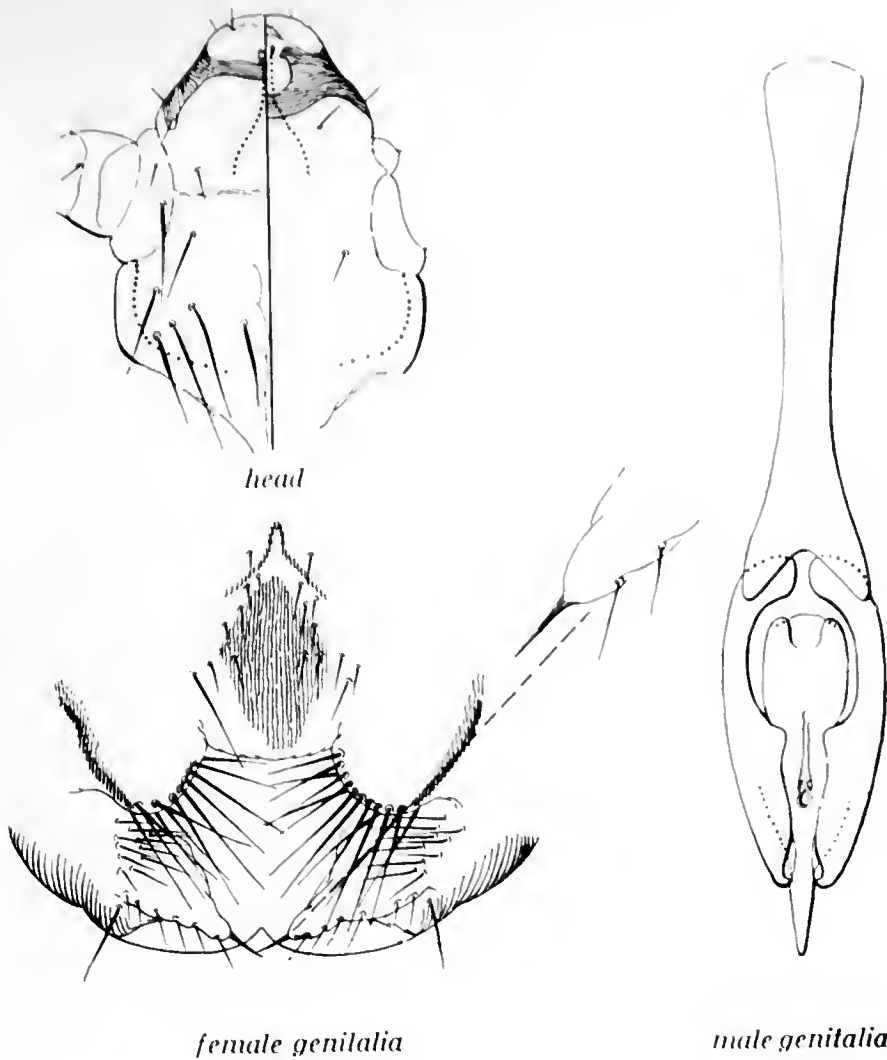
1816. *Pediculus setosus* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, page 80.



Linognathus setosus (von Olfers)

Figure 103

- 1838. *Pediculus piliferus* Burmeister, Genera Insectorum, Rhynchota, Species 13.
- 1842. *Haematopinus piliferus* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 28:Plate 25, figure 4.
- 1847. *Haematopinus bicolor* Lucas, Annales de la Société Entomologique de France (2)5:538; Plate 9, figure 2a.
- 1861. *Pediculus isopus* Nitzsch, Zeitschrift für die gesamten Naturwissenschaften 18:290.
- 1864. *Pediculus flavidus* Nitzsch, Zeitschrift für die gesamten Naturwissenschaften 23:27.
- 1874. *Haematopinus piliferus* (Burmeister), Giebel, Insecta Epizoa, page 40.
- 1905. *Linognathus piliferus* (Burmeister), Enderlein, Zoologischer Anzeiger 29:194.
- 1919. *Linognathus setosus* (von Olfers), Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 5-10:23.



Linognathus setosus (von Olfers)

Figure 104

1932. *Linognathus setosus* (von Olfers), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:70; figures 206, 207A, C, F, G and 216E.

HOSTS AND DISTRIBUTION. Described from the domestic dog in Europe and reported from this host throughout the world. Also recorded from the "white fox," or "Arctic fox," presumably *Alopex lagopus*, from various localities in Canada and Alaska; from fox in Manchuria; from *Canis cupus* in Croatia; from unspecified captive fox in the United States; from "coyote," (*Canis* sp.) in the United States and even recorded from ferret and from rabbit.

NOTES. This is the type of the genus *Linognathus*.

Linognathus spicatus Ferris

1932. *Linognathus spicatus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:388; figures 237, 238A, G, and 239E.

HOSTS AND DISTRIBUTION. From *Gorgon taurinus*, Maastrom, northern Transvaal.

NOTES. This species need not be confused with either of the other two members of this genus which occur on *Gorgon*. They are very distinct forms, as will be seen by reference to the key.

Linognathus stenopsis (Burmeister)
Figures 105, 106

1838. *Pediculus stenopsis* Burmeister, Genera Insectorum, Rhynchota, Species 3.
1842. *Haematopinus stenopsis* (Burmeister), Denny, Monographia Anoplurorum Britanniae, page 36.
1864. *Pediculus schistopygus* Nitzsch, Zeitschrift für die gesamten Naturwissenschaften 23:30.
1869. *Haematopinus forficulus* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:169.
1869. *Haematopinus rupicaprae* Rudow, Zeitschrift für die gesamten Naturwissenschaften 34:170.
1905. *Linognathus stenopsis* (Burmeister), Enderlein, Zoologischer Anzeiger 29:194.
1916. *Linognathus forficulus* (Rudow), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:24; figures 19, 20.
1932. *Linognathus stenopsis* (Burmeister), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:349; figures 210D, 211, 212A, C, D, F.

HOSTS AND DISTRIBUTION. Originally described from domestic goats in Europe and since recorded many times from this host in various parts of the world. Some of the numerous records are perhaps erroneous because of the presence of other species of this genus on this host. Described by Rudow as *forficulus* from *Capra ibex* and as *rupicaprae* from *Caprella rupicapra*.

NOTES. Ferris (1932) has discussed at length the problems connected with this species and the various names that have been employed for it. He had at hand specimens from *Capra ibex* and *Caprella rupicapra* which he considered to be identical with those from domestic goats and consequently reduced the names *forficulus* and *rupicaprae* to synonymy with *stenopsis*. A review of the matter in connection with the present work indicated no reason to change this opinion in spite of the fact that Jancke has attempted to revive both these names.

Linognathus taeniotrichus Werneck

1937. *Linognathus taeniotrichus* Werneck, Memorias do Instituto Oswaldo Cruz 32:391; figures 1-5.

HOSTS AND DISTRIBUTION. Described from *Canis brasiliensis* at São Bernardo das Russas, state of Ceará and recorded also from *Canis azarae* from Lassance, state of Minas Geraes, Brasil.

NOTES. This species seems clearly to be distinct from *Pediculus setosus*, which occurs on the domestic dog and also on arctic foxes.

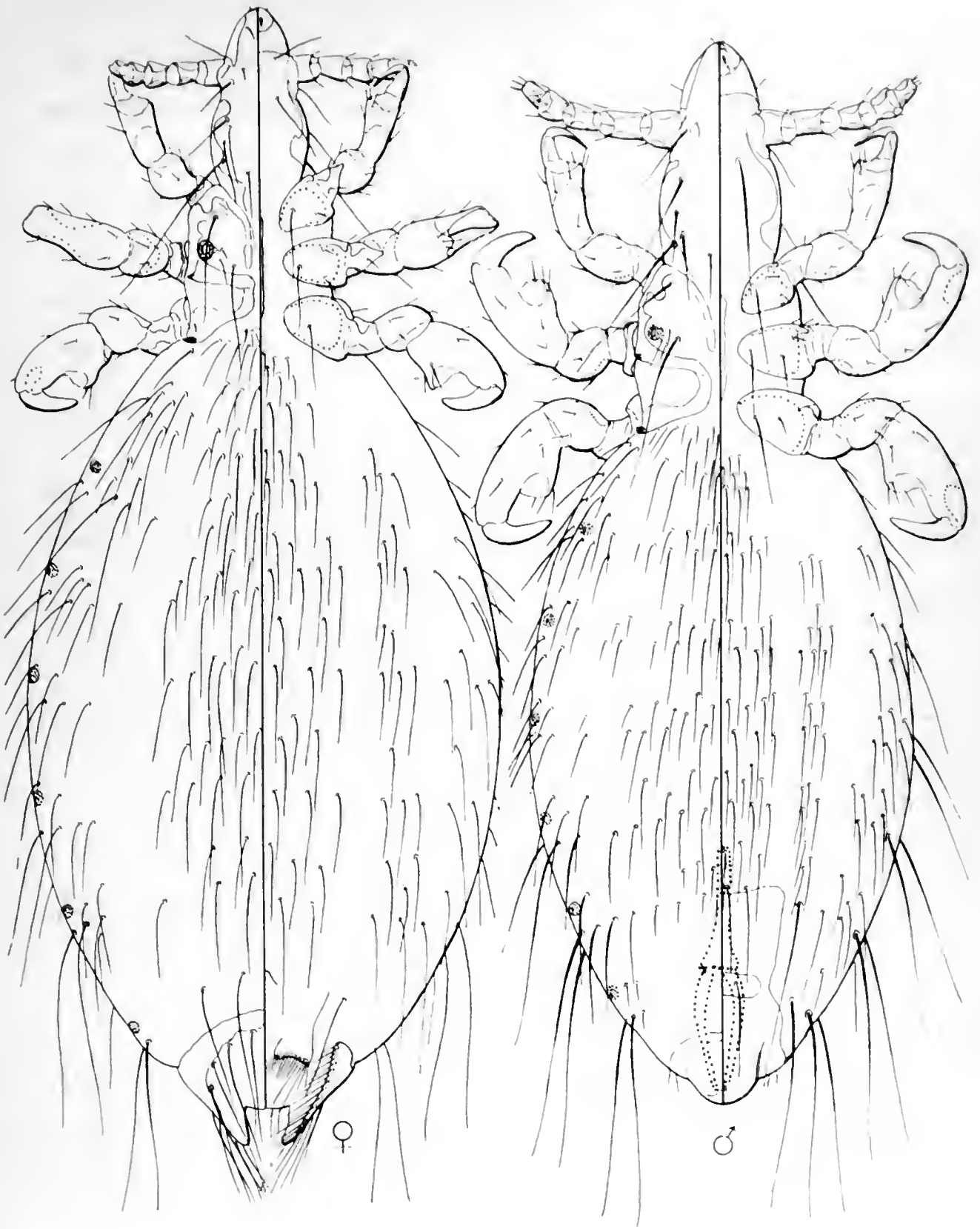
Linognathus taurotragus Bedford

1927. *Linognathus taurotragus* Bedford, Transactions of the Royal Society of South Africa 14:347; figures 1, 2.
1932. *Linognathus taurotragus* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:375; figures 228, 229.

HOSTS AND DISTRIBUTION. Described from *Taurotragus oryx* at Clocolan, Orange Free State. Also recorded from the same host in Natal, South Africa.

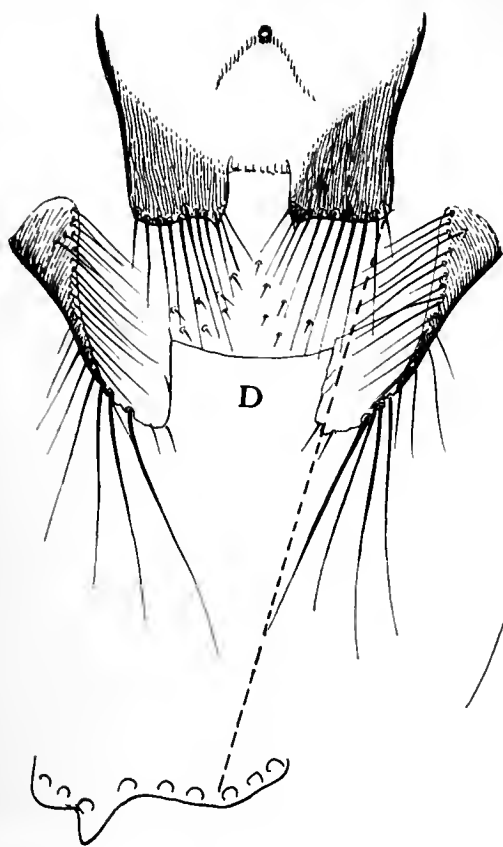
Linognathus tibialis (Piaget)

1880. *Haematopinus tibialis* Piaget, Les Pediculines, page 646; Plate 52, figure 8.
1880. *Haematopinus tibialis*, variety *antennatus* Piaget, Les Pediculines, page 647.



Linognathus stenopsis (Burmeister)

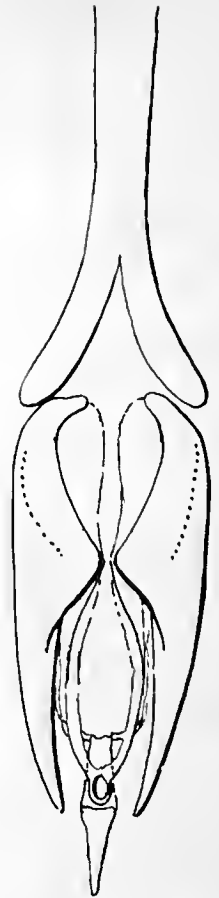
Figure 105



female genitalia



head



male genitalia

Linognathus stenopsis (Burmeister), details

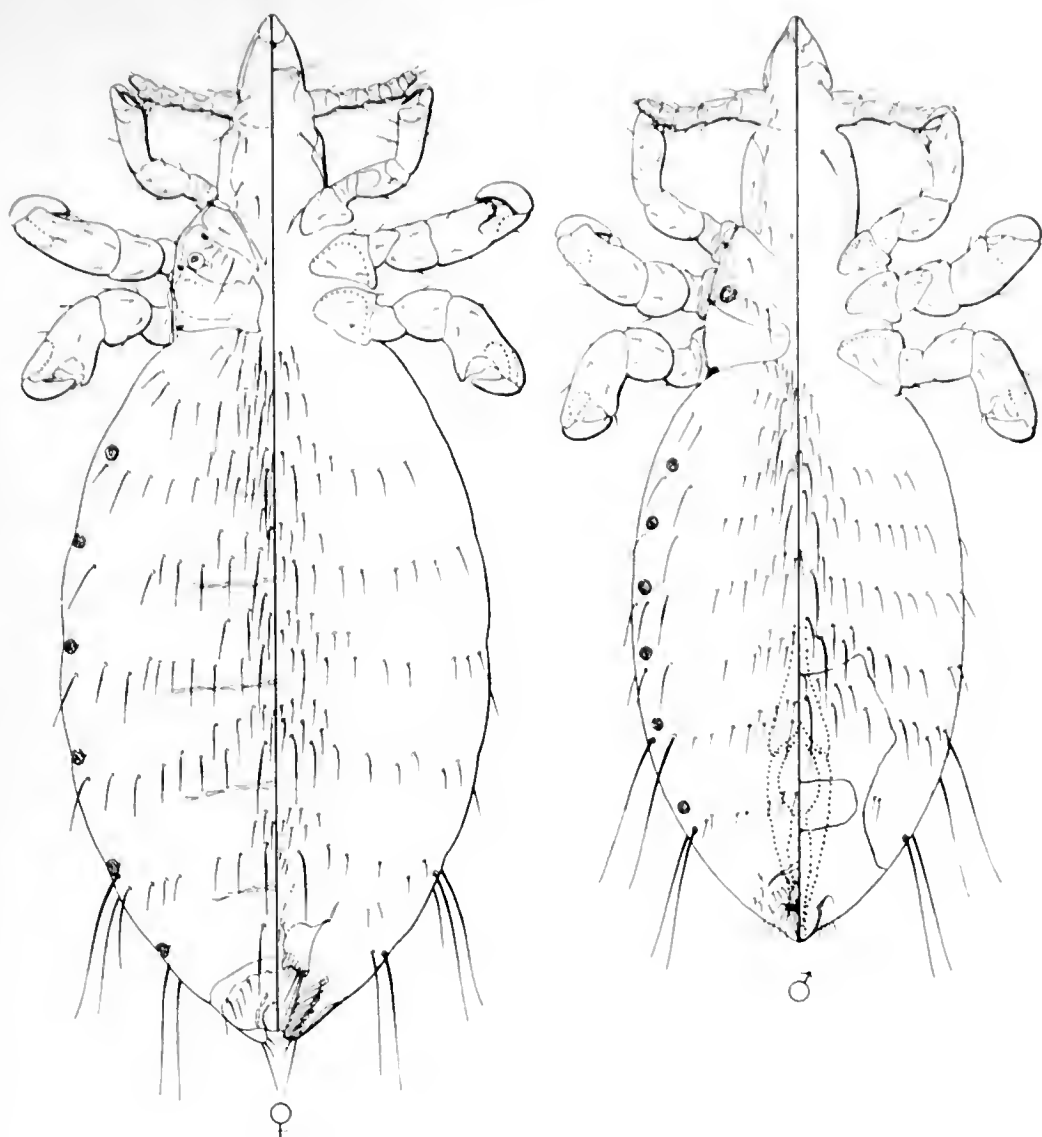
Figure 106

1880. *Haematopinus tibialis*, variety *appendiculatus* Piaget, Les Pediculi-
lines, page 647.
1916. *Linognathus tibialis*, variety *euchore* Waterston, Annals of the South
African Museum 10:275; figure.
1932. *Linognathus tibialis* (Piaget), Ferris, Contributions Toward a Mono-
graph of the Sucking Lice, Part 5:360; figures 217, 218.

HOSTS AND DISTRIBUTION. Type from "*Antilope maori*" from the zoological garden at Rotterdam and recorded also by Piaget from *Antilope subgutturosa* and *Antilope* sp. from the same place. The type of Waterston's variety *euchore* was from *Antilope euchore* in South Africa and the species has been recorded by Bedford from *Aepyceros melampus* from South Africa.

NOTES. Ferris, in connection with the reference cited, examined the types of the forms recorded above.

Specimens from *Antidorcas marsupialis* from Onderstepoort, Pretoria, South Africa, which were recorded by Ferris as *tibialis* have been re-examined and raise some doubt as to their identification. They are certainly very close to *tibialis*, but differ in the form of the genital plate of the female. Other specimens from *Raphicerus campestris* from the Rustenburg District in the Transvaal, South Africa, are extremely close to *tibialis* but are somewhat different. Questions concerning these may be allowed to rest until someone with more material can approach the problem.



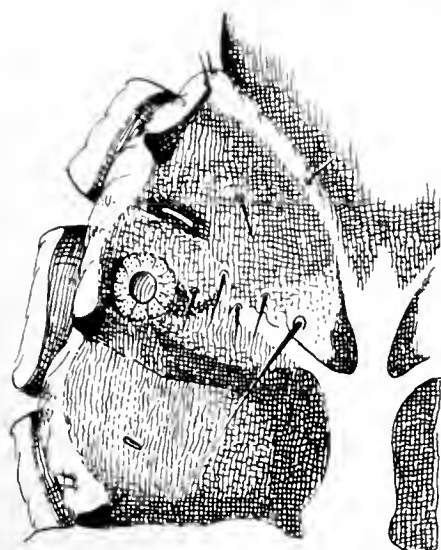
Linognathus vituli (Linnaeus)

Figure 107

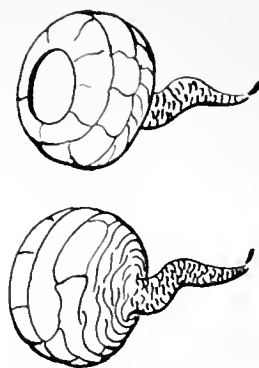
Linognathus vituli (Linnaeus)
 Figures 107, 108

1758. *Pediculus vituli* Linnaeus, *Systema Naturae*, Edition X, page 611.
 1829. *Haematopinus vituli* (Linnaeus), Stephens, *Catalogue of British Insects* 2:329.
 1838. *Pediculus tenuirostris* Burmeister, *Genera Insectorum*, Rhynchota, Species 17.
 1864. *Pediculus oxyrrhynchus* Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften* 23:21.
 1932. *Linognathus vituli* (Linnaeus), Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 5:356; figures 214, 215, 216C.

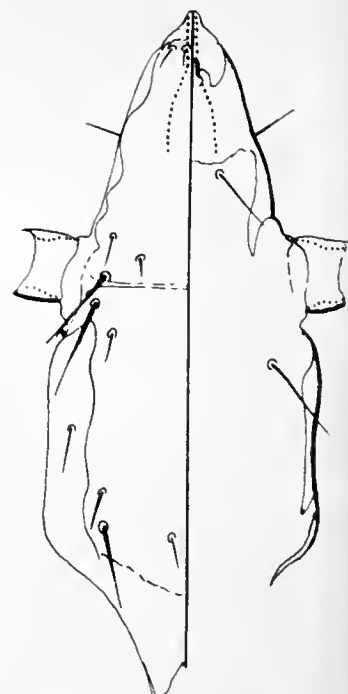
HOSTS AND DISTRIBUTION. Originally described from domestic cattle in Europe. Since reported from domestic cattle in all parts of the world. There are certain unusual records from wild boar in Europe, from sheep, and even from domestic dog, which may result from erroneous information as to the host.



thoracic dorsum



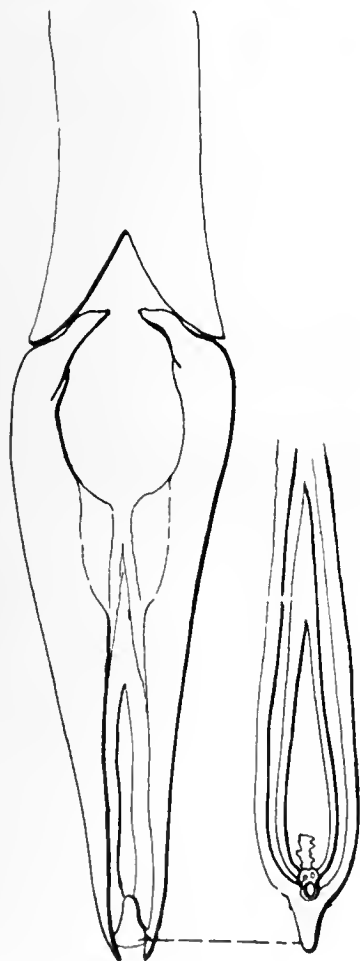
spiracle



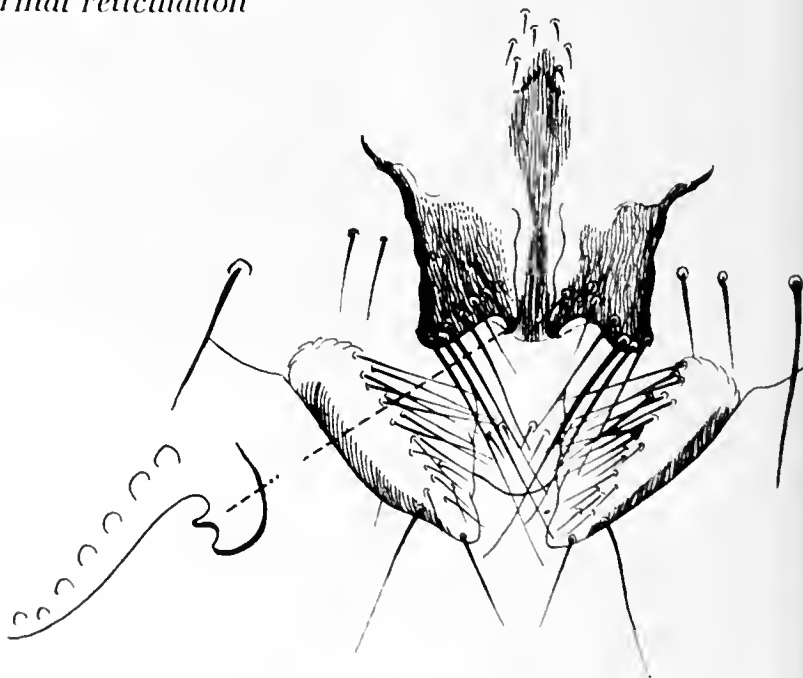
head



dermal reticulation



male genitalia



female genitalia

Linognathus vituli (Linnaeus), details

Figure 108

Genus MICROTHORACIUS Fahrenholz

1915. *Microthoractus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:29.

1932. *Microthoractus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:390.

1933. *Microthoraci*us, Werneck, Memorias do Instituto Oswaldo Cruz 27:21.

GENERIC TYPE. *Haematopinus* (*Linognathus*) *praelongiceps* Neumann.

CHARACTERS. Linognathidae in which clearly evident eyes are present, these being represented by a lens just posterior to the base of each antenna. Head greatly elongated and more or less fusiform, at times being almost as long as the abdomen. Thorax very small, with no indication of a sternal plate but with the sternal apophyses present and with a definite notal pit. Antennae five-segmented but with segments 4-5 at times more or less fused. Spiracles beset internally with points. Derm of the abdomen tending to be minutely wrinkled.

NOTES. The assignment of this genus to the Linognathidae is open to question, for an argument can certainly be made supporting its assignment rather to the Haematopinidae. The chief reason for the present assignment is the absence of the paratergal plates, but the presence of the thoracic sternal apophyses, the definite eyes, the thoracic notal pit, and possibly the spiracles, argue for its placement with the Haematopinidae.

Such understanding of this genus as we have we owe chiefly to the work of Dr. Fabio Werneck.

The history of this genus and especially of its type species is of interest and is worth recital. In 1688 Redi, in his famous work on the generation of insects, illustrated certain ectoparasites of birds and mammals, among these being one which he designated merely as the louse of the camel. There was apparently no discussion of any of these species, identity being indicated merely by the legend on the illustration.

In his "Systema Naturae," Linnaeus gave this louse a binomial name, calling it *Pediculus cameli*, purely on the basis of the illustration given by Redi. From the time of Redi until as recently as 1934 the insect was never again reported. In fact the illustration given by Redi seemed so fantastic that its faithfulness was doubted and the peculiarities of the species were ascribed merely to bad drawing of some other species, perhaps *Haematopinus tuberculatus*, which was the only sucking louse known from camels. However, in 1909, Neumann described a species from a llama which was sufficiently similar to *cameli* to indicate that the latter was not imaginary. In 1915 Fahrenholz assigned Neumann's species to the genus *Microthoraci*us.

In 1932 Ferris discussed this genus. He had examined a female from the type material of *praelongiceps* and had also at hand specimens from a llama from the zoological park at Washington. His conclusions concerning the species were thus based upon what seemed to be quite authentic material.

However, in 1932, Werneck described a new species, *Microthoraci*us *mazzai*, and in 1933 he discussed these two species at length, the result of his work being to indicate that Neumann actually had two quite distinct species in his type lot of *praelongiceps*. Neumann had indeed indicated that one of his specimens differed from the others in the form of the head and it seems clear that this was the specimen examined by Ferris.

Then in 1934 Werneck reported the rediscovery of the long-lost *Pediculus cameli* on the basis of specimens taken in Algeria and he described another species, *Microthoraci*us *minor*, from another llama. In 1935, Ferris discussed the genus again but his work had gone to press before Werneck's paper of 1934 had become available and full account had not been taken of Werneck's conclusions.

It is now evident that there are at least four species of this genus on members of the family Camelidae, a family that according to Lydekker's work

of as late as 1915 contains but two genera, *Camelus* with one species and *Lama* with but two. Whether or not we even yet have the full complement of Anoplura occurring on this family remains to be determined.

Key to Species of MICROTHORACIUS

Werneck has discussed the problem of separating the species of this genus and has noted that it is difficult to do so upon the basis of any single character but that, in the totality of their characters, they seem to be readily recognizable. Unfortunately, specimens of *minor* are not available and this species must be included in the key solely upon the basis of Werneck's description, while available material of the other species is extremely scanty. Furthermore, differences in the treatment of the specimens may cause apparent differences in the form of the head and lead to confusion. Thus in *mazzai*, a species in which the head is extremely slender, a slight collapse of the specimen will exaggerate this slenderness. In the light of this the following key must be used with discretion.

