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Notes on Anoplura

Per Brinck.

Opuscula Entomol. 1948
13.
Lund.

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Microtus agrestis (L.) ..... *Hoplopleura acanthopus* (Burm.)
Evotomys glareolus Schr. ..... *Hoplopleura acanthopus* (Burm.)
Lepus timidus L. ..... *Haemodipsus lyriocephalus* (Burm.)
Oryctolagus cuniculus (L.) ..... *Haemodipsus ventricosus* (Denny)

Ungulata

Equus caballus L. ..... *Haematopinus asini* (L.)
Sus scrofa L. (dom.) ..... *Haematopinus suis* (L.)
Bos taurus L. ..... *Linognathus vituli* (L.), *Solenopotes capillatus* End., *Haematopinus eurysternus* (Nitzsch)
Capra hircus L. ..... *Linognathus stenopsis* (Burm.)

Primates

Homo sapiens L. ..... *Pediculus h. humanus* L., *Pediculus humanus capitis* De G,. *Phthirus pubis* (L.).

Notes on Anoplura.

Especially with regard to the Swedish species.

By Per Brinck.

When working out the catalogue of the Swedish Anoplura I found it necessary to deal in detail with some problems which had been insufficiently cleared up by previous workers on the group. In the following I have given an account of some of the results.

I. *Nomenclatorial notes.*

Discussion of some Linnean *Pediculus* species.

In his descriptive works Linnaeus gathered a great number of ectoparasites under the generic name *Pediculus*. Of these species some are sucking lice and some others have been referred to this insect group temporarily. It is not surprising that opinion on certain species has varied, as descriptions are often lacking or, when present, are very insufficient. When no diagnosis is given, there is mostly one or more literature references. According to the nomenclatory rules such a reference is sufficient to validate the name. Most of these species without a diagnosis are marked with a cross, indicating that Linnaeus had not seen any material of it (*vide* for instance Syst. Nat. 1758, p. 613, the foot-note; cf. Nordström, 1943, p. 15). In the following I have treated all Linnaean *Pediculus* species which are sucking lice or have been mistaken as such parasites.

1. *Pediculus humanus* (first valid descr.: 1758, p. 610, no. 1). — The original description gives no indication that the head louse and the body louse were considered to represent different forms. This is, however, indicated in Fauna Svecica (1761, p. 475: Qui in vestimentis victitat ab eo, qui in capite vivit, non differt ut species, sed tantum varietas). Later on (1767, p. 1016) they occur as two described varieties: Varietas *Capitis durior, coloratior; Vestimentorum laxior, magis cinerea*). De Geer (1778, p. 67) named them *Pediculus humanus capitis* and *Pediculus humanus corporis* resp. Latreille (1806, p. 167) restricted the name *humanus* to the body louse, and thus the attempt of Ewing (1926, p. 3 and 22) to establish the head louse as the typical form (*P. humanus humanus*) fails. Kemner (1938, p. 59) follows Ewing. Further the opinion of Freund is incorrect (1935, p. 6: *P. corporis* De G. — *P. capitis* De G.). In 1936 (p. 663) Fahrenholz discusses at length the nomenclature of the human *Pediculus*. He concludes: »Wenn wir die Menschenläuse als 2 Unterarten auffassen, so müssen wir für die Kopflaus den Namen *Pediculus humanus capitis* beibehalten und für die Kleiderlaus *Pediculus humanus vestimentorum*. Nur wenn man der Meinung ist, dass Linné 1767 keine Benennung vorgenommen hätte, würde der Name der Kleiderlaus nach De Geer *Pedic. humanus corporis* lauten; für letztere Auffassung liegt aber tatsächlicher Grund nicht vor . . . Will man anderseits die Kopflaus als 2 selbständige Arten gelten lassen, so würde nach den heutigen Nomenklaturregeln Csiki recht haben, indem er die Kopflaus als *Pedic. humanus* s. str. bezeichnet und die Kleiderlaus müsste heissen entweder (Linné folgend) *Ped. vestimentorum* oder nach De Geer *Pediculus*

corporis (§ 12 int. Nom.).» This is not quite correct. The nomenclatory rules deal with species and subspecies only, and consequently the authors may call sub-subspecific forms what they want. But if the human *Pediculus* are dealt with as species or subspecies one of them must be named *P. humanus* (subsp. *humanus* resp.) as Linnaeus described the human lice under this species name. The possible Linnaean varieties *capitis* and *vestimentorum* (it is not evident from the Systema Naturae, 1767, p. 1016, that these words were meant as true names, perhaps they were used only to indicate the typical habitat of the lice) have no nomenclatural validity as they were not described as species or subspecies. They are valid at first from De Geer (1778) and Nitzsch (1818: *vestimenti*) resp. After art. 12 in the international rules of zoological nomenclature the »specific name becomes a subspecific name when the species so named becomes a subspecies, and *vice versa*». I cannot understand why Fahrenholz refers to this article when calling the head lice *P. humanus capitis* as a subspecies but *P. humanus* as a species. According to that article such a procedure is impossible.

Following Ferris (1935, p. 31) I regard *P. humanus humanus* as the body louse and deal with the human *Pediculus* as biological races.

2. *P. pubis* (1758, p. 611, no 2). — This species, now referred to the genus *Phthirus* (Leach) needs no discussion. Note, however, that the spellings used by previous Scandinavian authors are incorrect: not *Phthirius* or *Phtirius* but *Phthirus* as shown by Klein (1931, p. 536) and Ferris (1935, p. 602).

3. *P. suis* (1758, p. 611, no. 5). — Neumann (1911, p. 40) first recognized the fact that *Haematopinus suis* (L.) of early authors included some different forms. He described two of them and later on Fahrenholz (1917—1919) divided the species into five subspecies. Thereby the Linnaean name *suis* was restricted to the louse of the wild boar of Europe (*vide* also Fahrenholz 1939). As Linné in his descriptive publications has stated that *suis* occurs on Swedish domestic pigs, this restriction must be incorrect and the names were changed by Ferris (1933, p. 19). According to him two forms can be recognized, *viz. H. suis* (L.) from domestic pigs and Asiatic wild swine, and *H. aperis* Ferris from the European boar. I have examined Swedish boars from Eastern Scania but without finding any lice. The stock, originating from a preserve, is now exterminated.

4. *P. cameli* (1758, p. 611, no 7). — The species was unknown to Linnaeus who named it after a figure given by Redi (1668, t. 22). It was rediscovered in Algeria on *Camelus dromedarius* L. and described in detail by Werneck (1934, p. 179).

5. *P. cervi* (1758, p. 611, no. 8). — The name is not accompanied by a description. Linnaeus gives Frisch (1736, p. 15, t. 5) as reference, however, and in some works also Redi (1668, t. 5, not in Fauna Svecica 1761). Frisch figures a Hippoboscid fly, Redi a sucking louse and a Mallophagan. When discussing the Linnaean species Fahrenholz concludes (1916, p. 272): »Es ist also unmöglich zu entscheiden, auf welche der drei genannten Arten sich der Linnésche Name beziehen soll.» Undoubtedly it is impossible to demonstrate with certainty which was meant. As Linnaeus, however, gives Frisch as the first and most detailed reference and further as this reference is always to be found but Redi may be wanting, it seems to point to the use

of this name for the Hippoboscid fly living on deer, as is now customary. This interpretation is confirmed by the fact that Linnaeus who personally knew the species (no cross!) enumerates as hosts: »in Cervi Elapho, Dama, Capreolo». Of the ectoparasites cited the Hippoboscid fly is the one living on all these deer: it is a fairly common parasite on them in Southern and Central Sweden. The deer sucking louse is as yet not found in this country. Thus, the name must be retained for *Lipoptena cervi* (L.) auct., but suppressed for the *Trichodectes*-species of *Cervus elaphus* (*T. cervi* was used by Harrison 1917, p. 69, and some following authors; this species is named *Rhabdopedilon longicornis* Nitzsch by Kéler, 1938, p. 456). For the lice of deer the name has not been used in recent time. It can, however, be stated that Linnaeus must have been fairly unacquainted with the Hippoboscid fly of the deer (at least in his young years), as he left it under *Pediculus* but placed other Hippoboscids (as *H. equina* and *Melophagus ovinus*) *recte* at the end of the Diptera.

