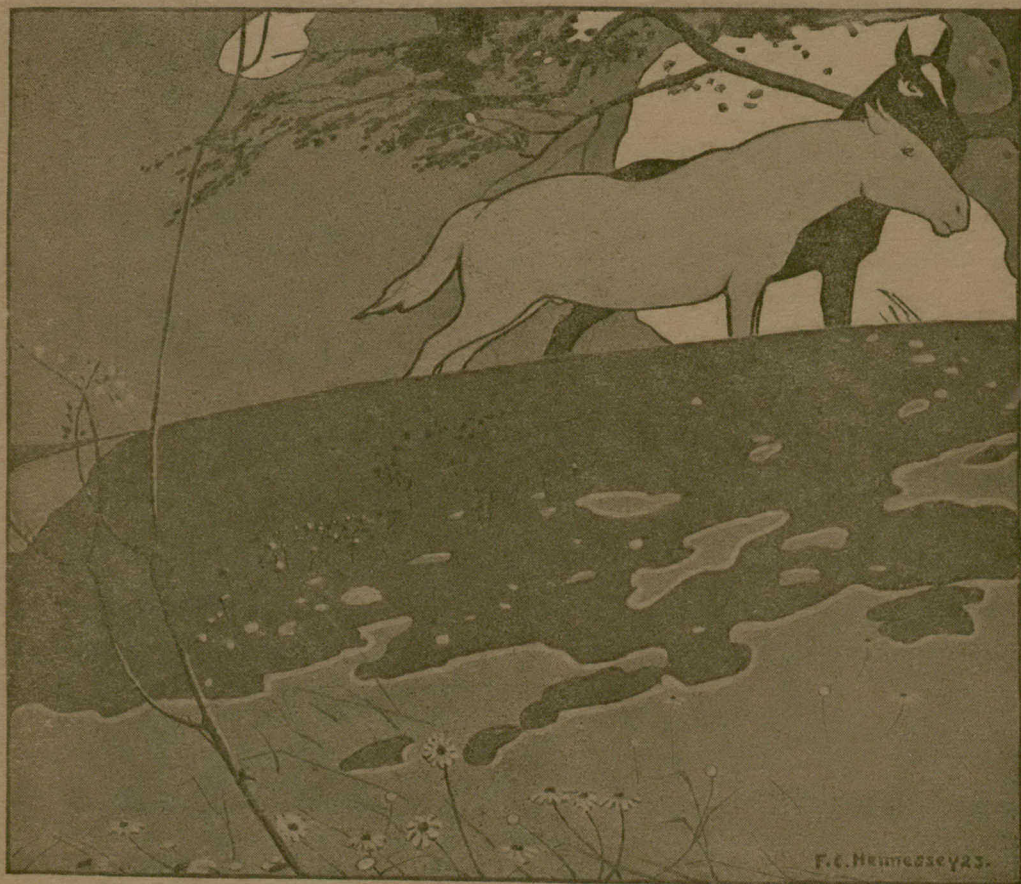


INSECTS AFFECTING LIVE STOCK.

By S. Hadwen.



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(Entomological Bulletin No. 24)

INSECTS AFFECTING LIVE STOCK

By S. HADWEN

INTRODUCTION

The insects affecting stock are of considerable interest to stockmen and farmers as they have one and all experienced trouble with them. In tropical countries, biting flies transfer several fatal diseases from one animal to another, but in Canada, fortunately, our blood-sucking insects do not carry these diseases. They are injurious principally because they suck blood from animals and the worry that follows causes the animals to become thin.

The parasitic insects which attack live stock may be divided into three groups: those which suck blood, such as horse flies; those which live in the bodies of animals during their young stages, like the bots; and those which act as mechanical carriers (or intermediate hosts) for worms and bacteria, like the house fly. The losses which occur in Canada as a direct result of insect parasites are very large. From warble fly grubs alone, 27.5 per cent of our hides are seriously damaged each year. Often insects injure the wool, the hair; others again burrow into the flesh of live animals, or spoil the dressed meat. In fact, stockmen must be continually on the watch to keep insects from doing harm. In this bulletin stress has been laid on the protection of stock from flies, not so much by the use of remedies, but by assisting them to escape from their attacks, either by housing them or by the construction of fly shelters in the pasture fields. This would appear to be the most logical way of helping them, as the expense is small and the resultant profits considerable to the farmer.

THE CARE OF ANIMALS DURING FLY TIME

Fly time usually coincides with the busy season on a farm, and it is for this reason largely that cattle are left out of doors to fight the flies as best they can. This is a mistaken policy, but it occurs even on the best farms which the average man will tell you are managed on the most approved lines. During the middle of the day, especially, when the men are taking their noon rest, the animals may be seen stamping and twitching their bodies or galloping about the fields, vainly searching for shelter from the flies.