1. Head very narrow throughout, but with a quite definite swelling on each side just posterior to the antenna, this swelling bearing the eyes; posterior to this swelling the head narrowing again.....MAZZAI
Head broader, definitely fusiform, expanding into a moderately sharp angle just posterior to each antenna, narrowing again immediately posterior to the swelling, the margins of the hindhead being smoothly convex.....2
2. Anterior legs almost identical in size and shape with the others; a larger form, attaining a length of 4 mm. for the female and 2.5 mm. for the male; 4th and 5th antennal segments quite closely fused....CAMELI
Smaller forms, the adult female not exceeding 3 mm. in length; first legs definitely more slender than the others.....3
3. Female attaining 3 mm. in length.....PRAELONGICEPS
Female recorded as less than 2 mm. long.....MINOR

Microthoracius cameli (Linnaeus)

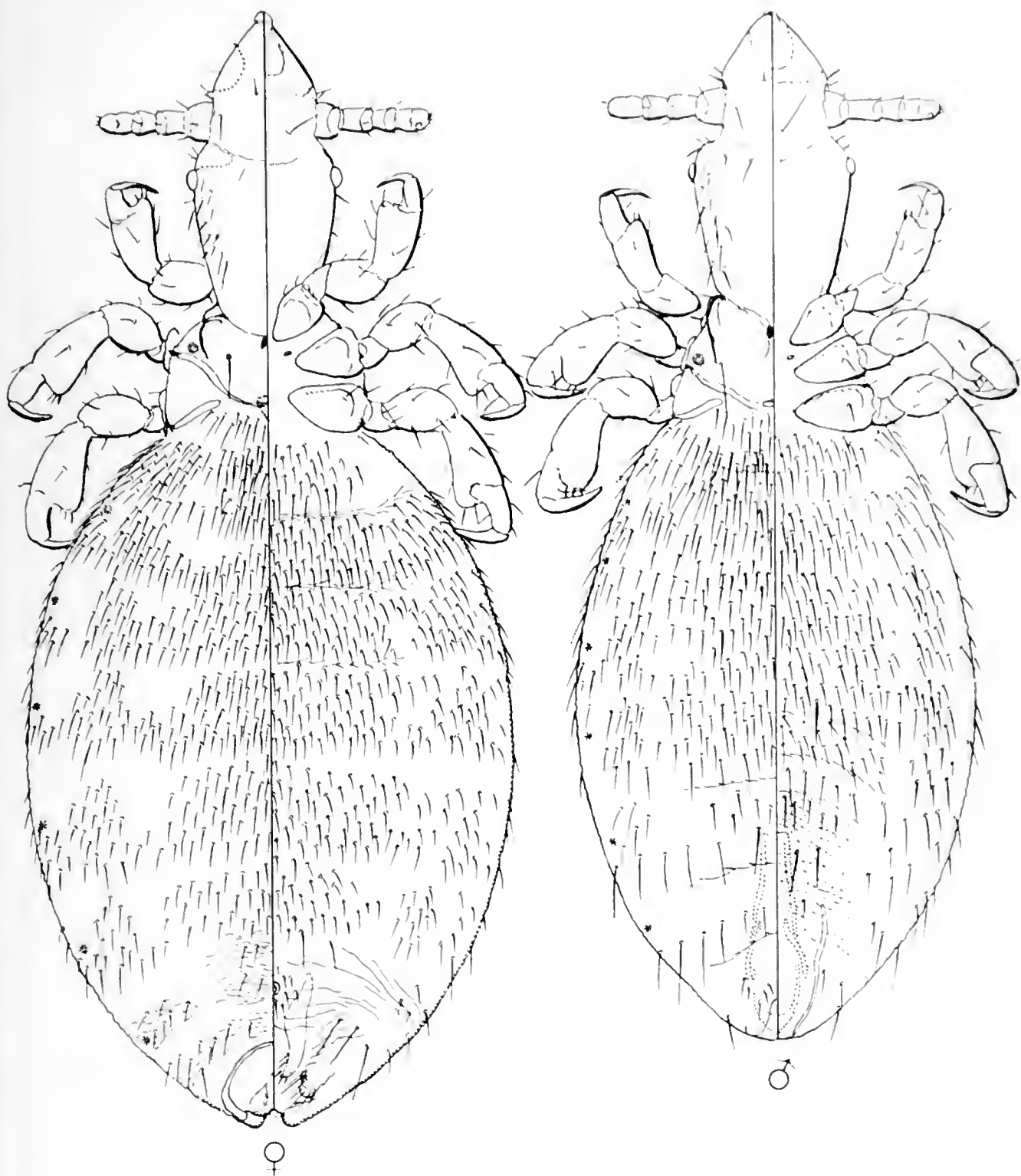
Figures 109, 110

1758. *Pediculus cameli* Linnaeus, Systema Naturae, Edition X, page 611.
1874. *Haematopinus cameli* (Linnaeus), Giebel, Insecta Epizoa, page 47.
1909. *Haematopinus tuberculatus* (Burmeister), Neumann, Archives de Parasitologie 13:499. (Misidentification)
1916. *Microthoracius cameli* (Linnaeus), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:30.
1932. *Microthoracius cameli* (Linnaeus), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:394; figure 242.
1934. *Microthoracius cameli* (Linnaeus), Werneck, Memorias do Instituto Oswaldo Cruz 29:179; figures 1-5.

HOSTS AND DISTRIBUTION. The only actual record of the species is that given by Werneck, from *Camelus dromedarius* in Algeria.

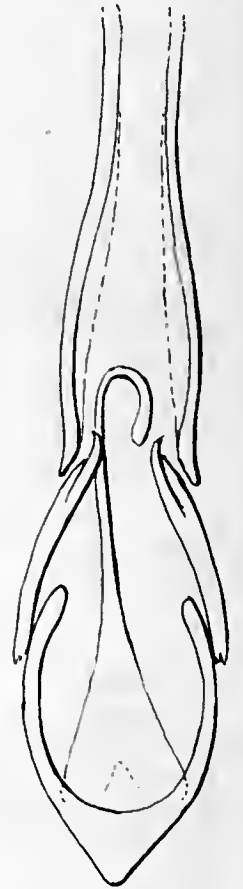
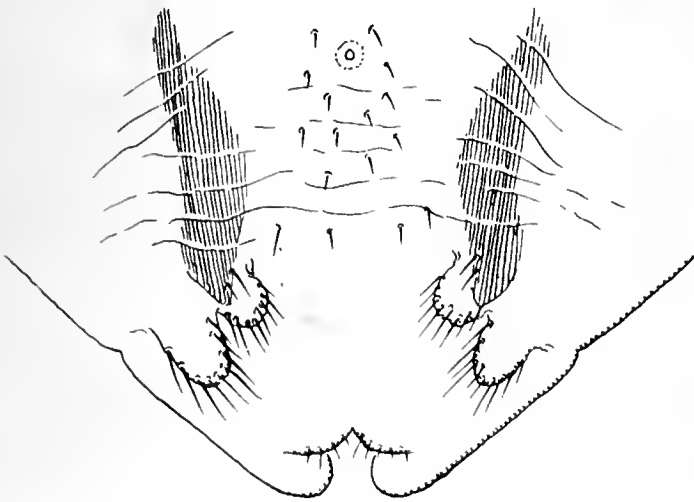
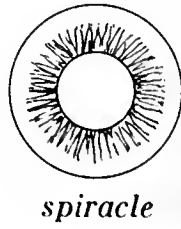
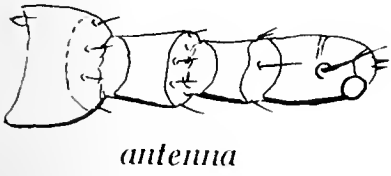
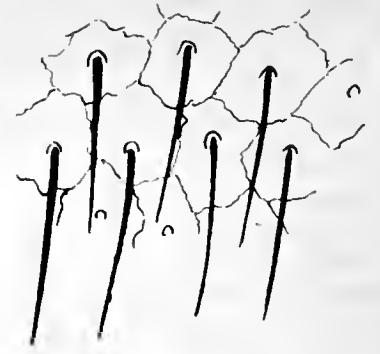
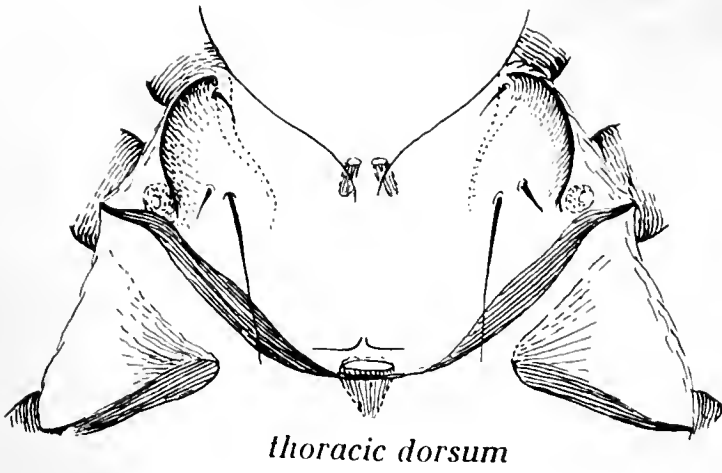
Microthoracius mazzai Werneck

1909. *Haematopinus (Linognathus) praelongiceps* Neumann, Archives de Parasitologie 13:509. (In part; specimen recorded in a footnote)
1916. *Microthoracius praelongiceps* (Neumann), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:30. (In part)
1932. *Microthoracius praelongiceps* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:39; figures 240, 241. (Misidentification)



Microthoracius cameli (Linnaeus)

Figure 109



Microthoracius cameli (Linnaeus), details

Figure 110

1932. *Microthoracius mazzai* Werneck, Revista medico-cirurgica do Brasil 40:346; figure.
1933. *Microthoracius mazzai* Werneck, Werneck, Memorias do Instituto Oswaldo Cruz 27:26; figures 9-15.
1935. *Microthoracius mazzai* Werneck, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:612; figures 33B-E.

HOSTS AND DISTRIBUTION. Types from *Auchenia llama* at Santa Catalina, province de Jujuy in Argentina. Presumably also the specimen recorded by Neumann in the footnote to his description of *praelongiceps*, this from *Auchenia llama* from Choquecomato, Bolivia, is this species, and the specimens recorded by Ferris from the same host, from an animal in the Zoological Park of Washington, are the same.

Microthoracius minor Werneck

1935. *Microthoracius minor* Werneck, Revista medico-cirurgica do Brasil 43:112.
1935. *Microthoracius minor* Werneck, Werneck, Revista de Entomologia 5:108; figures 1-4, 5.

HOSTS AND DISTRIBUTION. Types from *Lama pacos*, Abra Pampa, province de Jujuy, Argentina, and other specimens from *Lama glama* at the same place.

Microthoracius praelongiceps (Neumann)

1909. *Haematopinus (Linognathus) praelongiceps* Neumann, Archives de Parasitologie 13:508; figures 10-12. (In part)
1916. *Microthoracius praelongiceps* (Neumann), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:30. (In part)
1932. *Microthoracius praelongiceps* (Neumann), Werneck, Revista medico-cirurgica do Brasil 40:346; figure.
1933. *Microthoracius praelongiceps* (Neumann), Werneck, Memorias do Instituto Oswaldo Cruz 27:21; figures 1-8.
1935. *Microthoracius praelongiceps* (Neumann), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:610; figure 338A.

HOSTS AND DISTRIBUTION. Types recorded as from *Auchenia huanaca*, Choquecomato, Bolivia. Also recorded by Werneck from *Auchenia llama*. A specimen at hand from "llama" in the zoological garden at Onderstepoort, South Africa, received from the late Mr. G. A. H. Bedford, seems definitely to be this species.

Genus PROLINOGNATHUS Ewing

1929. *Prolinoognathus* Ewing, Manual of External Parasites, pages 136, 201.
1932. *Prolinoognathus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:408.
1939. *Prolinoognathus*, Fahrenholz, Zeitschrift für Parasitenkunde 111:1:1.

GENERIC TYPE. *Pediculus caviae-capensis* Pallas.

CHARACTERS. Linognathidae in which there is no external indication of eyes. Antennae apparently four-segmented because of a close fusion of the fourth and fifth segments, although the sensoria of these segments remain. Thorax without a sclerotized sternal plate and the ventral thoracic apophyses lacking. Spiracles of the abdomen extremely small. Abdominal setae much reduced in numbers, there being usually not more than two setae in the median group on each segment, either dorsally or ventrally, and never any indication of more than one row of setae on any segment. Gonopods of the female well developed and produced apically.

NOTES. The members of this genus occur exclusively on members of the family Procaviidae of the Order Hyracoidea.

The material at hand representing this genus is quite scanty and does not permit an extended treatment.

Key to Species of PROLINOGNATHUS

This key is based largely upon that given by Fahrenholz in the reference cited above, with some modifications suggested by such material as is available.

1. Head definitely more than twice as long as wide.....2
 Head not more than twice as long as wide.....3
2. Sclerotized areas at the lateral margins of the forehead produced somewhat posteriorly on the dorsal side about the bases of the antennae.....CAVIAE-CAPENSIS
 These sclerotized areas produced posteriorly on the dorsal side of the head until they meet at the mid-line.....ARCUATUS
3. Abdomen with a single long seta on the lateral margin of each of the segments anterior to the seventh, in addition to the usual, long, paired setae at the margins of segments 7 and 8.....LEPTOCEPHALUS
 Abdomen with such setae absent only on segments 5 and 6.....4
4. These setae present only on segments 2 and 3.....AETHIOPICUS
 These setae present on segments 2-4.....5
5. Forehead rather short and the sclerotized transverse area so broad that it involves at least half its length.....FERRISI
 Forehead with this transverse area involving at the most one-fourth of its length.....FOLEYI

Prolinognathus aethiopicus Fahrenholz

1939. *Prolinognathus aethiopicus* Fahrenholz, Zeitschrift für Parasitenkunde 11:1:13; figures 8A, 9.

HOSTS AND DISTRIBUTION. Described as taken from *Procavia shoana* in the zoological garden at Copenhagen. According to Hopkins the proper name of this host is *Procavia habessinica sciona*. A specimen that seems to be this species is at hand from a host identified merely as *Procavia capensis* from Rooi Krans, Transvaal.

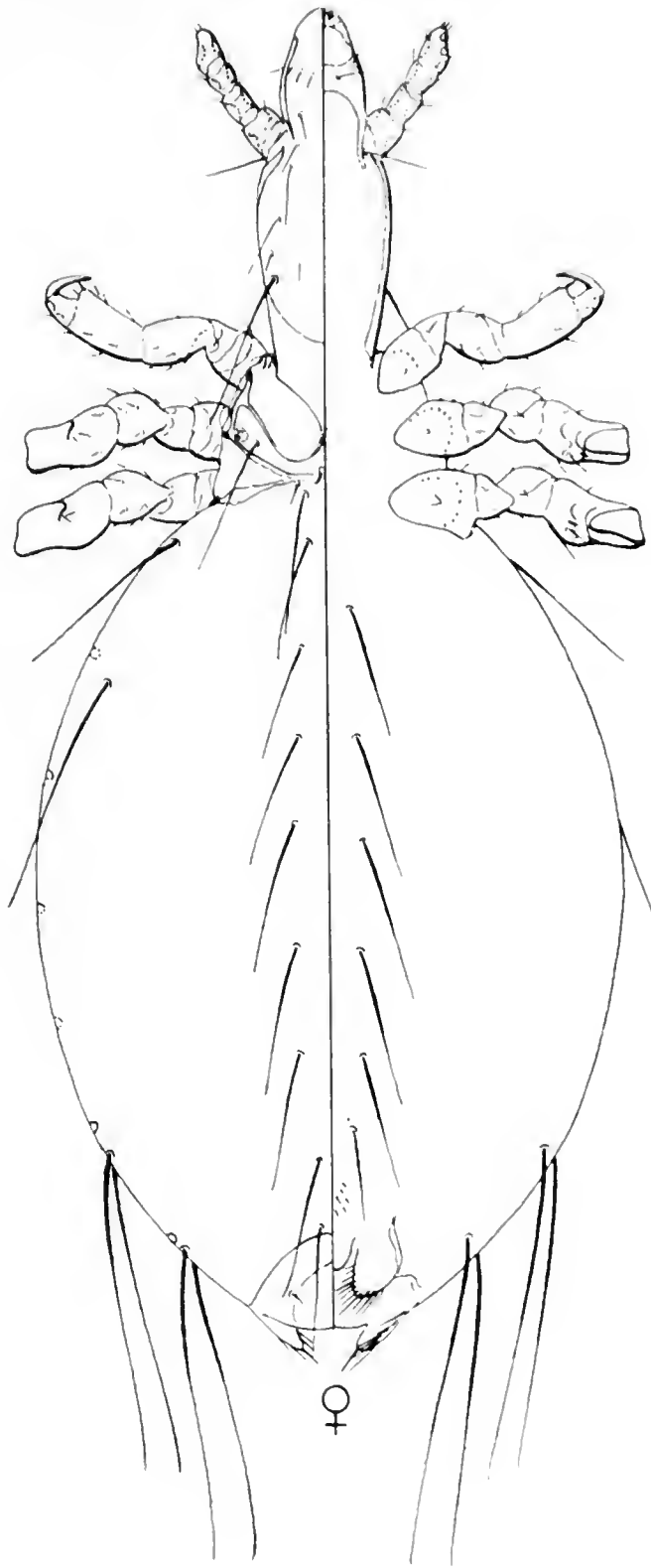
Prolinognathus arcuatus Fahrenholz

1939. *Prolinognathus arcuatus* Fahrenholz, Zeitschrift für Parasitenkunde 11:1:5; figures 1b, 2-4.

HOSTS AND DISTRIBUTION. Described as from the same animal as recorded under *aethiopicus*. Certain specimens at hand from a host identified as *Procavia coombi* at Onderstepoort, Pretoria, South Africa, seem to be this. This host seems to be regarded as a subspecies of *Procavia capensis*.

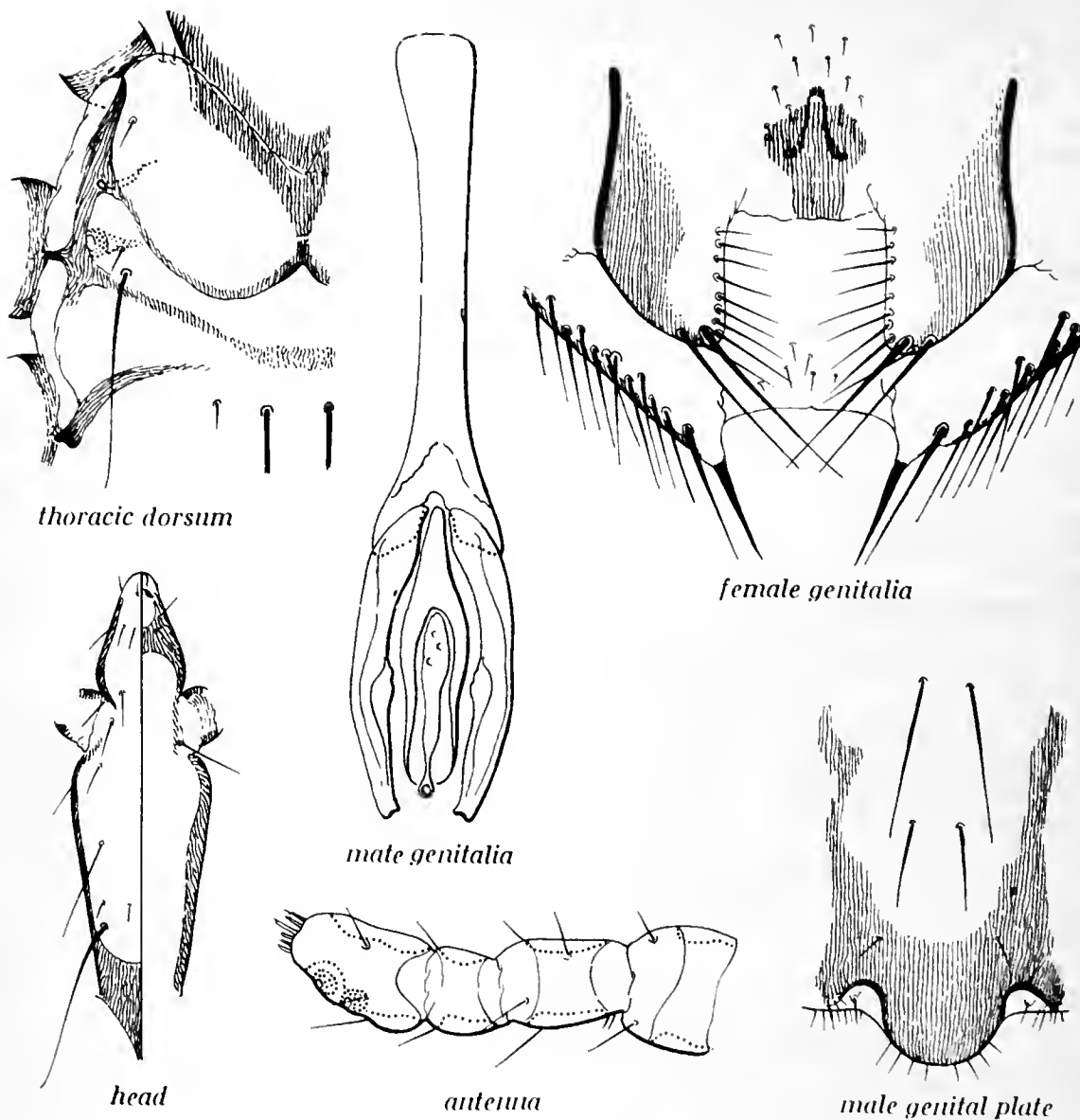
Prolinognathus caviae-capensis (Pallas) Figures 111, 112

1767. *Pediculus caviae-capensis* Pallas, Spicilegia Zoologica 2:32; Plate 3, figure 12.
1816. *Pediculus collaris* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, page 84.
1913. *Linognathus caviae-capensis* (Pallas), Cummings, Bulletin of Entomological Research 4:37; figures 2, 3.
1932. *Prolinognathus caviae-capensis* (Cummings), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:409; figures 250A, 251A, E, F, G, H, I, J.



Prolinognathus caviae-capensis (Pallas)

Figure 111



Prolinognathus caviae-capensis (Pallas), details

Figure 112

1939. *Prolinognathus caviae-capensis* (Pallas), Fahrenholz, *Zeitschrift für Parasitenkunde* 11:1:2; figure 1a.

1949. *Prolinognathus caviae-capensis* (Pallas), Hopkins, *Proceedings of the Zoological Society of London* 119:2:515, 516.

HOSTS AND DISTRIBUTION. Originally described as from *Procavia capensis* from the Cape of Good Hope. Recorded by Cummings from this host and from a host identified under the same name in the zoological garden at London. The species was redescribed by Ferris on the basis of Cummings' material and a record from a host identified as *Procavia coombi* from Onderstepoort, Pretoria, South Africa, was added. Hopkins records the species from a long list of subspecies of *Procavia capensis*, this including *capensis*, *marlothi*, *klaverensis*, *griqua*, *albanensis*, *natalensis*, *windhuki*, *reuningi*, and *waterbergensis*, and from *Procavia johnstoni johnstoni* from various localities.

NOTES. The present writer has previously maintained that the first genuine validation of the name *caviae-capensis* is to be ascribed to Cummings but Fahrenholz has given cogent reasons for accepting Pallas as the author of the specific name.

Whether or not Cummings actually had the species described by Pallas is open to question, but there is no special point to inquiring too closely into this. The accompanying illustrations are based upon his specimens.

Prolinognathus ferrisi Fahrenholz

1932. *Prolinognathus leptocephalus* (Ehrenberg), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:142; figures 250B, 251C. (Misidentification)

1939. *Prolinognathus ferrisi* Fahrenholz, Zeitschrift für Parasitenkunde 11:1:12.

HOSTS AND DISTRIBUTION. The name given by Fahrenholz seems to have been based entirely upon the illustration given by Ferris and consequently the type of the species must be the specimen from which this illustration was made, this having been recorded as from *Procavia brucei rudolfi*, Marsabit Road, British East Africa, which, according to Hopkins, is *Heterohyrax syriacus rudolfi*. This type specimen should be in the United States National Museum. Hopkins has also recorded the species from the same host.

Prolinognathus foleyi Fahrenholz

1939. *Prolinognathus foleyi* Fahrenholz, Zeitschrift für Parasitenkunde 11:1:9; figures 5-7, 8b.

HOSTS AND DISTRIBUTION. Recorded as from *Procavia rufescens bounhioli* from Algeria. This is the only record.

Prolinognathus leptocephalus (Ehrenberg)

1828. *Pediculus leptocephalus* Ehrenberg, Symbolae Physicae, Decas Prima, page f.

1874. *Haematopinus leptocephalus* (Ehrenberg), Giebel, Insecta Epizoa, page 47. (In part)

1932. *Prolinognathus leptocephalus* (Ehrenberg), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:142. (In part; not as to figures)

1939. *Prolinognathus leptocephalus* (Ehrenberg), Fahrenholz, Zeitschrift für Parasitenkunde 11:1:8.

HOSTS AND DISTRIBUTION. Described from *Procavia syriacus*, presumably from Syria. Ferris recorded a single immature specimen from this host from Syria and Fahrenholz has given additional notes on the species.

Genus SOLENOPOTES Enderlein

1904. *Solenopotes* Enderlein, Zoologischer Anzeiger 28:143.

1909. *Haematopinus (Solenopotes)* Neumann, Archives de Parasitologie 13:530.

1915. *Cervophthirius* Mjöberg, Entomologisk Tidskrift 36:282.

1916. *Linoëgnathus*, Ferris, Entomological News 27:199.

1921. *Solenopotes*, Bishop, Journal of Agricultural Research 21:797.

1929. *Cervophthirius*, Ewing, A Manual of External Parasites, page 136.

1929. *Solenopotes*, Ewing, A Manual of External Parasites, pages 136, 139.

1932. *Solenopotes*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:395.

GENERIC TYPE. *Solenopotes capillatus* Enderlein. Type of *Cervophthirius: Cervophthirius tarandi* Mjöberg.

CHARACTERS. Linognathidae without eyes. Antennae five-segmented. Head variously shaped but usually slightly elongate and broadened but little posterior to the antennae. Thorax with a sternal plate filling most of the space enclosed by the coxa but not marginally or apically free from the body. Abdomen membranous throughout except for the usual ninth tergite and the ventral genital areas; with not more than one row of setae on any segment either dorsally or ventrally. Spiracles, in the type species, more or less cylindrical, their apices projecting somewhat from the body on slightly sclerotized prominences. In other species they may be shorter, in some species being almost spherical, but some indication of the tubercle is present. Genitalia of female including a pair of quite large and prominent gonophyses. Ninth segment terminating in a pair of ventral, flattened lobes which may be quite long and slender. Genitalia of the male with the parameres well developed, elongate and enclosing the penis and pseudopenis.

NOTES. The type species of this genus was based upon a single male specimen which was rather poorly described and led Ferris to the belief that it was simply an immature specimen of *Linognathus vituli*. This was later shown to be quite erroneous when the species was rediscovered in North America. Mjöberg described the supposed new genus *Cervophthirus* in 1915, but this was placed as a synonym of *Solenopotes* by Ferris in 1932.

Except for the one species, *capillatus*, all the members of this genus at present known are from Cervidae. It is probable that several more remain to be found.

Key to Species of SOLENOPOTES

Only a partial key can at present be given, and identifications must depend largely upon host associations until the genus has been completely reviewed by someone.

1. Head with the lateral margins posterior to the antennae tending to converge and presenting neither postantennal nor posterior lateral angles.....2
 Head with the lateral margins posterior to the antennae tending to be nearly parallel, with definite postantennal and posterior lateral angles.....3
2. Abdominal spiracles strongly protuberant; female with apical lobes of the abdomen which are short and moderately broad and then are constricted sharply into a short, slender, terminal process; male with the parameres enclosing a broadly Y-shaped pseudopenis; as far as known occurring only on domestic cattle.....CAPILLATUS
 Abdominal spiracles but very slightly protuberant; female with the apical lobes of the abdomen constricted gradually into long, tapering processes; parameres of the male enclosing merely a very short aedeagus; occurring as far as known on New World deer of the genera *Odocoileus* and *Nazama*.....BINIPILOSUS
3. Abdomen of the female with not more than 2 long setae in the median group, either dorsally or ventrally, on any segment.....CAPREOLI
 Abdomen of the female with 4-8 long setae in the median cluster, both dorsally and ventrally, on the abdominal segments; occurring as far as known on New World deer of the genus *Odocoileus*.....FERRISI
 (The species *tarandi* and *burmeisteri* will run in this key to the last couplet.)

Solenopotes binipilosus (Fahrenholz)

1910. *Linognathus angulatus* (Piaget), Mjöberg, Arkiv för Zoologi 2:157.
 (Misidentification)

1916. *Linoğnathus binpilosus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:11; Plate, figures 11-13.
1916. *Linoğnathus coassus* Fahrenholz, Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten 34:2.
1927. *Linoğnathus panamensis* Ewing, Proceedings of the Entomological Society of Washington 29:119.
1932. *Solenopotes binpilosus* (Fahrenholz), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:131; figures 245, 246.

HOSTS AND DISTRIBUTION. First described by Fahrenholz from "Mazama Hirsch" without indication of origin, but this name implies a host of the genus *Mazama* from South or Central America. Recorded by Fahrenholz from "Coassus" from the Hamburg zoological garden, this generic name apparently being a synonym of *Mazama*. Recorded by Ewing from *Odocoileus chirtquiensis* from Panama and by Ferris from the same host species from the Panama Canal Zone. Specimens are at hand from *Mazama simplicicornis* at Jujuy, Argentina; from *Odocoileus couesi* at Tucson, Arizona; United States; and from "deer," at Sonora, Texas, United States.

Solenopotes burmeisteri (Fahrenholz)

1818. *Pediculus crassicornis* Nitzsch, Germar's Magazin der Entomologie 3:305. (Not *Pediculus crassicornis* Scopoli, and therefore preoccupied)
1916. *Linoğnathus crassicornis* (Nitzsch), Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:34.
1919. *Linoğnathus burmeisteri* Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 5-10:23.
1935. *Solenopotes burmeisteri* (Fahrenholz), Freund, Recueil de Travail dédié au 25^{me} Anniversaire scientifique du Professor Eugéne Pavlovsky, 1909, 1934, Leningrad et Moscow, page 278; figure A.

HOSTS AND DISTRIBUTION. Described from *Cervus elaphus* in Europe and known only from a few records from that continent.

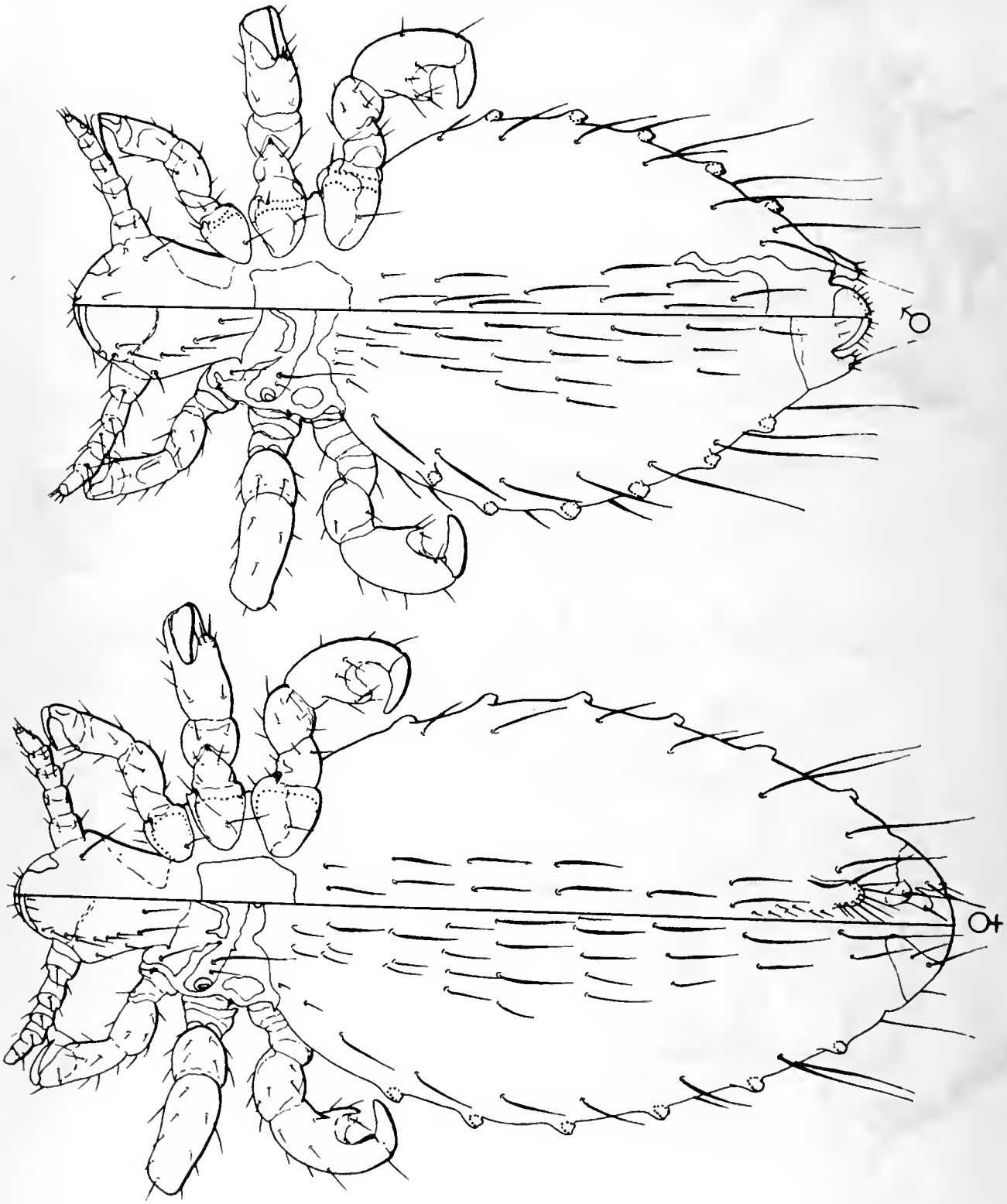
NOTES. European authors have considered that the species recorded from North America by Ferris as this, under the name of *Solenopotes crassicornis*, is distinct, as is also the species illustrated by Ferris as *burmeisteri* in 1932, and which has been named as *Solenopotes capreoli*. The name *crassicornis*, being preoccupied, was replaced by the name *burmeisteri* in 1919. These three species are very closely similar and it remains to be determined just how they can be separated.