6. *P. ovis* (1758, p. 611, no. 9). — Linnaeus gives no description, only the indication that the species lives »in Ovibus» and quotes Redi (1668, t. 22, fig. 1) with a sign of interrogation. Redi figures what is undoubtedly the biting louse of the sheep and thus the Linnaean name has been applied to this parasite. This seems to have been what Linnaeus meant, as no sucking louse is known from Swedish sheep. In this country only two insect parasites normally occur on that animal, *viz. Bovicola bovis* auct. and *Melophagus ovinus* auct. No doubt Linnaeus recognized both these parasites. When describing the Hippoboscid fly of the sheep in 1747 (p. 59) Linnaeus tells us, that »the lice of sheep are of different kinds» and of these the Hippoboscid fly is »the biggest kind» (transl.). *Bovicola ovis* (L.) is a common parasite of sheep in Sweden.

7. *P. bovis* (1758, p. 611, no. 10; by error named *tauri* in Fauna Svecica 1761, p. 476). — According to the description this species is doubtlessly the biting louse of the Swedish domestic cattle.

8. *P. vituli* (1758, p. 611, no. 11). — No doubt this is a sucking louse. It has mostly been treated as a *Linognathus* species. »The identification of this with the *Pediculus vituli* of Linnaeus is entirely traditional» (Ferris 1932, p. 360). The description runs: »Praecedenti major (sc. *P. bovis*): *Abdomine* ventricoso, acuminato, coeruleo-fusco; *Pedibus* brevibus, crassis, griseis, ut & *capite* & *thorace* griseis». No doubt, it must be difficult to state from this diagnosis what species has been meant. In Sweden I have found three Anoplurans, occurring on domestic cattle, *viz. Solenopotes capillatus* End., *Haematopinus eurysternus* (Nitzsch) and *Linognathus vituli* auct. The first mentioned is a small species with a northern distributional range and has, I think, recently come to Sweden. So it cannot have been familiar to Linnaeus, who describes his *vituli* as a common Swedish species and gives common names. The second one is a big species with stout legs; the strong chitinization and the uniform pigmentation of the legs, head and thorax make it, however, less possible that Linnaeus meant this species, as his description speaks of the grey colour of these body parts; further the abdomen of that species is fairly blunt-ended. It is true that *L. vituli* auct. is a rather small species, but the abdomen is distinctly acuminate (from a Linnaean point of view) and the statements as to the colour, given by

Linnaeus, fit this species best; further it is the most common species infesting Swedish domestic cattle. So I think it is well grounded to preserve the Linnaean name for this species.

9. *P. equi* (1758, p. 612, no. 12). — Linnaeus gives no description nor literature references, only: »Habitat in Equis». As the species occurs also in Fauna Svecica (1761, p. 476) it seems right to deal with it as Swedish. Basing the discussion on this supposition we may begin with the fact that we know from Swedish horses a sucking louse and a biting louse. The Hippoboscid fly of the horse can be ruled out as Linnaeus knew this species very well and correctly placed it among the Diptera. The horse Mallophagan is very common in Sweden. The sucking louse, however, seems to have been absent or rare in early times as no Swedish records are to be found before that of Kemner (1938, p. 56). Further the investigations begun by Kemner in the thirties and later persued by me revealed that at that time the species was restricted to the military stables and the great breeding-studs. During the last war, however, it spread all over the country and is now to be found also in many small stocks. Thus, it is possible that it is a fairly recent addition to the Swedish fauna, entering with imported stud horses. Then we can apply the name *equi* to the biting louse without scruples, as has been done by several authors. Kéler (1938, p. 450) rejects the Linnaean name as »Linné seinen *Ped. equi* niemals gekennzeichnet hat». He uses *Trichodectes equi* Denny, according to Denny (1842, p. 191) nothing but the Linnaean species, under the genus name *Trichodectes*. Because of this declaration of Denny's Werneck again preserves the Linnaean *equi*, after the following discussion (1936, p. 558): »Em 1758, Linnaeus creou o nome *Pediculus equi* para um parasito do cavallo, posteriormente (em 1842) redescripto por Denny com o mesmo nome especifico. Em vista da evidente deficiencia dos dados fornecidos por Linnaeus e na ausencia dos typos deste, a ninguem assiste o direito de afirmar que os parasitos referidos pelos autores citados não fossem identicos. Assim a especies de Linnaeus passou a ser conhecida pelos caracteres assignalados por Denny; em outras palavras: Denny definiu a especie de Linnaeus.» — In any case, I think it is not quite right to do as Kemner (1938, p. 57; and before him Simmonds, 1865, p. 60) who regarded *equi* as the name of the sucking louse of the horse and made *asini* a synonym, basing this upon the fact that *equi* was described as a *Pediculus* and »consequently must be a sucking louse». It needs no thorough study to find out that *Pediculus* Linné is a highly compounded genus, including species from several insect orders and even other animal groups.

10. *P. asini* (1758, p. 612, no. 13). — This species was unknown to Linnaeus who named it after Redi (1668, t. 21, f. 1). As is now well known this is the common sucking louse of the domestic horse (further it occurs on the ass and the zebra). It is now referred to the genus *Haematopinus* Leach.

II. *Taxonomical notes.*

Most of the Swedish lice species are well known and exactly described by Ferris (1919—1935). This is, however, not the case with two of them. *Solenopotes tarandi* described by Mjöberg 1915 from Swedish reindeer (*Rangifer tarandus*) is known only from the original record. The description is detailed but not as exact as to permit us to distinguish between this

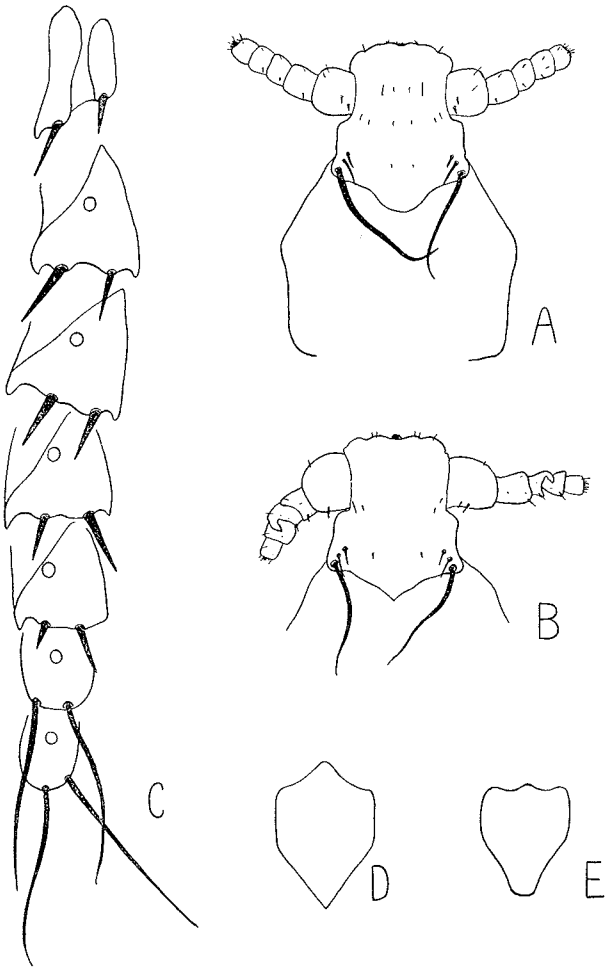


Fig. 1. *Polyplax spinigera* (Burm.). A. Head of female. B. Head of male. C. Paratergal plates. D. Sternal plate. (After specimens from Hl.: Svartrå). — *P. serrata* (Burm.). E. Sternal plate (after a specimen from Upl.: Stockholm).

species and the near allied *S. ferrisi* (Fahr.) (1919), living on the North American *Odocoileus columbianus*. Unfortunately, no specimens of *S. tarandi* are available. I have not succeeded in getting material from Scandinavian reindeer, nor have I found again the original material used by Mjöberg. According to the description the type material was passed over to the State Museum of Natural History, Stockholm. Now it is not there and it has been impossible to verify whether it ever was given to the museum or not. Further material from Mjöberg's investigations is in the Swedish Institute for Plant Protection, but no specimens of *S. tarandi* are preserved there. Thus, it is impossible for us at present to make a decision.

Polyplax is a genus rich in species and especially those of the *spinulosa*-group are closely related. Apparently, one of the species of this group has

been unknown to Ferris, viz. *P. spinigera* (Burm.), a parasite of *Arvicola terrestris* (*amphibius*). No doubt, this species is one of the rarest European lice. It has only been found a few times, in fact we have only one reliable record, plus a recognizable description (Neumann, 1909). The original diagnosis of Burmeister is almost worthless, and more recent authors have had nothing to add. Therefore, Ferris like several other authors was inclined to believe that *spinigera* is a synonym of *spinulosa*. Undoubtedly, the two species are closely related. As far as I have been able to conclude from the Scandinavian material examined, they are, however, distinct species. The sternal and the paratergal plates especially are good characteristics, separating them. No detailed description exists, and therefore I give below an account of the most important features.