Fly repellants and dressings of all sorts are advertised and sold to farmers, but though many of them will ward off the ordinary biting flies for a short time, their beneficial effects last for too short a period to be of any practical value. It has not been proved to the writer's satisfaction that any safe fly repellant has ever prevented cattle from running from warble flies, and, as the fear from these flies is contagious, a single fly may "stampede" a herd, so that fly repellants can only be said to mitigate the evil slightly and only for a short time. On some especially bad days, farmers have often been heard expressing the wish that someone would discover a "sure preventive" for flies, but, as stated above, even if such a thing were found the flies would still continue to annoy the animals with their attention. To explain further, the flies which pester animals all act independently of one another; each one makes a separate attack, and every one has to find out for herself (as it is only the females which are concerned in it) whether it is possible to attack the animal to suck its blood, or to deposit her eggs, as the case may be.

There is a distinction to be made at this point between the flies which breed and congregate round farm buildings, and those which breed in ponds and streams, such as horseflies, mosquitoes and black flies.

In the case of the former they can be materially reduced by following the directions given under the paragraph on the disposal of manure. In the case of the latter, with the improvements which are being made in drainage and the clearing away of timber, several species of "wild flies" will diminish or cease to be troublesome.

Milch cows, work-horses and pigs are generally kept close to the farm buildings, and a sure way of protecting them from flies is to put them back in the stable. Some farmers object to housing their animals in the day time as they claim they will have to feed them, but green feed is always abundant during fly time and the extra work of feeding will be amply repaid. Even if no extra food is given the animals will suffer less from this lack than they would if forced to fight the flies all day long. In the writer's opinion there is just as much need to house animals when they are suffering from fly worry as there is against cold weather. The animals need not be fetched after the first day or two and will return of their own accord. In the case of milch cows, shelter is an absolute necessity if the flow of milk is to be kept up.



Fig. 1—Sketch showing section of grove in which a fly shelter is located. A well made fly shelter should scarcely be visible from outside. (Original).

Young animals such as horses, cattle, and sheep are often put to graze on rough pastures far removed from the farm buildings where they may not be seen for days at a time. Dark sheds with a curtain hung over the door will provide the animals with all the protection they need. Such a shelter may serve two or more pastures if it is built at a corner intersecting the fields. In the case of bush pastures it will be noticed that the animals frequent the closest and darkest thickets where they find a measure of protection from flies. With a little axe work and a few poles nailed or tied to the standing timber to form a brush roof, and the sides thickened a little, very serviceable dark shelters

can be constructed where the animals may rest in comfort. In some districts, especially wooded areas, brush fly shelters will help in herding the animals. It is commonly known by stockmen that animals invariably seek the shelter of the timber when flies are bad. In figure 2, a clump of trees may be seen which would make an ideal shelter if the underbrush were cleared a little in the centre to make more room, and a roof and sides added. Smoke has a stupefying effect on insects, and in some localities where mosquitoes and black flies are bad, "smudges" are invaluable.



Fig. 2—Natural clump of cottonwood trees. Such clumps of trees can easily be made into fly shelters. (Original).

Lakes and streams are of service in districts where warble flies are plentiful. Cattle can protect themselves absolutely by standing in water. Range animals should never be driven or put into a corral when flies are bad, indeed they often refuse to be handled, especially if warble flies are about. Large "round-ups" must be made either before or after the fly season, though if only a small amount of work has to be done it may be accomplished in the early hours of the morning. When animals are being driven or are inside a corral they are unable to protect themselves, hence in the case of warble flies, cattle which have been handled a great deal during the summer will have a larger share of warble grubs in their backs the following spring than similar cattle which have been free.

In the preceding paragraph general statements have been made. In the accounts of each species of fly other recommendations will be suggested where remedies may be of use or where there is some weak spot in the insect's life-history which may be taken advantage of to our profit.

THE CARE AND DISPOSAL OF MANURE

Manure is a source of great profit and also of danger to the farmer. On one side he is urged to conserve it, and on the other hand he is warned about the risks he runs in keeping it. The fertility of the soil must be kept up to make farming pay. Hence, there is no further need for discussion on that point, but as many diseases and parasites are carried from one animal to another through the agency of manure, its proper disposal and application to the soil must be considered. Fortunately, there are simple and inexpensive ways of protecting stock from the dangers of manure. The following sanitary

measures will, if they be carefully carried out, reduce these dangers and also help in saving manure.