Solenopotes capillatus Enderlein Figures 113, 114

1904. *Solenopotes capillatus* Enderlein, Zoologischer Anzeiger 28:144; figures 14, 15.
1916. *Linoğnathus vituli* (Linnaeus), Ferris, Entomological News 27:199. (Misidentification)
1920. *Solenopotes capillatus* Enderlein, Freund, Zentralblatt für Bakteriologie und Parasitenkunde (1)84:142; figure.
1921. *Solenopotes capillatus* Enderlein, Bishop, Journal of Agricultural Research 21:797; figures.
1932. *Solenopotes capillatus* Enderlein, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:397; figures 243, 244.

HOSTS AND DISTRIBUTION. First recorded from domestic cattle in Germany. Now known from domestic cattle from various localities in Europe and North America.

NOTES. The opinion is held by the writer that this species has transferred to domestic cattle from deer, although it has never been taken from

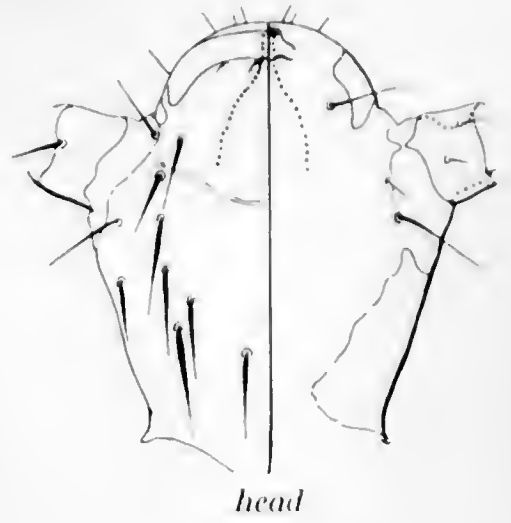


Solenopotes capillatus Enderlein

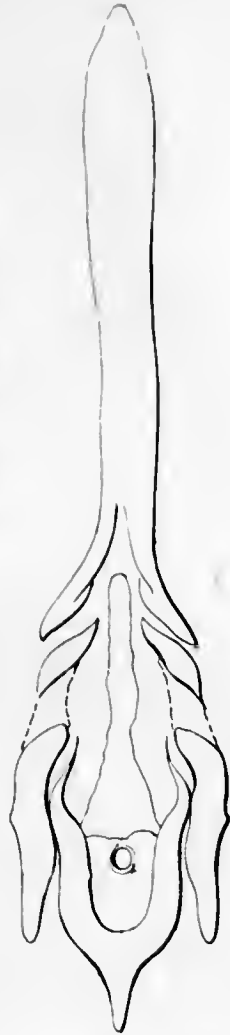
Figure 113



thoracic dorsum



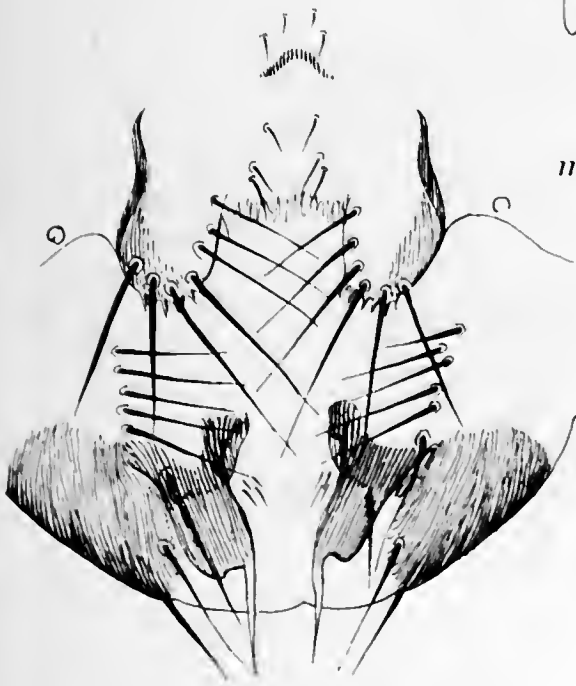
head



male genitalia



male abdomen , dorsal



female genitalia



male genital plate

Solenopotes capillatus Enderlein, details

Figure 114

any cervid and this opinion may be entirely erroneous. An extended discussion of the biology of the species is given in the reference by Bishop cited above.

Solenopotes capreoli Freund

1932. *Solenopotes burmeisteri* (Fahrenholz), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:404; figures 247, 248. (Misidentification)
1935. *Solenopotes capreoli* Freund, Recueil de Travail dédié au 25^{me} Anniversaire, Scientifique du Professor Eugéné Pawlowsky, 1909, 1934, Leningrad and Moscow, page 278; figure B.

HOSTS AND DISTRIBUTION. The specimens upon which the record and illustrations given by Ferris (reference cited above) were based were from *Capreolus caprea* from Czechoslovakia. Freund described the species as new on the basis of specimens from the same host without indication of origin.

NOTES. This species, as Freund remarked, is "In allen Details....praktisch identisch mit *Solenopotes ferrisi*...." differing only in the arrangement of the abdominal setae. Differences cited between this and *burmeisteri* are so slight as to offer no definite "key characters" for the separation of these two species.

Solenopotes ferrisi (Fahrenholz)

1916. *Cervophthirius crassicornis* (Nitzsch), Ferris, Entomological News 27:197; figures. (Misidentification)
1919. *Linoëgnathus ferrisi* Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 5-10:24.
1932. *Solenopotes ferrisi* (Fahrenholz), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 5:134; figures 247, 248.

HOSTS AND DISTRIBUTION. Type from *Odocoileus columbianus* at Laytonville, Mendocino County, and recorded also from the same host at San Gregorio, San Mateo County, California, United States.

NOTES. This species was identified by Ferris as the European species which is now known as *Solenopotes burmeisteri*, but Fahrenholz considered it to be distinct and named it as new on the basis of Ferris' description. For this reason it appears that the types of the species must be regarded as being in the material recorded by Ferris. Freund has given a redescription of *burmeisteri*, but it is still not clear wherein the two species differ, if they do so at all.

Solenopotes muntiacus Thompson

1938. *Solenopotes muntiacus* Thompson, Annals and Magazine of Natural History (Series 11) 1:634; figures.

HOSTS AND DISTRIBUTION. Known only from the original record from *Muntiacus malabaricus* at Mousakande, Gammaduwa, Ceylon. According to Hopkins this is *Muntiacus muntjak*.

NOTES. Unfortunately the description and illustrations of this species are not adequate to permit any very clear concept of it or to afford any "key characters" for its identification. It is said to be very similar to *binipilosus*.

Solenopotes tarandi (Mjöberg)

1915. *Cervophthirius tarandi* Mjöberg, Entomologisk Tijdskrift 36:283; figures 1-4.
1932. *Solenopotes tarandi* (Mjöberg), Ferris, Contributions Toward a Mono-

graph of the Sucking Lice, Part 5:136.

HOSTS AND DISTRIBUTION. Described as from *Rangifer tarandus* at Karesuando, Sweden. Hopkins, in his recent host list, indicates another record, which has not been traced in connection with the present work.

NOTES. The original description and illustrations of this species are inadequate and offer no basis for its separation from such species as *burmeisteri* and *ferrisi*.

Family NEOLINOGNATHIDAE Fahrenholz

1929. Neolinognathidae, Ewing, Manual of External Parasites, page 193.

1936. Neolinognathidae, Fahrenholz, Zeitschrift für Parasitenkunde 9:1:56.

DESCRIPTION OF THE FAMILY. Anoplura in which the abdominal spiracles are reduced to a single pair, this belonging to the eighth abdominal segment. Abdomen membranous throughout except for the usual sclerotizations of the genital region and the terminalia and except for the presence at times of minute sclerotized points; almost devoid of setae except for a pair at each lateral angle of segment eight and in the genital area. Legs with the first pair small and slender with slender claw; second and third pairs enlarged and stout, with stout claw. Antennae five-segmented, sexually dimorphic. Thoracic sternal plate present but not apically free, divided into two longitudinal plates.

NOTES. This family was first recognized as an entity by Ewing who established it as the subfamily Neolinognathinae of the family Haematopinidae. It was elevated to family rank by Fahrenholz in 1936.

The single included genus with two species occurs on members of the family Macroscelididae of the Order Insectivora.

The members of this family are peculiar forms. The probabilities are that their actual relationships are with the family Hoplopleuridae but they are so peculiar that even if referred to this family they would have to be maintained as a subfamily.

Genus NEOLINOGNATHUS Bedford

1920. *Neolinoğnathus* Bedford, Entomologist's Monthly Magazine (3)6:88.

1922. *Neolinoğnathus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:166.

GENERIC TYPE. *Neolinoğnathus elephantuli* Bedford, by monotypy. One other species is included in the genus.

CHARACTERS. Without eyes. Antennae five-segmented, not sexually dimorphic. Head fusiform. Thorax with the sternal plate not apically or marginally free, divided longitudinally into two small plates. Anterior legs small and with slender claw. Middle and posterior legs enlarged, somewhat flattened, with stout claw. Abdomen membranous throughout except for the ninth tergite and the genital sternites beset with small, sclerotized points and entirely without setae except for a pair at each lateral margin of segment eight. Abdominal spiracles present only on segment eight, these noticeably enlarged.

NOTES. The two species referred to this genus may be separated by the following key.

- With a retrorse, tooth-like process on the dorsal (outer) distal angle of the tibia of legs 2 and 3.....ELEPHANTULI
- Without such a tooth.....PRAELAUTUS

Neolinognathus elephantuli Bedford
Figure 115

1920. *Neolinognathus elephantuli* Bedford, Entomologist's Monthly Magazine (3)6:89-90; figure.

1922. *Neolinognathus elephantuli* Bedford, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:166; figures 110-111.

HOSTS AND DISTRIBUTION. First described as from *Elephantulus rupestris* (*myurus*) *jamesoni* at Onderstepoort, Transvaal, South Africa. Later recorded by Ferris from *Petrodromus tetradactylus* and *Nasilio brachyrhynchus delameri* from British Central Africa and Loita Plains, British East Africa.

Neolinognathus praelautus Ferris

1922. *Neolinognathus praelautus* Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:169; figure 111E and 112.

HOSTS AND DISTRIBUTION. Type from *Elephantulus pulcher phaeus* at Lime Springs, British East Africa. Also from *Elephantulus rufescens* at Vor, British East Africa.

Family PEDICULIDAE Leach

1817. Leach, The Zoological Miscellany 3:64.

1842. Denny, Monographia Anoplurorum Britanniae, page 1.

1880. Piaget, Les Pediculines, page 615.

1904. Enderlein, Zoologischer Anzeiger 28:136.

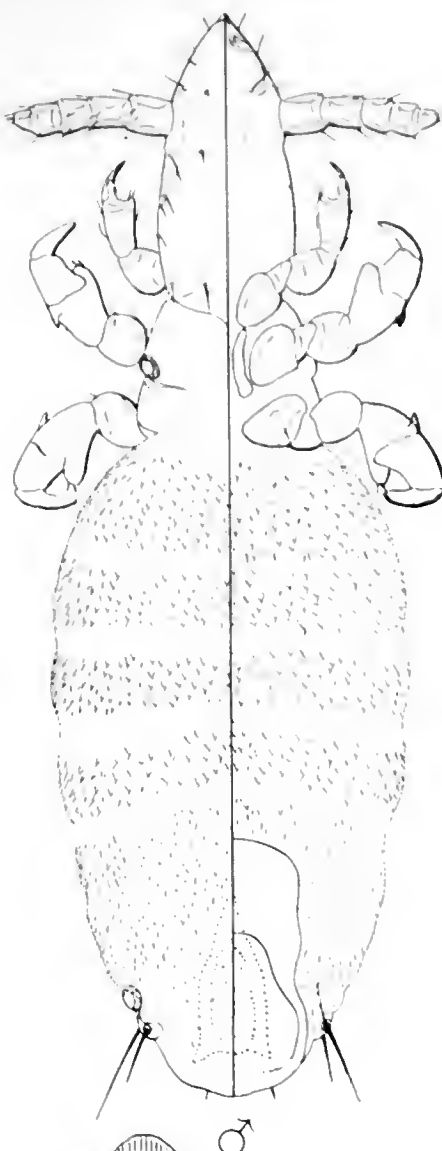
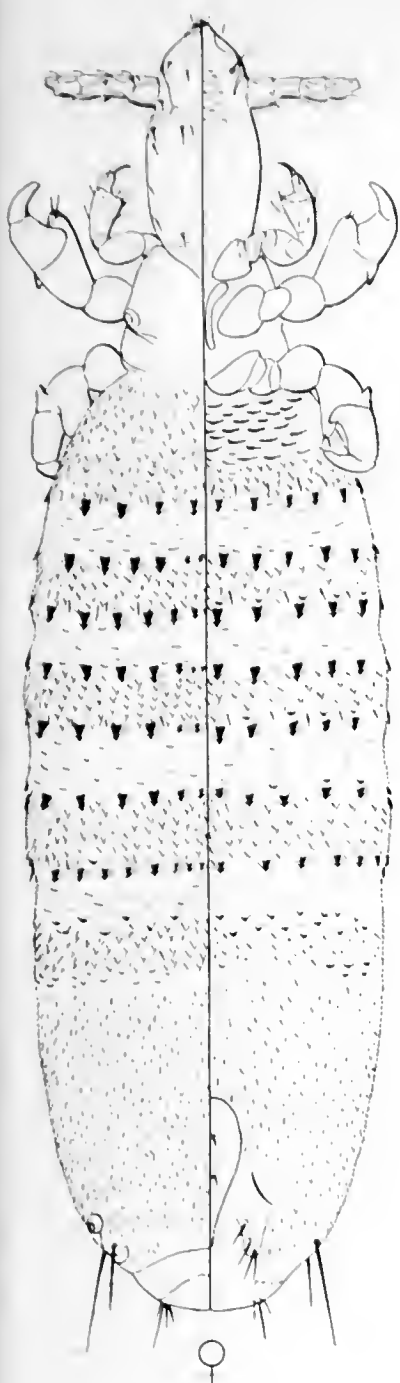
1929. Ewing, A Manual of External Parasites, page 141.

DESCRIPTION OF THE FAMILY. Anoplura in which the eyes are very definitely present externally as a pair of distinct lenses which are accompanied each by a distinct spot of pigmentation that shows in uncleared specimens. Antennae five-segmented, not sexually dimorphic. Legs variable in form, either all practically the same or with the first pair small and slender and the second and third pairs large and stout. Paratergal plates represented on certain of the abdominal segments by a sclerotization which covers the apex of lateral lobes of the abdomen and which never has any part free from the body wall, although at times with lateral lobes. Abdomen otherwise membranous except for the usual terminal and genitalic plates and small tergal plates in the male. Female with well-developed gonopods on the eighth segment but with no definite indication of the gonopods of segment nine present. Genitalia of the male with the parameres fused basally with the aedeagus.

NOTES. As here understood, this family—which at one time included all the Anoplura—is reduced to two genera that are here considered to involve not more than four unquestioned species. Ewing has held that the genus *Phthirus* should also be removed from it, leaving only the genus *Pediculus* in the family. While an argument can be made for this step it is not here accepted.

A step is taken, however, which undoubtedly will not meet with general approval, but which is supported by the facts of morphology. That is to remove the genus *Pedicinus* from the Pediculidae. Those who base their concept of the classification of the Anoplura upon the relationships of the hosts—real or supposed—will object to this procedure, but the fact remains that, considering the question from a morphological basis, the genus *Pedicinus* appears to have very little to do with *Pediculus*, being apparently more closely related to the members of the family Hoplopleuridae as here understood. The question is discussed at length in connection with *Pedicinus*.

The two genera remaining in the Pediculidae can be separated from each other so readily that no key for their differentiation is here presented.



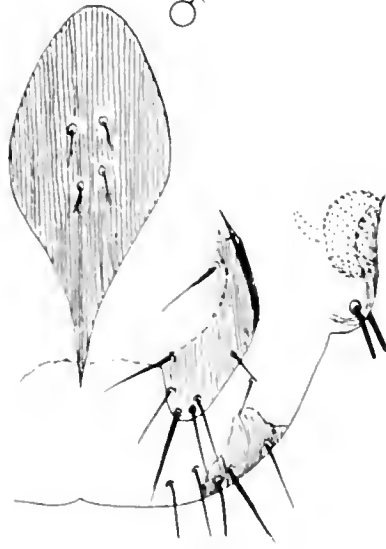
thoracic sternal plate



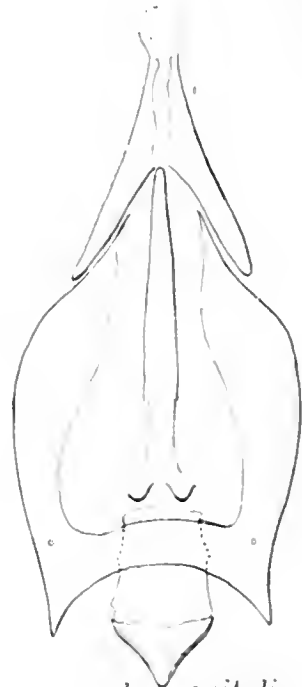
2nd or 3rd claw



abdominal ornamentation



female genitalia



male genitalia

Neolinognathus elephantuli Bedford

Figure 115

Genus PEDICULUS Linnaeus

It would be utterly impracticable here to present a complete bibliography of this genus. Consequently, only those references are given to which a specialized student of the group may refer for his purposes.

1758. *Pediculus* Linnaeus, *Systema Naturae*, Edition X, page 610.
1926. *Pediculus*, subgenus *Parapediculus* Ewing, *Proceedings of the United States National Museum* 68:Article 19:7.
1926. *Pediculus*, subgenus *Paenipediculus* Ewing, *Proceedings of the Biological Society of Washington* 45:117.
1935. *Pediculus*, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 8:534.
1938. *Pediculus*, Ewing, *Journal of Parasitology* 24:13.

GENERIC TYPE. The type of *Pediculus* is *Pediculus humanus* Linnaeus. The type of the proposed subgenus *Parapediculus* was stated by Ewing to be *Pediculus consobrinus* Piaget. The consequences of this latter type selection will be discussed in the notes which follow. The type of the proposed subgenus *Paenipediculus* was stated by Ewing to be *Pediculus simiae* Ewing, which is here considered to be a synonym of *Pediculus schäffi* Fahrenholz.

CHARACTERS. Anoplura in which eyes are very distinctly developed. Legs all of essentially the same size and shape, the tibiotarsal articulation distinct, the claws slender. Margins of the abdomen more or less strongly lobed, the lobes covered by the sclerotized paratergal plates which are not at all or at the most but in part and then only slightly free from the body at any point on their margins. Thorax with a distinct notal pit. Thoracic sternal plate sclerotized, but with its margins not free from the body. Dorsum of the abdomen in the female membranous or at the most with slightly developed, sclerotized plates; that of the male usually with small tergal plates, the surrounding derm not minutely wrinkled. Spiracles present in normal position on the abdomen, six pairs being present, these all enclosed within the borders of the paratergal plates. Male with the genitalia bearing very small parameres which are united basally with the pseudopenis.

HOSTS AND DISTRIBUTION. Occurring on members of the Order Primates, especially on man, the chimpanzee, and the New World monkeys of the family Cebidae. There are records of its occurrence on gibbons.

It may be stated at the outset that the two supposed subgenera, *Parapediculus* and *Paenipediculus* are here categorically rejected. The author of these two subgenera, himself, indicated (1938) doubts as to the justification of the first of these but suggested that the second might well be raised to the rank of a genus. That anything at all is to be gained by the recognition of either remains to be demonstrated. In the case of *Parapediculus* we have a question arising from a misidentified generic type. The type of this proposed subgenus was definitely stated to be *Pediculus consobrinus* Piaget, a species that has been shown, on the basis of an examination of the sole remaining specimen in the Piaget Collection at the British Museum, to be *Pediculus humanus*. Ewing, however, had before him when he named this subgenus specimens which were not this species and he had never seen this type specimen. If *Parapediculus*, as a name for the lice of the New World Cebidae, is ever recognized the question as to the status of its type species will need to be settled, but since it is here rejected no time will now be spent on the question.

Key to Species of PEDICULUS

Only those forms are included in this key which in the writer's opinion have a reasonable claim to be recognized as species.

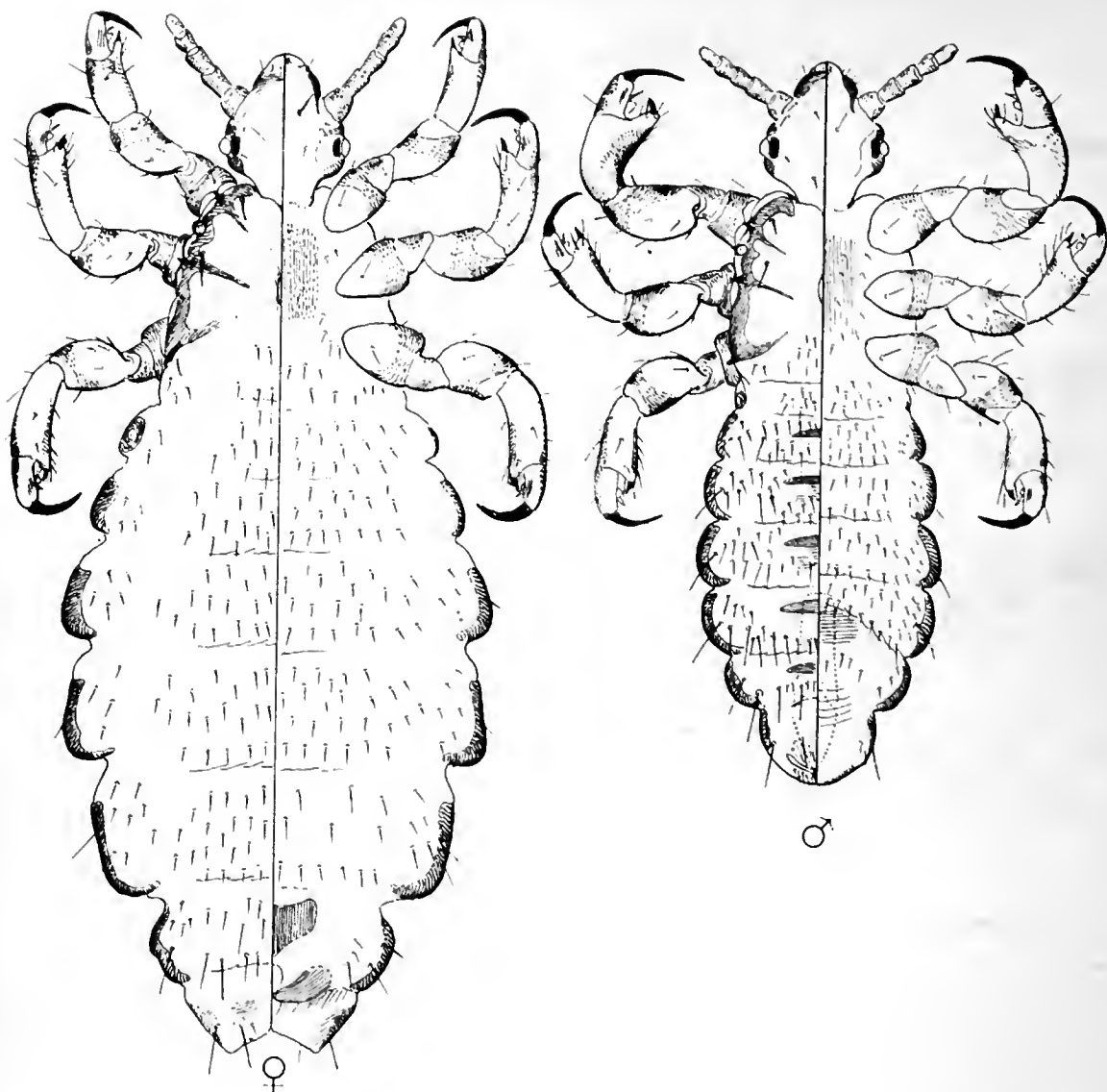
1. Spiracles of abdominal segments 3-5 each borne within a very small, circular, sclerotized area; occurring on chimpanzees.....SCHIACCI
Not so.....2
2. Paratergal plates throughout clearly without evidence of lateral lobes; occurring normally on man although at times to be found on monkeys of the family Cebidae and on gibbons in captivity.....HUMANUS
Paratergal plates of at least some abdominal segments showing clear evidence of lateral lobing, both dorsally and ventrally.....3
3. Paratergal plates of abdominal segments 5-6 bearing strong lateral lobes, both dorsally and ventrally; occurring on monkeys of the family Cebidae.....MÖBERGI
Paratergal plates of abdominal segments 5-7 with slight, but distinct, evidence of lateral lobes, both dorsally and ventrally; occurring on man and Cebidae in the New World tropics and on man in the southwestern Pacific area.....PSEUDOHUMANUS

In presenting the following review it has seemed desirable to consider the species by host group rather than alphabetically.

Pediculus humanus Linnaeus
Figures 116, 117, 118, 119

The literature on this species is very extensive, but for the most part is not pertinent in considering the taxonomy of the species. Only those references are cited which are of importance in establishing synonymy or in presenting evidence concerning the status of the various forms that have been described.