Female. Length 1.2 mm. General body form similar to that of *Polyplax spinulosa*. *Head* nearly as broad as long, almost truncate anteriorly, antennae simple, placed a little behind the anterior margin, postantennal angles prominent, the latero-posterior angle with two setae and a very long hair on each side; the lateral margins of the hind head almost parallel. *Thorax* somewhat broader and longer than the head, with the lateral margins angularly convex; *legs* of ordinary form; *sternal plate* broad, with the lateral margins almost parallel, the posterior margin strongly produced, nearly acute, the anterior margin produced into a blunt point. Tergal and sternal plates of the *abdomen* strongly developed, the plates with at the most 8—10 small setae. Between the end of the posterior plate and the corresponding pleurite on the third to seventh segments dorsally and the fourth to seventh segments ventrally is a single small seta. The *paratergal plate* of the second segment is distinctly divided into two lobes, the ventral lobe slender, each lobe with a short seta; the plate of the third segment with the dorsal angle strongly produced and the ventral slightly prominent; plates of the fourth — fifth segments with both angles produced, plate of the sixth segment with the dorsal angle produced and the ventral rounded; plates of the seventh — eighth segments smaller with rounded angles; the seventh and eighth paratergal plates with two long setae, the proximal five plates each with a pair of fairly short setae; spiracles small (*vide* fig. 1).

Male. Length 0.8 mm. Head relatively broader and stouter than in the female. Antennae stouter, the third segment strongly modified (as in *P. spinulosa* (vide fig. 1).

Including the species *P. borealis* [1], described by Ferris from Norway, but still unknown from Sweden, we know four Scandinavian *Polyplax*-species. They can be distinguished as follows:

A. Only the dorsal posterior angle of the paratergal plates of the third — sixth segments produced into a tooth, the ventral angle slightly rounded. Sternal plate irregularly hexagonal, anteriorly feebly produced ..... *spinulosa* (Burm.)

1 Fahrenholz (1939, p. 263) adopts the name *alaskensis* Ewing for this species, without further discussion. *P. alaskensis* was based upon a single male from *Microtus* sp., Alaska. When describing *P. borealis* Ferris discusses this species but makes no decision, as Ewing's description »is entirely inadequate and is unaccompanied by figures». As no further details have been brough to light I think there is no reason for making *borealis* a synonym of *alaskensis*.

B. The paratergal plates of the third — (fifth) sixth segments produced into a dorsal and a ventral tooth ..... a.
a. The paratergal postero-lateral points strongly produced, fimbriate.. *borealis* Ferris.
b. The paratergal postero-lateral angles simple ..... 1.
1. Sternal plate heart-shaped, anteriorly feebly bisinuate ..... *serrata* (Burm.).
2. Sternal plate irregularly hexagonal, anteriorly strongly produced *spinigera* (Burm.).

III. *General remarks on the geographical and host distribution of sucking lice.*

The sucking lice parasitize mammals only. Therefore, the composition of the louse fauna of a country depends on the number of mammal species present. Certain mammal groups, however, are less important as they harbour no or very few lice. Thus, no louse occurs on whales; the constant life in salt water and the adaptation of the skin for this water life do not permit any insect to infest this group. The seals of northern seas harbour a few sucking lice; the Swedish Pinnipedia one species only. It is curious that no lice are known to occur on bats, a mammal order rich in species. If the hibernation with very low body temperatures of the host animals does not permit lice to live on them in cold zones, why should not bat lice occur in warm regions? From the Carnivora Fissipedia we know only one species, *viz. Linognathus setosus* (Olf.), a parasite of the domestic dog. Its occurrence is peculiar as it is the one species of sucking lice, occuring normally on terrestrial members of this order. It seems right to assume that the Carnivora Fissipedia were originally devoid of Anoplura and that the dog louse is a fairly recent acquirement, perhaps a »straggler» from some member of the ungulate order Artiodactyla, as most species of *Linognathus* and related genera occur on the Bovids, cattle, sheep, goats, antelopes etc. Note that what is apparently the nearest relative of *L. setosus*, *L. pedalis* (Osborn), occurs on sheep. »It is difficult to avoid the speculative assumption that the long association of dogs and sheep has something to do with this anomalous condition» (*sc.* the occurrence of *L. setosus* on dog) (Ferris, 1932, p. 344).

The Rodentia and the Ungulata are mammal groups, all over the world infested with many sucking lice. It is remarkable that the species occuring on the last mentioned group are as a rule stenotopic (most of them occur on one host only), but the murid lice have often been caught from several hosts.

When studying the mammal orders with respect to infestation with sucking lice, we arrive at the peculiar result that orders chiefly including carnivora lack sucking lice or are parasitized by only a few (secondary?) species; seals are an exception. The bulk of these ectoparasites lives on phytophagous mammals. As it seems open to question whether the phylogeny of the mammal groups can be the reason for this host distribution, there is perhaps a possibility that the nutrition of the host plays or once played a rôle.

As will be seen from the following table there is in Sweden practically the same relation between the number of species in a mammal order and the number of louse species infesting them, as are met with in other parts of Europe.

Insectivora (6 Swedish species)	0 sucking louse species
Chiroptera (12)	0
Rodentia (20)	7
Carnivora Fissipedia (15)	1
Carnivora Pinnipedia (3)	1
Cetacea [1]	0
Ungulata (12)	7
Primates (1)	2

Thus, no lice have been found to occur on the Swedish Insectivora. In Central Europe the *Sorex* and *Crocidura spp.* harbour some *Polyplax* species, but I have not succeded in finding any Anopluran on Swedish shrew-mice.

Theoretically, the distributional range of a parasite ought to be that of its host. In practice it is found, however, that other facts than the presence or absence of the host control the distribution of the parasite. The Swedish botanist Arwidsson who discussed these problems with regard to parasitic plants in 1939 (p. 153) proposes the term homotopic species (»homotope Parasiten») for parasites following the hosts all over their distributional areas and the term heterotopic species for parasites, occuring in only part of the area of the host (»heterotope Parasiten»). I think it is possible to also use these terms in the discussion on the distribution of animal parasites such as the sucking lice. It is a pity, that for most sucking louse species the general distribution, is imperfectly known, and so it is impossible at present for us to give a full account of this question. Therefore, we must be content with a discussion of the distribution of the species within the Swedish boundaries. Several species are here typical homotopic: the human lice, *Echinophthirius horridus* (on seals along Swedish coasts), *Linognathus setosus, L. vituli, Haematopinus suis* and possibly *H. asini.* It is difficult to pick out the heterotopic species, as gaps in the columns of the Catalogue most often indicate want of investigation and not non-occurrence. I think, however, that after comprehensive studies we know the ectoparasitic fauna of the domestic cattle fairly well, and so it cannot be an accident that we have never found *Haematopinus eurysternus* in the northernmost part of the country and never *Solenopotes capillatus* south of the province Västerbotten. The first mentioned species is wide-spread in south Sweden, the second occurs frequently in northeastern Sweden. We know from other parts of its distributional area that *Solenopotes capillatus* is no high land species and it seems curious that it occurs only in this part of the country. This depends, I think, upon the fact that the species is now spreading from eastern parts of Fennoscandia and invading Scandinavia this way.

Fahrenholz (1939, p. 248) advances the opinion (»Arbeitshypothese») that »jede Säugetierart — soweit sie von Anopluren überhaupt bewohnt wird — ihre eigene Läuseart beherbergt», and disagrees with Ferris who in his monograph gives all the hosts established for each species. No doubt, Fahren-

[1] It is difficult to give an exact species number for this group, as most species occur along the Swedish coasts temporarily or accidentally. Lönnberg (1914) gives 17 species as observed in Swedish waters.

holz is right if meaning that each louse species seems to have a typical host, even if it is known to occur on several mammals. It cannot be doubted that many lice are capable of living on several species besides the typical hosts, for instance *Polyplax spinulosa* (typical host *Mus decumanus*; recorded from many other murids all over the world; acc. to Ferris insignificant racial tendencies can be found on the specimens from certain murid genera) and *Neohaematopinus sciurinus* (Mjöberg) (typical host *Sciurus niger*; occuring on many other squirrels in most parts of the world, inhabited by these animals; acc. to Ferris minute racial differences can be studied on parts of the population). Further, it is evident from this that a species which has the ability to invade several more or less closely related mammals as hosts, has not only a considerable power of distribution but also evolutional possibilities greater than the stenotopic species.