The barnyard should be tidied up and levelled. The drainage from the buildings or manure pile must not be allowed to collect in pools. Twice a week during hot weather the barnyard should be gone over and all the droppings from the animals collected and taken away. Flies breed rapidly in undisturbed dung piles, but if they are scattered and dried out the flies can no longer do so. The work of collecting the droppings is easy and takes but a short time, and it effects a decided saving in manure which would otherwise be lost.



Fig. 3—Cattle standing in water to avoid warble-fly attack. For some unknown reason the insect never annoys animals when they are standing in water. A few inches of water suffices to protect them. (Original photo by Ronald Buckell).



Fig. 4—Cattle being chased by warble-flies. It is very harmful to cattle to "round them up" or to put them into a corral when warble-flies are numerous. The animals have no chance to protect themselves, and in the year following such treatment they will have more warble grubs in their backs than cattle which have been allowed their freedom. (Original photo by Ronald Buckell).

The manure pile should be built outside the barnyard, otherwise the animals, especially the cattle, as soon as they are let out of the stable will trample it about and eat the litter which has been thrown out. If it is absolutely necessary to have the manure pile in the barnyard, then it must be fenced off. The pile itself should be well made and the sides kept square and trim. This is a very important matter as flies do not breed as rapidly in a well-packed square stack. To keep flies down to a minimum round the buildings, the manure must be hauled out frequently, at least twice a week during the hot season. A manure spreader is most valuable for this purpose, as it scatters the manure thinly and it dries out quickly. In winter, manure need not be removed as often, but it is just as necessary to keep it fenced off to prevent animals from feeding on it as it is in the summer time. Reasons for this will be given later. Other methods have been recommended for dealing with manure, but none of them, in the writer's opinion, are as safe or satisfactory as hauling it out onto the land at frequent intervals. On most farms there are one or two small paddocks or fields near the buildings where the calves or a few pigs are kept. Twice a week during the hot spells of weather a chain harrow or other suitable implement should be dragged over the grass to scatter the droppings to dry them out rapidly. In the paragraph on the protection of stock from flies it is recommended that sheds be provided in the fields as refuge when flies are bad. In and about the sheds manure will accumulate rapidly so that it is necessary to take care of it, both to keep the animals clean and to prevent the breeding of flies.

In certain parts of the western prairies, farmers have been known to stack the manure and to leave it unused year after year. This practice is bad in every respect, as enormous numbers of flies are bred in the stacks. If such farmers cannot make use of manure they should at least haul it to some waste piece of land and scatter it thinly enough so that it will dry out. Old manure stacks near the farm houses and buildings are a nuisance to both man and beast.

Flies often breed in large numbers around piggeries. Consequently, the surroundings must be watched to see that no pools of urine or manure are left exposed. All stables should be boarded up tightly so that animals, especially pigs, may not get underneath. After thoroughly tidying up, lime sprinkled about is helpful. In places where the soil has become soaked with manure it is well to spade or plough it.

The above measures are mainly to reduce house flies, stable flies and horn flies around the farm buildings, but, of course, the farm dwelling and the privies must also be attended to. The same general principles will apply.

In many Canadian cities the "cleaning up campaigns" have so reduced the number of flies that they are hardly a nuisance at the present time. It is on the farms that flies are bad, and it is only a question of time before the farmer will be forced to clean up better than he is doing in order to keep his trade in dairy products. *Therefore, it would seem opportune to suggest cleaning up campaigns wherever the farms are close enough together so that co-operative work can be undertaken.* It can safely be predicted that the farmer will profit far more from such action than the city man; yet the city man is eminently satisfied with what he has done, and it is certain that no city will ever go back to the old unsanitary methods now that the benefits from "fly campaigns" are so well known. In all sanitary work in Canada the women's clubs have taken a leading part. For some time they have been improving conditions in the farm houses, and if they will likewise extend their work to the surroundings, including the farm buildings, it is certain that a big and lasting improvement will result.

PARASITES AND DISEASES CONVEYED TO ANIMALS THROUGH THE AGENCY OF MANURE

Though some of the diseases and parasites mentioned below are not strictly speaking carried by insects, they are mentioned for the purpose of impressing stock owners with the fact that many of them are conveyed from one animal to another through the agency of manure. Many bacterial diseases such as anthrax, black leg, hog cholera, and tuberculosis, may be carried in manure. Tuberculosis is especially likely to be, as the germs are often found in cow manure. This is because tubercular cattle swallow any matter they cough up from the lungs, so that the germs pass straight out with the manure. For this reason alone cattle should never be allowed to feed on the manure pile. But there are other equally good reasons why they should not be permitted to do so.

