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INSECTS INJURIOUS IN 1896.

ST. ANTHONY PARK, RAMSEY COUNTY, MINNESOTA.

University of Minnesota.

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INSECTS INJURIOUS IN 1896.

OTTO LUGGER

THE CHINCH-BUG IN 1896.

During the early part of the year 1896 but comparatively few chinch-bugs could be found in our state, and owing to the general wet spring many of those that had wintered over successfully became infected with a disease and died. This happy condition did not, however, prevail everywhere, and some of the counties along the Mississippi and Minnesota rivers started with a fairly large number of these pests. Whether it is a coincidence or not one thing became very apparent: wherever large numbers of the disease-spores had been scattered during 1895, few chinch-bugs survived autumn, winter and spring; and in some localities, where the bugs had been exceedingly numerous before, but few, if any, could be found early in 1896. Numerous letters that were received from farmers living in such localities plainly proved that the bugs had gone, had been killed by a disease, and on that account fewer boxes with disease-spores were asked for in such places than the entomologist would have been glad to distribute, if only to make assurance doubly sure. It is a very unfortunate fact that if farmers do not actually suffer losses caused by insects they will not apply remedies against the few they know to be in their fields, simply because these can not cause any great damage; they do not bear in mind the wonderful fecundity of their enemies and how rapidly they can multiply again and overrun their fields. It is this fact that, among other things, has assisted the destructive potato beetle in 1896, and enabled it to multiply so that next year it will again become numerous enough in many fields to cause losses. It

would be wrong, however, to claim that farmers alone did not take time by the forelock; we all are apt to neglect precautions, and later have to suffer the consequences.

The climatic conditions of the season of 1896 were such that the chinch-bug disease worked to the satisfaction of all who tried it conscientiously, and if it had been more generally employed in all infested counties, a chinch-bug plague could have been prevented for a great number of years, as most of the few found in our fields could have been killed.

Soon after the abundant spring rains had ceased, and the soil had become dry and warm, a continuous southern wind set in, and this wind brought with it large numbers of chinch-bugs. In some cases it actually "rained" chinch-bugs, and in this manner many localities became again infested. With normal weather the first generation of these insects could not, however, become numerous enough to cause any serious losses to the small grains. A circular sent out at this time awoke many farmers to the fact that spores of the chinch-bug disease could be had free of charge, mailed to their post-office, simply for the asking; and numerous boxes were mailed in consequence. Where the contents of these boxes were used according to the directions and thoroughly applied, success followed; at least many letters received at that time so stated, and it was too bad that many more farmers did not at least try this remedy. Of course those that expected success by simply putting a pinch of such spores here and there in their fields did not succeed, nor did they deserve to do so. No one can expect success who does not diligently and intelligently work for it! As long as there was a fair amount of moisture in the soil, just so long the introduction of disease-spores proved a success; but as soon as our dry summer commenced the disease spread only in exceptional cases, and so slowly as to do but little good. The continuous dry weather assisted the chinch-bugs very materially, though they caused but very little injury to the small grains, with the exception of a few localities especially favorable to these sun-and-heat-loving insects. In some places the corn was invaded and suffered more or less. As the autumn of 1896 was also a re-

markably dry one, everything was in favor of the chinch-bug, and consequently large numbers are now with us snugly hidden in such shelters in which they spend the winter.

The counties that suffered most from the insects were Dakota, Goodhue, Wabasha, Winona and Scott, all, with the exception of Scott county, located in the Mississippi valley. Two boxes of spores, with instructions, were mailed to each applicant and the following table shows how many farmers applied for them in different counties:

Blue Earth county.....	16 farmers.
Brown county.....	62 "
Carver county.....	11 "
Chisago county.....	14 "
Dakota county.....	194 "
Dodge county.....	14 "
Douglas county	8 "
Fillmore county.....	32 "
Goodhue county.....	56 "
Hennepin county.....	36 "
Le Sueur county.....	21 "
Norman county.....	7 "
Olmstead county.....	27 "
Rice county.....	37 "
Steele county.....	8 "
Scott county.....	113 "
Wabasha county.....	238 "
Washington county.....	152 "
Winona county.....	187 "
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Total.....	1,233

Farmers living not too far from the State Experiment Farm called there and received large jars or boxes filled with spores, and many owners of mills and of drug-stores also obtained spores in bulk, so that they could distribute them among farmers living in their neighborhood. Owing to the liberality of the state, very large numbers of such spores can be produced very rapidly, and there is now no excuse for not trying this remedy on a fairly large scale. The spores were grown as in 1895 in glass jars upon a mixture of sterilized corn-meal and beef-tea. As long as fresh these spores are very active, but they can not be kept over winter without losing their vitality. This was disclosed by a number of ex-

periments. The jars containing such spores were kept over winter in warm rooms, cold rooms, and out of doors; in either case the spores could not be made to germinate in spring, and only those that were taken from the bugs killed by the disease could be successfully utilized to start fresh cultures.

The question is often asked: does this fungus, the spores of which are distributed, always kill the bugs? The more the writer and his assistant have worked with this plant the less do they feel satisfied with it as a remedy upon which we can depend. No doubt immense numbers of chinch-bugs are covered with the fungus in the fields where the disease is found, but the question naturally arises: does the disease kill healthy bugs or only those that are already feeble and that would die whether the disease was present or not? Notwithstanding the many very favorable reports received from farmers that have used the spores it remains still an open question whether it is not after all safer to use the other remedies proposed in the First Annual Report than to depend entirely upon the introduction of spores.

Fig. 1 (plate I) shows this injurious insect in its different stages of growth. A single egg is shown in *a*, as well as others upon the roots and upon a lower leaf. In *b* is shown the very young bug, and in *c*, *d*, and *e* the later stages, while *f* shows the adult and mature insect. All the figures are enlarged; their natural size is indicated, however, by the hair-lines near them, and bugs, natural size, are also shown upon the stems of the infested plant.

THE FRIT-FLY.

(*Oscinis soror* Macq.).

During the summer and early part of the fall numerous letters were received from many parts of the state, in which the writers complained about minute worms which infested the stems of wheat just above a joint from three to four inches above the ground. The specimens received at the same time showed that, as a general rule, the first and second joints of the plant were infested. Some farmers complained that their crop of wheat was thus very materially

reduced. The plants harboring these worms did not indicate their presence until flowering time, but as soon as the head began to form, the stem above the injured joint wilted, turned yellowish and soon broke down entirely by bending over the infested spot. All sorts of explanations were given at the time, such as too rapid growth of the plant on account of excess of moisture in spring, lack of strength in the stem, a blistering hot sun, and numerous other ones. But when the infested stems were investigated it was found that the worm had weakened them to such an extent, that when the head was formed the plant became top-heavy, and broke down at the weakest spot from force of gravity. This breaking down was not observed by most farmers, but the damage became visible after the grain had been cut and removed, when very many heads of wheat were found upon

the ground, which had broken down before harvest, and which consequently were not cut by the reaper. These heads were either entirely empty or filled with berries more or less badly shrunk. The bent or partly broken stems were as a general rule still adhering to the lower portion of the plant. This bending or breaking had taken place most frequently above a node or joint about three inches from the ground. Just below this breakage, and immediately above the joint, the culprits were

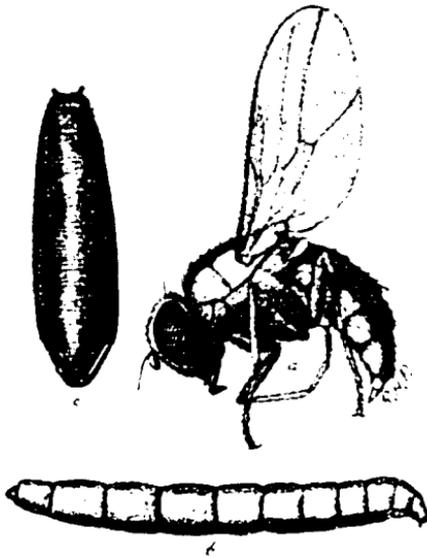


Fig. 2.—Frit-fly: *a*, adult fly; *b*, larva or maggot; *c*, puparium. Greatly enlarged, the mark under fly indicating natural. Original.

found. In most cases but one puparium, but in a few cases two, three, or even more puparia could be detected. Such a puparium (fig. 2, *c*) is the contracted and hardened skin of the larva or worm; it is of a glossy chestnut-brown color,

shading to yellowish-brown toward the smaller end. If closely inspected it shows faint traces of sutures or segments. The illustration (fig. 2) shows the different stages of the insect far better than words can describe them. These seed-like objects contain at this time (Oct.) whitish larvæ, or worms; and no pupæ have been detected inside of them up to this date. The larva, or worm, is also illustrated in fig. 2, *b*; it is of a greenish-white color when alive and just removed from the culm.

These puparia are very similar to those of the Hessian-fly in its "flax-seed stage" and their resemblance has given color to the belief that this injurious insect had found a home with us, which unfortunately proved true, as will be shown later. Judging from the fact that only pupæ can be found at this time it would appear as if this insect hibernates in that stage. This is really the only one in which it could well pass our northern winters, being in that stage well protected by its old and thickened skin and by the stem of the plant. The puparia are inserted in the material of the upper part of the node, inaccessible to any moisture from the outside, as the stem above does not break off entirely but simply bends in a more or less acute angle a short distance over them, thus preventing the entrance of water. Yet the culm is sufficiently fractured to permit a free exit of the future fly in spring.

As shown in the following question from Bulletin No. 23, the insect is not an entire stranger in Minnesota: "It is not always easy or even possible to explain why any one insect should suddenly appear in large numbers over an extended area. It is only by a very careful and long continued investigation that we may sometimes arrive at a true explanation. Here it is readily found in the fact that owing to the wet autumn of 1891, and the equally wet spring of 1892, not much more than one-half of the usual acreage of wheat was plowed, and in many places the shocks of grain had to be left upon the fields. Many inquiries plainly indicated that in 1891 small patches of wheat had been noticed which showed bleached heads long before harvest, and no doubt these white culms harbored the insect un-

noticed by anyone. Since the infested culms were left upon the fields the resulting winged insects were not destroyed, hence they issued during the spring of 1892 and greatly extended their domain. The very causes that killed off the armies of young migratory locusts, i. e. excessive moisture, protected this new pest.

“From the rather few facts which we possess in regard to this insect in Minnesota one very important conclusion may be reached. As the insects hibernate in the culms of wheat in stubble fields, and very likely remain in that condition until spring, simple remedies are available and can readily be applied. All that is necessary to kill the great majority of these insects is to destroy the stubble at this time of the year, or as soon as possible after harvest. Two methods are feasible: burning the stubble, or plowing it under. Burning can be practiced in some few cases, but in many fields there is not sufficient material to do it thoroughly. Plowing, therefore, is our best remedy, and no field should be left unplowed that contains such insects, or is suspected of containing them. A very superficial inspection of the fields will show the whereabouts of these insects, if the owner has not already detected the broken culms or heads. By splitting with a knife the joint just below the broken culm the dark puparium will be readily seen. Or if not, the discolored interior of the culm above will indicate its presence, and closer inspection will reveal the culprit. All fields that contain infested straw should be plowed, and this as soon as possible to make sure of the destruction of these insects; the rest of the fields can be plowed later. In doing this we shall be sure of one thing: the insects, although well protected against moisture, will come in lasting contact with the moist soil, the broken tube above will be filled with earth, and the fly can not escape the next spring to carry destruction near and far.

“The damage caused by this insect in 1892 was by no means small. In many places fully one-fourth of the entire crop of wheat was destroyed, and in a great many more the losses amounted at least to one tenth. As many places are badly infested, the total amount is quite large, and if no

steps are taken to prevent it a repetition may become ruinously large in 1893."

Most farmers plowed their fields during the fall of 1892 or early in 1893, and consequently the losses in the latter year were small, and in 1894 but very few of these insects could be found. The spring of this year, being very wet, prevented extensive plowing, and the insects not being disturbed or plowed under again became a pest and caused considerable damage. The name "Frit-fly" is a well deserved one, as the Swedish farmers call the worthless grain resulting from the attacks of such flies: "frits."

The life-history of this insect is still very obscure in many points and careful work is required to learn it.

THE WHEAT-STEM MAGGOT.

(*Meromyza americana* Fitch).

This insect (plate XIV) has again been destructive in many parts of Minnesota, and it threatens to become in the future a serious enemy to our crops of small grains. In some parts of the state the late sown rye, which had made but little growth during the autumn and which grew slowly in spring, was greatly damaged, in some cases to the extent of one-tenth of the crop. Wheat did not entirely escape, and the plants infested by the insects showed their presence by their small size and general weakly appearance. An account of the life-history of this insect was given in last year's report, so it is not necessary to discuss now its habits in detail. Many points in this life-history are still obscure: as yet we do not even know how this insect passes the winter in Minnesota, or where. In 1896 it could be found in many regions of the state, and the prominent white "bald heads" were not difficult to find. Large numbers of the infested stalks, especially those of rye, were kept in proper vessels to see whether parasites were numerous enough to promise assistance in the near future. But few were discovered, however, and thus far the only remedy we have is a systematic rotation of crops.

THE HESSIAN-FLY.

(*Cecidomyia destructor* Say).

This insect, perhaps for the first time in its history, has caused considerable losses to the farmers of Minnesota. Contrary to all expectations it has found a home in our state, but very likely only for a short time. A large area is infested, but especially the western part of central Minnesota, from Brown's Valley to the Mississippi river at St. Cloud. Farther north and south the fly is found in lesser numbers, and only few occur in the northern part of the Red River valley and along the Iowa state line. The damage in some places amounted to more than 25 per cent, in others to 5 per cent and less, but on an average our farmers lost from 5 to 10 per cent of their entire wheat crop. This is a very serious loss and one requiring close attention on the part of the farmers to prevent in future. The writer is glad to state that in many places a number of different parasites have been exceedingly numerous and active and have done such good work that the majority of the destructive flies have been destroyed.

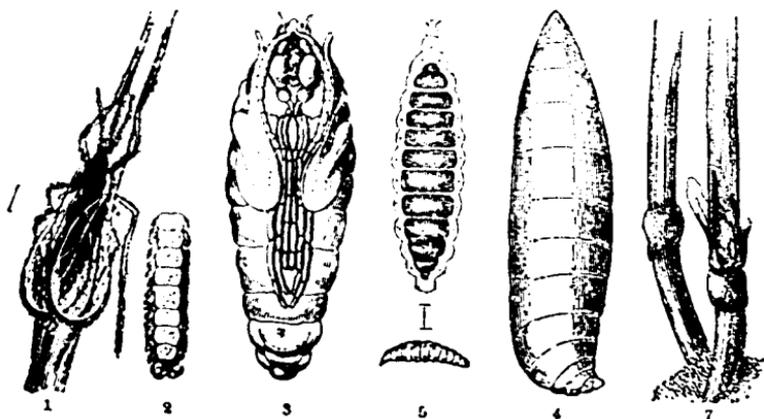


Fig. 3.—Hessian-fly: 1, adult female; 2, abdomen of male; 3, pupa removed from puparium (wheat-seed); 4, puparium; 5, larva; 6, larva; 7, puparia in position. All enlarge excepting 7. (After Taschenburg).

As the history of the Hessian-fly has already been given in last year's report it is not necessary to repeat it here. An illustration of its various stages is given in fig. 3. In south-

ern states this insect is double brooded, and hibernates in the flax-seed stage in winter-wheat, volunteer-wheat and in other plants including, possibly, some of the larger grasses. But this is their habit only in the south: here the insect must lead a different sort of life, for instead of being double-brooded it is single-brooded. This could be expected from the conditions prevailing in the greater portion of our state, but we have had no proofs thus far. Of all the infested



Fig. 4.—Female of *Merisus destructor* Say. Enlarged. Original.

stalks gathered as soon as the injury became visible, not a single Hessian-fly has issued, and numerous puparia (the flax-seed stage) are still unchanged in the breeding-cages. This assuredly seems to indicate that the flies do not issue during the autumn, as they do further south, but remain in the culm until spring. Another proof, though not a safe one to depend upon, is the fact that no larvæ or puparia could be found in the volunteer plants of wheat growing near fields that had been badly infested. The many puparia kept in properly constructed breeding-cages gave forth, however, very large numbers of parasites. Three different species were raised, and in such numbers that in some cases nearly all the Hessian-flies had been destroyed in the puparia. Two of the parasites are shown in the illustration. Fig. 4 represents a female of the most common parasite (*Merisus destructor* Say) and fig. 5 the male of (*Eupelmus allyni* French). The female of the latter occurs both with and without wings.

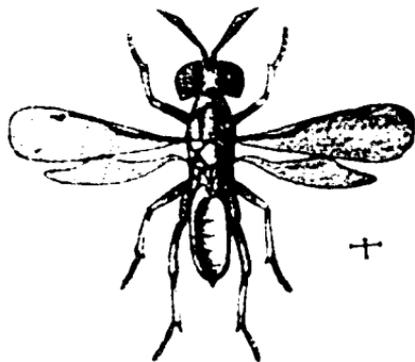


Fig. 5.—Male of *Eupelmus allyni* French. Enlarged. Original.

A third parasite (*Polygnotus hienalis* Forbes) was also raised. It is very small and six of them found sufficient food to pass through all their metamorphoses in a single puparium of the fly. In fig. 6 is shown the broken off culm, the puparium of the Hessian-fly, and the small cocoons of this minute insect still fastened to it.



Fig. 6.—Puparium of Hessian fly with six cocoons of a parasite. Enlarged. Original.

To find such numerous parasites is a very hopeful outlook for those farmers upon whose fields the straws containing them were gathered, and it is a very good thing for the entire state that these parasites are very numerous in many counties infested with the Hessian-fly. Straws received from other districts show fewer parasites, but not a single field was detected in which these useful insects were entirely absent. Their presence is easily detected as they make a perfectly circular hole through the straw to reach the outside of their prison; such holes are as large as a perforation made with a sewing needle.

To show where the puparia are located in the culm of the wheat-plant, fig. 7 has been prepared. At *a* are shown the puparia; to the right three are exposed by removing the base of the leaf, and above it to the left their presence over the first joint is indicated by dotted lines. It will be seen that the culm breaks down above the infested place, and in such a way as to prevent the entrance of moisture.

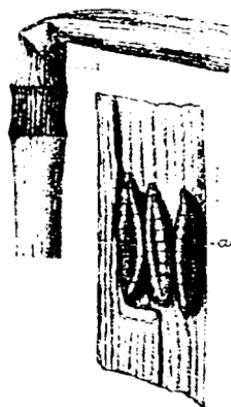


Fig. 7.—Hessian-fly: at the right three puparia (*a*) exposed; at the left puparia (*b*) and the manner in which stems bend and break. Enlarged. Original.

If this dangerous insect is single-brooded in Minnesota, a point now almost definitely settled, a remedy is very simple, and, in most years, can be applied without any extra expense or labor. The insects, hibernating in straws usually just over the first joint, remain in the stubble until early spring, when they hatch and de-

posit their eggs upon young growing wheat-plants. The exact time when this takes place in Minnesota we do not know at present. To prevent the pupæ inclosed in the puparia from hatching, early plowing in autumn is necessary. In doing so the stubble containing the insects is plowed under, and the puparia and enclosed insects are in constant contact with the moist earth; this will either destroy their vitality, or the soil will become packed so tightly around them that the very delicate adult insects can not issue. If the stubble could be burned soon after harvesting the great majority of these injurious insects would be destroyed.

It is still an open question whether the growing of winter wheat will increase the danger of introducing the Hessian-flies and of furnishing them the proper conditions for existence. If the insect is single-brooded then the growing of winter-wheat will make no difference whatever; if double-brooded we furnish the insects with an opportunity for a second generation.

Notwithstanding the fact that the parasites have done such wonderful execution and have killed the great majority of the Hessian-flies, every farmer should bear in mind that these insects rapidly increase in numbers, and he should not run the risk of depending upon these small friends but plow his stubble-fields as early and as thoroughly as possible, since in doing so he will employ the only method that can protect him against this pest. Some years ago a female fly, just leaving the puparium, was dissected, and it was found that it contained 238 eggs. This shows how rapidly this pest can increase if conditions are at all favorable.

THE ARMY-WORM.

(*Leuctnia unipuncta* Harv.).

Many of the newspapers published in our state contained in the middle of July and the first week in August many very gloomy accounts of a cut-worm which threatened ruin and destruction to every green thing, but which preferred wheat, oats, corn and grasses to other plants. Not only our state but a number of others were equally injured by large armies of these insects. All parts of Minnesota were infested, even

the as yet unsettled region in the far north, and people going there to cut wild grasses for hay came back very much disgusted, for instead of finding grasses they found multitudes of such worms. As some of the descriptions given by the newspapers would fit almost any crawling thing in nature, Mr. Pettit, the assistant, made a trip to Northfield on July 20th, to ascertain the real character of the worm and to see the extent of its depredations, as well as what means were necessary to stop their ravages. In this special case the army-worms were found in large numbers covering an area of from four to five square miles near the city, and in scattered patches over at least twenty miles in all directions from it. Upon some farms they were so numerous and destructive that it did not pay to harvest the crop, while on other farms one-quarter to one-half of it was destroyed. The grain being almost ripe, the greener portions of the fields contained the largest numbers of such worms, though they were also quite numerous in the other parts of the field. In some cases the oats were already cut and shocked; this did not, however, stop the depredation of these worms, for they climbed the shocks and destroyed all accessible grain in them. As a general rule the worms commenced their destructive work about seven o'clock in the evening, and continued it until morning. As stated by the assistant, the general direction of the moving armies was in most cases toward the north. Mr. Geo. Lyman had a large field which was completely destroyed; to protect his uninjured grain in other fields he plowed five ditches between the uninjured ones, turning the furrows toward the advancing worms, and in this manner prevented the worms from reaching the fields not yet invaded. These ditches stopped very large numbers of the army-worms. The same plan was followed by a number of other farmers, and whoever adopted it had good results.

In a number of other places where the plants were already nearly mature, or were badly rusted, only the husks were green, and these were greedily devoured by the caterpillars, thus exposing the immature kernel. As is usual the army-worms had already done most of the damage before

their presence was discovered. Some fields, that looked very promising in the distance proved on closer examination to be very badly injured by having the berries exposed to the drying influence of sun and wind which shrunk them badly. A closer inspection of all fields showed at once that the worms had been at work for some time; in fact they had eaten up all the foliage and the ground was thickly covered with bits of leaves and the frass or droppings. In most of the fields the caterpillars were not forced to migrate on account of lack of food, as enough of it was still left to enable the almost full-grown worms to mature. It seems a sort of instinct that prompts them to move away from such fields and to move toward new pastures. The armies thus formed are not composed even of social insects such as the tent-caterpillar, but are more like a mass of individuals routed by a common enemy. All worms run away and do so re-



Fig. 8—Tachina-fly of army-worm. Enlarged. After Walsh.

gardless of their neighbors. When we look into the matter a little more carefully we find, as a general rule, that it is not simply hunger that prompts them to wander, but that they are frequently harassed by numbers of parasitic insects. Out of ten worms picked up we may find at least six or more that harbor in their inside the maggots of flies or of small parasitic wasps. In one case fifty worms were picked up at random and forty of them showed the peculiar china-white and glossy eggs of a fly shown in fig. 8. The adult tachina-fly (*Exorista leucotrit* Walsh.), a little larger than a common house-fly, could also be observed in large numbers near the army-worms. It would dart toward an intended victim and notwithstanding the fact that this always tried to escape, the fly would succeed in fastening one or more eggs upon its neck. The maggots hatching from such eggs penetrate into the worm and there feast upon the material stored up to produce the future wings and other organs of the adult army-worm or moth. Other parasites were also very numerous, but their methods can not as readily be ob-

served. The one shown in fig. 9 inserts a number of eggs in the army-worm and the resulting cocoons, which are of a white color and surrounded with loose silk, could be found everywhere in the fields fastened to all kinds of plants, to sticks and even to loose pieces of sod. The illustration shows some of these cocoons fastened to a leaf, a single cocoon greatly enlarged, and also the adult parasite, (*Apanteles congregatus* Say), which leaves the cocoon by a neatly

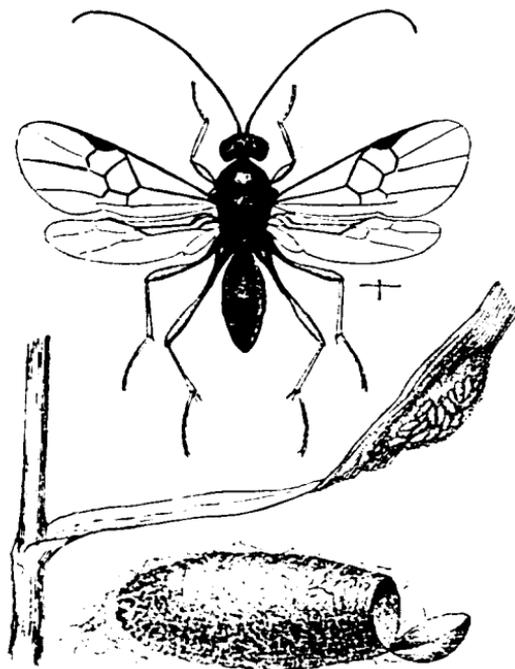


Fig. 9.—*Apanteles congregatus* Say: its cocoons, natural size, and a single cocoon with loose cap. Enlarged. Original.

made circular opening covered by a tight-fitting lid. When we dig in the ground after the larger part of the army-worms have disappeared, we find, besides the red pupa of the army-worm and a large number of dying ones, also numerous very tough, brown, oblong-oval, silken cocoons from which the parasite (*Ophiom. purgatum* Say) shown in fig. 10 issues in due time. When we visit a field invaded by army-worms we soon see that the worms have by no means every-

thing their own way. By watching them after dark we may see numerous black beetles chasing and grabbing them with their large and pointed mandibles; and after sucking them dry, dropping them for other victims.

A large number of birds are attracted to invaded fields and, though the worms usually hide during the day, they kill large numbers of them. Our best friends in exterminating these noxious worms are, however, such nocturnal mammals as shrews, skunks, weasels, and even gophers, which devour large numbers. Considering all these facts we realize that notwithstanding the vast number of worms in such armies but comparatively few of them reach the adult stage, and it is the experience of most observing people that one army-worm season is not usually followed by another one.

The life-history of army-worms is essentially that of the

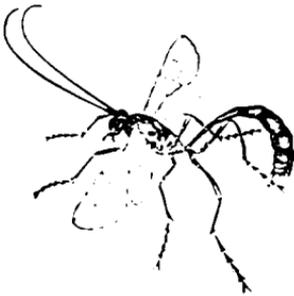


Fig. 10.—*Ophiion purgatum* Say, natural size.

common cut-worms. In reality they are nothing but cut-worms crowded together in large numbers by favorable conditions, and doomed, on that account, to suffer. Army-worms can be found in every season, but in normal years they do not act as army-worms, but lead the life of a common cut-worm. The adult insects, one of which is illustrated in fig. 11 (plate

II), fly in Minnesota from the middle of June till late in September, in fact some have been captured as early as May 19th and as late as Sept. 29th. In some cases large numbers are attracted to fermenting liquids, while at other times only solitary specimens can be seen. It is usually claimed that there are two annual broods of these insects in Minnesota, but we have been unable to verify this statement, and only know from experience that we can expect army-worms in a summer following a wet spring. Why this is so is not known. The metamorphosis of the army-worm can be given in a few words: the eggs, which are deposited early in the night, are thrust by means of a horny ovipositor between the folded sides of a blade of grass; usually fifteen or twenty eggs are glued together. Each fe-

male can deposit from 500 to 750 eggs, which hatch in the course of six to ten days, according to the prevailing temperature. The young larvæ, which move like geometers on account of the rudimentary first two pairs of prolegs, feed as soon as born and, as true cut-worms, only during the night, so that there may be millions in a field unknown to its owner. They require in warmer regions about one month to reach their full size. The full-grown caterpillars vary greatly in color and general appearance, but usually they have four lateral, almost equally broad stripes, of which the upper two are white, the lower two yellow. The only characteristic features of these caterpillars is their possessing a highly polished head mottled with confluent dark dots and marked by two darker lines, which commence at the corners of the mouth, approach each other near the center and recede again behind. A full-grown army-worm measures $1\frac{1}{2}$ inches. Entering the ground, it transforms inside of a cell of earth into a rather stout pupa of a shiny mahogany-brown color measuring three-quarters of an inch. With us the insect hibernates as a partly-grown larva. The food consumed by the army-worm consists of grasses and cereals, including, of course, corn. During their wanderings from one field to another the hungry worms will bite into all sorts of plants, and may cause considerable damage if they pass through a field of flax; here they will bite off the seed-pods without, however, utilizing the plants for food. This bad habit makes the worm also very destructive to oats since in this case they also bite off the loosely arranged kernels and thus injure more than they eat. The usual way of catching army-worms is to trap them in ditches and dispose of them there; this can be done in various ways and one of the most simple is to partly fill a ditch with straw and when fairly filled with worms, ignite it after adding some kerosene-oil. Another way is to drag through such a ditch a short log which will grind up the worms and at the same time keep the sides of the ditch in a smooth condition which prevents the worms from crawling out again. There are other remedies by means of which the worms can be destroyed by fire or by poisoning; ditching is, however, the best and most simple remedy we

have. In studying the road traveled by the armies of such worms we can usually detect where the majority of them were born, and find, as a very general rule, that this is an old straw stack. It seems to have wonderful attractions for this insect, and this being the case the removal or disposal of these useless or unsightly objects is an excellent method to prevent an undue increase of army-worms. The illustration shows the adult insect, a pupa in its underground cell, and a larva in the act of eating off the chaff from an ear of wheat.

THE ERRATIC ARMY-WORM.

(*Noctua finnicia* Tausch).

As has been stated before, almost any species of cut-worm, favored by exceptionally good conditions, may become a veritable army-worm. Early last spring reports reached this office that the country about Hinkley was invaded by immense numbers of caterpillars which devoured every green thing upon the face of the ground. At the invitation of a gentleman from that place, and also prompted by curiosity to see this new army-worm, the entomologist paid a visit to the invaded region and studied the worms. The great majority of these caterpillars which are shown in fig. 12 on plate III, had already disappeared and only comparatively few were still found running about in search of food (fig. 13, plate IV). The caterpillars are velvety black with a number of longitudinal yellowish lines and have a brownish head. The presence of these worms was painfully evident as they had devoured everything in the nature of a leaf, and had, prompted by hunger, even eaten the young bark of such plants as poplars, willows, cherry, sumach and others (fig. 14, plate IV). All the foliage of the plants that had found a home in this region since the great fire in 1893 seemed to be to the taste of these worms. They preferred, however, such plants that are bitter, hence the foliage of cherries, poplars, willows and sumachs was the first to be eaten; after these plants had been denuded nearly all others were devoured and only certain grasses fared better. Owing to the rainy spell numerous pools of water had been formed in which, like islands, were some young trees, but even these had been

discovered and defoliated by the hungry worms. After the wild plants had been denuded the worms made for the gardens and cultivated fields; in the former they destroyed all plants, preferring onions, which seemed to be particularly to their taste; in the latter all the small grains, just appearing above the ground, were eaten and even in large fields not a vestige of such plants could be found. Naturally the farmers, chiefly newcomers, were greatly alarmed about this invasion and many feared a repetition of the trouble. There is, however, no reason whatever to be alarmed, as the same conditions that assisted so much to multiply the worms may not occur again in many years. Nor was the actual damage done very great, as all the wild plants soon recovered and in time made a denser growth. The cereals, which had been cut down to the very ground, assisted by the moist and warm days following this invasion, not only recuperated but were in some cases even improved, as they stood better than those not cut by worms.

An investigation of these caterpillars showed that most of them were healthy and but few parasites could be found. This shows very clearly that this insect had increased very recently and very suddenly to such alarming numbers. The only parasite found was a small wasp, the *Metacoelus vulgatus* Cr., and even this insect was by no means very common.* Soon after the visit of the entomologist, in fact within twenty-four hours, all the worms had entered the ground in the usual way, had made for themselves cells inside of which they transformed to light-brown pupæ. The adult, which is rather a pretty insect and very different from the common army-worm, issued about ten days later. The illustrations on plate III show the different stages of the insect. Although large numbers of the moths were kept in captivity and fed with sweetened water, none deposited eggs. In fact they were exceedingly wild, and though chiefly active at night, were also wide-awake during the day.

Judging from experience in the past this moth is not liable to be numerous in consecutive years. Only once before has it occurred in such numbers as to deserve

* A tachina-fly, and two other parasitic flies were also bred from these caterpillars, viz. *Anthrax alternata* Say and *Psilocephala hæmorrhoidalis* Macq.

the name of army-worm, yet for a number of years it could not be found in the same region except by a trained collector. Here in St. Anthony Park it flies in large numbers from June 29th to Aug. 26th, and as the moths gathered on sugar during this time are all in fine condition it shows conclusively that they are constantly hatching throughout these three months. This insect was also found in great numbers at Duluth.

THE WHITE-GRUBS.

(*Lachnosternus* spec.).

During the past few years a number of beetles proved very destructive to various cultivated and wild plants. Some of these were old and well-known offenders, while one species, a rose-beetle, formerly quite uncommon in our state, appeared in large and destructive numbers. Most of these beetles belong to the well-known family of insects usually called WHITE-GRUBS, JUNE-BUGS or MAY-BEETLES. The genus *Lachnosternus*, which comprises beetles of this kind, is a very large one, and quite a number of species belonging to it occur in our state. Only two species, however, are very injurious, both as larvæ and adults; the smaller, *Lachnosternus tristis* Fab., is sometimes found in immense numbers in the vicinity of oaks, while *Lachnosternus rugosus* Melsh. occurs throughout the state. Fig. 15, plate II, shows both species of may-beetles. Early in June, when we pass a grove of oak trees at dusk, we sometimes hear sounds that seem to indicate the presence of bees in full activity, but as no bees fly at night we soon detect that this peculiar sound is not produced by them but by the first of the above named beetles. They do not measure much more than half an inch in length, and are distinguished from all other may-beetles found in Minnesota by their pale yellowish-brown color, which has a red tinge on the head, thorax and legs, and a more yellowish one on the wing-covers. The insect is quite hairy, especially if viewed from the side; these hairs in a fresh specimen are of a golden-yellow color. During the day none of these insects can be found except by digging for them in the ground, and even then it is merely done by accident. Toward evening, however, they leave the ground and fly to the nearest

oak-tree, especially white-oak, the foliage of which they seem to prefer, and here they gather in very large numbers and their presence is soon indicated by the ragged appearance of the foliage of the trees. This time of feeding is followed by a love-feast, and numerous pairs will be found mating if we go to the trouble of investigating the oak-trees during the night. Early in the morning all beetles leave the tree and hide in the ground by digging their way into it to the depth of one or two inches; here they rest during the day but leave it at dusk to repeat their destructive operations for a number of nights. Meanwhile the eggs become large and have to be disposed of, and for this purpose the females dig their way among roots of plants and deposit here and there these large and almost transparent objects. To obtain such eggs it is only necessary to gather a number of beetles and to put them in a flower-pot filled with moist and loose soil. A large number of eggs are laid, which soon hatch into small and almost transparent larvæ that feed upon the roots of many kinds of plants, but especially upon those of grasses. These young larvæ are very tender, and resemble an irregular drop of water surrounded by a very delicate skin. As they grow older they become whitish, with brown heads and legs, and possess the well-known form of the so-called white-grubs shown in the illustration (fig. 16, plate II). After feeding one or two years, according to the species, they reach their full size, and now transform into pupæ, which already indicate in a general way the future form of the adult beetles. Here in Minnesota the pupa is formed late in summer or early in autumn, and changes soon afterward to a beetle, which, however, never leaves the ground until spring. It is not at all uncommon that such beetles are plowed up in autumn; when thus exposed they are very pale in color and very much softer than in spring, showing that they are not yet entirely mature. If exhumed during autumn they gradually work their way back into the soil, but do so in a very slow and awkward manner, and thus are so much exposed in the shallow and poorly made cell that they are killed by rain and cold. If the cells they form around themselves as larvæ for hibernating purposes are not

disturbed, however, no amount of rain or severe cold will injure them. The old belief that insects go into the ground simply to protect themselves against cold is difficult to believe, for if they had to go below the frost-line in Minnesota they would have to go eight feet deep, and would have to be equipped with wonderful organs for such a purpose.

A second and much larger species is very destructive in our state; it occurs both in the wooded and in the prairie region. It is *Lechnosterna rugosa* Melsh., a reddish-brown smooth beetle with a very rugose thorax. It is shown in fig. 15, plate II). This is the white-grub that causes the most damage in our state and whose larva is so frequently mentioned in agricultural and horticultural papers. During the past season this insect has been especially destructive to lawns, and has caused a great deal of annoyance to those in charge of our public parks and cemeteries. In one case many acres of the most perfect lawns were destroyed in a cemetery, where large patches of grass turned yellow; when such spots were investigated it was found that the whole sod could be lifted from the ground, the grubs having cut off all the roots. The illustration showing the white-grubs (fig. 16, plate III) was taken from such larvæ found in the act of cutting off the roots. They, as well as those of related species, do not move in the usual way by means of their legs, but push themselves forward in a peculiar way by a wriggling motion of their backs. In other words the larvæ use their backs for locomotion, and their legs are simply utilized to pull the roots of plants toward their very hard and horny jaws. When we look at the peculiar shape of white-grubs we can clearly perceive why the legs are not used for locomotion, nor is much locomotion required, as they live underground in very short tunnels where they need to move but little, being surrounded by plenty of food. Some of our cultivated plants suffer very severely from the attacks of these insects and this is especially true of such plants as strawberries, and whole fields of them are destroyed from time to time. As these larvæ live under the ground they are not readily reached by insecticides, and consequently they can not be poisoned like potato beetles

and others. Nor can their presence be readily detected, and as a general rule most of the damage is done before we realize the cause of it. We see plants die and then by digging in the ground we find the culprits. There are a number of remedies, however, that can be used in case we detect the presence of such white grubs in time; for instance, if we find yellow spots in the lawn and on examination find the white-grubs, we can under certain conditions kill them, providing the soil is not a heavy clay and is not soaking wet. In a dry and sandy soil the application of a strong kerosene-emulsion, immediately followed by a drenching with water, will carry the oil down to where the soft insects are and kill them by contact. Four or five days after the application we find the grubs dead and black. In cases where these insects have already killed the sod we can use pure kerosene-oil and follow this with lots of water to carry it down. But after all one of the best remedies is to plow up the infested fields and give the enemies of the white-grubs a chance to eat them. All birds and mammals are exceedingly fond of these fat grubs. Wherever the latter are present in our prairies they attract large numbers of sea-swallows as soon as the fields containing them are plowed. Our black tern makes it a business to follow the plow for the sake of picking up such delicate morsels, and we see these birds constantly darting to the ground for this purpose. Wherever crows abound we find them also engaged in this good work and numerous other birds have the same beneficial habits. Such animals as skunks, weasels, shrews, gophers and even field-mice feast upon them. In the more southern part of the state the mole subsists almost entirely upon the white-grubs and angle-worms. Whenever we plow or spade in the garden we should permit chickens to witness this operation and give them an opportunity to pick up white-grubs, which they are not slow to do. If hogs are permitted to range in our fields they soon exterminate white-grubs.

Some people think that stable manure adds to the number of white-grubs, but this is only apparently the case. The larva of another beetle remotely allied to the *Lachnosternus* breeds in large numbers in manure heaps. The adult is a

black and shiny beetle (*Chalepus trachypygus* Burm.), which lays eggs in heaps of old manure, from which hatch larvæ resembling very closely the injurious white-grubs, but which are not injurious to the roots of living plants.

Among the many remedies proposed against the noxious may-beetles are several that should be mentioned, because they are of some benefit. It is well known that the winged beetles are readily attracted to light, and rooms that are not protected by screens will soon contain large numbers of such clumsy beetles attracted to them by burning lamps. To attract these beetles for the sake of killing them it is customary to place a burning lamp over a pan filled with water and kerosene-oil. The insects, attracted by the light, fly against the protecting glass and, falling in the water, come in contact with the deadly oil. In this manner large numbers of beetles can be caught, but on investigating the insects captured we find that most of them are individuals that have already deposited their eggs, or we find that only one sex, usually the male, has been captured. At all events, notwithstanding the number of insects killed, the benefit is not so great as could be expected. By beating the trees at night, and gathering the falling insects into sheets and bags, large numbers of the recently emerged beetles can be caught, but such an operation requires very much labor and is consequently not a practical remedy.

All birds, and most of our carnivorous mammals, should be protected, and not killed on sight, as is frequently the case at the present time. In fig. 15, plate II, the smaller beetle is *L. tristis*, the larger *L. rugosa*.

THE COMMON HAIRY ROSE-BEETLE.

(*Euphorin inda* Linn.).

This insect has of late years become very numerous and injurious in our state. It is a hairy beetle, gray in color, spotted with black, as may be seen in the illustration (fig. 17, plate VI), which shows a number of them. Its larva possesses also the general shape and appearance of the common white-grub. The adult insect occurs in large numbers during autumn, and again in spring and early summer. The

beetles flying during autumn are brighter in color, and have evidently all issued quite recently, while those found in spring and summer show considerable wear, hence it is very probable that the species issues in autumn and hibernates as a beetle, while the true may-beetles, though also mature at that season, do not leave the ground until spring.

Many complaints have been made about these sombre looking rose-beetles. In some cases they have eaten off the flowers of apple, plum, strawberries, blackberries, raspberries and others. They have destroyed the male flowers of the corn, and have eaten their way into the young ears of corn, and especially the ears of sweet corn have suffered severely in many places. Again the ripening fruit of many plants was eaten into, and when apples and berries were exposed to be dried these insects were not slow to appropriate a large share of them for themselves. Whenever a tree is injured and is bleeding, large numbers of such beetles congregate and are found in such numbers as to form clusters composed of many hundreds, even several thousands, of individuals, all intent on obtaining the sweet sap. Not unfrequently these beetles settle in the flower-heads of thistles, and feeding there become beneficial.

Poisoning their food is out of the question, and the only method we possess of reducing their number is to gather them in nets and bags wherever they occur in such clusters. Jarring the trees upon which they are found in numbers quite early in the morning over large sheets of muslin will bring many beetles down, and these can be readily gathered and disposed of. During the warmer portions of the day they are very active, much more so than most other beetles, and can not be captured. When drying fruit for the winter a screen of mosquito netting will protect it against these and most other insects attracted by such tempting food.

THE POTATO-BEETLE.

(*Doryphora decemlineata* Say).

This well-known insect was described last year and it was shown in that article why it had been so uncommon

during the last two years. This happy condition of affairs has ceased to exist and in many places the potato-beetle will be almost as numerous as ever. Still this is not the case everywhere, and there may be broad acres where the insects still appear only in very small numbers. If there is anything in the common saying "an ounce of prevention is worth more than a pound of cure" it can now be demonstrated. By killing the few beetles and their larvæ as soon as they appear on the potato vines, we can prevent their increase in that locality for a number of years. This is necessary, even if there should be but few insects and not enough to cause any injury. Knowing that most insects are famous on account of their fecundity, and that if left alone they soon increase past belief, a sensible farmer will take time by the forelock and prevent these enemies from increasing without let or hindrance. A good farmer will always do so and a poor farmer ought to be made to do so. This is like having certain contagious diseases prevailing in a given locality; an educated farmer will take the necessary precautions and either prevent the introduction of such diseases among his own animals or stamp it out as soon as discovered; and a poor farmer ought to be made to do so by well framed laws thoroughly executed.

Of course it is not necessary to repeat here that in such substances as Paris green and London purple we possess insecticides that always are successful if properly applied.

THE DOMESTIC CRICKET.

(*Gryllus domesticus* Linn).

Lovers of descriptions of the domestic life of European nations always enjoy the remarks about the presence of the musical insects so commonly found in the older houses and homes of the middle classes and farmers, and no description would be complete that did not mention the "cricket of the hearth" which sings all night, filling the air with melody. Now this reads very well, but not every person is musically inclined and what the one calls a sweet song is considered by the other as a miserable noise. As long as there was no chance to personally study the value of the music produced

by these insects opinions would vary, but since the domestic crickets have found a home in some of the houses of Minneapolis and elsewhere, there seems to be but one opinion in regard to them, and this is that they are a great nuisance. Agents

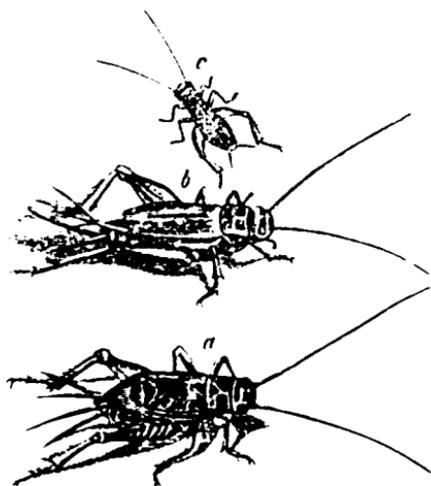


Fig. 18.—Domestic cricket; *a*, male; *b*, female; *c*, larva. Slightly enlarged. After Taschenburg.

whose business it is to rent houses are especially hard in their denunciations of these crickets of the hearth, called by poetic license musical insects. They say that they are very destructive, that a house invaded by them could not be rented, and they have tried all sorts of methods to get rid of them but have failed to do so in many cases. The insects are like the

English sparrows, which have come to stay, and this regardless of the opinions of other inhabitants of houses.

The general history of this insect is very similar to that of other crickets. They are nocturnal in their habits and hide during the day in dark cracks and crevices, providing such shelters are dry. Their motions are very rapid, and though they are enabled to jump, their plumpness induces them to prefer running to jumping. Being lovers of dryness and warmth they are apt to make their homes near stoves in kitchens and living-rooms; and in olden times, when the fire-places were open and built of brick, they found numerous shelters in such places, hence their name "Cricket of the hearth." Their mere presence in our houses would not be so very bad if it were not for the fact that the adult males were so active in producing love-songs by scraping their upper wings together, and judging from these long-continued songs their love is of a most lasting character. These wings are transformed for the purpose of producing sounds into a sort of musical instrument. During their love-season, which ac-

According to some lasts all the year round, they become very noisy at night and if at all numerous, sleep becomes an impossibility to people of a nervous constitution. Their numerous eggs are deposited throughout the warm season, or as long as the male produces music, but chiefly in spring. By means of a long ovipositor the female hides the elongated and yellow eggs in the earth of its home or nest, and the young hatch in the course of ten to twelve days. The young crickets resemble the adult ones, and after undergoing a number of transformations, assume the winged form without having passed through a resting pupal stage. The insect, having been domesticated for so many centuries, has in course of time somewhat changed its habits, and this accounts for the fact that we can find them in all stages at almost any time, though most of them winter as pupae and adults. Wherever numerous some of them leave the house during summer, and exist out doors, preferring stone walls and out-houses for their domiciles, but they all return to the warmer houses as soon as it becomes cold. During the summer they are sometimes attracted to the electric light. Being domesticated they eat many things that the wild species of crickets, which are more or less carnivorous, would not eat. But they have not lost their appetite for the flesh of insects, and if a number of them are confined over night in a small box but few badly crippled specimens will be found in the morning; the hind legs, which drop off quite readily, have nearly all been devoured, and of the weaker individuals only portions of the skin remain to tell the story of a cannibalistic feast. House-crickets are now very general feeders, and sometimes cause damage by eating clothes, especially if these are wet; in fact it seems that they are attracted by moisture and the general belief that if a cricket has been killed its relatives will take revenge by eating the clothes of the murderer is based on this preference.

It is not very difficult to prevent the undue increase of these noisy and uninvited tenants of our houses and there are a number of methods by which we can succeed. They are attracted to such tempting baits as carrots, which can be poisoned, and which will kill them in large numbers. The

safest way, however, is to destroy their homes, not our houses, but the shelters in them that they prefer to occupy. The brick pavement under stoves should be laid in such a manner that the insects can not force their way underneath which they are so well enabled to do, their legs being formed for digging. All the cracks should be hermetically sealed, and especial attention should be paid to the foot-boards which, as a general rule, do not fit tightly against the walls. The space between them and the walls should be filled in and a close fit should be made by means of putty. By taking away their breeding-places and homes we soon force them to leave our houses; they are very apt, however, to migrate to more hospitable people.

The illustration (fig. 18) shows the adult insects as well as a young cricket. The insect is of a light leather-brown color and marked with darker brown spots upon the head and two triangular brown spots and a band upon the thorax. Head and legs are lighter colored. As can be seen the male is distinguished by the musical instrument it carries on its back while the female possesses a long ovipositor.

THE BOX-ELDER LEAF-ROLLER IN 1896.

(*Coccyx semi-fervens* Walk.).

These leafrollers (illustrated on plate XV) which caused so much damage to box-elder trees in St. Paul in 1895, could again be found in considerable numbers during the early part of the year, but as the rainy weather in spring and early summer was decidedly to their disadvantage and to the benefit of the trees no very serious damage was done. Many of the trees were attacked, but the foliage had obtained an early start and as the worms were forced to eat wet foliage they grew but slowly. Still, if the parasites in 1895 had not greatly reduced the numbers of these worms most trees would again have been denuded.

Some experiments with Paris green were carried on to demonstrate the value of this poison against the insect in question and experiments with "Raupenleim" (caterpillar-glue) were also made to test its value against insects of this nature.

As the worms travel about considerably it was thought that raupenleim, which is a thick, viscid, tarry substance made during the process of refining petroleum, would prevent the ascent of the young caterpillars from the egg-masses, which are laid on the rough bark, to the smaller branches. Rings of raupenleim were accordingly spread around all the larger limbs and upon as many of the smaller ones as possible; this was done before the eggs hatched. Four small trees, about fourteen feet high, and two very large trees, were thus treated on April 26th. On May 13th, no effect of this application could be detected. The failure of the raupenleim to catch the insects was largely due to the dusty condition of the streets at that time, as the dust, blown about by the winds, was caught by the sticky material and soon changed its surface into a crust over which the insects passed in safety.

On May 1st the eggs began to hatch and on May 7th the young caterpillars had commenced to curl the leaves and to eat them. On May 13th four small trees on St. Alban's street in St. Paul were sprayed with Paris green and water, using a level teaspoonful of Paris green to a pailful of water. A quantity of milk of lime was added, using about twice as much lime by weight as Paris green. Six hours after spraying rain fell and continued to do so for several days, so that the Paris green was almost completely washed off, but the interval between spraying and the rain was sufficient to poison and destroy nearly all caterpillars. A few remained, however, and on May 25th the spraying was repeated. This time the Paris green remained on the foliage longer and only a very few caterpillars escaped death by poisoning, and these were killed later by a third spraying.

On June 6th two large trees on University avenue were sprayed with Paris green of the same strength; unfortunately a very heavy rain fell within two hours after the spraying and it was feared that the work had been done in vain, but as an inspection showed later, the time had been sufficient to kill the great majority of caterpillars, and in a few weeks afterward the trees showed a marked superiority over those not sprayed.

The above experiments demonstrate that this destruc-

tive caterpillar can readily be kept in check by the use of Paris green and at a very slight cost. But we can not expect that the owner of a few shade trees will go to the expense of buying a spraying outfit, even if this should be much cheaper than it is. It seems to the writer that as the city receives the benefit of having beautiful and shady streets it should also provide for keeping the trees that make them so in a healthy and vigorous condition, free from dust and worms. It would be best to place the Park Commission in charge of the trees ornamenting the streets, and let them see to it that they are not defoliated year after year. This need not be an expensive undertaking as the evil can or should be nipped in the bud by paying proper attention to the trees and their needs.

THE GRAPE-VINE LEAF-HOPPERS.

(*Typhlocyba spec.*).

For a number of years the above insects have been more numerous than usual and have caused considerable annoyances and losses, and as they seem to be still on the increase it was considered important to discover methods and means to prevent their increasing injuries. Not only have our grapevines suffered very greatly, but the beautiful Virginia creepers, so often utilized to adorn houses in and about the cities, have also been more or less injured by these leaf-hoppers. A glance at fig. 19, plate V, reveals how a grape-vine leaf is disfigured by the numerous insects seen resting on its underside; here are also shown other white objects, the characteristic empty pupal skins. A leaf infested with these insects has a mottled appearance, and in course of time becomes yellow, brown, and eventually drops off. The larger illustrations show a larva, pupa, and two different adults.