IV. *Seasonal and regional variations of the lice populations on the host.*

The topographical location of the ectoparasites has been discussed in general by Eichler (1939, p. 205; 1942, p. 49). Among the lice, he mentions as examples of specific location the species infesting man and the sucking lice of the sheep. As is well known, the first mentioned species have the following normal positions on the host: *Pediculus humanus humanus* (*corporis*) occurs on the garments, *P. humanus capitis* is confined to the hairy scalp, and *Phthirus pubis* is found in the inguinal region (and in the arm pits, on eyebrows and eyelashes). Of the sheep lice mentioned *Linognathus ovillus* Neum. occurs on the body (in the wool) and *L. pedalis* Osb. on the feet (on the short and coarse hair). Craufurd-Benson (1941, p. 343) discusses this question together with the seasonal variations in the lice populations of the English cattle (the species *Haematopinus eurysternus*, *Linognathus vituli*, and *Solenopotes capillatus*). In fact, we meet here a series of problems, intimately connected with each other. When a specific location is present, it is often submitted to seasonal variations, and these changes in the topographical position are connected with variations in the individual numbers of the lice populations.

I think many lice species, living under seasonal environmental conditions, show seasonal changes in the populations, sometimes connected with variations in the specific location. Even in man similar conditions are found (e. g. regarding *Pediculus h. capitis*), in spite of its power of controlling temperature and insolation, according to Buxton (1947, p. 70). At Agra, India, »it was shown that in February, March and early April most men were infested, and the number of lice generally high, but in the second part of April and May, that is to say in the extremely hot, dry weather before the monsoon, infestations were both few and light». The human lice, however, show no changes in location. But this is a very striking feature of the lice on some domestic animals, namely horses and cattle. I have myself studied the conditions in the South Swedish horse. In summer time when the horses graze and are directly exposed to the intense sun light and the temperatures in the coat reach high values, the insignificant populations hide on the long haired parts: at the hoof, at the root of the mane and the tail. In the autumn when the coat grows longer, the population begins to

increase and invade the nearest parts of the body. In winter they multiply rapidly and spread all over the body, but are always primarily to be found on the neck, parts of the brisket and the rump. In our country the optimal conditions for lice seem to commence late in winter and in the early spring. At that time the infestation is most heavy. When the animals begin to graze the populations normally decrease. But if the host animal is in especially bad condition due to underfeeding or ill-treatment the infestation continues to increase. When working with the control of scabies (*Chorioptes bovis* Her. var. *equi* Gerl.) in 1945—1946 I also noted the numerical variations of the sucking lice stock, occuring on three young horses, on a farm in the vicinity of Lund in South Sweden. The observations were made once or twice every month. The results are seen from the following table:

Month	*The density of the lice populations.*
September	Very light infestations (scattered lice occured on two of the animals).
October	Light infestations (lice were found on two of the animals; the third had to be artificially infested).
November	Light infestations.
December	Moderate infestations.
January	Moderate — fairly heavy infestations.
February	Fairly heavy infestations (two animals; one moderately infested only).
March	» » » » » » » » »
April	Moderate infestations.
May	Moderate — light infestations.
June	Very light infestations (lice were found on one animal only).

The seasonal changes in the cattle lice populations are marked, at least in South Sweden. It is difficult to find any louse in summer-time when a few lice hide especially in the tail areas (*Haematopinus eurysternus* and *Linognathus vituli*; *Solenopotes capillatus* is not studied from this point of view, as it apparently does not occur in the southern parts of this country). The increase of the louse stock begins in late autumn and the maximum infestation is reached in spring. Then the lice populations are found on the neck (and the base of the horns and the ears), and on the shoulders and also on the tail areas. As soon as the animals begin to graze the infestation normally decreases, if it has not grown so heavy that the host's power of resistence to further infections cannot be raised again. In the summer the lice are found especially inside the edge of the ears, but also at the base of the horns and the tail. I have made no detailed studies on the seasonal variations of the lice populations of the cattle, as Craufurd-Benson (l. c.) gives a full account of these changes. As is evident from what is mentioned above, my observations on South Swedish cattle agree almost completely with those made by that author.

It is curious that the hog louse shows no definite seasonal distribution in this region, as far as I have been able to ascertain. The lice practically always prefer the skin folds at eyes and ears and the inner side of the thighs. Heavy infestations are met on animals in the sty, even in the summer. Perhaps the reason is simply life in the sty: the indoor effacement of the seasons and the elimination of the effect of sun warmth and light during summer.

The factors affecting the population variations must be connected with the changes of the seasons, as the populations of all species studied increase in winter and decrease in summer. The factors have been discussed in detail by Craufurd-Benson (l. c.). He assumes that the interrelated factors of light intensity and the thickness of the coat of the host animal influence the activities of the lice at all times of the year more strongly than any other factors dependant on the climate, or changes in the condition of the host, affecting the population variations. The temperature is fundamentally the most important factor, but as said, does not limit reproduction of the lice as »any part of the body had a suitable skin temperature for breeding purposes at all times of the year» (p. 351). Craufurd-Benson's discussion seems convincing. Matthysse, however, when treating the similar life history of the cattle biting louse (*Bovicola bovis*) assums that there is a great difference in the skin temperatures in warm weather in the shade and when the animal is exposed to direct sun light. »Even on windy cool summer days the heat effect of direct sunlight for two minutes would raise the skin temperature to 125° F.» (51.°6 C.) (1944, p. 440). Further it was shown that this temperature is lethal within one hour for *Bovicola bovis*. Therefore, Matthysse concludes that »skin temperature is of great importance in influencing the relative abundance of cattle lice in the winter and summer in northern areas».

The general health of the host animal is of little importance for the mere occurrence of the lice: they are found to live on animals in poor health just as on animals in good health and on a sufficient diet. But I have never found that the populations multiply rapidly and cause extremely heavy infestations on such healthy animals. If they are badly fed or otherwise in poor health they tend, however, to be lousy. Then it is often found that the characteristic seasonal variations in location and individual number of the lice populations fail to occur. The divergences are mostly seen as a general overcrowding of the host animal by the lice. The reasons for this break down of the resistance power of the host are somewhat doubtful. Some authors (György 1938, György and Eckardt 1940, and Kartman 1942) have tried to show that the lousiness in laboratory rats, infested with *Polyplax*, is the result of some specific vitamin deficiency. This is not accepted by Buxton (1947) who shows that there is no specific relation to a particular vitamin: »If rats are gravely and chronically ill they allow themselves to become dirty and lousy ... If they are on a sufficient diet and in good health they give constant attention to their toilet and the rat louse remains infrequent.» From my studies on the parasites of Swedish domestic animals I am convinced that the reason for the striking upset of the parasite — host balance, which causes the extremely heavy lousiness, is firstly a decreasing general power of resistence (lowered vitality) and this may be a consequence of several different factors:

1. insufficient care of the animals (under this point we may also cite bad nutrition and vitamin deficiency; during the war a great part of the Swedish domestic animals fed on supply forage resulting in heavy lousiness in winter).
2. bad hygienic conditions in the stables.

3. reduced power of resistance owing to dying or onset of infectious disease, caused by microorganisms.
4. reduced power of resistance owing to dying or onset of infectious disease, caused by internal parasites.

V. *The importance of the Swedish sucking lice infesting man and domestic animals*

with some notes on their control.

The biology and the medical importance of the human lice has been studied by many scientists and is dealt with in a great many papers. A valuable comprehension is »The Louse» by Buxton (1946). The lice of the domestic animals, however, have been studied chiefly with regard to the control of the species and still many details of the biology and the effect of the invasion on the host are unknown.

It must be mentioned that the facts given below are based upon investigations on Swedish lice and thus, details regarding the importance of lice infestations in foreign countries are not included in the discussion, if they are not of interest for understanding the Swedish conditions.

1. The human lice.

Pediculus humanus (L.). — No doubt, both races of this species were in old times frequent in Sweden. The high standard reached in the last 30 years has, however, diminished the number of infestations considerably. The body louse is normally very rare; the few cases observed are distributed among those whose hygienic standard is lowest. Undoubtedly, the head louse is also most widely distributed among poor classes. But it spreads much more easily than the body louse, as it occurs on the school children. At least in certain districts in southern Sweden, the children (most heavily the girls) are frequently infested. Most infestations are light; very heavy remaining infestations are as a rule caused by disabling illness, feeble-mindedness, etc.

No means of control have been spared against these lice. The most persistant and effective, DDT, is now widely used. As it is not toxic to insect eggs, a second application is advisable. Hexachlor cyclohexan (666), which is extremely toxic to lice, is avoided owing to the odour.