In the colder parts of Canada, stablemen have a bad habit of using the stables as privies. The excreta are thrown out into the manure pile and cattle frequently contract measles from eating the eggs or portions of tapeworms voided by man. Ransom writing on this subject states as follows:—

“*Prevention.*—Preventive measures against *Taenia saginata* (beef tapeworm) consist in the avoidance of raw or rare beef as an article of diet. Human excreta should be properly disposed of in order to prevent contamination of the feed or water of cattle, and particularly should not be deposited in cattle barns or yards, or on the barnyard manure pile.” Human feces containing the eggs of *Taenia solium* (pork tapeworm) are equally dangerous to pigs and give rise to measles in that animal, so that there is the same reason for care in the case of pigs. According to the reports of the Canadian Meat Inspection Service, measles is much more common in districts populated by people of foreign extraction who habitually eat partially cooked or raw meat, and who are careless in their personal habits.

Worm eggs are present in the dung of practically all farm animals, much more so than in those which live in the city. The reason for this is because the animals which live on the farm are constantly exposed to infection by eating food which has been contaminated by manure. First they come into contact with manure round about the farm buildings, and secondly they pick up worms out at pasture, in the paddocks or fields which are left uncultivated year after year. These small rarely cultivated paddocks on a farm are most dangerous as regards worms, and doubly so because they are commonly infested with dung feeding beetles which also serve as secondary hosts or carriers for worms which they convey to stock.

The House Fly (*Musca domestica* L.)

It is probable that many diseases are carried by house flies to the domestic animals, but up to the present the list is much smaller than it is for man. The dangers from house flies as regards man have been discussed in many works, and as this article deals almost entirely with the parasites of animals, it is not proposed to go into detail with this question here. The works listed below* can be recommended to those who are interested in the subject. House flies do most of their own damage by mechanically transporting filthy matter from dirty to clean places. The injury done to dairy products each summer by flies is enormous, but most of it is preventable through the elimination of their breeding places and the proper screening of buildings. Though house flies do not bite, they worry animals fully as much as they do human beings by their constant attention, and their persistent return after they have been chased away. Consequently, the house fly should be added to the list of those which cause “fly worry” in stock.

* Graham-Smith, C.G., 1913, Flies in Relation to Disease, Non-blood sucking flies, Camb. Univ. Press.

Hewitt, C.G., 1917, The House Fly, Cambridge, Univ. Press.

Hewitt, C. G., 1910, The Structure, Development and Bionomics of the House Fly, *Musca domestica* Linn. Quarterly Journal of Mic. Sc., 1907-1909.

Howard, L. O., and Hutchinson, R. H., 1915, House Flies, U.S. Dept. Agr. Farmers' Bull. 679.

SUMMER SORE IN HORSES (*Habronema*).

House flies are often parasitized by worms with which they become infested while breeding in horse manure. These are the larval stages of three different species of worms (*Habronema*) which live in the stomachs of horses. The life-history, in brief, is as follows:—

The worm eggs pass out of the horse in the manure. The eggs hatch and the young larvæ search for house fly grubs into which they burrow and live, up to the time they transform into flies. A single fly may have several worm larvæ in its body. House flies are much attracted to the lips of horses and are constantly seen feeding upon them. It is perhaps at this time that the larvæ leave the fly and enter the horse's mouth. According to Ransom it is also possible that horses may occasionally swallow infested flies. When the worms reach the horse's stomach they form nodules in which they develop and reach maturity. Unfortunately, the worm has a second method of entering the bodies of horses. When an adult house fly carrying worms feeds upon the sores or wounds of horses, the worms take the opportunity of escaping from the fly and entering the flesh. If a number of young worms find their way into a wound, they set up an intense itching and horses will bite and gnaw at them until they become very large "summer" sores. The sores are frequently found round the fetlocks, but often occur on the body and may reach a diameter of six inches or more. Summer sores are common in the eastern provinces and in Manitoba.

Treatment.—The treatment of summer sores is difficult and when they are large a veterinarian should be called in. During fly time, small wounds or cuts should be dried up as quickly as possible by dusting with slacked lime or boracic acid, so that the flies will not be attracted to them. As long as flies can get at summer sores and introduce more worms, treatment will be of little avail.

Prevention by screening stables and by keeping them absolutely dark will remedy this trouble and give the animals a chance to rest during the day time. Fly screens on stables often fit badly and every time the door is opened flies get in. House flies are never troublesome in the dark, and work horses will appreciate a dark, cool stable.

EYE DISEASE OF CATTLE.

Inflammation of the eyes is common in cattle during fly time. This disease often spreads rapidly through a herd. The animals are unable to feed and suffer much agony from the sunlight. House flies are attracted to the discharges from the eyes and it is generally believed that they carry infection from diseased to healthy animals. Blindness may result in severe cases.

Treatment.—Veterinary aid should be called in for the treatment of the eyes, but to stop the spread of infection it is important to isolate the animals in dark stables until they are cured. This will serve a double purpose as in the treatment of the eyes darkness is imperative, and there will be no flies about if the stable is properly darkened.