Early in the season the vine-yards in the vicinity of Lake Minnetonka were reported to be suffering again from these insects, and the assistant, Mr. Pettit, made a number of trips to make some experiments. He visited especially the vine-yards of Mr. Reel, at Christmas Lake, who kindly assisted him in many ways, and gave him permission to utilize his vines for all and any experimental purposes with the hope

of being, perhaps, able to check the ravages of these minute insects. As most persons growing grape-vines know from sad experience how these insects look it is not necessary to describe them in detail; the illustrations show their general appearance much better than words could express it. Four different species were found, all about the same size and shape, only varying in markings. The most common ones were the two species illustrated, of which one is *Typhlocyba rubinata* Fitch, and the other one *T. comus* Say. The former is a reddish-brown insect marked with white lines and dots and also with two prominent black lines at margins of upper wings; the latter is of a translucent white color prettily marked with red lines and prominent black spots at the tip of wings and two black lines at margin. The younger stages of both are very pale and the insects in that period are almost as active as the adult ones, though lacking, of course, the wings. They will dodge about in a most amusing way, and as they, like the adult ones, jump readily they are not easily captured. Like all insects belonging to this order they are active and take food as soon as born, not passing through an inactive pupal stage like beetles and moths. They take their food by suction, hence the application of such poisons as Paris green or London purple is of no avail, though it will kill, by contact, some of the still very tender and younger specimens, or even adult ones while they are just shedding their skins and are still very soft and unable to clean themselves. The only remedies that promise success are insecticides which kill by contact, as kerosene-emulsions, tobacco-teas and others. The former, to be of any use at all, should be applied very early in the morning, when the insects are less active than later in the day. Mr. Pettit tried a number of different insecticides, and his report is given below. When he investigated the vines he found that the leaves showed already at that early date, (May 20), considerable injury; they were somewhat withered and curled, appearing scorched and very unhealthy.

Report of Mr. R. H. Pettit.—During the spring and early summer several trips were made to Christmas Lake, and the following experiments were made

"On May 20th a mixture of kerosene and water was applied with a knapsack sprayer having a special arrangement for mixing the two liquids without previously making an emulsion. This liquid was used in the proportion of one part of kerosene to fifteen parts of water, and the vines were thoroughly moistened with it. During the spraying the leaf-hoppers rose in swarms and many fell to the ground, but the greater part of these recovered and flew away to return in the course of half an hour. A few were rendered inactive and appeared paralyzed for a time but very many of these recovered in less than half an hour. The mixture seemed to produce no permanent effect upon the insects, simply because the integument of these minute beings is very smooth. To remove the offensive fluid the insects used their spiny hind-legs very diligently and with success.

A solution of tobacco-soap in the proportion of two ounces of the soap to one gallon of water, and another one of one-half pound of whale-oil-soap to the same amount of water was applied. Mr. Reel reported on June 10th that neither had been of much use, and that even a few hours after the application but very little difference could be detected between plants treated and not treated.

On July 3rd another trip was made for the purpose of trying a tobacco-extract sold as "Scabceura Sheep-dip." This mixture was applied with a knapsack sprayer in two different strengths; one row of vines was thoroughly sprayed using two ounces of the extract to one pailful of water, and another row was sprayed using four ounces of the extract. The effect was immediate and at the end of two hours but very few of the pests could be seen on the plants. On Aug. 25th Mr. Reel reported as follows: "I am pleased to be able to report that the grape-vines upon which you experimented show a much better foliage than the adjacent rows—although the hoppers appear on them to some extent, the foliage is not so badly browned. I am satisfied that by spraying in the spring, while the leaves are not too thick, it might drive them away. The stronger solution is by far the most effective one." The action of this extract is almost wholly that of a repellent, and

but few, if any, of the insects are killed. At the same time another test was made of the effectiveness of the kerosene and water spray against the leaf-hoppers which were at this season largely immature; three strengths were used, viz: 1:10, 1:15, 1:20 of water, and beside spraying several rows of vines, leaves which were covered with insects, were picked off and sprayed separately. It was found that when 1:20 was used it killed very few, 1:15 killed many of them, while 1:10 killed the great majority, but the difficulty of reaching all the leaves and thoroughly spraying the whole vine was very great as the foliage was at this time fully developed and very dense, and the insect invariably hides on their under side."

The above report shows that an extract made of tobacco, and sold under the name "Scabceura Sheep-dip" proved of considerable value, and that if applied early in the season we possess in it the means of protecting our grapes. Experiments early next year will show better, however, the true value of this substance.

Prevention is always better than cure, and much can be done to prevent the undue increase of these insects. They winter in all kinds of rubbish found in and about the vineyards and adjoining woods and fields. All such rubbish should be collected and burned after the first frosts have driven the insects into their winter quarters. By doing so many are killed by the fire, and still more are exposed to the inclemency of the winter and perish. This burning should be general, as the insects migrate to some distance to find suitable quarters for winter; hence the rubbish or dead leaves in neighboring woods should also be burned. The neighbors should unite in this work because if one person in the midst of many vineyards should neglect to do his duty he can harbor enough of these insects to endanger all his neighbors' vines. If mulching is used this material will offer, as long as still fairly fresh most excellent hiding-places for these leaf-hoppers; and special care should be taken to prevent them from utilizing such places for hibernation. This can be done in various ways, depending upon the conditions; but everyone recognizing this danger will doubtless find means to lessen or overcome the same.

A number of other methods have been used with more or less good results. By attracting the winged insects with a light many can be destroyed; hence a brightly burning torch is slowly carried at night along the rows of vines, which are at the same time disturbed to start the leaf-hoppers. Another plan is to carry a shield covered with a sticky substance between the vines during the hottest part of the day, and thus catch the insects that have been driven off the plants by beating these lightly with a stick.

THE CELERY TREE-HOPPER.

(*Cicadula 4-lineata* Forbes).

During the early part of July a small tree-hopper resembling that found on the grape-vine, but very much larger, was doing considerable damage to the celery plants in the vicinity of the Twin cities. As the injury did not seem to be very widespread and as the insect is probably to be controlled by the same remedies as is the grape-vine hopper, it was not thought best to carry on very extensive experiments with it until the success of the experiments on the latter insect could be determined. Raupenleim was tried as a repellent, but the results were not satisfactory. Probably the best remedy is a spray with the tobacco-extract described in the article on the grape-vine tree-hopper; this, while it would injure the sale of the celery if applied late in the season, would probably prove very effectual earlier and before the plants are too far advanced. The culprit, which is



Fig. 20.—Celery tree-hopper. Enlarged. Original.

a rather handsome insect, is illustrated in fig. 20. It is of a bright green color, marked with a few black spots upon the head, the under-side of which is illustrated to show the sharp and pointed beak which is inserted into the tissue of the plant to abstract the sap. Plants infested by many

sucking insects of this kind wilted and died; it seemed as if a poison was injected by the insect while imbibing the fluid food.

THE LILAC-BORER.

(*Sesia syringæ* Harr.).

In last year's report were described a number of our most common and destructive lepidopterous borers. Since that time another species has become very prominent; it is a rather beautiful moth resembling very closely a common paper-nest hornet. It greatly resembles the borer so very destructive to our ash-trees, but confines its operations to that beautiful, ornamental and hardy shrub, the lilac, in the older trunks of which it occurs in large numbers and which it soon kills. An illustration of the living insect is given in fig. 21, plate II.

As far as remedies are concerned but very little can be accomplished beyond a removal of the old wood. The presence of such borers is indicated by numerous holes and by the frass or saw-dust accumulating beneath. By coating the old wood very early in June with a mixture of soft-soap and Paris green we can repel the female and thus prevent her from laying eggs upon such plants. The soap will soon wash away but the poison is left in the cracks of the bark and all insects boring though it must necessarily come in contact with the Paris green and die in consequence.

THE PLUM-GOUGER.

(*Coccotopus prunicida* Walsh).

There is no kind of fruit that promises so well in Minnesota as the plum and wonderful progress has already been made in the past to improve our wild species, and to create, by selection, crosses, or other means, new and better varieties, and it seems, when we look at the samples of plums shown last year at the different fairs that before very long fruit far superior to all others grown now will be the result of such painstaking work. It seems to the writer that the only true road to success has been chosen, viz: to improve the native kinds, which are known to be hardy, and not to attempt to bring to our state others found in coun-

tries differing in climate from ours. We have, in improving our native plums, to follow the same steps that were taken in the past in Europe to change their native crab-apples into the beautiful, delicate varieties of apples now grown everywhere. But to grow plum-trees and to harvest plums are two quite distinct things. A little observation will almost convince the horticulturist that he is growing the plums not for his own use but for that of his enemies. He sees that after a plum orchard is once established these have taken possession of the same, and seem to consider it their own. There are few plants in Minnesota that have more enemies than the plum tree: black knot, plum pocket, powdery mildew, brown rot, plum leaf-blight, plum rust, leaf-spot or gum-shot and others are a few of the more important vegetable foes of this tree, while plant-lice, such as the plum-tree aphid, the plum gall-mite, many caterpillars, the plum-gouger and the plum-curculio are the more destructive insect enemies.

The plum-gouger, fig. 22, plate VI., is the most destructive of the above named insects in Minnesota. It is a reddish-brown snout-beetle, with a peculiar pruinose, almost velvety surface and of a very different shape than the better known but less common plum-curculio. Last spring (May 9) the plum trees upon and near the Experiment Farm were in full bloom and promised rich returns. But before long one flower after the other dropped off, and but comparatively few were left upon the trees, and in some cases none remained. When studying the cause of this trouble it was found that this snout-beetle was busily engaged in gouging holes in the flower (see fig. 22), which in consequence shrivelled and dropped. A rather suicidal way of doing things, as by acting in this manner the beetles actually destroyed their future food and home! As the fruit grows, the female beetle in depositing an egg does not form the crescent-shaped mark of the "little turk," but makes for this purpose a deep and small puncture. Prof. Bruner describes the egg-laying habit of the plum-gouger as follows: "The *modus operandi* is very simple, and requires but a minute and a half to two minutes for the performance of the entire operation. She first spreads

out to their full extent all of her legs, braces them, and then draws her beak or rostrum to as nearly a perpendicular position as possible, then by gnawing and with a twisting motion soon works her snout into the young fruit until it is buried a trifle above the bases of the antennæ, the latter being held close against and directed upward along the rostrum upon the head while the hole is being made. She now draws out her beak and deliberately turns about, and after a few preliminary thrusts of the ovipositor inserts the latter into the hole just made with the beak and deposits a single egg that is of the same diameter as the puncture. The egg is of a dirty whitish, somewhat transparent color, and is plainly visible with an ordinary pocket lens, being uncovered and nearly flush with the surface. It soon becomes covered by a healing of the injured fruit." Each female deposits only one egg in a young plum; if more are found it is the work of several females. The larva that hatches from such an egg is never exposed, hence can not be killed by sprays with arsenical poisons. In entering the fruit a transparent or gummy substance collects over the puncture, as is well shown in the illustration. The larva feeds not upon the flesh of the plum, but upon the flesh of the kernel inside of the stone. Here it undergoes its transformations from a larva to a pupa and to the adult insect, which later leaves as soon as strong enough to do so, and searches for hibernating quarters in and about the orchard. Many of the plums that contain the worms drop and should be removed and destroyed, but many others remain on the trees long after the beetles have left, and some of them are even still fit for culinary purposes. There is very little use in spraying. Jarring early in the season, at the time the trees are in full bloom, or even a little sooner, will bring down many of these injurious beetles, and if this is done early in the morning they can be readily gathered and killed. The jarring has to be done in a forcible manner, as the beetles cling very tightly to the tree.

Another species so closely resembling the above species as to be almost indistinguishable, is found upon the sand-cherry. It has similar life-habits.

THE PLUM-CURCULIO.

(*Conotrachelus nenuphar* Hbst.).

We can hardly open an entomological bulletin issued by any of the eastern, central, or southern states without finding a description of this insect, and of the remedies that will kill it and save the fruit. Yet as a very general rule more is claimed for such proposed remedies than is warranted by facts, and many of the measures have not proved very satisfactory. This is especially true of the applications of Paris green and London purple, which, with Bordeaux mixture, are now-a-days a sort of cure-all. All these substances are of great value, but as far as the "Little Turk" is concerned we have to depend for success very largely upon other methods, which, though requiring much more labor, are also much more certain. Though so well known it is perhaps best to give an outline of the life-history of this insect which is illustrated in fig. 23 upon plate VII. As the illustration shows, this snout-beetle is less than one-fourth of an inch in length, is of a brown color with four sealing-wax-like elevated excrescences on the hard wing-covers. The beetles hibernate among all sorts of rubbish, but prefer accumulated leaves and similar substances. Early in spring, and long before the buds of the plum-trees open, they visit the orchards, and eat the tender parts of the tree, such as green bark and buds; later they eat leaves, flowers, and the young fruit. Knowing this habit we can kill large numbers of the curculios by spraying the trees before their leaves and flowers appear. This should be done thoroughly and as the foliage otherwise so very tender as regards arsenical substances is still enclosed, there is no danger of injuring the trees. When the flowers open we should not spray; it is more or less useless, and we run the risk of killing many honey-bees, which are attracted to them and very important, as without them but few fruits will set. As soon as the latter have reached the size of a small marble the female curculio commences to deposit her eggs; she makes a crescent-shaped cut and then separates and elevates a small flap into which the egg is inserted. This peculiar crescent-shaped slit has given the insect the name: "Little Turk;" it is made, apparently, to deaden the flesh of the fruit, or to

delay its rapid growth, which otherwise might injure the enclosed delicate egg. This hatches in a few days, and the whitish larva or worm, also shown in the illustration, bores at once into the interior of the fruit until it reaches its stone, which it never enters, however, as is the case with the plum-gouger, which always does so. The work of the larva is also shown. Though we can not poison the larvæ which are hidden inside the fruit, a second spraying about this time will do some good, as the females continue to deposit their eggs for a long time and require some food. As such spraying will kill also many other injurious insects of the plum-tree it should not be neglected.

By midsummer the larva has reached its full size and leaves now to pupate; it does so in the earth beneath the tree, and the pupa soon changes to an adult insect. As soon as able to move the freshly issued beetles search for hibernating quarters and are not seen again in the orchard until next spring.

As will be seen from the above account of the habits of this insect it is not readily combatted by arsenical poisons, though two applications of them will do considerable good. Those who will apply either Paris green or London purple for this purpose should recollect that the foliage of the plum is very easily injured by all arsenical poisons, and that it is absolutely necessary to add at least equal parts of quick-lime which will neutralize all soluble arsenic and thus prevent injury.

The old remedy of jarring the trees every day or two over some sheet is after all the most successful one; in doing so during the day, when these beetles are not very active, they drop very readily and can be easily gathered and destroyed. The trees should be jarred, not simply shaken. It seems that by jarring we imitate the vibrations produced by the hammering of woodpeckers, and the curculios drop to escape them, while shaking simply imitates the motions produced by the wind. There are also a number of patented and unpatented devices to catch these insects by machinery, which jar the tree, collect the beetles and grind them up. More cannot be expected from one machine! "All fallen fruit

should be picked up" is a rule that should be strictly followed in every orchard. If the owners of trees have no time for this purpose let them permit turkeys and chickens to do so; even hogs and sheep may be made useful.

There are many other methods in vogue, and a few of them are of some use. Shingles laid close to the trunk of a tree to be protected will offer early in the spring a shelter for the beetles that have fed upon the trees during the night and which towards morning leave it—on foot—to hide during the day. By turning over and inspecting these traps many beetles can be found and destroyed.

PARASITES OF MAN AND DOMESTICATED ANIMALS.

INTRODUCTION.

The edifice of the world is only sustained by the impulse of hunger and love.—Schiller.

The numerous letters received during the last few years from farmers, stock-raisers, dairymen, poultry-raisers and others, show that many of our domesticated animals suffer more or less from parasites, and as these special branches of farming receive now more and more attention, a short treatise on parasites will be of some use.

The term parasitism is used in this treatise in its widest sense, and the parasites mentioned in it may be living upon the hosts infested, permanently or only for a short time.

In the struggle for existence animals and plants have been forced to adopt all sorts of peculiar methods to live; most of such methods are above-board, but others are at least dishonest or even worse. The majority of such beings are like honest farmers and mechanics; they till the soil or otherwise work for a living. Many, however, are not so honest, they rob the substance of others and thrive upon material not produced by them or belonging to them. These, at first perhaps by force of circumstances, became in the beginning simply occasional beggars or robbers, but as they enjoyed such an easy life, in course of time their off-spring became so modified in form and structure that they could no longer take care of themselves but had to lead the dependent mode of life first adopted by their parents. Most of the so-called parasites belong to this group of organisms, be they animals or plants. They lead all sorts of peculiar and dark existences; some simply utilize the host, or the organism upon which or in which they are found, as a means to reach the source of needed supplies, and in this case the hosts are

simply the carriers of the parasites; others live upon surplus food or upon food not entirely consumed by their hosts; still others make use of the host himself, by eating part of the same; and a few not satisfied with being such contemptible beings, commit even murder by enfeebling and killing the host that provided them with food and shelter.

Farmers have to fight almost constantly against all kinds of parasites, since otherwise their hopes of rich returns for their labors in the fields would come to naught. And yet how few farmers realize how much they lose year after year by the inroads of such pilfering beings, simply because these live a hidden life not easily observed. They, with other enemies such as plant-eating insects, take every year the lion's share of our crops, and some vegetable parasites, such as rusts, smuts, and similar lowly organized plants, not infrequently destroy all the plants so carefully planted and cultivated by the farmer. Some still smaller parasites, as certain kinds of bacteria, cause diseases among man and domesticated animals, and frequently to such an extent that they are swept away or decimated over a large area. Other parasites live inside man and his two or four-footed friends, and cause great losses, by weakening or even killing them. Still others, less dangerous but equally annoying, and in extreme cases as bad, live upon the various kinds of domesticated animals, and cause all sorts of trouble and diseases. And even man, the crown of creation, is not entirely immune; even he, not excepting her, has been seen—in other States of course—to scratch himself, or to investigate with great industry the heads of her promising offspring.

All parasites dwell either upon the bodies of their hosts or inside of them, for a short time or permanently, and as they subsist upon substances of great and even vital importance to the latter they cause more or less serious disturbances, even fatal diseases. Such parasites belong either to the vegetable or to the animal kingdom. It is not the intention to discuss the former, or all of the latter, as being foreign to an entomological report. Only such parasites will be discussed as are either genuine insects, or so closely allied to them as to be usually considered as such. They will be

described in as few and simple words as possible, and as the portraits of all species found thus far in Minnesota will be given, those interested will find no trouble in recognizing them.

We divide the animal parasites mentioned in this report into two groups:

1. EXTERNAL PARASITES (*Epizoa*) which live upon the skin, and

2. INTERNAL PARASITES (*Entozoa*) which live inside of the organs and tissues of their hosts.

I. EXTERNAL PARASITES. (*Epizoa*).

- A. FACE-MITES; BLACK-HEADS. (*Demodocidae*).
- B. ITCH-MITES. (*Sarcoptida*).
- C. HARVEST-BUGS; JIGGERS. (*Trombididae*).
- D. GAMASIDS. (*Gamasida*).
- E. TICKS. (*Ixodidae*).
- F. SUCKING-LICE. (*Pediculi*).
- G. BITING-LICE; FEATHER-LICE. (*Mallophaga*).
- H. FLEAS. (*Siphonaptera*).
- I. LOUSE-FLIES. (*Hippoboscidae*).
- J. OTHER FLIES. (*Diptera*).
- K. BUGS. (*Hemiptera*).
- L. OTHER INSECTS.

II. INTERNAL PARASITES. (*Entozoa*).

- A. FIVE-MOUTHS. (*Linguatulidae*).
- B. BOT-FLIES. (*Estrida*).

I. EXTERNAL PARASITES (*Epizoa*).

- A. FACE-MITES: BLACK-HEADS.
(*Demodocidae*).

These singular parasitic beings do not exactly fit into any classification, at least naturalists have disagreed about their true position until quite recently. But they are no doubt mites with quite an anomalous structure, so much so in fact that they might be said to form a sort of transition from annelids or worms to arachnids or spider-like animals. As they have many points in common with itch-mites, which

are described next, it has been thought best to discuss them in this place.

Face-mites live in the sweat-glands at the roots of hairs and in diseased follicles in the skin of the human face, chiefly about the nose, eyes and chin where they cause the well-known comedones or black-heads; they also occur in a number of domesticated animals. Such diseased follicles become filled with a plug of fatty matter the upper end of which is usually hardened and blackened. If these "black-heads"



Fig. 21. Face mite of man, greatly enlarged. (Original.)

are forced out by pressure the minute mites may be found in all stages of development. To detect them more readily it is necessary to dissolve this fatty matter in a drop of oil or ether. The young mites possess six legs, the adults eight; both are quite worm-like in appearance, their elongated abdomen is transversely wrinkled; their mouth is a suctorial beak possessing dagger-shaped mandibles with two palpi. In the adult parasite the four pairs of legs are very short, two jointed and each armed with four claws.

These mites cause no harm to man except marring his or her beauty, but they can severely injure dogs, cats, hogs, sheep, horses and cattle; sometimes they even produce upon them a scab-like disease called the "red-mange," and in extreme cases they can cause the death of their hosts. Dogs and cats sometimes suffer very much from their presence, and in the case of a dog as many as ten to one hundred and more mites have been found in a single hair-follicle. In bad cases the hair falls out, and the skin becomes covered with a reddish scab, which is very difficult to eradicate, and almost never without the loss of all the hair; in fact a cure is consid-

ered impossible by many veterinarians. The illustration (fig. 24) shows the general appearance of an adult face-mite of man.

There are a number of so-called species found upon different hosts, but all are very similar, and the description and figure of one is sufficient for all.

The Face-Mite of Man (*Demodex* (*Simonia*) *folliculorum* Sim.) (fig. 24) was discovered in 1842 by Simon. It is not a dangerous parasite to man, but if transmitted to a dog, as was purposely done, the mites rapidly increase upon this new host and in a short time cause very serious trouble. In man these mites prefer such parts of the face as are free from hairs. They are very small, the male measuring 0.30 by 0.04 mm., the female 0.40 by 0.05 mm., the heart-shaped egg is 0.08 mm. long.

The Demodex of the Dog (*D. folliculorum* var. *canis*) was discovered in 1844 by Tulk. Its head is almost square. This parasite produces at first small swellings, which gradually unite in large sores containing 50 to 500 and more mites; such sores are chiefly found upon the throat, breast, abdomen and inner surfaces of the thighs.

The Demodex of the Cat (*D. folliculorum* var. *cati*) was discovered by Leidy in the noses and ears of cats infested by *Streptococcus minor*. This species is exceedingly small, and infests most frequently the head of its host.

The Demodex of the Hog (*D. phylloides suis*) was discovered in 1878 by Csoker.

Other species of *Demodex* occur upon the cow, sheep and deer.

The *Demodex* of the dog especially is a very dangerous parasite, and by no means very uncommon, causing an almost incurable disease, the red scab or mange; and whenever it finds a home upon an unfortunate dog the animal soon becomes ill and dies. This mite prefers the hairy skin of the host. Here it causes either a disease of a squamose nature, in which the epidermis becomes scurfy, the hair drops out, with little inflammation, or of a pustulose form with intense inflammation and the formation of pustules in and about the

glands of the hair. If purposely introduced from the dog to the skin of man, it causes an itching sensation, and soon afterwards a sorespot and a scab. As proved by many trials it is a very fortunate thing that this parasite does not readily migrate to man. Fig. 25 shows a number of the parasites in the hair-follicle of a dog.



Fig. 25.—*Demodex* of the dog; mites shown in hair-follicle. Greatly enlarged. Original.

REMEDIES.—The disease caused by these parasites upon domesticated animals is not easily cured, and only in the early stages is a cure possible. In this case salves or ointments made from salicylic acid, or a mixture of one part benzine to 4 to 8 parts of soft soap, do good service. A strong kerosene-emulsion would also, no doubt, be of great value, especially if an extract of pyrethrum is added. An ointment made of half a pound of lard, 2 ounces of tar, and 4 ounces of sulphur, rubbed

in before a fire or in the sun, is very effective, if it is allowed to remain on the skin for some days. Peruvian balsam, a salve made of corrosive sublimate (1:100), Creolin (2: 100), Lysole, Styrax (1: 30 oil), a salve made of cantharides (1: 6 fat) are also recommended. Several other washes are frequently used which will be given later. Success depends much more on the manner in which the medicinal agents are used than upon the agent itself, and the strongest ones may prove perfectly useless if not properly applied. Nothing short of a thorough rubbing in of the salves will suffice, and this operation has to be performed many times. Of course the patient should be well fed, as even after the death of the parasites the skin is for a long time in an inflamed condition. Cleanliness is here also the best preventive, and the diseased animal must be isolated and its old sleeping place should be thoroughly disinfected.

There is still another species of *Demodex*, similar to the one infesting the dog, that has repeatedly been more or less injurious to cattle. Mr. W. Faxon first called attention to the diseased condition of cow-hides received in Boston from

Illinois and Minnesota. The leather from the hides appeared disfigured with pits from one to six millimeters in width, which in many cases penetrated nearly through its entire thickness.

B. ITCH-MITES.

(*Sarcoptida*).

In former times, and even quite recently, doctors did a very strange and unheard of thing; they disagreed among themselves, and this about the cause of a well-known disease called the itch. They did so because they could not always, easily and readily find the itch-mites in the burrows made by these parasites. Consequently other explanations for the itch were given such, as "special fermentations," "thickened bile," "irritating salts," "drying of the blood," "melancholic juices," and other equally convincing ones. During the late war, when the itch became very common, and for some very good reasons too, they invented such terms as "army itch" or "seven-year's itch." A soldier having the latter disease could of course not expect to become well in a few days or weeks, and was consequently sent home to spread the itch among other people.

Itch-mites are the cause of a disease called acariasis or itch in man, of mange in horses, hogs, dogs, and cats, and of scab in sheep and chickens. Wherever this disease occurs it is invariably caused by these parasites, which burrow in self-made tunnels in the skin of their hosts, live free upon them or snugly hidden under scales or hairs. They either feed upon the blood of their host, or gnaw and destroy the younger epidermal cells. It has been claimed, but not proven, that these mites inject a poison in the skin to cause a more rapid flow of blood to the injured spot. Since these mites live in or upon the skin all internal applications or remedies are in vain, because they do not reach the source of the evil, and can not kill the invaders without killing the host.

The itch-mites, a number of which are illustrated, have flat bodies, with a striated skin, and a roundish or squarish

shape; their eight short legs, which extend but a short distance beyond the body, are supported by bands of harder substance (chitin), and usually possess at their ends toes with suckers. Itch-mites take their food by means of peculiar nipper or needle-like mandibles, and as they lead a burrowing life they need and possess no eyes. Neither do they possess a respiratory apparatus, the respiration being cutaneous. The different kinds of itch-mites are chiefly distinguished from each other by the number and position of the spines, by the hooks on the tarsi, and by the chitinous bands. Fig. 26 shows the structure of head and leg of a member of this order of parasites.

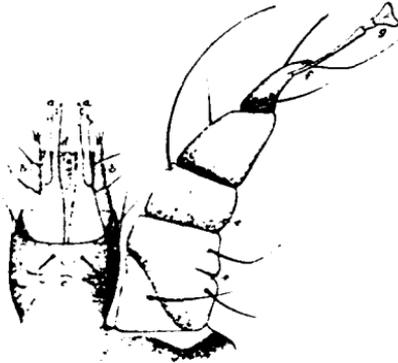


Fig. 26.—Head and front leg of scab-mite, ventral view; *a*, mandibles; *b*, antennae; *c*, maxilla; *d*, membrane joining the antennae; *e, e*, joints of limb; *f*, claw; *g*, ambulacrum or sucker. Greatly enlarged. After Curtice.

Itch-mites are all very small, and for this reason not readily detected, though some, for instance the one causing the mange of the horse, can be seen with the naked eye. Notwithstanding the small size of the mites causing the itch in man it was already known to be the cause of that disease as early as 1197, and it had already been closely observed and illustrated by Wichmann in 1780. Yet all real knowledge of this case of cause and effect seems to have been lost, and the Academy of Science in Paris offered in the beginning of this century (1812) a prize of \$1500 to anybody who could demonstrate its existence. For a long time no one could pro-

duce this mysterious being, until at last a certain doctor Gales mystified and tricked the Academy and pocketed the prize. He showed to a medical commission selected for this purpose, a mite which he claimed to have taken directly from a patient suffering with the itch. He was awarded the prize, and received in addition to it a medal for his great discovery; it was shown later that he had palmed off a common cheese-mite for the itch-mite. Many physicians searched for the mite in vain, misled by the book in which Gales had the audacity to publish descriptions of the parasite. In 1829 another prize was offered by Lugol, and a student of medicine, Renucci, showed at last in 1834 a way by which it could be found. He simply utilized a method used in Corsica and elsewhere to kill the mites by removing them with a needle.

We can distinguish three groups of itch-mites:

1. **Burrowing-mites** (*Sarcoptes*), which make tunnels in the skins of their hosts and which live by sucking blood. All members of this group can successfully migrate from an infested animal to man, and cause upon this new host the itch, which disease, however, may again disappear without the application of remedies.

These mites have a round or slightly oval body, a short beak margined by two cheeks, short, thick and conical legs, of which the two posterior ones are quite or nearly concealed beneath the abdomen; the tarsus has often an ambulacrous sucker in the form of a simple and somewhat long pedicel; the male possesses usually no copulatory suckers and never has abdominal lobes.

2. **Skin-eating Itch-mites** (*Psoroptes*), which live only upon the surface of the skins of their hosts, or among the crust they form by irritating the skin, and which feed upon young epidermal cells by gnawing the upper surface of the skin and hairs. Such mites, if they reach the skin of man, do not cause the itch.

These mites have the body oval; the beak conical, elongated and destitute of cheeks; the legs are thick, especially the front ones, and all are visible beyond the sides of the

body; the ambulatory suckers are carried on a long tri-articulated pedicle; the male has copulatory suckers and abdominal prolongations.

3. **Sucking Itch-mites** (*Symbiotes*), which live only upon the surface of the skin, but which penetrate with their mandibles through the upper skin to suck blood, lymph and serum. Usually they can not thrive upon the human skin, though cases have been reported in which species infesting sheep invaded successfully another host, man.

These mites have an oval body; beak slightly conical, as wide as long, and destitute of cheeks; the legs long, thick, and visible beyond the sides of the body; the ambulatory suckers are very wide and carried at the end of a simple and short pedicle; the male has copulatory suckers, and more or less developed abdominal prolongations.

1. **Burrowing-mites** (*Sarcoptes*).—This genus contains two sub-genera, one infesting mammalia, the other, birds. The former contains two species, the common itch-mite (*Sarcoptes scabiei* De Geer), and the dwarf itch-mite (*Sarcoptes minor* Fuerst.).

The common itch-mite (*Sarcoptes scabiei* De G.) is found on man and on a large number of mammals, where it causes the ordinary itch or mange. The parasite varies according to the species of mammals upon which it lives, and not alone in dimensions, but even in secondary anatomical details. Formerly these varieties were described as so many species. The following varieties are found upon our domesticated animals:

MANGE OF HORSE (*S. scabiei* var. *equi*).

SCAB OF SHEEP (*S. scabiei* var. *ovis*).

SCAB OF GOAT (*S. scabiei* var. *capra*).

SCAB OF PIG (*S. scabiei* var. *suis*).

MANGE OF DOG (*S. scabiei* var. *canis*).

MANGE OF WOLF (*S. scabiei* var. *lupi*).

According to Fuerstenberg this last variety causes the Norwegian itch mentioned later.

THE ITCH-MITE OF MAN.

(*Sarcoptes scabiei* De G. var. *hominis*).

This mite (fig. 27 and 28) is very minute, whitish, and barely visible to the naked eye unless moving over a dark surface. Its body is rounded and soft, in the female with small roundish scales upon the middle of the back; in the male with but few isolated scales; the surface of the body has radiating lines or ridges. The mites resemble in a general way a minute tortoise, are very sluggish during the day, but become quite active during the night in a warm bed, and can even leap to some distance. The head is distinctly separated from the rest of the body, and possesses four pairs

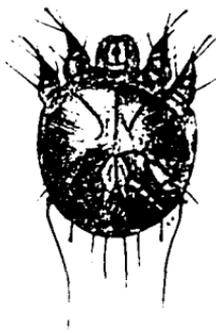


Fig. 27.—Itch-mite of man, male. Greatly enlarged. Original.



Fig. 28.—Itch-mite of man, female. Greatly enlarged. Original.

of jaws which are needle-like. The mite has eight legs, four in front and four behind; when young, or as a larva, it has but six legs. The sides of the body and legs bear long bristle-like hairs; there are six upon the thorax and fourteen upon the abdomen. The males (fig. 27) are quite different from the females (fig. 28), are much smaller, and have bell-shaped suckers upon the ends of their legs. The female is about one-sixtieth to one-seventieth of an inch in length (0.45mm. long and 0.35mm. wide), the male (0.23mm. by 0.19mm., and the

eggs 0.14mm). This species has been found upon man, ape, horse, sheep, lion, llama, ferret, and other animals.

The itch-mite lives in self-made burrows just beneath the epidermis or scurf-skin. These burrows (fig. 29), called by physicians "acarian furrows," extend through the deeper layers of the epidermis to and into the true skin. During the existence of the mites in the burrows, which are similar to the underground tunnels made by a mole, the mite moults

three times, without, however, greatly changing in general appearance except in size. The eggs, large in comparison to the size of the mother, are elongate-oval, with a smooth skin. From 20 to 24 eggs are said to be deposited at a time, and they hatch in 4 or 7 days. Such eggs, if kept in moist surroundings, remain good from three to four weeks. The mites, if removed from the host, can also exist for a long time if kept moist, but die in four to six days in dry surroundings. The female mite, as she progresses in digging a burrow, lays the eggs behind her, and soon dies. These eggs can be seen in a regular row in the burrow (fig. 29).

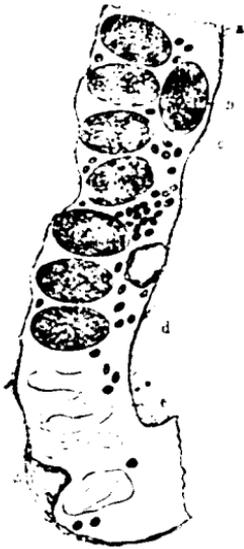


Fig. 29.—Acarian furrow: *a*, freshly laid egg; *b*, eggs showing segmentation; *c* to *d*, eggs showing embryo; *e*, empty eggshells; the black spots are excrement. Greatly enlarged. After Heller.

We know the skin of the host is constantly wearing off and as constantly renewed by new growth from beneath. This being the case the eggs in the burrow will reach the surface just about in time to hatch and to permit the young animal to escape. These burrows are from one-twelfth to a quarter of an inch long and possess a serpentine form. They can be detected below the surface of the skin as a whitish dotted line, the dots corresponding to the eggs. Over the entrance made by the mite there is usually a little pimple on the skin containing a watery fluid. When we try to obtain the mite by puncturing

this pimple we never succeed, as the parasite is some distance away in the blind end of the burrow.

The mining and boring operations of the mite cause intense itching and irritation of the nerves of the skin, and quite often an inflammation, which produces peculiar eruptions on the surface. This intolerable itching causes the one infested to scratch himself incessantly, and the patients have no rest on that account, and consequently tear and lacerate their skin in all directions. But not all portions of the body of man are suitable for these intruders; they need a soft skin to enable them to enter. This is the reason that we usually find the first indications of the itch between the fingers, where the skin is tender, and here the peculiar looking burrows can be readily detected. The region infested by this unpleasant parasite of man is so definite, that those familiar with skin diseases can detect their presence at once.

REMEDIES.—How can we separate ourselves from these intimate friends? They are hidden beneath the tough layers of our skin, which have to be removed to reach them; next we have to apply something that will come in contact with the intruders, that will kill them but not injure us; and finally we have to cure the eruptions and sores caused by such constant scratchings. Of course a great deal depends upon the length of time a person has been affected, or in other words upon the number of mites he harbors, and upon the sensibility of the skin. It is well known that the longer the parasites are neglected the more numerous they become. It is a good thing, however, that their increase in numbers is quite slow; if the mites are not destroyed by proper methods they will flourish just as long as the host lives. To kill them we must first of all soften and remove the loose epidermis of the patient. Everyone ought to be familiar with the effect of a long-continued application of warm water and soap to the skin; this treatment swells up the scurf-skin, softens the same, and enables us to scrape or rub it off. Soaking in hot water and rubbing all parts of the body with strong soft-soap is the first step to remove this very unpleasant intruder. To do this well requires about half an hour's work. Of course for very delicate skins this operation can or should

be greatly shortened. Next it is necessary to kill the parasites. For this purpose the common sulphur-ointment should be rubbed thoroughly over the body, and if this operation is performed well all mites that were exposed by the previous rubbing and came in contact with this medicine, are killed. Those patients who possess a tougher skin can have this ointment left on over night, when it should be removed by a hot bath in the morning. Of course a thick-skinned laborer needs a very different treatment than that of a delicate child. If the patient possesses a very tender skin sulphur-soap can be substituted. A solution of sulphuret of potassium in water, two or four ounces to the gallon of cold water, varying the strength according to the age of the patient and the tenderness of the skin, is also a very safe wash. As the odor of this substance is very unpleasant it should only be used where plenty of ventilation can be had. All these substances will succeed if thoroughly applied; a few mites left could soon multiply again and cause fresh trouble. To prevent this the wash should be applied at least three times, at intervals of three or four days, to destroy the young mites as fast as they hatch. There are many other remedies, such as sulphur, tar, naphthol, styrax, Peruvina balsam and others, and specialists of skin-diseases have a large choice of substances and methods of applications adapted to the purse of the patient, and to their cutaneous sensibilities. But we strongly advise anyone suffering from this nasty disease to apply to a physician, and let him conduct the treatment. All underclothes should be washed most thoroughly in very hot water, bed clothes must be heated to 100° C. for several hours to destroy the mites. The outer garments, contrary to expectations, do not need such a vigorous scouring.

As the parasites live in the skin of their hosts, contagion comes from personal contact, particularly from hand to hand, and the most high-bred, refined, or cleanly persons are not exempt.

NORWEGIAN ITCH-MITE OF MAN.

(*Sarcoptes crustosus* Fuerst.).

This itch-mite is very similar to the common one infesting man, but is smaller and darker. It was first described in Christiania, Norway, and seems to be confined to that country, though it has several times been found elsewhere. It has so far as known not been found in Minnesota, and it is to be hoped never will find its way into our state, as it is a very much worse parasite than the common itch-mite.

SCAB OF HOG OR THE SCALE-BEARING ITCH-MITE.

(*Sarcoptes scabiei* var. *suus*) or (*Sarcoptes squamiferus* Fuerst.).

This mite is found upon the skin of dogs, hogs, goats, sheep, and probably of man, where it produces scab. The upper sur-

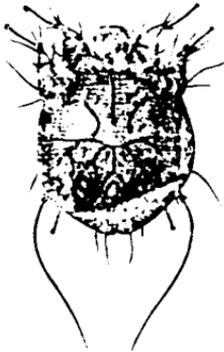


Fig. 30.—Scab-mite of the hog, male. Greatly enlarged. Original.



Fig. 31.—Scab-mite of the hog, female and egg. Greatly enlarged. Original.

face of the female bears a number of triangular scales, which are not arranged in regular rows. The first row of scales commences behind the first spines upon the thorax. Head and legs are more hairy than in the common itch-mite. There are 6 sickle-shaped thorns upon the thorax, and 13 or 14 pointed ones upon the back.

The length of the male varies from 0.25 to 0.32 mm.,

that of the female from 0.40 to 0.48 mm.; the former is 0.39 mm. wide, the latter 0.35 mm. The eggs measure 0.17 mm.

The illustrations (fig. 30, male and fig. 31, female and egg) were made from specimens which infested some hogs in the vicinity of the State Experiment Farm. The legs of these animals were in a terrible condition, showing that mites had been permitted to inhabit them for a long time. The strange and ridiculous thing about this case was the fact that the hogs were condemned to be killed as suffering from hog cholera.

THE MANGE OF THE HORSE.

(*Sarcoptes scabiei* var. *equi*).

This itch-mite is found upon the horse, ass, and mule, but can also migrate to man where it will thrive as well. Though very small it can be readily detected moving among the scurf of an infested skin if a strong magnifying lens is used. Like the other true itch-mites it forms small galleries beneath the scurf-skin, in which it hides and multiplies. If the hide of an infested horse is warmed by the sun, or in a warm stable, the mite becomes very active, and is found quite readily by those trained in such work. Prof. Law writes that to obtain specimens "it may be needful to tie the scab on the human arm till a prickling is felt, when the acarus will be found in the centre of a minute papule caused by its bite." The writer did not think it absolutely necessary to offer his arm for such a purpose, and this accounts for the fact that no illustration has been made of this parasite. Perhaps some reader may be inclined to offer his assistance, and after isolating the mite in the above manner to donate it to the writer so that a picture can be made.

Like all true burrowing itch-mites they can not exist for a long time if removed from their burrow and exposed to the dry air; in moist places they can exist, however, for many days, even for several weeks.

Horses, etc. invaded by such parasites show the presence of them by their restlessness, which is caused by their incessant itching about the heads, manes, tails and backs. Here

numerous open sores and scabs make the presence of the itch-mite very certain and plain.

REMEDIES.—“Remove scabs by soapsuds and brush, and apply a tea made by boiling 1½ ounces of tobacco in two pints of water. This application should be repeated after fifteen days to kill the new brood that may have hatched in the interval. Cleanliness in the stable is another important factor, and if a case of this disease has been found in a stable, all blankets and rubbers should be boiled, and the walls should be whitewashed with quicklime containing one-fourth pound of chloride of lime to the gallon.”

THE HEAD-SCAB OF SHEEP.

(*Sarcoptes scabiei* var. *ovis*).

This variety of the common itch-mite is very small, almost invisible to the naked eye. It presents some characters not found in the other varieties, but they are of very little importance to the flockmaster.

Dr. Cooper Curtice describes this disease in “The Animal Parasites of Sheep” as follows: “Head scab begins on the upper lip and about the nostrils; more rarely it may show itself for the first time about the eyelids and ear. In these places there is less hair and grease, affording the pests better opportunities of getting at the skin. From these starting points the scabs spread over the forehead, cheeks, eyelids, and occasionally over the space under the jaws. In badly infested sheep the disease may sometimes spread over the fore limbs, under the belly, around the joints, and especially between the folds of the knees, hocks and pasterns. Sheep with coarse dry wool are more likely to suffer than those with fine, oily, and soft wool. Long wool seems to offer a barrier to its progress, for the invasion of parts covered with short wool is much more rapid. The demarkation between the invaded parts of the head and the healthy wool-bearing portions is quite abrupt.”

REMEDIES.—As these parasites thrive chiefly upon the parts of the sheep and goat that are only covered with short wool or hair a cure is easy. When found no time should be

lost to apply the proper remedies, as the presence of such itch-mites will affect the health of the invaded animals. Early treatment of such cases is all important, and if the parasites are detected soon after having found a home upon the sheep, a thorough application of scab-dips or ointments will destroy them. In cases of longer standing the scabs have to be softened and loosened by some kind of grease or oil before the dip is applied.

A number of different dips will be given later under sheep-scab.

THE MANGE OF THE DOG.

(*Sarcoptes scabiei* var. *canis*).

This disease is also caused by the presence of itch-mites, and can be cured in the same way as in other animals.

THE SMALL ITCH-MITE.

(*Sarcoptes minor* Fuerst.).

This itch-mite causes the mange of cats and rabbits, and received the corresponding names of *S. cuniculi* and *S. cati*.



Fig. 32. Scab-mite of cat. male. Greatly enlarged. Original

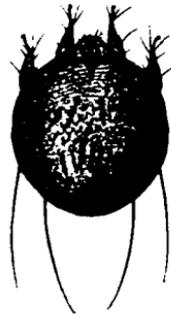


Fig. 33. Scab-mite of cat. female. Greatly enlarged. Original.

This parasite is considerably smaller, the male measuring 0.18mm. in length and 0.14mm. in breadth, the female 0.25 and 0.20, and the eggs 0.10mm. The female has a large number of long and very small scales upon the back, the male but a few. Thorns upon the thorax are not present, while twelve

can be counted upon the dorsal side of the abdomen. Fig. 32 shows the male, and fig. 33 the female mite.

These parasites attack at first the head, and chiefly the base of the nose, lips, ears and eyes of the host. On account of the hairs they make very tortuous burrows, which can, however, be readily detected in such places. As the parasites become more numerous, and thus cause more violent and frequent scratching, the parts affected soon become covered with a hard and very offensive looking scab. The sores gradually extend over the shoulders and even over the back and sides, and by degrees poor pussy becomes weaker, and her skin increases in thickness, forming stiff folds around the neck. Soon inflammation sets in, extends to the nostrils, obstructs respiration, and at last the head enlarges beyond all proportions. In time, if not checked, the whole body becomes thus diseased, and the animal can scarcely drag itself along. It is really and truly devoured while still living, and thus suffers until death puts an end to its miserable existence.

This disease is much more frequent in cities than in the country, because the cats have greater opportunities to come in contact with mangy ones and thus become the abode of this parasite.

REMEDIES.—The same remedies that relieve man of the presence of these horrible parasites will also cure the mange of the cat.

As mentioned before the genus *Sarcoptes* contains two sections or sub-genera; the itch-mites of the first, or those infesting mammals, have been described, and it remains to mention those infesting birds. A large number of mites infest birds, but do not produce an itch-like disease, as they simply absorb the blood of their host, and being nocturnal in their habits cause loss of sleep; both factors together weaken the infested bird. But there are several genuine itch-mites that utilize chickens, turkeys, pheasants, parrots, thrushes, crows and small birds in aviaries as dwelling places.

THE CHICKEN-SCAB.

(*Sarcoptes mutans* Rob. or *Knemidokoptes ciliaris* Fuerst.).

This mite selects such portions of the skin as are free from feathers, and causes a peculiar itch upon the legs of the bird (fig. 35), sometimes extending to the head (fig. 36), where it forms discolored spots. The mites possibly reach the combs of chickens when the latter are scratching these organs, or when they peck at the itching legs. Combs invaded by this mite show white dots and lines covered by minute scales, which rub off quite readily; below them the skin is brownish, contrasting strongly with



Fig. 34. Scab-mite of chick. en. female. Greatly enlarged. Original.

the normal red color. Later the feathers on the head undergo a peculiar change; they turn whitish, lose their glossy appearance, and stand on end. Infested legs are distinguished by greyish-white spots or scabs of various shapes and sizes, and by brownish swellings in the skin, and in extreme cases by a greatly swollen and scabby appearance. Under these scales we see a yellowish substance

in which are the numerous burrows of the mites. The scabs thus formed give the legs a very peculiar and unsightly appearance—they look "chalky."

All the actions of the fowls show that considerable itching takes place, which, however, does not as a general rule destroy the appetite of the patients. The young and six-legged mites are fairly active, and one diseased fowl will soon scatter the infection to all other birds living in the same roost.

If we investigate, by means of a microscope, a small piece of the scab caused by these parasites, we find in most of the burrows small and young mites, and in the blind end of the burrow large females and males. But we do not find eggs in such burrows, as we do in the case of other itch-mites. Prof. Fuerstenberg discovered that these mites produced living young, and therefore changed the former name of these

mites, *Sarcoptes mutans*, to the second name used above in parenthesis.

These mites possess a round and very flat body, as can be seen in the illustration (fig. 34), and they are further characterized by the absence of spines on their backs. The average size of a female is 0.314 by 0.307 mm.; of a male 0.230 by 0.165 mm. The latter differs not alone in being much smaller, but also by possessing a different shape.

The disease can be communicated not alone to other fowls but even to man and to the horse.

REMEDIES.—Creolin, which is highly recommended as a remedy against itch-mites and other parasites, was tried upon a hen with badly infested legs. The comb and head, from which the feathers were dropping, showed also the presence of mites. The right foot was soaked in a ten per cent solution of creolin, the left was soaked in one of five per cent, while the head and comb was also washed with a solution of the latter strength. On the following day, (March 12th), the treatment was repeated, and again on April 4. At this latter date a very marked improvement had taken place, and the scab and scales so prominent upon the legs before were fast disappearing, and new feathers commenced to grow upon the naked spots upon the head; the brightly colored comb also showed improved health, being no longer pale and spotted. But little difference could be detected between the effects of the two applications of different strengths.

2. **Skin-eating Itch-mites** (*Psoroptes*).—Mites belonging to this genus of itch mites are also very small, and can only be studied by means of a microscope. Their round or oval body carries a short and thick cylindrical head, broader than long, with two claw-like mandibles and two three-jointed feelers. The striated skin carries two long spines and eight stiff hairs starting from round chitinous bands. Beside these the female has stiff hairs upon the back and sides of abdomen, but chiefly two larger and two smaller spines and two cylindrical projections at the posterior end. The male has at the end of the abdomen two clasping organs, each of which bears three spines and a sword-shaped

organ. The adult animal has eight legs, the young six. The roundish male has one fine claw on the first two pairs of legs, two larger ones on the third, and none on the fourth and last. The mites moult four times.

This genus contains a single species, the *Psoroptes communis* Fuerst. Besides the characters already given for the genus it is only necessary to state that it also occurs in numerous forms upon a number of domesticated animals, upon which it causes crusts by pricking their skins. The differences between these forms or varieties are not great, but sufficiently so to give them each a name according to the host upon which they occur.

THE COMMON MANGE OF THE HORSE.

(*Psoroptes communis* var. *equi*).

This disease caused by parasitic mites is the most common and longest known of all skin-diseases of the horse, ass and mule. It can appear upon any part of the body except the extremities of the limbs, but it is most usually found upon the upper part of the neck, the root of the mane, the poll and the tail. The mites live in colonies on the surface of the skin, hiding under the shelter of hairs, and their presence is readily discovered. Fig. 37 shows the two sexes of this mite.

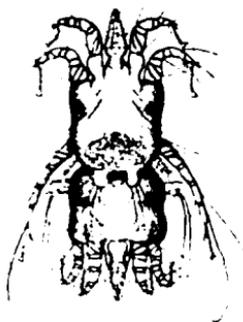


Fig. 37.—Mange-mites of horse; male and female. Greatly enlarged. After Meguin.

If we take some scabs from the invaded parts and put them upon black paper, we can even with the unaided eye see numerous mites moving about actively in all stages of growth. The mites, in feeding upon the surface of the skin, make punctures, and these soon form a crust, and as the parasites multiply rapidly they cause before long similar symptoms to those produced by the true burrowing itch-mites. The constant irritation caused by their presence forces the horse to the most energetic rubbings, which add to the inflammation of the skin, and the sores and ulcers thus produced are often impregnated with blood.

These parasites are very hardy, and consequently any treatment to remove them must be very thorough to succeed. They have been known to be able to exist for thirty days in the moist atmosphere of a stable away from the horse, and fourteen days in dry air; they may even recover after six or eight weeks when subjected to moist warmth. Fecundated females possess greater vital resistance than males, and these more than non-fecundated females. Pastures in which mangy horses have been kept are dangerous for six to eight weeks to healthy horses on that account.

REMEDIES.—What will kill itch-mites will also kill these skin-eating mites, and any of the proposed remedies against scab-insects will answer if applied thoroughly and repeatedly, so as to kill the eggs as well as the mites. Not alone the parts affected, but also the adjacent regions should be treated. In case of common horses two parts of tar mixed warm with one part of soft-soap, and well rubbed into the diseased patches on the skin by means of a brush, will eradicate the mites.

THE MANGE OF THE OX.

(*Psoroptes communis* var. *bovis*).

This disease is very similar to the one caused by the mites upon the horse. It usually commences at the root of the tail, at the neck or withers, and gradually extends to the head, back, shoulders and finally invades the entire surface of the body excepting the limbs.

REMEDIES.—The same remedies indicated for the mange of the horse are applicable. The disease in either case can only become serious when it has been neglected, as it yields readily if the applications are repeatedly made in a thorough manner.

THE COMMON SHEEP-SCAB.

(*Psoroptes communis* var. *ovis*).

The following description of this itch-mite, and the different methods of curing the disease caused by its presence, are copied from the bulletin No. 16 of the Minnesota Agri-

cultural Experiment Station, published by the writer in April, 1891, and which is now out of print.