Phthirus pubis (L.). — As stated above this species is said by the Swedish physicians to be infrequent in this country nowadays. Normally the crab louse occurs on the hair in the pubic and peri-anal region. It is found also on the thighs and abdomen. We have no Swedish reports indicating an occurrence in the axillae, eyebrows and eyelashes, nor in the scalp or the beard. Thus it seems evident that very heavy infestations with this »papillon d'amour» are rare in Sweden of to-day.

In the last years the control has been very much facilitated by DDT and 666.

2. The lice of domestic animals.

We know 18 Swedish sucking lice species. Of these, half feed on domestic animals: horse (1 species), cattle (3 species), pig (1 species), dog (1 species), goat (1 species), rabbit (1 species), and reindeer (1 species). The lice of the

three last mentioned animals are rare, and will not be discussed here, but the others occur frequently enough to cause loss.

Haematopinus asini (L.), the horse louse, is very widespread in the southern parts of Sweden and occurs frequently especially in the military stables and the studs. I have never found a pure *H. asini*-infestation; the species is always accompanied by the biting louse *Werneckiella equi* (L.).

Sometimes the horse louse infestation grow heavy. Then the host often shows a very characteristic appearance, caused by the lice and the itching of their stings. The horses rub on hard objects and bite the irritated body parts. The skin becomes wounded; it begins to scale and the hair comes off. Small epidermal inflammations are seen. Thus, the late stage is reminiscent of scabies; it is however, slightly distinguished by the absence of callosity. At this stage the Mallophagans and Anoplurans occur in large numbers. Often it is found that the entoparasitic infection has also increased rapidly and the number of strongylids is especially large. The natural tolerance to the parasites is easily broken down by adverse factors, such as internal parasites. The general results of the infestations is a decreasing power of resistance, and this involves a further increase of the parasites. This reciprocal action often continues until the disease ends in the death of the host.

The Swedish cattle lice, *Haematopinus eurysternus* (Nitzsch) and *Solenopotes capillatus* End. are as mentioned above geographically restricted to certain areas, the first one to the southern part of the country, the second one to the northeastern district. The southern as well as the northeastern species is accompanied by *Linognathus vituli* (L.) and the bitting louse *Bovicola bovis* (L.). The last mentioned species is very common and only rarely a lousy cow is found which is not also infested by this parasite. In South Sweden the heavy infestations are all caused by the *Haematopinus*-species and the biting louse, whereas *Linognathus vituli* plays an insignificant rôle. In the northern parts, however, the *Linognathus*-species is most frequent, also in the northeastern area where it is accompanied by *Solenopotes capillatus*.

Heavy louse infestations (»lousy disease») are fairly common among cattle. The irritation of the louse stings makes the animals rub themselves. Hair losses, skin lesions and wounds arise. The skin scales off and often crusts are to be seen, reminiscent of scabies. An increasing entoparasitic infection has not been found among Swedish cattle, severely infested by lice.

The hog louse, *Haematopinus suis* (L.), is common in Sweden. The lice are found especially in the wrinkles at eyes and ears and on the inner side of the hind thigs, where the skin can be easily penetrated. Pigs especially are irritated by louse stings, which cause severe itching. They rub on projecting corners, and they often show erythematous patches.

The dog louse, *Linognathus setosus* (Olf.), is fairly common in certain districts in South Sweden, where scattered heavy infestations are seen. They are practically always pure, as the biting louse *Trichodectes canis* (De G.) is very rare in this country. A slight infestation seems to cause a considerable itching and the dog reacts by scratching and biting. It is curious that this reaction sometimes does not persist throughout the infestation, in my experience. In late stages the animal is feeble and tired; mostly it does not move and the itching sensations have disappeared. Then large numbers

of lice feed on the animal; they are found chiefly around eyes and ears, and on the chest.

It is difficult to survey the economic importance of the lice infestation of the Swedish live stock, and as yet it seems to me quite impossible to sum up the damage and value it monetarily. We know that in certain animals the lice cause losses: most important in horses and cattle. As death from lousy disease, in my experience, overtakes only some few animals a year, this fatal pediculosis must be fairly rare in Sweden now (the reason is the general use of DDT and 666).

The economic damage is, I think, first recognized in the reaction of the host on the infestation. In 1946 I discussed the consequences of attacks of arthropod parasites (excl. scabies) on the domestic animals and from this I take the following summary. Thus, the lice cause:

A. Primary injuries (the direct parasitic effect on the host).
   1. The presence of a large number of lice disturbs and troubles the host. The general state of health is influenced. The host's capacity for work and production (e. g. milk) is reduced. The yield is lowered.
   2. The piercing of skin and the taking of blood, just as the parasites' creeping over the body, often cause a heavy skin irritation. The host tries to assuage the pain by rubbing and biting the itching parts of body. In the more serious cases the result is eczema, and further the scratching damages the skin which becomes infected by micro-organisms (a serious dermatitis).
   3. Heavy infestation, the blood taking causes anaemia esp. in young animals.
   4. Save for exhibition animals, the damage to the coat by the parasites' faeces, dead parasites, eggs, cutaneous scales and the twisted knots of the hair are less important. For the sheep breeder, however, the damage to the wool is a heavy loss.

B. Secondary injuries (possible results of the lice infestation; upsetting of the host — parasite balance may produce disease acc. to 3 and 4).
   1. Certain species transmit diseases, as the human louse (*Pediculus humanus*: epidemic typhus, trench fever, and relapsing fever). The hog louse is known to spread swine fever and anthrax, and the horse louse, *Haematopinus asini*, may spread infectious anaemia.
   2. Certain species may transmit intestinal parasites.
   3. A heavy louse infestation is often accompanied by a low general state of health. The internal parasites, esp. the strongylids, are provided with an opportunity to invade in large amounts. It happens that a strongylosis is added to the pediculosis.
   4. The low state of health and the reduced resistence bring increasing risk of subsequent infections from microorganisms.

In many cases the secondary damages caused by the infestation are more important from an economic point of view than the immediate effect of the attack. The upset of the natural resistance to parasitic invasion often results in infections with helminth parasites or microorganisms which have much more fatal consequences than the lice infestation itself.

3. The control of lice of domestic animals in Sweden.

The control of lice has been very much facilitated in the last years by DDT (dichlor diphenyl trichlorethane) and especially 666 (hexachlor cyclohexan). In the years 1943—1945 we used only DDT in this country. From the beginning it was used on a large scale in the field. For instance in the winter of 1944—1945 we treated 25.000 animals (cattle, horses, sheep, goats) coming with refugees from Finland. No doubt, it was great progress in comparison with previous control methods. It was found, however, that the application of dry DDT was not always infallible — not because of low toxicity of the powder but because of the difficulties of distributing it all over the lousy animals. If the grooms had to dust a large number of animals it often happened that minor parts of the body, which were difficult to get at were left untreated and then the louse survived there, even after a second later application necessitated by the fact that DDT is not ovicidal. But when 666 was added, these results of insufficient treatment disappeared. In the laboratory we recognized that the dry material (the pure gamma isomere) was about 100 times more toxic to the horse louse than the DDT compound previously used. Another important reason for the beautiful results in the field was found to be the volatility of the material. The air in the coat of the host animal becomes intermingled with 666 gas, and so the insecticidal effect increases, and even undusted parts are reached. Previously, when only DDT was available, we used to recommend two or more often three applications for large stocks to be sure of the results. Now the DDT- 666 compound permits us to stop after two or even one application.

Thus it is obvious that the volatility of the hexachlor cyclohexan is advantageous to the veterinarian's use of this material as the slow ventilation of the coat of hair involves a considerable gas effect which is not attained with the non-volatile contact insecticide DDT. As has been shown by Sylvén (1947) and others 666 may add little to the DDT when used in the field for plant protection. Often wind can carry the toxic gas away, and the contact effect of the material left is often not greater than that of DDT — as this already gives a very high per cent mortality.

The toxicity of DDT and 666 to mammals can be demonstrated in the laboratory. There, in experimental animals it is easy to produce symptoms of poisoning by using large doses in a solvent. The dry material, however, is safe, just as the solutions and emulsions used for control in the field. It is reassuring that we have no records of injury to man or live-stock, though the materials have been used on a very large scale in the field in recent years.