CONTROL OF HOUSE FLIES.

The house fly has been named "domestic" because of its familiar ways and also because it sticks so closely to man and his haunts. The breeding places for house flies are almost exclusively around human dwellings and stables. From egg to egg in hot weather the life-cycle may be completed in as short a period as eight to eighteen days. Household garbage and manure are the chief substances which house flies select to breed in. The control of house flies has been discussed in the paragraph on manure and its proper disposal. There is, however, one point worth drawing attention to, which is that house

flies never cause annoyance in the early spring, and that they do not become numerous until warm weather really starts. This gives ample time for a spring clean-up of the breeding places. On the farms there is usually a little rest after the spring seeding when such work could be done.

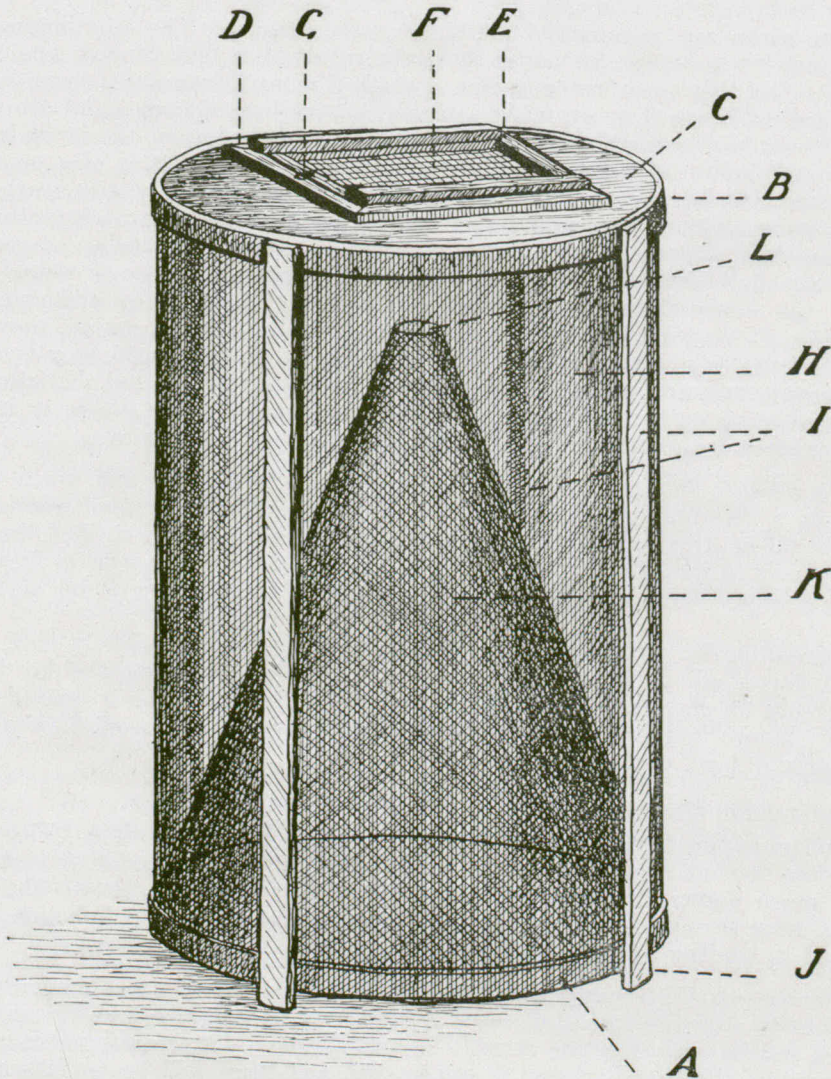


Fig. 5—Bishop's fly trap. A, hoops forming frame at bottom. B, hoops forming frame at top. C, top of trap made of barrel head. D, strips around door. H, screen on outside of trap. I, strips on side of trap between hoops. J, tips of these strips projecting to form legs. K, cone. L, united edges of screen forming cone. M, aperture at apex of cone. (After Bishop).

FLY TRAPS AND POISONOUS BAITS.

Fly screens are often badly fitting and defective, so that it is necessary to catch the flies which have got inside the buildings. Bishop has designed a simple fly trap which is very effective and easy to construct. See Fig. 5. Traps of this type are useful in barns or other buildings where it is difficult to keep out flies entirely. The most attractive baits to use are, sour milk and brown sugar, or fish and meat scraps. The baits must be renewed often. Fly papers may be used in houses or in buildings where flies are not so numerous.