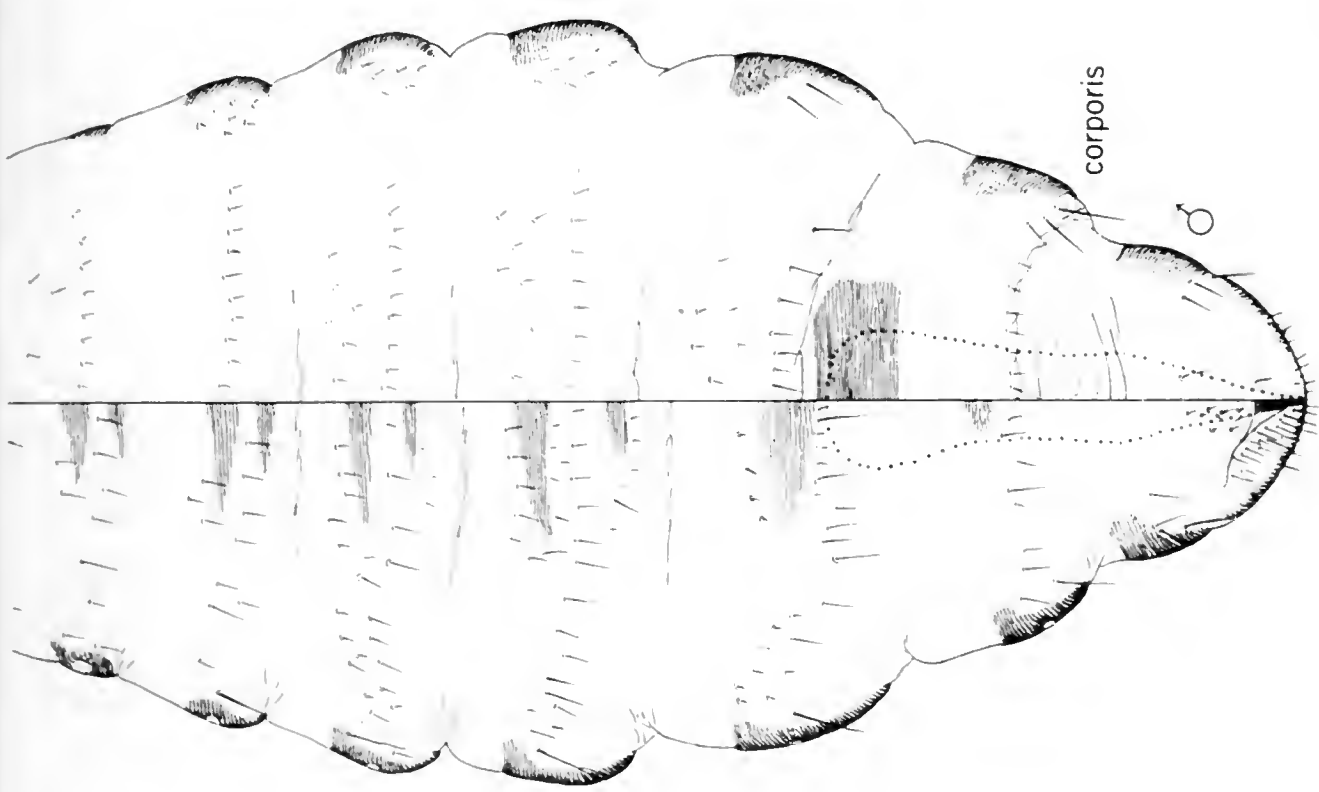
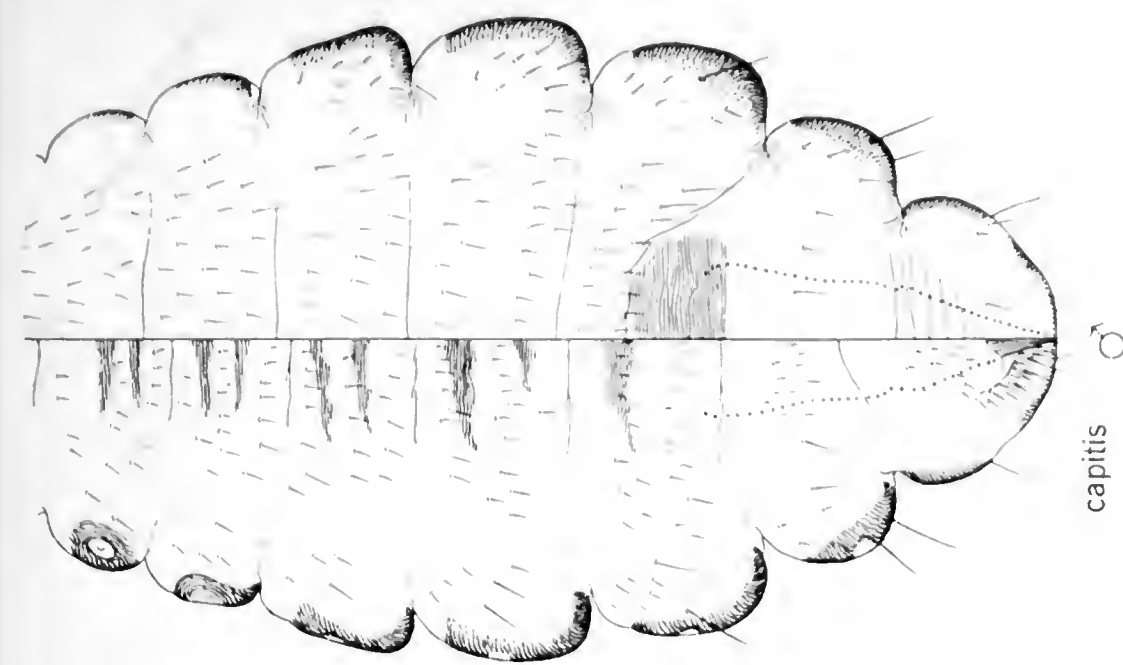
1758. *Pediculus humanus* Linnaeus, *Systema Naturae*, Edition X, page 610. (The original description of the species, containing no indication that the head and body lice were considered to represent varieties.)
1761. *Pediculus humanus* Linnaeus, *Linnaeus, Fauna Suecica*, Edition 2, page 475. (The beginning of the controversy concerning the two varieties. "Qui in vestimentis victitat ab eo, qui in capite vivit, non differt ut species, sed tantum varietas.")
1767. *Pediculus humanus* Linnaeus, *Linnaeus, Systema Naturae*, Edition XII, page 1016. (The two supposed varieties are designated as 1 and 2, respectively, for the head louse and the body louse and characterized thus: "Varietas Capitis durior, coloratio; Vestimentorum laxior, magis cinerea.")
1778. *Pediculus humanus* Linnaeus, de Geer, *Mémoires pour servir á l'histoire des insectes* 7:67; Plate 1, figures 6, 7. (Here the terms "capitis" and "corporis" are first employed. "Il y a donc une différence palpable entre ces deux sortes de poux, et qui semble indiquer qu'ils sont d'espèce différente, á moins qu'on ne veuille plutôt, comme a fait M. de Linné, les regarder comme deux variétés. Quoiqu'il en soit, on pourroit les distinguer par les démoninations suivantes: (1) *Pediculus (humanus capitis) cinereus*, thorace abdomineque fascia interrupta nigra marginatus; (2) *Pediculus (humanus corporis) albidus*, totus immaculatus.")
1803. *Pediculus humanus* Linnaeus, Latreille, *In Nouveau dictionnaire d'histoire naturelle* 18:403. (This reference not seen. According to Nuttall, the name "humanus" is here definitely restricted to "le pou du corps," which would constitute the first type fixation.)
1803. *Pediculus cervicalis* Latreille, *In Nouveau dictionnaire d'histoire naturelle* 18:403. (This reference according to Nuttall. The name is indicated as applying to "le pou de tête.")
1805. *Pediculus nigritarum* Fabricius, *Systema Antliatorum*, page 340. (Es-



Pediculus humanus Linnaeus, the typical form called *capitis*

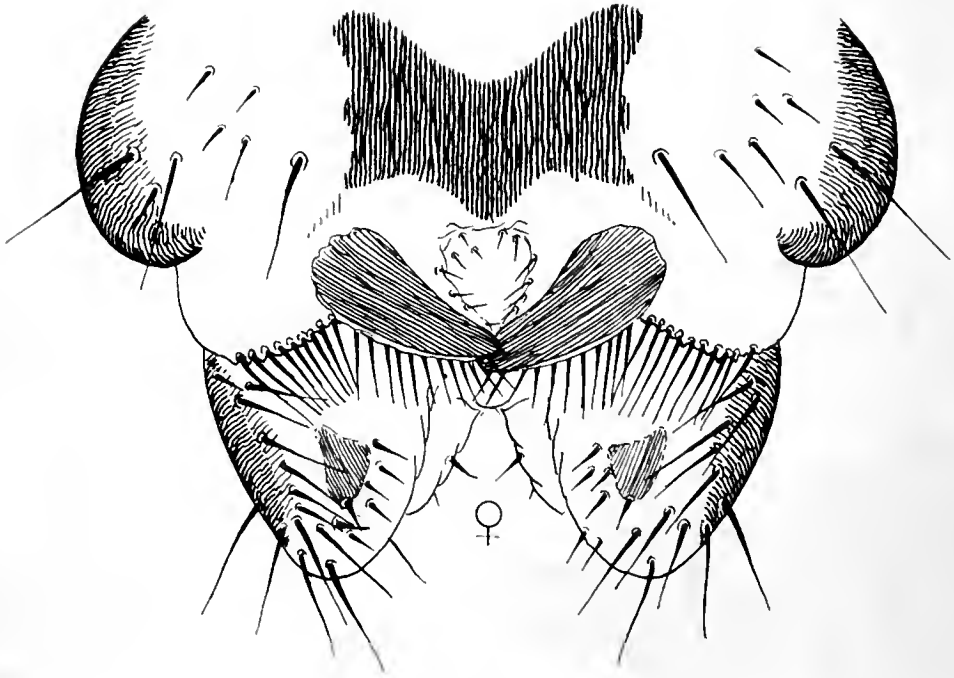
Figure 116

- established for lice having their "habitat in nigritarum corpore.")
1816. *Pediculus nigrescens* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, Part 1, page 81.
1816. *Pediculus albidior* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, Part 1, page 81. (Merely a new name for the body louse.)
1816. *Pediculus pubescens* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius, Part 1, page 81. (Merely a new name for the head louse.)
1818. *Pediculus vestimenti* Nitzsch, Germar's Magazin der Entomologie 3: 305. (New name for the body louse.)
1824. *Pediculus tabescentium* Alt, De Phthiriasi, page 7.
1834. *Pediculus capitis* de Geer, Burmeister, Genera Insectorum, Rhynchota, Order 1, Tribe 1, Family 1, Species 1.
1880. *Pediculus consobrinus* Piaget, Les Pediculines, page 626; Plate 51, figure 4. (Doubtfully described as new.)

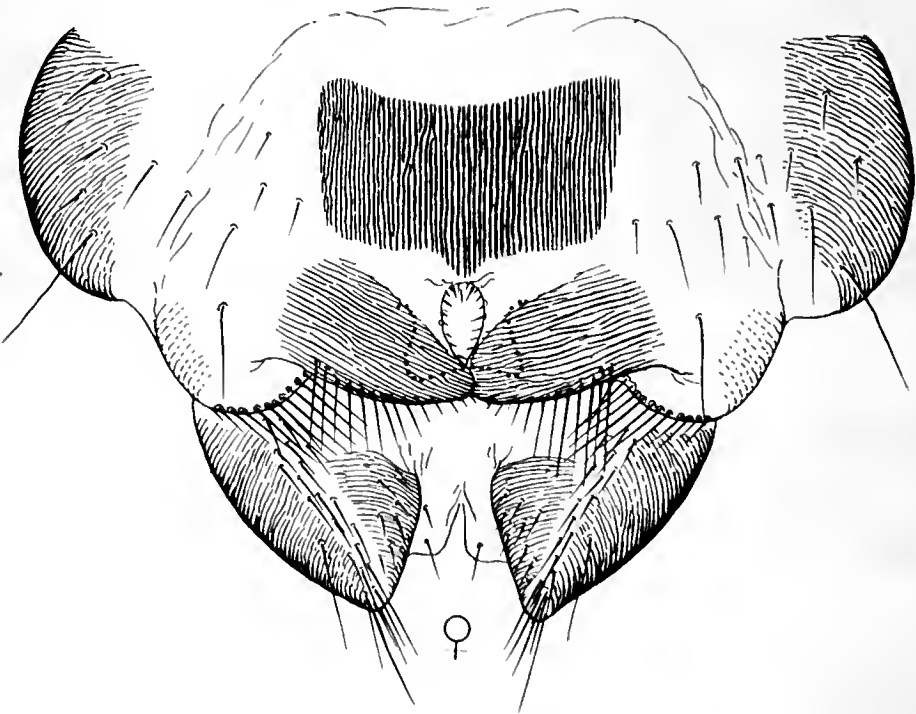


Pediculus humanus Linnaeus, abdomen of male

Figure 117

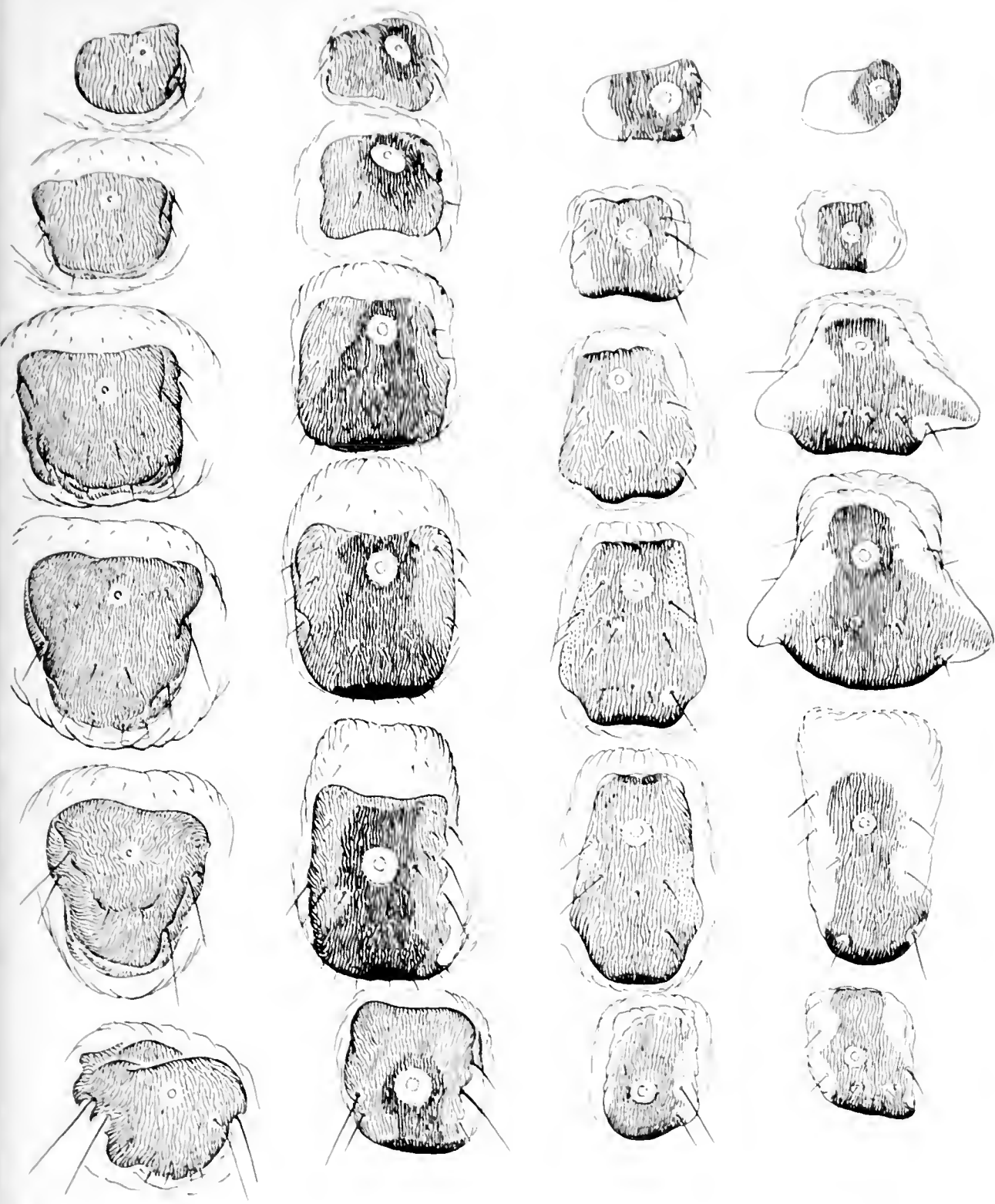


Pediculus mjobergi Ferris, from *Ateles dariensis*, genitalia of female



Pediculus humanus Linnaeus, genitalia of female

Figure 118



corporis
typical form

capitis
typical form

pseudohumanus
from man,
Marquesas Islands

mjöbergi
from
Ateles dariensis

Pediculus, paratergal plates

Figure 119

1911. *Pediculus capitis* de Geer and *Pediculus capitis vestimenti* Nitzsch, Neumann, Archives de Parasitologie 14:410-413. (Neumann concludes that the body louse is but a variety of the head louse and assigns to it, contrary to all rules of nomenclature, the name combination given above. He concludes also that *Pediculus consobrinus* Piaget is identical with *Pediculus capitis*.)
1912. *Pediculus capitis* de Geer and *Pediculus corporis* de Geer, Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 2-4:2-12; text figures 1-7; Plate 2, figures 16-19; Plate 3, figures 1-4. (Maintains the distinctness of head and body lice.)
1915. *Pediculus corporis nigritarum* Fabricius, Fahrenholz, Zeitschrift für Morphologie und Anthropologie 17:596-597; text figure 1. (Assumes to recognize this form on the basis of a single specimen.)
1915. *Pediculus capitis angustus* Fahrenholz, Zeitschrift für Morphologie und Anthropologie 17:597; text figure 2; Plate 21, figure 1. (From Japanese.)
1915. *Pediculus capitis maculatus* Fahrenholz, Zeitschrift für Morphologie und Anthropologie 17:598; text figures 3, 4; Plate 21, figures 2, 3. (For the head louse of African negroes.)
1915. *Pediculus corporis marginatus* Fahrenholz, Zeitschrift für Morphologie und Anthropologie 17:599. (The body louse of Japanese.)
1916. *Pediculus humanus* Linnaeus, Fahrenholz, Zoologischer Anzeiger 47:269-271. (Points out the proper application of the name "humanus," and gives data on literature.)
1916. *Pediculus friedenthali* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:2; text figures 1, 2; Plate, figure 1. (For a louse from *Hylobates mülleri*. Date of issue indicated as July.)
1916. *Pediculus oblongus* Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:15; text figure 14. (For a louse from *Hylobates syndactylus*.) (Not *Pediculus oblongus* Geoffroy)
1916. *Pediculus humanus marginatus* Fahrenholz, Zoologischer Anzeiger 48:87. (This apparently was intended as a preliminary diagnosis to appear before the description in the reference cited above which, however, has priority. Date of issue indicated as October.)
1916. *Pediculus corporis angustus* Fahrenholz, Zoologischer Anzeiger 48:88. (The same note applies.)
1916. *Pediculus capitis maculatus* Fahrenholz, Zoologischer Anzeiger 48:88. (The same note applies.)
1916. *Pediculus friedenthali* Fahrenholz, Zoologischer Anzeiger 48:88. (The same note applies. The intended later description of this species apparently has priority of three months.)
1916. *Pediculus oblongus* Fahrenholz, Zoologischer Anzeiger 48:88. (The same note as for the next preceding species applies.)
1916. *Pediculus humanus chinensis* Fahrenholz, Zoologischer Anzeiger 48:87. (Preliminary description of the body louse of Chinese.)
1917. *Pediculus humanus chinensis* Fahrenholz, Fahrenholz, Mitteilungen aus dem zoologischen Museum zu Hamburg (Beiheft zum Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten [2]) 34:2, 6; text figure 1. (Definitive description.)
1917. *Pediculus capitis maculatus* Fahrenholz, Fahrenholz, Mitteilungen aus dem zoologischen Museum zu Hamburg (Beiheft zum Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten [2]) 34:2. (Records this form from Negroes in Dutch Guiana.)
1917. *Pediculus humanus* Linnaeus, Nuttall, Parasitology 10:1-79. (An extensive bibliography is presented.)
1919. *Pediculus assimilis* Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 5-10:27. (New name for *Pediculus oblongus*, which was preoccupied.)

1919. *Pediculus humanus* Linnaeus, Nuttall, Parasitology 11:329-345. (Systematic position, synonymy, and iconography. All the species of *Pediculus* thus far described are regarded as being probably synonyms of *humanus*.)
1919. *Pediculus humanus* Linnaeus, Nuttall, Parasitology 11:279-328; 27 text figures; Plates 12-17. (Records of abnormalities, together with consideration of hybridism between "*capitis*" and "*corporis*" and other evidence that they constitute but races of a single species.)
1920. *Pediculus humanus* Linnaeus, Nuttall, Parasitology 12:136-153. (On Fahrenholz' purported new species, subspecies, and varieties of *Pediculus*. A scathing and well-justified criticism in which it is, however, erroneously concluded that all the named forms of *Pediculus* belong to the same species.)
1924. *Pediculus capitis* de Geer and *Pediculus vestimenti* Nitzsch, Freund, Tierärztliches Archiv, Prag 4(A):42; text figures 1-4. (Revives the idea of the specific distinctness of head and body lice and presents evidence intended to support this view.)
1926. *Pediculus (Pediculus) humanus nigritarum* Fabricius, Ewing, Proceedings of the United States National Museum 68:19:16; text figures 1C, 2, 3C, 5, 6; Plate 2, figures 6, 7. (Revived for lice from Negroes.)
1926. *Pediculus (Pediculus) humanus angustus* Fahrenholz, Ewing, Proceedings of the United States National Museum 68:19:19. (While assuming to identify this form on the basis of two specimens, the author united with it *Pediculus capitis marginatus* Fahrenholz and *Pediculus humanus chinensis* Fahrenholz.)
1926. *Pediculus (Pediculus) humanus americanus* Ewing, Proceedings of the United States National Museum 68:19:20; text figures 1B, 2, 3B; Plate 3, figures 9, 10, 11. (Established for lice from the heads of Peruvian mummies.)
1933. *Pediculus humanus americanus* Ewing, Bequaert, Carnegie Institution of Washington Publication Number 431, page 573. (From Maya Indians, Yucatán and Guatemala.)
1936. *Pediculus humanus americanus* Ewing, Proceedings of the Helminthological Society of Washington 3:36.
1938. *Pediculus pseudohumanus* Ewing, The Journal of Parasitology 24:23; figures 5a, 6a.

Review of the PEDICULI Ascribed to Man

The nomenclatorial history of *Pediculus humanus* begins with the tenth edition of Linnaeus' "Systema Naturae" in 1758. Here he named the species but gave no indication of recognizing more than one form. In his "Fauna Suecica" of 1761 he indicated the head and body infesting forms as varieties and in the twelfth edition of the "Systema Naturae" they were numbered as varieties 1 and 2 respectively.

In 1778, de Geer named these varieties as *Pediculus humanus capitis* and *Pediculus humanus corporis*. We need not go into the nomenclatorial problem as to which of these varieties should be called *Pediculus humanus humanus*, in accordance with the present rules of nomenclature, other than to indicate that following the literature it appears that this name should be used for the head louse, while *Pediculus humanus corporis* should be used for the body louse, if the distinction between them is to be recognized in nomenclature.

In 1805, Fabricius named a *Pediculus nigritarum* from Negroes and if the form which seems actually to occur on Negroes is to be recognized nomenclatorially it would appear that this name is available for it.

In 1816, von Olfers named a *Pediculus nigrescens* from Negroes and re-

named the head and body lice as *pubescens* and *albidior* respectively.

In 1818, Nitzsch used the name *capitis* for the head louse and employed the name *vestimenti* for the body louse.

In 1824, Alt proposed the name *Pediculus tabescentium* for the body louse.

In 1880, Piaget named *Pediculus consobrinus* from a New World monkey of the genus *Ateles*, this being, according to the evidence of the one specimen remaining in the Piaget collection, nothing more than *Pediculus humanus*.

Now the idea came to be generally accepted that the head louse and the body louse constitute two distinct species, these being referred to under various combinations of the names previously mentioned.

In 1911, Neumann concluded that these two forms can at the most be regarded as only subspecies and employed the names *Pediculus capitis* and *Pediculus capitis vestimenti* for them in complete disregard of the accepted rules of nomenclature.

Fahrenholz, beginning in 1912, maintained the distinctness of the head louse and the body louse as species and began the process of supplying each presumed race of man with a subspecies or variety of each of them. He assumed to recognize *Pediculus corporis nigritarum*—on the basis of a single specimen—and named the varieties *Pediculus capitis angustus* and *Pediculus corporis marginatus* from Japanese. In 1916, he named *Pediculus humanus chinensis* from Chinese and added, also, the supposed species *Pediculus friedenthali* and *Pediculus oblongus*, both from gibbons, and the species *Pediculus lobatus* from a New World monkey of the genus *Ateles*. The name *oblongus* being preoccupied, he later altered it to *assimilis*.

During the first World War the recognition of the importance of the lice as the carriers of disease, most importantly typhus, led to a very large amount of study of them. Professor G. H. F. Nuttall gathered a large amount of material from various parts of the world and various races of man and came to the conclusion that the lice of man constitute at the most two unstable races of a single species. Work done by Bacot seemed to show that the head louse can be converted into the body louse experimentally, although he did not demonstrate the converse of this. His experiments are open to question in regard to the material that he employed, but he at least demonstrated that the two forms will interbreed successfully. Nuttall concluded that all records up to that time of supposedly distinct species of *Pediculus* on New World monkeys referred also to *humanus*, although this conclusion can not now be supported. He vigorously—and from the point of view here held quite justifiably—criticized the work of Fahrenholz, although in some respects his conclusions were erroneous.

Freund, in a series of papers (1924, 1925, 1927) maintained the distinctness of head and body lice as species.

In 1926, Ewing accepted the opinion that head and body lice of Europeans constitute a single species, but clung to the opinion that they represent subspecies. Although he was unable to accept Fahrenholz' assignment of three forms to Japanese and Chinese, he assumed to recognize one of these forms and also accepted the *Pediculus nigritarum* of Fabricius for lice from Negroes. He then, for his own part, added a supposed subspecies, *Pediculus humanus americanus*, for lice from American Indians. In addition, he named two supposedly new species for lice from New World monkeys and accepted two already established names.

The result of all this naming stood at this time at about twelve names for the lice of man himself, two names for lice from gibbons, two names for lice of the chimpanzee—which are discussed elsewhere—and seven names for the lice of New World monkeys, which will be discussed elsewhere.

In 1935, Ferris reported upon his studies upon the large collection of lice assembled by Professor Nuttall and material accumulated from other sources. He was able to examine types or other authentic specimens of the forms named by Fahrenholz and the type of *Pediculus humanus americanus*,

named by Ewing, as well as the sole remaining specimen from the type lot of Piaget's *Pediculus consobrinus*.

It may as well be frankly stated that his conclusions were to a considerable degree influenced by disgust at what he had seen in the course of this work and revolt against the methods that had been employed in the systematics of this group. It was clear that some forms had been named solely upon differences in the method of preparation of specimens, upon supposed differences of the utmost triviality which had not been checked against a series of specimens to determine normal variation, and upon a philosophy of taxonomy which apparently adopted the concept that a species "is a specimen which looks different from other specimens." It is entirely possible that in this revolt against such methods he may himself have gone too far and in his turn made errors that arose from too great conservatism, but he still holds that the revolt was sound in principle.

In 1936, Ewing, in a paper dealing specifically with the lice of New World monkeys, expounded the view that Piaget must have had two species in his material of *Pediculus consobrinus*, one from monkeys and one from man. He recognized, however, that in selecting the sole remaining specimen from the Piaget collection as type Ferris had relegated this species to synonymy with *Pediculus humanus*. In addition he named a new species, *Pediculus pseudohumanus*, which, while based upon lice from monkeys, also included specimens from American Indians. It will be discussed especially in connection with the lice of the Cebidae.

This, then, in brief is how the matter of the lice of the genus *Pediculus* occurring on man stands at the present moment.

The Problem of the PEDICULI of Man

This problem has been recognized and argued about for nearly a hundred and fifty years, with still no satisfactory solution. Ferris (1935) has presented the story in detail up to that date and it will here merely be abstracted.

As early as 1761, Linnaeus, in his "Fauna Svecica," recognized the existence of two forms of *Pediculus* on man, these being the head louse and the body louse. In 1878, de Geer applied names to these forms, calling them respectively *Pediculus humanus capitis* and *Pediculus humanus corporis*. Under our now accepted rules of nomenclature one of these forms should have been called *Pediculus humanus humanus*. Tracing the matter out it appears that the first restriction, at least by implication, was by Latreille about 1805, in such a manner that the name *Pediculus humanus humanus* should be applied to the body louse and *humanus capitis* be used for the head louse, if the two forms are considered sufficiently distinct to be worthy of scientific names.

Since our present rules of nomenclature were not well developed and not widely followed until almost 1900, other names came to be applied to these lice. Thus, the names *vestimenti*, *cervicalis*, and *tabescentium*, as well as both *capitis* and *corporis* were variously employed and the name *vestimenti* especially was much used for the body louse. Also, the idea developed that the head louse and the body louse constitute two distinct species and it was not until 1911 that this idea was challenged by Neumann. Since that time it has been both supported and attacked. Fahrenholz and Freund especially have supported the idea that two species are involved, while Nuttall and Ferris have maintained the opposing point of view. It should here be emphasized that at the bottom of this difference of opinion lies the fundamental question of "what do we mean by species?" So important is that question that a brief discussion of it and of the writer's point of view will be presented somewhat farther along.

Concurrently with the idea that two species are involved has gone also

the idea that different forms occur on the different races of man. As early as 1805, Fabricius named a *Pediculus nigritarum* from Negroes and in 1816 von Olfers named a *Pediculus nigrescens* from the same source. In 1912, Fahrenholz not only maintained the distinctness of head and body lice as species, but apparently set out to provide every race of man with its own "variety" of each of these species and this was added to by Ewing, who as late as 1936 named *Pediculus humanus americanus* from American Indians.

Now, in the light of the evidence afforded by some other quite clear examples of the occurrence of two or more species of lice of the same genus on hosts of the same species, the possibility must be admitted that we may have to do with a similar situation in connection with the *Pediculi* of man. Thus, leaving out of consideration the extraordinary situation connected with the biting lice of the Order Hyracoidea, it appears that something of this sort occurs in the sucking lice of the Hyracoidea. Three clearly distinct species of the same genus of Anoplura occur on domestic sheep. Two clearly distinct species of the same genus occur on rodents of the genus *Thryonomys*. Apparently two quite distinct species of *Haematopinus* occur on zebras. So in the light of these considerations there is no a priori reason to assume that a parallel situation could not occur in the case of the lice of man. The question is merely as to whether or not it does.

It is a risky business for an entomologist to become involved in anthropology without any personal basis of knowledge and in the face of the very considerable differences of opinion which exist among anthropologists. However, there are certain ideas which seem rather widely to be accepted. Thus it appears rather generally agreed that present-day *Homo sapiens* falls into three broad groups which seem to be subspecies as that term is generally understood by mammalogists. Furthermore, it is to be recalled that up to a relatively few thousand years ago there existed what is generally considered to have been a distinct species of man, *Homo neanderthalensis*—if one can untangle the weird nomenclatorial practices of the anthropologists—who must certainly have had contact with *Homo sapiens* and whose females may very well have furnished sport and variety for the males of a conquering race. Somewhat parallel situations are not unknown today. It must also be recalled that there is evidence of other ancient forms of man regarded by some anthropologists as distinct species, which doubtless were to some degree contemporaneous with the ancestors of the living subspecies.

In fact, it appears that these three existing groups or subspecies, which display an apparently unlimited capacity for exchanging genes with unimpaired fertility to unnumbered generations, offer one of the best examples of the biological meaning of the word "species." Relatively pure representatives of each of these groups exist and if considered by systematists working from a few preserved specimens would almost inevitably be regarded as belonging to distinct species. But there exist in the total population of man every conceivable degree of variation and every conceivable combination of the characters that mark these races as they presumably were constituted in their original state of nature.

Thus man, as he exists today, is a species within the formula which seems best to express the biological concept of that term as used in zoology. That formula, as the writer has attempted to express it after a careful weighing of every word is this:

A species is a population, the members of which are parts of a continuously interlinked genetic complex, which is separated from other such complexes by barriers or incompatibilities of genetic origin and which under natural conditions, that is, the conditions which have been concerned with evolution, maintains itself from its own genetic resources.

An enormous experiment has been going on for many thousands of years, in which man has been the experimental animal. In the course of that experiment we may assume that certain mutants appeared from an original common

stock. These mutants became geographically localized and distributed as subspecies and minor groupings within the population of man.

Certain of these minor genetic groups, being perhaps more aggressive than others, spread from their original centers, and since no genetic barriers existed between them and the groups which they overcame or with which they mingled, hybridization resulted and finally we have a world population in which all the mutations are mingled in every combination and to such a degree that the population as a whole is continuously genetically inter-linked. Nor do the hybrid offspring have to be renewed by continued hybridization in order to maintain themselves. In contrast to this we may cite the case of the domestic mule, which must continually be re-established by renewed crossings and which otherwise cannot maintain itself.

This would seem to be a reasonably objective statement of the conditions which exist in the human population of the earth and of the basis for considering man to constitute a single species.