"It is no longer a theory but a well established fact that large portions of our state are well adapted to sheep husbandry. A dry region, covered with small-leaved plants and grasses, is essential to success, and no good results can be expected upon low or swampy lands, nor in very dry and dusty regions, which are neither good for the animals nor for their wool. Sheep are the only domesticated animals which can fully utilize the vegetation of our wild prairies, as they graze down to the very roots of nearly all plants growing there. With the exception of the seeds of some species of grasses (*Stipa*), that are injurious to them, in extreme cases even causing death, all other plants are eaten with impunity, even should they be poisonous to other stock. By means of sheep husbandry our farmers are enabled to fully utilize much of the cultivated land in the vicinity of their farms, as well as all the land lying fallow or in stubble. Many of the most noxious weeds introduced into the extensive cultivation of the soil can only be successfully kept in check by the use of sheep. Of course wherever the natural conditions are not in favor of this industry, or where but scant food can be obtained upon the natural meadows, farmers must either be satisfied with fewer sheep, or they must grow food for them. Frequently too many animals are kept by farmers, who can not take proper care of them, and naturally the result is a more or less complete failure. If proper attention is given to it sheep husbandry is one of the most important branches of farming, and one that pays well in more than one sense.

For most of our farmers sheep husbandry is still a new enterprise, and numerous errors in the management of the animals are the consequence. Simply possessing suitable land for this business does by no means insure success. Among the errors usually made one stands out very prominently, *i. e.* the farmers are very apt to keep more sheep than they can properly take care of; or, in other words: the sheep are left on the prairies to take care of themselves. The consequences are failure, at least in many cases. No enter-

prise can be a success unless proper pains are taken to make it such. Herding together large numbers of sheep belonging to a number of farmers has the very dangerous tendency to rapidly spread any disease which by separating the large flocks into smaller ones would not occur. If, for instance, one farmer is careless and allows the scab to enter his flock, his animals, grazing together with others well taken care of, will soon spread this disease, and thus force all his neighbors to go to a heavy expense to exterminate it. Concerted ac-

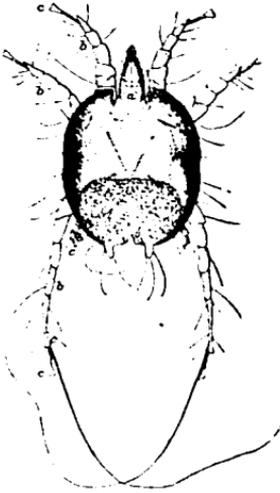


Fig. 38.—Scab-mite of sheep, male; a, head; b, b, legs; c, c, suckers. Greatly enlarged. After Curtice.

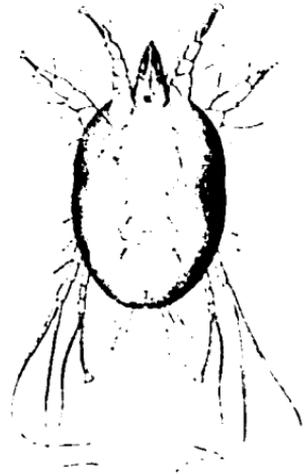


Fig. 39.—Scab-mite of sheep, female. Greatly enlarged. After Curtice.

tion is absolutely necessary to prevent this disease from entering any region, or to stamp it out if once found among the sheep. Most countries have stringent laws, well enforced, to prevent the introduction of sheep that are not perfectly healthy. We have as yet no such laws and therefore it behooves each farmer so much more to be on his guard. "An ounce of prevention is better than a pound of cure" is an old truth, and exceedingly well applicable to sheep husbandry.

Of the three distinct species of scab-mites found upon sheep the above one is the worst and the losses caused by it are very great in some of our western states, and as the pest has found a lodgment in several parts of our own state,

great care should now be taken to stamp it out, and prevent other flocks from becoming infested. Our farmers, and chiefly those that are still unfamiliar with the details of sheep husbandry, can not be too careful in regard to this disease: Wherever sheep husbandry has been well established for some time, and where farmers have learned to cure the disease, the losses caused by scab are gradually reduced by the proper use of remedies, and by the exercise of good judgment in furnishing their animals sanitary surroundings. This scab-mite can be more completely and readily exterminated than many of the other parasites of sheep.

The mite is very small, barely visible to the unaided eye; it has an elongated oval body, resembling in shape a turtle. Its skin shows numerous small wrinkles, and is covered with spines, hairs, scales and wart-like projections. The mature mite has eight legs, each composed of five joints. The illustrations (fig. 38, 39 and 26) show the male, female, and the mouth parts. The male (fig. 38) upper side, is quite different from the female (fig. 39), as can be readily seen by comparing the illustrations. The young larval mite possesses but six legs. Both males and females make burrows or tunnels in the skin of their host, but those of the former are always very short.

Neither sex lives longer than from three to six weeks, but during this time the female is almost constantly engaged in laying eggs. These are smooth objects, of an elongated oval shape, and are deposited in small patches, each containing from twenty to twenty-four eggs, which hatch in the course of four to seven days. The six-legged larvæ undergo three moults in the tunnels, and reach maturity in about fourteen days, when they leave their old quarters and start tunnels for their own use. Gerlach computed that a single female could produce in three months a progeny of 1,500,000. He gives the result in a tabular form:

First generation after 15 days produces	10 females and 5 males.
Second " " 30 " "	100 " 50 "
Third " " 45 " "	1,000 " 500 "
Fourth " " 60 " "	10,000 " 5,000 "
Fifth " " 75 " "	100,000 " 50,000 "
Sixth " " 90 " "	1,000,000 " 500,000 "

This estimate of their rapid multiplication, which is by no means exaggerated, but is a very moderate one, plainly proves that the farmers keeping sheep can not be too careful to prevent the scab from infecting their flocks. Mites, and their eggs as well, if removed from their abodes and placed upon a moist piece of blotting paper, or if kept in a moist atmosphere, can exist from fourteen days to four weeks, but in dry surroundings they will soon perish. This shows the necessity of preventing healthy sheep from sleeping upon moist soil upon which diseased animals have been resting. All such scab-mites seem to become more active in warm stables, and thus cause more violent itching. In the case of the human itch-mite it has been observed that the mites leave their tunnels at night, if the patient is in a warm bed, and commence to make new tunnels, hence the increased itching at that time.

The skin disease caused by the common scab-mite has a different appearance upon different breeds of sheep. Upon some breeds, characterized by wool nearly free from fat, the disease can spread over the whole body. Starting from small and isolated spots the scab extends slowly but steadily. In Merino sheep the disease is not so readily communicated, and affects mainly spots free from long wool. The first indication of the disease is violent itching, which the infested animals show by rubbing against all sorts of objects and by biting the infested spots. This itching sensation becomes more evident when the animals become heated by exercise. The sensation produced by rubbing against posts, etc., is evidently of a pleasant character to the sheep, as is shown by a trembling motion of their lips, as well as by the rapid opening and closing of their jaws. The spots of skin infested usually upon the back—show small yellowish knots, which soon change to little pus balls filled with lymph. Later this fluid is discharged and dries, forming small yellowish-brown scabs. The wool upon the invaded spots becomes paler and dry, is slightly lifted, but usually remains in position, being glued to the skin by the drying lymph. Very often these first indications are very slight, and escape de-

tection. Separating with the hand the wool of infested animals, the presence of mites will become evident if we find round spots upon the skin, which appear whitish where the epidermis is a little elevated, and where the lymph forms yellowish thin deposits that are easily lifted with the loosened wool. In some cases the animals show pain if scratched, instead of pleasure. The skin of infected animals, if butchered, show upon their under side red points. The disease always starts from small spots, and spreads but very gradually. If neglected, the scabs become thick and of a brown color, as if soaked with oil; eventually the skin, entirely denuded of wool, becomes wrinkled, and between the wrinkles cracks appear. If the further increase of the scab-mites is not checked the animals become poorer and poorer, and die before long.

By rubbing against posts and other objects many mites and their eggs are removed, and thus frequently find lodgment upon healthy sheep. The mites can readily be found, but not in the early stages of the disease.

REMEDIES.—“Whatever kills the mite cures the scab” may be said to be the rule that we have to follow to exterminate them. Internal remedies have no value whatever, except in cases where the animal infested is weak, and where rich food is necessary to strengthen the patient.

Creosote, solutions of potash, alkalies mixed with fat, oil of turpentine, benzine, kerosene, tar, tobacco, hellebore, mercury, and arsenic kill the mites more or less rapidly.

Vogel made some experiments, under the microscope, and found that scab-mites were killed as follows:

Within one minute by creosote, carbolic soap and benzine.

Within several minutes by tar and caustic potash solutions.

Within one-quarter to one-half hour by tobacco or hellebore.

Within one hour by soft soap.

Within two hours by arsenic.

Within four hours by corrosive sublimate.

In Europe, where all flocks of sheep are given in charge

of shepherds who know all the individuals, and who notice, almost immediately, if anything is wrong with them, the presence of the scab-mite is quickly followed by the proper remedy. The shepherds, although they frequently do not know that a mite is the cause of the trouble, search for the infested spots, remove the wool already loosened, and, scraping away the scab, apply a little extract of tobacco, which they always keep on hand, or apply a gray salve, made of mercury, to which is added a little oil of turpentine. In this way the young colonies made by the mites are soon destroyed.

To kill the scab-mites in any given locality, and to prevent infection of healthy sheep, two operations have to be carried out, and ought to be enforced, if necessary, by law; *i. e.*

1. *Direct destruction of the mites, and*
2. *Disinfection of stables, etc.*

Both are most effectively carried out immediately after shearing, as at that time the scabs are exposed to view. The sheep, after being dipped, should be kept away for some time from their old stables to prevent new infection.

To kill the mites in a thorough manner, it is best to apply the remedy over the whole surface of the animal, and not alone to the region showing scab. For this purpose two baths, or dips, are required, one to loosen the scab, so as to permit the scab remedy to reach the mite, and the other to perform the actual work of killing the parasites.

For the first bath, or dip, it is best to make a solution of two parts of potash, one part of lime, and fifty parts of water, or, in other words, dissolve in 100 quarts of water 10lb of potash and 5lb of lime.

For the second bath, a good dip is composed of 80 gallons of water and 40lb of tobacco. In both baths the water should be warmed to a temperature of 100° to 110° Fahr. This second bath should be applied twenty-four hours after the first one. With proper appliances, each sheep, after shearing, requires about two gallons of either fluid, and in winter, or when the wool is long, about four gallons.

It requires four men to do the work thoroughly, one to hold the front legs, one the hind legs, and one the head. The

animal is kept in the bath from three to four minutes. A fourth man separates with his hands the wool, and thoroughly rubs the infested skin, using a sharp brush to remove the scab. The legs of the sheep are kept in the bath, the head must be well washed and should be immersed several times; in doing so one man should keep the eyes of the animal closed with his hands. After the bath the sheep is put in an adjoining empty box to collect the drippings, which are added from time to time to the bath. Of course the animals should be kept in a sheltered place, free from the disease, after each bath, and should be protected from the winds until dry.

This bath kills only the mites, but not their eggs, and consequently—as the egg stage lasts from three to seven days—another bath must be given seven to eight days after the first one to kill the young mites just hatched. It is usually not necessary to give still another bath after this. The animals still suffer a little from the itching of their skin, but this will gradually disappear as the sores become healed. If, however, after a sufficient time the itching does not stop, then it is necessary to repeat the bath.

Where large flocks have to be dipped tubs merely large enough to completely immerse one sheep are not sufficient, and dipping pens or tanks have to be made, through which the animals to be treated may be driven. Large boilers to prepare the dip and to heat the water are also necessary.

Disinfection of Stables, etc.—The first step necessary is to remove the dung from the stables to fields not accessible to sheep, where it should be plowed under. The earth composing the floor of the stables should be dug up to a depth of several inches and should be removed and replaced by fresh material. All the wood work in stables must be washed with hot soapsuds, and white-washed to a height of five feet. Posts in or near pastures should be treated in a similar manner. After leaving the well-ventilated stables in this condition for two weeks sheep can again be housed in them.

Composition of Dips.—There are a very large number of dips recommended, and most of them are satisfactory if thor-

oughly well applied. A few of the leading ones are here given.

Australian Dip.—100lb of flower of sulphur, 150lb of quick lime, and 100 gallons of water. Mix and stir, while boiling, for ten minutes, until the mixture assumes a bright red color, then add three gallons of water. Use the dip, heated to 100°–110° Fahr. twice, at an interval of two weeks.

Texas Dip.—30lb of tobacco, 7lb of sulphur, 3lb of concentrated lye, dissolved in 100 gallons of water.

Nevada Dip.—Sulphur, 10lb; lime, 20lb; water, 60 gallons.

California Dip.—Sulphur, 4lb; lime, 1lb; water, enough to make 4 gallons.

Kansas Dip.—Sulphur, 22lb; lime, 7lb; water, 100 gallons.

Curtice's Dip.—Probably tobacco and sulphur form the best combination known for the treatment of scab. To every hundred gallons of water there should be used 35lb of good strong tobacco (if stems or other inferior parts are used there should be more), and 10lb of flowers of sulphur. This preparation, used at a temperature of 120° Fahr., will kill all mites, ticks and lice, and leave the wool in a clean condition. Has to be applied a second time in ten to fourteen days.

Walz's Dip.—6lb of freshly burned slaked lime, 6lb pot-ash, 10 quarts of water; boil an hour, stirring occasionally. Add pine-oil 8lb, and tar 2 quarts. Make an infusion of 20lb tobacco in 130 quarts of water; add the lye already made and stir. This quantity suffices for 100 sheep. Apply by immersing the sheep, separating the wool and breaking the scabs. Repeat in eight or ten days.

Law's Dip.—Take 16lb tobacco, 3 pints of oil of tar, 20lb soda ash, 4lb soft soap, 58 gallons of water. This quantity suffices for 50 sheep. The tobacco should be steeped, afterwards the other ingredients should be added at 70° Fahr.

Zundel's Dip.—13½lb tobacco, infuse in 66 gallons of

water; dissolve in it 8lb soda, add 4lb freshly burned or slaked lime. Dilute 8lb soft soap with hot tobacco broth, add it to the rest, then add 4lb crude carbolic acid. Mix. This quantity is sufficient for 100 sheep.

Roloff's Dip.—For 100 sheep. Take 20lb of tobacco, steep it with 66 gallons of water for half an hour; heat it to 95 Fahr. and add 2½lb each of pure carbolic acid and potash.

Mix an infusion of 15lb tobacco with 2½lb carbolic acid and 13½lb wood tar, pour it into 66 gallons of water at 125 Fahr., in which 3 lb soda have been dissolved. Use it at a temperature of 80° or 90° Fahr., and repeat in six or seven days.

Clement's Dip.—Arsenious acid 1 part; sulphate of zinc, 5 parts; water, 100 parts. The water is put over the fire, the chemicals added, and it is allowed to boil for 5 or 10 minutes. When cool enough for use the sheep is entirely submerged in the liquid with the exception of the head. The laborers should grease their arms with linseed oil, as well as the udder of ewes, to prevent the action of the astringent on the skin and on the secretion of milk.

Mathew's Dip.—1 part arsenious acid, 10 parts alum, 100 parts water.

Scheurle and Kehm's Dip. 1 pt. arsenic, 12 parts alum, 200 parts of water.

Kerosene-Emulsion as a Sheep Dip.—Prof. Gillette has made a number of experiments with an 8 per cent kerosene-emulsion, and says that a dip of this strength could be safely used. Such an emulsion is much cheaper than any of the commercial dips, and it is a matter of great importance to try this remedy very fully.

Patent dips are objectionable because their formulas are not given, and consequently may be valueless or not strong enough, and they are usually more costly than they are actually worth."

3. **Sucking Itch-mites.** (*Symbiotes*). (*Chorioptes*). Two species of *Symbiotes* are found in Minnesota, the Common Symbiotes (*Symbiotes communis* Verheyen), and the Auricular Symbiotes (*Symbiotes auricularum* Lucas).

THE FOOT-MANGE OF THE HORSE.

(*Symbiotes communis* var. *equi*).

This mite attacks the heels and lower parts of the legs, especially the hind ones, and may be present for a long time, even years, before extending upon the body of the



Fig. 40.—Mite causing foot-mange of horse; ovigerous female. Greatly enl'g'd. After Neuman.



Fig. 41.—Mite causing foot-mange of horse; pubescent female. Greatly enlarged. After Neuman.

horse. Such mites live in colonies, without excavating galleries, and cause only a local mange or scab. The presence of these, as well as the restlessness of the invaded animals, shown by stamping and by rubbing one leg with the other, indicates the necessity of a local treatment with the remedies given elsewhere.

The male of this mite measures 0.34 by 0.30 mm.; the female 0.42 by 0.27.; the egg 0.16 mm. Fig. 40 shows an ovigerous, and fig. 41 a pubescent female.

The ox and goat are invaded by similar parasites, which do not greatly differ from the above, nor do they require a different treatment.

THE FOOT-SCAB OF THE SHEEP.

(*Symbiotes communis* var. *ovis*).

This is caused by a smaller mite and is of rare occurrence. It is not a serious disease, affecting only the feet and limbs of the animal, and as it progresses but very slowly to other parts it is easily cured. One sheep in a very large herd may

be badly affected for a very long time, and yet no other sheep will catch the disease. The animals invaded by such mites, show their presence by stamping, scratching and biting the affected parts. The remedies proposed elsewhere for the treatment of the common scab of the sheep can be used with good effect.

THE EAR ITCH-MITE OF THE DOG.

(*Symbiotes auricularum* var. *canis*).

As early as 1834 Hering of Stuttgart discovered an ulcer in the ear of a dog caused by an itch-mite. Since that time it has been found very often, and the parasite is by no means uncommon in Minnesota, where it affects all breeds of dogs, but especially hunting-dogs. Animals invaded by these parasites are, in extreme cases, seized by convulsions, which are frequently mistaken for epilepsy, or even for rabies. Dogs infested with such mites flap their ears very often and scratch them violently, showing the irritation produced by the parasites. They also cry loudly from time to time, become angry,



Fig. 42.—Ear-mite of dog, male. Greatly enlarged. After Neuman.

foam at the mouth, and run howling against obstacles, or turn several times in a circle and fall down as in a fit. Such attacks are repeated and the animals become unfit for service and sometimes deaf. If the auditory canal is investigated it is found to be lined with a dark and ill-smelling substance, in which are multitudes of the parasites of all ages and sexes. This substance is sometimes so very abundant as to compress and push back the membrane of the tympanum. The mites (fig. 42) look like tiny white specks, oval in shape; they are very active, and if the ear is carefully watched they may be detected running about the skin. This activity no doubt greatly adds to their irritating presence.

REMEDIES.—Wherever this parasite is found the kennels,

etc., should be carefully disinfected. The ears of the affected dogs have to be kept clean, the dark substance found must be removed, and one or the other of the following mixtures should be injected.

Olive-oil	100 grammes
Naphthol	10 "
Ether	30 "

Some of this fluid, which has to be kept in a well-stoppered bottle, should be injected every day into the external auditory canal, which is then closed for ten or fifteen minutes by a cotton plug to prevent the evaporation of the ether.

A mixture of one ounce of olive-oil with one drachm of ointment of the nitrate of mercury, daily painted over the internal surface of the ear with a soft brush, has also answered the purpose. After a week the ear should be syringed out with tepid water and methylated spirit, about one to ten.

The same or a very similar parasite has been found in the ear of the cat, where it causes extraordinary symptoms, the animal being almost unable to walk; in fact, when it attempts to do so it rolls about as if intoxicated, frequently falling over on its side.

The ferret, which in many places is kept as a domesticated animal, is also affected by this or a very similar parasite.

The Itch-mites contain, besides those already described, a number of other small mites which infest birds. Such mites are found upon nearly all birds, and whoever searches for them will discover new and most remarkable forms. The two forms, male and female, shown in fig. 43 and 44, were found with others of a still different shape upon the Purple Grackle. Some of these mites are really beautiful objects, which pass through wonderful and most complex metamorphoses. Many torment their hosts, while others simply dwell upon them without causing any apparent disturbance or injury. In some cases each species inhabits only one kind of host, even a certain part of it, while others seem to care but little where they dwell providing the host is a bird. Every bird possesses one or more of such parasites, and cases are known where one bird gave a home to four

distinct species of mites belonging to three different genera.

As but very few of these parasites cause real injury to their hosts excepting if they should become very numerous, it is not necessary to describe them in detail. In extreme cases they disturb, locally, the formation of feathers, and may, by deranging nutrition, cause a fatal consumption. Proper cleanliness in poultry-houses and bird-cages will greatly lessen their numbers.



Fig. 43. Mite infesting bird, male. Greatly enlarged. Original.

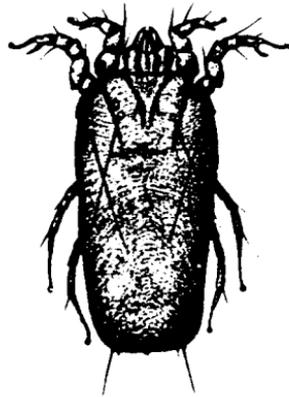


Fig. 44. Mite infesting bird, female. Greatly enlarged. Original.

There are a number of other mites, belonging to different families, which can also, in extreme cases, cause itch-like diseases. Such mites are not usually found permanently upon man and domesticated animals, but only occasionally invade them.

But it is not alone the skin of animals that is inhabited by mites; even the air-sacs of chickens are invaded by white mites large enough to be seen with the naked eye. Such parasites (*Cyrtolites nodus* Vizioli) enter the bronchi and may even reach the interior of air-canals in the bones. If not numerous their presence is not detected, but if favored by suitable conditions they increase rapidly in number and kill their hosts. An autopsy revealed them also in the lungs, liver, and kidney. Another species of mite (*Symplectoptes cysticola* Vizioli) causes an irritation in the connective tissues, forming tubercles, inside of which they may be found; they also

occur on the abdominal viscera, in the muscles and beneath the skin.

C. HARVEST-BUGS. JIGGERS.

(*Trombididae*).

These mites are soft, bright-colored, and more or less hairy. They possess a conical sucker composed of two

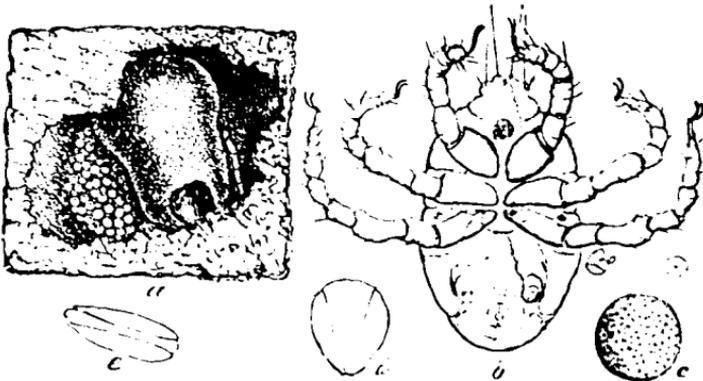


Fig. 45.—*Trombidium locustarum*; a, female laying eggs; b, young larva; c, fresh egg; d, d, egg shells. Enlarged. After Riley.

hooked or styliform chelifers hidden in a tube formed by the lower lip and the joined maxillæ. The palpi are usually large, the second joint is longest, while the last bears a peculiar appendage which can be used as a finger and thumb. The eight legs have five or six joints, usually with two hooks.

Two eyes are often present. The six-legged larvæ lead a parasitic life, and not alone upon insects and spiders, but also upon warm-blooded animals, which they torment, and where they can produce itch-like sores. The larvæ of some of the species of *Trombidium* are, however, exceedingly beneficial; for instance the young of the locust-mite check most



Fig. 47.—Mite from house-fly. Enlarged. Original.

effectually the increase of the Rocky-mountain locust. Another small and red mite is frequently found upon our common house-fly, where it becomes the torment of our tormenter. May it prosper! In figure 45 is shown a female *Trombidium* laying eggs, and a young larva; in fig. 46,

plate VII, a fly upon which nine larvæ of *Trombidium muscarum* have fastened themselves; and in fig. 47 we have an enlarged illustration of one of them.

About the very worst pests of man and domesticated animals are the HARVEST-BUGS, RED-BUGS or JIGGERS, which are illustrated in fig. 48. They are barely visible mites, the

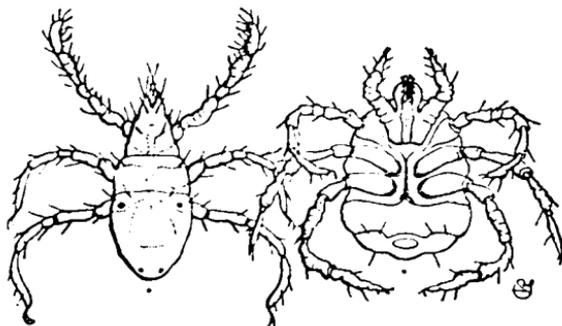


Fig. 48.—Red-bugs. The American harvest-mite at the left, the irritating harvest-mite at the right. Greatly enlarged. After Riley.

young stage of a *Trombidium* not yet ascertained, of a brick-red color and are found in large numbers among low growing plants. They are not common in Minnesota, and it is to be fervently hoped will remain so forever. Men and animals, passing through low herbage that harbors them are attacked by these pests, which, whenever they succeed in finding a host, burrow in and under the skin, causing intolerable itching and sores, the latter caused by the feverish activity of the finger-nails of the host, if that should be a man, whose energy in scratching, apparently, can not be controlled and who is bound forcibly to remove the intruders. The writer has been there! Those who have ever passed through meadows infested with red-bugs will remember the occasion.

Horses and other animals in pastures suffer mainly on the lower part of the face; if kept in their stables the inflammation caused by the mites will soon disappear with the mites themselves. Dogs and cats suffer greatly in regions where such mites abound, and look as scabby and mangy as if infested by some itch-mite. Other animals do not escape, and the parasite has even been found upon the mole, field-

mouse, and bat. They are most numerous late in July and during August, hence the name "Harvest-mite."

As the writer was present when the two following harvest-mites were discovered and described, when, in fact, he had to sacrifice a piece of his skin containing them for the above purpose, he will quote the describer's article in "Colman's Rural World" for June 2, 1876.

THE AMERICAN HARVEST-MITE.

(*Leptus americanus* Ril.).

"This species is barely visible to the naked eye, moves readily, and is found more frequently upon children than upon adults. It lives mostly upon the scalp and under the arm-pits, but is frequently found on the other parts of the body. It does not bury itself in the flesh, but simply insinuates the anterior part of its body just under the skin, thereby causing intense irritation, followed by a little red pimple. As with our common ticks, the irritation lasts only while the animal is securing itself, and its presence would afterward scarcely be noticed but for the pimple which results.

THE IRRITATING HARVEST-MITE.

(*Leptus irritans* Ril.).

"This is the most troublesome and perhaps best known of the two causing intense irritation and swelling on all parts of the body, but more especially around the legs and ankles. Woe betide the person who, after bathing in the Mississippi, or anywhere in this latitude (Missouri), is lured to some green dressing spot of grass or weeds. He may for the time consider himself fortunate in getting rid of mud and dirt, but he will afterward find, to his sorrow, that he got hold of something far more tenacious in these microscopic harvest-mites. If he has obtained a good supply of them he will in a few hours begin to suffer from severe itching, and for the next two or three days he will be likely to scratch until his limbs are sore.

"With the strong mandibles and the elbowed maxillæ, which act like arms, this mite is able to bury itself complete-

ly in the flesh, thereby causing a red swelling with a pale pustulous center, containing watery matter. If, in scratching, one is fortunate enough to remove the mite before it enters, the part soon heals. But otherwise the irritation lasts for two, three, or four days, the pustulous centre reappearing as often as it is broken.

"The animal itself, on account of its minute size, is seldom seen, and the uninitiated, when first troubled with it, are often alarmed at the symptoms, and at a loss to account for them. Fortunately, these little plagues never attach themselves to persons in such immense numbers as do sometimes young or so-called "seed" ticks; but I have known cases where, what with irritation and consequent scratching, the flesh has the appearance of being covered with ulcers; and in some localities where these pests most abound sulphur is often sprinkled in foot-gear, as a protection during "jigger" season.

"REMEDIES.—"Sulphur ointment is the best remedy against the effects of either of these mites, though, when that can not be obtained, saleratus-water or salt water will probably allay the irritation. Whether anything better than sulphur can be used as a preventive I have no real knowledge, and shall be glad to learn from those who have had experience. Any oily substance will act as a preventive, and, while kerosene is too offensive, sweet-oil might be tried. I would also recommend for trial alum-water, made by dissolving the alum in hot water, at the rate of an ounce or two to the quart.

"The normal food of these mites must, apparently, consist of the juices of plants, and the love of blood proves ruinous to those individuals which get a chance to indulge it. For, unlike the true chigoe, the female of which deposits eggs in the wound she makes, these harvest-mites have no object of the kind, and when not killed at the hands of those they torment they soon die victims to their sanguinary appetite."

THE HARVEST-BUG OF EUROPE.

"(*Leptus autumnalis*, or *Tetranychus autumnalis* Shaw).

This mite is very similar to our species. It is sometimes so nu-

merous that crops of currants and other berries have been abandoned. These mites seem to be able to penetrate stockings and drawers, and other thin clothing, for though generally most numerous and annoying about the legs, they are found all over the body. Cats and dogs, from their prowling habits in field and garden, suffer greatly. They scratch and nip their skin with their teeth, so much so that they are sometimes supposed to be suffering from the itch, when it is only from a daily reinforcement of these mites. Fig. 49 shows a skin infested with these mites, and the imbedded heads after the removal of the parasites.

"Kirby and Spence mention a similar insect which occurs in Brazil, abounding in the rainy season, particularly during

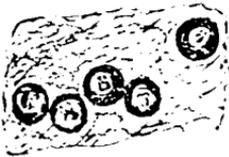


Fig. 49.—European harvest-bug. Skin of man showing imbedded heads. Enlarged. After Heller.

the gleams of sunshine on fine days that intervene, and which resembles a small point moving very fast. These animals they say, get upon the linen and cover it in a moment; afterward they insinuate themselves into the skin, and occasion a most intolerable itching. They are with difficulty extracted, and leave behind them large livid tumors, which subside

in a day or two. An insect very tormenting to the woodcutters and settlers on the Mosquito Shore and Bay of Honduras, and called by them the "doctor," is thought to be identical with this. It is also stated on good authority that still more serious consequences have been known to follow the bite of a mite, related to the above if not the same species, common in Martinique, and called there the *bete rouge*. When the English soldiers in camp were attacked by these creatures, dangerous ulcers succeeded the symptoms just mentioned, which in several instances became so bad that the limb affected had to be amputated."

D. GAMASIDS.

(*Gamasidae*.)

The species of mites belonging here are either found in damp places on the ground, or are parasitic on some animal. They possess filiform or thread-like feelers, mandibles with

minute nippers, and no eyes. Their legs possess seven joints, and the tarsi have two claws with a sucker between them. Only two genera contain species that are parasitic upon domesticated animals; these are *Dermatnyssus* and *Gamatus*.

THE CHICKEN-MITE OR "TICK."

(*Dermatnyssus gallinae* Redi.).

This mite infests domestic fowls, cage-birds, and not infrequently torments man and beast. In extreme cases, or

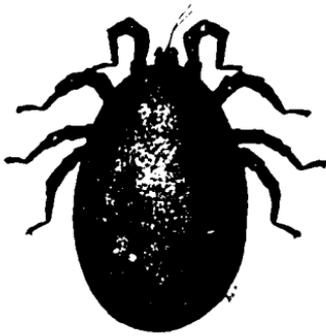


Fig. 50.—Chicken-mite or "tick."
Enlarged. Original.

when very numerous, it has even caused a form of phthiriasis, a disease otherwise caused by the presence of immense numbers of sucking-lice. Three species have been described, namely, *D. gallinae* upon chickens, *D. acium* upon birds, and *D. hirundinis* upon swallows, but very probably they are all the same. The Bird Tick (*D. acium*) occurs in

large numbers in bird cages, and is sometimes very annoying to the birds, robbing them of their sleep, and if not removed may cause their death.

The so-called "tick" of chickens is very much larger than all the other mites mentioned thus far, the male measuring 0.60 by 0.20mm., the female 0.80 by 0.28mm., and the egg 0.20mm. As seen in the illustration (fig. 50) the mite possesses eight legs, of which the first two are longest, not well shown as the specimen were rather poorly mounted. The mite is either blood-red, reddish-brown or whitish, the color depending largely upon the last meal consumed. Chicken-mites of this kind are most abundantly found in hen-manure, or behind the frame-work of the hen-house. Large numbers breed and hide in the nest of chickens, and if an egg should be broken in such a place it is soon covered with myriads of them. They occur also in bird-cages, pigeon-houses, and nests of swallows or other birds. They attack also the skin of man, horse, dog, cats, and other animals, where they

cause great irritation, sores, and scabs, and cases are known where they have settled permanently upon birds, chiefly pigeons, and upon the cat, killing these animals in course of time. As they are nocturnal in their habits they are not often found upon the tormented animals during the day, but as soon as it becomes dark they leave their hiding-places to

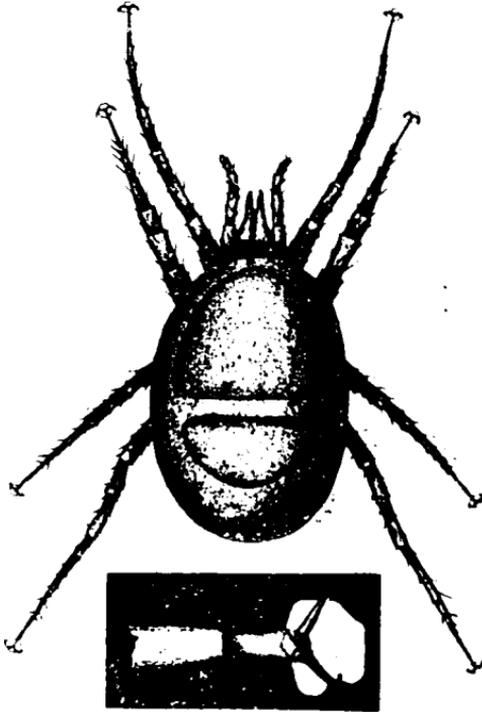


Fig. 51.—*Gammasus* spec. Mite and leg greatly enlarged. Original.

suck blood. They obtain this by means of very keen mandibles, and if at all numerous they extract considerable quantities of it and thus become very injurious, even fatal to younger or weaker birds. Even when not very numerous they prevent the fowls from sleeping at night, and not infrequently force setting hens to leave the eggs. They have also been known to enter the nasal cavities of birds, causing a severe inflammation.

REMEDIES.—Cleanliness is always the best preventive. The houses and cages must be washed from time to time

with hot water; the perches should be solid, so as to offer no hiding places. In bird-cages it is best, however, to use hollow perches, which act as traps in which the mites congregate during the day, and from which they can readily be removed by boiling water. There are a number of other remedies, such as the use of insecticidal powders, lime-wash, kerosene-emulsion or kerosene alone, sulphuret of carbon, creolin and others. But no matter which of these substances are used they have to be applied frequently and most thoroughly as the mites can remain hidden without food for many months. In one case specimens were kept for ten months in a glass without food, and the mites, though very feeble, were still living. Hen manure, swarming with such dangerous foes to the sleep and rest of all domesticated animals, has to be removed from stables, or the inhabitants will be infested; in fact poultry-houses should always be isolated.

The *Gimmsus* shown in fig. 51 was found in large numbers in a neglected hen-house, and greatly tormented the inhabitants. It took a long time and many applications of kerosene to dislodge it.

Prof. Leidy described in 1872 a mite found in the ear of a bull. Many specimens were discovered upon the ear-drum, and hence received the name of *Gimmsus auris*. Mr. Turnbull found them repeatedly in similar situations and believes this mite to be a genuine parasite.

Other mites, as *Gimmsus pteropteroides*, which normally are found only in musty fodder, occasionally also reach our domesticated animals and cause all sorts of irritations. Still others, for instance those found in old flour, cheese, dried plums and figs, have been detected repeatedly in sores upon horses and in other places. To show the general appearance of such mites one of the cheese-mites (*Tyroglyphus longior* Gervais) has been illustrated in fig. 52. This mite, common enough in houses, enjoyed for some time the ephemeral fame of being a human creation, as it was claimed to have been produced by subjecting a volcanic stone, kept moist with a weak solution of silicate of potash, to a continuous current of electricity. This mite, if eaten with cheese, can also cause sickness. Whenever fodder spoils

mites are sure to be found in immense numbers, and as they are equipped with all kinds of tools to reduce the fodder to dust, and as such spoiled material is only found in stables

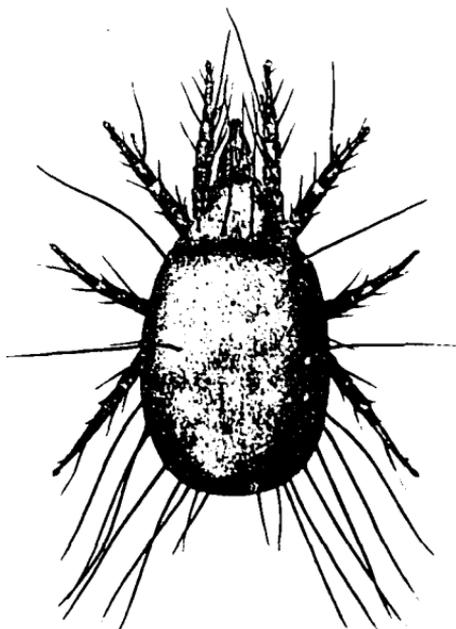


Fig. 52.—*Tyroglyphus longior* Gervain.
Greatly enlarged. Original.

not well cared for, it is not so very strange that animals forced to live in such places will soon show the presence of such mites by their restlessness and scabby appearance.

Unrefined sugar sometimes swarms with minute mites (*Tyroglyphus (Acarus) sacchari*) and Mr. Cameron of Dublin counted five hundred of them in ten grains of sugar, which means that one pound of sugar harbored more than one hundred thousand of these minute beings (fig. 53). This is a decidedly bad case of adulteration! The disease known as "grocer's itch" is said to be caused by the presence of such mites, which, like the true itch-mites, burrow under the skin of the hands of persons frequently handling such sugar.

Dr. Packard received a peculiar Cheletus-like mite (fig. 54 shows an allied species) from New Orleans, said to have been extracted from the human face. "Its body is oblong and square behind; the head is long and pointed, while the

maxillæ end in a long, curved, toothed, sickle-like blade. That this creature has the habits of the itch-mite is suggested by the curious, large, hair-like spines with which the body and legs are sparsely armed, some being nearly half as long as the body. These hairs are covered with very fine spinules.

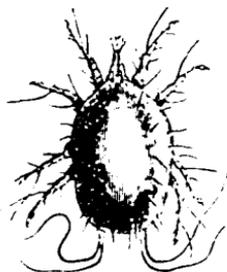


Fig. 53.—*Tyroglyphus (Acarus) sacchari*. Greatly enlarged. After Packard.

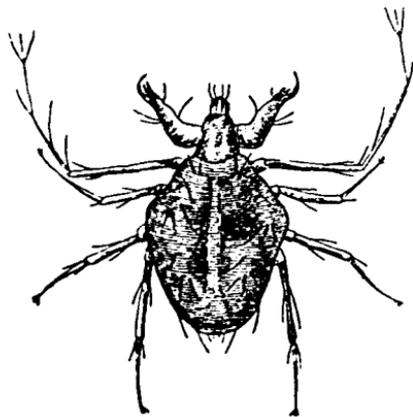


Fig. 54.—*Cheletus* spec. Greatly enlarged. After Packard.

Those on the end of the body are regularly spoon-shaped. These strange hairs which are thickest on the legs, probably assisted the mite in anchoring itself in the skin of the host."

It is quite certain that a number of other mites belonging to various families can exist, for some time at least, upon the skin of man and domesticated animals, and these mites need not necessarily be blood-sucking species. For instance *Cyrtophyes monanquiculatus* has been found in Germany to be the cause of an endemic disease attacking some laborers who were loading barley containing such immature six-legged and dark-red mites. Another mite, *Cheletus*, was found in the pus coming from the ear of a sailor.

E. TICKS.

(*Irodidae*.)

The ticks or wood-ticks are well known to all people that live near uncultivated land, and to hunters and others that are in the habit of visiting forests. They all have learned that these parasites can be very troublesome to man

and beast. They hide among bushes and other low plants, and holding themselves with some of their legs to blades of tall grasses, perhaps overhanging a path, they stretch out the other legs at full length to detect any animal that may happen to pass that way and to which they attach themselves. Once fastened they select a suitable spot to insert their peculiar sucking-organs for the purpose of securing a feast of blood. All ticks are parasitic, infesting chiefly mammals and reptiles, but also birds.

Their body is round or broadly oval, very flat, and protected by an exceedingly tough integument. When swollen with blood their legs, which appeared very long in the hungry creature, are now almost useless, and the tick in this shape resembles very closely a castor-oil bean. When the brute has reached its acme of happiness, fullness, it withdraws the sucking-organs and drops to the ground. Fig. 55, plate IX, shows ticks of various sizes just removed from a dog.

The mandibles (fig. 56) are covered with teeth and have terminal hooks; their maxilla are small, not reaching beyond the beak, but bear a peculiar organ called the glossoid, which is also covered with hooks. Their slender, seven-jointed legs have two claws, and those of the six-legged young mites, pads or suckers. These



Fig. 56. Mouthparts of common tick. Enlarged. Original.

parasites crowd together in large numbers when still young, clinging like the mature ticks to the tips of leaves, with a number of their slender legs extended, and wait for "something to turn up." When they succeed in reaching a victim they insert their glossoids and mandibles into the skin, to which they cling very firmly by means of the numerous hooks. This operation causes considerable irritation. If pulled out violently, these sucking-organs and the head remain in the skin and cause bad sores. To remove the entire animal, we have to apply oil; as soon as the parasite is touched with this substance it will withdraw the imbedded proboscis. Animals upon which large numbers of ticks are fastened can be relieved by means of kerosene-emulsion.

The eggs of the ticks are deposited in large masses dur-

ing May and June; they hatch early in July, the "shell opening like a clam."

Ticks are quite numerous in Minnesota, but only in the south do they become extremely troublesome to persons and animals.

THE CATTLE-TICK.

(*Boophilus bovis* Ril.).

This is a flat, leathery, reddish and seed-like species with an oblong oval body (fig. 57). When mature it reaches nearly half an inch in length. It does not occur in Minnesota,

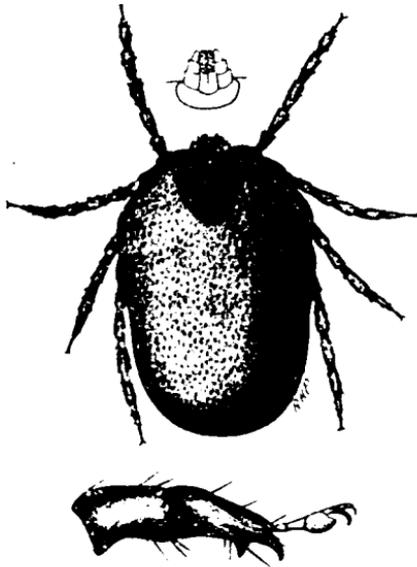


Fig. 57.—Cattle-tick. Enlarged. Original.

but is a southern and, originally, a tropical species which is annually killed by frost north of the Ohio and Potomac rivers. Generally speaking, the injury caused by this gigantic mite, sucking the blood of animals, would be but small, if it were not for the fact that it is the chief and perhaps the only agent that spreads the "Texas Fever" or "Red Water." This disease is caused by a microbe which enters the veins and arteries of cattle and rapidly and extensively destroys the red corpuscles of the blood. The cattle-tick, which sucks

the blood of diseased cattle, conveys the disease-germs to its young, which carry it to other cattle invaded by them. In the region south of the two rivers mentioned above, the disease is seldom fatal to the native stock, in the blood of which it always seems to exist; at least it can be artificially inoculated from apparently healthy southern cattle into healthy northern stock. If native cattle are brought from the northern regions into the permanently infected region they are almost certain to contract the disease if permitted to run at large. Younger cattle may be acclimated and not catch the disease in its dangerous form. If southern cattle, carrying with them such ticks, are sent north, the latter drop off when mature and deposit eggs upon the soil of the pastures, stables and yards; the young ticks, hatching in eighteen to twenty-four days, thus reach other stock and as they carry with them the microbe causing the disease and as they are not slow to bite, they convey this disease, which in from two to three weeks develops into Texas fever. All these interesting facts were discovered by the careful investigations made by the U. S. Department of Agriculture.

REMEDIES.—Though we do not find this dangerous tick in Minnesota it is well to know the proper treatment, especially as this is equally effective against the ticks found here. Pine tar, one gallon; kerosene, fish-oil or crude carbolic acid, one quart; and powdered sulphur, two pounds, should be thoroughly mixed. This makes an excellent salve for sores, and will also protect animals against flies; as a protection fish-oil is better than either kerosene or carbolic acid. The salve should be thoroughly rubbed in, and this operation should be repeated from time to time.

THE COMMON TICK.

(*Dermacentor americanus* L.).

This tick is the only one that is common in our state, and very common in some localities. It is found especially numerous upon hunting-dogs. As very little seemed to be known about the life-history of this tick some full-grown specimens, swollen with eggs, were put in a moist-chamber. They were not slow in depositing immense numbers of eggs,

(fig. 58, plate IX) which seemed to issue from the wrong end of the animal. By looking



Fig. 61.—Young tick. Enlarged. Original.

at fig. 59, plate IX, it will be seen that the opening of the sexual organs, *b*, is situated between the haunches of the first pair of legs, and close to the mouth. Many thousands of eggs were laid by each female, which hatched in the course of three or four weeks. The young ticks remained for some time huddled together (fig. 60, plate IX) and appear enlarged, as in fig. 61.

They show already upon the margin of the abdomen plates of chitin which enable them to greatly expand with food. Male and female ticks are shown in fig.

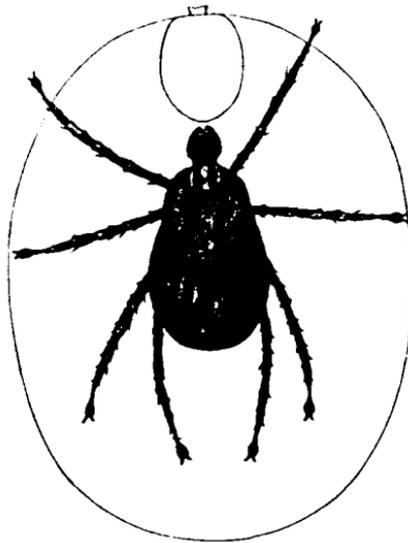


Fig. 62.—Common tick before and after a meal. Greatly enlarged. Original.

55, plate IX, just as they were removed from a dog. The mouth-parts of this species, described before, are shown in fig. 56, and the illustration (fig. 62) shows the tick before and after a meal. The outline of the tick filled with blood

is simply indicated by a line enclosing a still hungry parasite.

As the dogs infested with such ticks generally drop them in and near their sleeping places, these become soon badly

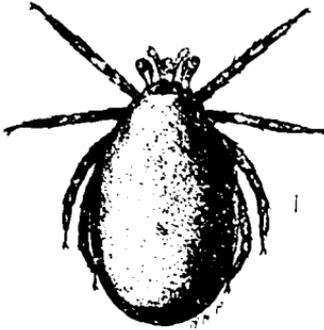


Fig. 63.—Tick from Pocket-gopher, adult. Enlarged. Original.



Fig. 64.—Tick from Pocket-gopher, young. Enlarged. Original.

invaded with the small and hungry ticks, sometimes called "seed-ticks," and in this case they greatly torment the animals in the vicinity of such breeding places. A thorough and repeated spraying with kerosene oil will kill these pests. The ticks were also found upon horses and other mammals, and even upon a rattlesnake.

Many other species occur in Minnesota. Some are quite small, as the one upon the pocket-gopher illustrated in figs. 63 and 64, which shows the adult and the young six-legged larva.

All the parasites described thus far are not true insects, differing from them by the possession of eight legs when mature, by never possessing any wings, and by numerous other characters not necessary to mention in this place.

F. SUCKING-LICE.

(*Pediculi*.)

This family of insects includes a number of unsavory parasites that infest man and quadrupeds. Though those attacking man are not usually mentioned in polite society it is sometimes not only important to describe them, but even necessary to give remedies to reduce their numbers. Of course the time has passed when insects of this or of a similar charac-

ter were such a common occurrence that few school rooms could boast of not having such inhabitants. It shows that civilization after all depends largely upon the free use of soap and some mechanical appliances as fine-toothed combs.

Lice are true insects furnished with a sucking mouth (fig. 65). They are very degraded insects, however, and do not even possess wings, for which they have no use, being generally surrounded in their dwelling-places by plenty of



Fig. 65.—Mouth-parts of body-lice; *a, a*, summit of head with bristles; *b, b*, the chitinous band; *c, c*, hind part of lower lip; *d, d*, protruding part of lower lip (*haustellum*); *e, e*, hooks turned outwards; *f*, inner tube of suction, with two pairs of jaws shown as lines on the outside, and a few drops of blood in the interior. Greatly enlarged. After Schwædtc.

food. The small head is conical; the thorax is also small and indistinctly segmented; the abdomen, however, is large, flat, round or oval, and contains nine segments. The slender feelers possess five joints; the simple eyes, if they possess any, are minute; the feet have two joints, of which the last one forms a strong hook for grasping the hairs while climbing upon them. The mouth forms a very slender, fleshy

tube, which is retracted if not in use; inside this tube is a fine bristle-like organ which can be introduced into the skin for the purpose of sucking blood. According to Schiœdte it has the following construction: "the peculiar attenuation of the head in front of the antennæ at once suggests to the practiced eye the existence of a mouth adapted for suction. The mouth differs from that of *Rhynchota* (as bed-bugs, etc.) generally, in the circumstance that the labium is capable of being retracted into the upper part of the head, which therefore presents a little fold which is extended when the labium is protruded. In order to strengthen this part, a flat band of chitine is placed on the under surface, just as a shoemaker puts a small piece of gutta-percha into the back of an india-rubber shoe; as, however, the chitine is not very elastic, this band is rather thinner in the middle, in order that it may bend and fold a little when the skin is not extended by the lower lip. The latter consists, as usual, of two hard lateral pieces, of which the fore ends are united by a membrane so that they form a tube, of which the interior covering is a continuation of the elastic membrane in the top of the head; inside its orifice there are a number of small hooks, which assume different positions according to the degree of protrusion; if this is at its highest point the orifice is turned inside out, like a collar, whereby the small hooks are directed backwards, so that they can serve as barbs. These are the movements which the animal executes after having first inserted the labium through a sweat-pore. When the hooks have got a firm hold, the first pair of setæ (the real mandibles transformed) are protruded; these are, towards the points, united by a membrane so as to form a closed tube from which, again, is exerted the second pair of setæ, or maxillæ, which in the same manner are transformed into a tube ending in four small lobes placed crosswise. It follows that when the whole instrument is exerted, we perceive a long membranous, flexible tube hanging down from the labium, and along the walls of this tube the setiform mandibles and maxillæ in the shape of long narrow bands of chitine. In this way the tube of suction can be made longer or shorter as required, and easily adjusted to the thickness

of the skin in the particular place where the animal is sucking, whereby access to the capillary system is secured at any part of the body. It is apparent, from the whole structure of the instrument, that it is by no means calculated for being used as a sting, but is rather to be compared to a delicate elastic probe, in the use of which the terminal lobes probably serve as feelers. As soon as the capillary system is reached, the blood will at once flow in the narrow tube, after which the current is continued with increasing rapidity by means of the pulsation of the pumping ventricle and the powerful peristaltic movement of the digestive tube."

All true lice have very similar habits, all are blood-suckers, but each species inhabits only a certain kind of animal, some are even restricted to certain parts of the skin. Some animals harbor several species, and five kinds are stated to be found upon man, three of which are common enough under certain conditions.

Whenever lice become very abundant by negligence they cause great irritation to the skin of their host. Animals thus invaded try to overcome this constant itching by rubbing themselves against fences, trees, and buildings, and soon wear off their hair and injure their skins. In time lousy animals become weak and otherwise diseased.