Among poison baits, formaldehyde is one of the best. A one or two per cent solution of commercial formaldehyde in milk, or water, and brown sugar, will kill astonishing numbers of flies. Wherever moist poison baits are used it is important to cover up all other liquids so that the flies will be forced to drink the poison. Whenever a room or a building is partially darkened it will be noticed that the flies will congregate at any point where the light strikes. Advantage may be taken of this habit. For instance, if all the windows in a barn are covered except one, all the flies will go to it; hence, this is the best place to put out poison baits, or to trap the flies.

The Stable Fly (*Stomoxys calcitrans* L.)

The stable fly (*Stomoxys calcitrans* L.) appears early in the season and remains until late in the autumn. In appearance it resembles the house fly, but the difference is soon apparent as its bite gives quite a sharp sting. This insect annoys all the domestic animals, and man is not exempt. Cattle and horses are bitten principally on the legs, and when stable flies are numerous the animals get no rest from daylight until dark. They are constantly stamping their feet and twitching their bodies. When the house fly and the horn fly are added to the stable fly's attack on an animal then a complete picture of unrest may be seen.

Stable flies, as their name applies, congregate principally around stables and nearby buildings. When they are not sucking blood they can often be seen in great numbers on the sunny walls of the buildings waiting for animals to come near them. Pigs suffer very much from their attacks, and when stable flies are numerous endeavour to protect themselves by lying in holes in the ground or by burrowing under buildings. In the darkness or deep shade the flies cease to annoy, so that the same measure advocated for the house fly and the horn fly should be followed. In the case of work horses canvas trousers may be used. The canvas need not come much higher than the knees or hocks as the flies bite low down on the legs. The stable fly breeds in horse's manure principally, but recently Bishopp has proved that it may breed around the moist edges of straw stacks and in other decaying vegetable refuse. The same advice which has been given about the building of the manure pile can be followed, which is to make the stacks as square and as straight sided as possible, to prevent the flies from breeding round the edges.

The Horn Fly (*Lyperosia irritans* L.)

These flies are most abundant during the hottest weather and attack cattle principally. The horn fly, when it is not feeding, often rests on the base of the horn. This habit has given it its name. The reason for this peculiarity is no doubt because it finds that in this situation it can remain undisturbed. At other times the fly rests on the hairs, generally on either side of the withers. The insect sits near the extremity of the hairs with its head pointing outwardly. Usually, the flies congregate in clusters and stay with their hosts very persistently, even when cattle are put into the stable, during the day time, the horn fly is apt to go in with them. Inside the stable they do not appear to annoy the animals, however. They merely seem to rest on them. According to Fletcher, the horn fly was introduced into Canada in 1892, and crossed the continent in 1903. When first introduced it caused great alarm among cattlemen; now it is not spoken about so often, though the damage it does cannot have been materially lessened. Oily dressings applied to the withers will keep the flies off for a time, but oily applications to the skin in hot weather are not pleasant for the animals. Dark stables or shelters for the cattle to go into is the very best way

of protecting them. The fly can be greatly reduced on a farm if the cow pats are scattered so that they will dry out. This must be done at least twice a week in hot weather. The fly lays its eggs in fresh cow manure and the larvae develop in it, but if the manure dries out when the grubs are in a young stage they will die.

Horse Flies (*Tabanus*, *Chrysops*, *Hæmatopota*)

There are many kinds of horse flies in Canada, commonly known as "bull dogs" and "deer flies." Most of the species differ from each other in appearance, but they have one feature which is common among them—their eyes show rainbow colours. Sometimes the eyes are banded, at other times spotted or lined. Horse flies lay their eggs on the leaves of aquatic plants, or on trees and rocks near water. The larvae are carnivorous and feed upon the small invertebrate animals which occur in the soil or water. According to Hine the large horse flies (*Tabanus*) may require as long a period as two years to complete their life cycle. The biting habits of the insects vary greatly. Some bite the abdomen almost exclusively, others seem to prefer the face or other parts of the body. Generally speaking, the small species are the most annoying to stock. The larger forms, perhaps owing to their size, alight very gently on the animals, and their bites seem to inflict less pain than the smaller species; at any rate they often appear to be unnoticed by the animals. One fortunate characteristic of horse flies is that they are shy as a rule, and if a horse whisks his tail they will fly away in a hurry. It is true that they come back almost as fast, but usually animals can protect themselves better from horse flies than they are able to from bot flies, black flies, or mosquitoes. Horses are the worst sufferers from horse fly attack, especially when they are in harness, or under saddle. Thin-skinned animals feel the bites more acutely than do thick-skinned ones. Cattle are heavier in the hide than horses and being less sensitive, often appear indifferent to their bites, unless they are very numerous. The writer has found by a study of horse flies in one district, covering a period of years, that each species has a regular season of its own. In some cases the appearance of two or three varieties may coincide, but they do not all come at once like the black flies or mosquitoes.