Now it would seem probable that something of this sort may very well have happened in connection with the *Pediculi* which have been the constant companions of man and which have accompanied him in his original process of diverging into subspecies and his later reunification by hybridization.

These *Pediculi* may very well have begun to develop into genetically differentiated forms upon the various species of man, for the past existence of which there is evidence, and the various subspecies that still exist. But as their hosts have intermingled with each other the opportunity for the intermingling of the parasites also has occurred. Thus we would arrive at a condition among the parasites which may rather closely parallel the condition found among their hosts. A population has resulted which conforms to the same formula as does the host population. Here and there relatively pure populations of the parasites may exist. It is conceivable that certain forms may have inherited physiological as well as morphological differences which would lead to some degree of segregation in the hybrids in accord with the degree of inheritance of these physiological characteristics. But the population as a whole presents a picture which closely parallels that presented by man himself.

It is the writer's belief, based upon an examination of many specimens of lice from different races of man and from various parts of the world, that the situation above described is that which actually exists in the population of *Pediculus* on man.

Material at hand from Negroes in Africa and South America would offer to a systematist working merely from a few specimens a real basis for the belief that a distinct species of *Pediculus* occurs on Negroes. Ten specimens of this form compared with ten specimens of the characteristic "body louse" of Europeans would almost inevitably lead to such a conclusion. These lice from Negroes are very darkly pigmented, their bodies are very compact, their length is scarcely more than one-half the length of the European body lice. However, other specimens present in a lot from Negroes in Africa show every degree of gradation into normal head lice of Europeans.

And so with a comparison between normal "head lice" and normal "body lice" of Europeans. The body louse, in its most characteristic form, is much larger than the typical head louse, is paler in color and differs morphologically in the fact that the paratergal plates of the abdomen do not extend around the apex of their abdominal lobes into the intersegmental notch as is the case with the paratergal plates of typical head lice. But every degree of variation among these forms exists.

There have been available a wide range of specimens from Europeans, Eskimos, Hindus, Arabs, Negroes, American Indians, Chinese, and so on. From the point of view here adopted these constitute a single species, within the definition of the term explained above.

There remains the questions involved with the nomenclatorial procedure

which should be followed in dealing with this material.

Within this material certain rather well-marked forms can be recognized and certainly some basis exists for the recognition of two or more groups that might be called subspecies, within the meaning of that term as employed by those who accept it on a biological basis. Actually, however, only a certain portion of this material will fall within these subspecies. The remainder consists of variants from the typical forms in such combinations that nothing more can be said of them than that they are *Pediculus humanus*.

Under these conditions and until the whole problem can be submitted to examination by experimentation the opinion is here held that nothing whatsoever is to be gained by naming a series of "varieties" or subspecies. In fact, if this process is once started and carried to its logical conclusion the number of named forms could be extended indefinitely. For example, a lot is at hand from natives of Rennell Island, one of the Solomon Islands group, that could certainly be named as a new species if we were to employ criteria of the order of those used by Fahrenholz and Ewing. And when we have carried this process of naming to its ultimate limits, what have we gained? Nothing more than a series of names of forms which can be recognized only if a perfectly typical example is at hand, which will be relatively seldom. When the needed experimental work has been done it may prove that some definite nomenclature can be supported, but there seems to be no justification for complicating the nomenclatorial situation in advance of such work.

The employment of the name *Pediculus humanus* Linnaeus to cover this population as a whole, with the addition of the vernacular names head louse and body louse for those forms when the occasion demands, would seem adequately to take care of the situation as it exists at present.

Review of the Purported Species of PEDICULUS from Gibbons

In the bibliography of *Pediculus humanus* there are included two names which have been given to lice reputed to have been taken from gibbons, which are Primates of the genus *Hylobates*. The two purported species are *Pediculus assimilis* Fahrenholz and *Pediculus friedenthali* Fahrenholz.

The writer has earlier seen specimens of the first-named of these, determined by Fahrenholz, which came from *Hylobates syndactylus* in the Zoological Garden at Berlin, but has not seen specimens of the second, which was described as from *Hylobates mülleri* without indication of locality.

The examination of specimens of *assimilis* and the description of *friedenthali* indicate no reason whatsoever for the recognition of these species as distinct from *Pediculus humanus*.

Review of the Purported Species of PEDICULUS from New World Monkeys

As will appear from the following discussion the question of the name to be used for the characteristic louse of the New World monkeys, which belong to the family Cebidae, is much confused. In the opinion here held there is but one species, apart from the at present very dubious question of *Pediculus humanus* Ewing, but if this be true what shall this species be called?

Actually, not until the matter has been subjected to an extended investigation involving an examination of a large mass of material, including the types—such as still exist—and an experimental genetic study of all the forms involved, will it be possible to arrive at a solution that may be generally satisfactory.

Leaving aside the name *quadrumanus*, for which no evidence of any sort is—or is likely to become—available, the first possible name is *Pediculus*

mjöbergi Ferris. But this is clouded by the deficiency of the original description and by the fact that the type—the whereabouts of which is unknown—has not been re-examined. The name *lobatus* Fahrenholz is entirely unclouded, although the type is probably not now in existence.

Pending the final study which must be made, the writer is inclined to retain the use of the name *Pediculus mjöbergi* Ferris pending a final settlement.

Realizing fully that the questions concerning the species of lice on the New World monkeys involve many differences of opinion and that future workers may decide that certain of the purported species are valid, the following review lists these names and their bibliographies separately in order to minimize future confusion as far as may be.

Pediculus atelophilus Ewing

1926. *Pediculus (Parapediculus) atelophilus* Ewing, Proceedings of the United States National Museum 68:19:9; figures 4A, 5.
1931. *Pediculus (Parapediculus) atelophilus* Ewing, Hinman, Parasitology 23: 488.
1935. *Pediculus mjöbergi* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:588; figures 318E, 319E, 322F, 323I, 328-332.
1938. *Pediculus atelophilus* Ewing, Ewing, The Journal of Parasitology 24: 26; figures 2, 5b, 6b.

HOSTS AND DISTRIBUTION. The type of this species was recorded as from *Ateles geoffroyi* with unspecified type locality. Recorded at the same time from skins of the same host taken in Costa Rica. Recorded by Ewing in 1938 from *Ateles pan* from Guatemala; from *Ateles dariensis* from Panama; from *Ateles hybridus* from the National Zoological Park at Washington, D. C.

There is at hand a considerable amount of material undoubtedly referable to this name, including specimens from the material recorded by Hinman out of a lot identified by Ewing from *Ateles geoffroyi* in captivity and others from this host in Panama; numerous specimens from *Ateles dariensis*, *Cebus capuchinus*, and *Alouatta palliata*, all from Panama from monkeys in captivity; "ring-tailed monkey" from the Bronx Zoological Park in New York.

NOTES. No basis appears in all this material for the recognition of more than one species. It is here held that all these specimens are covered by *Pediculus lobatus* Fahrenholz.

Pediculus chapini Ewing

1926. *Pediculus (Parapediculus) chapini* Ewing, Proceedings of the United States National Museum 68:19:13; figs. 2, 4b, 5; Plate 1, figs. 3-4.
1935. *Pediculus mjöbergi* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 3:588.
1938. *Pediculus chapini* Ewing, Ewing, The Journal of Parasitology 24:28; figures 4a, 5c, 6c.

HOSTS AND DISTRIBUTION. The types were recorded as from *Ateles ater* from the National Zoological Park at Washington. Specimens considered by Ewing to be stragglers were later recorded by him (1938) from *Ateles geoffroyi* from the same place and from *Cebus capuchinus* from Panama.

NOTES. Unfortunately the only specimens at hand from the type host of this supposed species are immature. In the absence of authentic specimens it is not possible to assert that this species is identical with any other, although in the opinion here held it is the same as *atelophilus*.

Pediculus lobatus Fahrenholz

1916. *Pediculus lobatus* Fahrenholz, Archiv für Naturgeschichte, Abteilung

- A, 81:11:16; Plate, figures 6, 7. (August)
1926. *Pediculus (Parapediculus) lobatus* Fahrenholz, Ewing, Proceedings of the United States National Museum 68:19:8; Plate 2, figure 5.
1935. *Pediculus mjobergi* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:538.
1938. *Pediculus lobatus* Fahrenholz, Ewing, The Journal of Parasitology 24:29; Plate 2, figure 5.

HOSTS AND DISTRIBUTION. Recorded by Fahrenholz from *Ateles rellerosus* from the Berlin Zoological Gardens. Ewing (1938) identified with this specimens from *Ateles paniscus* from the National Zoological Park at Washington and recorded specimens which he considered to be stragglers from *Leontocebus nigricollis* at the same institution.

NOTES. The original description of this species is composed chiefly of useless detail which aids not at all in recognizing the species and the accompanying photographic illustrations do nothing more than indicate from the form that the species is probably of the type of those known from New World monkeys. Actually, comparing the illustration of the male given by Fahrenholz with that given by Mjöberg for his *Pediculus affinis* (=mjobergi) there is no more basis for the identification of a species on the basis of one of these illustrations than of assuming it to represent some other species.

Pediculus mjobergi Ferris

1910. *Pediculus affinis* Mjöberg, Arkiv för Zoologi 6:169, 258; text figures 85, 151; Plate 5, figure 8. (Preoccupied)
1916. *Pediculus mjobergi* Ferris, Proceedings of the California Academy of Sciences (Series 4) 6:136. (May)
1935. *Pediculus mjobergi* Ferris, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:538.

HOSTS AND DISTRIBUTION. The types were recorded from *Ateles* sp. in a traveling menagerie. This constitutes the only positive record of the species.

NOTES. The name *mjobergi* was proposed by Ferris to replace *affinis* of Mjöberg which was preoccupied by an earlier *Pediculus affinis*. A question might arise as to the priority of *mjobergi* and *lobatus*, both of which were established in 1916. In 1913, Fahrenholz used the name *lobatus* without any accompanying description and the name was not nomenclatorially established until August, 1916. Unfortunately, the name *mjobergi* was established by publication in May, 1916, to replace the preoccupied name *affinis* of Mjöberg and therefore has priority in case any question arises in the future concerning these names.

If it be concluded that the lice of the New World monkeys represent but a single species it apparently should be called by the name *mjobergi*.

Ewing (1936) has put forward the thesis that Mjöberg's description indicates his specimens to have been *Pediculus humanus*. Actually, Mjöberg's inconsequential description and the very poor accompanying illustrations offer little or nothing to demonstrate anything, one way or another. The photograph of a male contains nothing more than a faint suggestion, which can be magnified by a slight application of the imagination, into the characteristic louse of the New World monkeys. Ewing has maintained that Mjöberg's illustration of the egg indicates *humanus*, but in fact the drawing is erroneous even for that.

The writer will concede that until and unless Mjöberg's types are rediscovered the status of this name will have to be held in abeyance, although on the basis of a theory of probabilities it is used in this work to cover the entire list of names employed for the lice of Cebidae except as is later indicated.

Pediculus pseudohumanus Ewing
Figure 120

1938. *Pediculus (Parapediculus) pseudohumanus* Ewing, The Journal of Parasitology 24:23; figures 3, 5a, 6a.

HOSTS AND DISTRIBUTION. Type from a monkey, *Pithecia monachus*. Also recorded by Ewing from another monkey, *Cacajao rubicundus*, from the National Zoological Park at Washington. Also recorded by Ewing from an Indian at Coban, Guatemala.

NOTES. We have here a most extraordinary situation. The form which Ewing described exists, without question, but its distribution is extremely peculiar. Ferris (1935) mentioned the presence in his material of specimens from Central American Indians and from natives in the Marquesas Islands in the south Pacific which show a slight lateral lobing of certain of the paratergal plates. This is the form that Ewing ascribes to his *pseudohumanus* and the illustration here given, based upon a specimen from the Marquesas Islands, almost duplicates that given by him. It may be noted that the specimens from the south Pacific all have a noticeably larger number of setae on the dorsum of the abdomen than do those from the New World.

The material at hand which appears to be covered by the name *pseudohumanus* is as follows: from natives at the village of Kakahitau, Uapou, Marquesas Islands; from natives at Hitiaa, Tahiti; from Indian hut at Santa Emilia, Guatemala; from "dried head from Ecuador." Specimens from head of Maya Indian, Xichel, Yucatan (from a lot one time identified by Ewing as *americanus*), and others from "natives," at Guayabilete, Panama, have the lobing of the paratergites of segments 5-6 even more strongly developed and approximating that to be seen in typical specimens of *atelophilus*.

Unfortunately, no specimens of this form are at hand from monkeys, but since Ewing himself has recorded this supposed species from man, there should be no objections to the records given above.

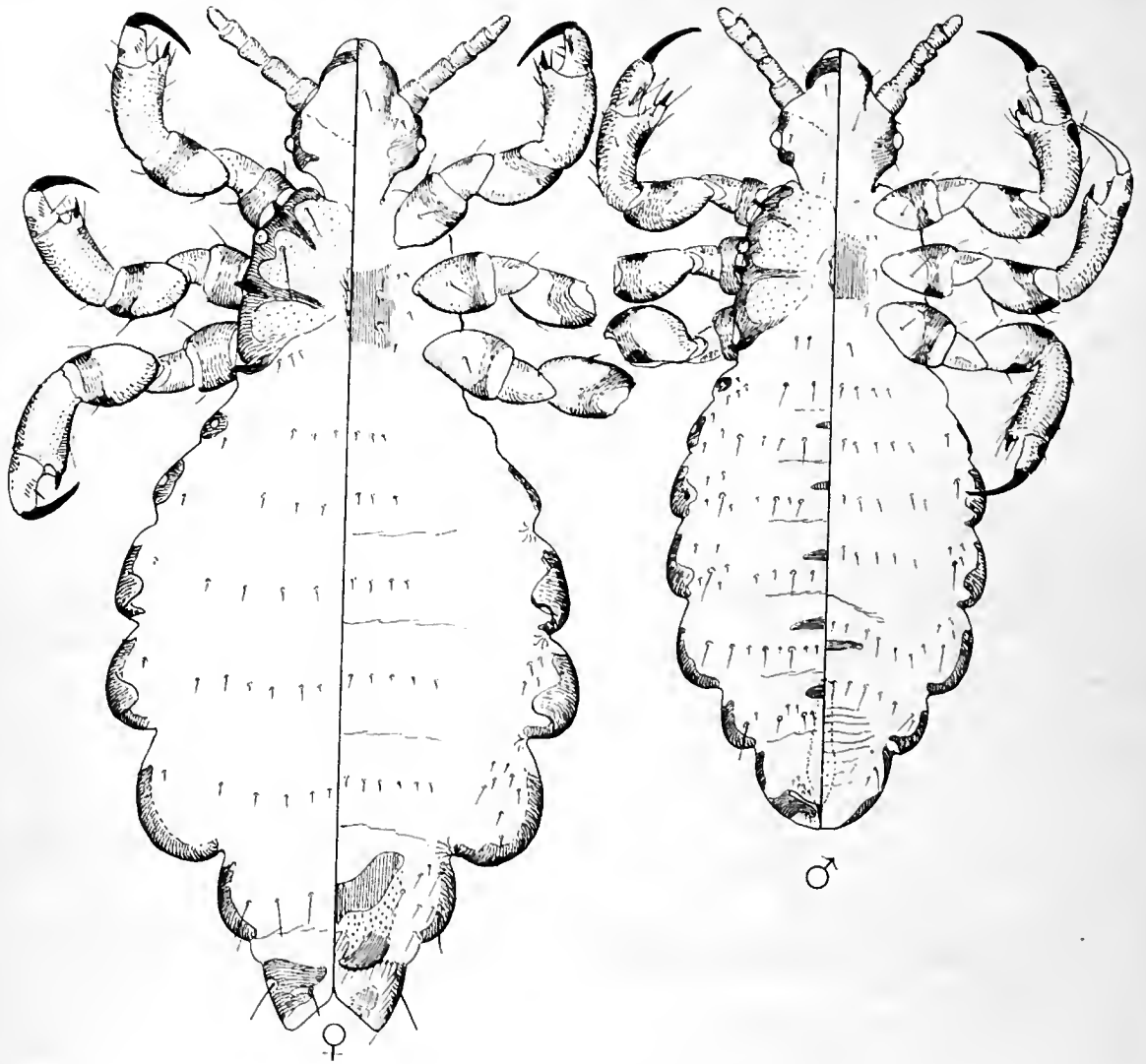
The name *pseudohumanus* is here recognized to cover a form which may possibly be worthy of recognition.

The Problem of the Lice of the Cebidae

This problem has been reviewed by Ferris (1935) and by Ewing (1926, 1938), these authors coming to quite different conclusions. The general story is briefly this:

In 1877, Murray ("Economic Entomology, Aptera," page 3) described a *Pediculus quadrumanus* which was said to have been taken from a captive monkey of the genus *Ateles*. The species is entirely unrecognizable from the description and inquiry has led to the conclusion that if there ever were any types these are not now in existence. Whatever the possibilities may be there is certainly no justification for dispossessing any later name in favor of *quadrumanus*.

In 1880, Piaget ("Les Pediculines," page 626; Plate 51, figure 4) described a *Pediculus consobrinus* taken from *Ateles pentadactylus*, Museum of Leyden, whether from a living or preserved animal not being indicated. No indication was given as to the number of specimens examined, except for the statement that no male was observed. Ferris (1935) reported upon the single specimen from the Piaget Collection, which still exists at the British Museum, and illustrated this specimen. It is in his opinion definitely not separable from *Pediculus humanus*. There is no reason to suppose that this specimen is not one of those which Piaget had before him but Ewing, entirely on the basis of a comparison of the figures given by Piaget and by Ferris, has offered the entirely gratuitous assumption that Piaget had two species in his material. Only some exercise of the imagination and a firm will to believe in the results of that imagination could lead to such a



Pediculus mjobergi Ferris, from *Ateles dariensis*

Figure 120

conclusion. The opinion is here maintained that we must accept the evidence from this one remaining specimen and place *Pediculus consobrinus* as a synonym of *Pediculus humanus*. This is supported by the fact that other specimens of what seems undoubtedly to be *humanus*, ascribed to monkeys of this group, have been seen by the writer.

In 1910, Mjöberg described as *Pediculus affinis* a louse which was said to have been taken from some species of *Ateles* in a traveling menagerie. The name *affinis* being preoccupied it was later changed to *mjobergi* by Ferris in 1916. Unfortunately, the description given by Mjöberg is useless and the illustration of the male given by him falls short of being actually decisive. Not until the types have been re-examined—if they exist—can the question of what this species actually is be definitely settled. Ferris (1935) was willing to accept the species, but Ewing (1938) considered the species to be *humanus*, partly on the basis of an illustration of the egg given by Mjöberg.

The next name available is *Pediculus lobatus* Fahrenholz (1916). The

name *mjöbergi* has precedence of about three months over *lobatus* which, although first proposed in 1913, remained a nomen nudum until 1916. The present writer has examined the types of *lobatus* and illustrated them (1935). This species is here held to be distinct from *humanus* on good morphological grounds. The illustration given by Ferris was based upon the uncleaned type specimen and represents that particular specimen as well as possible.

In 1926, Freund recorded specimens from *Ateles ater* from the Leipzig Zoological Garden and employed for them the name *Pediculus capitis* forma *atellis*. This is unrecognizable from the description.

In 1926, Ewing presented an extensive paper on the New World lice of the genus *Pediculus* (Proceedings of the United States National Museum 68, Article 19) in which he presumed to recognize *Pediculus consobrinus* Piaget and *Pediculus lobatus* Fahrenholz and named two new species, *Pediculus atelophilus* and *Pediculus chapini* from New World monkeys.

In 1935, Ferris (Contributions Toward a Monograph of the Sucking Lice, Part 8) reviewed the whole question of the species of *Pediculus* and came to the conclusion that there is but one valid species on the family Cebidae—exclusive of occasional occurrences of what seems definitely to be *Pediculus humanus*. For this species he employed the name *Pediculus mjöbergi* Ferris.

In 1938, Ewing (The Journal of Parasitology 24:13-33; figures 1-6) presented another paper on the lice of the New World monkeys, maintained the validity of the two species previously described by him and named another, *Pediculus pseudohumanus*.

A considerable amount of material has been available in connection with the present work and on the basis of this material the writer still maintains the opinion that—apart from *Pediculus humanus*, which apparently can transfer to and survive upon members of the Cebidae, and *Pediculus pseudohumanus*—there is but one actual species which seems to be normal to the New World monkeys of the family Cebidae. That species seems to be distinct from *Pediculus humanus*.

Pediculus schäffi Fahrenholz
Figure 121

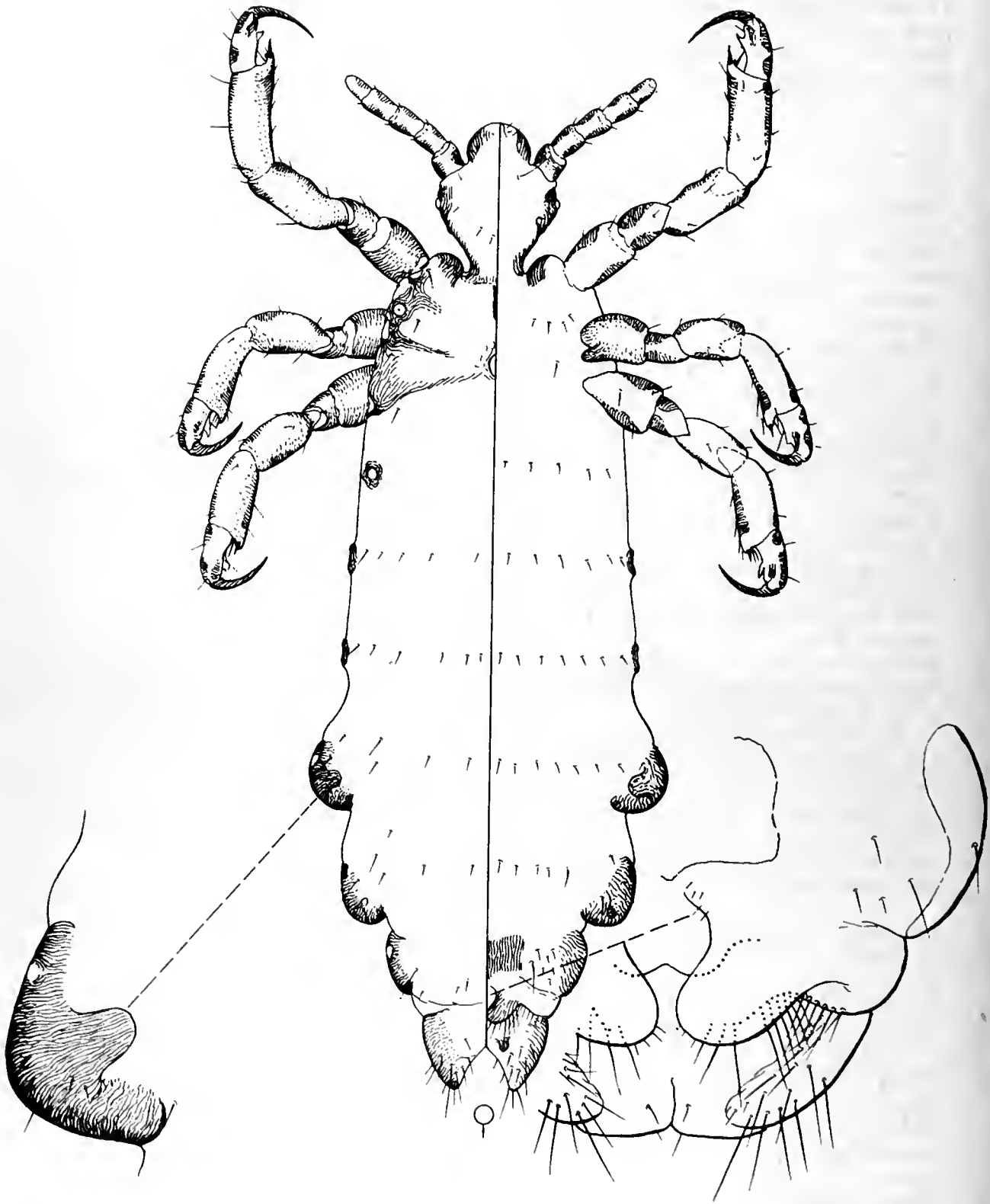
1910. *Pediculus schäffi* Fahrenholz, Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover 1:57; Plate 1, figures 1-3; Plate 3, figures 1, 2, 4, 5; Plate 4, figures 2, 6.
1915. *Pediculus schäffi* Fahrenholz, Fahrenholz, Archiv für Naturgeschichte, Abteilung A, 81:11:1.
1919. *Pediculus humanus* race *schäffi* Fahrenholz, Nuttall, Parasitology 11: 336.
1932. *Pediculus (Paenipediculus) simiae* Ewing, Proceedings of the Biological Society of Washington 45:117.
1933. *Pediculus (Paenipediculus) simiae* Ewing, Ewing, Proceedings of the Biological Society of Washington 46:168; figure 2c.
1935. *Pediculus schäffi* Fahrenholz, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:599; figures 322H, 333, 334.

HOSTS AND DISTRIBUTION. Recorded by Fahrenholz from chimpanzee, *Pan (=Simia) troglodytes* from the Zoological Gardens in Hamburg, and by Ewing from the same host from the London Zoological Gardens.

NOTES. The accompanying illustrations, which are those given by Ferris in 1935, were made from specimens which are apparently a part of the same lot on which Ewing based his name *simiae*.

The type of *schäffi* was not seen by Ferris, but the description is sufficient to indicate clearly that only one species is involved.

Ewing has based the subgenus *Paenipediculus* upon this species. This is not here accepted.



Pediculus schäffi Fahrenholz

Figure 121

Suggestions for Future Research

In the species of *Pediculus* occurring on man and on the New World monkeys of the family Cebidae there appear a number of problems which should be approached from a biological point of view and submitted to examination by the methods of experimental biology. It is evident that no solution can be achieved merely by the contemplation of preserved specimens.

First of all there is the problem of the lice of man himself. While this has been submitted to a certain amount of experimental investigation those experiments are not entirely free from criticism and they are not sufficiently extensive to permit definite biological conclusions. Thus the experiments of Bacot seemed to show that it is possible to convert the head lice of man into forms having the appearance of body lice, but the converse of this experiment was not described. The experiments of Bacot showed a complete hybridization of what he considered to be head lice with what he considered to be body lice. But in the offspring of these hybridizations there appeared a large number of abnormalities that have been considered by Keilin and Nuttall (*Parasitology* 11:279-328; text figures 1-26; Plates 12-17. 1919). Some occurrence of abnormalities seems to appear in "wild" populations, but that shown in this material is relatively large. Certain of the abnormalities are perhaps genetic. The suspicion occurs that these abnormalities may have in part resulted from the hybridization of genetically disharmonious individuals. Also, as the work was done in Egypt there is a suggestion that perhaps the supposed head louse employed represented a strain that is possibly farther removed from typical *humanus* than are typical head and body lice from each other. Attention has been called to the existence on African Negroes of a form which is so different from the typical head lice of Europeans that if specimens of both extremes were placed side by side the conclusion would almost inevitably be reached that we are dealing with different species. It is conceivable that Bacot had this extreme form actually in his possession and that the experiments on hybridization were in part based upon it. If so, these abnormalities might be explained on this basis.

Nuttall records experiments (*Parasitology* 11:345. 1919) which led him to the conclusion that the two supposed subspecies, *capitis* and *corporis*, represent merely two unstable races of a single species. He indicates that the head louse can be converted into the body louse by environmental conditions. But it remains to be shown that the changes of color and size recorded by him also extend to the apparent differences in structure which are revealed by typical specimens of either race.

So it appears that this experimental work should be done again, with proper precautions as to the status of all the material employed and proper attention to all changes that might be ascribed to changes in environment and proper consideration of all genetic factors that might be involved.

But this problem of the lice occurring normally on man is by no means all of the problem. There remains that of the lice of the Cebidae.

The Cebidae are supposed to be rather far removed from the remainder of the Primates. Simpson (*The Principles of Classification and a Classification of the Mammals*, "Bulletin of the American Museum of Natural History," Volume 85, 1945) divides the Primates into three superfamilies—Ceboidea, Cercopithecoidea, and Hominoidea. There occurs on the Cercopithecoidea a group of lice, the genus *Pedicinus*, which is far removed from the lice of the Hominoidea. Why is it that the lice of the Ceboidea seem to be so closely related to those of the Hominoidea that they belong in the same genus? The Ceboidea are considered to be connected with the remainder of the Primates only at the base of the stem of the Order. Is it to be suggested that the members of the Ceboidea have retained the genus *Pediculus* from the time when the various stocks diverged, or is it to be supposed

that they have received them from man in the time that man has been in the New World? How close are they genetically to the lice of man?

And yet it is supposed that the lice of the Cebidae are sufficiently plastic in an evolutionary sense, to have formed at least four species, although at the best the characters assigned to those species are extremely unconvincing. What are the genetic relationships of these supposed species to each other? It certainly appears on morphological grounds that the New World monkeys have upon them a species that can be easily distinguished from the lice of man, but even this is somewhat clouded.

And, to add the last bit to this tantalizing problem, what is the situation in regard to the supposed *Pediculus subhumanus*? Here is a form that is supposed to occur both on New World monkeys and upon man. More than that, it occurs not only upon man in the region where these monkeys occur naturally but what is apparently the same form occurs on man in the far distant South Sea Islands? What are the genetic relationships of the lice of this form in the New World to those on man in the New World and to those of the South Pacific?

These are problems for which the solution is to be obtained—if at all—by experimental methods. Speculation on the basis of the present known specimens might easily lead the systematist to the endorsement of some idea that this form developed on man and monkeys after man appeared in the New World and then passed to the South Pacific following the migration of man from the New World to that area, supporting the views of the author of *Kon-Tiki*. It is futile to speculate upon such matters when all that is known of the lice is actually but a relatively few specimens.

The author holds that this is a problem which is eminently suited to an approach by experimental methods. Should some one gather together at one place representatives of typical head lice and body lice of Europeans, typical lice from African Negroes, lice of the type of *Pediculus pseudohumanus* from both man and monkeys from Central America and from the South Seas, and typical lice from a wide assortment of New World monkeys, subjecting them to careful genetic experiments, we might at last put an end to the otherwise endless argument concerning their relationships to each other. More than that, we might possibly have an answer that would apply to other cases involving parasitic insects and thus to a general biological problem.

Until that has been done the problems associated with the genus *Pediculus* will remain for mere opinion and for speculation.