VI. *Swedish collection data.*

As is mentioned in the introduction to the Catalogue I have examined not only the material in the Swedish museums of natural history but also specimens I have obtained in the field, or from individuals and laboratories, interested in the investigation. Further we have sent a questionnaire to the Swedish physicans and veterinarians and obtained samples of lice and information about the occurrence of species of medical importance. Most people who have contributed with material or communications are mentioned in the following list. Further information is given where the material, when

preserved, is to be found. There I have used the following abbreviations: RM (State Museum of Natural History; Riksmuseum, Stockholm), ML (the Entomological Museum of the Zoological Institute, Lund), MU (the Zoological Institute, Uppsala), MG (the Museum of Natural History, Gothenburg), IPI (the Swedish Institute for Plant Protection; Statens Växtskyddsanstalt, Stockholm), SVL (the State Veterinary Laboratory, Statens Veterinärmedicinska anstalt, Experimentalfältet), RVI (the Royal Veterinary Institute, Stockholm), PLM (the Parasitological Laboratory of the Agricultural Society, Malmö), and Bk (collectio Brinck).

1. *Echinophthirius horridus* (Olf.). — Sk.: Scania, 2 specimens, coll. ML. Further there are in the Lund collection 3 old specimens, dated $^{15}/_{7}$ 1837, and labelled Scania, Lund. — Vg.: Dörjeskär, archipelago of Gothenburg, 3 specimens on *Phoca vitulina*, $^{2}/_{7}$ 1909, leg. L. A. Jägerskiöld, MG; Gothenburg many specimens on *Phoca vitulina*, $^{10}/_{7}$ 1936, leg. T. Hansson, coll. MG. — Boh.: Björkö, 4 specimens on *Phoca vitulina*, $^{25}/_{7}$ 1904, coll. MG. Sdm.: Utö, 2 specimens on *Phoca hispida*, coll. Bk. — Upl.: Archipelago of Stockholm, 1 specimen, coll. RM. — Vb: Umeå, Holmön, 1 specimen on *Phoca hispida*, $^{3}/_{6}$ 1939, leg. N. A. Kemner, coll. ML. — Nb.: Luleå, several specimens on *Phoca hispida*, coll. ML. — Further Koffman (1944, p. 138) mentions that the has examined material from *Phoca vitulina* from the southern (Swedish) parts of the Baltic Sea.

2. *Enderleinellus nitzschi* Fahr. — Sk.: Vankiva, $^{24}/_{1}$ 1939, many specimens on *Sciurus vulgaris*, leg. A. Lundström, coll. ML. — Upl.: Stockholm, 3 specimens on *Sciurus vulgaris*, leg. E. Mjöberg (published by Mjöberg, 1910, p. 159, *sub nom. Polyplax sphaerocephala* Burm.).

3. *Polyplax serrata* (Burm.). — Sk.: Malmö, $^{}/_{5}$ 1944, many specimens, leg. P. Brinck, coll. Bk., ML. — Vg.: Gothenburg, $^{12}/_{2}$ 1944, 3 specimens, leg. P. Brinck, coll. Bk. — Upl.: Stockholm, $^{}/_{12}$ 1939—$^{}/_{1}$ 1940, many specimens, leg. N. Noréhn, coll. ML. — All the specimens were caught from white, domestic mice. — Further O'Mahony (1944, p. 60) publishes the following finding: Upl.: Uppsala, on *Apodemus s. sylvaticus*.

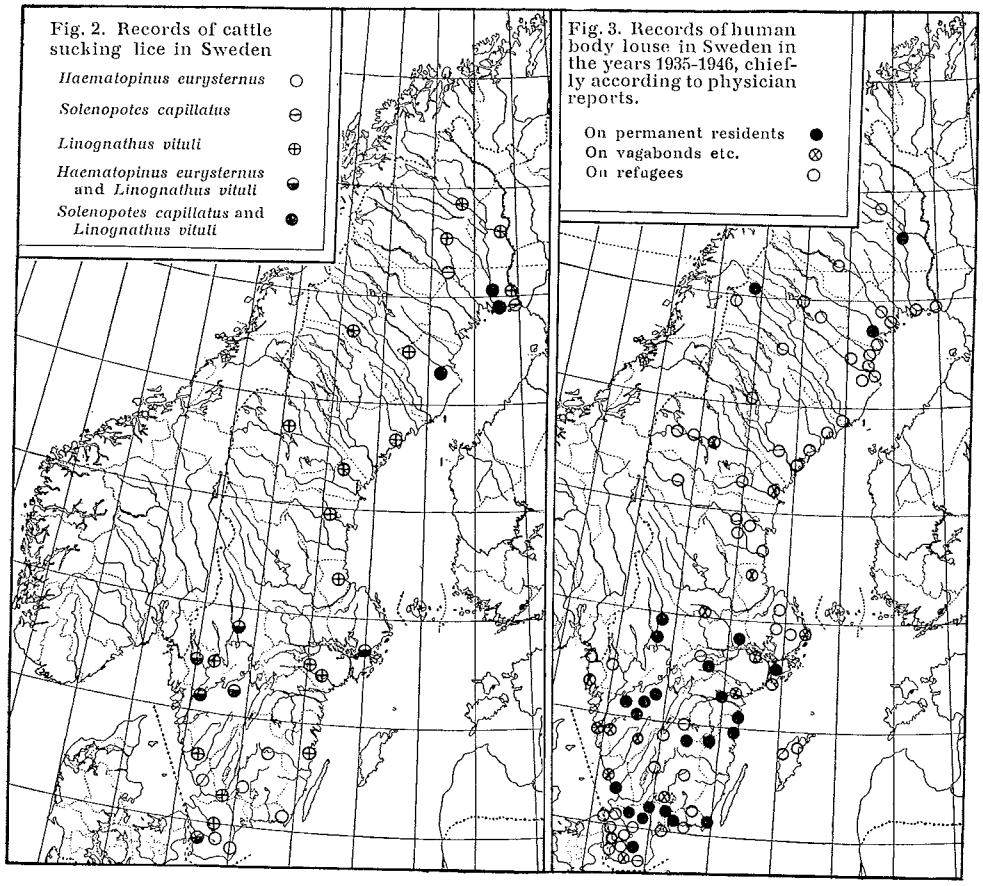
4. *P. spinulosa* (Burm.). — Sk.: Malmö, $^{23}/_{3}$ 1945, 2 specimens on *Mus decumanus*, coll. Bk. — Hl.: Svartrå, 2 specimens on *Apodemus s. sylvaticus*, leg. Brodén, coll. MG. — Upl.: Stockholm, many specimens on *Mus decumanus*, leg. E. Mjöberg, coll. RM.

5. *P. spinigera* (Burm.). — Hl.: Svartrå, several specimens on *Arvicola terrestris* (*amphibius*), leg. Brodén, coll. MG.

6. *Hoplopleura acanthopus* (Burm.). — Sk.: Falsterbo, $^{20}/_{6}$ 1942, many specimens on *Microtus agrestris*, leg. Y. Melander, coll. ML.; Skanörs Ljung, several specimens on *Microtus agrestis*, leg. Y. Melander, coll. ML.; Malmö, $^{5}/_{11}$ 1944, 2 specimens on *Microtus agrestis*, leg. N. A. Kemner, coll. ML. — Hl.: Svartrå, 1 specimen on *Microtus agrestis*, leg. Brodén, coll. MG. — Sdm.: Gripsholm, many specimens on *Microtus agrestis*, leg. A. Tullgren, coll. IPI. — Upl.: Uppsala, on *Mus musculus* (after Ferris, 1921, p. 65; the host published *sub nom. Mus spicilegus*). Vrm.: Munkebol, $^{20}/_{5}$ 1939, several specimens on *Evotomys glareolus*, some larvae on another example of this rodent, leg. A. Lundström, coll. ML. — Jmt.: without further locality, on *Microtus agrestis* (acc. to Ferris, 1921, p. 65).

7. *Haemodipsus ventricosus* (Denny). — Sk.: Vankiva, $^{6}/_{2}$ 1940, several specimens on *Oryctolagus cuniculus*, leg. A. Lundström, coll. ML. — Sm.: Lessebo, $^{22}/_{2}$ 1940, 1 specimen on *Oryctolagus cuniculus*, leg. A. Lundström, coll. ML. — Upl.: Stockholm, 2 specimens on *Oryctolagus cuniculus*, leg. E. Mjöberg.

8. *H. lyriocephalus* (Burm.). — Jmt.: Hosjö, Sundsjö parish, winter 1943, on *Lepus timidus*, shot by O. Odsten, leg. M. Koffman, coll. SVL.