THE HEAD-LOUSE OF MAN.

(*Pediculus capitis* De Geer).

This kind is probably the best known of all species, and but few young children in our public schools have had no opportunity to observe their actions. Of course the presence of such parasites is an indication, nay, a proof, that personal cleanliness is sadly neglected. The old belief that these parasites were indications of healthy blood is not true, and it should surely be no longer fashionable to be thus tenanted, as it used to be in old times and in some countries. This parasite is confined to the human head, and only in extreme cases does it spread over the whole body.

All races of man are infested, and Kuechenmeister reports that he even found the eggs of this species in the hairs of a

Peruvian mummy. The lice infesting the heads of negroes are darker, but among caucasians also colored varieties are not uncommon.

This louse (fig. 66) is too well known to require a detailed description; the male is 1 to 1.5mm. long, the female almost 2mm. The white eggs or "nits," 0.6mm. long, are elongated oval, with several little conical prominences at their large ends, which are open at the top, while the small end bears a cluster of bristles. About fifty eggs are glued at their pointed ends to hairs; in about six days the young hatch, grow rapidly, and after shedding their skins three times reach their adult condition in about three weeks.



Fig. 66.—Head-lice of man. Greatly enlarged. Original.

The young lice resemble the adult ones except in size; they are also less distinctly marked. The belief often expressed that a female louse could become a grandmother in the course of twenty-four hours is of course absurd.

As the habits of these parasites are so well known, and the treatment of getting rid of them is familiar to those most interested in such matters, it is needless to mention them. Cleanliness and the application of hair-oils, etc., are good preventive measures. A little benzine is deadly for such intruders, but being very inflammable it should not be applied when near a light or fire, otherwise the hairs with their inhabitants might be removed. Sulphur ointment and white precipitate are also well-known remedies against these insects.

THE BODY-LOUSE OF MAN.

(*Pediculus vestimentis* Leach).

This species has received a number of names on account of some fancied peculiarities. They closely resemble the head-lice but are larger, the female measuring as much as 2mm. to 4mm. The smaller males are not as numerous as the females. The eggs, 0.8 to 1.0mm. long, 0.8mm. broad,

are attached to the clothing, especially along the seams where these come in contact with the human body. From about 60 to 70 eggs are deposited by each female. During the warmer part of the year these lice can increase very rapidly in numbers, and Leeuwenhoek has estimated that a single adult female could have in eight weeks a progeny of 5000. This rapid increase accounts for the many authentic accounts of their sudden appearance. A disease, mentioned by the very earliest writers, the *Phthiriasis*, was stated to be caused by lice and it seems probable that this is the species referred to. These parasites prefer the less hairy parts of



Fig. 67. Body-louse of man. Greatly enlarged. Original.

the body, as the neck, back, and abdomen, where they can cause a sort of eruption; or they simply redden the skin in larger or smaller spots, which, on account of the constant scratching induced by the itching presence of the insect, become sores. Fig. 67 shows this nasty parasite.

In cases in which the clothing is seldom changed, as is usually the case in armies during war, these insects, frequently called "Grey-backs," increase very rapidly in numbers

and become a great source of annoyance. Many, if not most of our veterans can tell wonderful stories about these parasites; in fact some yarns have been told about them that require a very strong constitution to stand the strain in believing them. These lice become also very numerous in lumber-camps and other places where bathing and a frequent change of clothing are out of the question. Persons forced to live for a long time in camps can only protect themselves against these unpleasant intruders by cleanliness, and by changing their underwear as frequently as possible. The parasites in soiled clothing are readily killed by boiling or baking it.

THE CRAB-LOUSE.

(*Phthirus inguinalis* or *pubis* Leach).

This parasitic insect belongs to a different genus of lice, as can be seen by its heart-shaped form and broad thorax, which is not separated from the abdomen (fig. 68). The former is composed of two segments soldered together, the latter of eight flat joints. The first pair of legs are feeler-like and possess slender tarsi; the claws of the two other pairs are large and strong, with a moveable thorn, to enable the insect to secure a strong hold upon the hairs. The head, broad in front, carries five-jointed feelers, and behind them, upon two projections, the two simple eyes. The end of the abdomen in the male is rounded, that of the female is bilobed. Owing to the peculiar shape, the strong legs spreading out laterally, this louse resembles a minute crab, hence the name "crab-louse." It is of a whitish color, with a dusky ill-defined spot upon each shoulder; the legs are red-



Fig. 68.—Crab-louse of man. Greatly enlarged. Original.



Fig. 69.—Crab-louse of man, egg. Greatly enlarged. Original.

dish, with darker claws. The male measures 1mm. in length, the female 1.2mm. The pear-shaped eggs (fig. 69), 0.9mm. long and 0.5mm. wide, are glued at their pointed ends to hairs; about ten eggs are deposited.

This species lives among the hairs of the pubic regions of man, and, also, though not very frequently, upon the breast, arm-pits, even in the beard, eye-brows and on the head. As these nasty parasites cling frequently to linen and other

clothing, they occur even in closets of hotels, depots, and similar much-frequented places.

If these lice occur only in few numbers they simply cause a violent itching; if large numbers are found together they can cause a sort of scab, a consequence of the continuous scratchings by the infested person.

They can be destroyed by simple ointments, emulsions of etherial oils, by unguents, or by the sulphuret washes already mentioned. Red precipitate is most frequently used.

This louse, as well as the body-louse, had formerly a very bad reputation, and judging from numerous accounts given in old publications they caused a fearful disease, the Phthiriasis. According to history Herodes, Philipp II. of Spain, Max. I. of Germany, and other persons, died from this disease, but in more recent times no authentic cases have been observed.

All true lice which infest our domesticated animals have been placed in another genus of lice, for very insufficient reasons, however, as they vary but little from those infesting man. The generic characteristics of the genus *Hæmatopinus* are: head obtuse or truncated in front, the middle segments of the abdomen well separated, and the posterior legs much the longer. Eyes very minute or absent. Lice of this genus have the same habits as those found upon man, and are most abundant upon neglected animals, or upon animals that have been for a long time confined in stables.

THE HOG-LOUSE.

(*Hæmatopinus uricus* Nitzsch).

This is the largest louse known, measuring from 3 to 4.5mm. (one-quarter of an inch) in length. Its color is brown, yellowish-brown, or yellow, with a whitish abdomen. The margin of the head is dark-brown, and each joint of the feeler possesses in the middle a dark ring. A brown, six-cornered spot is usually found upon the under-side of the thorax; the legs are also ornamented with brown rings, and the claws are quite dark. The spiracles are placed in blackish, horny plates along the sides of the abdomen.

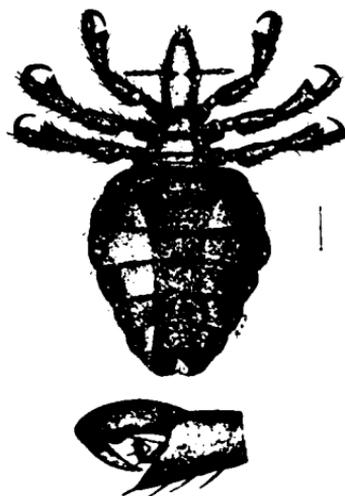


Fig. 70.—Hog-louse. Greatly enlarged. Original.

The louse is sometimes very abundant upon hogs, preferring as a home the thighs.

Fig. 70 shows this nasty insect. Its claw and tibial tooth, which act as finger and thumb, and enable the louse to walk quite well, are also shown.

THE HORSE-LOUSE.

(*Haematopinus asini* Linn. (*macrocephalus* Burm.).)

This parasite is found upon the horse and ass; it is distinguished by a very narrow and elongated head, and by possessing a triangular indentation behind each feeler. In this indentation is located the eye. The abdomen is short and oval, and the segments are deeply dentated at the margin; the whole abdomen is but a little longer than the rest of the body. Color yellowish or rust-colored; the thorax brownish, at base of feelers a triangular black spot. Front of head, claws and horny plates surrounding the spiracles are dark brown. Length 2 to 3.25mm. These lice infest chiefly the throat and neck of their hosts (fig. 71, plate VI).

THE SHORT-NOSED CATTLE-LOUSE.

(*Haematopinus eurysternus* Nitzsch).

This common parasite of our cattle is 1.5mm. long. Its

head is bluntly rounded in front, and broadest behind the feelers which are as long as the head. Eyes very small and difficult to detect. The thorax is very broad, much broader



Fig. 72.—Short-nosed cattle-louse; male, and tip of abdomen from below. Greatly enlarged. Original.



Fig. 73.—Short-nosed cattle-louse: female abdomen from below, and egg. Greatly enlarged. Original.

than long, and widest where it joins the abdomen. The head, which is wedge-shaped behind, fits into a triangular indentation of the anterior margin of the thorax, the abdomen is strongly segmented. The louse is light-brown; the posterior half of head, the thorax and legs are darker; the abdomen bluish-gray. The elongate oval eggs tapering at the lower end, and having a cap-like lid at the upper end, are deposited on the hairs close to the skin. Fig. 72 shows the male louse with enlarged tip of abdomen seen from below, and fig. 73 the corresponding part of a female and an egg fastened to the hair of a cow.

This parasite is especially troublesome on the neck and shoulders of the infested animals, and these parts are frequently worn bare of hair by efforts to dislodge the irritating intruder.

It is not easily dislodged if once settled in large numbers upon an animal. Veterinarians seem to prefer Stavesacre as a remedy. Kerosene-emulsion, or even a mixture of kero

sene and soft soap, well rubbed in, will quickly and thoroughly kill these intruders.

THE LONG-NOSED CATTLE-LOUSE.

(*Hematopinus vituli* Linn).

This parasite (fig. 74) possesses a long and narrow body, measuring 2 to 2.30mm. The small head, pointed in front, shows very plainly the long and projecting beak. A very small eye is found behind each feeler. The head is wedged into a squarish thorax. The legs are not of the



Fig. 74.—Long-nosed cattle-louse. Greatly enlarged. Original.

same length, increasing in length from the first to the third pair. The abdomen is long and narrow, almost spindle-shaped, not sharply segmented, and lacks the chitinous plates along the sides. The head and thorax are brown, the abdomen bluish-gray, the legs brown, darker at the tips.

THE GOAT-LOUSE.

(*Hematopinus stenopsis* Burm.).

This insect possesses a long head with a wedge-like and pointed basal end. The feelers are shorter than the head, the thorax is square, the legs short, with strong and heavy claws. Head and thorax brownish-yellow, end of feet brown, abdomen grayish-white or grayish-yellow. It measures

2.25mm., and is found upon the goat. This species has not been found in Minnesota as goats are not numerous in our state.

THE SHEEP-LOUSE.

(*Hematopinus ovis* n. sp.).

It seems that no sucking-lice have been found upon the sheep, at least none have been described as far as the writer has been able to discover. While looking for other parasites upon this animal Mr. R. H. Pettit discovered a sheep that had the hind-legs badly infested by a louse. Those parts covered by hair or short wool were chiefly invaded, though



Fig. 75.—Sheep-louse; female and egg. Greatly enlarged. Original.



Fig. 76.—Sheep-louse, male. Greatly enlarged. Original.

some lice were found higher up in the wool. During the colder days in December the lice also invaded other parts of the sheep, still preferring, however, the legs, quarters and shoulders. The work of these parasites had been noticed some six months previous to their discovery, and they had during all this time not extended the region invaded, nor had they spread to other sheep. This would almost indicate that this louse was out of place upon sheep. This species is on that account less to be feared than the others already described. Yet they had increased in the invaded region in immense numbers, which makes it still more remarkable that they did not wander to the other

sheep confined in the same pen. The effect of the presence of such multitudes of irritating lice was plainly seen by the poor condition of the sheep, and by its restlessness. The illustrations (figs. 75 and 76) show both sexes, and one of the eggs. The entire skin of this louse is beautifully chagreened, as indicated in the illustration.

THE DOG-LOUSE.

(*Hematopinus piliferus* Burm.).

This extremely troublesome louse seems to defy all attempts to dislodge it from its host, the dog; at all events it



Fig. 77.—Dog-louse. Greatly enlarged. Original.

is no easy matter to free dogs once infested by these unpleasant guests. The louse is about 2mm. long with a six-sided head and thick feelers. The thorax shows divisions into segments and is trapezoidal in shape. The large abdomen has segments not strongly marked. The underside of the parasite is closely covered with hairs and minute eminences, which are fewer in numbers upon the dorsal surface. Legs are about equal in length and thickness. Head and thorax yellow or brownish-yellow, abdomen yellowish-brown or light yellow. Fig. 77.

The skin of this louse is quite transparent, so that the food consumed can be detected in the intestines.

REMEDIES.—All lice infesting our domesticated animals should be removed as soon as detected, as animals harboring such blood-sucking and irritating guests become restless and weak. There are many remedies that can be used. White precipitate or ammoniated chloride of mercury, used as an ointment and well rubbed in, is an excellent remedy for this purpose. Being very poisonous, the dog has to be muzzled, and the substance has to be washed off with soap and water after a few days or when no longer required. A very weak solution of nitric acid is stated to be also a good liquid remedy.

Tobacco-tea.—This tea, made of one part common tobacco boiled in 20 to 25 parts of water, or in 20 parts of water and 10 parts of vinegar, is a very good wash to kill lice on dogs and sheep; it should not be used against those infesting horses or cattle, as these animals are very sensitive to the use of this remedy.

Gray mercurial ointment should only be used against lice infesting horses and hogs; cattle are injured by this poison, and it should only be applied to the parts of the skin invaded by the parasites.

Persian insect-powder.—This powder, if fresh, is a very excellent remedy. It should be applied to the skins after they have been moistened slightly so that it will stick.

Benzine.—1 part to 4 parts of soft-soap and 10 to 15 parts of water will kill most lice.

Kerosene-emulsion, to which may be added an extract of Persian insect-powder, is one of the best remedies known. If no emulsion can be made we have a good remedy by mixing 3 to 6 parts of linseed oil with one part of kerosene oil.

Carbolic acid.—Very dilute solutions of this substance in water make a fairly good wash.

Raw linseed-oil.—This will readily kill the lice infesting the hog. If none of these mixtures or ointments should help, *Arsenious Acid* will surely do so, though being a very poisonous substance it is not wise to use it except in extreme cases. A good proportion is the following one: dissolve 16 gr. of white arsenic and 16 gr. of potash each in $1\frac{1}{2}$ kg. water, and add to the mixture of both $1\frac{1}{2}$ kg. vinegar.

No matter which of the above remedies we may apply it is always necessary to use them at least twice within an interval of 5 to 7 days. This is required so as to kill the young lice hatching from the eggs or "nits". The latter can be readily killed by vinegar.

Cleanliness is all important. To simply comb and brush our domesticated animals, if time permits, is not the true way of treating them. Besides sufficient food they should be cleaned at least once every day.

G. FEATHER OR HAIR-LICE.

(*Mallophaga*).

These insects have been shifted about in classification from one place to another. At one time they were associated with true lice; later they were considered members of the orders of *Orthoptera* and *Neuroptera*, or allied to the white-ants, book-lice and similiar insects. At present they have been elevated to the position of forming an independent order, the *Mallophaga*. From the above it will be seen that they do not merely cause a restless condition to their hosts! Nor is it strange that they are not easily placed in a classification when we consider that these insects lead a parasitic life, and have their whole organization modified for this purpose.

Feather-lice have an incomplete metamorphosis. They are produced from whitish, elongate-oval eggs, which are fastened with some sticky substance to the bars or vanes of feathers. The eggs are furnished with a circular lid at the larger end, which is pushed off by the hatching young. It seems to require several weeks before such eggs will hatch. How many are laid by a female is not known, but not very many, as the eggs are very large for the size of the parent. The writer saw upon several occasions such eggs deposited by lice removed from their host; the former were kept in a warm place about his person, but would not hatch. The young lice are always white, without any markings or chitinous bands.

The adults possess a small, flat, and very tough body, and there are no traces of wings. The peculiarly shaped horizontal head is very large in proportion, flat and usually sparsely haired. The mouth-parts (fig. 83) are located below the head; the antennæ are short, 3, 4, or 5 jointed. The very large clypeus forms the principal part of the head, and is prolonged into a more or less colored plate. The simple eyes are located behind the antennæ. The biting mouth-parts are difficult to study. The legs are strong, and the shorter first pair is used to carry food to the mouth. The abdomen is flat, short, oval to long and slender, and differs frequently very much in the sexes.

The food of these parasites, which possess a biting and not, like true lice, a sucking mouth, consists of epidermal cells and minute particles of hairs and feathers. If they are very numerous they cause their host a great deal of inconvenience and real injury. This is almost entirely caused by their sharp claws, which irritate the host, thus making rest impossible, and not so much by any abstraction of food, as has frequently been claimed. The ear-shaped crop of these parasites, filled with food, and located in the abdomen, has been dissected again and again, but no blood could be found.

These insects remain for life upon the body of their hosts, though some, like the common louse of the hen (*Menopon gallidum*), are sometimes found walking upon the roosts. Yet they are by no means stationary, but move about so rapidly among the feathers and hairs that they are not readily captured. In this manner they can reach, by actual emigration, other birds of their kind, since these usually associate together. Birds, infested by such lice, though they would furnish the same amount of food after death as before, are still no longer suitable abodes for these parasites, for they require not only food but warm shelters. This is the reason why dead game-birds and poultry are sometimes such unpleasant objects to handle, as the lice are leaving them for warm places, very much to the disgust of cooks and taxidermists.

The order *Mallophaga* is divided into the two sub-orders *Ischnocera* and *Amblycera*; insects belonging to the former have three to five-jointed, filiform feelers and no labial palpi; those belonging to the latter have club-shaped, four-jointed feelers and four-jointed labial palpi. Of the feather-lice found upon domesticated animals and birds in Minnesota the following genera: *Trichodectes*, *Docophorus*, *Goniodes*, *Gonicotus* and *Oreithobius* belong to the *Ischnocera*, and *Calpocephalum*, *Triaotum* and *Menopon* to the *Amblycera*. To avoid unnecessary repetition of technical details these parasites have been arranged according to the hosts they infest, and not according to a scientific classification.

We will first describe the hair-lice found only upon our domesticated animals. All belong to the genus *Trichodectes*;

and the parasites belonging here are characterized by possessing three-jointed feelers, while all others have five-jointed ones.

THE BITING-LOUSE OF THE DOG.

(*Trichodectes latus* Nitzsch).

This parasite is found not very commonly upon our dogs. It shows, apparently, a preference for puppies, and is said to migrate from older to younger hosts in large numbers when opportunity offers. Its hairy head is large, almost square, but slightly rounded in front, and of a dark yellow color, with four brown marginal spots. The three-jointed feelers are inserted in a depression, behind which is a dark spot. The thorax is composed of two joints of equal length, of which the former is the narrower. The legs are of equal length, thick, with a strongly curved claw upon each



Fig. 78.—Biting louse of dog. Greatly enlarged. After Nitzsch.



Fig. 79.—Biting louse of cat. Greatly enlarged. Original. After Nitzsch.

tarsus. The ten-jointed, elongated-oval abdomen is covered with bristles, and is light yellow; the thorax is darker. Length 1 to 1.5mm., seldom 2mm. Fig. 78 is copied from Nitzsch's *Insecta epizoot.*, edited by Giebel.

The early stage of a tape-worm (*Trinia cucumerina* or *Dipylidium caninum* L.) occurs in this louse. The dog, by crushing this source of irritation with the teeth, can thus directly become infected by this tape-worm.

THE BITING-LOUSE OF THE CAT.

(Trichodectes subrostratus Nitzsch).

Our domesticated cat is sometimes infested with these parasites. The insect is 1.2mm. long and is distinguished from species found upon other mammals by its pointed head. Below the front of the head is found a deep furrow, into which fits a hair of the host so closely that it can not be readily removed. Fig. 79 from *Insecta Epizoa* shows this parasite.

THE BITING-LOUSE OF THE SHEEP.

(Trichodectes splurocephalus Nitzsch).

This louse is distinguished by an almost circular, hairy, and yellow head, with darker margins in front of the feelers.

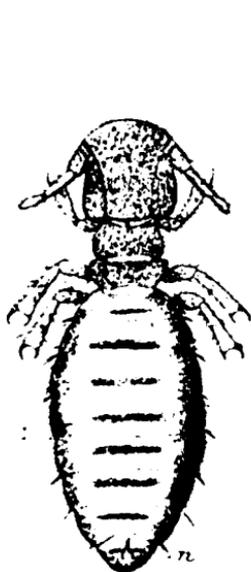


Fig. 80. — Biting-louse of sheep, male, *n*, genital orifice. Greatly enlarged. After Curtice.

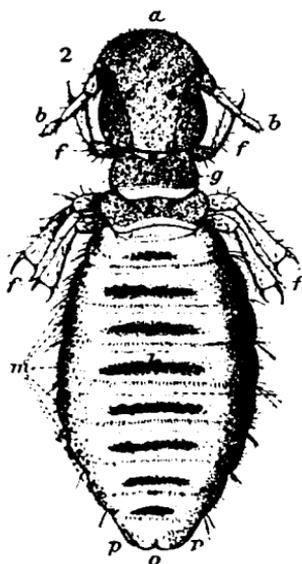


Fig. 81.—Biting louse of sheep, female; *a*, head; *b*, antenna; *c*, face; *d*, cheeks; *e, e*, dorsal sutures; *f*, legs; *g*, prothorax; *h*, metathorax; *i*, abdomen; *k*, dark transverse bands; *l*, line of hairs on each segment; *m, m*, breathing pores; *o*, female genital orifice; *p*, female claspers. Greatly enlarged. After Curtice.

No eyes are present. The thorax shows two segments, of which the former is as broad as the head, the second one broader but shorter. The elongated yellowish abdomen

possesses on the first seven segments dark margins. Length 1.7mm.

This insect has not as yet been reported from Minnesota, but as the interest in sheep-husbandry is becoming greater

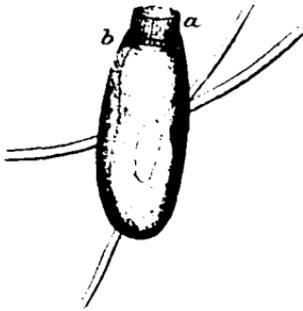


Fig. 82.—Biting-louse of sheep; egg, soon after being laid; *a*, cap; *b*, where the cap is joined to the egg. Greatly enlarged. After Curtice.

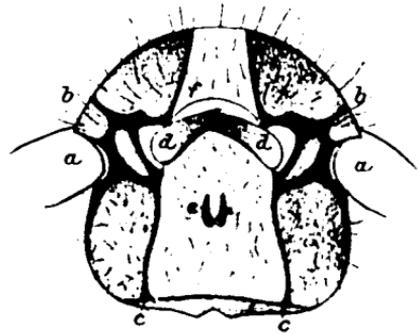


Fig. 83.—Biting-louse of sheep, showing head with mouth-parts from ventral side; *a*, *a*, antenna; *b*, *b*, continuation of dorsal suture; *c*, *c*, ventral suture; *d*, *d*, mandibles; *e*, maxilla showing through skin; *f*, labrum. Greatly enlarged.

every year it is wise to look out for this parasite, which can not be as easily destroyed as many others, on account of the longer wool of the host. Wherever it occurs it causes great annoyance to the infested animals, which try to stop the continuous irritations by as constant scratchings and bitings. Those not familiar with the true sheep-scab are very apt to mistake this one for the other. During the time of

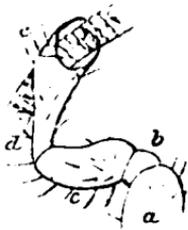


Fig. 84.—Biting-louse of sheep, anterior leg; *a*, coxa; *b*, trochanter; *c*, femur; *d*, tibia; *e*, tarsi and claws, the latter grasping a hair. Greatly enlarged. After Curtice.

clipping the sheep close attention should be paid to these parasites. Fig. 80 shows a male of this species, fig. 81 the female, and figs. 82, 83, 84 show the egg, head and front leg of this species, as well as the anatomical details.

BITING-LOUSE OF CATTLE.

(*Trichodectes scalaris* Nitzsch).

This louse (fig. 85) is well-known the world over, and is sometimes so abundant upon cattle as to become really injurious, though not as much so as sucking-lice. They are distinguished by the herdsmen as "red-lice," while sucking-lice are called "blue-lice." They occur in greatest numbers during the spring of the year, when they may be found in all stages of growth, from the freshly laid egg to the adult insect. They have a heart-shaped head, as broad as long, with triangular dark spots in front of the head and feelers, which latter are located in depressions.



Fig. 85. — Biting-louse of cattle. Greatly enlarged. Original.

The sides of head bear bristles. The eyes are very small. The first segment of the thorax is narrower than the second; between both, on either side, is a triangular piece, so that the segments show lateral corners. The thorax is covered with bristles; the claws are slender and but little bent, the abdomen elongated-oval; the edges of segments show corners; the dorsal surface bears bristles, and brown transverse bands mark the middle of each segment. At the sides of the last dorsal joint of abdomen is a peculiar chitinous appendage. The general color is reddish-yellow, the abdomen paler than head and thorax. Length 1.5 to 2mm.

BITING-LOUSE OF THE HORSE AND ASS.

(*Trichodectes pilosus* Giebel).

This parasite is also a very familiar insect, being found upon the horse and ass, where crowds of them are usually found upon the throat, mane, and neck. The species has not as yet been found in our state. The head of this parasite is rounded in front, and as long as broad. Marginal spots occur in front and behind the feelers; upon the middle of the head is also found a dark spot, while its posterior margin is dark brown. The thick feelers start well forward on the

head, so much so that their base is nearly in line with the front border of the head. All claws are slender. The first segment of the thorax is narrow, the second broader but shorter. The cylindrical abdomen is yellow with dark bands



Fig. 86. — Biting-louse of the horse and ass. Greatly enlarged. After Giebel.

across the segments. The whole body is covered with short hairs. General color brown. Length 1.5 to 2mm. (Fig. 86).

BITING-LOUSE OF THE HORSE.

(*Trichodectes parumpilosus* Piaget).

This is a very common parasite upon our horses, especially upon the younger ones kept in pastures. Their presence becomes decidedly manifest in stables towards spring, and the irritation caused by their presence makes the infested animals very restless, so that, in their attempts to rid themselves of their tormenters, they rub off all the hair upon infested places of their skins. The neck, base of tail, and space between the legs are particularly invaded.



Fig. 87. — Biting-louse of the horse. Greatly enlarged. Original.

Though resembling both the *scularis* and *pilosus* it is readily distinguished from both by good and constant characters. Its head is very decidedly rounded in front, forming a regular semi-circle; the antennæ are inserted well back; the abdomen is more slender and tapering than that of the *scularis*, but less so than that of the *pilosus*. Head,

thorax and legs are reddish-brown, the abdomen yellowish with a transverse dusky band in the middle of the anterior portion of the last eight segments. (Fig. 87).

THE BITING-LICE OF THE GOAT.

(*Trichodectes limbatus* and *clinax*).

Dr. Cooper Curtice, in his excellent work on "The Animal Parasites of Sheep," describes and illustrates two spe-

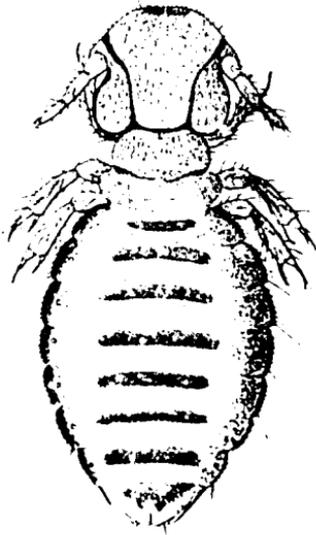


Fig. 88.—Biting-louse of the goat, female. Greatly enlarged. After Curtice.

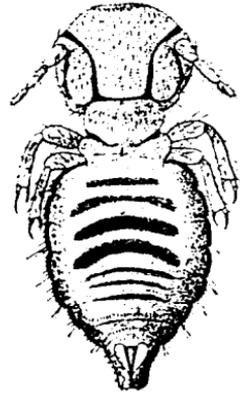


Fig. 89.—Biting-louse of the goat, male. Greatly enlarged. After Curtice.

cies of *Trichodectes* as infesting the goat. These two species are very similar to each other, and are, perhaps, only varieties. His illustrations are very fine, and his figures of the female of *limbatus* (fig. 88) and of the male of *clinax* (fig. 89) are reproduced.

The former species, *limbatus*, is fairly common in some localities, but not here in Minnesota. It usually occurs among the coarse hair along the back and sides of the infested animals and causes much discomfort, and in extreme cases even a form of scab.

A number of other hair-lice are found upon mammals.

Some of them possess a very peculiar shape, as the one found so commonly upon pocket-gophers. But as most farmers do not care to assist these injurious animals to rid themselves of any parasites that may trouble them, no remedies have been tried in this particular case, and none are given. Perhaps it is well, however, to mention how we can kill these parasites, since by applying the remedy we can kill the host as well. Locate the gopher, close all openings to its underground home but one, and pour into this a wine-glass full of Bisulphide of Carbon, and cover up the hole with a wet sack. This chemical is very volatile, and the quickly formed fumes being heavier than the air soon fill all the underground burrows and kill every living being. This remedy, as far as the parasite is concerned, is like burning a house to get rid of the bed-bugs.

Some pets like the guinea-pig are also infested with biting lice, and remedies given for sucking-lice should be applied to kill them.

Besides mammals nearly all birds are infested with feather-lice, and some so badly as to suffer very greatly; in extreme cases these parasites even cause the death of their hosts. As a general rule each species thrives only upon one kind of host, but not always so, as some few seem to be rather general feeders. The same bird can, however, harbor at the same time a number of different kinds of feather-lice. As far as our chickens are concerned we have in the United States not less than nine different kinds that make it their business to prevent hens from sitting, either as a recreation or as a business.

All other domesticated birds are also badly infested, and to keep these parasites away or in check involves no little labor, and only very pains-taking poultry-keepers will succeed. To possess a large number of chickens is one thing, but to possess healthy and contented ones is quite a different matter. Cleanliness in every detail is just as important as the food, and even more so, as most fowls have the run of the farm and are perfectly able to forage for themselves.

As all these parasites have very similar habits, and can be fought in the same manner, only the more important ones

will be given and figured, since practical people, for whom the report is written, do not greatly care whether they kill with Persian insect-powder, a *Goniocotes*, *Goniodes*, or *Menopon*, providing that the insect dies a sudden death.

The remedies we can apply against feather-lice infesting birds are not numerous, nor can they be applied as in treating hairy animals. An ounce of prevention in this case is worth more than a pound of cure. All birds, be they fowls or caged pets, useful or ornamental, should have access to a dust-pan filled with sifted coal-ashes. Whoever has watched birds enjoying a bath of this kind knows how useful it must be, and how beneficial and soothing, otherwise they would not repeat it as often as they do. If birds are infested with lice they seem to require such a dusting, which is evidently nature's remedy against all vermin of this character, and by means of which they dislodge them. The frequent use of Persian or Dalmatian insect-powder (*Pyrethrum*) is the very best remedy we possess for the purpose of killing these parasites. In buying this powder, we should make certain that it is fresh, as old powder becomes almost worthless. The active principle of *Pyrethrum* is an essential or etherial oil, which is volatile; if the powder is, therefore, not kept in a tight vessel nothing remains "but the dry substance, the spirit is gone." This powder, or the better one produced in California and sold under the name of Buhach, should be dusted between the feathers of the infested fowls. Their nests should also be treated in the same way.

Thorough fumigation of the hen-house with sulphur during the absence of the chickens is also an excellent rule, though the very great majority of biting-lice are away with the birds and not in the roosts. But the fumes of sulphur destroy at the same time also numerous other insects that invade the hen-houses, as well as vegetable parasites. For this very reason the inside of the hen-house should be white-washed from time to time, and a thorough spraying with kerosene should not be omitted. Sand-baths, in which the sand is slightly moistened with kerosene oil, has also many advantages. If hen-houses were built in such a manner that

sunlight could reach every nook and corner, all sorts of parasites would become scarce.

FEATHER-LICE INFESTING CHICKENS.

(*Goniocotes holoqaster* Nitzsch).

This very common and troublesome parasite, the female of which is shown in fig. 90 and the male in fig. 91, is only about 1mm. in length. It has a nearly square head; its ab-

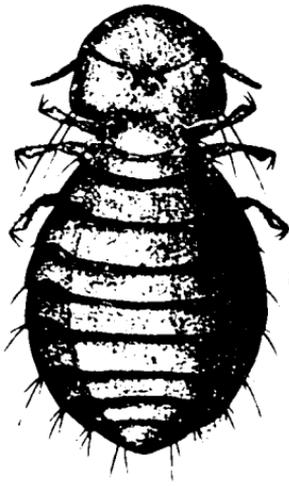


Fig. 90.—Biting-louse of the chicken, female. Greatly enlarged. Original.



Fig. 91.—Biting-louse of the chicken, male. Greatly enlarged. Original.

domen is not very conspicuously marked, and the incurved margins of the segments do not extend very much upon the dorsal surface, as is the case in many other species, and which produce the very distinct lines and borders seen there.

Goniocotes abdominalis Piaget.

This very conspicuous parasite is also fairly common and decidedly troublesome. It is much larger, measuring about 3mm. in length. The head is almost circular in front, constricted behind; the thorax is small. Head, thorax and legs are yellowish, marked with dark margins and spots. The segments of the abdomen are marked with white fasciæ with black borders, as shown in the illustration, fig. 92.

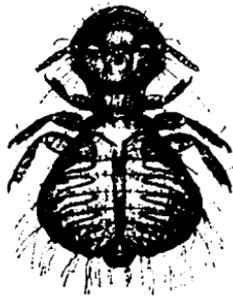


Fig. 92.—Biting-louse of the chicken. Greatly enlarged. After Nitzsch.

Goniocotes burnettii Pack.

Dr. Packard describes this feather-louse as occurring in large numbers on the domestic fowl. The illustration (fig.



Fig. 93.—Biting-louse of the chicken. Greatly enlarged. After Packard.



Fig. 94.—Biting-louse of the chicken. Greatly enlarged. Original.

93) shows its general appearance. It is a slightly yellowish insect streaked with black markings.

Goniodes dissimilis Nitzsch.

This large species seems to be rather common upon our chickens; it measures from 2 to 2½ mm. in length, and is of a tawny color. It is rather smooth and shining. The parasite has a large subquadrate head, a short transverse thorax

and a large abdomen, with confluent markings on the sides. The illustration (fig. 94) shows a female.

Lipeurus heterographus Nitzsch.

This parasite has been described as occurring quite commonly in Europe upon the domestic fowl and upon pheasants, and is very likely to be found here as well. It is illustrated in fig. 95.

Lipeurus variabilis Nitzsch.

The illustration (fig. 96) shows this peculiar insect, which is quite common in Minnesota. It measures about 2mm. in



Fig. 95.—Biting-louse of the chicken. Greatly enlarged. After Piaget.

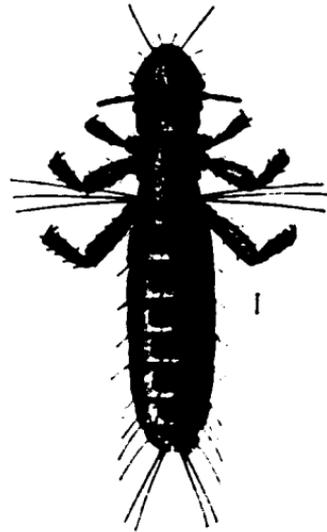


Fig. 96.—Biting-louse of the chicken. Greatly enlarged. Original.

length, and possesses a very elongated, smooth and shining body of a whitish color. The black margins of the body, and the markings of the dorsal surface, distinguish it from all other feather-lice infesting chickens.

Menopon pallidum Nitzsch.

This is the common hen-louse, so familiar to all interested in poultry raising, and so injurious to the chickens, and chiefly so to the younger ones. There is scarcely a chicken, which, if closely inspected, will not reveal its presence. This parasite is very active, and moves about the feathers of the

infested fowls with great celerity. But it also leaves its host quite readily, and passes upon the heads and bodies of persons holding the same, where it is quite annoying, though, of course, for only a short time, as it either soon leaves or dies. Horses in the vicinity of hen-houses, in which are kept infested chickens, soon suffer from the presence of such lice.

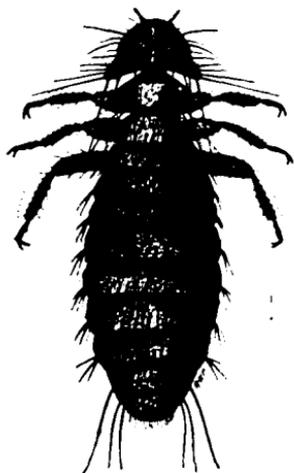


Fig. 97.—Biting-louse of the chicken. Greatly enlarged. Original.

The louse is of a yellowish color, slender, and measures from 1 to 1½mm. in length. As the illustration (fig. 97) shows, it is quite distinct in shape from the other feather-lice infesting the same animal.

Hen-houses once infested have to be thoroughly cleaned, and the remedies given elsewhere must be most thoroughly applied to secure good results.

As all insects breathe by means of spiracles located in their sides, any kind of oil spread over an insect will kill it by suffocation, because the spiracles become closed. If a little fat or grease is put under the wings of a hen, close to the body, most lice will be killed; the same result will be reached if a small bit of fat is put upon the head of a young chicken just hatched. But care must be taken not to apply too much fat, as the remedy would be worse than the evil, by coating the skin of the young chicken, which would result in its speedy death. Pyrethrum is in such a case the only safe remedy.

FEATHER-LICE OF DUCKS, GEESE, AND SWANS.

(*Docophorus icteroides* Nitzsch).

Species of parasites belonging to this genus possess in front of their feelers a small and moveable tooth-like projection, and are thus easily separated from other feather-lice.

They occur upon many species of aquatic birds like ducks and geese. This species is about 1mm. long. The head and thorax are of a bright red color with dark bands; the abdo-



Fig. 98. — Biting-louse of ducks, etc. Greatly enlarged. Original.

men is whitish in the center, and has broad and horny bands of a dark reddish color at the sides, which possess a still darker spot at the margin (fig. 98).

Docophorus cygni Denny.

This small parasite, only 1mm. long, and of a robust form, is found upon the swan. Its roundish head, the narrow thorax, and the legs are bright reddish-brown; the abdomen is white in the center, while the harder plates on the sides are brown.

Lipeurus tadornae Denny.

According to Prof. Comstock this feather-louse is found upon the goose; others have been found upon the sheldrake. This parasite is white, with a smooth and shining surface and of an elongated form; its heart-shaped head, the thorax, and the abdomen possess black spots along the margins.

Lipeurus squalidus Nitzsch.

Most species of wild ducks, as well as the domesticated ones, are infested with this parasite. It is a large insect measuring about 4mm. in length. Its elongate form is of a light-yellowish color with a darker border of the thorax and



Fig. 99.—Biting-louse of ducks, etc. Greatly enlarged. Original.

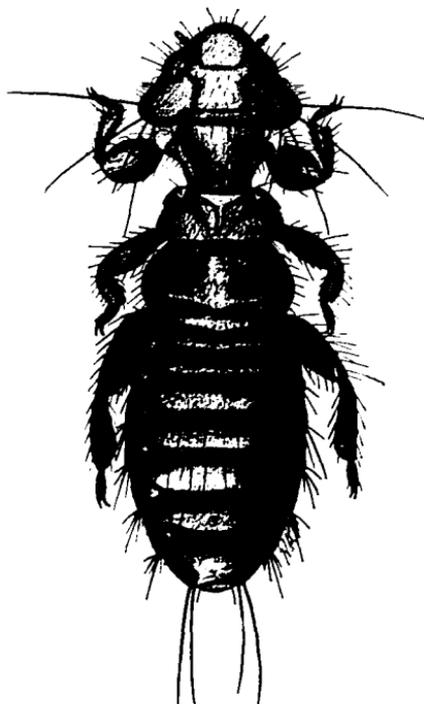


Fig. 100.—Biting-louse of ducks, etc. Greatly enlarged. Original.

abdomen, which in the latter, is broken up into little squarish patches. (Fig. 99.)

Lipeurus anseris Gurlt.

This species is also stated to occur upon the domesticated goose.

Lipeurus jejunus Nitzsch.

This slender pale yellowish-white parasite, with a black margin and four-sided bands upon the first eight segments, and with dark legs, is also found upon our domestic and wild goose.

Ornithobius cygni Denny.

This handsome feather-louse occurs in large numbers upon wild and domestic swans. It is a large species, measuring about 4mm. in length, with a slender and flattened body.

Its color is white and very transparent; it is ornamented with a number of black spots.

Trinotum luridum Nitzsch.

Most of our ducks are more or less badly infested with this large feather-louse, which measures 4 to 5mm. in length. It is a well-marked species, as can be seen in the illustration (fig. 100).

Trinotum conspurcatum Nitzsch.

This species is said to be found upon the goose and swan.

Trinotum lituratum Nitzsch.

This peculiar animal is not uncommon upon the domestic goose, but has also been repeatedly taken from Green

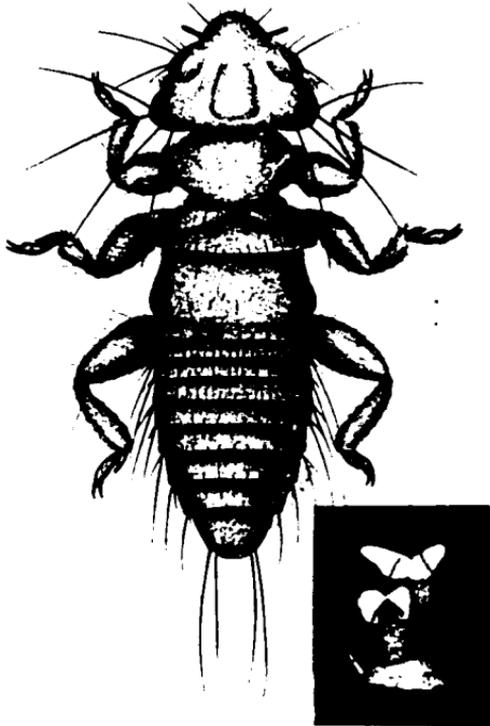


Fig. 101.—Biting-louse of ducks, etc., and tarsus. Greatly enlarged. Original. Teals. It is white and almost transparent. The illustra-

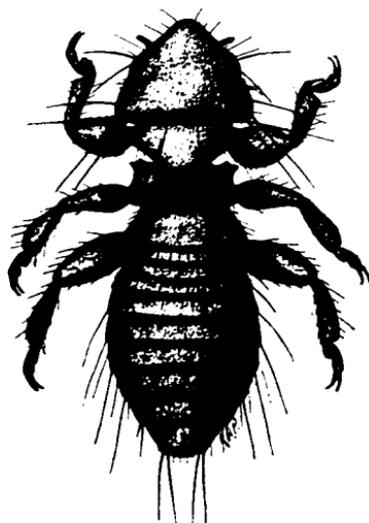


Fig. 102.—Biting-louse of ducks, etc. Greatly enlarged. Original.

tion, (fig. 101) which is too dark, shows this peculiar parasite.

Still another species of *Trinotum* is found on duck; it is illustrated in fig. 102.

FEATHER-LICE INFESTING THE PIGEON.

It seems that pigeons are very prone to being infested by parasites. There is no doubt that many species of feather-lice occur upon them, and it is not infrequently stated that they can carry bed-bugs from house to house, in fact that they are to blame for the very existence of these nocturnal blood-suckers, which, without pigeons, would not have invaded our dwellings. All such statements do not amount to much, however, as they can not be substantiated by facts. But there is no doubt about feather-lice infesting pigeons, as will be seen by the following descriptions of species found upon them.

Goniocotes compitæ Nitzsch.

This parasite is quite common upon domesticated pigeons. It possesses a head well-rounded in front, narrow between the feelers, and broadest near the posterior margin. The

thorax is narrow, the abdomen, in the male (fig. 103) broadest near the posterior end, in the female (fig. 104),



Fig. 103.—Biting-lice of pigeon, male, posterior end. Greatly enlarged. Original.

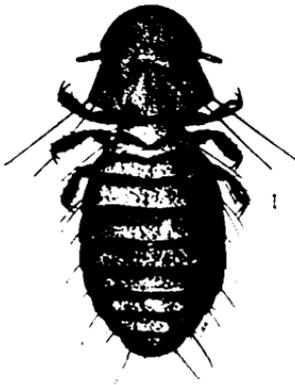


Fig. 104.—Biting-lice of pigeon, female. Greatly enlarged. Original.



Fig. 105.—Biting-lice of pigeon. Greatly enlarged. After Nitzsch.

more regular and broadest in the middle. The insect is whitish, with a brownish margin. It measures a little more than 1mm. in length.

Goniodes damicornis Nitzsch.

This species, about 2mm. long, and of a brownish color, has a head well rounded in front and strongly angular behind. It appears to be common upon pigeons. Fig. 105 shows a male of this parasite.

Goniodes minor Piaget.

This species is also found upon the domestic pigeon.

Lipocerus baculus Nitzsch.

Almost every pigeon is infested with this peculiar insect. Its shape is very striking, and quite different from that of almost any other feather-lice, being extremely slender, al-

most hair-like. The head and thorax of this parasite, illustrated in fig. 106, is bright reddish-brown; the abdomen

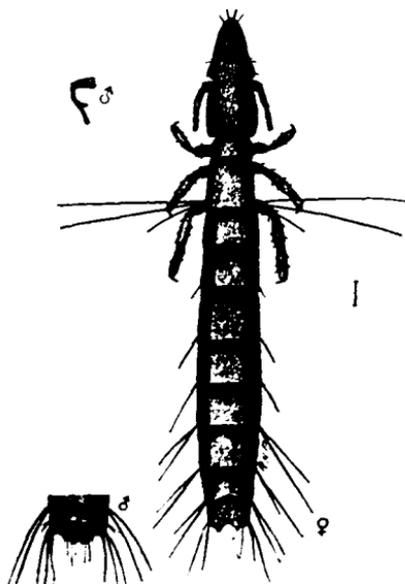


Fig. 106.—Biting-louse of pigeon. Greatly enlarged. Original.

is dusky with a series of bright brown patches. It measures about 2mm. in length.

Colpocephalum longicaudum Nitzsch.

This feather-louse is also described as a parasite of the pigeon, but seems to be uncommon, at least in the United States.

FEATHER-LICE OF PEACOCK, GUINEA-FOWL AND TURKEY.

Goniocotes rectangulatus Nitzsch.

This is a small parasite with a squarish head rounded in front, and with a short and oval abdomen. It is a quite common inhabitant of the feathers of the peacock.

Goniodes fulvicornis Nitzsch.

This parasite of the peacock is quite large, measuring

from 3 to 4mm. in length; it is of a bright reddish-yellow color. The abdomen, quite broad, is yellow, with very prominent transverse bands extending almost to the dorsal line. The large head possesses acute and prominent hind angles; the feelers in the male are large and bear a prominent tooth.

Goniodes numidicus Denny.

A number of these and of a very similar parasite were taken some years ago from the guinea-fowl, but the specimens could not be found to use for an illustration.

Goniodes stylifer Nitzsch.

This insect has been described a long time ago as being common with three other species upon the domestic and wild turkey, where it infests chiefly the head and neck. It can be



Fig. 107.—Biting-louse of turkey. Greatly enlarged. Original.

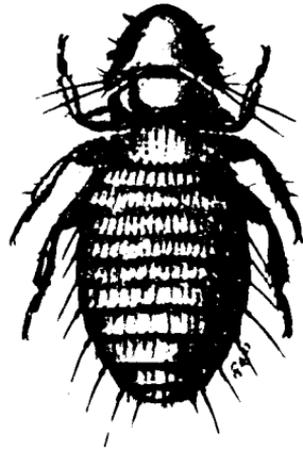


Fig. 108.—Biting-louse of peacock. Greatly enlarged. Original.

distinguished from others by the peculiar hind angles of the head, which are extended backwards into long styles armed with stout bristles. The very narrow first segment of the thorax, and the broader second one, are marked with a dark margin; the abdomen is pale with dark transverse bands. The species measures about 3mm. in length. (Fig. 107.)

Lipeurus numidae Denny.

This livid-yellow louse is said to occur on the guinea-fowl.

Lipeurus polytrapezius Nitzsch.

The peculiar species is common wherever turkeys are kept, and is easily detected, being large enough to be readily seen, measuring from 3.0 to 3.5mm. in length. It has a very elongated, flat, and pointed body, which is pale-yellowish, with a dark margin. All the segments of the abdomen, with the exception of the last, have a grayish-brown trapezoidal spot on each side, whence the scientific name. This very active insect prefers the wing-feathers.

Menopon pharostomum Nitzsch.

This parasite infests the peacock, and seems to be very common. It is illustrated in fig. 108.

Menopon numidae G.

This insect is found on guinea-fowls.

H. FLEAS.

(Siphonaptera Pulicidae).

These insects possess a laterally compressed body; the thoracic segments are well separated; wings are missing but represented by two pairs of short and stiff scales, that have no or very little power of motion; feelers are very short, composed of three flat and singularly lobed joints, which are in most species closely folded away in a cavity behind the eyes, while in some others they are exposed and erect. The peculiar sucking mouth (fig. 109) is well adapted for piercing the skin. The mandibles and labium form three slender lancets; the blood is drawn up through the channels or spaces between them and the labial palpi and lower lip, by means of a sucking stomach. The large posterior legs are very powerful, enabling the fleas to leap with remarkable agility enormous distances compared to their size. The head is small; the eyes are simple, and in some cases very minute. The white and worm-like larvæ are long and

cylindrical, composed of head and thirteen segments, which are provided with long hairs; the pupa is inactive.

Fleas, which are degraded flies—degraded by leading a parasitic life—are not as common in the United States as in other countries; at least the species attacking man is not universally found. Other species, however, are sometimes extremely troublesome, chiefly in warm regions with a sandy soil; here few persons are found that do not know from personal experience these active parasites. Portions of the Mississippi Valley, Southern California, and Florida are not favorably celebrated on their account, and chasing the festive flea in these states is said to be a sport not limited by any game law.

THE HUMAN-FLEA.

(*Pulex irritans* Linn.).

This parasite, perhaps better known than any other one, is a very common insect in the old world, being found almost everywhere, and consequently an intruder and tormenter that is not readily excluded from houses, no matter how careful and cleanly the inhabitants may be. Here in the United States it is not common. In fact most of the complaints made about fleas do not apply to this insect at all, but to fleas that infest dogs, cats, and other animals found in houses. They will attack man, however, without the slightest hesitation, though they do not feel at ease upon this new host, being used to move among dense hair; and on this account they are always restless upon man, move about constantly and so cause great irritation.

The old statement: "who sleeps with dogs rises with fleas" is wrong, however, as the dog flea is nowhere so happy as upon the dog. The female deposits in the course of her existence, about 800 eggs, which are large, pearl-gray and elongated-oval; from 12 to 20 eggs are laid in the cracks on the floor, in dark corners, or wherever dead organic matter accumulates. As a general rule the female surrounds the egg with some blood, which, though dry long before the young larval flea hatches, forms part of its food; dead flies, which are found in such localities, are also eaten.

The eggs hatch in about six days, at least during the warmer part of the year. The white larvæ are furnished with feelers and eyes, a very unusual thing in insects. Though without feet they move about very rapidly in a ser-

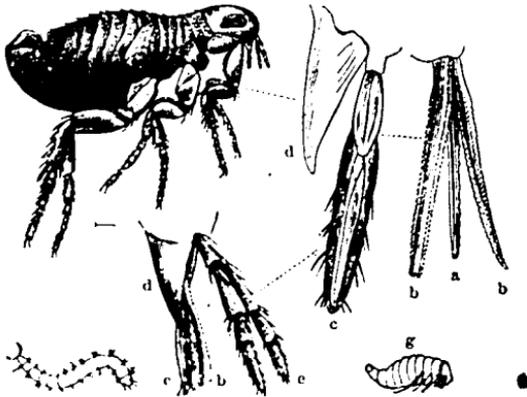


Fig. 109.—Mouth-parts of human-flea. After Taschenberg

entine fashion; they soon turn yellowish, and later they gradually become brownish. In about eleven days they are fully grown. They now form a sort of loose cocoon, composed of particles of dust, inside of which they transform into a

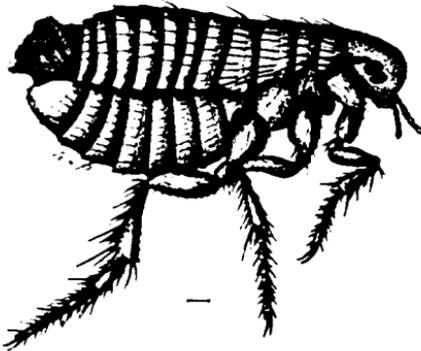


Fig. 110.—Human-flea. Greatly enlarged. Original.

pupa, which is at first of a white, but later of a brown color. After ten to twelve days more the adult flea (fig. 110) appears, ready to torment its host, man. In warmer countries the flea passes all these metamorphoses in much shorter

time. Born, perhaps, in a filthy hut, the flea, depending upon the great strength of its armor and its power of rapid motion, boldly attacks even princes born in castles. The flea is decidedly a republican, who cares for neither titles nor positions! To realize how great tormenters fleas can become it is only necessary to enter a house tenanted by them, and which has not been occupied by man for some time. To get rid of them sticky fly-paper fastened to the legs is an excellent remedy, and immense numbers of fleas are caught while the person thus equipped walks over the floors of infested rooms.