Genus PTHIRUS Leach

1815. *Pthirus* Leach, Edinburgh Encyclopaedia 9:77.

1817. *Pthirus*, Leach, Zoological Miscellany 3:365.

1935. *Phthirus*, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:602.

GENERIC TYPE. *Pediculus pubis* Linnaeus.

CHARACTERS. Pediculidae with distinctly five-segmented antennae which are not sexually dimorphic. Anterior legs very slender, with slender claw; middle and posterior legs very large and stout, with stout claw; the coxae of all the legs set at the extreme margins of the thorax and thus the members of corresponding pairs set far apart. Thorax very wide, forming the greater part of the body, without a sternal plate and without a notal pit, the sclerotization of the apparent notum confined to the lateral areas. Abdomen relatively small, as broad basally as the posterior part of the thorax and tapering somewhat posteriorly, membranous except for the projecting lateral, segmentally arranged tubercles. These lateral tubercles sclerotized and prominent, there being one at the margin on each side of segments 6-8. Spiracles of these segments borne slightly removed from the base of tubercles, those of segments 3-4 being crowded close to those of

segment four, somewhat displaced toward the median line and being the only clear evidence of these segments. The spiracles are of a peculiar form, the atrium being much enlarged, conical, with the base of the cone at the inner end, the walls marked by parallel, longitudinal ridges. Female with well-developed gonopods on segment eight and with a very large spermatheca. Male with small, pointed parameres which articulate near their apices with a pair of small sclerotized points; no endomeral plate present and no sclerotized penis, the gonopore being surrounded merely by a partially sclerotized ring.

NOTES. This genus was employed by Ewing (1929) as the type of the family Phthiridae, it being the only genus of this family. Other workers have recognized it as the type of a subfamily, Phthirinae, of the Pediculidae. It is a peculiar form, indeed, yet its relationship seems to be with *Pediculus* and to place it in a separate family is to obscure this relationship. Its peculiar position is here recognized to the extent of accepting the subfamily Phthirinae of the Pediculidae.

Pthirus pubis (Linnaeus)
Figures 122, 123, 124

1758. *Pediculus pubis* Linnaeus, Systema Naturae, Edition X, page 611.
1815. *Pthirus inguinalis* Leach, Edinburgh Encyclopaedia 9:77.
1816. *Pediculus fesus* von Olfers, De vegetativis et animatis corporibus in corporibus animatis reperiendis commentarius, page 83. (Definitely a synonym of *Pthirus pubis* (Linnaeus))
1904. *Pthirus pubis* (Linnaeus), Enderlein, Zoologischer Anzeiger 28:136; figures 10, 11.
1918. *Phthirus pubis* (Linnaeus), Nuttall, Parasitology 10:383; figures 1, 3-5, 7-9.
1935. *Phthirus pubis* (Linnaeus), Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:603; figures 335, 336, 337.
1935. *Phthirus chavesi* Escomel and Velando, Cronicas de Medicina (Lima, Peru) 52:335.
1936. *Phthirus pubis* (Linnaeus), Bedford, Onderstepoort Journal of Veterinary Science and Animal Medicine 7:105.
1939. *Phthirus pubis* (Linnaeus), Buxton, The Louse, page 93; figure 25.

HOSTS AND DISTRIBUTION. Occurring on man in many parts of the world. Bedford (1935) has recorded it from a chimpanzee from the French Congo. There have been occasional records of its occurrence on dogs, but no information exists that these are anything more than incidental.

NOTES. The original description of *Phthirus chavesi* Escomel and Velando has not been seen in connection with this work, but the species was recorded as occurring in the eyebrows of man and since this is well known for *pubis* there is no reason to suppose that any other species was involved.

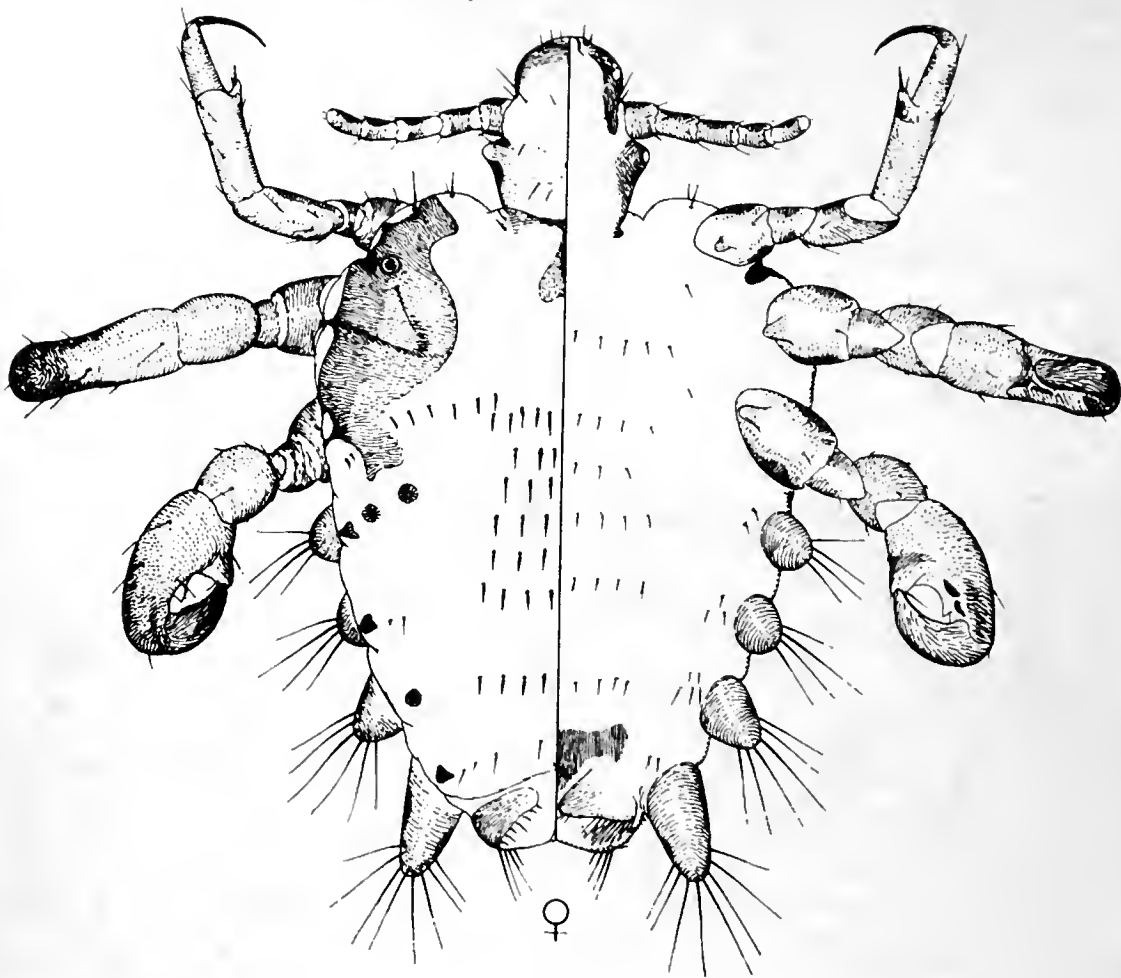
The account by Buxton (1939) sums up what is known concerning the biology of the species.

Pthirus gorillae Ewing

1927. *Phthirus gorillae* Ewing, Proceedings of the Entomological Society of Washington 29:120.
1933. *Phthirus gorillae* Ewing, Ewing, Proceedings of the Biological Society of Washington 46:170; figures 1c, 2b.
1935. *Phthirus gorillae* Ewing, Ferris, Contributions Toward a Monograph of the Sucking Lice, Part 8:608.

HOSTS AND DISTRIBUTION. Described from eggs and first-stage nymphs taken from skins of *Gorilla berengeri* in the Belgian Congo.

NOTES. In the absence of any information other than that given by its



Pthirus pubis (Linnaeus)

Figure 122

describer, nothing can be said concerning this species other than that it presumably demonstrates the occurrence of a species of *Pthirus* on a gorilla.

Unplaced Names

The following species names have been proposed, but the original descriptions are unavailable or are so inadequate that the genera to which they belong cannot be determined. Perhaps future workers may be able to clarify them either through the rediscovery of their types or through circumstantial evidence.

Pediculus aquaticus Pontoppidan

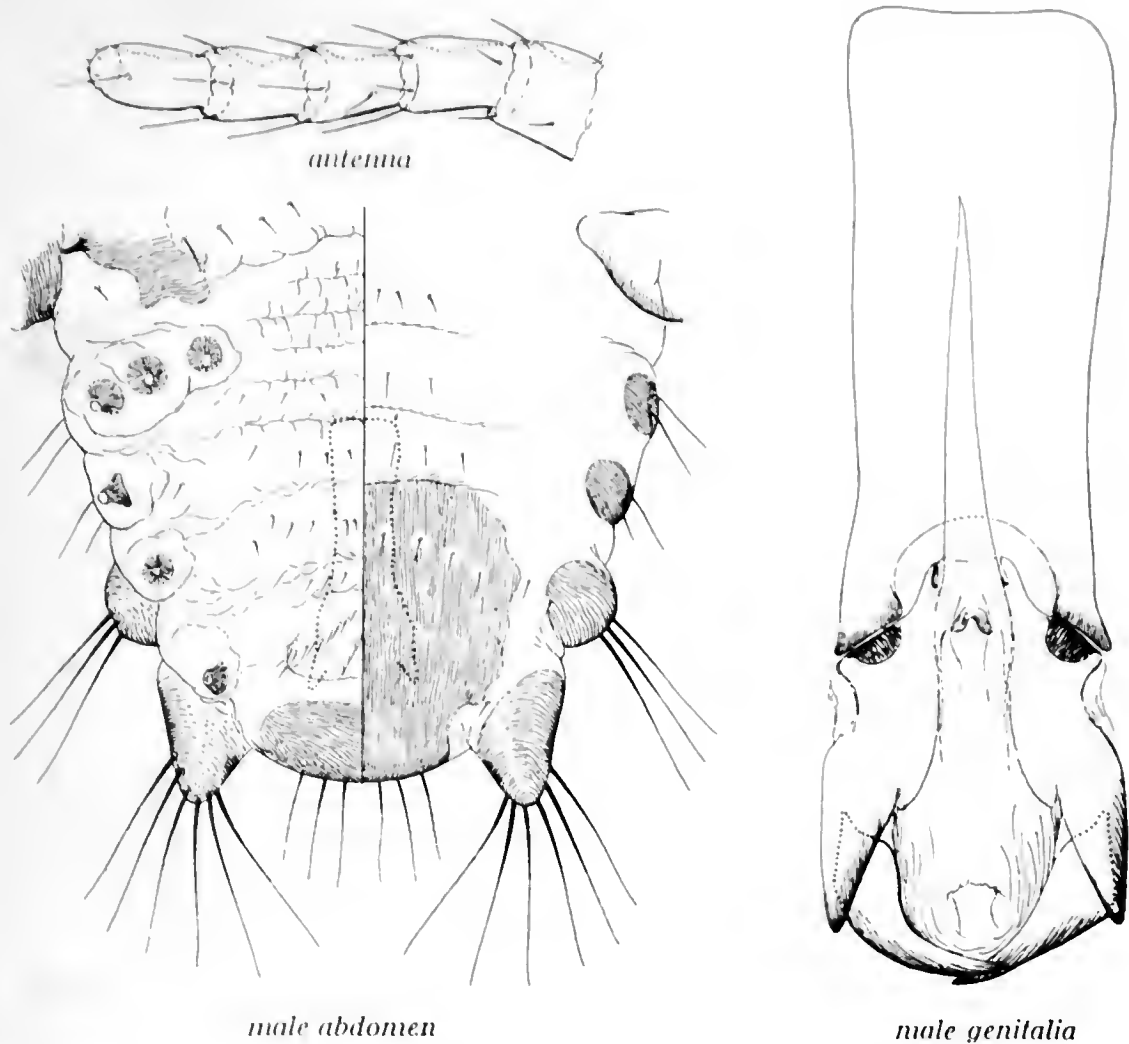
1763. *Pediculus aquaticus* Pontoppidan, Danske Atlas 1:699.

The original description of this species has not been available and I know nothing of it except a bibliographic reference by Fahrenholz.

Pediculus clavicornis Nitzsch

1864. *Pediculus clavicornis* Nitzsch, Zeitschrift für die gesamten Naturwissenschaften 23:32.

1874. *Haematopinus clavicornis* (Nitzsch), Giebel, Insecta Epizoa, page 37. Perhaps a species of *Hoplopleura*, if we may judge by Giebel's redescription, which was based upon a single female from *Meriones* sp., from Africa.



Pthirus pubis (Linnaeus), details

Figure 123

Pediculus spiculifer Gervais

1844. *Pediculus spiculifer* Gervais, In Walckenaer's *Histoire naturelle des insectes apteres* 3:302.

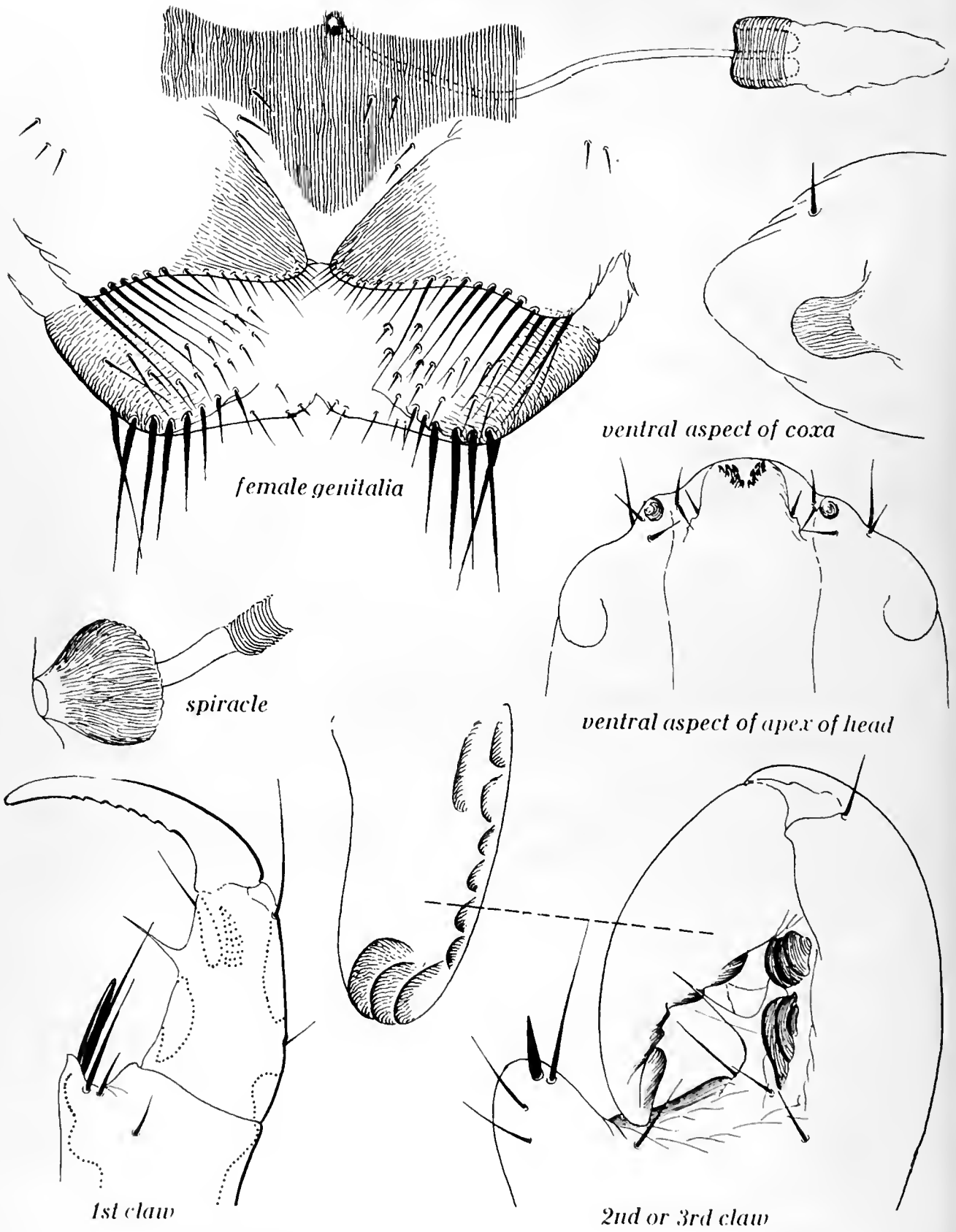
This is apparently a species either of *Polyplax* or *Hoplopleura*. It was recorded as from "*Mus barbarus*" from Algiers. This host is now called *Lemniscomy barbarus*.

Polyplax miacantha Speiser

1905. *Polyplax miacantha* Speiser, *Centralblatt für Bakteriologie, Originale* 33:318. (The figure does not belong with this.)

1935. *Polyplax miacantha* Speiser, Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Part 4:237.

Recorded as from a small rat with very thick, spine-like hair, from Salomona in Abyssinia, in the collections of the Museum at Königsberg in Prussia. The original description is entirely inadequate for placing the species even generically, although it is probably either a *Polyplax* or a *Hoplopleura*.



Pthirus pubis (Linnaeus), details

Figure 124

ERRATA

The following references have been omitted from the preceding text:

Haematopinus asini (Linnaeus)

1865. *Haematopinus equi* Simmonds, Journal of the Royal Agricultural Society of England (2)1:60.
1880. *Haematopinus asini*, variety *colorata* Piaget, Les Pediculines, page 654.

Schizophthirus pleurophaeus (Burmeister)

1874. *Haematopinus leucophaeus* Giebel, Insecta Epizoa, page 37.

Haemodipsus lyricephalus (Burmeister)

1864. *Pediculus lyriceps* Nitzsch, Zeitschrift für den gesamten Naturwissenschaften 23:24.

CHAPTER VII

Host List

The preparation of a dependable list of the mammal species from which Anoplura are known is not entirely a simple matter. In the first place, some of the hosts have been recorded merely by their vernacular names and these are not always sufficient to fix the record to a particular animal species. Then there have been a certain number of definite errors by the entomological recorders and there have been errors in the transcription of names from mammal specimens and also in regard to the identifications of mammals from which Anoplura have been taken in zoological gardens where the mammals may have been misidentified. But the greatest source of difficulty arises from the fact that in many instances mammalogists themselves are not or have not been in agreement either as to the nomenclature or even the zoological status of the mammals.

Furthermore, there is no one master list of the mammals of the world which we may utilize as a source of reference. The catalogue of the mammals of the world, which was published many years ago by Trouessart, has long been obsolete and nothing has been published that takes its place. We are therefore compelled to rely upon a series of lists, some regional, some applying only to the mammals of a limited group, and where these lists overlap they are not always in agreement either as to nomenclature or as to zoological status of some particular species. Under such circumstances an additional source of error is added, since the compiler of a host list, in pursuing names through these various lists of mammals, may himself go wrong and commit errors of his own. All this should be understood by future students of the parasites.

In preparing the following list the following sources have especially been utilized.

First of all appreciation needs to be expressed of the work of Mr. G. H. E. Hopkins, who has published a host list of the Mallophaga and Anoplura of mammals. This was very carefully done and has aided greatly in checking the records of the names which had already independently been arranged in such a list for this work. Hopkins' paper is replete with notes, many of which are beyond the scope of the list here presented. The reference to his work is as follows.

HOPKINS, G. H. E. The host association of the lice of mammals. "Proceedings of the Zoological Society of London," Volume 119, Part 2, pages 387-604, 1949.

Fortunately, a large percentage of the known species of the Anoplura occur on rodents and for this group we have available the great work of Ellerman which relatively simplifies the preparation of this portion of the host list.

ELLERMAN, J. R. "The Families and Genera of Living Rodents." Three volumes. Published by the British Museum (Natural History). Volume 1, issued June, 1940; Volume 2, issued March, 1941; Volume 3, issued March, 1949.

For the so-called "Ungulates," the only work that the writer has been able to find that is at all comprehensive is that of Lydekker, in which, although it is scarcely recent, one can at least find the names that have been employed for most of the mammals of this series, very few having been described since its publication.

LYDEKKER, R. "Catalogue of the Ungulate Mammals in the British Museum (Natural History)." Five volumes. Published by the British Museum (Natural History). Volume 1, issued 1913; Volumes 2 and 3, issued 1914; Volumes

4 and 5, issued 1915.

For the Primates the large work of Elliot appears to be the only available general reference although the entire group seems still to be in a confused condition nomenclatorially. Thus, Simpson (1945, page 181) remarks that "most Primates have alternative names and hardly any two students use the same nomenclature for them." Simpson's work (cited below) has been employed for the names of genera and larger groups and Elliot's for the names of species.

ELLIOT, D. G. A review of the Primates. "Monographs of the American Museum of Natural History," Volumes 1-3, 1913.

Of regional lists the most useful are the following. The first named of these is especially important because of the large number of mammal species involved.

ALLEN, G. M. A checklist of African mammals. "Bulletin of the Museum of Comparative Zoology at Harvard College," Volume 83, 1939.

MILLER, G. S. "Catalogue of the Mammals of Western Europe (Europe exclusive of Russia) in the Collections of the British Museum." Published by the British Museum. 1912.

MILLER, G. S. List of North American land mammals in the United States National Museum. "Bulletin of the United States National Museum" 79, 1912.

For the higher categories of the mammals the recent work by Simpson is here relied upon.

SIMPSON, G. G. The principles of classification and a classification of the mammals. "Bulletin of the American Museum of Natural History" 85, (350 pages) 1945.

For a few forms such as the Pinnipedia it has seemed necessary to accept all names as given by the recorders of the lice.

Since the hosts of all the comparatively few sucking lice known from South America are, with few exceptions, rodents, they are cared for in the work of Ellerman, as are also the rodents of Asia. The Carnivora, except for the Canidae and the Pinnipedia, have no sucking lice and the few names here needed cause no special difficulty. The Insectivora are cared for chiefly in the list of African mammals given by Allen and in various other regional lists.

Names of hosts are usually given in the review of species of lice in the text as given by the original recorders of the lice, but the correct names—as far as they can be determined—will be found in the host list.

One other source of possible error in this list should be noted. This begins with the collecting of the mammals. The writer has himself participated in such field collecting and is familiar with the problem involved. The collector of mammals is likely to obtain a considerable number of specimens and to pile them up on his work table before preparing the skins. As the animal becomes cold the parasites tend to come out to the ends of the hairs and from that position may cross over to other animals that may be in contact, thus leading to their ascription to the wrong host. Then the dried skins may be packed together in shipment, leading to the possibility that the dead lice may be shaken from one host to another and this may be followed by other possibilities of accident.

Many of the records of lice, especially from the rodents, have been based upon specimens secured by examination of museum skins. It is therefore probable that at least some of these records are erroneous. Not until repeated collections, or the finding of the parasites on freshly collected animals, have been made can this possibility be eliminated. On the other hand, merely to dismiss any peculiar record immediately as the result of such straggling or contamination is probably also a mistake and is likely to produce a too great assurance that normal transfers never occur.

A small proportion of the records of lice from the larger mammals are based upon specimens taken in zoological gardens. Some of these are espe-

cially questionable, but they must be accepted until more positive information is available.

Considerable thought has been given to the question as to whether or not the host list should include subspecific mammalian names. The decision has been to ignore subspecific names and to present all mammal names under the species names to which the subspecies are to be referred. The reasons for this action are as follows. In the first place, the writer knows of no instance where the subspecies make any difference in the distribution of the lice, except perhaps in the Hyracoidea. The whole subject of the lice of the Hyracoidea must be subjected to later review on the basis of much more extensive material of the lice than is available to anyone at present. In the second place, a listing of the mammalian subspecies would greatly extend the host list, to no special purpose. Mammalogists have been much enamored of the subspecies concept and have employed it to such a degree that in the rodents, for example, most "full species" have at least five supposed subspecies, if not more. *Peromyscus maniculatus* is credited with forty-five subspecies. Since the Anoplura from *Peromyscus* seem not even to discriminate among species, it becomes, from the point of view here held, merely pretentious nonsense solemnly to list the parasites according to the subspecies of the host.

In the following list the arrangement of the higher categories of the mammals is in accord with that presented by Simpson, but the families, subfamilies, tribes, and genera are arranged alphabetically under the next higher category.

From the writer's point of view nothing is to be gained in such a list by attaching the names of the authors of mammalian names. They are therefore omitted.

- | | |
|------------------------------------|--|
| Class MAMMALIA | Polyplax asiatica Ferris |
| Subclass THERIA | Crocidura horsfieldi |
| Infraclass EUTHERIA | Ancistroplax crocidurae Waterston |
| Order INSECTIVORA | Crocidura leucodon |
| Superfamily MACROSCELIDIDAE | Polyplax reclinata (Nitzsch) |
| Family Macroscelididae | Pachyura luzonensis |
| Elephantulus pulcher and rufescens | Polyplax reclinata (Nitzsch) |
| Neolinognathus praelautus Ferris | Scutisorex conigicus |
| Elephantulus rupestris | Polyplax reclinata (Nitzsch) |
| Neolinognathus elephantuli Bedford | Suncus coeruleus |
| Nasilio brachyrhynchus | Polyplax reclinata (Nitzsch) |
| Neolinognathus elephantuli Bedford | |
| Petrodromus tetradactylus | Family Talpidae |
| Neolinognathus elephantuli Bedford | Subfamily Scalopininae |
| | Parascalops breweri |
| Superfamily SORICOIDEA | Haematopinoides squamosus (Osborn) |
| Family Soricidae | Scalopus aquaticus |
| Subfamily Soricinae | Haematopinoides squamosus (Osborn) |
| Sorex araneus | |
| Polyplax reclinata (Nitzsch) | Order DERMOPTERA |
| | Family Cynocephalidae |
| Subfamily Crocidurinae | Cynocephalus sp. (=variegatus, according to Hopkins) |
| Crocidura aranea (see Sorex) | Hamophthirus galeopithecii Mjöberg |
| Crocidura coerulea | Galeopithecus sp.=Cynocephalus |

Order PRIMATES
Suborder PROSIMII
Infraorder LEMURIFORMES
Superfamily LEMUROIDEA
Family Indridae

Propithecus diadema
Phthirpediculus propithecii Ewing
Propithecus edwardsi=diadema

Superfamily TUPAIOIDEA
Family Tupaiidae
Subfamily Tupaiinae

Anathana ellioti
Docophthirus acinetus Waterston

Infraorder LORISIFORMES
Family Lorisidae
Subfamily Galaginae

Cheirogaleus sp.
Lemurphthirus verruculosus Ward
Galago demidovii
Lemurphthirus galagus Bedford
Galago moholi
Lemurphthirus galagus Bedford
Galagus=misspelling of Galago
Mouse lemur (=Cheirogaleus)

Suborder ANTHROPOIDEA
Superfamily CEBOIDEA
Family Cebidae
Subfamily Pitheciinae

Cacajó rubicundus
Pediculus subhumanus Ewing
Pithecis monacha
Pediculus pseudohumanus Ewing

Subfamily Alaouttinae

Alouatta palliata
Pediculus mjöbergi Ferris

Subfamily Cebinae

Cebus capuchinus
Pediculus atelophilus Ewing
Pediculus chapini Ewing

Subfamily Atelinae

Ateles ater
Pediculus chapini Ewing
Ateles geoffroyi
Pediculus atelophilus Ewing
Pediculus chapini Ewing

Ateles dariensis
Pediculus atelophilus Ewing
Ateles hybridus
Pediculus atelophilus Ewing
Ateles pan
Pediculus atelophilus Ewing
Ateles paniscus
Pediculus lobatus Fahrenholz
Ateles vellerosus (recorded as *rel-
lerosus*). This name apparently
has been applied to *Ateles
beelzebul* and *Ateles pan*.
Pediculus lobatus Fahrenholz
Lagothrix sp.
Pediculus pseudohumanus Ewing

Subfamily Callithricidae

Leontocebus nigricollis
Pediculus lobatus Fahrenholz

Superfamily CERCOPITHECOIDEA

In speaking of this group Simpson (1945, page 185 and following) refers to the "confusion bequeathed to us by swarms of students, of all degrees of competence and shades of judgment," and further remarks "the macaques have been placed in at least twenty-five different genera or subgenera, yet it is the present consensus that all belong to one genus with perhaps three subgenera, requiring a total of three names, only one of generic (and hence also subgeneric) rank." It is hopeless for an entomologist to try to untangle all of this. Consequently, records are cited as they were given, with such accompanying notes as are possible. There is always the possibility that in trying to do even this many new errors have been added. Also probably many of the host names are misidentifications.