9. *Linognathus setosus* (Olf.). — Sk.: Malmö, (P. Brinck, N. Burrau, N. A. Kemner), Lund (P. Brinck, E. Fornmark), Hörby (L. Axelsson), Teckomatorp (O. Botvid), Eslöv (E. Nihlén), Örkelljunga (G. Nilsson), Kattarp (J. Persson), Kristianstad (J. Holmquist), Ystad (N. O. Persson), Löderup (G. Lindahl), Vollsjö (S. Erlandsson), Brösarp (A. Neander). — Bl. Sölvesborg (S. Mattson), Lyckeby (B. Ekestubbe). — Sm.: Gamleby (E. Särne), Tingsryd (A. Garmer), Lenhovda (H. Pewe), Alvesta (I. Hässler), Emmaboda (G. Nordström), Säfsjö (E. Björkman), Målilla (Y. Lange), Nybro (C. Lexner). — Ög.: Brokind (R. Ollén), Norrköping (G. Johansson), Ödeshög (S. Mårtensson). — Vg.: Jörlanda (K. Allansson), Ulricehamn (A. Lindelöf), Rävlanda (G. Magnusson), Vartofta (M. Borglin), Götene (H. Magnéli), Göteborg (Chr. Ottander). — Hl.: Halmstad (G. Fagerberg). — Dls.: Bengtsfors (E. Gawe). — Sdm.: Drottningholm (H. Sandefeldt). — Upl.: Tierp (R. Floderus), Alunda (G. Åsbrink), Uppsala (P. Ekman), Skärplinge (E. Högwall), Stockholm (E. Mjöberg, M. Koffman, U. Plasikowski). — Vstm.: Östervåla (A. Andersson), Arboga (J. O. Engfeldt), Västerås (V. Snöberg), Sala (S. Elzén). — Nrk.: Fjugesta (N. Jacobsson), Karlskoga (H. Nystedt), Kopparberg (B. Laurell). — Gstr.: Gysinge (W. Almgren), Gävle (P. I. Rönnmar). — Hls.: Delsbo (C. A. Thunholm), Ljusdal (H. Dahlgren), Söderhamn (I. Åstrand), Edsbyn (E. Byhlén). — Vrm.: Kil (O. Sultan), Uddeholm (I. Peterson). — Dlr.: Orsa (J. Thalén), Malung (S. Eriksson), Fors (A. Olsson),

Älvdalen (Å. Johansson). — Hjd.: Sveg (K. E. Söderberg). — Jmt.: Bredbyn (N. Engquist), Månsåsen (G. Castler), Offerdal (P. Hemmingsson), Strömsund (A. Malmqvist), Bräcke (S. Westerlund), Ragunda (K. Nilsson), Svensta (S. Svensson). — Med.: Liden (H. Fredriksson). — Ång.: Örnsköldsvik (S. A. Andersson), Backe (B. Sundin). — Vb.: Bjurholm (T. Dahlström), Nysätra (K. E. Dolk). — Nb.: Haparanda (E. Lindeman). — Ly. lpm.: Storuman (S. Svensson). — The species occurs frequently in all Swedish collections.

All the above mentioned records are based upon material or information on material from the domestic dog. The following findings represent abnormal occurrence: Sk.: Kågeröd, 3/4 1946, 3 specimens on domestic fox, leg. et coll. Bk.; Malmö, Sjölunda, 25/3 1942, 1 larva on *Apodemus s. sylvaticus* (among many *Polyplax spinulosa*), leg. E. Hansen-Melander, coll. Bk.

10. *L. stenopsis* (Burm.). — Sk.: Lund, 4/5 1946, 1 specimen on *Capra hircus*, leg. et coll. Bk. — Upl.: Stockholm, on *Capra hircus*, leg. E. Mjöberg, coll. RM.

11. *L. vituli* (L.). — Sk: Malmö, 8/11 1942, leg. et coll. Bk.; Höör, 4/3 1943, coll. ML. — Hl.: Källsjö, coll. ML. — Sm.: Mörtfors, leg. J. Locrantz, coll. ML; Markaryd, coll. ML. — Vg.: Skara, coll. PLM. — Dls.: Bengtsfors, leg. E. Gawe, coll. PLM. — Sdm.: Katrineholm, leg. E. Säfholm, coll. PLM. — Upl.: Drottningsholm (H. Sandefeldt), Stockholm, coll. RVI. — Gstr.: Gävle, leg. P. Rönnmar, coll. PLM. — Hls.: Delsbo (C. A. Thunholm), Ljusdal (H. Dahlgren). — Vrm.: Deje, /2 1945, leg. B. Möller, coll. PLM; Säffle (S. Nilsson). — Med.: Liden, leg. H. Fredriksson. — Jmt.: Bredbyn (N. Engquist). — Ång.: Örnsköldsvik, /4 1947, leg. S. Svensson, coll. PLM. — Vb.: Burträsk, 11/4 1945, leg. H. Westermarck, coll. PLM, ML; Norsjö, 2/2 1944, leg S. Andersson, coll. PLM. — Nb.: Ylmilä, 19/2 1945, leg. G. Rönnbäck, coll. PLM, ML; Luleå, 27/1 1945, leg. N. G. Enequist, coll. ML; Karungi, 4/3 1945, leg. N. Eneryd, coll. PLM, Bk; Pajala, 17/1 1945, leg. T. Andersson. — Ly. lpm.: Storuman, leg. Sven Svensson. — Lu. lpm.: Gällivara, 5/3 1945, leg. P. Fohlin, coll. PLM, Bk. — To. lpm.: Vittangi, coll. PLM. — All samples originate from domestic cattle.

12. *Cervophthirius tarandi* Mjöb. — To. lpm.: on reindeer from Karesuando. (Original record, material lost).

13. *Solenopotes capillatus* End. — Vb.: Burträsk, 11/4 1945, leg. H. Westermarck, coll. PLM. — Nb.: Nederluleå, 11/2 1945, coll. PLM, ML; Kalix, Hällan, 5/3 1945, leg. E. Persson, coll. ML, Bk; Morjärv, 13/3 1945, leg. E. Persson, coll. ML, Bk. — Lu. lpm.: Murjek, 12/4 1945, leg. N. Svensson, coll. PLM. — All samples originate from domestic cattle.

14. *Haematopinus asini* (L.). — Sk.: Torna Hällestad, 3/2 1938, leg. N. A. Kemner, coll. ML; Malmö, /4 1941, /3 1944, /1—/4 1945, 27/2 1946, leg. P. Brinck, Bo Karlsson, coll. PLM, ML, Bk; Hässleholm leg. C. Bertilsson & I. Garpman; Kristianstad, leg. C. Bertilsson & I. Garpman; Hälsingborg, 10/3 1945, leg. P. Brinck, coll. Bk. — Hl.: Halmstad, leg. T. Hallenborg. — Sm.: Växjö, 13/3 1946, coll. PLM. — Vg.: Skara, 6/5 1941, leg. U. Bergström, coll. ML. — Sdm.: Stockholm, 22/3 1941, leg. F. Nilsson, coll. ML. — Upl.: Stockholm, 10/4 1941, leg. E. Eriksson, /3 1943, leg. M. Koffman, coll. ML. — Jmt.: Östersund, coll. ML. — Vb.: Burträsk, 11/4 1945, leg. H. Westermarck, coll. PLM. — Nb.: Boden, 19/4 1941. leg. A. Fahlquist, coll. ML. — All samples originate from domestic horse.

15. *H. eurysternus* (Nitzsch). — Sk.: Malmö, winter 1944—1945, leg. P. Brinck, coll. PLM, ML; Torna Hällestad, 4/12 1945, leg. N. A. Kemner, coll. ML; Hörby, /4 1940, leg. O. Persson, coll. ML; Tommarp, coll. PLM; Veberöd, 10/11 1946, leg. Å. Jeppsson, coll. PLM. — Bl.: Lyckeby, leg. B. Ekestubbe, coll. ML. — Hl.: Halmstad, leg. T. Hallenborg, — Sm.: Vetlanda, 3/4 1944, leg. E. Hansson, coll. PLM; Målaskog, /4 1948, leg. A. Gustafsson. — Vg.: Skara, coll. Bk; Lilla Edet, leg. T. Andersson. — Dls.: Bengtsfors, every winter acc. to E. Gawe. — Upl.: Stockholm, leg. et det. M. Koffman, coll. SVL. — Vrm.: Deje,

/2 1945, leg. B. Möller; Deje, coll. SVL. — All samples originate from domestic cattle.

16. *H. suis* (L.). — I have 181 records of this species, based upon material or reports from all the Swedish provinces. I think it is unnecessary to take up space and give them all here. The species occurs frequently and is homotopic: it follows the host (the domestic pig) from the low land in the south up to the mountain chain in the northwestern part of the country.