In some parts of the old world fleas are exceedingly abundant, and it seems that the more that are killed the more come to attend the funeral, and their activity, their energy and their appetites are prodigious. In Tom Moore's words—

"You may crush, you may smother, the flea as you will,
But his brothers and sisters will cling round you still!"

We have in our own country also many localities where a "flea hunt" is a regular occupation of many a mother as she tucks up the little ones before retiring to rest.

The length of the reddish-brown or pitchy-brown male varies from 2 to 2.5mm.; of the female from 3 to 4mm.; the larva measures 3.5mm., and the egg 0.7 to 0.8mm.

It is frequently stated that fleas multiply very rapidly in saw-dust impregnated with liquid manure, and saw-pits near mills are said to breed even millions of them. In fact many people claim that they are here produced in spite of all natural laws, i. e. by spontaneous generation. Of course the latter is all nonsense, though the fact remains that such places, being just suitable for the growing larvae of fleas, attract the adult ones. Strange to say many fleas obtained from saw-pits in Minnesota were all specimens of the human-flea.

It is well-known that fleas have been trained to perform in a kind of minute circus. Of course such fleas are not really trained; they are simply forced to act in a certain manner and the whole performance is a case of cruelty that should not be permitted. The strength of fleas is best given

by stating that a single flea has been known to draw, with ease, a silver cannon weighing 70 times its own weight.

Good and thorough ventilation of the rooms, cleanliness, and the free and repeated use of insect-powder will drive fleas from houses infested by them.

The flea infesting man differs greatly from those infesting animals; it has no spines on the head or on the back of the thorax, while the posterior margins of the segments of the thorax and abdomen possess rows of stiff hairs pointing backwards. The peculiar comb-like bristles upon the head and the posterior part of the thorax found upon the dog-flea and others are absent.

THE DOG AND CAT-FLEA.

(*Pulex serraticeps* Gerv.).

This is the well-known flea infesting cats and dogs. Wherever pets are kept that harbor the above parasites these latter are certain to cause much trouble, as they seem to pre-



Fig. 111.—Dog and cat-flea. Greatly enlarged. Original.

fer carpets and similar places, in which they conceal themselves during the day. In this way they will reach the bodies of persons walking over them, and tender-skinned children and ladies are frequently poisoned by their bites. Fleas are not like mosquitoes or other blood-sucking insects, which bite but once if not disturbed; they bite as they move about, literally "bite on the run."

These dark chestnut-brown fleas (fig. 111) are stouter and thicker in the thoracic region than those infesting man, which are darker and have a more slender waist. A row of sharp spines is found on the lower margin of the head, and another one on the posterior edge of the first segment of the thorax; both sets of spines are absent in the human flea.

The female flea deposits her eggs among the fur; as these very small, white, elongated eggs (fig. 112, *a*) are but slightly attached to the hair they drop off quite readily and are thus scattered; they can be easily found wherever infested cats or dogs sleep. The young larvæ hatch in a few days, according to the season; they have a pale yellow head and are furnished,



Fig. 112 — Dog and cat-flea: *a*, egg; *b*, larva. Greatly enlarged. Original.

like the larvæ of other fleas, with two spines on the last segment of the body, and with very long hair along the sides. The footless larvæ (fig. 112, *b*) move by means of these spines and hairs. The pupa, which resembles more the adult stage than the larval one, has free legs. As soon as the adult flea is born, it attacks the first living animal to obtain blood. As the larvæ can exist upon all sorts of dead organic matter they even hatch from eggs dropped by dogs or cats in gardens, and these can reach maturity in such places. Such fleas are called "sand-fleas", but they are simply the offspring of cat or dog-fleas.

Fleas pass the winter in all stages; in fact they are always active and the females seem to drop eggs quite frequently, even during the coldest season, hence many must perish. During the late cold spell (Nov. 1896) the female fleas taken from a rabbit dropped their eggs quite readily, but as it is not likely that they would do so if these would or could not hatch, the eggs, perhaps, do not develop until spring. As fleas increase so rapidly in numbers there may be a number of broods during a year.

The dog-flea was at one time considered to be different from the cat-flea, but it is so very similar, and the differences in the mouth-parts and proportions of the posterior tarsi

are so slight, both have been united into one species. The habits of both are identical. Human blood is to the taste of both, but is not preferred as being better and richer than that of the normal hosts.

REMEDIES.—Fresh insect-powder, dusted or blown among the hairs of the infested animals, is an excellent remedy; it should also be dusted upon the places where they sleep. As the insect-powder usually bought is very much adulterated or too old, it would be best if we grew in our gardens the plant from which it is made. This is *Pyrethrum roseum*, a rather pretty plant, which makes also a nice border for flower-beds. The flower-heads should be cut off when fully expanded, and have to be dried in the shade. When needed these dry heads should be ground as fine as possible, and excellent results will follow wherever such powder is used in a legitimate way, *i. e.* against such insects as can be killed by it.

THE SAND-FLEA.

(*Sarcopsylla pan'ratu*s L.).

This is a flea that is not found in Minnesota, being an inhabitant of Central and South America, where it abounds in and about indian lodges, wood-cutters' camps, and similar

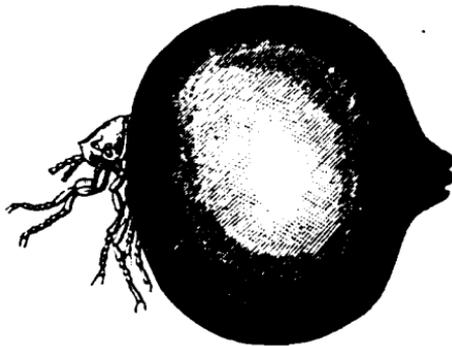


Fig. 113.—Sand-flea, female with eggs. Greatly enlarged. After Karsten.

places free from the rank vegetation found in those countries. This parasite is known by a number of names, such as Jigger, Chigoe, Chique, Biche, or Pique. As it has a somewhat different form from those mentioned before it has been taken

from the old genus *Phlebotomus* and placed in another one. Both sexes imbibe blood of man and many other animals, as dogs, hogs, cats, goats, sheep, cattle and rodents, just like other fleas; but as soon as the female is ready to deposit her eggs she penetrates so deep into the skin of man or animal that only the posterior end is visible. In man she selects the



Fig. 114.—Sand flea, male. Greatly enlarged. After Karsten

space beneath the nails, chiefly of the toes, and here her abdomen swells to the size of a pea (fig. 113). The eggs are deposited from time to time, and forced out of the invaded place drop to the ground, where they hatch and live like the eggs and larvæ of other fleas. The male is shown in fig. 114.

Sand-fleas have been carried from America to Africa, and with greater intercourse between the United States and tropical America it is possible that they may also become much more numerous in our more southern states.

The injuries caused by the female of Chigoe to the human host are not great if the proper pains are taken to remove the swollen insect from beneath the toes without rupturing her skin. Yet all sores caused by insects in the tropics are much more dangerous than elsewhere, and in many cases the loss of a toe, even of a life, has been the consequence of carelessness. If the female is left under the toe no serious consequences take place, as the larval fleas do not live there, as is frequently stated.

Length of sand-flea 1 to 1.2mm.; of females swollen with eggs 5 to 7mm.

A simple remedy, or rather preventive, is rubbing the feet with Peruvian-balsam or Kopai-balsam.

THE HEN-FLEA.

(*Sarcopsylla gallinacea* Westwood).

This flea (fig. 115) was but once found in a chicken-house in Minnesota. It is common in Florida and Texas, where it



Fig. 115.—Hen-flea. Greatly enlarged. Original.

is known as the "Jigger-flea." It is a peculiar, roundish looking flea, quite smooth, and of a yellowish-brown color. As it is assuredly not a common insect with us no detailed description is given, as the illustration shows its peculiar shape quite well.

The Pigeon-Flea (*Pulex arinum* Tasch.) is also found in



Fig. 116.—Flea of the mouse. Greatly enlarged. Original.

the United States, but the writer has not been able to obtain specimens thus far in our own state, and it is very doubtful whether it exists here.

A number of other species of fleas are found in Minnesota, which infest rats, mice, bats, rabbits, pocket-gophers and various other wild animals. The following four spe-



Fig. 117.—Flea of shrew. Greatly enlarged. Original. Fig. 118.—Flea of bat. Greatly enlarged. Original.

cies have been found in dwelling places, no doubt brought there by the hosts they infest. No description is given of them, as the illustrations are sufficient to show their peculiarities.



Fig. 119.—Flea of rabbit. Greatly enlarged. Original.

The flea infesting the *Shrew* is illustrated in fig. 117, and the one found upon the *Bat* in fig. 118. Even if found in houses they are only accidental visitors, and as they can not exist upon man and domesticated animals they will soon disappear. The flea infesting the *Wild Rabbits*, sometimes in very large numbers, is also occasionally found in the kitchens where this game is made ready for dinner. This species is shown in fig. 119.

The Flea of the Mouse is shown in fig. 116, the one infesting the *Shrew* is illustrated in fig. 117, and the one found upon the *Bat* in fig. 118. Even if found in houses they are only accidental visitors, and as they can not exist upon man and domesticated animals they will soon disappear. The flea infesting the *Wild Rabbits*, some-

I. LOUSE-FLIES.
 (*Hippoboscidae, Puppipara*).

Louse-flies are very peculiar insects, belonging to the order of flies (*Diptera*); both their form and mode of reproduction are very abnormal. They are parasitic, living upon the bodies of mammals and birds. Closely allied insects, with similar life-histories, are found upon bats and the honey-bee. Some louse-flies are winged, others are not, but in the latter case we find on each side of the thorax, near the an-

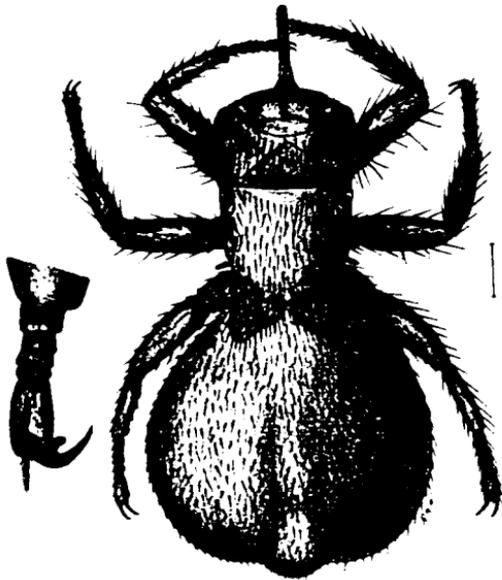


Fig. 120.—Sheep-tick and enlarged foot. Greatly enlarged. Original.

terior angle, a small round spot, indicating where the upper-wing should be, and near the posterior angle a small projection which seems to represent the balancers, or remnants of hind wings. All louse-flies possess a depressed body and widely separated, short, and stout legs, furnished with strong claws, which in some cases have teeth. The last joint of each foot bears a feather-like organ, probably used to coil around the hair for a stronger foothold, (see enlarged foot in fig. 120). The head, nearly as wide or wider than the thorax, is sunk in the same without a distinct neck; the feelers are very short, apparently one-jointed, with a termi-

nal bristle, and situated in a depression near the mouth. This is a tubular proboscis, protected on the outside by two flat and elongated bristly pieces, the labrum. The organs



Fig. 121.—Head of sheep-tick. Original. Below uterus-like enlargement of oviduct. Greatly enlarged. After Leuckart.

used in piercing the skin and in drawing blood are **three long and slender bristles of equal length but unequal size**, which are withdrawn when not in use. A glance at the illustration of a head of the sheep-tick, (fig. 121), will explain this peculiar structure better than words. The abdomen is flat and bag-like. The whole insect is densely clothed with hair and bristles; the sexes resemble each other, the male being simply smaller.



Fig. 122.—Young larva and puparium, with breathing-pores, of sheep-tick. Greatly enlarged. Original.

The insect, instead of depositing an egg upon suitable food, as nearly all other insects are in the habit of doing, retains the same inside an uterus-like enlargement of the oviduct, (shown below head in fig. 121), where it is hatched. Here it is

nourished by a milky secretion produced in special glands, also shown in illustration, until the larva has attained its full size, when it is born. Such a larva is white, but it soon turns brown and becomes a puparium, as shown in fig. 122. To prevent this puparium from dropping from the host it is fastened to it by means of a sticky material. Here it remains for sometime, when the mature insect emerges by forcing off a round lid from one end of the dry and glassy puparium. The illustration (fig. 122) shows such a puparium; the upper and pointed end was connected with a membrane through which the larva obtained food; below are seen the spiracles, and to the right a young larva removed from the mother fly.

All louse-flies seldom remain attached to the skin longer than to fill themselves with blood. They are active and try to escape by running in a peculiar sideways fashion among hairs and feathers. They can move forward with equal ease, and act somewhat like a crab. Those equipped with wings fly away when disturbed, and leave their host, as do those found upon birds of prey as soon as the body of the dead bird becomes stiff and cold.

Only two species of louse-flies infest our domesticated animals, and the best known of all the external parasites of the sheep, the so-called "sheep-tick," is one of them.

THE SHEEP-TICK.

(*Melophagus ovinus* Linn).

It is not a true tick, which possesses eight legs, as illustrated elsewhere, but a true six-legged insect. It is less than a quarter of an inch long (4.4mm.), with a short, flattened, tough and leathery body covered with hairs. The illustration (fig. 120) shows this insect, and some of its structural details.

It is a veritable pest, especially in spring, to the younger animals it infests. Sheep always kept in stables are almost free from such parasites, which seem to require conditions only found upon pastures. When we consider that a female of this parasite only produces one offspring at a time, and perhaps only four to five during her whole existence, it is

difficult to explain the very large numbers of ticks sometimes found upon a single sheep.

Dr. Curtice who studied the parasites of the sheep most thoroughly, writes: "to feed them they were placed upon the back of my hand. By this means I could, with a lens, watch them bore into the skin and see the abdomen slowly enlarge as they drew in the blood. They had some difficulty in penetrating the thick skin, but usually succeeded by slipping their tube into a hair follicle. At first no itching or irritation was felt, except a slight twinge when the bills first penetrated the skin; but little swellings came on a day or two later which itched for over a week. The itching was far more persistent than with mosquito bites. They must in this way cause lambs much discomfort. It was at first thought that a fluid could be seen running from the parasite to the hand through the bill, but no more was thought of it until the elevations began to rise and itch; then it appeared that the little pests had secreted a poisonous fluid. The office of this secreted fluid is probably to assist the flow of blood by keeping it from clotting." It is more likely, however, that such poison is injected to draw the blood to the spot inflamed by it.

REMEDIES.—The presence of such parasites must cause considerable itching, and particularly so to lambs with a tender skin, and if very numerous they can cause serious trouble. As they multiply but very slowly there is no reason why they should ever become so numerous as is really the case, even in so-called well-kept herds. If not numerous, tobacco or other mixtures used for sheep-dips will rid the animals of these intruders. Such remedies should be used at shearing time, when all parasites not removed with the wool can be readily reached. Fall dipping is advised by many. For this purpose, as well as for dipping at any other time, a kerosene-emulsion is recommended. This is made in the following manner: "Churn fresh skimmed milk and kerosene together in the proportion of one gallon of milk to two gallons of kerosene, either in a churn or by using a force-pump, until an emulsion is made. The method of using a force-pump is to set it in a vessel containing the mixture and to

force the stream back into the same vessel. The emulsion will form quicker if boiling hot milk is used. For dipping use one gallon of the emulsion for each ten gallons of water is required. Fifty gallons of this dip will suffice for fifty sheep, seventy will probably answer for one hundred. Much depends upon the amount of waste on account of the liquor being carried off by the fleece."

Another very effective remedy, much used in Europe, from where this parasite reached the United States, is the following one, which seems to be very simple. A small piece of gray mercurial salve, about the size of a hazelnut, is well rubbed upon each animal along the back, below the throat, and between the front legs, immediately after shearing. This application should be repeated after ten days to destroy any new intruders.

THE HORSE-TICK OR FOREST-FLY.

(*Hippoboscæ equina* Linn.).

These parasites are winged, and attack, during summer and early autumn, horses, cattle, and even dogs. They in-



Fig. 123.—Horse-tick. Greatly enlarged. Original.

fest those parts of the animals which have the thinnest skin and fewest hairs, as regions about the tail and the belly.

Here they insert their beaks to draw blood. It seems that they irritate the infested animals more by their running over them than by the absorption of blood, though they must also cause pain. Horses attacked by such tormenters become very restless, even dangerous and unmanageable. As the insects are very active they are not very easily captured.

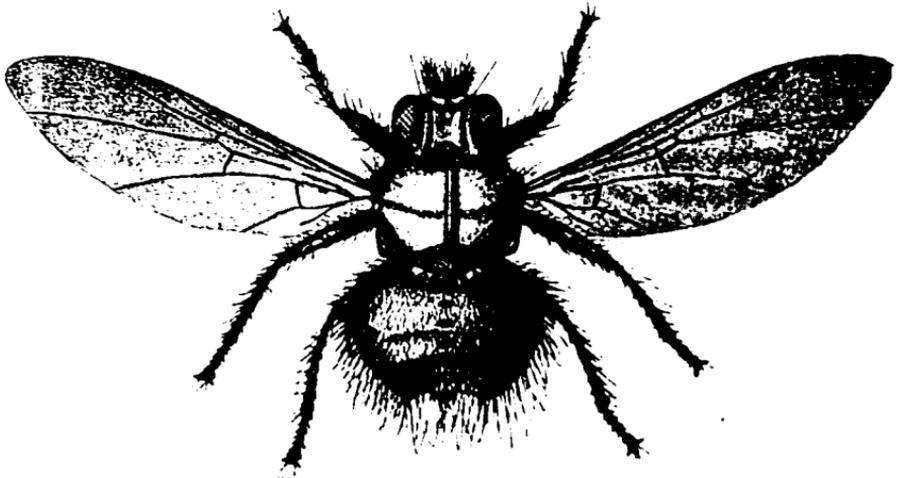


Fig. 124.—Louse-fly from Grossbeak. Greatly enlarged. Original.

for they either fly away or cling so firmly to the skin that they can not be removed without difficulty, nor can they be crushed, as they are well protected by a very smooth and exceedingly tough skin. If these parasites escape, after having been captured, they are apt to return instantly to the horse; but as mistakes are not impossible they have been known to invade the heads of men, where they are, for a short time, very unpleasant and unwelcome guests.

This fly measures from 6.6 to 8.8mm. The thorax is very dark-brown with conspicuous yellowish markings; the legs are yellowish with brown rings; the abdomen is grayish-brown. The illustration (fig. 123) shows the structure of this peculiar parasite; it was made from a rather poor specimen.

The whitish larva, when leaving the mother, is already enclosed in a very thin shell, which turns brown in about four hours, and bright black in twenty. The adult fly leaves this puparium in about four weeks.

The same remedies as those mentioned against the sheep-tick should be applied in this case.

Some birds, such as hawks and owls, almost always harbor a number of such winged parasites among their feathers, and taxidermists are often tormented by them when skinning such birds. But other birds do not escape, for instance the louse-fly illustrated in fig. 124 was found upon a pet Crossbeak.

J. OTHER FLIES.

(*Diptera*).

A very large number of insects belonging to the order of Diptera or Flies, which includes insects that possess but two wings instead of four, are more or less troublesome to man and domesticated animals. Some simply irritate them by running over their bodies; others live upon the moisture (sweat, etc.), that is found upon the skins of their hosts; still others suck their blood, and some enter them bodily, causing sores and even death.

THE COMMON HOUSE-FLY.

(*Musca domestica* Linn.).

Perhaps this is the best known of all insects, and few persons are not familiar with their actions. House-flies are, however, more familiar with us than we are with them, judging from the general ignorance in regard to their life-history. As most persons know so very little about this common insect, the following article of the writer is reprinted from the Annual Report of the Minnesota State Horticultural Society for 1895:

"Your active secretary gave me a rather peculiar text for a paper. I do not quite understand why he should have selected such a theme, as he assuredly knows that 'there are no flies on' Minnesota horticulturists." Or did he, perhaps, mean that they are constantly on the fly, meeting here and there in our beautiful state? But whatever were his reasons, I will try to give you the true history, habits, diseases and other troubles of our great tormenter, the house-fly. Per-

haps such a paper should have been read at a time when the supply of flies exceeded the demand for them, and not now in mid-winter, when, as the commercial papers have it, the market in flies is dull. To study flies we should have them about, so that they can be seen, heard, and felt, as lessons are only well learned by studying the objects themselves.

“The history of the common house-fly has been studied thoroughly but quite recently. The memoirs of the Swedish Count DeGeer, published a little over a hundred years ago, contain the first notice of this interesting insect, while a fuller account was given in an obscure book by Bouche, a German entomologist, published in 1834. Both accounts are far from thorough. Dr. A. S. Packard published his prize essay upon this insect in 1874, this being the first real scientific work upon it. About the same time the question came up: is our fly identical with the house-fly of Europe? Strange to say, when the question arose in mid-winter, all our museums were ransacked for specimens for comparison, and to the great disgust of entomologists it was discovered that not a single fly could be found in any American collection of insects. There was a corner in flies—perhaps the first time in history! Later material was not lacking, and Dr. Packard could not find any difference between house-flies from different countries.

“How long this fly has been living in this country there are no data to show, and it may have sailed on the Mayflower, or buzzed in the cabin of Captain John Smith’s vessel, or even performed its measured flight near the ceilings in the ancient town of Pemaquid. At all events, the house-fly is one of the earliest settlers, and is entitled to the liberty it takes every summer with the upper Four Hundred of New York. Perhaps it may have been here before America was discovered; and when Christopher Columbus wiped his brow upon landing on our shores, it may have been ready to settle upon his nose. The fly is impudent enough to have done so, though history does not throw light upon this subject.

“During the month of August the house-fly is particularly abundant, and especially so in the neighborhood of stables.

On placing a fly in a glass bottle she laid, between 6 p. m. Aug. 12, and 8 a. m. next morning, 120 eggs. They were deposited irregularly in stacks, lying loose in two piles at the bottom of the bottle. At 8 a. m. of Aug. 14, several were found hatched and the maggots were crawling about. The egg of the house-fly is long, cylindrical and a little smaller at the anterior end than at the other. It is 0.4 to 0.5 of an inch long, and about one-quarter as thick. The shell is very dense. The eggs hatch twenty-four hours after being laid—in confinement they require five to ten hours more, and the maggots hatched in confinement were smaller than those reared from eggs deposited in warm manure. For several days the worms living in this dry manure did not grow sensibly. Lack of direct warmth, but more especially the want of sufficient moisture and, consequently, of available and semi-liquid food, seemed to cause them to become dwarfed. It is evident that heat and moisture are required for the normal development of the fly, as they are for nearly all insects.

“The maggots moult twice, consequently there are three stages of development, and they become sensibly larger at each stage. After feeding six or seven days the larva is nearly full grown; its body is long and slender, somewhat conical, the head and mouth-parts being rudimentary; the end of the body is truncated, and bears two short tubercles or spiracles, which contain circular breathing holes with sinuous openings, the edges of which are armed with fine projections, forming a rude sieve for the exclusion of dust and dirt. When about to transform into the pupal state, the body contracts into a barrel-shaped form, turns brown and hard, forming a case, within which the larva transforms itself into a pupa. Our house-fly having, as a maggot, lived a life of squalor, immersed in its revolting food, appears after a short pupal sleep of from five to seven days, as a winged being with legs and wings of which before there were no traces, and is animated by new instincts and mental traits.

“If in its winged condition it is one of the most disagreeable features of dog-days and people wonder why flies were

ever made at all, it should be remembered that flies have an infancy as maggots, and the loathsome life they then lead as scavengers cleanses and purifies the August air and lowers the death-rate of our cities and towns. Thus, while stables and other filthy places are tolerated by city and town authorities, the young of the house-flies, and of flesh- and blow-flies, with their thousand allies, are doing something toward purifying the pestilential air, averting the summer brood of cholera, dysentery, diphtheria, typhus and typhoid fever, which descend like harpies upon the devoted towns and cities. It may be regarded as an axiom that where flies most abound there filth, death-dealing and baneful, is most abundant, and where filth-diseases such as just mentioned do most congregate.

“When the fly leaves its pupal case, it pushes away the front end of it, which opens like a lid, by means of the distention of the membranous front of the head, which may be seen pushing out and in as the fly walks rapidly about. When free from its prison the fly runs nervously about, as laboring under a good deal of mental excitement and quite dazed by the new world of light and life about it, for as a maggot it was blind, deaf, and dumb. Now its wings are soft, small, baggy and half their final size. The fluid that fills them, soon, however, dries up, the skin of the fly attains the colors of maturity, and it flies off with a buzz suggestive of contentment and light-heartedness born of its mercurial temperament. Fig. 125, plate X, shows the fly in all its beauty.

“When we consider that each female may deposit as many as one thousand eggs, and that in the course of one summer we may have from seven to nine generations of flies, it should not astonish us that these winged tormenters appear as by magic. The question, why do flies appear suddenly and in such immense numbers, may be answered by the statement that they multiply in a geometrical progression, and that a single female in suitable seasons and surrounded by plenty of food may produce such a number of descendants in one year that to express it requires thirteen figures. But flies have not their own way in everything as

will appear later. As soon as the nights become cool, flies try their very best to find shelters for the winter, and no matter how carefully we may protect doors and windows with screens they will find an entrance, to the great worry of our better halves. Sufficient numbers would thus find a shelter and survive the rigors of a northern winter, if they did not bring with them at the same time an enemy they can not escape, and one that will kill the very great majority of all house-flies at that season. Only a few escape this "slaughter of the innocents," and these few are the ones that may be seen during the winter in our houses; others will find wintering quarters under rubbish, and remain in a torpid condition until the warm weather of spring coaxes them back to life. Most flies that escape death in autumn hibernate in their winged form; a few may also winter over as pupæ, though this is doubtful, at least in Minnesota.

"Have you ever observed a genuine house-fly, one with a full pedigree? This question seems absurd, but the writer's experience has been that really few persons can tell the difference between a house-fly and other flies so common in our houses. All flies found upon our walls, upon windows and tables, are called house-flies, yet at least a dozen species are mixed up in that congregation, all widely different, more so than cows and horses. One of the most curious habits of the genuine Simon-pure house-fly is its peculiar position during sleep, and once observed it will always be recollected. When we enter a dark room all flies are sleeping, but only the house-flies sleep with their heads downwards, the others in a more normal position. By bringing a light into the room, you may ascertain very rapidly the proportion of true house-flies to that of other intruders. Notwithstanding our intimacy with the fly, or rather its intimacy with us, how very little is really known of it by the plurality of tormented humanity! Those present always excepted, not ten per cent of our fellow citizens ever know how many legs or wings a fly has or where it spends its early days in infantile sports. How many know why it so suddenly appears in countless numbers to torment the masterpiece of creation, not caring a straw when or where it attacks him? The ministers in

church as well as the public speakers, during some of their most eloquent passages, must scratch their noses as freely as does the poor laborer who diligently or otherwise digs trenches for a new gas company. A study of the proboscis of the fly (fig. 126) reveals a wonderful adaptability for its uses and misuses. In this proboscis, we see a fleshy, tongue-like organ, bent up beneath the head when at rest. The maxillæ are minute, their palpi being single-jointed, and the mandibles or jaws are comparatively useless, being very short and small, compared with the lancet-like jaws of the mosquito or horse-fly. But the structure of the tongue itself (labium), is most curious.

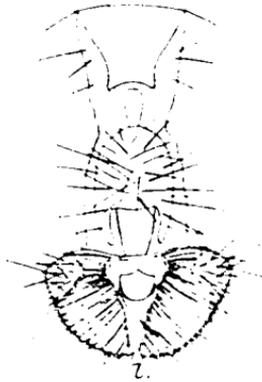


Fig. 126.—Mouth-parts of house-fly. Greatly enlarged. Original.

When a fly settles upon a lump of sugar or other sweet object, it unbends its tongue, extends it and the broad knob-like end divided into two broad, flat, muscular leaves which thus present a sucker-like surface, with which the fly laps up the liquid sweets. These two leaves are supported upon a framework of tracheal tubes; these modified tracheæ end in hairs projecting externally. Thus the inside of this broad, fleshy expansion is rough like a rasp, and, as Newport states, "is easily employed by the insect in scraping or tearing delicate surfaces." It is by means of this curious structure that the busy house-fly occasions such mischief to the covers of our books by scraping off the albuminous polish and leaving tracings of its depredations in the soiled and spotted appearance which it occasions on them. It is by the means of these that it teases us in the heat of summer, when it alights on the hand or face to sip the perspiration that exudes from and is condensed upon the skin. The microscope reveals wonders quite unexpected in such a common insect as the house-fly, but it will take too much time to describe them now in detail.

"The very fact that flies run over our skins in search of

liquid food is sometimes the cause of diseases. Bad ulcers, caused by contagious diseases, are visited by flies whenever they have an opportunity to do so. Being hairy insects, and having upon their feet sucking-pads, bacteria found in such sores must adhere, and, if another person is visited in turn, disease-spores will be carried to his skin, and should conditions be favorable the germ of the disease thus brought there will not be slow to act. I had an opportunity some years ago to study the eggs of a tape-worm. These eggs were counted and covered with a watch-glass. A piece of freshly-cut beef was put in another part of the same room, the watch-glass was removed to give the house-flies access to the eggs, some of which, soon afterward, were detected upon the flesh, showing that even larger objects than bacteria can be carried about by these insects.

The following quotation from John A. Ryder in the *Entomological News* for 1892 will no doubt be of interest:

“Cholera and flies.—It may not be amiss to call the attention of the public to the great danger from house-flies as agents in spreading the contagion should there be an epidemic of cholera. I have repeatedly observed that these insects will ride for a number of miles on street cars, and doubtless also upon other vehicles of transit, such as railway coaches, etc., though I have never made observations upon any conveyances but the ordinary tram or horse car. Suppose a case: imagine a cholera victim upon the street or anywhere else vomiting; the flies present are attracted and drink until sated, and have their feet and mouth parts wetted with the vomit containing the germs. They then, perhaps, fly out into the street, take a place on a horse car, ride several miles, dismount, fly into another house, where the family are at dinner, and contaminate the food set before them with the germs of the cholera carried on the mouth parts and feet of the insects. Some of the family sicken and die, yet no one of them will ever, perhaps, suspect that the flies have carried the germs, as supposed above, for miles from some other case. The safeguards are to at once clear away, disinfect with corrosive sublimate solution and scald the spots where the vomit has been thrown, and to be

vigilant in the use of fly-screens, fly-traps, etc. During the late war the late Professor Leidy pointed out, with beneficent results, that the common house-fly was instrumental in spreading the contagion of hospital gangrene. Why not beware of this imprudent and ubiquitous little dipter in carrying and spreading the contagion of the dreaded Asiatic plague now menacing us?"

"During the months of August, September and October, but mainly during September, it is a very common occur-

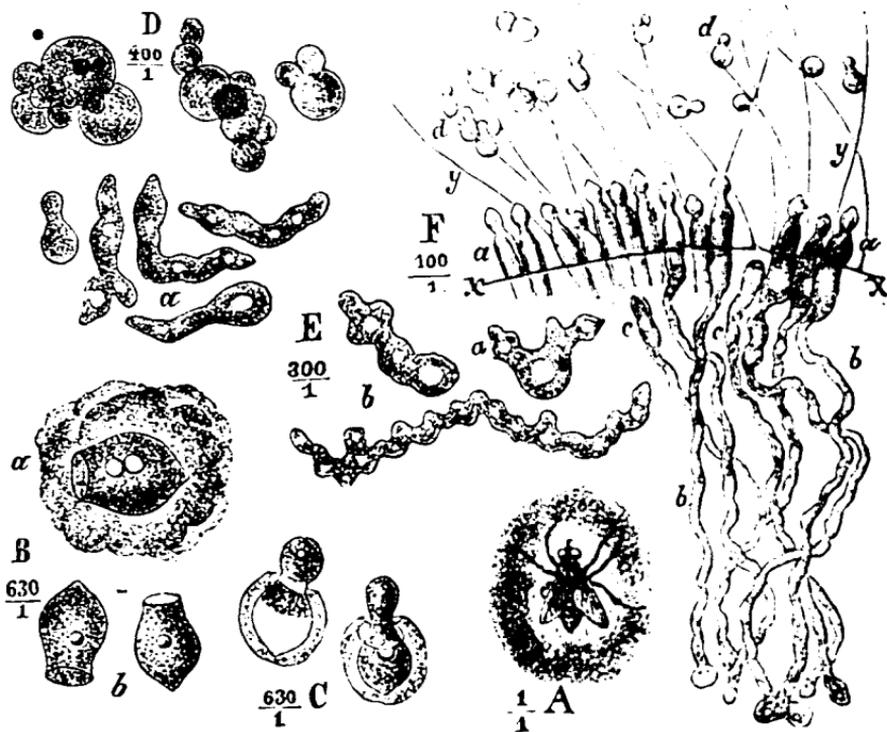


Fig. 127.—Disease of house-fly. Greatly enlarged.

rence to find dead house-flies adhering to the walls, window-panes and other conductors of heat, firmly fixed by their proboscis and with the legs spread out in quite an unnatural manner, thus differing from dead flies in general which have the legs contracted. In about twenty-four hours after death a kind of fatty substance of a white color is found in the form of a ring projecting out between each of the rings of the

abdomen, and in a day or two after the whole will be found dried, and the surface of the wall or glass lightly covered in a semi-circle, at about one-half to one inch from the fly's abdomen, with a cloud of whitish powder. This whitish, fatty substance is found on examination to consist of a vast number of short, erect filaments growing out from the body of the fly, between the rings. These filaments contain large oil-globules, often arranged in a row, and these having been mistaken for spores gave origin to the name of *Sporodomoium*, applied to this fungus. Mr. Cohn has described its growth somewhat minutely and changed the generic name to *Empusa*, or rather *Empusina*, the first of these names being already appropriated. He states that the vesicle filaments terminate in the abdomen in a continuous, often branched tube and consist therefore of a single tubular cell. The upper free end, however, becomes cut off by a septum, and the terminal cell acquires a campanulate form and a dark color; when ripe it is thrown off with some force, and a number of these form the white cloud above mentioned. Fig. 127 shows these parasitic plants. You have all no doubt observed this halo or oriole surrounding a dead fly fastened to the window or looking-glass.

"Mr. Cohn endeavored in vain to make these spores germinate; and nothing like them were found in the cavity of the abdomen of numerous flies in which the filaments were traced in their earlier stages. Mr. Griffith inclines to regard them as peridioles or spore-cases; or they may be stylospores, which after a stage of rest produce an intermediate mycelial structure, and then give birth to the ripe spores.

"When we turn our attention to the poor sufferer, we observe no outward signs of the disease in its early stage; yet watching carefully great numbers of flies we soon detect some that differ from the rest by a more erect abdomen and by their awkward way of walking. At first they are restless, constantly running and flying about; if the disease, however, grows worse, their motions become very sluggish, and if you approach them with your fingers they either do not fly away at all or in a very clumsy way, soon settling again. At last they are unable to walk more than a few

steps. About an hour before they die, all intentional motion ceases, and the fly fixes its proboscis firmly to the object it happens to have settled upon, only the legs spasmodically contract and extend in a very unsymmetrical way, as shown in the illustrations, figs. 127 and 128. The abdomen gradually swells and shows on its underside a whitish color; the upper surface of the insect, however, does not change at all, and no trace is as yet visible of the white rings between the segments, nor is any white dust to be seen. Gradually all motion ceases, and the animal is dead. After death the abdomen still swells, and about eight hours afterward it is so much distended that the segments are pulled apart, and the fine connecting skin between them becomes visible, and here a white substance is gradually pushed out from the interior, so that eventually three white and parallel rings or belts are formed. The first trace of loose dust becomes now visible under the insect. The fly remains unaltered in this condition for several days, only these belts become more prominent, and frequently a white ring is also visible between head and thorax. The dust around the dead fly becomes denser, the corpse eventually dries up, the white belts disappear, and the body shrinks so that the fly looks like a living one, though wings and legs are covered with dust (fig. 128, plate VII). Thus far all the symptoms could be followed with the naked eye, but the microscope alone can give us an explanation of the whole process.

“Being afraid that, by this time, you will be thoroughly sick of the *Empusa*, I will not inflict upon your patience the history of the microscopic influenza, another disease that attacks our domesticated fly. It goes by the name of *Isaria*, was first discovered by Meigen, and has but one good point about it—it kills flies.

“To wind up this already lengthy discourse upon diseases of flies, let me only mention some other enemies—besides yourselves—of this troublesome intruder to an afternoon’s snooze, knowing that it will please you to hear that the life of the fly is far from being an eternal round of revelry and pleasure, and that it is troubled in more than one way.

Several kinds of true worms (*Nematodes*) are found in the house-fly. Sometimes they are very numerous, and if the detached head of the fly is pressed between two flat pieces of glass they can readily be seen. As many as seventeen have been counted in the head of a single fly, and it is no wonder that this fly showed all symptoms of insanity, being perfectly reckless and very erratic in all its motions. It is preyed on

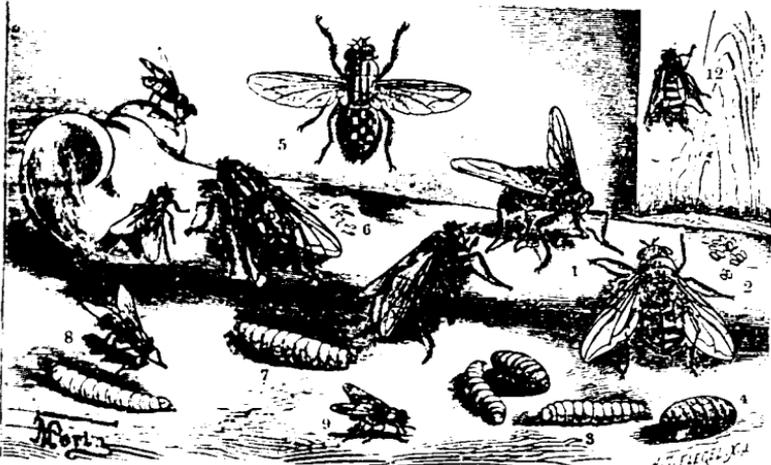


Fig. 129.—Different stages of house and blow-flies. Enlarged. After Taschenberg. in Europe by two kinds of ichneumon-flies, whose larvæ feed inside of their host; also by a fly-parasite (*Astoma parasiticum*). It is a pity that these useful parasites have not as yet been introduced into this country. We already possess, however, one fly-parasite in this country (*Astoma muscarum*) (fig. 47). You have no doubt seen small red dots upon the base of the wings of our fly (fig. 46, plate VII). This red dot is the parasite just mentioned, and let us hope that it may increase at the same ratio as all his relatives are in the habit of doing. Fig. 129 shows house-flies and blow-flies upon a bone; also their earlier stages."

THE BLOW-FLY OR FLESH-FLY.

(*Sarcophaga carnaria* Linn.).

Many other flies, although they do not actually bite man or beast, become a great nuisance and torment by running over them in search of liquid food, perspiration. Nearly all

species of blow-, meat- or flesh-flies belong here. But some of them are not satisfied with simply trying to obtain food for themselves, but take care of their offspring by dropping either eggs or larvæ upon the host. Many species of blow-flies have this habit, and as they produce living young and as these increase rapidly in size, they can cause trouble, even death. The viviparous females retain the eggs in spiral dilations of their oviducts until hatched, when they are deposited upon decaying flesh of all kinds. The sexual organs of the horse, cattle, and hogs, the interior of the ears, but principally wounds and sores are selected by such flies and here they drop living maggots in large numbers. Whoever has observed even fairly fresh meat exposed for but a few moments in places where blow-flies abound must have seen the innumerable small heaps of very minute maggots deposited upon it. The female flesh-fly (*Sarcophaga carnaria* Linn.) can deposit at least 20,000 of these maggots, and as they grow very rapidly they consume a large amount of food, and forcing their way into the festering substance about them they soon enlarge sores ("living sores"), and make them very dangerous. All these flies multiply very rapidly, producing many generations during the course of a warm season. It has been computed that a single female, within six months, can have 508,000,000 descendants. No wonder, then, that they can devour the carcass of a large animal in a few days, and that we have so many flies about dwelling-places and stables not kept clean.

The maggots of these flies grow so rapidly, if food is plenty, that from a mere speck they grow in two or three days to half an inch in length. They are whitish, long, soft-bodied, footless, and are smaller towards the head and thicker and blunt behind. When full-grown they leave their odoriferous food and crawl to some convenient spot, force their way into the soil, where they contract into elongated-oval, barrel-shaped, and reddish-brown puparia, inside of which the adult insects are formed. This requires but a very short time, a few days, and the winged fly issues ready to start another generation. Fig. 130, plate X, illustrates this common insect.

All blow-flies can become the authors of epidemics. Dr. Maddox read a paper before the Royal Microscopical Society, in which he detailed the results of experiments especially about the relations between the common-fly and the *comma bacillus*. According to the Scientific American the results of all his investigations lead him to believe that the *comma bacillus* from cultures can pass in a living state through the digestive tubes of some insects, and through this fact, that such insects are likely to become an important means of distributing disease, especially to animals that feed upon them. This is in accordance with the views of Dr. Grossi, that "insects, especially flies, may be considered as veritable authors of epidemics and agents in infectious maladies."

As these flies deposit their eggs on open sores or upon wet, filthy parts of the skin, serious trouble may be caused. To prevent this all wet and filthy hair should be cut and the wounds should be kept clean and rendered antiseptic. A good lotion for this purpose is made by mixing one part of carbolic acid with fifty parts of water; or a mixture should be made of one ounce oil of tar and twenty ounces of sweet-oil.

It is stated from time to time that maggots have been vomited from the human stomach. Such maggots are the young of blow-flies or of other similar flies which may have been swallowed in some way, and as they can exist for some time in the stomach and intestines they can cause serious trouble. The mysterious fly-disease (*Myiasis*) is caused by the presence of such maggots in the interior of human beings.

The maggots of *Sarcophaga latifrons* have repeatedly been removed from ulcers in the ear, and other cases have been reported where such maggots had destroyed vision by penetrating to the eye.

About the very worst of such flesh- or blow-flies is the Texas screw-worm, an insect that has a very bad reputation, and what is worse, one that is well-earned. As this insect is also found in Minnesota, and has already done some harm, it is best to describe it more in detail.

THE SCREW-WORM.

(*Cimprosygia* (*Lucilia*) *macellaria* Fab.).

This fly is a flesh-fly with the additional bad habit of being very impatient, as it does not always wait until the animal is dead that is to furnish the food for the offspring. As a general rule, it lives, like all its relatives, upon decaying animal and vegetable matter in and about which it undergoes all its transformations. The eggs, about one-sixteenth of an inch long, of a light yellow color, are deposited by the female on or near dead animals. The mother must possess wonderful organs of smell, or of some other sense, which enable her to detect such food, even if well hidden or obscured by other odors. These eggs being quite soft, would soon be destroyed by the direct rays of the sun, hence they are deposited under the carcass, or on its shady side. Such flies are known to contain as many as 20,000 eggs in their ovaries. These eggs hatch in one or two days, depending upon the length of the time that they were retained in the ovaries by the mother-fly before discovering the proper food for her young. The dirty-white larva possesses the usual form of fly-maggots; a ring of bristles between each pair of segments gives the maggot a fancied resemblance to a screw, hence the above popular name. These bristles act as legs in locomotion. The mature maggot is three-fourths of an inch in length, and about one-eighth of an inch in diameter; it possesses a tapering head, that contains two pointed black hooks, which are the mouth-parts used to obtain food. The posterior end of the maggot is very much truncated. The maggots grow very rapidly and reach their full size in four to six days, when they leave the substance upon which they have fed and enter the ground, where, just below the surface, they contract into dark-reddish and barrel-shaped puparia, about one-third of an inch in length. Inside such a puparium the fly is formed, which takes about 7 days, when it leaves both the puparium and the ground to fly about and enjoy life according to its peculiar fashion. This fly (fig. 131, plate XI) is a very beautiful insect, a little larger than our common house-fly, of a bright metallic green color, and having prominent dull-red eyes; its back is marked with three

distinct black stripes running from head to abdomen. When leaving the pupa the fly is gray, but very soon it assumes its glittering uniform, and the female is able to deposit her eggs the second day after emerging.

The above life-history does not vary from that of any other flesh-or blow-fly. But the screw-worm attacks also living man, dogs, sheep, cattle, horses, and even fowls, and if it succeeds in forcing an entrance into the body of such hosts it causes the most excruciating pains, and not unfrequently death. Its points of attack are the sheaths of male animals, the navels of new-born stock, and any abrasion of the skin. In man those suffering from a severe cold are most apt to be attacked by these flies, which were formerly called the "man-eating flies" (*hominivorax*) on account of their devouring man. In or near wounds found upon animals, or in nostrils and other openings, they deposit their eggs which immediately or very soon afterwards hatch. The young and active maggots force their way into the flesh, feeding and growing as they go, and thus rapidly enlarge the sores. They are soon out of sight and revel now in living flesh, until the wounds enlarge to such an extent, if not discovered and treated in time, that the infested animal has to die. If such maggots enter the nostrils of man in numbers they are very apt to kill him unless steps are taken at once to remove them.

In regions where such flies are common great care should be taken not to expose wounds and sores, as these flies have been observed to deposit their eggs in them while they were being dressed. For the same reason persons should never sleep out of doors, nor unprotected by mosquito bars, wherever such flies abound.

But it is not in the south alone that these flies occur. We have them in our state as well, though they have caused but few injuries, being here in fact rather beneficial as scavengers. Several cases are, however, on record, in which their larvæ have been found in the human ear.* In other cases fowls suffering from cold were killed by these maggots; they were eaten alive, so to speak.

*Dr. Howard McL. Morton, of Minneapolis, reports two cases which he treated in 1895.

The best way to prevent losses among our domesticated animals is to give them the proper care they deserve, and to pay prompt attention to their health. All sores should be attended to as soon as discovered, and should be carefully cleaned. By permitting no filth, no matter of what character, to accumulate, we prevent the increase of such suspicious and dangerous insects. Carcasses of all kinds should not be simply dragged into the woods, or some distance away from houses, to decay there, but should be promptly buried, and deep enough that no maggot or the resulting flies bred in them can ever reach the light of day. Maggots of all flesh-flies are very tenacious of life, and even an immersion of several minutes in pure carbolic acid and strong turpentine does not kill them; even chloroform and ether do not kill them at once. Whenever persons or animals become infested with such dangerous maggots a physician should be consulted without delay.

The use of fresh pyrethrum (insect-powder) is claimed to be a very good remedy. Of course all maggots that can be reached with an instrument should be removed by mechanical means.

THE STABLE-FLY.

(*Stomoxys calcitrans* Linn.).

This fly, so frequently mistaken for the troublesome, restless, but otherwise innocent house-fly, is no stranger to our habitations; in fact it takes possession of our rooms without having been invited. If it behaved as a visitor is expected to do matters would be all right, but this impudent fly is not satisfied, like the house-fly, with anything we may have upon our bill of fare, but it requires more precious food, human blood, and is not slow to take it whenever it pleases. We often hear the complaint made that house-flies would bite most viciously whenever rain was approaching, and during and after a shower. There is no doubt about such bites, but they were not inflicted by our domestic friend, the house fly, but by the above intruder, the stable-fly. As the name tells it is an insect most commonly found in and near stables; here, when at all numerous, they cause considerable

irritation to the animals confined there and in extreme cases these become frantic with pain and unmanageable.

The stable-fly (fig. 132, plate XI), found most abundantly late in autumn, resembles very closely a house-fly, but can be distinguished from it by its pointed proboscis projecting in front of the head (fig. 133) and by its feathered feelers.



Fig. 133.—Mouth-parts of stable-fly. Greatly enlarged. Original.

Its general color is gray; the anterior half of the thorax possesses four darker stripes, while the posterior half is spotted. The abdomen, with a yellowish-brown cast, has upon the second to last segment three brown and poorly-defined spots. It seems as if this fly produced but a few generations each



4.—Tsetse-fly. A modern and Bruce's original illustration. Enlarged.

year. The maggot, very similar to that of the house-fly, has a somewhat different head, and can be distinguished readily by the fact that the two posterior spiracles possess three openings arranged in a triangle, while the former has but one. The larval stage of this very annoying insect is passed in horse-manure, though it has also been found mining in the leaves of various plants (Taschenberg).

A fly related to the stable-fly, and also similar to the-breeze-fly, has a particularly bad reputation; it is the TSE-

TSE-FLY (*Glossina morsitans*), which is said to be so dangerous that whole regions in Africa are uninhabitable during the season in which they are numerous. The mortality caused by them is no doubt due to a disease disseminated by their attacks. Bruce, in his travels to discover the source of the Nile, in 1790 first figured this insect, and a copy of it is shown in fig. 134, while a more modern one is also given to the left.

He gives in the books published by him a very interesting account of its mode of life, and a still more interesting historical sketch of the changes produced by it in the political history of the countries in which it abounds.

THE BLUE-BOTTLE-FLY.

(*Calliphora vomitoria* Linn.).

This beautiful fly, beautiful in colors but not in manners, is known to everybody. It can not be classed as a parasite, or as infesting man and beast. It is very frequently found in our houses, usually trying to run its head through the glass of our windows, and as constantly complaining about the hardness of the latter by a deep humming sound. But when we ask those in charge of our eatables they will complain bitterly about this insect which loves meat of all kinds and is very apt to spoil the same in more than one way. It is shown in fig. 135, plate XII.

THE HORN-FLY.

(*Hematobia serrata* R. Desv.).

This insect is a recent acquisition, and one we could well do without. It reached this side of the Atlantic coast, according to Prof. John B. Smith, the well-known entomologist of New Jersey, either in 1886 or in 1887, and soon spread westward. In 1892 the writer noticed it in large numbers in Otter Tail County, and was told that it had there troubled cattle for some years. Mr. L. A. Foote, of Worthington, Minn., a very careful observer, told me very late in the fall of 1895, that it had been common in that vicinity long before 1886, and to demonstrate that he knew

the insect he went, in the dark, to his cattle-yard and returned soon after with undoubted specimens of horn-flies. This would indicate that the insects had been introduced before, but had remained unnoticed.

Owing to a series of very dry summers the insect is no longer as common and troublesome in Minnesota as it was a few years ago. It is confined to cattle which it torments day and night in the stable or in the pastures. The flies burrow among the hair, preferring the region about the shoulders and the root of the tail, though other portions do not escape. While biting the flies spread out their wings in a peculiar way, and do not keep them closed as do the stable-flies. The flies have still another peculiar habit which caused them to be called "horn-flies." They cluster about the horns, especially their bases, and frequently encircle them as a broad ring. This position is selected to rest, and not to injure the horns, as has frequently been claimed; in fact their mouth-parts could not penetrate such hard material, being constructed simply to suck blood. This blood-sucking habit, the constant irritation caused by it, and their running about over the skin, prevent the cattle from feeding, disturb quiet digestion, and as a consequence cause a falling off in milk and cream. Some cattle suffer less than others; and if equally infested with these tormenters some animals will quietly remain chewing their food while others become frantic.

The small fly, about 4mm. long (a little over one sixth of an inch), is of a dark ash-gray color with a faint tinge of yellow. As the insect is illustrated (fig. 136, plate XII) it is not necessary to describe it in detail.