Cercopithecus aethiops (synonyms
griseoviridis and pygerythraeus)
Pediculus obtusus
Cercopithecus albogularis=mitis
Cercopithecus cynomolgus=Macaca
cynomolgus
Cercopithecus diana
Pediculus obtusus
Cercopithecus griseoviridis=aethiops
Cercopithecus kolbi=mitis
Cercopithecus martini=nictitans

- Cercopithecus mona*
Pedcinus obtusus (Rudow)
Pedcinus eurygaster (Burmeister)
Cercopithecus mitis
Pedcinus patas (Fahrenheit)
Cercopithecus patas=*Erythrocebus patas*
Cercopithecus pruinus, apparently
 =*Pygathrix cristata*
Cercopithecus pygerythraeus-*aethiops*
Comopithecus hamadryas
Pedcinus hamadryas Mjöberg
Cynocephalus=*Papio*
Cynomolgus=*Macaca*
Erythrocebus patas
Pedcinus patas (Fahrenheit)
Erythrocebus whitei
Pedcinus patas (Fahrenheit)
 Guenon. Perhaps an *Erythrocebus*
Hamadryas, as a generic name this ap-
 pears to =*Comopithecus*
Inuus nemestrinus=*Macaca nemestrina*
Inuus sinicus=*Macaca sinica*
Lasiopyga=*Cercopithecus*, under which
 genus all names are listed.
Macaca. Frequently spelled *Macacus*.
 Includes *Silenus* and *Rhesus*.
Macaca adusta
Pedcinus eurygaster (Burmeister)
Pedcinus obtusus (Rudow)
Macaca albibarbata
Pedcinus eurygaster (Burmeister)
Macaca andamensis
Pedcinus obtusus (Rudow)
Macaca arctoides=*speciosa*
Macaca cynomolga. Probably =*Macaca*
fascicularis, although according
 to Elliot the name was long mis-
 applied to *Macaca ira*.
Macaca erythraea=*rhesa*
Macaca fascicularis, possibly, for
 records under the name *Macacus*
cynomolgus.
Pedcinus eurygaster (Burmeister)
Macaca inuus, most probably *Macaca*
sylvana.
Macaca ira, possibly for records
 under *Macacus cynomolgus*.
Pedcinus eurygaster (Burmeister)
Macaca mindanensi=*philippinensis*
Macaca mindora
Pedcinus eurygaster (Burmeister)
Pedcinus obtusus (Rudow)
Macaca nemestrina, recorded as *Inuus*
nemestrinus
Pedcinus obtusus (Rudow)
Macaca philippinensis
Pedcinus obtusus (Rudow)
- Macaca rhesa*
Pedcinus eurygaster (Burmeister)
Pedcinus obtusus (Rudow)
Macaca silena. Apparently =*Macaca*
albibarbata.
Macaca sinica
Pedcinus obtusus (Rudow)
Macaca speciosa
Pedcinus obtusus (Rudow)
Macaca sylvana
Pedcinus albidus (Rudow)
Papio. Includes *Cynocephalus*.
Papio sp.
Pedcinus obtusus (Rudow)
Papio griseipes
Pedcinus hamadryas Mjöberg
Pithecus=*Macaca*; all names attributed
 to it will be found under the lat-
 ter, except as listed.
Pithecus patas. Is probably *Erythro-*
cebus patas.
Simia sylvanus=*Macaca sylvana*
- Subfamily Colobinae
- Colobus caudatus*=*Colobus polykomos*
Colobus polykomos
Pedcinus pictus Ferris
Pedcinus obtusus (Rudow)
Nasalis larvalis, error for *larvatus*.
Nasalis larvatus
Pedcinus obtusus (Rudow)
Presbytis. Includes all records un-
 der *Semnopithecus*
Presbytis cristata
Pedcinus ancoratus Ferris
Presbytis entellus
Pedcinus obtusus (Rudow)
Presbytis germaini
Pedcinus ancoratus Ferris
Presbytis pullata. Regarded by
 Elliot as a subspecies of *cristata*
Presbytis rubicunda
Pedcinus ancoratus Ferris
Presbytis sanctorum
Pedcinus obtusus (Rudow)
Presbytis schistaceus
Pedcinus ancoratus Ferris
Pygathrix aurata
Pedcinus obtusus (Rudow)
Pygathrix priamus
Pedcinus ancoratus Ferris
Rhinopithecus concolor. Presumably
 is *Simias concolor*.
Simias concolor
Pedcinus eurygaster (Burmeister)
Semnopithecus entellus. Here placed
 as =*Presbytis entellus*.

Semnopithecus maurus. Apparently
-*Presbytis aurata*.
Semnopithecus pruinosus. Here placed
as -*Presbytis cristatus*.

Superfamily HOMINOIDEA
Family Pongidae
Subfamily Hylobatinae

Hylobates syndactylus
Pediculus humanus Linnaeus
Symphalanges syndactylus=*Hylobates*
syndactylus

Subfamily Ponginae

Gorilla berengeri
Phthirus gorillae Ewing
Pan sp.
Pediculus schäffi Fahrenholz
Phthirus pubis (Linnaeus)

Family Hominidae

Homo sapiens
Pediculus humanus Linnaeus
Pediculus subhumanus Ewing
Phthirus pubis (Linnaeus)

Cohort GLIRES
Order LAGOMORPHA
Family Leporidae

Lepus arcticus
Haemodipsus lyriocephalus (Bur-
meister)
Haemodipsus setoni Ewing
Lepus californicus
Haemodipsus setoni Ewing
Lepus europaeus
Haemodipsus lyriocephalus (Bur-
meister)
Lepus glacialis=*arcticus*
Lepus saxatilis
Haemodipsus africanus Bedford
Lepus townsendi
Haemodipsus setoni Ewing
Lepus zuluensis=*saxatilis*
Oryctolagus cuniculus
Haemodipsus ventricosus (Denny)
Rabbit, domestic
Haemodipsus ventricosus (Denny)
Sylvilagus sp.
Haemodipsus setoni Ewing

Family Ochotonidae

Ochotona cansus=*thibetana*

Ochotona damurica
Hoplopleura ochotonae Ferris
Ochotona roylei
Hoplopleura ochotonae Ferris
Ochotona thibetana
Hoplopleura ochotonae Ferris

Order RODENTIA

The arrangement here followed is strictly according to Ellerman, except that his ending *oidae* for the superfamily is altered to *oidea* in accord with more generally accepted practice and families are arranged alphabetically under superfamilies, subfamilies alphabetically under families, and genera alphabetically under subfamilies.

Superfamily BATHYERGOIDEA
Family Bathyergidae

Bathyergus maritimus
Eulinognathus lawrensis (Bedford)
Georhynchus hottentotus=*Cryptomys*
hottentotus
Cryptomys hottentotus
Eulinognathus hilli (Bedford)

Superfamily HYSTRICOIDEA
Family Chinchillidae

Lagidium inca-peruanum
Lagidium peruanum
Lagidiophthirus parvus (Kellogg and Ferris)

Family Echimyidae
Subfamily Abrocominae

Abrocoma cinerea
Neohaematopinus longus Werneck

Subfamily Echimyinae

Cercomys cunicularius
Ctenophthirus cercomydis Ferris
Cercomys sosteri=*cunicularius*
Proechimys cayennensis
Pterophthirus audax (Ferris)
Proechimys oris=*cayennensis*
Proechimys semispinosus=*cayennensis*

Subfamily Octodontinae

Ctenomys brasiliensis
Eulinognathus americanus Ewing

Ctenomys sericeus
Eulinognathus americanus Ewing
Octodontomys gliroides
Hoplopleura disgrega Ferris
Octodontomys simonsi-gliroides

Subfamily Petromyinae

Petromus typicus
Scipio tripedata Ferris
Petromys=Petromus

Subfamily Thyronomyinae

Aulacodus=Thyromys
Thyromys aulacodus=swinderianus
Thyromys gregor=gregorianus
Thyromys gregorianus
Scipio longiceps Ewing
Proenderleinellus calva (Waterston)
Thyromys swinderianus
Scipio aulacodi (Neumann)
Scipio breviceps Ferris

Superfamily CAVIODEA
Family Caviidae

Cavia apearea
Pterophthirus imitans Werneck
Caviella australis
Pterophthirus alatus (Ferris)
Galea leucoblephara=musteloides
Galea musteloides
Galeophthirus caviae (Werneck)
Kerodon australis apparently=
Caviella australis

Superfamily SCIUROIDEA
Family Sciuridae

Ellerman recognizes no subfamilies in this family, but employs the terms "group" and "section." These are here arranged alphabetically.

Pteromys group

Glaucomys sabrinus
Hoplopleura trispinosa Kellogg and Ferris
Microphthirus uncinatus (Ferris)
Neohaematopinus sciuropteri (Osborn)
Glaucomys volans
Hoplopleura trispinosa Kellogg and Ferris
Neohaematopinus sciuropteri (Osborn)

Petaurista batuana=petaurista
Petaurista inornata
Neohaematopinus petauristae Ferris
Petaurista petaurista
Neohaematopinus batuanae Ferris
Pteromys volans
Enderleinellus replicatus
Redikorzey
Sciuropterus=Pteromys in part and
Glaucomys in part.

Sciurus group

Lariscus section

Lariscus diversus=insignis
Lariscus insignis
Enderleinellus larisci Ferris
Neohaematopinus sciurinus (Mjöberg)
Lariscus obscurus=insignis
Menetes berdmorei
Enderleinellus menetensis Ferris
Neohaematopinus sciurinus (Mjöberg)

Marmota section

Ammospermophilus sp.
Neohaematopinus patiki Rubin
Callospermophilus=Citellus
Citellus adocetus
Neohaematopinus traubi Rubin
Citellus barrowensis=parryi
Citellus beecheyi
Enderleinellus osborni (Kellogg and Ferris)
Neohaematopinus laeviusculus (Grube)
Citellus beldingi
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus (Grube)
Citellus buckleyi=variegata
Citellus buxtoni=eversmanni
Citellus castanurus=lateralis
Citellus chrysodeirus=lateralis
Citellus columbianus
Neohaematopinus laeviusculi (Grube)
Citellus dauricus
Enderleinellus suturalis (Osborn)
Citellus douglasii=beecheyi
Citellus elegans=richardsoni
Citellus eversmanni
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus (Grube)

- Citellus franklinii*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Citellus harrisi*
Neohaematopinus citellinus Ferris
- Citellus grammurus=variegatus*
- Citellus lateralis*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Citellus leptodactylus*, belongs to
Spermophilopsis
- Citellus madrensis*
Enderleinellus occidentalis Kellogg
 and Ferris
- Citellus mexicanus*
Enderleinellus suturalis (Osborn)
- Citellus mollis=townsendi*
- Citellus mongolicus=dauricus*
Enderleinellus suturalis (Osborn)
- Citellus nelsoni*
Enderleinellus suturalis (Osborn)
- Citellus oregonus=beldingi*
- Citellus osgoodi*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Citellus parryi*
Neohaematopinus laeviusculus
 (Grube)
- Citellus plesius=parryi*
- Citellus richardsoni*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Citellus rufescens*
Neohaematopinus laeviusculus
 (Grube)
- Citellus spilosoma*
Enderleinellus suturalis (Osborn)
Neohaematopinus citellinus Ferris
Neohaematopinus laeviusculus
 (Grube)
Neohaematopinus marmotae Ferris
- Citellus tereticaudus*
Enderleinellus osborni Kellogg
 and Ferris
Neohaematopinus citellinus Ferris
- Citellus townsendi*
Enderleinellus suturalis (Osborn)
- Citellus tridecemlineatus*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Citellus variegatus*
Enderleinellus osborni Kellogg and
 Ferris
- Neohaematopinus mathesoni* Rubin
- Cynomys gunnisoni*
Enderleinellus suturalis (Osborn)
- Cynomys leucurus*
Enderleinellus suturalis (Osborn)
Neohaematopinus laeviusculus
 (Grube)
- Cynomys lucovicianus*
Neohaematopinus marmotae Ferris
- Marmota aurea*
 ?*Neohaematopinus marmotae* Ferris
- Marmota flaviventer=flaviventris*
Marmota flaviventris
Neohaematopinus marmotae Ferris
- Marmota monax*
Enderleinellus marmotae Ferris
- Paraxerus section
- Indicated by Ellerman merely as
 section D, without name, but for our
 purposes it may be listed as the
Paraxerus section.
- Heliosciurus daucinus=gambianus*
Heliosciurus gambianus
Enderleinellus heliosciuri Ferris
Neohaematopinus keniae Ferris
- Heliosciurus keniae=gambianus*
Heliosciurus multicolor=gambianus
Heliosciurus palliatus=Paraxerus
palliatus
- Heliosciurus rufobrachiatus=gambianus*
Heliosciurus ruwenzorii
Enderleinellus heliosciuri (Ferris)
Neohaematopinus keniae Ferris
- Heliosciurus undulatus=gambianus*
Parasciurus=an error for Paraxerus
Parasciurus animosus=Paraxerus
ochraceus
- Paraxerus jacksoni=capitis*
Paraxerus ochraceus
Werneckia minuta (Werneck)
Neohaematopinus heliosciuri
 Cummings
- Neohaematopinus suahelicus* Ferris
- Paraxerus palliatus*
Neohaematopinus heliosciuri
 Cummings
- Neohaematopinus suahelicus* Ferris
Werneckia paraxeri (Werneck)
- Protoxerus stangeri*
Enderleinellus heliosciuri Ferris
- Sciurus section
- Callosciurus benticanus=caniceps*
Callosciurus borneoensis=prevosti

Callosciurus caniceps
Enderleinellus malaysianus Ferris
Hoplopleura erismata Ferris
Neohaematopinus sciurinus (Mjöberg)
Callosciurus davisoni=*caniceps*
Callosciurus domelanus, misspelling
for *domelicus*=*caniceps*
Callosciurus ferrugineus
Hoplopleura erismata Ferris
Neohaematopinus sciurinus (Mjöberg)
Callosciurus finlaysoni
Neohaematopinus sciurinus (Mjöberg)
Callosciurus juvenus
Neohaematopinus sciurinus (Mjöberg)
Callosciurus lancavensis=*caniceps*
Callosciurus lucas=*caniceps*
Callosciurus maclellandi
Hoplopleura erismata Ferris
Callosciurus prevosti
Enderleinellus malaysianus Ferris
Neohaematopinus sciurinus (Mjöberg)
Callosciurus procerus
Neohaematopinus sciurinus (Mjöberg)
Callosciurus vestitus
Hoplopleura distorta Ferris
Funambulus species (recorded as
palmarum)
Hoplopleura maniculata (Neumann)
Neohaematopinus echinatus (Neumann)
Funambulus palmarum
Enderleinellus platyspicatus Ferris
Neohaematopinus ceylonicus Ferris
Funambulus tristriatus (presumably=
palmarum)
Hoplopleura maniculata (Neumann)
Microsciurus mimilus
Enderleinellus microsciuri Werneck
Sciurus aberti
Enderleinellus longiceps Kellogg and
Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus aestuans
Neohaematopinus sciurinus (Mjöberg)
Sciurus alleni
Enderleinellus longiceps Kellogg and
Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus anomalus
Enderleinellus nitzschi (Burmeister)
Neohaematopinus syriacus Ferris
Sciurus apache
Neohaematopinus sciurinus (Mjöberg)
Sciurus arizonensis
Hoplopleura sciuricola Ferris
Sciurus aureogaster
Enderleinellus extremus Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus bentinckanus=*Callosciurus*
Sciurus borneoensis=*Callosciurus*
Sciurus carolinensis
Enderleinellus longiceps Kellogg and
Ferris
Hoplopleura sciuricola Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus colliae
Enderleinellus mexicanus Werneck
Neohaematopinus sciurinus (Mjöberg)
Sciurus deppei
Enderleinellus extremus Ferris
Sciurus domelensis=*Callosciurus*
Sciurus douglasi=*Tamiasciurus*
Sciurus fremonti=*Tamiasciurus*
Sciurus ferrugineus=*Callosciurus*
Sciurus gerrardi
Enderleinellus venezuelae Werneck
Hoplopleura sciuricola Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus goldmani=*variegatoides*
Sciurus griseoflavus
Enderleinellus extremus Ferris
Sciurus griseogena
Enderleinellus venezuelae Werneck
Hoplopleura sciuricola Ferris
Sciurus griseus
Enderleinellus kelloggi Ferris
Hoplopleura sciuricola Ferris
Neohaematopinus griseicolus Ferris
Sciurus ignitus
Hoplopleura sciuricola Ferris
Sciurus kaibabensis
Enderleinellus longiceps Ferris
Sciurus lancavensis=*Callosciurus*
Sciurus lucas=*Callosciurus*
Sciurus melania=*variegatoides*
Sciurus meridensis=*griseogena*
Sciurus nayaritensis
Enderleinellus longiceps Ferris
Sciurus negligens
Enderleinellus extremus Ferris
Sciurus nelsoni
Enderleinellus mexicanus Werneck
Sciurus nesaeus
Enderleinellus insularis Werneck
Hoplopleura sciuricola Ferris
Sciurus niger
Enderleinellus longiceps Kellogg
and Ferris
Neohaematopinus sciurinus (Mjöberg)
Sciurus oculatus
Enderleinellus longiceps Kellogg
and Ferris
Sciurus poliopus
Enderleinellus extremus Ferris
Sciurus syriacus=*anomalus*
Sciurus truei
Enderleinellus mexicanus Werneck

Sciurus variabilis-gerrardi

Sciurus vulgaris

Enderleinellus nitzschi
(Burmeister)

Neohaematopinus sciuri Jancke

Sciurus vulpinus-niger

Urosciurus-Sciurus

Tamias section

Eutamias is retained by Ellerman solely for certain Asiatic species, while the North American forms commonly referred to it are placed by him under the genus *Tamias*.

Sciurotamias davidianus

Enderleinellus sciurotamiasis
Ferris

Hoplopleura emarginata Ferris

Tamias alleni

Hoplopleura arboricola Kellogg and
Ferris

Neohaematopinus pacificus Kellogg
and Ferris

Tamias alpinus

Neohaematopinus pacificus Kellogg
and Ferris

Tamias amoenus

Hoplopleura erratica (Osborn)

Tamias hindsi-townsendi

Tamias merriami

Hoplopleura arboricola Kellogg and
Ferris

Tamias quadrivittatus

Hoplopleura arboricola Kellogg and
Ferris

Neohaematopinus pacificus Kellogg
and Ferris

Tamias speciosus=quadrivittatus

Tamias striatus

Enderleinellus tamiasis Fahrenholz
Hoplopleura erratica (Osborn)

Tamias townsendi

Hoplopleura arboricola Kellogg and
Ferris

Neohaematopinus pacificus Kellogg
and Ferris

Tamiasciurus douglasi

Enderleinellus nitzschi Fahrenholz
Hoplopleura sciuricola Ferris

Neohaematopinus sciurinus (Mjöberg)

Tamiasciurus fremonti

Enderleinellus nitzschi Fahrenholz

Tamiasciurus hudsonicus

Enderleinellus nitzschi Fahrenholz
Hoplopleura sciuricola Ferris

Neohaematopinus sciurinus (Mjöberg)

Xerus section

Atlantoxerus getulus

Neohaematopinus pectinifer
(Neumann)

Euxerus microdon-Xerus erythropus

Geosciurus-Xerus

Spermophilopsis leptodactylus

Neohaematopinus citelli (Cummings)

Xerus capensis-inauris

Xerus erythropus

Enderleinellus euxeri Ferris

Xerus inauris

Neohaematopinus faurei (Bedford)

Superfamily GEOMYOIDEA

Family Heteromyidae

Dipodomys californicus-heermanni

Dipodomys deserti

Fahrenholzia pinnata Kellogg and
Ferris

Dipodomys heermanni

Fahrenholzia pinnata Kellogg and
Ferris

Dipodomys merriami

Fahrenholzia pinnata Kellogg and
Ferris

Dipodomys ordi

Fahrenholzia pinnata Kellogg and
Ferris

Dipodomys ornatus

Fahrenholzia pinnata Kellogg and
Ferris

Dipodomys phillipsi

Fahrenholzia pinnata Kellogg and
Ferris

Heteromys goldmanni

Fahrenholzia microcephala Ferris

Heteromys pictus-Liomys

Liomys irroratus

Fahrenholzia microcephala Ferris

Liomys pictus

Fahrenholzia microcephala Ferris

Liomys texensis-irroratus

Microcipodops polionotus

Fahrenholzia pinnata Kellogg and
Ferris

Perodipus-Dipodomys

Perognathus californicus

Fahrenholzia tribulosa Ferris

Perognathus formosus

Fahrenholzia reducta Ferris

Perognathus hispidus

Fahrenholzia zacatecae Ferris

Perognathus parvus
 Fahrenholzia pinnata Kellogg and
 Ferris
 Perognathus sp.
 Fahrenholzia pinnata Ferris

Superfamily PEDETOIDEA
 Family Pedetidae

Pedetes cafer
 Eulinognathus denticulatus Cummings
 Pedetes larvalis=surdaster
 Pedetes surdaster
 Eulinognathus denticulatus Cummings

Superfamily DIPODOIDEA
 Family Dipodoidea
 Subfamily Dipodinae

Allactaga mongolica=sibirica
 Allactaga sibirica
 Eulinognathus aculeatus (Neumann)
 Dipodipus=Dipus
 Dipus sp. Probably a species of
 Jaculus
 Eulinognathus aculeatus (Neumann)
 Dipus sagitta
 Eulinognathus biuncatus Ferris

Superfamily MUROIIDEA
 Family Lophiomyidae

Lophiomyys ibeanus=imhausi
 Lophiomyys imhausi
 Eulinognathus lophiomydis Ferris
 Lophiomyys thomasi=imhausi

Family Muridae
 Subfamily Cricetinae

Ellerman remarks concerning this subfamily that the South American members are "an appalling chaos." Fortunately, from a nomenclatorial point of view, very few Anoplura are known from the South American species.

Akodon arenicola
 Hoplopleura affinis (Burmeister)
 Akodon arviculoides
 Hoplopleura affinis (Burmeister)
 Akodon aerosus
 Hoplopleura affinis (Burmeister)
 Akodon arosus=misspelling of aerosus
 Akodon cursor=arviculoides
 Akodon mollis
 Hoplopleura affinis (Burmeister)

Akodon pulcherrimus
 Hoplopleura affinis (Burmeister)
 Cricetulus andersoni=longicaudatus
 Cricetulus incanus=triton
 Cricetulus longicaudatus
 Polyplax dentaticornis Ewing
 Cricetulus migratorius
 Neohaematopinus citelli (Cummings)
 (Probably an error)
 Eligmodontia collisae, misspelling of
 specific name=Hesperomys callosus
 Euneomys pictus=Phyllotis pictus
 Graomys griseoflavus
 Hoplopleura affinis (Burmeister)
 Hesperomys. In part=Peromyscus
 Hesperomys callosus
 Hoplopleura hesperomydis (Osborn)
 Hesperomys venustus
 Hoplopleura nesoryzomydis Ferris
 Hodomys alleni
 Neohaematopinus neotomae Ferris
 Holochilus balnearum
 Hoplopleura nesoryzomydis Ferris
 Holochilus sciureus
 Hoplopleura nesoryzomydis Ferris
 Holochilus squamipes=Nectomys
 squamipes
 Holochilus vulpinus
 Hoplopleura nesoryzomydis Ferris
 Nectomys palmipes=Nectomys squamipes
 Nectomys squamipes
 Hoplopleura quadridentata (Neumann)
 Neotoma albigula
 Neohaematopinus neotomae Ferris
 Neotoma cinerea
 Neohaematopinus inornatus Kellogg
 and Ferris
 Neotoma fuscipes
 Neohaematopinus neotomae Ferris
 Neotoma micropus
 Neohaematopinus neotomae Ferris
 Neotoma streatorifuscipes
 Neotomodon allstoni
 Polyplax auricularis Kellogg and
 Ferris
 Nesoryzomys=Oryzomys
 Nesoryzomys defessus=Oryzomys
 indefessus
 Onychomys leucogaster
 Hoplopleura hesperomydis (Osborn)
 Polyplax auricularis Kellogg and
 Ferris
 Onychomys torridus
 Hoplopleura hesperomydis (Osborn)
 Polyplax auricularis Kellogg and
 Ferris
 Oryzomys angouya
 Hoplopleura nesoryzomydis Ferris

Oryzomys chaparensis
 Hoplopleura hesperomydis (Osborn)
Oryzomys eliurus
 Hoplopleura affinis (Burmeister)
Oryzomys flavescens
 Hoplopleura travassosi Werneck
Oryzomys fulvescens
 Hoplopleura hesperomydis (Osborn)
Oryzomys indefessus
 Hoplopleura nesoryzomydis Ferris
Oryzomys narboroughi
 Hoplopleura nesoryzomydis Ferris
Oryzomys ratticeps
 Hoplopleura quadridentata (Neumann)
Oryzomys rostratus
 Hoplopleura quadridentata (Neumann)
Oryzomys xantheolus
 Hoplopleura nesoryzomydis Ferris
Peromyscus boylei
 Hoplopleura hesperomydis (Osborn)
Peromyscus californicus
 Polyplax auricularis Kellogg and Ferris
Peromyscus leucopus
 Hoplopleura hesperomydis (Osborn)
Peromyscus maniculatus
 Hoplopleura hesperomydis (Osborn)
 Polyplax auricularis Kellogg and Ferris
Peromyscus sitkensis
 Polyplax auricularis Kellogg and Ferris
Phyllotis arenarius
 Hoplopleura affinis (Burmeister)
Phyllotis boliviensis
 Hoplopleura affinis (Burmeister)
Phyllotis domorum=*Graomys griseo-*
 flavus
Phyllotis micropus
 Hoplopleura affinis (Burmeister)
 Hoplopleura reducta Ferris
Phyllotis pictus
 Hoplopleura affinis (Burmeister)
Phyllotis ricardulus
 Hoplopleura affinis (Burmeister)
Reithrodon cuniculoides
 Hoplopleura affinis (Burmeister)
Reithrodon hatcheri=*cuniculoides*
Reithrodontomys mexicanus
 Polyplax auricularis Kellogg and Ferris
Rhipidomys leucodactylus
 Hoplopleura angulata Ferris
Rhipidomys venezuelae
 Hoplopleura angulata Ferris
Rhipidomys venustus
 Hoplopleura angulata Ferris
 Hoplopleura hirsuta Ferris

Sigmodon hispidus
 Hoplopleura hirsuta Ferris
Sigmodon ochrognathus
 Hoplopleura hirsuta Ferris
Sigmodon peruanus
 Hoplopleura hirsuta Ferris
Thomasomys cinereus
 Hoplopleura angulata Ferris
Xenomys nelsoni
 Hoplopleura hirsuta Ferris

Subfamily Dendromyinae

Dendromus mesomelas
 Hoplopleura intermedia Kellogg and Ferris

Subfamily Gerbillinae

Gerbillus indica=*Tatera indica*
Gerbillus pyramidum
 Polyplax gerbilli Ferris
Meriones auceps=*meridianus*
Meriones meridianus
 Polyplax chinensis Ferris
 Hoplopleura merionidis Ferris
Meriones psammophilus=*meridianus*
Pachyuromys duprasi
 Polyplax wernerii (Glinkiewicz)
Tatera angolae
 Hoplopleura biseriata Ferris
Tatera boehmi
 Hoplopleura veprecula Ferris
Tatera brantsi
 Hoplopleura biseriata Ferris
 Polyplax biseriata Ferris
Tatera indica
 Polyplax stephensi (Christophers and Newstead)
Tatera joanae
 Hoplopleura biseriata Ferris
Tatera liodon
 Polyplax taterae Bedford
Tatera lobengulae
 Hoplopleura biseriata Ferris
 Polyplax biseriata Ferris
Tatera nigricauda
 Polyplax neumanni Fahrenholz
Tatera vicina
 Polyplax taterae Ferris
Taterillus emini
 Polyplax taterae Ferris

Subfamily Hydromyinae

Chrotomys whiteheadi
 Hoplopleura chrotomydis Ferris
Hydromys chrysogaster
 Hoplopleura bidentata (Neumann)

Subfamily Microtinae

- Arvicola-Microtus in large part
 Arvicola amphibius
 Polyplax spiniger (Burmeister)
 Clethrionomys gapperi
 Hoplopleura acanthopus (Burmeister)
 Clethrionomys nivarius
 Hoplopleura acanthopus (Burmeister)
 Clethrionomys rufocanus
 Polyplax alaskensis Ewing
 Clethrionomys rutilus
 Hoplopleura edentulus Fahrenholz
 Dicrostonyx torquatus
 Hoplopleura acanthopus (Burmeister)
 Lagurus intermedius
 Polyplax abscisa Fahrenholz
 Lemmus alascensis
 Hoplopleura acanthopus (Burmeister)
 Lemmus obensis
 Hoplopleura hispida (Grube)
 Microtus agrestis
 Hoplopleura acanthopus (Burmeister)
 Microtus arvalis
 Hoplopleura acanthopus (Burmeister)
 Microtus californicus
 Polyplax abscisa Fahrenholz
 Microtus constrictus=californicus
 Microtus mordax
 Polyplax abscisa Fahrenholz
 Microtus nivalis
 Hoplopleura acanthopus (Burmeister)
 Microtus pennsylvanicus
 Polyplax abscisa Fahrenholz
 Microtus sp.
 Polyplax alaskensis Ewing
 Phaiomys blythei=leucurus
 Phaiomys leucurus
 Hoplopleura phaiomydis Ferris
 Phenacomys longicaudus
 Polyplax spinulosa (Burmeister)
 Pitymys pinetorum
 Hoplopleura acanthopus (Burmeister)
 Pitymys savii
 Hoplopleura acanthopus (Burmeister)
 Pitymys subterraneus
 Hoplopleura aequidentis Fahrenholz

Subfamily Murinae

- Acomys cahirinus[†]
 Symoca brachyrrhyncha (Cummings)
 Polyplax oxyrrhynchus Cummings
 Acomys hystrella
 Polyplax oxyrrhyncha Cummings
 Symoca brachyrrhyncha (Cummings)
 Acomys percivali
 Polyplax oxyrrhyncha Cummings

- Symoca brachyrrhynchus (Cummings)
 Acomys sp. (Probably)
 Polyplax miacantha Speiser
 Aethomys chrysophilus
 Polyplax cummingsi Ferris
 Apodemus agrarius
 Polyplax affinis (Burmeister)
 Apodemus insignis
 Hoplopleura apomydis Ferris
 Apodemus speciosus
 Polyplax serrate (Burmeister)
 Apodemus sylvaticus
 Polyplax spinulosa (Burmeister)
 (questionable)
 Polyplax serrate (Burmeister)
 Hoplopleura affinis (Burmeister)
 Apodemus bardus=insignis
 Arvicanthis abyssinicus
 Polyplax abyssinica Ferris
 Arvicanthis niloticus
 Polyplax abyssinica Ferris
 Arvicanthis pumilio=Rhabdomys pumilio
 Arvicanthis univittatus=Hybomys uni-
 vittatus
 Bandicota bengalensis
 Polyplax spinulosa (Burmeister)
 Bandicota malabarica
 Polyplax asiatica Ferris
 Cricetomys cosensi
 Proenderleinellus calvus
 (Waterston)
 Cricetomys emini
 Proenderleinellus calvus
 (Waterston)
 Cricetomys gambianus
 Proenderleinellus calvus
 (Waterston)
 Dasymys incomtus
 Hoplopleura oenomydis Ferris
 Hoplopleura somereni Waterston
 Polyplax cummingsi Ferris
 Dasymys helukus=incomtus
 Epimys=rattus
 Eropeplus canus
 Polyplax eropepli Ewing
 Grammomys ibeanus
 Polyplax phthisica Ferris
 Grammomys surdaster
 Hoplopleura oenomydis Ferris
 Gunomys=bandicota
 Hybomys univittatus
 Hoplopleura laticeps Ferris
 Lemniscomys barbarus
 Hoplopleura enormis Kellogg and
 Ferris
 Lemniscomys griselda
 Hoplopleura enormis Kellogg and
 Ferris