Protection of stock.—Nets and canvas coverings are a great help to horses when they are at work; in fact, it is the only way of protecting them satisfactorily. Fly repellants are of very little use, and only protect for a short time. Darkened shelters are most helpful to animals, and are only required during the heat of the day, because the flies are not active until late in the morning and usually disappear soon after sundown.

Black Flies (*Simulium*)

Black flies breed in swift running water. The larva attaches itself by a sucker to stones; it has two conspicuous head fans used for collecting food. Cameron has found in Saskatchewan that the flies take about six weeks to complete their life-history. He states that swarms of black flies issue from the rivers from about the middle of June until September. "Swarming may occur at any time of the day in the open prairie, where cattle and horses are grazing, and the animals are often enshrouded in a shimmering haze of flies, especially when the weather conditions are bright and warm."* Cattle appear to suffer more from black flies than other animals. The regions of the body selected for attack are principally the head, fore-quarters and under surface of the belly. Large oedematous swellings of the nostrils, eyes, and brisket arise. Owing to the irritating effects of so many bites around the nostrils, the animals snort, take deep breaths, and sometimes inhale large numbers of flies. These apparently

*Cameron, A. E. Morphology and Biology of a Canadian Cattle Infesting Black-fly. *Simulium simile* Mall. Bull. No. 8. Entom. Br. Dept. of Agr., Canada.

irritate the air passages and cause them to cough. When a large swarm of black flies envelops a herd of cattle the effects are sometimes disastrous and many cattle die apparently from suffocation. The fatalities occur very quickly at times, and in Saskatchewan there have been a number of what would appear at first sight to be outbreaks of a suddenly fatal disease. The swarms when they appear quickly may not at times be noticed by those in charge of the animals, and perhaps they will not realize there is any danger until they find some of them dead. The distribution of certain species of black flies is uneven in Canada and there is a great seasonal variation in the numbers.

Control.—Phinotas or other miscible oil, which has the property of mixing with water, is a valuable larvicide. The oil may be poured into the water at the head of a small stream, and as it flows down stream it kills all the larvae it touches. Unfortunately this method is inapplicable in large rivers.

Protection of cattle.—Quick action is necessary to protect stock when a large swarm of black flies arrives. The easiest and best method is to make smoke "smudges." Once the animals have found relief from smoke they will return to the same spot just as soon as the flies become troublesome, expecting to find the "smudge" in operation. Therefore, the place chosen for the "smudge" must be somewhere in easy reach of the farm buildings, and it should be the special duty of one person to see that the fire is kindled just as soon as the cattle require protection. Oiling the skin is a protection for working animals; raw linseed oil or kerosene emulsion are recommended. The oil should be used on the lower parts of the body, such as the chest and belly, as it is not safe to apply oily preparations extensively, and especially to the back in sunny weather.

Mosquitoes (*Culicidae*)

Mosquitoes in their early stages require water for their development. It will be found in those seasons when mosquitoes have been especially bad, that their appearance has generally been preceded by high water in the rivers. Overflow waters are well suited for the development of mosquito larvæ. Many people believe that mosquitoes breed very rapidly, but some species at any rate, have only one single generation each year. In northern latitudes there are only a limited number of different kinds of mosquitoes, but what they lack in variety of species they make up in numbers. Northern mosquitoes appear as "wrigglers" in melting snow water in the spring and emerge full grown during the latter part of June. July and August are the worst months for them. Cameron has found a similar life-history on the prairies. He says that the eggs are laid in the summer on the ground and that they hatch the following spring in the snow water. This explains the swarms of mosquitoes which are sometimes found in districts which are comparatively dry in summer. Mosquitoes also make long flights, and the prairie forms appear to be long lived.

Mosquito control.—As mosquitoes require water for their development, the drainage of the pools in which they breed will eliminate them entirely. This has been done in many instances and has proved highly successful. Whenever the expense of draining is too high or impracticable, then oiling the surface of the water with kerosene or crude oils is of great value. The "wrigglers" come up to the surface of the water to get air, but if it is covered by a coating of oil they are unable to do so and die. The oiling of ponds is recommended near towns and villages providing that the area of water which has to be covered is not too extensive.

Injury to stock.—If dairy cows are left out of doors when mosquitoes are numerous they become dry in a short period. Other classes of stock lose flesh through loss of blood and worry. In extreme cases animals have been known to die from mosquito attack.

Protection of stock.—It is very difficult to suggest any system of protection against mosquitoes which is really effective. They bite day and night and will enter buildings and get under coverings, so that the animals can hardly escape them. Smoke is perhaps the best protection for stock, but the "smudges" must be kept going continuously when mosquitoes are numerous. For horses, fly nets are useful during work hours. In addition to screening the stables, the buildings may be filled with smoke after the animals are tied up.