The life-history of this pest may be summed up as follows: the white egg, 1.5mm. long, elongate and a little curved, turns brownish before hatching. The white and footless maggot, which soon hatches, tapers toward the head and terminates abruptly behind, where it is furnished with a pair of black spiracles. When mature it measures about three-eighths of an inch, and is of a dirty yellowish-white color.

Like all maggots of this family of insects it moves by contracting and extending its body, and is assisted by a

double row of peculiar fleshy mobile organs on the last six segments. The larva or maggot is very active and soon reaches its full size, when it contracts in the usual way and becomes a reddish-brown puparium, less than half its former length. The whole life-cycle from egg to fly requires but twelve to fifteen days.

Tobacco-powder dusted among the hairs is a fairly good remedy; it will not entirely prevent the fly from settling upon the animal, but will repel them before they have had time to bite. Other remedies will be given later. The true remedy, however, is to prevent these flies from breeding, and this is not such a very difficult matter as it might seem. The larvæ of this fly can exist only in soft, almost liquid manure. All that is necessary to do is to accelerate the drying of this food, a matter not at all difficult in our usually dry summers. This may be done by spreading all fresh droppings every day, when the moisture will be absorbed and the food will become too dry for the maggots. Neither would a general distribution of such manure destroy the value of the same. The liberal application of plaster to the manure removed from the stable, in which eggs were deposited, as well as in the manure-heap, deprives the maggots of food and at the same improves the value of the fertilizer. Cleanliness is as essential in stables as elsewhere, and clean stables do not possess the attraction for such insects that the neglected ones do. To make the remedy of depriving the maggots of appropriate food as effective as possible united and persistent action throughout the invaded region is absolutely necessary, and it should be put in operation very early in summer, for if postponed until late it will not be of much benefit.

All flies mentioned thus far, with the exception of the horn-fly, can become exceedingly dangerous to man and his servants, the domesticated animals, in another way quite independent from their bites. All are buzzards on a small scale, and remove much of the disease-breeding material apt to be found near the domicile of man. Being scavengers they must necessarily come in contact with dead animals, which may have been killed by a contagious disease, and thus they

may carry away on their bodies disease-germs of all kinds. Settling again upon a healthy being they may communicate such a disease by contact. In this manner diseases have been carried about by such flies. Again some of them can eat the eggs of various parasitic worms, and discharge them unharmed with their fæces. It has been demonstrated that several internal parasites of man have thus been distributed. Dr. Grassi has shown that the eggs of the tape-worm (*Taenia solium*) and of *Tricocephalus dispar* were carried by the common house-fly.

How to protect man and animals against flies in houses and stables is not an uncommon question. It is not difficult at all to prevent all such tormenters as house-flies, stable-flies, flesh-and-blow-flies, mosquitoes and others from biting us in our homes, or our domesticated animals in their stables, nor is it very expensive. Persian and Dalmation insect-powder, or Buhach, is a most excellent substance for this purpose, and if not too old or too much adulterated will succeed. It can be applied in several ways; as a powder or as fumes. The former should be blown in the air; the latter should be burned upon an old saucer or plate. A very nice way is to form the finely powdered and slightly moistened pyrethrum into cones, which after being dried in an oven can be ignited at the apex, when they will slowly burn and give off the deadly fumes. Only a small amount is required, providing the doors and windows are closed, the quantity depending upon the quality of the powder. All flies in rooms or stables will soon show the effects of this insect-powder; they either die from it, or become too disabled to do mischief for quite a while.

According to the "Denver Field and Farm" of April 25, 1896, a machine for catching flies from the backs of cattle, and so affording the animals relief and comfort, has been invented by a farmer in Madison County, Kentucky. The fly-catcher is a kind of covered pen or passageway, through which the animal must walk to secure relief. A few feet from the entrance there is a cupola, or dome, in the roof of the passage-way, made of glass and arranged as a fly-trap. Beyond this the passage-way is in darkness. The animal

walks through the machine, and just as it passes the dome and enters the darkened part a set of brushes sweep off the flies, which naturally rise into the lighted dome, and the steer passes out at the other side free from flies. The flies are retained in the dome trap. The inventor has experimented with his machine, and finds that animals soon learn the value of it and know enough to walk through the same when the flies begin to bite. The device is said to be patented, but a plan involving the same principle has been in use among farmers for the destruction of horn-flies for a year or two past.

GAD-FLIES. BREEZE-FLIES.

(*Tabanidae*).

There is quite a large family of flies the members of which have gained for themselves a very bad reputation. They are usually called Gad- or Breeze-flies. Such flies are found everywhere, and each climate has its own species, but all possess the same blood-thirsty character and attack warm-blooded animals, be they lions in the torrid zone or reindeers in Lapland, and none escape their attacks, be they domesticated oxen and horses or wild and swift-footed moose and deer. The family is distinguished by a broad and slightly flattened body, by a large head depressed from front to rear, by very large eyes, which are contiguous in the males, and which are frequently beautifully colored, by a thick and compact thorax, with a large and elevated scutellum, and by legs whose tarsi are furnished with three cushions. The last joint of the feelers is annulated but has no stylet; the exerted proboscis of the female encloses six lancet-like instruments, while that of the male possesses but four; it ends in two fleshy and lip-like lobes and is covered on the sides by the large two-jointed maxillary palpi. The wings, which extend horizontally, are propelled by powerful muscles and contain a larger number of veins than is usual in flies. The flight of these flies is very rapid and accompanied by a buzzing sound which greatly alarms animals hearing it.

Only the females of Gad- or Breeze-Flies attack animals; the males live on the sap of flowers. These insects are most

commonly found in the neighborhood of marshes, and our prairies with their numerous low and swampy places abound in them. Woods and pastures are also frequently visited by them. This is accounted for by the fact that the early stages of this insect are passed below the ground, in wet soil, and even in water. Their eggs are brown or black, spindle-shaped, and are deposited in groups upon aquatic plants and stems of grass. When the sun is very hot in summer these insects are most active, and thousands of them fly about, and frequently torment the larger animals to such an extent as to make them perfectly wild and frantic. The moose and deer, attacked by such tormenters, lose all fear of man and plunge into rivers and lakes to escape their at-

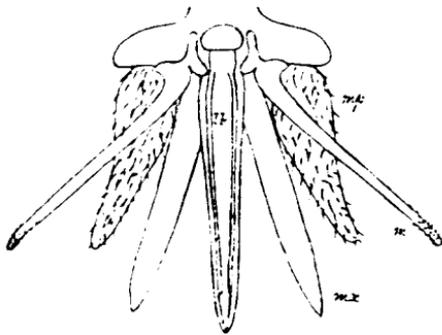


Fig. 137.—Mouth-parts of *Tabanus*. Greatly enlarged. Original.

tacks; they soon become very poor, as they have no rest to feed excepting at night. Even the most rapid animals can not escape these swift tormenters, which descend upon them and, choosing the most tender portions of the skin, bury their powerful proboscis (fig. 137) in it and do not withdraw it

until satisfied with blood. A slight swelling, which soon disappears, shows where the skin is perforated. Their flight is so rapid that they can not only follow an express train but can make excursions into the country at the same time. This is frequently seen when one of them settles upon the window of a fast train in motion, and after awhile darts off some distance soon to return to its resting-place. It is believed that such flies are agents in transmitting virulent diseases, when they leave an animal affected with one of them and introduce their proboscis into the skin of a healthy one.

We have a large number of such insects in Minnesota, but all possess a very similar life-history, at least as far as

we know. In our southern counties the "Green-head" (*Tabanus lincola* Fab.) has a very bad reputation and further south in the Mississippi valley it is sometimes impossible to work horses in midsummer without a protecting covering. In fact cases are on record that horses fastened to a tree or a fence were bitten to death. This fly is illustrated in fig. 138.



Fig. 138.—Green-head. Greatly enlarged. Original.

"The Black Breeze-fly" (*Tabanus atratus* Fab.), though found in Minnesota, is not common, hence causes less trouble to cattle, which it prefers to horses. Its large larva is found under stones in water, where it feeds upon other aquatic animals. The most common of our breeze-flies is illustrated in fig. 139, plate XIII. It is "Reinwardt's Breeze-fly" (*Tabanus reinwardtii* Wied.). This fly, less blood-thirsty than the two mentioned above, is found in immense numbers in our prairie region. It sometimes gathers in the small railway stations in such numbers on the window-panes that no light can fall through them, and the writer counted upon one window, and below it upon the bench, the astonishing number of 2117 flies. Why they should remain and die in such places is difficult to explain; at all events these rooms acted as traps, and the flies had not sense enough to escape by the open door, but battered their heads against the glass in their vain efforts to force their way out. The larger breeze- or gad-flies attack only larger domesticated animals, such as horses and cattle. The genus *Chrysops* is distinguished from *Tabanus* by possessing three simple eyes, which are readily seen on the top of the head. The scientific name is derived from the beautiful golden-yellow eyes, with purple lines and spots, which these

flies possess. As seen in fig. 140, plate XIII, which illustrates the most common kind found in Minnesota, the *Chrysops astutus* v. d. Wulp., the insect is also quite ornamental in general appearance, being spotted and banded with pale yellow and white.

A number of different kinds occur in Minnesota; all are very prettily marked insects, with wings wide apart, and with a flattened abdomen, square-shaped almost to the posterior end; the wings are colored with large hyaline spots.

Notwithstanding their beautiful eyes and bright colors these flies are a great pest, and when at all numerous, stock of all kinds suffers very greatly. Man does not escape, and those who are in the habit of bathing in rivers and lakes know to their sorrow that such flies are always lying in wait, and are not slow to attack them; they find their victims even before they have had time to undress, and the long proboscis of these blood-thirsty tormenters can be felt even through the undergarments. If they are at all numerous, bathing becomes a luxury that one can not enjoy at all in the open air. Animals also suffer greatly from their attacks, and they frequently make horses so frantic with apprehension and pain that they will run away. It seems that some prefer to puncture the domesticated animals around the eyes, and one species has on that account been named the "blinding chrysops."

Like the gad-flies these insects are most numerous in the neighborhood of their breeding places, *i. e.* regions with low and moist places, in which the early stages of these flies are passed.

There is another family of flies which is reputed to attack man and domesticated animals for the sake of abstracting blood. This family (*Asilidae*) contains a number of blood-thirsty flies that resemble wasps, having a brownish-yellow thorax, a narrow and very elongated abdomen with variously colored wings, and very long feet, of which the first pair can grasp the insects they kill. They are very common in Minnesota, but attack only insects, chiefly such as move slowly. One species becomes very destructive to bees, by selecting those that are carrying a very heavy load

to the hive; it has received the very appropriate name of "bee-killer." Their reputation of being tormenters of warm-blooded animals is badly founded, however; at least the writer has never observed them sucking blood. If kept between the fingers these flies are not slow to inflict a very severe bite. But other flies, for instance the members of the family *Bombylidae*, small and very hairy insects with bright colors, do the same thing, and will not permit themselves to be handled with impunity.

There are a number of very small flies that sometimes attack man and domesticated animals, and which notwithstanding their small size, can cause considerable irritation and inflict no little pain.

THE BLOOD-SUCKING OSCINIS.

(*Oscinis pullipes* Loew).

This minute fly, illustrated in fig. 141, is a polished black insect, with yellow face and legs. It is small, as can be seen by the hair-line in the illustration, which gives the natural size of the insect with expanded wings. During June, July

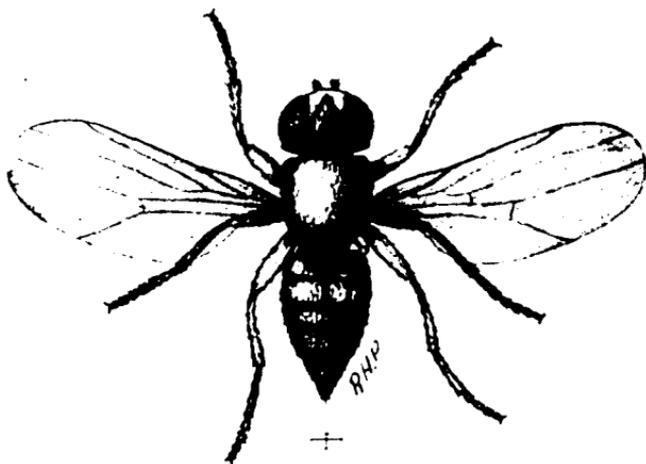


Fig. 141.—Blood-sucking *Oscinis*. Greatly enlarged. Original.

and August this fly is exceedingly abundant in some places, and large numbers of them attack such animals as horses, cattle and dogs. They are very quick in all their actions, and can not be readily driven off, always returning and try-

ing to find a suitable spot to insert their long proboscis. They usually select places where they are protected by hairs, and soon cause the blood to flow over the infested area. When filled with blood they drop to the ground, being almost too heavy to fly. Other flies of the same kind, attracted by the blood, are sure to add to the previous injury, and soon large sore spots are the consequence, which are always crowded with new and hungry insects. They can, when numerous, make the infested animal perfectly wild and unmanageable, and those that can reach water invariably make for it, so as to escape their tormenters. Man does not escape, though in his case usually only the exposed part, the head and hands, can be bitten.

This fly belongs to a family of insects which are, as a general rule, plant-feeders, and some species of *Oscinis* are known to be very destructive to our small grains and to our vegetables. Whether the early stages of this "Yellow-legged *Oscinis*" are also passed as vegetable-feeders the writer does not know, but it is very likely that such is the case.

THE "NO-SEE-UM" OR "PUNKIE."

(*Ceratopogon spec.*).

This is another fly that is very aggressive, attacking man and domesticated animals wherever it can. It is well-named by our Indians the "No-see um," being so very small that it can only be felt but not seen. It is a mere speck of matter, and it is difficult to understand how this small being can harbor the vast amount of "cussedness" it is known to possess. As the illustration (fig. 142) shows, it is well equipped with a biting mouth, and those that have ever visited the northern lakes and woods know from experience that the insect knows how to apply this tool. Whenever these flies light upon the hands and face they immediately insert this proboscis in the flesh, and judging from the burning sensation these bites cause, a large amount of poison must be injected at the same time. Where these tormenters abound the finest scenery loses its attraction, and the disappointed visitor leaves the spot with some forcible expressions—if not spoken with his lips they are nevertheless thought.

Dr. L. O. Howard, the chief entomologist of the Department of Agriculture, to whom the writer applied for specimens, writes:—"I have seen specimens in the New York mountains, but have always found that reflex action was too strong for scientific instinct, and I have unfortunately smacked and smashed them instead of putting them in a cyanide bottle for preservation; there are no specimens in the national col-

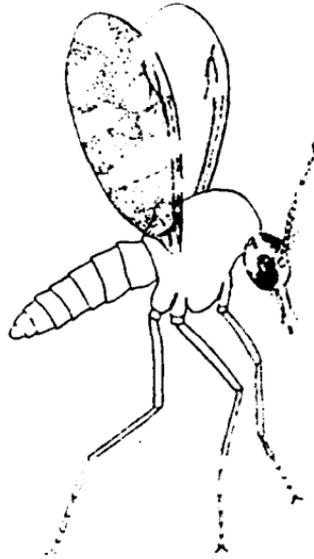


Fig. 142.—"No-see-um" or "Punkie." Greatly enlarged. Original.

lection." Prof. Comstock has kindly furnished a slide upon which some of these tormenters have been mounted for the microscope, and from this slide the above illustration has been made. They are of a yellowish color, have transparent whitish wings with darker hyaline spots, as shown. According to Prof. Comstock the larvæ of these minute beings are found living under the bark of decaying branches, under fallen leaves, and in the sap flowing from wounded trees.

BUFFALO-GNATS, BLACK-FLIES.

(*Simulida*.)

The family of *Simulida* furnishes a large number of flies that attack man and domesticated animals.

The flies belonging to the genus *Simulium* possess a heavy

body, bulging thorax, eleven-jointed feelers, of which the first two are separated from the rest; the broad abdomen is rather short; the legs are powerful with broad tarsi; the wings are broad and short. The body of these insects is invested with a fine downy covering; the males are darker and more velvety, and possess broader and more hairy legs than the females. The mouth-parts are very curious, and Prof. J. B. Smith has demonstrated that the female, which is the only one that sucks blood, possesses beside the usual sucking organs, genuine biting mandibles.

These small flies breed in rapidly flowing water, hence are very numerous in the northern part of our state where streams abound. The adult flies are well-known tormenters, and occur sometimes in such numbers as to prevent travel. Prospectors, and surveyors, though usually thick-skinned by living constantly out of doors, have been repeatedly forced to leave a region thus infested. They even force the Labrador fishermen to the coast in summer, as it is impossible to live in the interior on account of these tormenters. Prof. A. S. Packard, in "Our Common Insects," relates his experience in the following words:—"During a summer residence on this coast, we sailed up the Esquimaux River for six or eight miles, spending a few hours at a house situated on the bank. The day was warm and but little wind blowing, and the swarms of black flies were absolutely terrific. In vain we frantically waved our moth net among them and after making a few desperate charges in the face of the thronging pests, we had to retire to the house where the windows actually swarmed with them; but here they would fly in our faces, crawl under our clothes where they would remain and bite in the night. The children in the house were sickly and worn by their unceasing torments; and the shaggy Newfoundland dogs, whose thick coats would seem to be proof against their bites, ran from their shelter beneath the bench and dashed into the river, their only retreat. In cloudy weather, unlike the mosquito, the black fly disappears, only flying when the sun shines. The bite of the black fly is often severe, the creature leaving a large clot of blood to mark the scene of its surgical triumphs."

Such tormenters are also exceedingly annoying in the northern part of Minnesota, and especially near Lake Superior. "Neither the love of the picturesque, however, nor the interests of science, could tempt us into the woods, so terrible were the black flies. This pest of flies which all the way hither had confined our ramblings on shore pretty closely to the rocks and the beach, and had been growing constantly worse and worse, here reached its climax. Although detained nearly two days, yet we could only sit with folded hands, or employ ourselves in arranging specimens, and such other occupations as could be pursued in camp, and under protection of a "smudge." One, whom scientific ardor tempted a little way up the river in a canoe, after water plants, came back a frightful spectacle, with blood-red rings round his eyes, his face bloody and covered with punctures. The next morning his head and neck were swollen as if from an attack of erysipelas."

The above quotation, from "Lake Superior" by Louis Agassiz, applies equally well today to the same locality, as experienced by such energetic entomologists as N. G. Hubbard and E. A. Schwartz, who tried in vain to collect insects while black flies were out in force.

Nor do such flies exist only in the north; they are as blood-thirsty in southern regions, and whoever has traveled in the tropics will have some very painful recollections of these pests, which are there usually called "sand-flies." In the southern part of the Mississippi Valley cattle, horses, mules, and even fowls suffer terribly and many are killed outright. The common Buffalo Gnat (*Simulium meridionale* Ril.) is a very large species which appears more or less suddenly in large numbers, and as they gorge themselves with the blood of animals, these soon succumb. The loss of blood, together with the terrible irritation of the skin caused by the poison injected, is sufficient to kill in a very short time even such proverbially tough animals as the mule. All domesticated animals know this their worst enemy, and try to escape, but usually in vain, as the attack is always made very suddenly and unexpectedly. Farmers in the region infested by such gnats resort to smudges,

which repel these insects to some extent; dark stables are also a partial protection, also greasing with strong-smelling oils.

Nobody can realize the beauty of a southern scenery who has not been there during plowing-time and when the buffalo-gnats were out in force. Just imagine a mule coated with stinking oil, or painted with mud or molasses, pulling a plow from which is suspended a tin pail containing a smudge, while the mule is further adorned by another tin-pail suspended from its neck; the latter contains also glow-



Fig. 143.—*Simulium*. Greatly enlarged. Original.

ing embers in which are produced such fine odors as can be made by burning leather and similar substances.

The losses caused by this insect are, in some years, very great, and the State of Tennessee alone lost in 1874 as much as \$500,000. This southern Buffalo-gnat occurs as far north as Minneapolis, at least a few specimens have been found there. Here in Minnesota we have a number of other species of this family of flies, which cause more or less injury to our stock. A few of them are illustrated in figs. 143 to 151. The first species seen and felt occurs very early in spring, soon after the snow has disappeared. It is a very small species,

which flies with great force so that it can be felt when striking the face. It seems that it does not care much for human blood, but it irritates considerably by being of a very inquisitive nature, even entering mouth, nose, ear and what is worse, the eye. If horses are left standing for some time in the roads, they are apt to become restive, shake their heads in a violent manner, frequently stamping and snorting at the same time. If the ears of the horse are inspected we usually find the cause of their irritation in a large number of such small flies, which are busily engaged in sucking the



Fig. 144.—*Simulium decorum*. Female. Greatly enlarged. Original.

blood, and they do so by inserting their powerful piercing organs into a vein, hence they seem to be arranged in regular rows. If not occurring in very large numbers they cause but little harm, and an application of a little grease rubbed together with a few drops of carbolic acid, soon remedies the evil, and drives away other intruders. According to Coquillett, who kindly determined a number of species of this genus for the writer, it is an undescribed species. On account of its very small size the name of *Simulium acinutum* is proposed. The female insect is illustrated in fig. 145; the male has not been seen. This species flies from May 15 to

June 1, and very likely breeds in the Mississippi river near Minneapolis, though the earlier stages have, as yet, not been found.

A little later in the season, but chiefly during June and July, a somewhat larger species (*Simulium decorum* Walk.) becomes numerous. A female is shown in fig. 144. This species occurs sometimes in large numbers, but only females have been found thus far. This is of course easily explained by the fact that only the females of these flies are blood-thirsty; the males remain near the place of their birth, some running water, and as they have only a rudimentary mouth



Fig. 145.—*Simulium irritatum*, n. s. Male. Greatly enlarged. Original.

they could not imbibe blood, even if they were inclined to do so. This fly attacks, by preference, cows, and is sometimes found in such large numbers as to cause some injury to them. They are found most usually in the ears, and between the legs, or wherever the skin of the animal is thin and not well covered with hairs. Sometimes the cows suffer severely from their attacks, and being constantly irritated by these small tormenters they lose in flesh and give less milk. As seen in the illustration this fly is rather prettily marked. The front feet are in constant motion, a habit all species have, and are utilized more as feelers than as legs.

This species is found active during the whole summer and autumn, but only in certain places, which can, however, be very far from the breeding-places, and these insects must possess some very powerful senses to detect their victims such long distances.

In our lake regions we find a large number of streams that flow over rocky bottoms and are obstructed by floating grasses, and other submerged plants. When we see a place

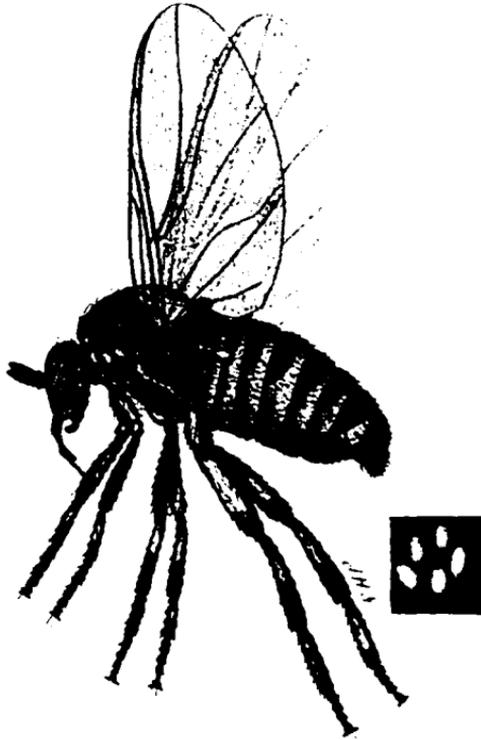


Fig. 146.—*Simulium irritatum*, n. s. Female and eggs. Greatly enlarged. Original.

in which the water flows more rapidly than in others, we can be certain to find there the early stages of buffalo-gnats. By investigating the plants that cause an obstruction, we find large numbers of larvæ and pupæ fastened to them. In the more central part of the state we find the adults, illustrated in figs. 143 to 146, (the former showing a male, the latter a female) the most common species, while in the northern rivers the species illustrated in figs. 147 to 151 is

the common one. This latter species is a great tormenter to humanity, and the proverbial patience of fishermen is severely taxed by their bites. In the northern part of Minnesota this species is called the "black-fly." Their bite is very severe, and the experience narrated by A. S. Packard would apply to this insect as well as to the one that tormented him in Labrador. In many places fishermen have to build smudges to drive away some of these tormenters. As both these kinds seem to be undescribed, the name *S. irritatum*

is proposed for the first and *S. tribulatum* for the second species.

All these insects have a very similar life-history, and the one given will apply to all. Their peculiar larvæ (fig. 147) live in swift currents of creeks and rivers, where they feed upon small aquatic animals. To obtain this food they are equipped with peculiar fans on their heads, which are constantly moving in the water, thus creating a current towards the mouth proper, and the material thus brought there is sorted by the other mouth-organs and either utilized or repelled. The larvæ living in such a swift current anchor themselves by a peculiar sucking-disk at the end of their body and by a tough silken line, and are thus kept in position, which is an upright one, and one in which the face fronts the current.

Fig. 147.—*Simulium tribulatum*, n. s.; larva. Greatly enlarged. Original.



The larvæ breathe by means of a peculiar organ situated near the tail, and the different species are distinguished by these breathing-organs, which are either very simple as the one shown in fig. 147, or are quite complicated. Only one leg is found upon these strange looking beings, and this is found upon the first joint, yet by means of it and the sucking disk at the tail end the larvæ can move about like the well-known measuring-worms or geometers.

Constantly feeding, these larvæ grow very rapidly, and are soon ready to transform into pupæ. But before they can do so they have to construct some protection for the inactive pupæ, otherwise this would be swept away by the cur-

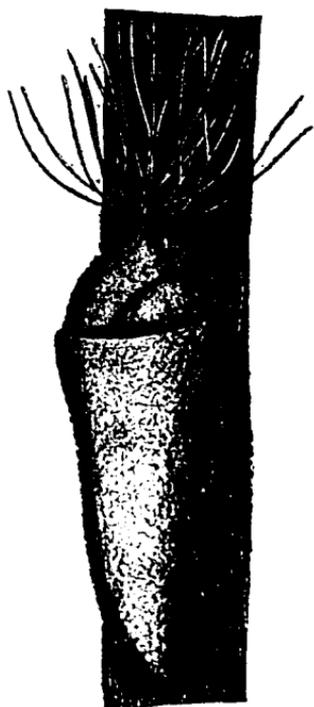


Fig. 148.—*Simulium tribolatum*, cocoon.
Greatly enlarged. Original.



Fig. 149.—*Simulium tribolatum*, pupa.
Greatly enlarged. Original.

rent. They construct for this purpose a neat little cradle-like house, made loosely of silk, and open at the top. This cradle, shown in fig. 148, is built against a stone, or upon submerged plants. In it the larva fastens itself by a little loose silk in the closed part, and now transforms to a pupa, as shown in the illustration, and again, removed from the cradle, in fig. 149. But a great change has taken place, and the insect no longer breathes through an organ located near the tail, but by an entirely different one near the head. These breathing-organs differ greatly in the different species, but are always composed of a number of fine thread-like tubes closed at the end, and which unite near the base in a

larger tube that communicates with the interior tracheal system. Gradually the fly forms inside the pupa, and when ready to issue it leaves its old quarters, and popping to the surface like a cork runs over it, and flies off to the shore to harden its chitinous covering. Such larvæ and pupæ abound in all our northern streams, but only in places where there is a swift current. Here the eggs are also deposited, and most frequently upon stones near enough to the surface of the water to be kept moist, or upon the projecting parts of submerged objects. The female is, in fact, able to dive, and can deposit her eggs even under water. These eggs are arranged in a very neat manner, and are usually white, as



Fig. 150.—*Simulium tribulatum*. Female.
Greatly enlarged. Original.



Fig. 151.—*Simulium tribulatum*. Male.
Greatly enlarged. Original.

shown in fig. 146. The adult gnats, that were obtained from the larvæ and pupæ illustrated, are shown in figs. 150 and 151. The male, as can be seen in fig. 151, varies very much from the female, fig. 150, being much smaller and having very large, brilliant red eyes that meet on top of head; the markings are also quite different, the body being velvety black with bright golden-yellow and blue spots; the female is gray with black markings. This species is the most abundant one, usually called in Minnesota the "black-fly" though quite different from the genuine article.

Very little can be done to destroy this insect in its earlier stages. The removal of obstructions in the rivers, which cause an acceleration of the motion of the water, would de-

stroy some of their breeding-places, but when there are so many this would make but little difference. Any chemicals to kill the larvæ and pupæ in the water would also kill fish, as they would have to be used very strong. The only way we have to protect ourselves and our animals are repelling substances, such as stinking-oils and smudges. A number of repellants are sold and some of them are very good, for instance the "Black-fly Cream," made in Portland, Maine. Our fishermen and hunters frequently use a mixture of kerosene-oil and mutton-tallow, with which the exposed parts are greased. For animals any of the strong-smelling oils can be used, but repeated applications are apt to injure them or to remove the hair. Oil of tar is a simple and easily applied wash. To make it, a quantity of coal-tar is placed in a large shallow receptacle in which is stirred a small quantity of oil of tar, or oil of turpentine, or any similar material. After filling the receptacle with water it is kept undisturbed for several days, when the animals to be protected are washed with the impregnated water whenever necessary. Smudges are best as a protection and the animals soon realize their protecting influence and crowd to them for shelter, even refusing to leave them when needed elsewhere. As the black-flies are active only during the day, and the mosquitoes towards evening and night, dwellers in our northern woods have a bad time of it and sometimes suffer very greatly on their account. It is easy, however, to drive these tormenters from houses or tents. By burning inside of them a little pyrethrum powder (Persian or Dalmatian insect-powder) upon a piece of bark these intruders are either killed or become so stupefied that they do not bite for some time. This method is in general use in the houses and stores of the Hudson Bay Company, and the writer has always used it successfully in his numerous trips. The fumes of the burning insect-powder are not very offensive, at least not nearly so much so as the poisonous bites of such insects as black-flies and mosquitoes.

MOSQUITOES.

(*Culicida*).

Like the flies belonging to the family of *Simuliida* just

mentioned, they also pass their early stages in water, and also, perhaps, in damp and shady ground. Here the adults are very numerous, though winds may carry them also far from their place of birth. They subsist on vegetable juices,* but if opportunity offers the females attack and suck the blood of all kinds of animals. Members of this family are recognized by their long body, by the fourteen-jointed, filiform and very plumose feelers, especially in the males; by the bulging thorax, by the narrow, cylindrical abdomen and thin legs, elongated narrow wings, lying flat on the body during rest, and by their humming sound during flight. The wings are covered, especially along the veins, with scales, some of which are shown in fig. 154. At least 30 species of these bloodthirsty insects are found in the United States, and some of the names *molestus*, *musicus*, *damnosus*, *cærucatus*, *prococtus*, *territans* and others they received show that their powers of tormenting man and beast were fully realized by the authors. Dr. A. S. Packard, in his interesting book "Our Common Insects," describes the mosquito and its mouth-parts in the following poetical words: "as she leaps off from her light bark, the cast chrysalis skin of her early life beneath the waters, and sails away in the sun-light, her velvety wings fringed with silken hairs, and her neatly bodiced trim figure (though her nose is rather salient, considering that it is half as long as her entire body), present a beauty and grace of form and movement quite unsurpassed by her dipterous allies. She draws near and softly alights upon the hand of the charmed beholder, subdues her trumpeting notes, folds her wings noiselessly upon her back, daintily sets down one foot after the other, and with an eagerness chastened by the most refined delicacy for the feelings of her victim, and with the air of Velpeau redivivus, drives through crushed and bleeding capillaries, shrinking nerves and injured tissues, a many-bladed lancet of marvellous fineness, of wonderful complexity and fitness. While she is engorging herself with our blood, we will examine under the microscope the mosquito's mouth. The head (fig. 152) is rounded, with the two

* When sugaring for moths, a method often employed by entomologists to collect large numbers of owl-moths, the bait is frequently covered with mosquitoes, all busily engaged in sucking this sweet material.

eyes occupying a large part of the surface, and nearly meeting on the top of the head. Out of the forehead, so to speak, grow the long, delicate, hairy antennæ (*a*), and just below arises the long beak which consists of bristle-like maxillæ (*mx* with their palpi, *mp*) and mandibles (*m*), and the single hair-like labrum, (labrum-epipharynx (*lr-e*) and hypo-

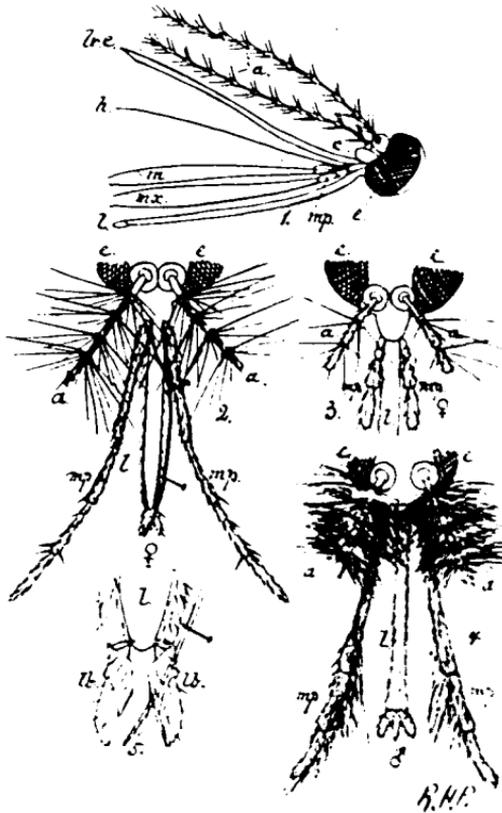


Fig. 152.—Head of mosquito (several species, males and females); *a*, antennæ; *mx*, maxillæ; *mp*, maxillary palpi; *m*, mandibles; *lr-e*, labrum-epipharynx; *h*, hypo-pharynx; *l*, labium. Greatly enlarged. Original.

pharynx (*h*), these five bristle-like organs being laid in the hollowed labium (*l*). Thus massed into a single awl-like beak, the mosquito, without any apparent effort, thrusts them all except the labium into the flesh. Her hind body may be seen filling with the red blood, until it cries quits, and the insect withdraws its sting and flies sluggishly away. In a moment the wounded part itches slightly, though a very

robust person may not notice the irritation, or a more delicate person if asleep; though if weakened by disease, or if stung in a highly vascular and sensitive part, such as the eyelid, the bite becomes really a serious matter. Multiply the mosquito a thousand fold, and one flees their attacks and avoids their haunts as he would a nest of hornets."

It is perhaps not necessary to introduce this insect, as most persons claim a very intimate acquaintance with the female mosquito, while they hardly know her more retiring husband, who is also more beautiful, both physically and morally. There are, however, many peculiar traits in the history of this aggressive insect, which but few persons are aware of, and at the risk of repeating well-known facts, the essential points of its life-history will be given. A glance at the illustration (fig. 153) will make some of them quite plain.

Early this spring, 1896, when all plant-life was in the bonds of winter, no insects could be discovered by those whose eyes were not trained for seeing such things. Yet a close and trained observer could readily discover in sheltered nooks and corners, in cellars and stables, under loose boards and under stones, a large number of insects that had found winter quarters in such places. Besides a number of different flies and other insects detected in cellars, a few mosquitoes could be seen which were pale and by no means such active beings as they are later in the season. The last snow, which fell towards the end of April, brought with it immense numbers of mosquitoes of a large size and of a pale-brown color (*Culex consobrinus*). The writer counted as many as four to twenty-one mosquitoes upon a square yard of level surface. In northern latitudes it is not uncommon to find mosquitoes even in mid-winter, and thousands appear as soon as the sun comes out warm. Many years ago the writer saw in February a very large swarm of mosquitoes in Detroit, Mich.; they were very annoying for some weeks, when their numbers gradually became less. Whence did they come? To treat these emigrants in a hospitable manner, an old barrel was cut in two and filled with rain-water, to attract and give them a home for their offspring. Of course such

hospitality should not in such a case become a general practice, as these insects are apt to take an unfair advantage of their host. The mosquitoes were not slow to utilize these artificial ponds and in a manner that will be shown later. At the same time large numbers of both sexes of these mosquitoes congregated upon the windows, and many entered



Fig. 153.—Mosquitoes at home; *a*, larva; *b*, pupa; *c*, adult leaving pupal skin; *d*, female depositing egg; *e*, male. Greatly enlarged. After Brehm

the houses, as if to indicate to the inhabitants that mosquito-screens would soon be of some use. The great majority of mosquitoes entering houses were females, and but very few males could be detected. Early in May, and throughout the summer, numerous generations of mosquitoes were produced in these barrels and in all stagnant water that

possessed certain properties. The water had to be rain-water full of animal or vegetable matter, and had to be located in a depression so that the wind could not disturb its surface very greatly. Ponds were also utilized, providing plenty of grass and other plants formed an obstruction to retard or prevent the waves from disturbing the surface in too violent a manner. In the middle or in the deeper part of ponds but few larvæ or pupæ of mosquitoes could be found. With the arrival of warmer weather those mosquitoes, that had found a shelter in which to hibernate, also started into renewed activity, and they also commenced to multiply in a very rapid manner.

After a short season of love the female mosquito deposited her eggs upon the surface of the water, and selected for this purpose almost invariably the very early morning, so that it was somewhat troublesome to watch this operation, especially, as all other female mosquitoes not engaged in such work would try their very best to drive away the intruder. They did this not in a very ladylike manner and their remarks about the intruder were of a most biting character! Of course the gentlemanly male did not engage in biting, simply because he can not do so, lacking the necessary organs for that purpose. Selecting a floating object or a quiet spot where the water is not greatly disturbed, the female deposits a large number of eggs in the shape of a raft. In doing so the female supports her body upon the four front legs, while her two hind legs are crossed, as seen in the illustration (153 *d*). In this angle thus formed by the hind legs, the eggs are formed into a sort of raft as they pass one by one from the abdomen, and being sticky they adhere to each other. These small egg-masses look like a bit of floating soot, and if investigated more closely it will be found that each contains on an average over 300 eggs, and that each egg is a very elongated affair, resembling an old-styled flask with a stopper. Such egg-masses, which must float upon the surface of the water to obtain the necessary air and warmth, will always float in the proper position, no matter how violently we may stir the water. To enable them to do so a film of air surrounds the eggs,

thus also preventing a direct contact with the water; yet this film disappears from the exposed surface of the eggs by evaporation as soon as the raft is in a proper position. In three to five days these eggs hatch and produce from the lower ends the well-known "wigglers," so commonly seen in rain barrels and watering troughs. This common name is well-deserved by the wiggling motion of the larvæ. These feed mainly below the surface of the water, and move just below it, as if it were a solid substance. This is a very queer thing, as the specific weight of these larvæ is greater than that of the water in which they move. If they move away from this surface film of water, they invariably sink to the bottom, at least they do if not using their swimming plates at the ends of their tails. The larger and stronger larvæ feed near the bottom of the water upon decaying vegetable matter, and only rise to the surface to obtain air. Such a larva (*a*) has a large head and thorax, while its abdomen is much more slender. Its head, which usually points downward, possesses vibratile organs for sweeping minute particles of food into the mouth. In this shape the larvæ have to breathe air, but being surrounded by water this would be very difficult if they did not possess a cylindrical siphon or breathing-tube at the end of the last segment. The tail-like breathing-tube is pushed above the water, and the necessary supply of air is thus secured. As this does not last very long the larvæ are forced to repeat this operation quite frequently. The larval stage lasts but a very short time in some species of mosquitoes, while in others it extends over a much longer period. This depends to some extent upon the season. The writer kept larvæ which changed in five days to pupæ; other larvæ of a different species of mosquito require almost three weeks to reach their full size. During this period the latter ones moulted three times. When full grown a very remarkable change takes place, and a club-shaped pupa with greatly enlarged head and thorax, is now seen (*b*). The strange part of this wonderful change is the possession of two slender breathing-tubes upon the back of the thorax instead of a single one in front of the tail. Though the pupa does not require any

food it must be able to save itself when disturbed and it does so the very moment the surface of the water becomes agitated, by a few strokes with paddle-like swimming-organs located at the tail. The trumpet-shaped breathing-tubes contain upon their inner surface a large number of peculiar hairs, which prevent the water from entering. Like the larva the pupa has to come frequently to the surface to breathe air, and if not disturbed always hangs suspended from the surface-film of the water. In a few days the last transformation takes place, which is well shown in (*c*). The pupal skin splits open in the back, thus forming a boat, and the adult and winged mosquito works its way very carefully out of the many fine skins that enclose its various members. As soon as the wings are expanded and dry the insect flies away, now breathing air in the usual manner of insects by means of fine openings located in the sides of the thorax and abdomen. We have here the interesting fact that the same insect has to breathe air in three different ways and by three different sets of organs, each seen to be most wonderful in structure if carefully studied by means of a microscope.

Thus far both sexes were very similar in structure, but if we now study them in their winged shape we shall find them quite different. The male (*♂*) is distinguished by very large and feather-like feelers, and by rudimentary mouth-parts. The female (*♀* and *♀*) has smaller feelers, and a hard, long and slender proboscis, decidedly well adapted to sucking blood. Of course in nature but few of these bloodthirsty females ever have an opportunity to obtain such food, and they must subsist upon something else. It is suspected, and the experiments made this summer but not yet finished seem to prove it, that females imbibing such blood die in consequence. Where is the benefit to the species if such is the case?

Regions in which stagnant water abounds are famous, or rather infamous, on account of the vast number of such insects, and their presence is easily accounted for. But we find them many miles away from water and sometimes in equally large numbers. Where do they come from and where do they breed?

There are many other very interesting points in the life-history of this insect. But what earthly good is it to study all these details? Where is the benefit to farmers? As a reply it might be stated that by knowing all these details it is easy to reduce the numbers of these insects very materially near our houses; at least this can be done in many cases. Knowing that the eggs are laid upon the water, that larvæ and pupæ have to live in it and have to come to the surface to breathe air, we have an excellent way of killing vast

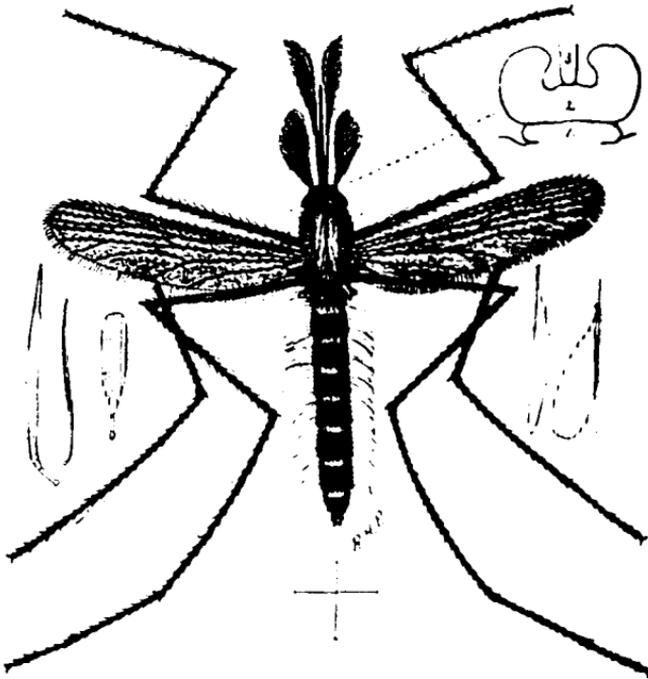


Fig. 154.—Mosquito, male; showing also scales and section through ear. Greatly enlarged. Original.

numbers. During the summer the writer has kept a sort of census of the number of mosquitoes raised in rain-water in two barrels, and two counts will be given to show how many mosquitoes can be raised near the farm-house, or where they are most needed! July 6th, 1896, the water in one barrel was filtered. It contained 35 grams of mosquitoes, each gram, by count, numbering 217, hence $35 \times 217 = 7,595$ larvæ and pupæ. Besides this 32 egg-masses, each containing on an average 302 eggs, were found, which would hatch

into $302 \times 32 = 9,664$ mosquitoes. Total number of eggs, larvæ and pupæ, 17,259. July 22d, 1896, by a similar process, 19,110 mosquitoes were counted. At the present time (Sept.) not so many eggs are deposited, but there are still immense numbers of immature insects in pools and ditches and other suitable breeding-places.

It is assuredly not a good thing to breed mosquitoes near our houses. To prevent them from doing so all that is

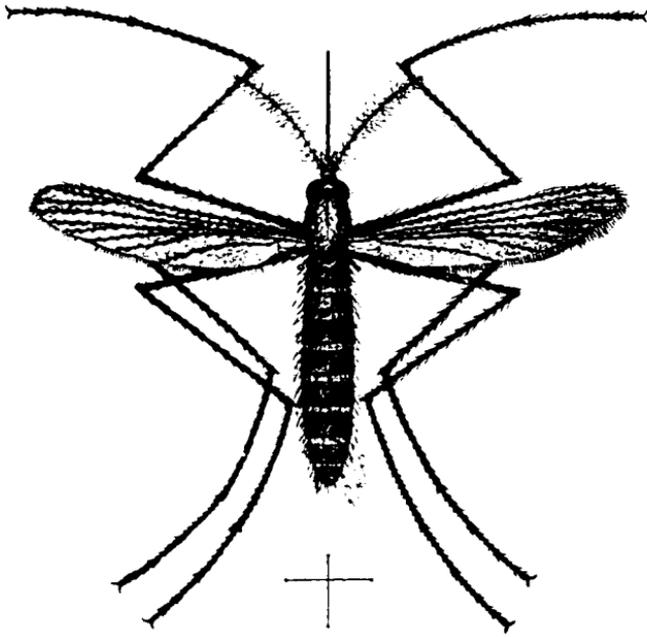


Fig. 155.—Mosquito, female. Greatly enlarged. Original.

necessary is to shut them off from a supply of air and there is an exceedingly simple and cheap way of doing it most effectually. Many trials have shown that by pouring just one or two spoonfuls of kerosene-oil upon the water in rain-barrels, and by stirring the water so that the surface is equally covered with a film of oil, all eggs, larvæ, and pupæ die by suffocation within five minutes. This is surely a simple way of killing multitudes of such insects, and as the oil will evaporate very soon, the water is by no means spoiled. If done very early in the season, and repeated every four-

teen days, no mosquitoes will breed in this water so important upon prairie farms. Small bodies of water in pools, ditches and ponds should be treated in a similar manner, especially early in the season, when the surface is still free

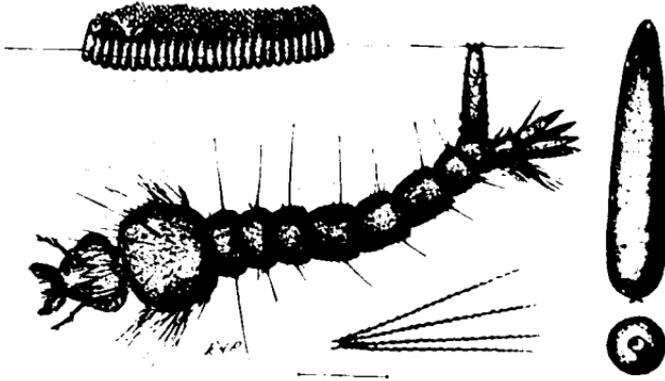


Fig. 156.—Mosquito, larva and eggs; also a single egg. Greatly enlarged. Original.

from projecting plants. A few gallons, or even quarts, thrown upon the surface of the water when the wind is blowing fairly strong, will distribute the oil uniformly over the whole surface of the pond, and thus kill all the mosquitoes. Like most remedies against noxious insects this one should be used in time, or before the enemy has be-

come very numerous. These aggressive insects can be kept away from houses, barns and cattle in the field by a smudge, or by strong-smelling substances, and in regions where they occur in vast numbers, such smudges are built in the evenings. Sportsmen anoint their



Fig. 157.—Mosquito, pupa. Greatly enlarged. Original.

faces and hands with various compounds composed of mutton tallow and oil of pennyroyal, or of oil of tar. The following mixture is excellent for this purpose:

Olive oil, 3 parts; oil of pennyroyal, 2 parts; glycerine, 1 part; ammonia, 1 part.

A wash with ammonia usually removes all bad effects of their bites, at least in most persons. The poison injected by

these tormenters acts very differently upon different persons; in some it causes large swellings, in others fever and pains in limbs, and in extreme cases even insanity, while others are but little annoyed.

We have a large number of species in our state and in certain years and localities they make such places almost uninhabitable for man. Prof. Riley remarks in "Little Known Facts about Well Known Animals," that "they have caused the rout of armies and the desertion of

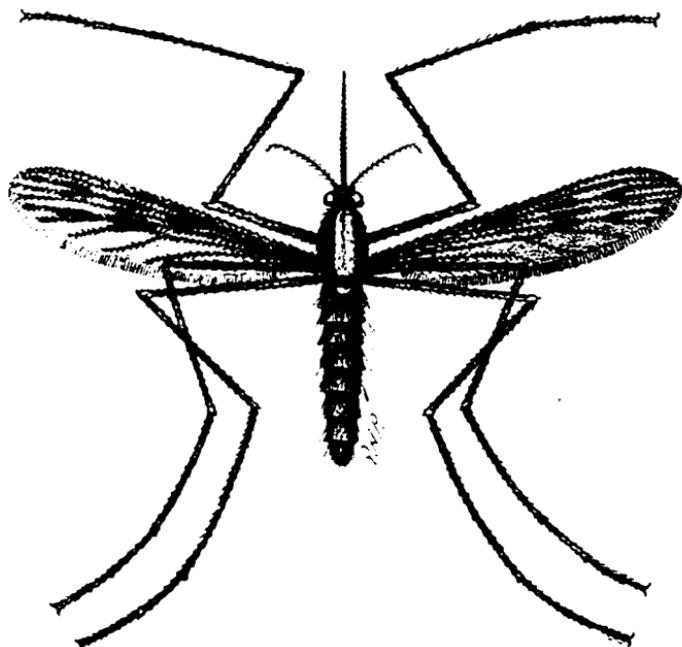


Fig. 158.—*Anopheles quadrimaculatus* Say. Greatly enlarged. Original.

cities, and the hum of an insignificant gnat may inspire more terror than the roar of the lion." (Historical data are not given.) "The bravest man on the fleetest horse dare not cross some of the more rank and dark prairies of Northern Minnesota in June. It is well known that Father De Smith once nearly died from mosquito bites, his flesh being so swollen around the arms and legs that it literally burst. Those who have traveled in summer on the lower Mississippi or in the North-west, have experienced the torment which

these frail flies can inflict; at times they drive everyone from the boat, and trains can sometimes only run with comfort on the Northern Pacific by keeping a smudge in the baggage car and the doors of all the coaches open to the fumes."

Prof. Riley wrote the above lines many years ago, and conditions have greatly changed since. The mosquito is still a great pest in some places in Minnesota, sometimes even killing animals that can not escape it, but the prairies are rapidly settled in spite of them, and as the land is gradually better drained mosquitoes become fewer and fewer. They are very abundant north. In Davis's straits, in lat. 72° N., Dr. Bessels, on board the *Polaris*, was obliged to interrupt his observations on account of the multitudes of these insects. A great number were also seen up to the 81st. deg. of latitude. An old writer, writing about the northern shores of Lake Superior, expresses himself in this way: "When the mosquitoes disappeared the black-flies came; the mosquito pumps up a drop of blood and flies away, the black-fly bites and makes a wound which continues to bleed."

In tropical America these insects are still worse, and they are the source of such incessant torments that some of the most beautiful regions of the globe are unfit for a white population. In the llanos and prairies of Venezuela they persecute cattle to such an extent that they do not thrive even on the richest pastures.

Of the many species found in our state a few have been studied more in detail, as well as their life-history. The illustrations (figs. 154, 155, 156 and 157) show a common species (*Culispinna* Wied.); it is the first seen in the spring and the last to disappear late in autumn. Fig. 154 shows the male, and some of the peculiar scales found upon the veins of the wings; the first three joints of one of the feelers is greatly enlarged, to show the auditory organ (Johnson's organ). Fig. 155 shows the female, fig. 156 the full-grown larva, a bunch of hairs from the tail, an egg mass and the enlarged egg; fig. 157 shows the pupa. The color of both male and female is dark gray with lighter yellowish-white bands.