- Lemniscomys pulchellus*=*striatus*
Lemniscomys striatus
Hoplopleura pelomydis Ferris
Limnomys meurnsi
Hoplopleura oenomydis Ferris
Lophuromys sikapusi
Polyplax phthisica Ferris
Lophuromys=*squillus*
Polyplax phthisica Ferris
Lophuromys zena=*aquilus*
Mastomys=*Rattus*
Micromys minutus
Hoplopleura longula Fahrenholz
Polyplax gracilis Fahrenholz
Mus coucha=*Rattus coucha*
Mus chrysophilus=*Aethomys chrysophilus*
Mus decumanus=*Rattus decumanus*
Mus gansus, error for *gansuensis*=*musculus*
Mus minutus=*Micromys minutus*
Mus musculus
Hoplopleura acanthopus (Burmeister)
Hoplopleura hesperomydis (Osborn)
Polyplax serrate (Burmeister)
Mus spicilegus=*musculus*
Mus triton
Hoplopleura rukenyae Ferris
Mus wagneri=*musculus*
Mylomys cunninghami
Hoplopleura mylomydis Ferris
Mylomys roosevelti=*cunninghami*
Nesokia indica
Polyplax asiatica Ferris
Nesokia hardwickei=*indica*
Oenomys hypoxanthus
Hoplopleura oenomydis Ferris
Pelomys fallax
Hoplopleura pelomydis Ferris
Praomys=*Rattus*
Praomys namaquensis=*Thallomys*
Rattus calcis
Hoplopleura oenomydis Ferris
Polyplax spinulosa (Burmeister)
Rattus coucha
Hoplopleura intermedia Kellogg and Ferris
Polyplax praecisa (Neumann)
Eulinognathus denticulatus Cummings
Rattus culmorum
Polyplax spinulosa (Burmeister)
Rattus exulans
Hoplopleura oenomydis Ferris
Rattus hawaiiensis
Hoplopleura oenomydis Ferris
Rattus migricaudus=*Thallomys*
Rattus norvegicus
Polyplax spinulosa (Burmeister)
- Hoplopleura oenomydis* Ferris
Eulinognathus denticulatus (Cummings)
Rattus rattus
Rattus sabanus
Hoplopleura malaysiana Ferris
Polyplax insulsa
Rattus stridens
Polyplax spinulosa (Burmeister)
Rattus surifer
Hoplopleura pectinata (Cummings)
Rattus tullbergi
Hoplopleura intermedia Kellogg and Ferris
Polyplax waterstoni Bedford
Rattus vociferans
Hoplopleura malaysiana Ferris
Rhabdomys pumilio
Polyplax arvicanthis Bedford
Saccostomus campestris
Polyplax jonesi Kellogg and Ferris
Thallomys moggi
Hoplopleura affinis (Burmeister)
Polyplax spinulosa (Burmeister)
Thallomys namaquensis
Polyplax praomydis Bedford
Thallomys nigricauda
Hoplopleura affinis (Burmeister)
Thamnomys=*Grammomys*
Zelotomys hildegardae
Hoplopleura intermedia Kellogg and Ferris
- Subfamily Otomyinae
- Otomys angoniensis*
Polyplax otomydis Cummings
Otomys brantsii=*Parotomys brantsii*
Otomys irroratus
Polyplax otomydis Cummings
Otomys irroratus tropicalis=*tropicalis*
Otomys tropicalis
Polyplax otomydis Cummings
Parotomys brantsii
Polyplax otomydis Cummings
- Family Muscardinidae
Subfamily Graphiurinae
- Graphiurus alticola*
Schizophtirus graphiuri Ferris
Graphiurus murinus
Schizophtirus graphiuri Ferris
Graphiurus nanus
Schizophtirus graphiuri Ferris
Graphiurus raptor=*murinus*

Subfamily Muscardininae

- Dryomys nitedula
- Schizophthirus pleurophaeus
(Burmeister)
- Dryomys pallidus=nitedula
- Eliomys pallidus=Dryomys nitedula
- Eliomys quercinus
- Schizophthirus pleurophaeus
(Burmeister)
- Muscardinus avellanarius
- Schizophthirus pleurophaeus
(Burmeister)

Cohort FERUNGULATA

Superorder FERAЕ

Order CARNIVORA

Suborder FISSIPEDA

Superfamily CANOIDEA

Family Canidae

Subfamily Caninae

- Alopes lagopus
- Linognathus setosus (von Olfers)
(blue fox and arctic fox=pre-
sumably Alopes lagopus)
- Canis aureus
- Linognathus setosus (von Olfers)
- Canis brasiliensis=Dusicyon
- Linognathus taeniotrichus Werneck
- Canis cupus, misprint for lupus
- Canis lupus
- Linognathus setosus (von Olfers)
- Canis mesomelas
- Linognathus setosus (von Olfers)
- Domestic dog
- Linognathus setosus (von Olfers)
- Dusicyon fulvipes
- Linognathus taeniotrichus Werneck
- Dusicyon thous
- Linognathus taeniotrichus Werneck
- Vulpes fulva
- Linognathus setosus (von Olfers)
- Vulpes vulpes
- Linognathus setosus (von Olfers)

Suborder PINNIPEDIA

Family Odobenidae

- Odobenus obesus
- Antarctophthirus trichechi
(Bohemann)
- Odobenus rosmarus
- Antarctophthirus trichechi
(Bohemann)

Family Otariidae

- Callorhinus alascanus

- Antarctophthirus callorhini
(Osborn)
- Proechinophthirus fluctus
(Ferris)
- Eumetopias jubata
- Antarctophthirus microchir
(Trouessart and Neumann)
- Otaria hookeri
- Antarctophthirus microchir
(Trouessart and Neumann)
- Phocarctos=Otaria
- Zalophus californianus
- Antarctophthirus microchir
(Trouessart and Neumann)

Family Phocidae

Subfamily Phocinae

- Greenland seal
- Echinophthirus horridus (von Olfers)
- Halichoerus grypus
- Echinophthirus horridus (von Olfers)
- Phoca foetida=hispidia
- Phoca groenlandica
- Echinophthirus horridus (von Olfers)
- Phoca hispida
- Echinophthirus horridus (von Olfers)
- Phoca richardii
- Echinophthirus horridus (von Olfers)
- Phoca sibirica
- Echinophthirus horridus (von Olfers)
- Phoca variegata
- Echinophthirus horridus (von Olfers)
- Phoca vitulina
- Echinophthirus horridus (von Olfers)

Subfamily Lobodontinae

- Hydrurga leptonyx
- Antarctophthirus ogmorhini
Enderlein
- Leptonychotes weddelli
- Antarctophthirus ogmorhini
Enderlein
- Lobodon carcinophagus
- Antarctophthirus lobodontis
Enderlein
- Ogmorhinus=Hydrurga
- Ommatophoca rossi
- Antarctophthirus mawsoni Harrison

Subfamily Cystophorinae

- Cystophorus cristata
- Echinophthirus horridus (von Olfers)
- Macrorhinus=Mirounga
- Mirounga leonina
- Lepidophthirus macrorhini Enderlein

Superorder PROTUNGULATA
Order TUBULIDENTATA
Family Orycteropodidae

Orycteropus afer
Ilybophthirus notophallus (Neumann)
Orycteropus capensis
Ilybophthirus notophallus (Neumann)

Order HYRACOIDEA
Family Procaviidae

There seems to be considerable disagreement concerning the species of this group. They are listed here according to Lydeker, 1916, merely as a standard point of reference.

Procavia bounhioli=ruficeps
Procavia brucei=ruficeps
Procavia capensis
Prolinognathus aethiopicus
Fahrenheit
Prolinognathus caviae-capensis
(Pallas)
Procavia coombi=capensis
Procavia natalensis=capensis
Procavia rufescens=misspelling for
ruficeps
Procavia ruficeps
Prolinognathus foleyi Fahrenheit
Procavia shoana (properly sciona)=
habessinica
Procavia habessinica
Proliuognathus aethiopicus
Fahrenheit
Prolinognathus arcuatus
Fahrenheit
Heterohyrax syriacus
Prolinognathus leptcephalus
(Ehrenberg)

Superorder MESAXONIA
Order PERISSODACTYLA
Suborder HIPPO MORPHA
Family Equidae

Equus asinus
Haematopinus asini (Linnaeus)
Ratemia squamulata (Neumann)
Equus burchelli
Haematopinus acuticeps Ferris
haematopinus asini (Linnaeus)
Ratemia squamulata (Neumann)
Equus caballus
Haematopinus asini (Linnaeus)

Superorder PARAGONIA
Order ARTIODACTYLA
Suborder SUIFORMES
Infraorder SUINA
Family Suidae
Subfamily Suinae

Koiropotamus choeropotamus apparently=
Potomochoerus choeropotamus
Phacochoerus aeliani-aethiopicus
Phacochoerus aethiopicus
Haematopinus phacochoeri Enderlein
Phacochoerus sundevalii-aethiopicus
Potamochoerus affinis (unable to
trace)
Haematopinus latus Neumann
Potamochoerus africanus-larvatus
Potamochoerus choeropotamus
Haematopinus latus Neumann
Sus cristatus
Haematopinus suis (Linnaeus)
Sus scrofa
Haematopinus apri Goureaux
Sus vittatus
Haematopinus suis (Linnaeus)
Domestic swine
Haematopinus suis (Linnaeus)

Family Tayassuidae
Subfamily Tayassuinae

Dicotyles=Tayassu
Pecari=Tayassu
Pecari javalii=Tayassu angulatus
Tayassu javalii
Pecarocercus javalii Babcock and
Ewing

Infraorder OREODONTA
Suborder TYLOPODA
Family Camelidae

Auchenia=Lama
Auchenia lama=Lama glama
Camelus dromedarius
Haematopinus tuberculatus
(Burmeister)
Microthoracius cameli (Linnaeus)
Lama glama
Microthoracius mazzai Werneck
Microthoracius minor Werneck
Microthoracius praelongiceps
(Neumann)
Lama huanaca=glama
Lama pacos=glama

Suborder RUMINANTIA
Infraorder PECORA
Superfamily CERVOIDEA
Family Cervidae
Subfamily Cervinae

Cervus elaphus
Solenopotes burmeisteri Fahrenholz
Cervus nippon
unnamed species of *Solenopotes*
Cervus unicolor
Haematopinus longus Neumann

Subfamily Muntiacinae

Muntiacus muntjak
Solenopotes muntiacus Thompson

Subfamily Odocoileinae

Capreolus capreolus
Solenopotes capreoli Freund
Coassus-Mazama
Mazama rondoni
Solenopotes binipilosus
(Fahrenholz)
Mazama simplicicornis
Solenopotes binipilosus
(Fahrenholz)
Odocoileus chiriquiensis=rothschildi
Odocoileus columbianus
Solenopotes ferrisi (Fahrenholz)
Odocoileus couesi
Solenopotes binipilosus
(Fahrenholz)
Odocoileus hemionis
Solenopotes ferrisi (Fahrenholz)
Rangifer tarandus
Solenopotes tarandi (Mjöberg)

Superfamily GIRAFFOIDEA
Family Giraffidae

Giraffa camelopardalis
Linognathus brevicornis (Giebel)

Superfamily BOVOIDEA
Family Bovidae
Subfamily Antilopinae
Tribe Antilopini

Aepyceros melampus
Linognathus aepyceros Bedford
Antidorcas marsupialis
Linognathus bedfordi Ferris
Linognathus tibialis (Piaget)
Antilope cervicapra
Linognathus cervicaprae (Lucas)
Linognathus pithodes Cummings

Antilope euchore=Antidorcas marsupialis
Antilope maori (as recorded by Piaget. The name does not appear in available lists).

Linognathus tibialis (Piaget)
Antilope subgutturosa
Linognathus tibialis (Piaget)
"Antilope"
Linognathus tibialis (Piaget)
"Antilope, North African"
Linognathus petasata Ferris
Gazella (possibly either a misidentification or owing to straggling)
Linognathus gazella Mjöberg
Gazella thomsoni
Linognathus lewisi Bedford
Oreotragus saltator=oreotragus
Oreotragus oreotragus
Linognathus africanus Kellogg and Paine
Raphicerus campestris
Linognathus tibialis (Piaget)

Tribe Bovini

Bison americanus=bison
Bison bison
Haematopinus tuberculatus
(Burmeister)
Bos grunniens
haematopinus tuberculatus
(Burmeister)
Bos indicus
Haematopinus eurysternus (Nitzsch)
Bos taurus
Haematopinus eurysternus (Nitzsch)
Linognathus vituli (Linnaeus)
Solenopotes capillatus Enderlein
Bubalus bubalis
Haematopinus tuberculatus
(Burmeister)
Syncerus cafer
Haematopinus bufali (de Geer)

Tribe Strepsicerotini

According to Simpson the generic name *Strepsicerus* antedates *Tragelaphus* and *Limnotragus* should be regarded as a subgenus of the former. There seems to be some question here, however, and the latter names are retained for this list.

Also, there seems to be confusion concerning *Boselaphus*. The name has been used for *Taurotragus*, but seems to apply to an entirely different animal.

Boselaphus oreas=*Taurotragus oryx*
Limnotragus gnatus
Linognathus limnotragi Cummings
Taurotragus oryx
Haematopinus taurotragi Cummings
Linognathus taurotragus Bedford
Tragelaphus scriptus
Linognathus fractus Ferris
Linognathus limnotragi Cummings
Tragelaphus sylvaticus=*scriptus*

Subfamily Caprinae
 Tribe Caprini

Capra hircus
Linognathus africanus Kellogg and Paine
Linognathus stenopsis (Burmeister)
Capra ibex
Linognathus stenopsis (Burmeister)
Capra manificus (no such name in any list)
Linognathus oviformis (Rudow)
Caprella rupicapra=*Rupicapra*
 Domestic goat=*Capra hircus*
Ovis aries
Linognathus africanus Kellogg and Paine
Linognathus ovillus (Neumann)
Linognathus pedalis (Osborn)
Ovis longipes
Linognathus ovillus (Neumann)
Rupicapra rupicapra
Linognathus stenopsis (Burmeister)

Subfamily Cephalophinae
 Tribe Cephalophini

Cephalophus grimmi=*Sylviacapra grimmi*
Cephalophus maxwelli
Linognathus breviceps (Piaget)
Cephalophus natalensis

Linognathus breviceps (Piaget)
Cephalophus nigrifrons
Linognathus angulata (Piaget)
Philantomba. At times used for some species generally referred to *Cephalophus*.
Sylviacapra grimmi
Linognathus breviceps (Piaget)

Subfamily Hippotraginae
 Tribe Alcelaphini

Connochaetes gnu
Linognathus gnu Bedford
Damaliscus albifrons
Linognathus damaliscus Bedford
Damaliscus dorcas=*Damaliscus pygargus*
Damaliscus korrigum
Linognathus damaliscus Bedford
Damaliscus pygargus
Linognathus damaliscus Bedford
Gorgon taurinus
Linognathus gnu Bedford
Linognathus hologastrus Werneck
Linognathus spicatus Ferris

Tribe Hippotragini

Hippotragus niger
Linognathus hippotragi Ferris

Tribe Reduncini

Cervicapra=*Redunca*
Pelea capreolus
Linognathus peleus Bedford
Redunca arundinum
Linognathus fahrenheitzi Paine
Redunca fulvorufula
Linognathus fahrenheitzi Paine
Redunca redunca
Linognathus fahrenheitzi Paine

CHAPTER VIII

The Distribution of the Anoplura

The problems associated with the spatial distribution of plants and animals have attracted a vast amount of attention and have come to represent a field by themselves which is gathered under the general title of biogeography. This field impinges upon other fields of inquiry in relation to which there may be a high degree of reciprocal agreement and support, or conversely, an equal degree of entertaining disagreement. Thus, the geological concept of continental drift may on the one hand be supported by conclusions drawn from biogeography or on the other hand be exposed to most vigorous criticism from the same source. The strictly practical field of economic entomology may find a utilitarian aid since it may employ the geographical distribution of insect pests for which the discovery of their natural enemies is desirable. The purely philosophical aspects of biology and geography may be concerned with the problems of the spread of natural populations and the light that present-day distribution of plants and animals may throw upon the distribution of ancient land masses.

The distribution of parasitic forms is a specialized aspect of biogeography and is one of special philosophical interest. It is a matter of common biological knowledge that in the evolution of their parasitic habit many organisms—whether plant or animal—are very closely adjusted, both physically and physiologically, to the environment of a single host or host group. Thus, in the Anoplura there is a general adjustment to the environment afforded by the hair of the hosts. This involves the loss of the wings, the reduction or loss of the eyes, the modification of the legs for clasping the hairs, and the alteration of the ovipositor for the laying of eggs attached to the hairs of the host. Obviously, this physical adjustment has been carried still farther into an adjustment to a particular host, for an Anopluran which can grasp the delicate hairs of a mouse would be completely helpless among the huge bristles of a pig. But beyond such obvious adjustments as these, there seems also to be an adjustment to the physiology of the host. There are indications that a sucking louse transferred from its normal host to one of a very different kind may find the blood of the new host physiologically unsuited. One may surmise that we have here something analogous to the allergies which at least make life miserable for many people. These factors seem to apply rather generally among many kinds of parasites and they appear very strongly to influence the distribution of the parasites.

Nor is this all. The adjustment of the parasite may be so delicate that it cannot pass from one host to another of the same species except under a limited set of conditions. Thus, in the Anoplura the modifications of the legs for clasping the hairs of the host have proceeded so far that the louse is unable to move about effectively when detached from its host. Consequently, such an animal can pass readily from one host to another only when the hosts are in contact and a bridge of hair is available.

The outcome of all these factors is that one might expect to find a particular louse species confined to a particular species of host. At times this is true, but usually the distribution of the louse species is broader. The louse species may, and very frequently does, occur on various closely related hosts. It seems to be a quite tenable assumption that the louse species has been inherited from the common ancestor of the various host species and that the lice have evolved somewhat more slowly than have the hosts.

If this hypothesis be pursued further in its implications, it may very well be utilized to account for the occurrence of related species of lice upon related hosts, such as the occurrence of species of the louse genus *Enderleinellus* upon rodents of the family Sciuridae throughout the world and of other instances that can be cited.

Now, the question arises as to how far this hypothesis may be pursued. Can it be that the phylogeny of the lice has paralleled the phylogeny of the hosts back to the time when the ancestors of the lice first became established on the ancestors of the mammals? It is most tempting to suggest that the classification of the lice, which are a small and compact group, might be utilized to throw light upon the phylogeny of the much larger and more diverse group of the mammals. These are most intriguing speculations for the expression of hypotheses. But before we convert speculations into hypotheses and hypotheses into expressions of opinion we need to inquire into all the available facts and to take into consideration all the various pitfalls that may be encountered. Before the student of lice presumes to offer advice to the mammalogist concerning moot points in mammal classification he should first be sure that the classification of the lice is placed upon a sound basis and that he genuinely knows whereof he speaks.

In considering such matters, it should be emphasized at the outset that at the present time we know probably only about half the species of Anoplura that may be expected to occur in the world and that until we know substantially the whole fauna we are scarcely justified in devising a classification of the Anoplura that may be regarded as approaching finality. At the moment, as is emphasized elsewhere, we do not have a satisfactory classification of the Anoplura as a whole. Most of the genera are relatively clear, but the way in which these genera may be assembled into genuinely significant higher categories is not yet so. Tribes, subfamilies, families, superfamilies, these elements in any classificatory system that will be biologically sound, remain still to be elucidated.

A few things, however, appear to be reasonably clear.

First, it appears that the Anoplura are confined to the mammals.

Next, it appears that they are confined to the Eutheria, although it is still possible that they may be found upon the Monotremata which have not yet been adequately examined. No evidence exists that they occur on the Metatheria (the Marsupials) although biting lice are known from this group.

Then it appears that they do not occur on certain large groups of the Eutheria. They seem definitely not to be included among the weird assortment of parasites that occur on the bats. Among the Ferungulata, which includes the living Orders Carnivora and Pinnipedia, the Carnivora seem to have no Anoplura—with the exception of two species—although they are well supplied with Mallophaga. The Pinnipedia, on the other hand, seem to possess only Anoplura.

Further it appears that there are groups of Anoplura which are definitely restricted to groups of related hosts, so much so that if any Anopluran specimen of one of these groups came to hand with no host data it would be possible to predict with a high degree of probability the family of mammals from which it came. But not always! There are enough discrepancies to introduce the possibility of error into such a prediction. Some of these discrepancies are very strange and at the moment admit of no logical solution on the basis of present evidence.

Thus, we have the Anopluran genus *Linoognathus*, with about 30 included and apparently evidently related species, which is restricted absolutely to hosts of the Order Artiodactyla, with two strange exceptions. One species occurs on the domestic dog and the arctic fox and another species occurs on a wild dog of South America. These are all the Anoplura that are known from the terrestrial Carnivora.

There is also the genus *Polyplax*, with about 30 included species, which

occurs on rodents of the family Muridae, except that two species—clearly belonging to this genus—occur on shrews of the family Soricidae.

But apart from such glaring exceptions, the species of the various genera of Anoplura are as far as known rather generally restricted to host groups among which some degree of relationship is commonly recognized.

Thus the genus *Enderleinellus* with about 28 species is, as at present known, restricted to rodents of the family Sciuridae. The genus *Neohaematomus* with 25 known species is restricted to the same family, except for two species which occur on members of the family Muridae. The genus *Microthoracius*, with four known species, is restricted to the family Camelidae, occurring in both South America and the Old World. The peculiar genus *Neolinognathus*, with two known species, is confined to the elephant shrews of the family Macroscelididae. The genus *Prolinognathus*, with at least five apparently distinct species, is confined to the Hyracoidea. The genera *Antarctophthirus* and *Echinophthirus* are confined to the Pinnipedia. The genus *Schizophthirus*, with two included species, is confined to the rodent family Muscardinidae. The genus *Fahrenholzia*, with about five known species, is confined to the rodent family Heteromyidae. The genus *Pedicinus* with seven included species is confined to the monkey group Cercopithecoidea.

These instances are clear enough. It matters not at all if there be differences of opinion concerning whether these Anopluran groups be called genera or are broken each into more than one genus. The group—subgenus, genus, supergenus, tribe, or whatever it may be called—as a whole is associated with a particular group of mammals.

Up to this point everything works out nicely. The hypothesis that the phylogeny of the lice and the phylogeny of the Anoplura are correlated is entirely tenable. But beginning with these instances we must proceed in two directions. On the one hand, how much farther does the correlation go in associating these groups of lice with larger groups? On the other hand, how much farther does it go in associating closely related species of Anoplura with closely related hosts?

Here again we have some beautiful instances of correlation and equally we have some discrepancies.

Enderleinellus nitzschi occurs in North America on squirrels that according to the most recent classification by mammalogists are placed in the genus *Sciurotamias*. But what is apparently the same species occurs also on the European *Sciurus vulgaris*, while other species of *Enderleinellus* occur on other North American species of *Sciurus*. We have here a partial agreement and a larger area of disagreement. It would certainly be presumptuous for a student of the Anoplura to advise the mammalogists that *Tamiasciurus* should be made to include a species which they utilize as the type of the genus *Sciurus* and that other species should be removed from *Sciurus*!

However, within one section of the genus *Enderleinellus* we have a very interesting condition. There is a certain group of squirrels that has been recognized by mammalogists as a category, although the status of this category seems not generally to be agreed upon. By some the group has been called the subfamily Marmotinae, but Ellerman places it simply as a "Section" of the Sciuridae. The basic genera are *Marmota*, *Citellus*, and *Cynomys*. The indications at present concerning the members of the genus *Enderleinellus* occurring upon them are as follows.

The section of the genus *Enderleinellus* involved has been elevated to a genus, *Cyclophthirus*, by Ewing and whatever opinion be held concerning this genus it exists as a group. Much more collecting needs to be done before any final conclusions are possible, but the evidence at present indicates that the members of this group of lice are restricted to what we may call the Marmotinae. The genus *Marmota* seems to have a distinct species. The genus *Cynomys* has upon it a species that seems possibly to be distinct. But otherwise the problem of the possible species of *Enderleinellus* is much

confused, and recent studies concerning the relationships of the squirrels of this group seem to be equally so. We cannot here go into the matter in detail, but the situation in the classification of the squirrels seems very much to parallel that found among the lice. When a study of the lice has been carried to completion it may show a very interesting parallel with the conclusions of mammalogists.

Other illustrations are even more confusing. Thus, the species of the genus *Hoplopleura* range over a wide variety of rodents of the various subfamilies of what Ellerman calls the family Muridae and the Sciuridae. A louse of very similar type occurs on the Lagomorph genus *Ochotona*. Within the genus *Hoplopleura* various minor groups can be recognized, which seem to be associated with minor groups of rodents, there being a fairly well defined group on the Sciuridae. But one species, or at least a series of very closely similar forms, ranges from Europe and Asia into South America on various genera of both Murinae and Cricetinae.

A rather striking instance of an anomalous distribution is that of the species *Hoplopleura oenomytis*, which was described from a rodent of the Murine genus *Oenomys* in Africa and recorded from other genera of this group in Africa and Asia, but which has apparently transferred to domestic rats and is now common in southern United States. The identification is on available evidence correct.

At the other end of the scale are such genera as *Ancistroplax* and *Haematopinoides* which on the totality of their structure seem merely to be somewhat modified relatives of *Hoplopleura*, but occur on Insectivora.

A very peculiar genus is *Lemurphthirus*, with one species, which occurs on a lemuroid. In the characters of head and thorax it seems evidently related to *Neohaematopinus*, which is a genus that occurs on squirrels, but in the characters of its abdomen it is very much a thing by itself although it is here placed in company with *Neohaematopinus* in the Polyplacinae. Other species from lemuroids show no general agreement among themselves and are placed in this subfamily, which mostly occurs on rodents.

A very illuminating instance is furnished by the one known species of *Phthirpediculus*. In describing this genus Ewing remarked that it stands "intermediate between *Pediculus* Linnaeus and *Phthirus* Leach." This seems reasonable enough, since *Phthirpediculus* is from a lemur and the lemurs are supposed to stand somewhere near the bottom of the phylogeny of the Primates. But the genus *Phthirpediculus*, considered on morphological grounds, has nothing to do with either of these other two genera. In fact, none of the few lice known from lemuroids seems to have anything especially to do with the lice of the Primates.

We may here once more call attention to the genus *Pedicinus*. In all previous classifications this has been placed in the Pediculidae as a relative of *Pediculus*. This has seemed eminently reasonable, since the hosts of *Pedicinus* and *Pediculus* are Primates. But it is here questioned that these two genera of lice have anything to do with each other and *Pedicinus* is here removed to the Hoplopleuridae, where it is placed as constituting a subfamily by itself. The morphological evidence does not indicate any close relationship with *Pediculus*.

Webb has been much impressed by considerations of host relationship and the phylogeny of the Anoplura and has used host relationships to influence his opinions concerning louse classification to a degree that seems to the writer not to be supported by the evidence of morphology other than his somewhat questionable evidence derived from the spiracles.

Hopkins (1949) has considered this matter at considerable length in connection with his list of host-associations of the lice of mammals and pointed out factors concerned with the presence—or, of equal interest, the absence—of certain groups of lice on various host groups. He suggests that where Anoplura and Mallophaga occur on the same host there is perhaps a

competition between the members of the two groups of lice which may result unfavorably for the sucking forms and lead to their disappearance. It may be pointed out that the rodent family Heteromyidae supports only sucking lice of the peculiar genus *Fahrenholzia*, while the Geomyidae support only biting lice of the family Trichodectidae. Yet while in most lists of mammals these two groups of rodents are placed as separate families there are mammalogists who have maintained that they are nothing more than subfamilies of the same family. Again, the rodents of the family Erethizontidae, the porcupines, seem to possess only biting lice, although in general sucking lice are much developed on the rodents. However, there are groups of mammals, such as many of the Ungulates, on which both biting and sucking lice are well represented. The idea that the absence of the sucking lice may be due to competition with biting lice must be considered, but there are other causes that can be envisioned and the present writer is not convinced that this can have been a tremendously important factor in the present host distribution of the Anoplura.

With such matters as these in mind we may approach the problem of the correlation of a classification of the higher groups of the Anoplura with their distribution.

From the writer's point of view the matter of classification should be developed first and then the problem of distribution should be considered after the morphological evidence has been developed.

From the point of view here adopted the distribution of the lice in general is on the whole rather consistent with the idea of a correlation of the phylogeny of the lice with the phylogeny of their hosts. But above that point it becomes increasingly inconsistent, and finally fades away into the realm of pure speculation. If it were pushed to its extreme limits one would assume that the original ancestor of the sucking lice boarded the original ancestor of the mammals and the descendants of the one have divided and followed the various successors of the original ancestor of the mammals—with the interposition of various accidents—ever since. But it seems probable that the lice could not have joined the mammals until the latter had already reached some measure of differentiation into groups. Under this speculation it may be assumed that some of the ancestral mammals never achieved the company of any sucking lice. Also, it may be speculated that the originals of the lice were not specifically adapted to a limited host group and therefore may have passed rather freely from host to host, even long after the hosts were quite widely separated phylogenetically, thus placing the members of a single phylogenetic line of the parasites upon many phylogenetic lines of hosts. Even after the lice had differentiated to a considerable degree this possibility of transfer may have remained. Then there may have been a certain number of what may be considered to be accidental transfers having nothing to do with phylogeny.

Out of all this the correlation of the phylogeny of the parasites with the phylogeny of the hosts may have begun a process of obscurity early in the period of differentiation of both groups. This being possible, it therefore becomes improbable that the phylogeny of the two groups would follow parallel paths back to the points of origin of both.

The problem then centers merely upon the question of how far these parallel paths extend before they become entangled in the criss-crossing of roads that may have occurred before a system of parallel paths had developed.

From the writer's point of view it is upon this question that future interest in the general problem should be concentrated.

The conclusions here adopted are as follows:

1. The distribution of the smaller groups—such as genera—is in general reasonably consistent with the idea that they have followed the phylogeny of the hosts in their development.

2. It must be recognized that even here there have been occasional anomalies of distribution which must be accepted as they are.

3. To a more limited degree the phylogeny of the groups above the genera have followed a similar pattern. But here the number of apparent discrepancies increases.

4. When we come to the larger groups of genera, which we may call families, this parallelism of phylogenies is but faintly shown.

5. Speculation in regard to the problem should remain firmly within the bounds of ascertained fact.

6. Discrepancies which cannot be accounted for on a basis of known fact should be accepted as they exist and not forced into some framework of ideas as to how they *ought* to be accounted for by the system of classification.

7. Future work should be directed in large part toward the completion of our knowledge of the species of Anoplura that still remain to be found and the fitting of these into a system of classification that is based on the Anoplura themselves.

8. Then and then only will we be in a position to theorize concerning the relation of the phylogeny of the lice to the phylogeny of their hosts.



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