17 a. *Pediculus humanus* subsp. *humanus* L. — In April 1945 the Swedish Directors of the Medical Department (Medicinalstyrelsen) sent a circular to the official physicians in this country asking them to give information on the occurrence of human lice in their districts. I am much obliged to the Board which let me study the results. To complete them we sent a form with questions to the physicians from the Zoological Institute in Lund. We received answers on the louse occurrence from most of them. The physicians were asked to inform us about the cases they had met in the last 10 years. This was done in August, 1946, and thus we got information on the influence of the war conditions and the importance of the stream of refugees from this point of view. As it is difficult for many physicians to make out differential diagnoses on their journeys in the districts, which are especially vast in the northernmost part of Sweden, I think some of the original notes on the body louse may be incorrect. We have however, disregarded all records which are given as doubtful by the physicians or seem to us to be uncertain. As we had to verify several of the remaining identifications, when the lice were handed over to the laboratory during the war, it seems probable that the material given below is reliable.

In the following list the records from each province are placed into three groups:

I. Records from refugees coming from other countries [1].
II. Records from people not at home at the place where they have been examined (vagabonds, gipsies, circus artists, soldiers a. s. o.)[1].
III. Records from permanent residents; here the physicians specifications of the cases are cited.

Sk.: I. Malmö (R. Huss), Lund (M. Hansson), Hälsingborg (P. Brinck, E. Olsson), Ystad (G. Karström), Limhamn (N. Ekberg), Eslöv (H. Blomstedt), Båstad (L. Ströbeck), Höganäs (H. Widding). — II. Lund (O. Johansson), Hässleholm (E. Wifeldt), Svedala (G. Lenningen). — III. Örkelljunga (M. Ahlberg: some cases), Osby (K. Rosén: rare, Veberöd (A. Eriksson: one case only), Broby (G. Herner: very rare).

Bl.: I. Ronneby (B. Hedlund), Eringsboda (R. Bengtsson), Sölvesborg (S. Jerre). — III. Kyrkhult (S. Elowsson: in rare cases), Kristianopel (the Board: 2 tenements), Karlskrona (the Board: 1 case).

Hl.: II. Falkenberg (B. Helldal). — III. Halmstad (A. Jeppsson: one or two cases a year).

Sm.: I. Tranås (R. Kempe), Jönköping (K. Bergström), Värnamo (G. Lundskog), Lenhovda (G. Nilsson), Växjö (Bergström). — II. Ryd (K. Jonsson). — III. Eksjö (Nils Nial: twice), Växjö (Bergström: 1 case, an old woman), Vimmerby (J. Castenfors: 1 case in 18 years).

Öl.: no records.

Gotl.: I. Slite (T. Funck), Visby (E. Fries, Å. Nordlander).

[1] Groups I and II are not accounted for in the Catalogue.

Ög.: I. Norrköping (I. Wildner). — III. Ödeshög (H. Wiberg: rare), Gryt (E. Sundqvist: on old unhygienic men), Ö. Ed (E. Sundqvist: on some school children), Valdemarsvik (the Board: 3 cases in a family), Norrköping (the Board: 1 case in 1943, 1 case in 1945).

Vg.: I. Mölndal (the Board: 1 tenement). — II. Gothenburg (Spaak), Mölndal (E. Björck), Ulricehamn (V. Arfwidsson). — III. Skara (G. Hallbäck: extremely rare), Vara (J. Hultén: some cases during the last 24 years), Herrljunga (some cases yearly), Grästorp (K. Lagerborg: rare).

Boh.: I. Strömstad (G. Hegadt). — II. Fjällbacka (Bergsten).

Dls.: I. Ed (A. Jonsson).

Nrk.: I. Odensbacken (S. Roman), Laxå (E. Lychou). — III. Örebro (R. Zachrisson, the Board: 1 case), Askersund (S. Wåhlstedt: 1 case during 4 years, old people living under very dirty conditions).

Sdm.: I. Nyköping (S. Bissmarck), Södertälje (L. Rydmark). — II. Nyköping (J. Molander) Stockholm (the Board). — III. Västerhaninge (I. Wallerström: some cases), Nynäshamn (the Board: 1 case).

Upl.: I. Rimbo (N. Magnusson), Uppsala (O. Wåhlin), Dannemora (O. Oredsson). — II. Norrtälje (A. Birke), Stockholm (the Board).

Vstm.: III. Västerås (G. Andrén: rare).

Vrm.: III. Munkfors (S. Halle: rare), Deje (O. Ohlén: some cases).

Dlr.: II. Ludvika (T. Kjellin).

Gstr.: II. Ockelbo (de Ron).

Hls.: I. Färila (E. Kullander), Söderhamn (F. Fex), Delsbo (Å. Bergström), Ljusdal (T. Sundberg).

Med.: I. Fränsta (J. Wersäll). — II. Alnö (S. Lindahl).

Hrj.: I. Hede (J. Wallman).

Jmt.: I. Duved and Mattmar (W. Ivarsson). — II. Östersund (F. Grahn).

Ång.: I. Alfredshem (K. E. Lundquist), Sollefteå (E. Willén), Ullånger (C. Smith), Hoting (H. Brismark), Bjästa (E. Åkerblom), Nordmaling (M. Lagerlöf).

Vb.: I. Boliden (E. Thyselius), Umeå (G. Cedergren), Bureå (A. Hultman), Lövånger (B. Qvarnström), Burträsk (A. Fagerström), Skellefteå (G. Falk), Byske (O. Lindahl).

Nb.: I. Haparanda (A. Mörtberg), Öjebyn (L. Ekblom), Nederkalix (J. Kallander), Luleå (O. Thelander), Älvsbyn (T. Fritjofsson), Övertorneå (W. Woller). — II. Kalix (the Board). — III. Piteå (P. Söderbaum: a family), Tärendö district (B. Ohlsson: in some villages).

Ås. lpm.: I. Vilhelmina (N. Björkman).

Ly. lpm.: I. Tärna (G. Klingspor). — III. Ammarnäs (the Board: some families).

Pi. lpm.: I. Arvidsjaur (S. Asklin), Arjeploug (S. Wallqvist).

Lu. lpm.: I. Jokkmokk (M. Lindblad).

To. lpm.: I. Wittangi (F. Englund).

It is interesting to study this list. Most records are found in the group I (refugees): 62. In some provinces, especially in south Sweden (Scania) and northeastern Sweden (Västerbotten and Norrbotten), where the bulk of the refugees entered the country, each record represents several examined cases. During the last years of the war many of the physicians districts in these provinces harboured 500—1500 refugees each. They came from Denmark, Germany, Poland, the Baltic States, Finland, and Norway and represented a dozen nationalities. Especially those coming from Central Europe had undergone great privation. Mostly, the louse stock on the refugees did not

get the possibility of straggling over to the residents. In some cases, however, it has been reported that body lice for a short time settled on Swedish people: in the districts Arvidsjaur (S. Asklin), Skellefteå (G. Falk), Lövånger (B. Qvarnström), and Boliden (E. Thyselius). In another case (district Malmö) lice went over to the attendants on the sick.

The records in group II are fairly few: 18 items. As is mentioned above they originate from vagabonds and other people without permanent residence.

Group III (cases among the permanent residents) is also small: 27 records. Further it is notable that these records practically all base upon one or very few cases, examined in the last 10 years. Thus, it seems straight forward to state that the body louse is rare in Sweden.

To make the results of the investigation clear we have assembled the records on a map, where the three groups are marked with different signs (fig. 3). From this it is evident that the refugees brought a large louse stock to Sweden during the last war. They concentrated in the southern and north-eastern part of the country; there we find the sign on the map especially along the coast where the stream was stopped. It seems, however, that it was impossible to stop the lice entering the inner part of the country with the refugees, when they left the coastal cities. We have several records from encampments in Central Sweden. Further we have a series of records along the boundary between Norway and Sweden, representing refugees coming from the west.

17 b. *P. humanus* subsp. *capitis* De G. — I have collected 325 records from all Swedish provinces. I think it is unnecessary to give them here. No doubt, this species has for a long time been the most frequent of the human lice, in Sweden. According to the reports of the physicians it is now not so common in most districts, as we have in recent years got a better chance of controlling the species. But, in southern Sweden at least, it must be fairly common among the school children, as many school-masters have sent us samples and told us that practically each class with young children is some time infested.

18. *Phthirus pubis* (L.). — This species is represented with 263 records from all Swedish provinces. No doubt, it was previously a common species. According to the reports of the physicians it is now fairly rare among the permanent residents; most cases are met with among vagabonds, soldiers and prostitutes.

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