Another species belonging to a different genus, is illustrated in fig. 158; it is less common, and readily recognized by the spotted appearance of the wings; it is *Anopheles quadrimaculatus* Say.

There are a large number of other species of flies which occasionally torment man and his four-footed servants, but it would take too much space to give their history and illustrate their forms. Flies, small and insignificant as they seem, can oppose a stronger barrier to man's explorations than lofty mountains or swift streams.

L. BUGS

(*Hemiptera*).

Bugs or Half-wing insects, have received the latter name by being characterized by having the basal half of the front-wings leathery, while the apical half is thin and membranaceous. Below these upper wings is a pair of larger and thin wings, which are mainly used for flight. The wings, at rest, are crossed flatly over the back. In this order of insects it is not alone the adult or winged insect and its larva that takes food, but the pupa is equally active and hungry. The beak is a horny, pointed, tapering, three- or four-jointed tube (labium), which is inserted beneath the front of the head. Four stiff bristles (mandibles and maxillæ) are enclosed in this tube, and these are adapted for piercing vegetable or animal tissues. The setaceous maxillæ and mandibles, the latter armed with recurved teeth, are inserted, and a drop of poison is injected at the same time, which accounts for the inflammation caused by the bites of such insects. Bugs sucking the juice of plants possess usually a long and slender beak; those sucking blood have a curved, short and thick one. The former can become very destructive, as for instance, the well-known chinch-bug, mentioned elsewhere in this report. There are also a large number of true bugs that will attack warm-blooded animals if opportunity offers, yet but very few make it their business to do so constantly, and these have in the course of time become veritable blood-sucking parasites.

THE BED-BUG.

(*Acanthia lectularia* Linn.).

Some persons claim that they have never seen these parasites; this means that they have either been very fortunate, or that they did not use their eyes or their nose, as bed-bugs are found wherever man has made a home for himself. It is a mooted point whence they came originally, but this, although interesting, makes but little difference at present, as they are now everywhere.

The illustration (fig. 159) shows how this nasty insect looks. We see that, being a parasite, and no longer leading

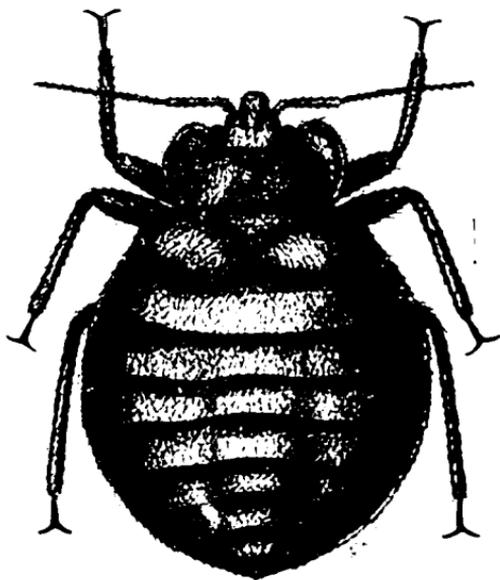


Fig. 159.—Bed-bug. Greatly enlarged. Original.

a rambling existence like other bugs, but being a sort of domesticated animal, it has lost the wings, these being no longer required, and it possesses simply rudiments of them. These are indicated in the illustration, and look like a little chitinous flap on each side of the thorax. The adult bugs, as well as the younger ones, are well adapted to enter narrow cracks, having a very flattened shape, and in such shelters they hide during the day, being active only at night. They deposit during spring about fifty white and oval eggs, 1.12mm. long, and similar to those shown in fig. 161, in the

joints of bed-steeds, cracks in walls, under loose wall-paper, but especially near iron, be this an old nail in the wall or the hooks that are used to fasten the bedstead together. These eggs are very beautiful objects; they are terminated by a cap, which is removed by the escaping young bugs. These latter

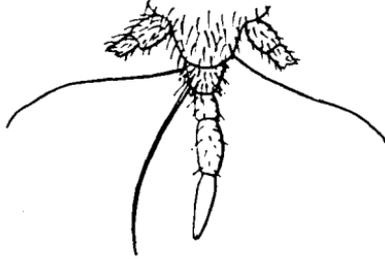


Fig. 160.—Mouth-part of bed-bug. Greatly enlarged. Original.

possess the color of innocence, being white and almost transparent; they look, in shape, very much like the old ones, and are only a little broader in comparison, and have stouter feelers. As soon as they can attack a victim they become round and resemble a minute globule of blood. Imbibing blood whenever they have an opportunity they quickly grow, and after moulting several times they reach their adult and sexually mature condition. The organ by means of which

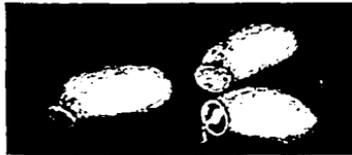


Fig. 161.—Eggs of bed-bugs found in swallow-nest. Greatly enlarged. Original.

they obtain blood, is a sucking-tube or haustellum. (Fig. 160.) This is composed of two half cylindrical side-pieces, analogous with the labium and labial-palpi, and enclosed in this tube are four sharp and pointed lancets, the transformed mandibles and maxillary palpi.

The female deposits eggs during the warmer season four times, and about fifty at a time. In Minnesota these bugs have only one annual generation, yet judging from their numbers in certain, not first-class, hotels not hundreds of miles dis-

tant from the "twin cities," they should have numerous broods every few weeks. With plenty of food and a warm temperature, they multiply rapidly; and if things are favorable it requires only eleven weeks for the bug to undergo its transformation from egg to adult. Only the adult insects hibernate or are able to withstand severe cold. It is not necessary to describe this insect in detail, as the illustration shows well the structure of this yellowish-brown parasite. The disagreeable "bed-buggy" odor is produced in minute glands which are situated in the adult bug on the under side of the body, and in the young one on the back of the thorax. The peculiar and penetrating odor of these parasites is, to many persons, even worse than their bites. Those who have been forced to sleep in a room which had not been occupied for weeks, and in a bed alive with hungry bed-bugs, know how interesting these parasites can make it, and how active they become as soon as the light is extinguished. Like harpies they attack the would-be sleeper and their bites produce the sensation of being stung with hot needles; soon the whole body is in a fever, and big swellings appear wherever a bug has inserted his beak. If a light is suddenly ignited, the bugs run away as quickly as they can to their hiding-places. A glance at the ceiling of the occupied rooms will reveal many bugs, which have crawled there with the intention of dropping down upon the sleeper. Though always hungry and ready to imbibe blood bed-bugs can also exist for a long time, even for a year, without any food. Prof. Lemis kept a female bed-bug in an empty paper-box for six months; when the box was opened not only the living female was found, but she was surrounded by numerous young bugs, which, like the mother, were white and transparent as glass.

We have a large number of remedies against this insect. Cleanliness is, of course, the best preventive. Yet with all care bed-bugs can and will enter houses, because they are so readily carried with trunks, etc. from infested places, and if they once find a home they are, on account of their form, which is well adapted for hiding, and their capacity for fasting, not readily driven away. The free use of benzine, or of kerosene, sprayed with a hand-atomizer into all suspected

cracks, will kill all insects including the eggs, with which it actually comes in contact. This spraying has to be repeated from time to time, and if carefully and thoroughly done the bed-bugs have no chance to exist in such beds or rooms. If we paint the cracks in a bedstead or the wall, the ends of the slats, and all other suspected places, with one ounce corrosive sublimate dissolved in a half-pint of alcohol and one-fourth pint of oil of turpentine, we have an excellent remedy.

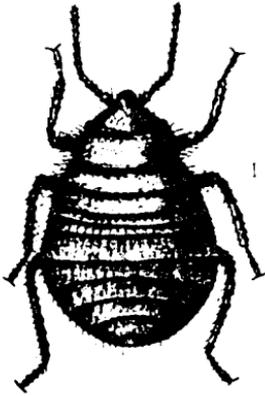


Fig. 162.—Larva of bed-bug found in nest of swallow. Greatly enlarged. Original.

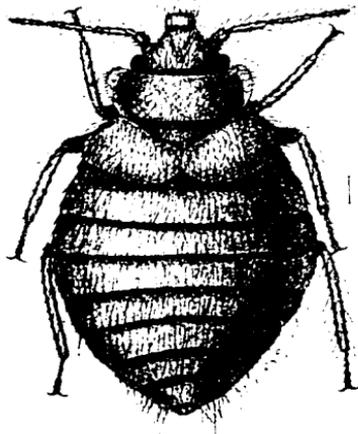


Fig. 163.—Adult of bed-bug found in nest of swallow. Greatly enlarged. Original.

All remedies are best applied in early spring, so as to kill all the old hibernating females before they have deposited eggs.

While traveling, it is well to remember that bed-bugs are only active during the night and that they abhor light. So if forced to sleep in a bed suspected of containing such unwelcome inhabitants it is wise to permit the lamp to burn all night.

Bugs, very similar to bed-bugs, attack chickens, pigeons, swallows and bats. Those found in the nests of swallows not infrequently reach the inside of houses against which these beneficial birds have built their clay-nests. Such bugs (fig. 161, 162, 163) resemble very closely the genuine bed-bug, yet are quite different when studied in detail; they are much smaller, darker, and can not exist for any length of time away from their proper home, the nest of the swallow,

where they are sometimes exceedingly numerous. The illustration shows the eggs, young and adult, of this species (*Acanthia hirundinis* Senyus).

It is frequently stated that bed-bugs occur in our pine-woods in a wild condition under bark, etc., and that whenever a log-cabin is erected this would immediately swarm with bed-bugs. Truth and fiction are here sadly mixed! It is truth that such cabins often contain a dense population of various insects parasitic upon man, but they have been brought there by the inhabitants, and did not come with

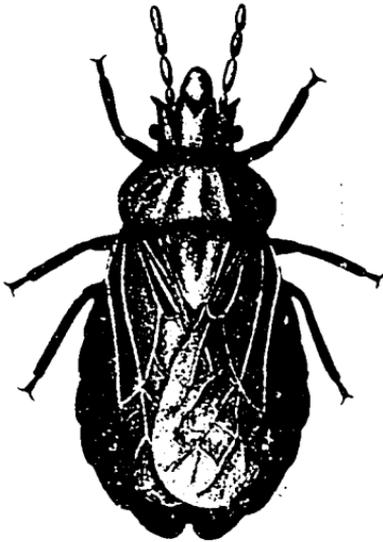


Fig. 164.—Adult of *Aradus* spec. Greatly enlarged. Original.



Fig. 165.—Larva of *Aradus* spec. Greatly enlarged. Original.

the timber from the woods. In many cases, when the writer asked for the proofs, such insects as are shown in figs. 164 and 165 were sent to him as examples of them. They resemble bed-bugs in many ways, especially in their earlier and unwinged stages, but a trained eye can readily detect the very great difference between the two. Two species are most commonly found in and about log-cabins; the one illustrated (fig. 164, adult; and fig. 165, larva) is black, as flat as the genuine bed-bug, and just as inactive during the day. It is a species of *Aradus*. Another species not illustrated, resembles the bed-bug even more closely, being of the same color and size; this is *Aradus cinnamomeus*. These insects,

as well as a number of similar ones, live normally under bark of dead and living trees; they are true vegetable feeders, subsisting upon the sap of plants. Whenever logs are cut the sap contained in them and especially that near the surface, ferments, and this attracts a large number of insects fond of such fluid. This explains why so many insects can be found near saw-mills, and chiefly upon freshly cut boards.

Notwithstanding the bad odor of the bed-bugs they have a number of enemies that are said to destroy them. Prof. C. Vogt writes that the inhabitants of Switzerland claim that fleas and bugs were living in a state of war, and that the fleas had to leave dwellings occupied by bed-bugs, which



Fig. 166.—Water-boatman. Greatly enlarged. Original.

would indicate that fleas are very sensible insects. Prof. Riley says that little red ants, if invading a house infested with bed-bugs, make short work of the latter, and tear them to pieces wherever found. This may be a consolation, but these ants are far from being good tenants in our dwelling places.

A number of blood-thirsty bugs are known that make it their aim in life to destroy bed-bugs. This would be an excellent trait in the character of any bug, but these are otherwise so stupid as to treat man and bed-bugs in the same way by biting both, and as the bite of the Pirate-bug (this is the name of the bed-bug destroying kind) is very poisonous and painful, their presence in our houses is not desirable. In the southern states several bugs, such as the Two-spotted Corsair and the Blood-sucking Cone-nose or Big Bed-bug, enter houses for the same laudable purpose but both kinds make the same lamentable mistake and inflict the most painful bites which may disable a weak person for many days.

As already mentioned, other true bugs sometimes bite man and animal, but they do not habitually do so. We can not, therefore, call them genuine parasites. Yet a few come very near to deserving such an appellation, for instance the bug illustrated in fig. 166. This is an aquatic insect and usually called a *Water Boatman* (*Notonecta undulata* Say). This is a well-chosen name! When we observe these insects in their homes we find them floating upon their backs, the long hind legs, admirably adapted for swimming, are spread



Fig. 167.—Electric-light bug. Slightly enlarged.

apart, as if waiting for the command: pull away. These white and black bugs have an oval form, and are deeper-bodied than most other insects, having the convexity of the surface above. They possess large eyes, and a very powerful, four-jointed, elongated beak, which is conical and very acute, as shown in the illustration at the left. Their bite is very poisonous, and it is a fortunate thing for bathers that they do not attack man unless provoked to do so. They will not permit any familiarity and bite whenever roughly handled. Ponds that are drying up, or where all the inhabitants are crowded into a small space, are good places not to bathe in, as the writer can testify.

The "Electric-light Bug" or *The Giant Water-bug* (*Belostomatidae* *griseus* Say, fig. 167) is a well-known bug that can inflict very severe bites and in handling them the proper precaution should be taken to hold the insect in such a way



Fig. 168.—*Lopidea media* Say. Greatly enlarged. Original.

that it can not use its short beak. Their bite is very poisonous, and whenever they bite a fish this almost immediately dies.

Unexpected things are apt to occur, and insects that are usually found only upon plants may develop a taste for blood. While camping for a few days upon an island largely covered with wild gooseberries, the insect illustrated in fig. 168 was frequently observed upon these plants, where it seemed to feed, like all its near relatives, upon the sap. But soon after, the persons living in the camp were bitten very frequently by these bugs, and their bite caused considerable pain and swellings of the bitten part. The bugs would imbibe blood until barely able to fly. But as if to prove their love for human blood they even invaded the tent, and large numbers of them were killed to prevent them from biting. The insect (*Lopidea media* Say) is a rather brightly-colored bug, being yellowish-red marked with black.

M. OTHER INSECTS.

We find in all orders of insects some species that occasionally attack man and animals and that may injure either by their bite or by their poison. None of them can, however, be called true parasites.

Among the butterflies and moths we have a few whose larvæ cause great pain if they are handled with the bare hands. This pain is caused by peculiarly-shaped, branched spines, which contain poison, or by very fine hairs possessing similar properties.

Among the beetles we have such poisonous insects as the blister-beetles or Spanish-flies; they are utilized as vesicants,



Fig. 169.—*Lamophlus fasciatus*, Melsch. Greatly enlarged. Original.

hence can be useful in the hands of a physician. There is, however, one small beetle) *Lamophlus fasciatus*, Melsch.), that deserves more than a passing notice; it is illustrated in fig. 169. This small and flat insect, of a light-brown color, highly polished surface, with a light space upon each wing-cover, is very abundant near saw-mills, especially near those in which hard wood is sawed. In running over the persons engaged in mill work they become not simply annoying, but as they bite often and without any provocation, they become a great nuisance, and the writer has seen very bad sores caused by them. They seem to prefer the neck of their victims, and notwithstanding their small size, as indicated by the line in the illustration, their bite is a painful one.

Among the bees, wasps, etc., we find a large number of insects that can inflict a very severe sting. But as a very general rule they sting only when provoked, in self-defense, or if they fear for their young. None can therefore be called true parasites of man. Yet ants, at the time when they swarm and cover everything with their active bodies, are not infrequently called parasites. The ant shown in fig. 170

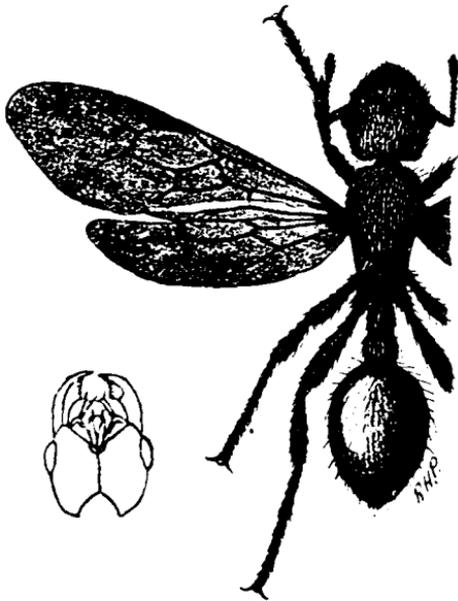


Fig. 170.—Winged ant, *Myrmica scabrinodis* Nyl. Greatly enlarged. Original.

(*Myrmica scabrinodis* Nyl.) was captured during September in an open street-car. Passing through a swarm of these ants the car was taken by storm, and in a very few minutes all the legitimate passengers were stamping, shaking and investigating their clothes. And not in vain, as the perplexed looks of the ladies and of some of the gentlemen clearly showed. If one of the ants was roughly handled in putting it off the car it was not slow to retaliate, and a bite with the formidable jaws shown in the illustration, and a poisonous sting, soon convinced everyone in that car that a more tender handling of these intruders was the better and safer method of dislodging them.

As it is not an uncommon occurrence that persons are bitten or stung by insects, it is well to know what will allay the pain. Generally speaking all the poison injected by insects into wounds, made either by the sharp mandibles or by the still sharper sting, is composed mainly of formic acid, hence any fluid that will neutralize this acid is of benefit. If

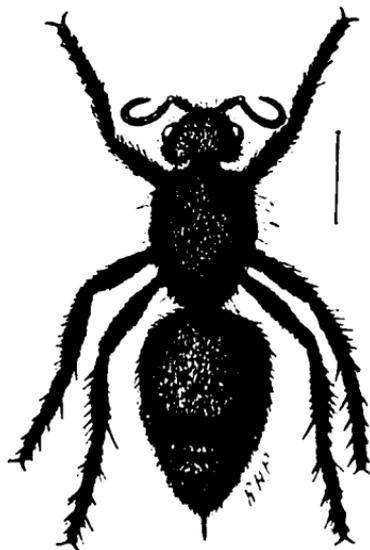


Fig. 171.—Cow-killer, female. Greatly enlarged. Original.

liquid ammonia can be had, this should be rubbed into the wound and all pain will cease very soon. In absence of this fluid, moist soil will give relief.

It is always best not to handle insects one does not know, no matter how innocent they may appear. For instance the insect illustrated in fig. 171, (*Sphorophthalma similima* Smith), which is so commonly seen running about sandy spots, should be left alone. Children are very apt to catch this prettily marked red and black insect, which resembles a large ant. If they should succeed they will be stung very severely, and may be sick for many days. This insect, or rather a larger southern species, has received the very appropriate name: "cow-killer," a name indicating its poisonous qualities.

II. INTERNAL PARASITES (*Entozoa*).

A. FIVE-MOUTHS.

(*Linguatulidæ*.)

Among the many parasites infesting man, domesticated animals, certain wild animals, and even amphibians, few are more degraded in consequence of a parasitic mode of life than the *Tongue-worm*, *Tonguelets* or *Five-mouths*. According to the careful researches of Leuckart these parasites are simply degraded mites forming the order *Linguatulidæ*. This comprises arthropods with elongated, worm-shaped and annu-

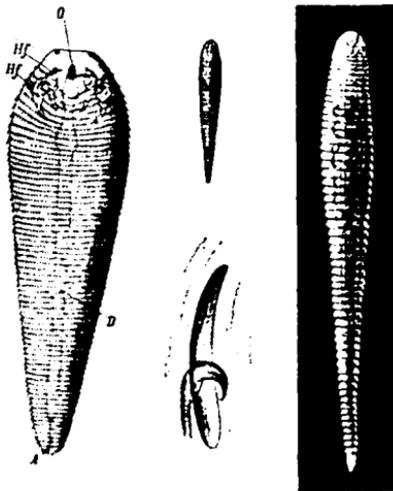


Fig. 172.—Five-mouth. To the left, secondary larva; in center, male, and below a single hook; to the right, a female. Greatly enlarged. After Brass.

lated bodies, possessing mouths without jaws, and which are surrounded by two pairs of hooks representing rudimentary legs. In the adults these parasites possess no hearts, and breathe through their skins. The annulated skin contains numerous glands of uncertain use. The ventral mouth, surrounded by a chitinous ring, opens into a central, straight, intestinal tube ending at the posterior end. The illustration (fig. 172) shows this peculiar parasite, and indicates also why it was not so very strange that formerly it was considered a tremadode-worm or a fluke. When young

the five-mouths resemble mites, and possess four legs, but when adult no external organs are visible except two pairs of small hooks on the head (*IIf*), a mouth (*o*), and two minute tactile organs at the anterior border. The hooks can be withdrawn into little sheaths or pockets, which, with the mouth, make five openings in the head, hence the name "Five-mouths." They possess no organs of vision. The sexes are separate; the grayish-white female, 7 to 10mm. long, is very much larger than the white male, which measures from 2 to 2.5mm.

The Tapeworm-shaped Five-mouth (*Linguatula (Pentastoma) tenuicollis*) is illustrated in fig. 172. The female deposits her eggs, about 500,000, in the nasal cavities of the dog, fox, wolf, and other carnivorous animals, whence they are expelled with mucus during the fits of sneezing caused by their presence, and in this manner they reach the surface of various low-growing plants or water. Protected by the mucus they keep alive for a number of weeks. If the plants coated with such eggs are eaten by any herbivorous animal, the mucus and egg-shells are dissolved, and the embryos, which were fully formed when the eggs were laid, are liberated in the intestines of the new host. The embryo is flat on the lower, round on the upper surface, and constricted and dentated at the posterior end. In this larval shape it bores through the walls of the digestive tube by means of a perforating apparatus formed by a style with two hooks, and thus reaches the liver, lungs, etc., where it becomes encysted. Here it gradually assumes the pupal shape. During the next five months a number of moults take place, and the body of this secondary larva becomes elongated, broader in front, and is divided into 80 to 90 segments, which possess a series of fine points on their posterior borders. (Fig. 172). Towards the seventh month these larvæ are completely developed, measuring from 6 to 8mm., and now leave their old home. Most of them die in their attempts to reach the nasal cavities of a new host, but some succeed. Dogs that eat the viscera of animals containing these parasites are certain to become infested with them. At all events the larvæ must reach respiratory organs to complete their growth, which

they do by throwing off their old skins and replacing them with smooth and lancet-shaped new ones. The nomadic males are found not only in the nasal cavity, but also in the pharynx and larynx, while the females are less active. They are shown in position in fig. 173.

Generally speaking this parasite is not as common in the United States as it is in Europe. It has been found in the nasal cavities of the horse, mule, sheep, goat, hog and man. The actual and most natural hosts are the dog and the rabbit. If we prevent our dogs from eating the entrails of rabbits, sheep, etc., and do not permit them to visit slaughter-houses, there is little danger of an infection. To

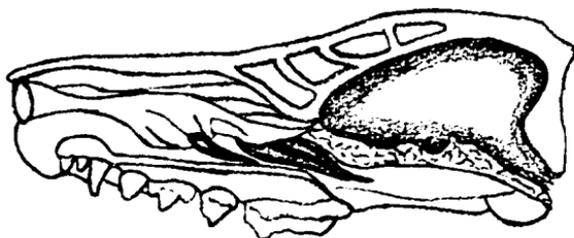


Fig. 173.—Three parasites in position in head of dog.

remove such parasites an injection of dilute ammonia, benzine, etc., is used; but in case of a valuable animal a veterinary surgeon should be consulted. Dogs infested rub their noses quite often, sneeze frequently, are easily excited, and become angry and bite. If numerous in the internal organs the parasites may cause death. The mature parasites cause, in man, bleeding of the nose, violent catarrh, and intensive headaches; those encysted in the liver cause other serious disturbances, and if they migrate, bleeding of the lungs, inflammation, and even death. Another species of Five-mouths is very common in Egypt, where it is found encysted in the livers of negroes.

Children should never be permitted to kiss dogs!

B. BOT-FLIES. GAD-FLIES.

(*Estridae*).

The flies that belong to the above family are only parasitic in their larval state; the inactive pupal state is passed

in the soil, and in the winged or adult form they fly about in search of quadrupeds upon which to deposit their eggs. In this winged state the flies are very active only during the warmer portion of the day and delight to bask in the sun, sitting upon some elevated rock or dead tree. Many species of Bot- or Gad-flies are known, each living, as a general rule, in its larval state in some particular animal, and usually even in a certain organ of that host. Man is not exempt, and in tropical America tumors caused by one or more species of such parasites are not uncommon. Even in more temperate regions such larvæ are found from time to time under the skin of man.



Fig. 174.—Bot-fly of man.
Enlarged. After Brauer.

Fig. 174 shows a larva of the Bot-fly of man (*Dermatobia noxialis* Goudot) taken from man. Dr. John Hamilton describes in the Entomological News a case that came under his observation. He writes:

“Several years ago I saw, professionally, a boy six years of age who had been suffering for some months from the glands on one side of his neck being swollen and a fetid ulceration around the back teeth of the lower jaw of the same side. Three months treatment was of no avail, and the end seemed near; one day a white object which was seen to move, was observed in the ulcer at the root of the tongue, which on being carefully extracted proved to be a large grub, which, from having frequently seen them, I recognized as a full-grown larva of *Hypoderma*. It was of the usual tawny color, about half an inch long when contracted, about one-third that thickness, and quite lively. The case ended fatally. This boy had been on a farm in Illinois the previous fall, where probably the egg was in some way taken into his mouth, and the larva found between the base of the tongue and the jaw suitable tissue in which to develop, coming to maturity at the same time with those bred in cattle:

Bot-flies are stout and hairy insects, usually resembling

bumble-bees. Their very small mouth has only abortive mouth-parts; the feelers are small and are almost hidden in little depressions or pits. The female fly differs from the male by possessing a more pointed abdomen, with a very extensive ovipositor. As is the case with most parasites a large number of eggs are deposited; the necessity for this is self-evident, as many of the young larvæ do not succeed in entering the host, but perish upon the way. In some cases the flies are viviparous, and bring forth the larvæ already hatched. The more mature larvæ or grubs are thick and fleshy; instead of feet they are provided with rows of hooks or spines, which they utilize in moving about. They breathe through one or two scaly plates at the end of the body. Those larvæ that live in the stomachs of their hosts have a mouth furnished with horny hooks, which they use to cling to the lining membrane; those, however, that live in tumors under the skin have no such hooks, but possess instead fleshy tubercles; they seem to live on the pus caused by their irritating presence. The younger larvæ are quite different from the older ones, and as most of them lead a different mode of life this is but natural. All these larvæ or grubs, when mature and ready to transform, leave their hosts, drop to the ground, and burrow in the soil, where they contract into peculiar puparia, inside of which the final changes take place. Because such grubs have to burrow in the soil few city-horses are troubled with bots, as the grubs which drop to the ground with the excrement can not burrow through the pavement, and are killed by exposure and by other means before they have found such a suitable shelter. Dr. Williston, our great authority on flies, has observed how the larvæ of Bot- and Warble-flies enter the ground, and how the latter leave the tumors they have produced. He writes in the Standard Natural History:

“They have the peculiar ability to contract either end into an elongate cylindrical form, which not only serves them in their egress, but also to bore into the ground. A few days before they are ready to emerge they begin to enlarge the opening by this expansion and contraction; when they have enlarged it sufficiently, a ring-like contraction of the body

that begins at the posterior end and progresses toward the head enables them in a few minutes to free themselves, which they usually do in the morning hours. Upon the ground they creep about until they meet some obstruction, when they burrow from one to two inches below the surface, and remain as in the *Gastrophilus* species."

The bot-flies which infest domesticated animals have been transported with their hosts to nearly all parts of the globe; others are found in wild animals. These flies can be divided into three groups, according to their mode of existence: 1, *Gastric*, or grubs that live in the stomach of their host; for example the Bot-flies of the horse (fig. 175). 2, *Cephalic*, or grubs that live in the nostrils and frontal sinuses of their host; for example, the Sheep Gad-fly (fig. 181). 3, *Cutaneous*, or grubs that cause and live in tumors just below the skin; for example the Ox Warble-fly (fig. 183).

The Bot-flies belonging to the genus *Gastrophilus* are well-known parasitic insects, most of which live in their larval stages in the stomach of horses. At least three species are found in Minnesota, but as all possess a very similar life-history only that of the best known species will be given.

THE COMMON BOT-FLY.

(*Gastrophilus equi* Fab.).

The illustration (fig. 175) shows this wooly insect which resembles in many ways a common honey-bee. It has a fawn-colored face, which is covered with a silky down; the thorax is covered with reddish hairs, and has, very frequently, a black transverse band. The abdomen is yellowish or reddish-brown with irregular darker spots; that of the female ends in a long ovipositor bent around, as seen to the left of the figure, while that of the male is obtuse. The wings in this species are transparent, and have near their middle a transverse smoky bar and two spots of the same color near the tip. The fly measures from 12 to 14mm.

During the whole summer these insects can be found, but principally during July and August, when the females are most active during the warmer part of the day; they may be seen buzzing about horses, asses and mules, balanc-

ing themselves in the air with the telescopic ovipositor directed downwards and forwards. When not disturbed by the animal the female deposits an egg upon those parts of the horse most accessible to that animal's tongue, or upon the fore-limbs, knees and shanks, and this operation is repeated so that many hundreds of eggs can be found upon the same animal. Horses in stables are not molested. The egg, one of which is shown on a hair in the illustration, is at first white, but soon becomes yellowish-white, is conical, about 1.25mm. long, finely transversely striated and provided at the upper end with a peculiar cap obliquely truncated. Such eggs are fastened to the hairs at their narrower end by

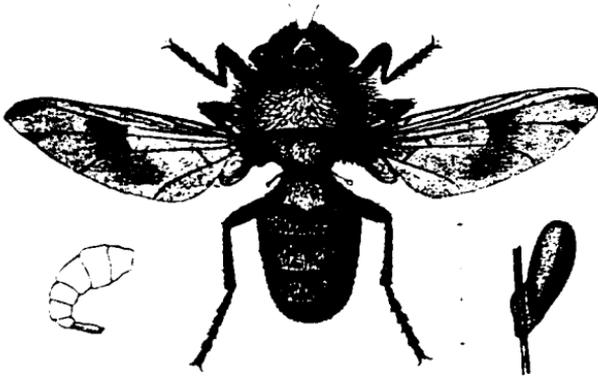


Fig. 175.—Bot-fly of horse; male; abdomen of female, and egg. Greatly enlarged. Original.

means of a sticky material, which secures them so well in position that they can not be removed simply by brushing, as has been frequently stated. These eggs soon hatch, the time varying greatly according to the climatic conditions, into very active larvæ, which, crawling over the skin, cause an itching that induces the horse to lick such places. In some cases the eggs themselves are removed by licking, and thus reach the stomach; in other cases the very young larvæ crawl into the mouth, being enabled to do so by two black hooks in the head, which are bent almost at right angles. In this manner the larvæ reach the interior of the horse, where they fasten themselves to the mucous membrane of the stomach. This is accomplished by means of hooks found upon the head of the larvæ; the head gradually sinks

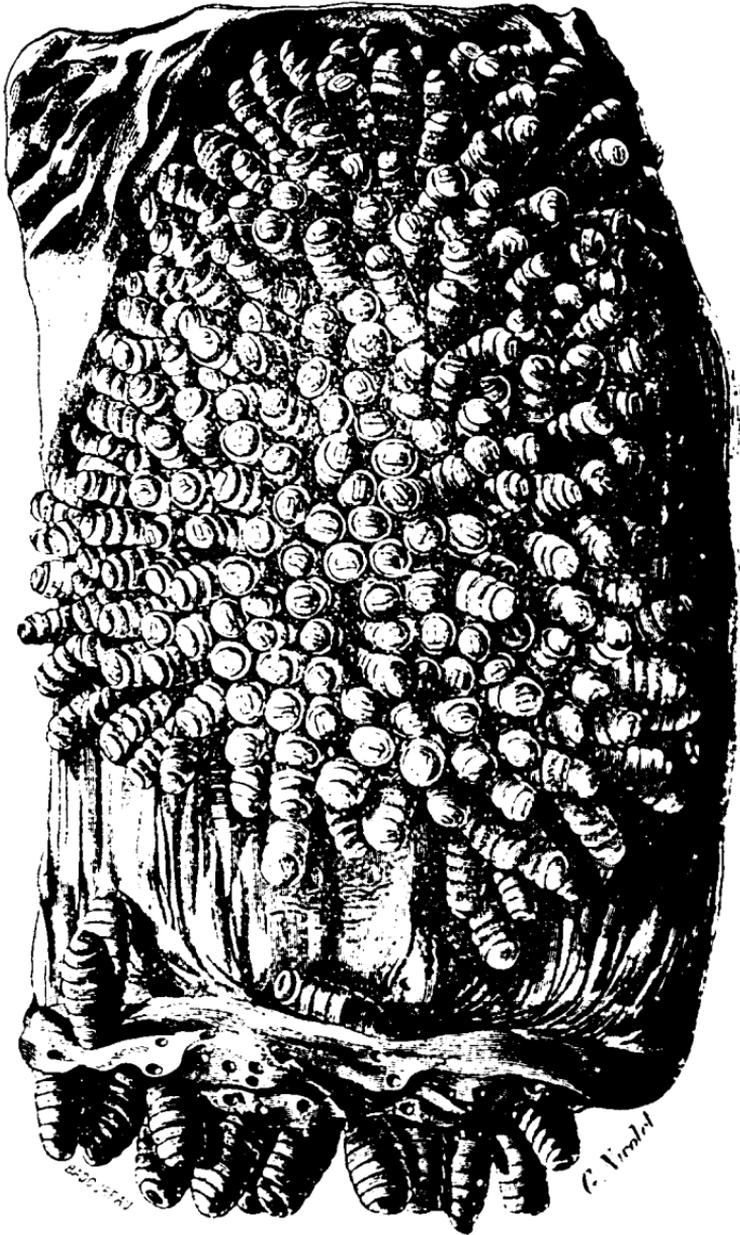


Fig. 176.—Bots in stomach of horse. Natural size. After Heller.

deeper and deeper into the alveolus that is formed under the influence of the irritation due to these hooks, and the products of the inflammation secreted by the small wound in the membrane furnish the food for these maggots or bots. Fig. 176 shows an infested stomach and also the numerous bots (as many as seven hundred have been counted in ex-

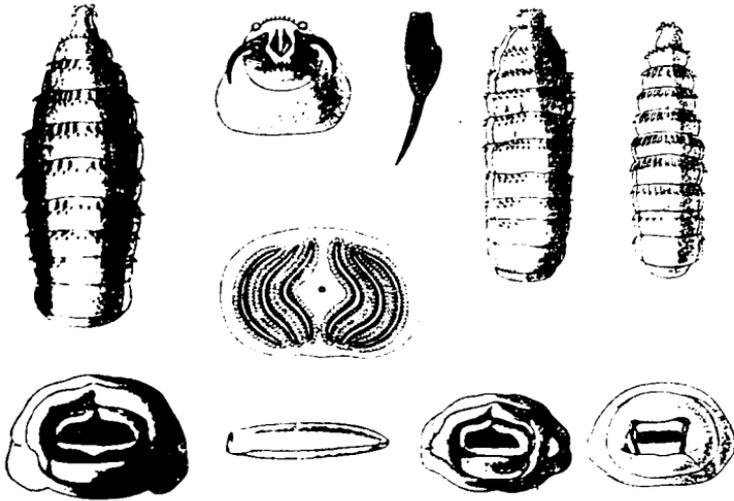


Fig. 177.—*Gastrophilus* larva; to the left *G. equi*; near middle *G. hamorrhoidalis*; to the right, *G. nasalis*; below larvae their last joints from behind. Enlarged. After Brauer

treme cases), and the little pits produced by them. These bots are, when young, flesh-colored, later they are yellowish-brown.

The larva, after moulting twice, and changing from a very long and fusiform being into one shaped like those shown in the illustration, at last reaches its full size, which takes place after having been in the stomach of its host about ten months. It now detaches itself voluntarily, and passing along with the alimentary matters is finally expelled, and in this way reaches the ground. It is at this period still quite active and is enabled to penetrate the ground to a slight depth where it gradually becomes rigid and motionless. After one or two days its old larval skin assumes a bright brown color, which later becomes darker and darker; the skin hardens and shrinks a little, and gradually assumes

the shape of a shining pupal-case, inside of which the true pupa is formed. The insects remain in this shape for about one month, when the mature winged and sexual flies force their way out of the old shell through an operculum, and enjoy for the first time after a long prison-life the light of day. To enable the flies to force their way out they possess a peculiar bladder-like organ on the front of the head, which, by inflation, swells up and thus can exert considerable pressure. It disappears when no longer needed.

In fig. 177 are shown the larvæ of our three bot-flies, as well as the hooks that enable them to fasten themselves to the mucous lining of the stomach, and the peculiar stigma at the end of the body, through which the insects obtain the necessary air.

THE RED-TAILED BOT-FLY.

(*Gastrophilus hemorrhoidalis* Linn.).

This insect was captured upon a horse in St. Anthony Park, hence there is no doubt of its occurrence in Minnesota.

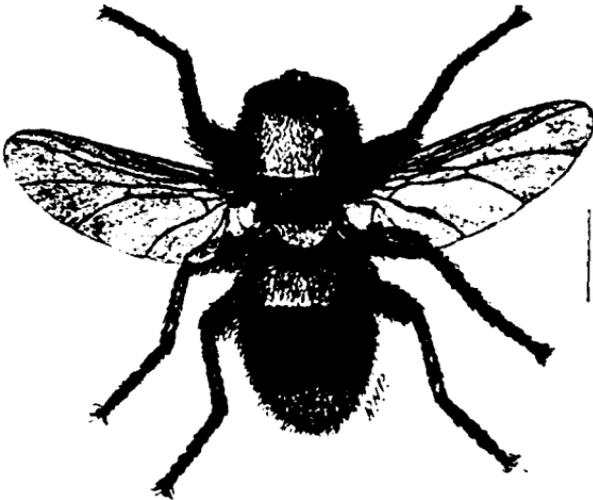


Fig. 178.—Red-tailed bot-fly. Greatly enlarged Original.

The specimen, a male, is illustrated in fig. 178. It is at once distinguished from the above species by the absence of the black spots in the wings. The face is covered with light-colored hairs, the thorax is clothed with olive-gray hairs

in front of the suture, and with black ones behind, which form a well-marked transverse band; the abdomen is covered with whitish hair in front, with black ones in the middle and with orange-colored ones behind. The fly is smaller than the one described before, measuring from 9 to 11mm. in length.

Judging from the description given of the habits of this fly it seems that they are almost identical with those of the larger bot-fly. It is stated that the female prefers to deposit her eggs on the lips of the horse, and on the long hairs covering them. This, of course, greatly irritates the animals, which is shown by their rubbing their lips against the ground, the fore-limbs, or trees. The eggs are said to be darker than those of *equi*. The adult larvæ are smaller and deeper red, and they have also the habit of remaining for some time in the folds of the rectal mucous membrane, where they assume a greenish color before leaving the infested animal. The young larvæ of this species may sometimes fasten to the epiglottis and in the pharynx, and thus can become dangerous to the horse.

THE NASAL BOT-FLY.

(*Gastrophilus nasalis* Linn.).

This species of bot-fly is illustrated in fig. 179. The upper surface of the thorax is clothed with dark hairs intermixed with others of a golden color; the anterior portion is much lighter colored, and fairly sharply separated from the darker posterior portion. The shining scutellum is of a dark-brown, bright-brown, or a chestnut color. The color of the dense hair covering the abdomen varies in the different specimens; in the example illustrated it is white on the second, black on the third, and orange on the last segments. The wings are hyaline, and small for the size of the fly, which measures from 12 to 13mm.

The elliptical white eggs are truncated in front, and are most frequently deposited upon the wings of the nose and on the lips of horses, hence the scientific name *nasalis*. Meigen and B. Clark designated this fly by such names as *salutaris* and *salutiferus*, to express the unfounded belief

that the presence of such bots had a beneficial influence upon the digestive functions. The larvæ, when mature, are of a light-yellow color, with spines white at base and dark-brown at the tip. They are distinguished from the other bot-fly larvæ by having only one row of spines at the anterior border of their segments, of which the tenth one is unarmed.

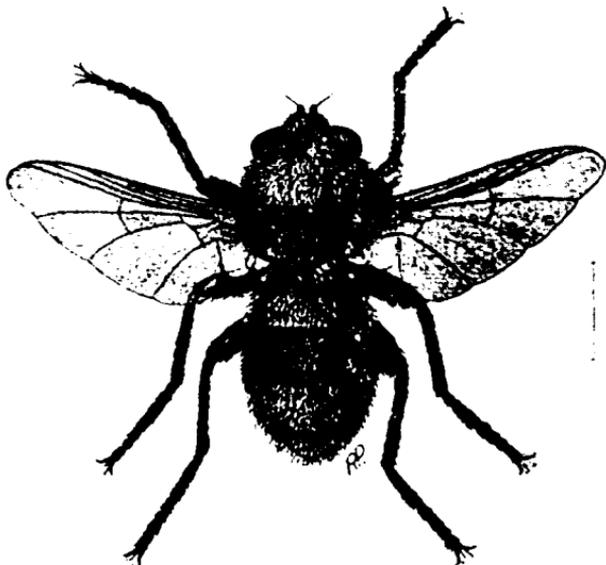


Fig. 179.—Nasal bot-fly. Greatly enlarged. Original.

They are found only in the pyloric regions of the duodenum, and they do not fix themselves to the margin of the anus before being evacuated.

If but few bots occur in the host they are harmless, but if very numerous they assuredly cause some pains, and in very extreme cases even colic; and where they penetrate through the mucous membrane into the body cavity, they cause violent inflammation and death.

REMEDIES: As these larvæ are exceedingly tough, and very difficult to kill even if immersed in fluids that would kill all other insects, and as they are well hidden in the stomachs of their hosts, all efforts to dislodge them are more or less useless. Still some veterinarians claim good results with such substances as Bryonia root, 15 to 20 grammes powdered and given in half a pint of water; or tar,

8 to 40 grammes in an aromatic infusion; or even benzine. An application of such substances may have good results, but an easy cure should not be expected. In fact Neumann arrived at this conclusion: "that agents endowed with great energy, and which arrive in the stomach without undergoing any modification, act upon that viscus, but scarcely produce any effect upon the larvæ. No medication can therefore be recommended for their destruction and expulsion." It is a very fortunate fact that they leave themselves without any medication, and that it is unnecessary to apply remedies unless the health of the animal is seriously endangered. If this should happen mucilaginous fluids should be given to allay the irritation, and the patient should be well fed to make up for the loss of nutriment caused by the bots. In the case of the *hemorrhoidalis* larvæ in the rectal mucous membrane and the margin of the anus, they should be removed by hand, or by a weak emulsion of kerosene or benzine.

Prevention is the only true method we have to combat the various species of bots, and this is not a very difficult one. The eggs are readily seen, and should be removed as soon as seen. This seems to be simple, but it requires more labor than most people imagine. To simply use a brush, or a comb, is not sufficient, since they are so thoroughly well attached to the hair that a more heroic treatment has to be resorted to. The writer has found it best to paint the eggs with pure kerosene, and to do so every day, or whenever the horse has been out-doors. This oil will kill the eggs, which soon collapse and gradually disappear. With a little care the horse can be kept free of bots, which, even if they should be entirely harmless, are not a necessity to its well-being.

THE SHEEP GAD-FLY.

(*Extrus ovis* Linn.).

This insect is a well-known parasite of the sheep and according to some authors, of the goat. It is the parent of the "Grub in the Head" and of the "False gid." As seen in the illustrations (figs. 180 and 181) it is a small fly, very rapid in all its actions, and one which when flying, is not readily

detected, hence few persons have ever seen it, and judging from the fact that it is not represented in most of the larger collections in this country even entomologists have not frequently observed it. Fig. 181 was made by J. W. Folsom from a specimen in the Cambridge museum. It resembles a very large house-fly; the upper parts of the head and thorax are of a dull-yellow color and are covered with little elevated, round, black spots and still smaller brown specks. The five-jointed abdomen is velvety and variegated with brown and yellow colors; the feet are brown; the swollen underside of the head is white; the eyes are purplish-brown; three eyelets are found upon the top of the head, and two very min-

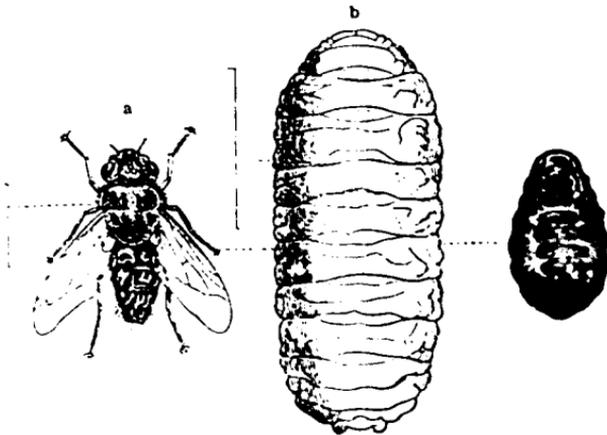


Fig. 180.—Sheep Gad-fly; *a*, adult; *b*, larva; *c*, puparium. After Brauer.

ute feelers in front. As the fly possesses no mouth it can take no food; and it is only active during the warmer days of summer, when it attempts to deposit the young larvæ in the nostrils of sheep. Of course these larvæ come from eggs that were already hatched in the oviduct. Both sexes are nearly of the same size, measuring from 10 to 12mm. in length.

This parasite is found throughout Europe, Asia, Africa, and the Americas. Very likely it was introduced into the United States with the earliest flocks of sheep; more recently it has been introduced into Chili.

The Sheep Gad-fly flies only during dry and warm

weather, from May to October; in cold and rainy days it hides near the sheep-folds and in other protected places. Like all flies of this order it delights to rest on warm and exposed rocks found in high elevations. The gravid female, approaching flocks of sheep, scares and disturbs them very greatly, and they try all sorts of ways to prevent it from depositing its young larvæ or maggots. The sheep lie down, bury their noses in the dust, huddle together, and even raise clouds of dust to deceive their enemy. But generally all their efforts prove of no avail. Just one hundred years ago Mr. Clark so well described the effects of an attack of the fly,

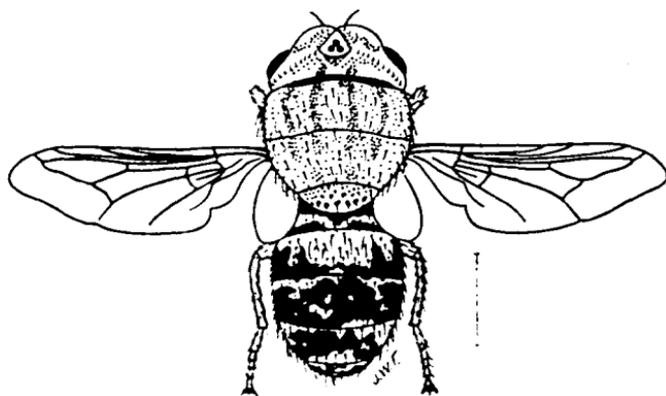


Fig. 181.—Sheep gad-fly from Cambridge Museum. Enlarged. Original.

that his words are repeated: "the moment the fly touches this part (the nose) of the sheep, they shake their heads and strike the ground violently with their fore-feet; at the same time holding their noses close to the earth, they run away, looking about them on every side to see if the fly pursues. They also "smell to the grass," as they go, lest one should be lying in wait for them. If they observe one, they gallop back, or take some other direction. As they can not, like the horses, take refuge in the water, they have recourse to a rut, or dry, dusty road, or gravel-pit, where they crowd together during the heat of the day, with their noses held close to the ground, which renders it difficult for the fly conveniently to get at the nostrils." As the gad-fly is only active during the warmer parts of the day the sheep can enjoy feeding early in the morning and late in the evening.

The young grubs, as soon as they are deposited in the nostrils of the sheep, begin their migrations upwards into the dark passages of the nose and frontal sinuses. This movement is performed by means of hooks and spines, as the maggots do not possess any legs. Of course the use of such hooks and spines is very irritating to the sheep, and the poor victims make many attempts to get rid of their foes.

The grubs remain about ten months in the nasal cavities of the sheep. During this period they undergo a number of molts; in the first stage they are white and almost transparent, and measure about 2mm. in length; in the second stage they are 6mm. in length, yellowish-white, and have no spines except a few near the mouth. In the third stage the full size and form is attained as shown in fig. 180, *b*. When mature the larvæ detach themselves from the mucous membrane, creep about, reach the nose, and are expelled by the violent snorting of their host. A day later the larval skin, which was thus far soft and of a reddish color, becomes contracted, and gradually turns brown and black, forming a puparium inside of which the future fly is formed. This pupal stage lasts from four to six weeks. If many larvæ are present they cause in the sheep a catarrhal discharge on the affected side of the nose; this is commonly known as "Snot Nose." Neumann gives an excellent description of the symptoms: "Three or four larvæ of the *Esthus* are frequently found in the frontal sinuses of sheep which, during life, have never manifested any symptoms. It is only when the larvæ are numerous, and when they are quite well advanced in their development at the commencement of spring-time, that they occasion morbid troubles. The latter begin by a discharge, often unilateral, which is at first clear and serous, then thick and mucous. Frequently there is sneezing and snorting, accompanied by the expulsion of mucus and sometimes of *Esthus* larvæ. Later the animals turn the head backward, often shake it, rub the nose against the ground or some other object within reach, or with their front feet. As the malady gradually advances the sheep go with lowered head, lifting the feet high as if they were walking in water. Sometimes they quickly raise the head, carrying the nose to the

wind, and then bend it backward convulsively. From time to time they stagger and are seized with vertigo, but do not turn in a circle. In severer cases there is difficulty of breathing, the first respiratory passages being obstructed by the larvæ or the inflammation of the mucous membrane. The eyes are red and watery. The disease may be still further complicated. The sick lose appetite and rapidly grow poor; they grate their teeth; a frothy saliva runs from the mouth; their eyes roll in the sockets; convulsions arise and finally death ensues sometimes within six or eight days after the appearance of the first symptoms.

"But the disease is rarely so fatal; it lasts longer, and the larvæ having been successfully cast out, the symptoms gradually become more favorable and by degrees completely disappear.

"This affection has sometimes been mistaken for "gid" or "turn-sick" due to *Cannus cephalis*, whence the name "false gid" or vertigo of *Astrus*, which has been given to it. Confusion will be avoided by recalling that turning in a circle does not take place in the present disease. The latter is nearly always accompanied by nasal discharges and snortings, which do not appear in true "gid," and which, besides, show themselves only in young subjects."

All interested in sheep husbandry should secure a copy of Dr. Cooper Curtice's book, "The Animal Parasites of Sheep." It was published by the Department of Agriculture in 1890, and is a very important document. In it are given a number of preventives, medicinal and surgical treatments, but the final conclusion is a quotation from Neumann, an advice sound to follow except in the case of breeders of valuable sheep. It is: "at all times, if the number of animals affected is considerable, the malady should be left to follow its own course, and those which present the gravest symptoms should be sent to the shambles."

Still there are a number of preventives and remedies that it is well to mention. Of course it is very doubtful whether remedies can reach larvæ hidden in the more remote cavities in the bones of the forehead and beneath the bases of the horns. When the grubs have entered the nostrils many can

be dislodged and removed by a feather dipped in oil of turpentine, or a weak solution of carbolic acid, or of creosote. Salt water or diluted carbolic acid solution, injected with a syringe, does good service. Finely powdered lime is also used to cause violent sneezing, thus dislodging the larvæ. Some stock breeders smear the noses of their sheep with tar, or force them to do so themselves by attracting the animal to large auger-holes in logs baited with salt, and by coating the rims with tar; still others provide in the yards dry places covered with deep dust, into which the animals can thrust their noses if pursued by their tormenters. In a few

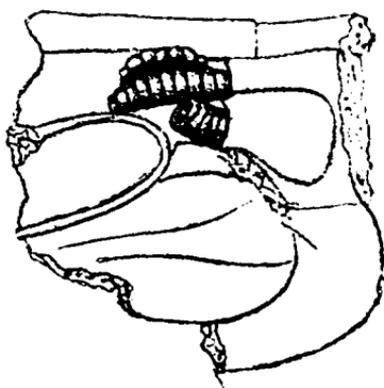


Fig. 182.—Sheep gad-fly in frontal sinuses of sheep. Enlarged. Original.

cases the writer had an opportunity to use pyrethrum or Persian insect-powder. This material was blown forcibly into the nostrils of the sheep, and dislodged a number of the worms. It can also be used as an extract in alcohol, and will no doubt be very effective, as most dipterous larvæ are very sensitive in regard to this substance.

The illustration (fig. 180) shows the different stages of this insect, and fig. 182 three larvæ in the frontal sinuses of a sheep.

There are a large number of bot-flies which exist in tumors they themselves have caused. The genus *Hypoderma* especially contains species that infest domesticated animals, hence these are best known; yet how little is really known about these parasites is indicated by the fact that until quite recently it was thought that the young larvæ forced

their way directly through the skin into the host, instead of entering the mouth and thence making their way beneath the skin, where they are found in large tumors. Dr. Cooper Curtice was the first to draw the attention of entomologists to this fact. The life-history of these insects is about like this: the eggs are deposited by means of a horny and blunt tube, the ovipositor, which ends in a trifold tip, and shows by its structure that it could not be used to perforate a tough skin; this takes place early in the season, about the time when the cattle begin to shed their winter hair, and fore-legs, sides, belly and heels are selected for this purpose. The eggs are glued to the hairs in a similar manner as was described in other bot-flies. From here they are removed by the animals, which at this period are continually licking themselves to remove the old hairs. In this manner they reach the mouth, where the saliva rapidly dissolves the hard shells of the eggs and the young larvæ already formed inside are liberated. These young and spiny worms find their way down the gullet, and after boring through its walls, wander about in the tissues of the host; when they reach the skin they form the peculiar swellings known as warbles. Here they mature, and boring their way out, drop to the ground into which they enter, and where they contract into the dormant pupal stage. In about four weeks the winged insects appear, to start again a new cycle of life. The larval stage lasts from nine to ten months; during this period and especially while forcing their way through the tissues of the host, they cause inflammations and frequently injure the animals to such an extent that they lose flesh and become very poor. They cause a peculiar greenish and slimy discoloration and appearance of the flesh of their hosts, which is termed by the butchers: "licked beef;" when leaving the skin they produce holes in it called by tanners, "warbles."

These parasites are not common in Minnesota, hence we lose but little by their injuries. But a little further south they cause immense losses, which a Chicago newspaper, that made an investigation of the amount of damages caused by this fly in 1889, stated to be \$3,337,565. This was for the markets of Chicago alone, so that the loss for the whole country must have been many times greater.

THE OX WARBLE-FLY.

(*Hypoderma bovis* DeGeer).

This species is the best known of all warble-flies and is the one most frequently described. Yet it seems doubtful whether it is found in the United States. The one that has been most usually mistaken for it is the following species.

THE STRIPED WARBLE-FLY OR HEEL-FLY.

(*Hypoderma lineata* Villers).

This species is illustrated in fig. 183. It is a very hairy insect, and characterized by four lines upon the thorax,

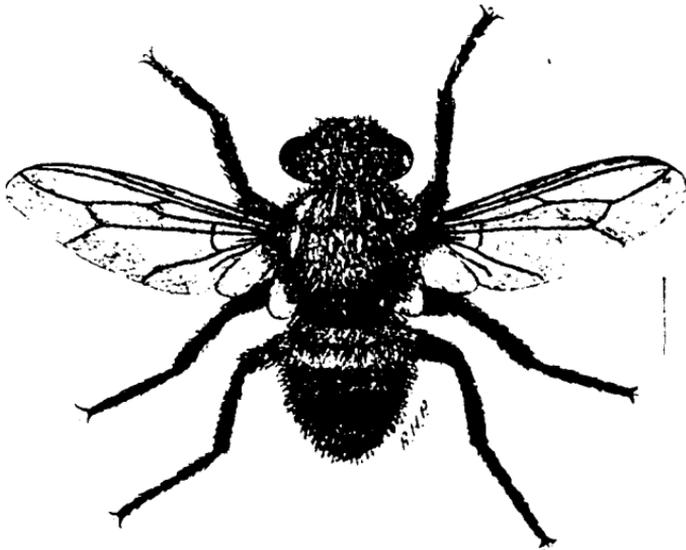


Fig. 183.—Heel-fly. Enlarged. Original.

which lines are by no means as well defined as some illustrations show them. It resembles a small black bee. The black and polished thorax is covered with yellowish-white hairs; the region about the scutellum is black, then follows a white band of hairs covering two rings of the abdomen, then a broad black band, while the posterior end is again whitish.

REMEDIES.—Here again the best remedy is prevention. The eggs can be discovered without very much trouble, at

least upon animals that are kept upon the farms. Of course cattle that have to take care of themselves all through the seasons, or in other words that are neglected, will not be benefited by any remedies and have to suffer unless we rub a mixture of pine-tar (1 gallon), kerosene, fish oil, or crude carbolic acid (1 quart), and powdered sulphur (2 pounds), over their sides, fore-legs, belly and roots of tail, which will protect them to some extent. This should be done at the time when they shed their old coats. Those animals that are kept upon the farm should be examined every day, and

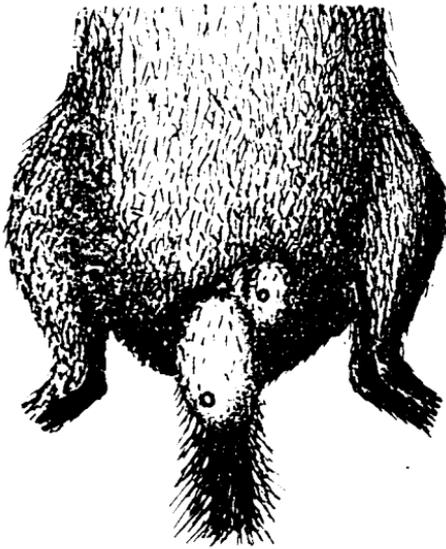


Fig. 184.—Larva of emasculating fly in striped gopher. Natural size. Original.

if any eggs are discovered they should be moistened with pure kerosene, which will kill the enclosed embryo. If such precautions have not been taken, and the tumors caused by the larvæ appear during January and February, they should be lanced, and the maggots should be removed by squeezing. By rubbing the wounds with a little carbolated vaseline they soon heal and disappear.

There is another genus of hot-flies, *Cuterebra*, that contains a number of very interesting flies, and as not infrequently letters are received asking for information in regard

to some a few words about them will not come amiss, though these flies do not injure our domesticated animals. Fig. 184 explains itself. The host is a striped gopher, which harbored three of these bot-flies, two smaller ones and one almost fully grown. The tumors made by the large one and by one of the smaller ones are shown; they are under the skin and each communicates with the outside by means of an opening. Against these openings were pressed the anal ends of the larvæ, which contained the breathing-organs. The third larva was found in the neck of the gopher. The old story told by hunters that mature male squirrels are in the habit of emasculating the younger ones, for very selfish reasons, finds



Fig. 185.—Adult of emasculating-fly. Enlarged. Original.

thus a more natural explanation. Some years ago the writer observed a fly belonging to the above genus leaving the burrow of a striped gopher. Though it is not wise to jump to conclusions, we may take it for granted that this fly is the adult of such emasculating bots. It is illustrated in fig. 185. As seen by the line giving the size of the insect it is a large fly, with a black face free from hair, large red eyes, a polished black thorax covered on the sides with long yellow hairs, the scutellum is covered with short black hairs, the abdomen is polished, of a dark steel-blue color, and sparsely covered with short black hair; only the penultimate

segment has its anterior half covered with exceedingly short whitish hairs, in which are found a few spots showing the polished surface below. The legs are black and covered with short black hairs. As it does not agree with the description given of *Cuterebra emasculator* Fitch, it deserves a scientific name and *C. sterilator* is proposed for it.

Another large fly, illustrated in fig. 186, was captured

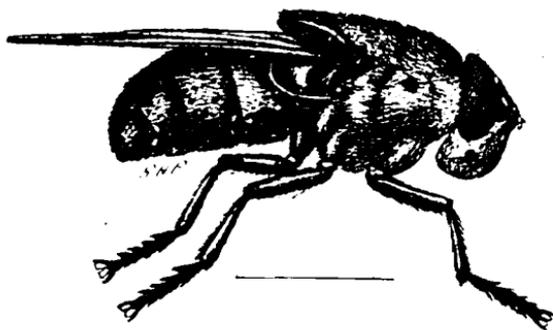


Fig. 186.—*Cuterebra baccata*. Enlarged. Original.

in the prairie region of Minnesota; it seems to be *C. baccata*, an insect said to produce the large maggots found so frequently in the neck and other parts of our three species of hares. Fig. 187 shows a still larger fly, remarkable on ac-

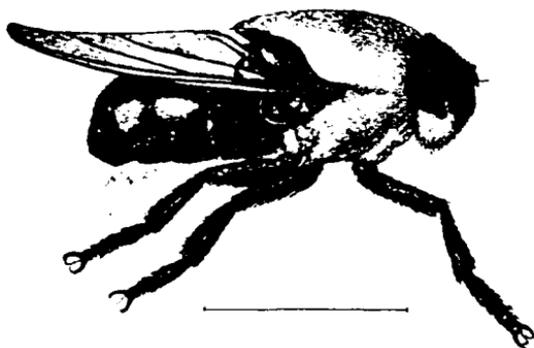


Fig. 187.—*Cuterebra horripilum* Clark. Enlarged. Original.

count not only of its large size, but also of the dense yellowish-brown fur upon the thorax. It is *C. horripilum* of Clark. Still another species, entirely black, and almost as large as the fly shown above is found in our prairies. The history of all is obscure, and possibly a number of these flies

may cause the various tumors found in our rodents, such as the hares, squirrels, and gophers. The study of such flies is a very interesting one, but for many reasons one full of difficulties, apparently unsurmountable. Many interesting facts can still be discovered in this field, and it seems strange that thus far so very little has been done in tracing the life-histories of the American species of these insects.

Many other internal parasites are found in our domesticated animals, such as *Round-worms*, *Flat-worms*, *Leeches* and others, but to discuss and describe them, and to give the proper remedies, is the work of the veterinarian.

THE SNOW-FLY.

(*Chionea vulgaris* Harr.).

It is the general opinion that with cold weather all insects disappear. This is true to a certain extent, yet there are a fairly large number of exceptions which are very interesting on account of being found at such times. As far as the globe has been explored in the north, just so far have insects been found, and not alone during summer and in well-sheltered spots but even in winter. The illustrations given in figs. 188 and 189 (plate XVI) show the male and female of a fly which is found in our state about Christmas, and as far as observed only after a fresh fall of snow. Owing to the whiteness of this material the insects are readily discovered, especially if they are moving about. As a general rule the wingless flies are found only early in the morning, though in one case a female was discovered crawling over the snow in the evening. As the illustrations show both males and females are entirely wingless and there is no trace left of the wings. The yellow halteres, however, are very large and prominent.

The insects move in a very deliberate way and are apparently not afraid of getting cold feet. As a general rule they are observed when the thermometer indicates the freezing

point, though some have been found when it was below zero and the surface of the snow was frozen into a solid crust. The long legs of the insect are very slender and it is difficult to understand why the blood circulating in them does not freeze solid when exposed to such low temperatures, especially as the flies move so very slowly. In the illustration the legs are not drawn in a natural position as this would require altogether too much space. Notwithstanding the cold it is love that brings the sexes together at this time and if a female has been discovered on the snow we usually find a male not far away. A few winters ago the writer discovered a female moving slowly over the snow and by searching he soon detected a male. Putting both together under an inverted glass the snow-flies immediately mated, notwithstanding it was several degrees below the freezing point. Soon afterward the female found a crack in the glassy surface of the frozen snow, and forcing herself into it slowly disappeared from view. Penetrating to some depth into the snow she deposited a number of elongated eggs, which, however, did not hatch. Most females found seemed to have the eggs already fully matured and only lacked to be fertilized. In despositing their eggs the female inserts them into some crack by means of a large ovipositor, very large for the size of the insect. The male also possesses some remarkable features and especially two powerful claspers at the end of the abdomen. Both sexes are shown, as well as some of their peculiar anatomical features.

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PLATE I.

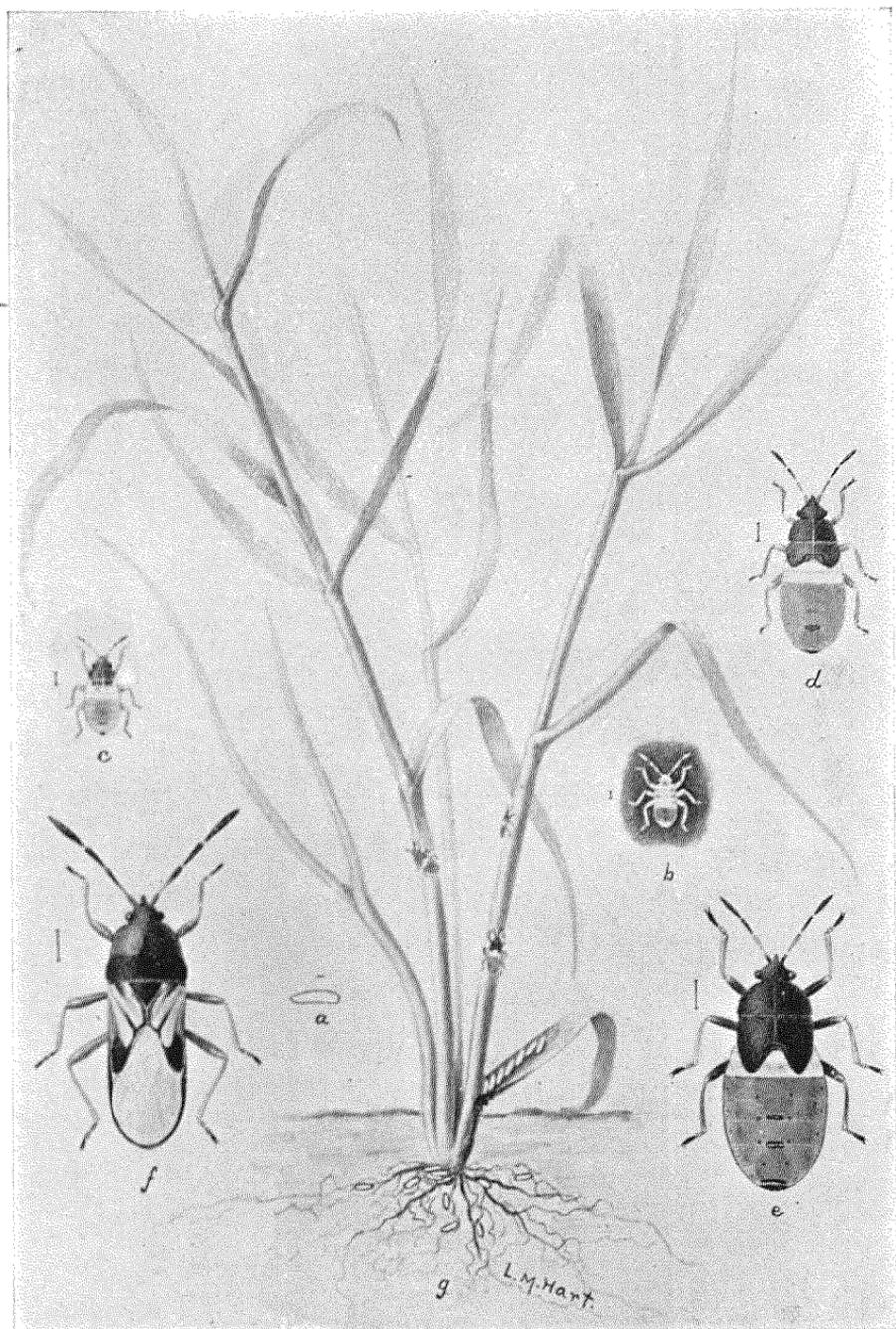


FIG. 1.

PLATE II.

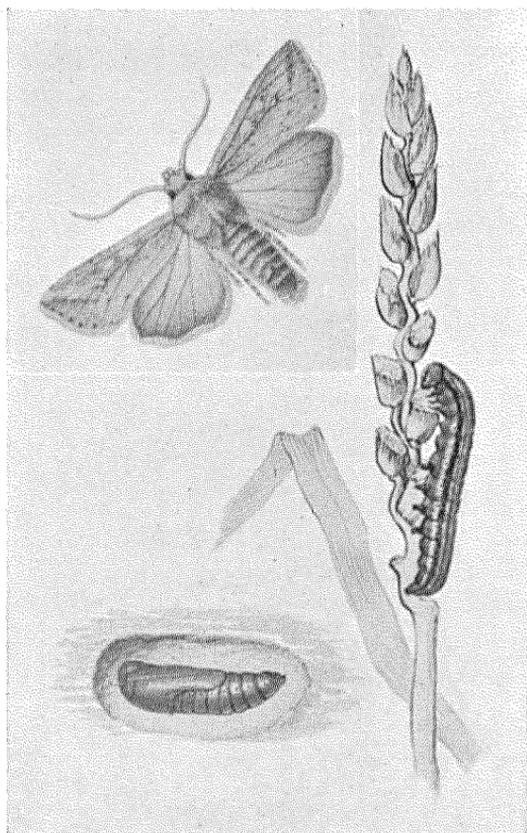


FIG. 11.



FIG. 21.

PLATE III.

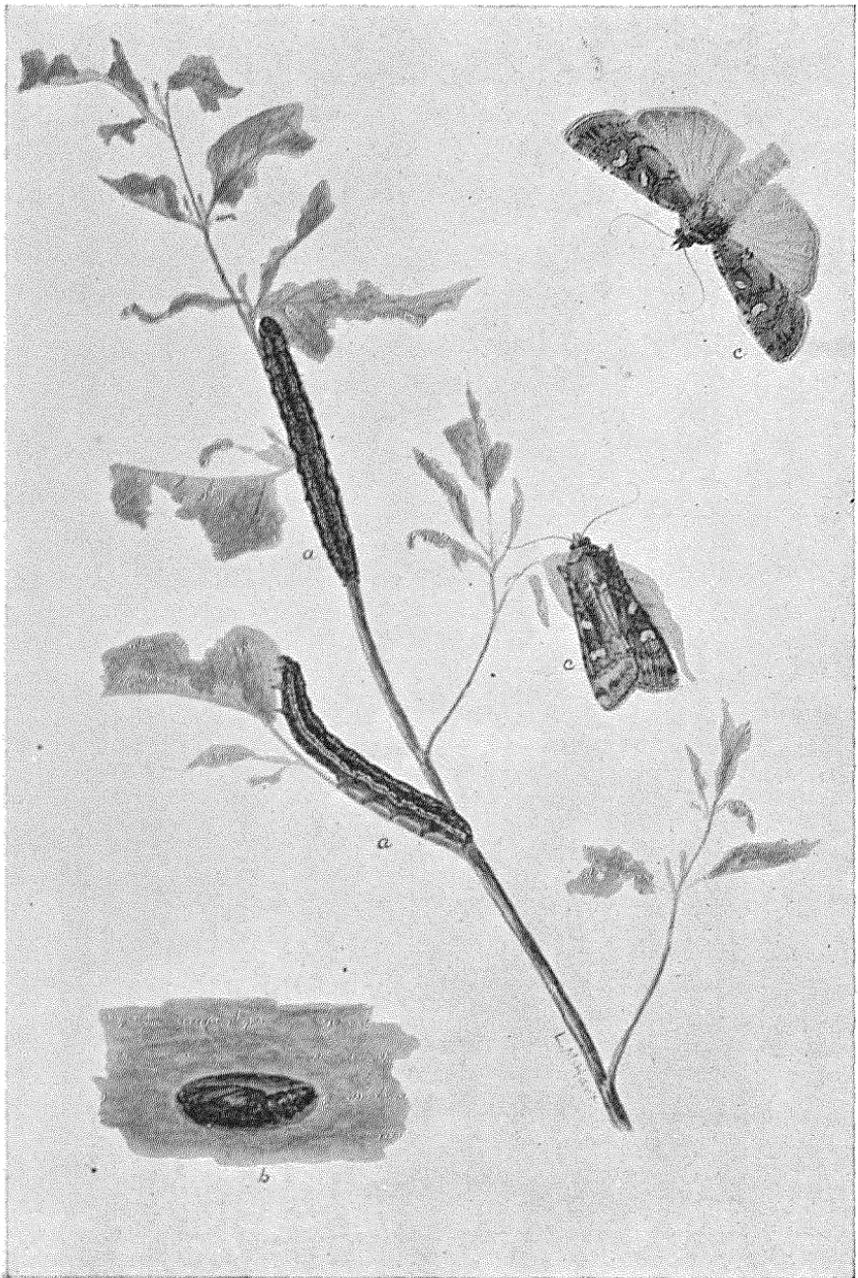


FIG. 12.

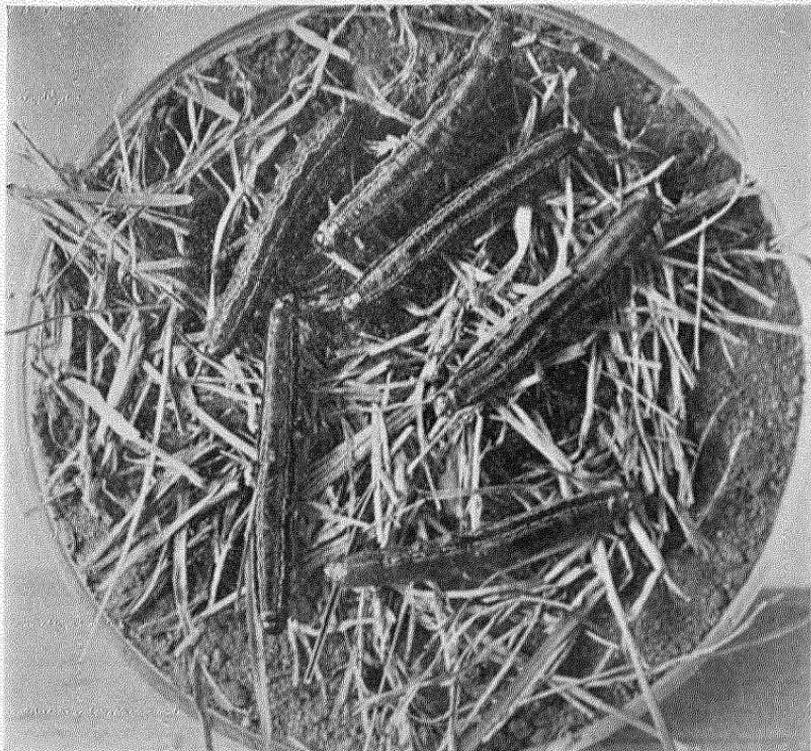


FIG. 13.



FIG. 14.

PLATE V.

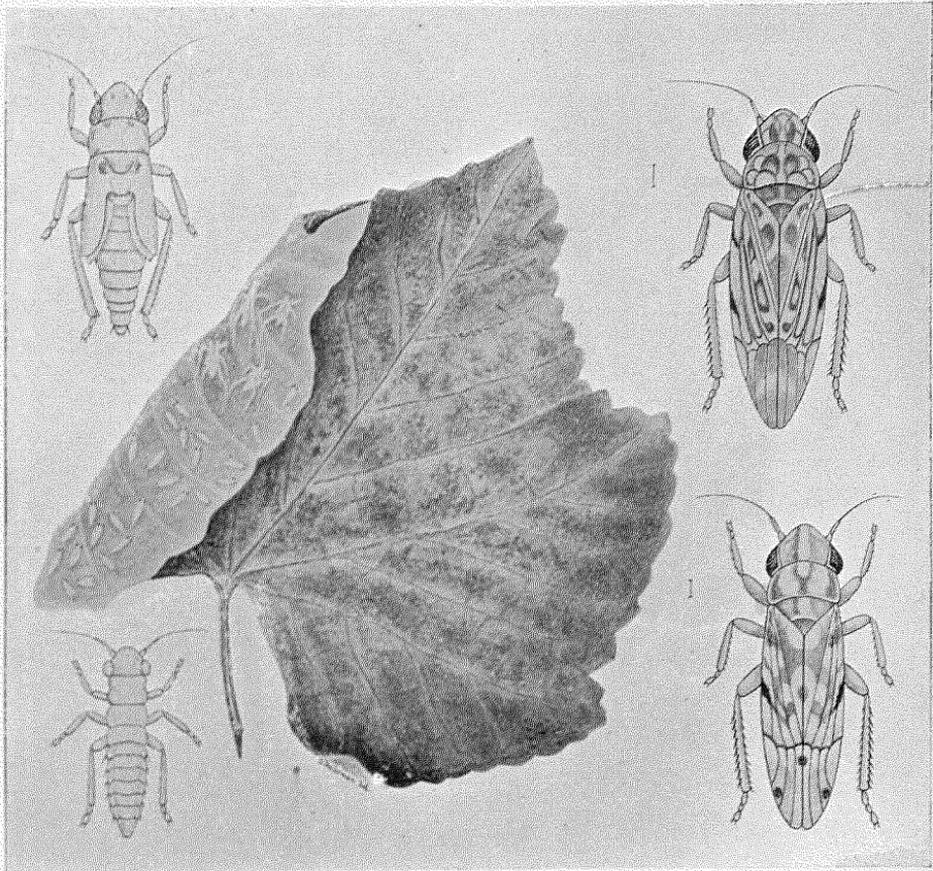


FIG. 19.

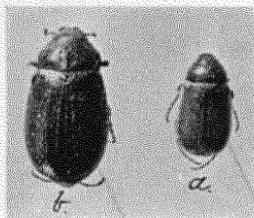


FIG. 15.

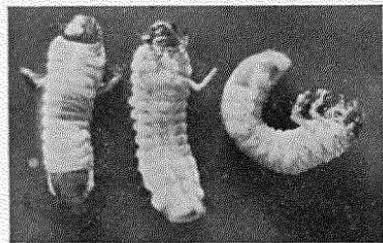


Fig. 16.

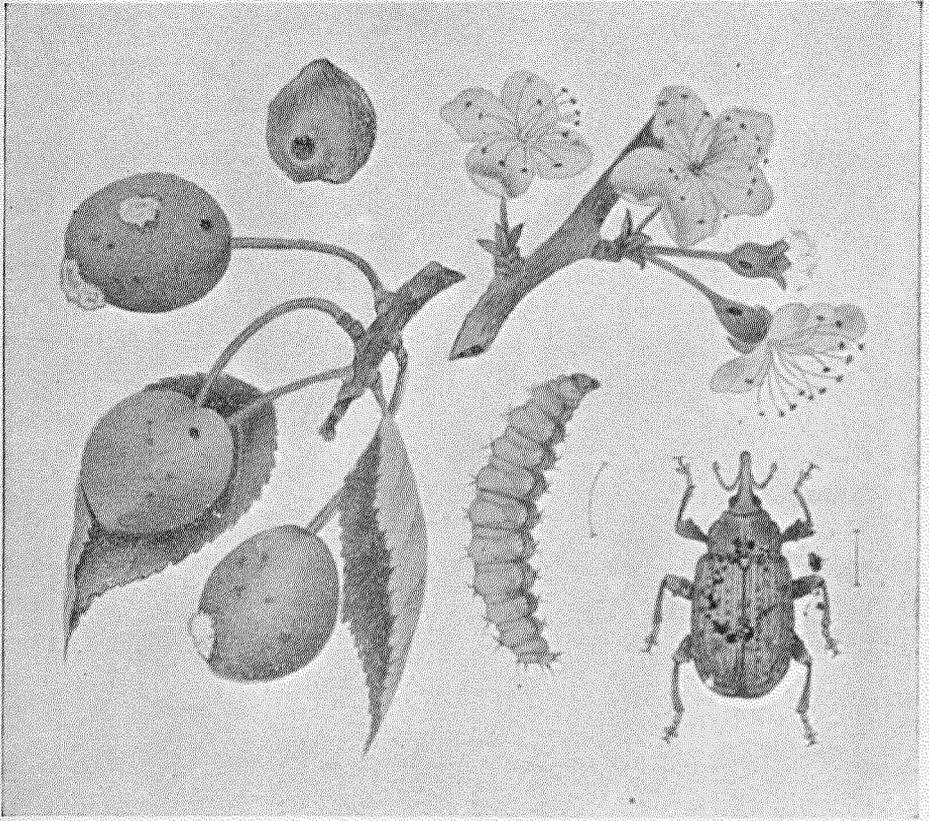


FIG. 22.

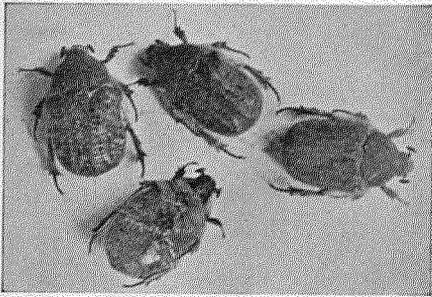


FIG. 17.

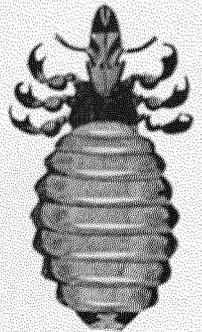


FIG. 71.

PLATE VII.

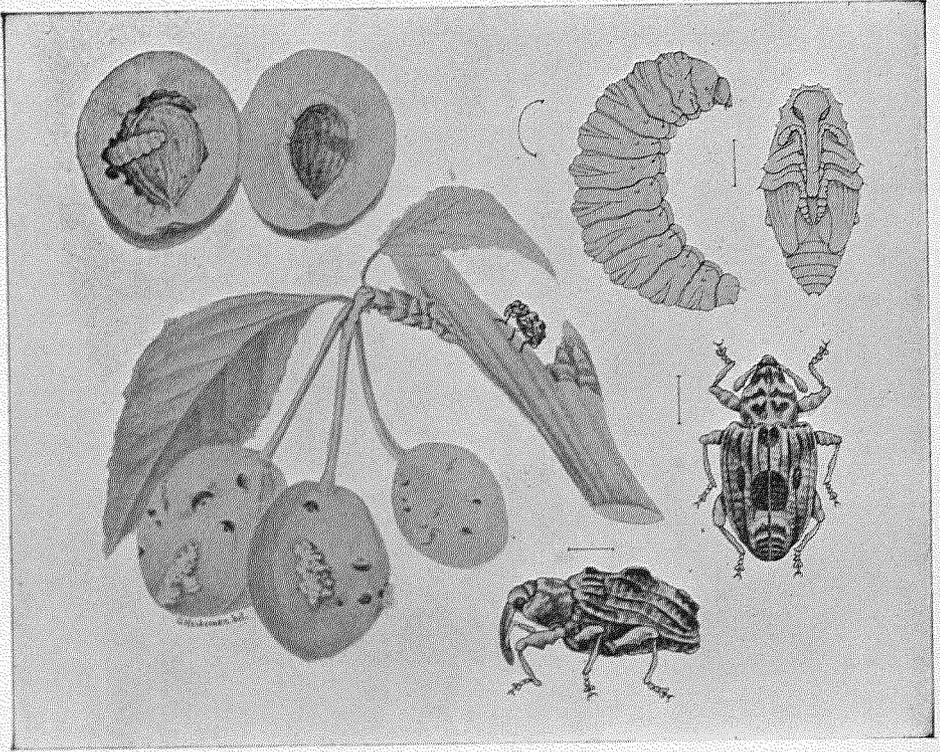


FIG. 23.

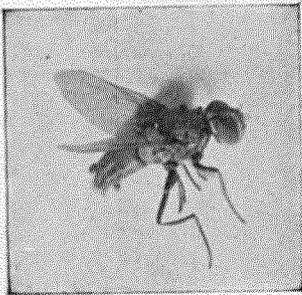


FIG. 46.

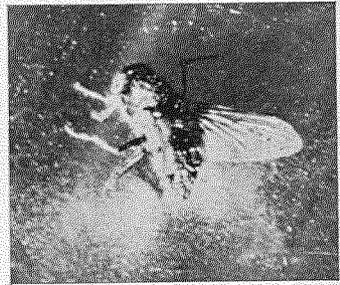


FIG. 128.

PLATE VIII.



FIG. 36.

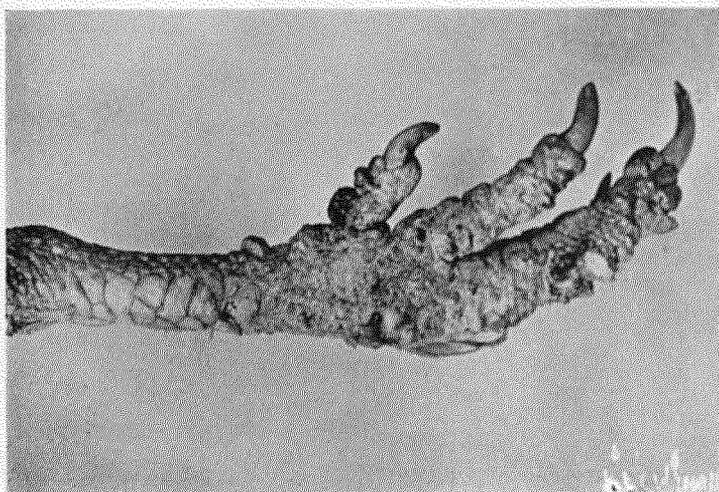


FIG. 35.

PLATE IX.

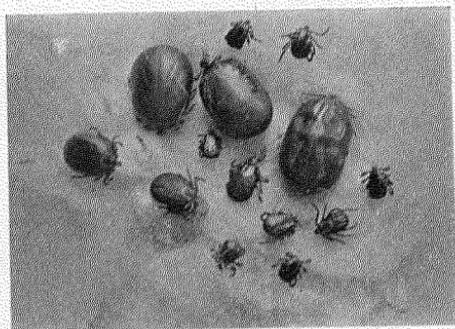


FIG. 55.

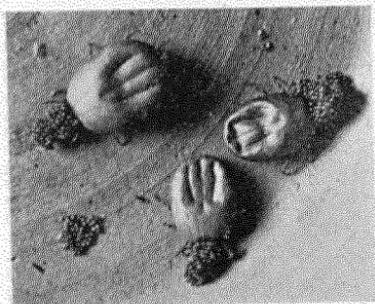


FIG. 58.

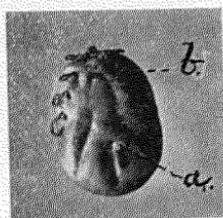


FIG. 59.

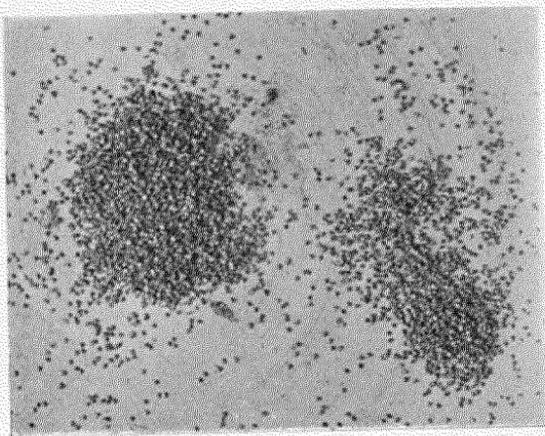


FIG. 60.

PLATE X.

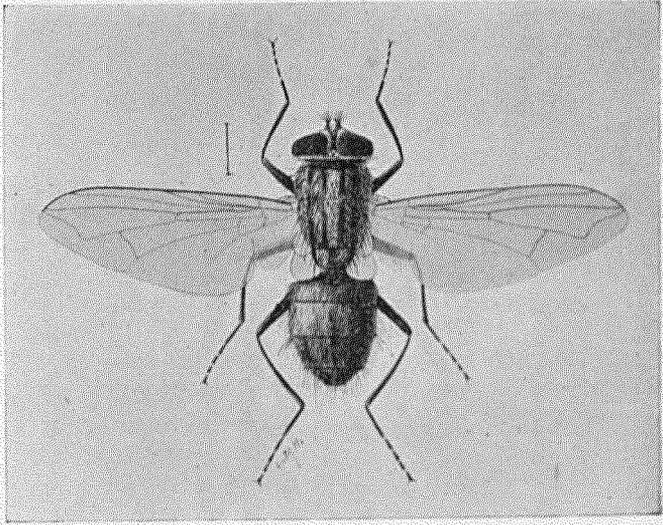


FIG. 125.

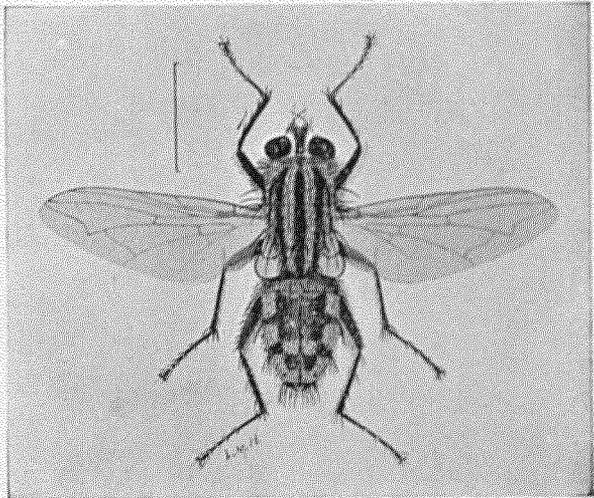


FIG. 130.

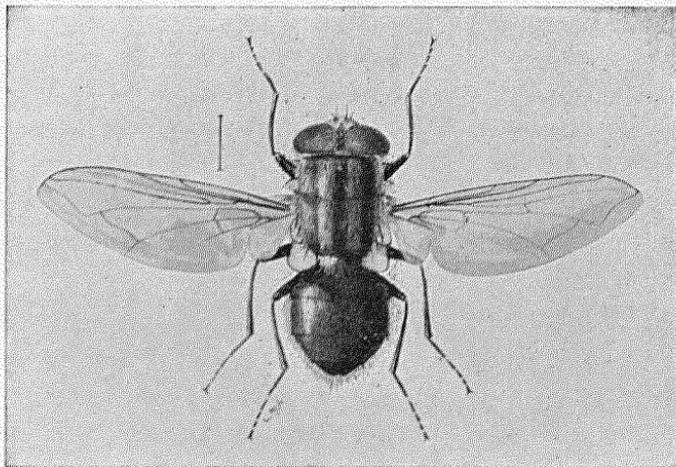


FIG. 131.

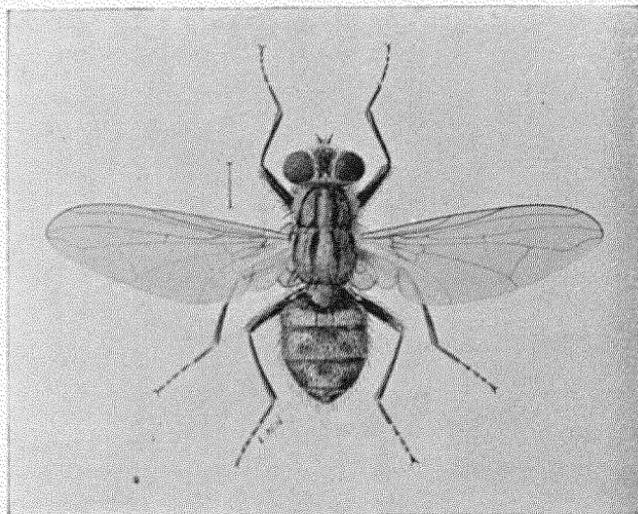


FIG. 132.

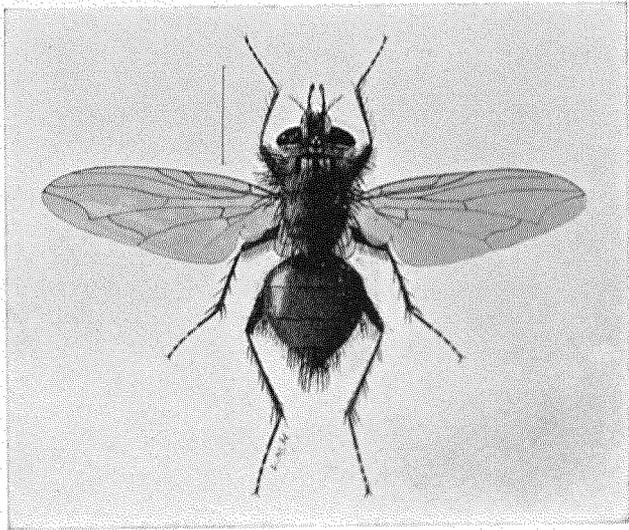


FIG. 135.

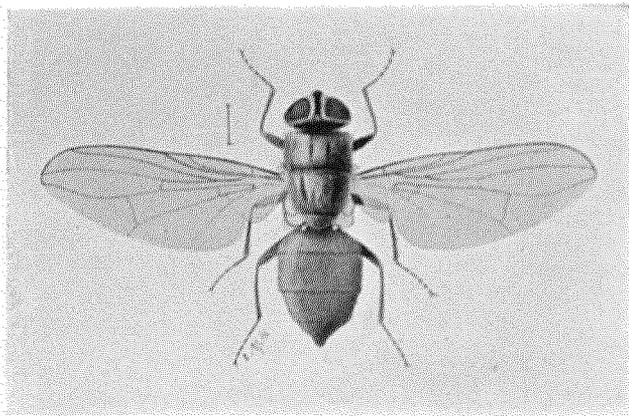


FIG. 136.

PLATE XIII.

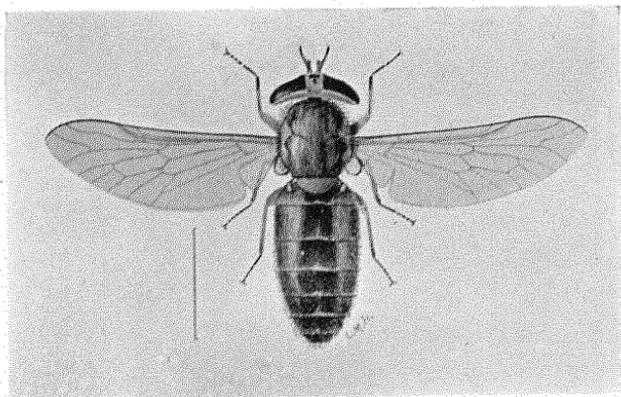


FIG. 139.

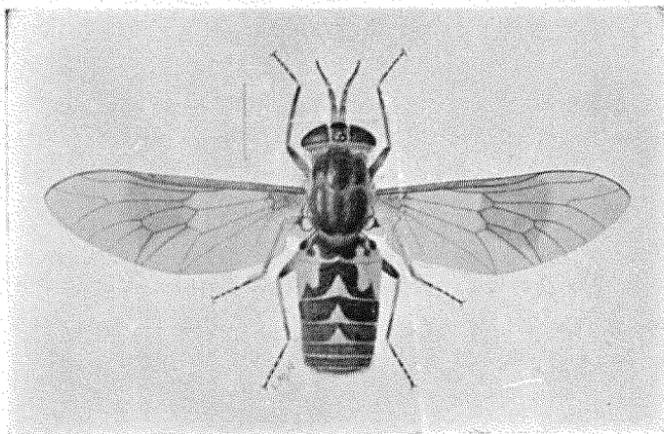
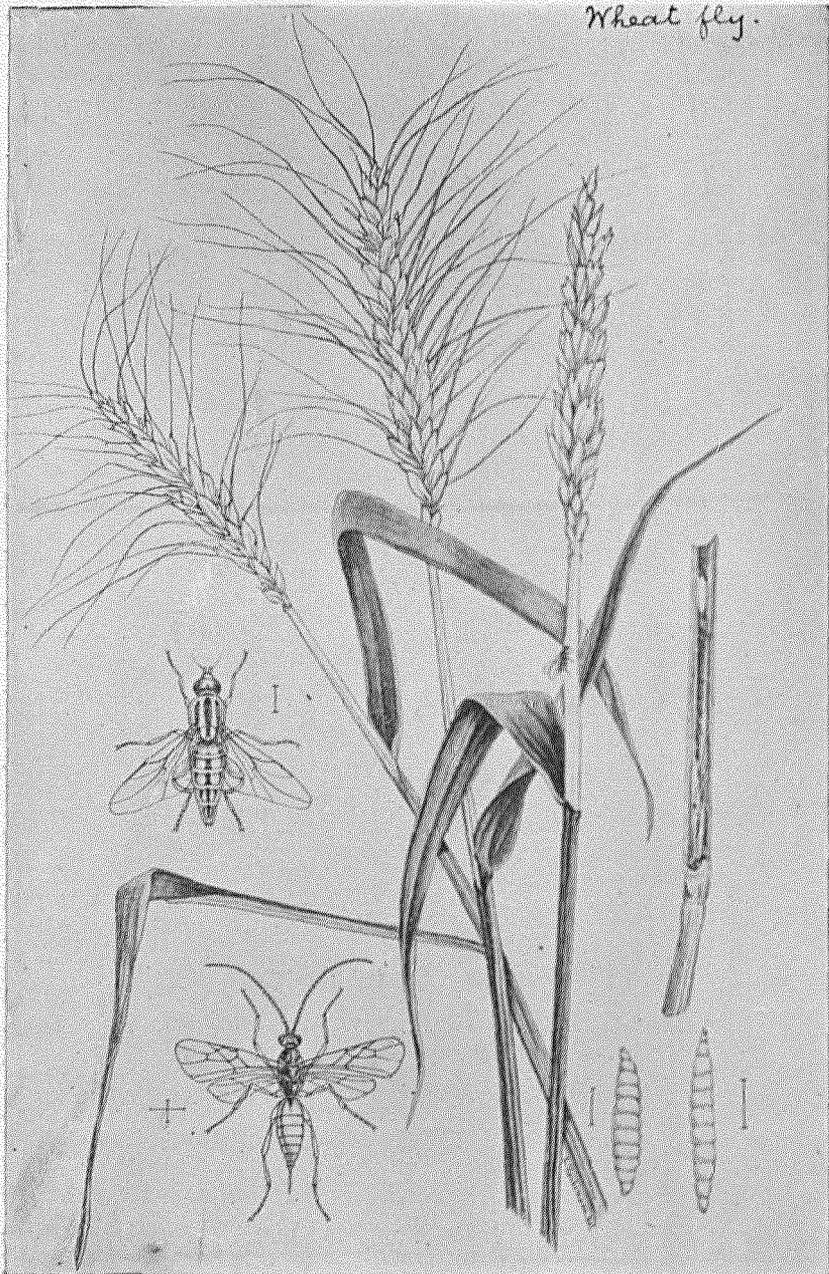


FIG. 140.

Wheat fly.



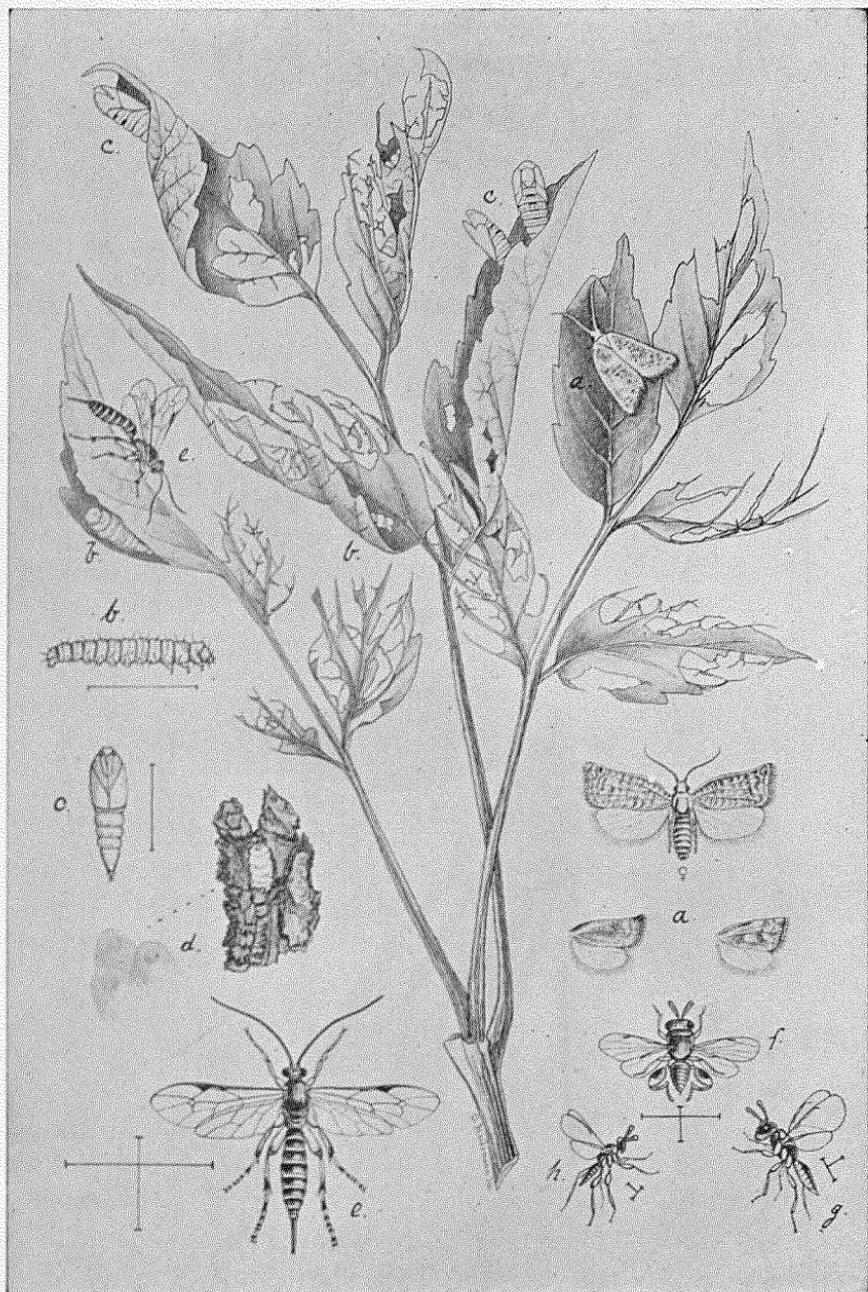


PLATE XVI.

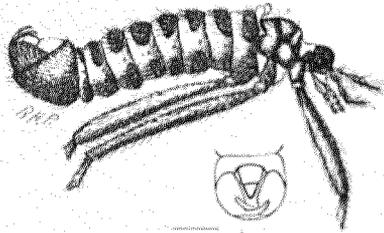


FIG. 188.

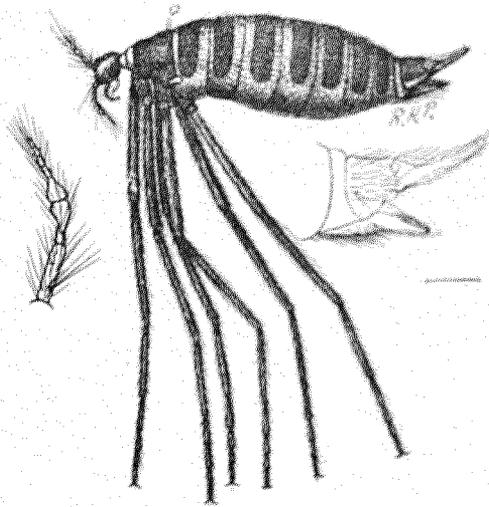


FIG. 189.

ERRATA.

Page 39, line 2, read *Cecidomyia* for *Cecidomia*.

Page 77, fig. 25 is upside down.

Page 107, under fig. 43, read original for origina .

Page 133, under fig. 75, read egg for gg.

Page 137, line 6 from bottom, read *Amblycera* for *Am-
blicera*.

Page 138, under fig. 78, read Biting-louse for Biting
l use.

Page 148, line 8, read *Lipeurus* for *Lipecurus*.

Page 154, line 4 from bottom, read *Lipeurus* for *Lipu-
erus*.

Pages 187 and 188 appear twice.

Page 202, line 2 from bottom, read fig. 143 for 145.

Page 204, line 3 from bottom, read 145 and 146 for 143
to 146.