Horse Bot Flies

Three different species of bot flies are parasitic upon horses, *Gastrophilus intestinalis* De Geer, *G. veterinus* Clark and *G. haemorrhoidalis* L. Each species has a different habit so they must be described separately.

THE COMMON BOT, *Gastrophilus intestinalis* De Geer.

This fly is the largest of the three and also the commonest. In colour it is a brownish grey with dark smoky patches on its wings and a bald, whitish face. When preparing to attach its eggs the insect assumes a V-shaped position. Its large ovipositor or egg-laying tube is bent upward giving the insect its peculiar shape. The eggs are attached one after another on a hair and are

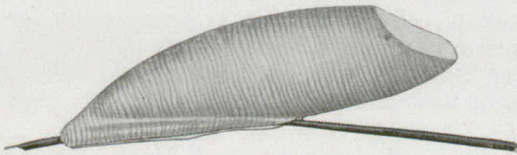


Fig. 6—Egg of common bot fly, (*Gastrophilus intestinalis* DeGeer). Colour yellowish white. The eggs may be found on almost any part of the body, but are especially numerous on the fore legs. Greatly enlarged. After Hadwen and Cameron).

cemented on very firmly. So strong is the attachment that brushing or rubbing fails to remove them. The eggs do not hatch of their own accord and it takes friction, heat and moisture to remove the egg cap and allow the young grub to emerge. The egg is attached for about two-thirds of its length to a hair. The capped end of the egg projects out from the hair at an angle of about 30 degrees. It is probable that this formation is a help to the larva in sticking to the horse's mouth or lips. If the egg was absolutely parallel to the hair the grub would not perhaps be able to leave it so easily. When a horse licks, or rubs, its lips on its legs the grubs come out of the eggs and adhere to the rough surfaces of the tongue and mouth. As soon as the larva finds itself in the horse's mouth it begins at once to work, and probably burrows its way under the surface of the tongue. Those who are interested and wish to confirm the above statements may do so by placing some bot eggs in the palm of the hand, applying a little moisture and then rubbing them with the fingers. The young larvæ will come out of the eggs and can be seen with the naked eye wriggling about in the moisture. In the series of joint experiments made with Dr. A. E. Cameron, of the University of Saskatchewan, the writer found that newly hatched bot grubs when placed on an excised piece of horse's tongue were capable of burrowing under the surface, the shortest time being about two and one-half hours. Roubaud, in France, obtained similar results with a guinea pig host. Up to the present it is not known exactly how the bot larvæ reach the stomach. For a long time it was thought that horses licked the bot eggs and swallowed the young grubs, and that they attached themselves as soon as they reached the stomach.* Now that the grubs have been seen burrowing under the surface of the tongue it seems probable that another path is chosen by the grubs to reach the stomach.

The regions in which the eggs of *G. intestinalis* may be found are principally on the shoulders, mane, fore legs (especially on the long hairs situated on the inside of the leg), and around the fetlock. Eggs are also found on the hind legs but do not occur in such numbers as they do on the fore legs. What makes horses lick their legs?, is a question which is often asked. Bracy Clark, when he studied this question at the beginning of the last century, thought that the biting of other flies caused the horse to lick the eggs. This may be correct in some instances, but the irritation caused by bot flies in attaching their eggs to the hairs is quite sufficient to make a horse rub its legs with its lips. *G. intestinalis* is the commonest of the three bot-flies and has the widest distribution in Canada. About nine to ten months in the year are occupied by the larvæ inside the stomach of the horse. The grubs attach themselves by their mouth hooks near the pyloric or exit end of the stomach. When full grown the grubs loosen their hold and pass out with the droppings. In about six weeks they emerge as flies ready to lay eggs. It is common occurrence to hear farmers say that they have seen the stomachs of horses half eaten away by bots. This mistake arises from the fact that the lining of a horse's stomach is divided into two parts normally; the lining at the end next to the gullet is white in colour and the other end is covered by a soft reddish mucous coat. Another idea is that bots make deep holes in the walls of the stomach. This is not correct because the bot larva attaches itself to the stomach and the wall of the latter raises and swells round about the bot, which gives the impression that the walls have been punctured. The formation is in reality similar to that of a crater.

THE THROAT BOT (*Gastrophilus veterinus* Clark).

This bot fly is a trifle smaller than the preceding species. It has clear wings and a red-coloured chest or thorax. The abdomen is black and is partly covered with whitish hairs with a conspicuous black band in the centre. The eggs are laid almost exclusively on the hairs between the jaws of horses. The fly

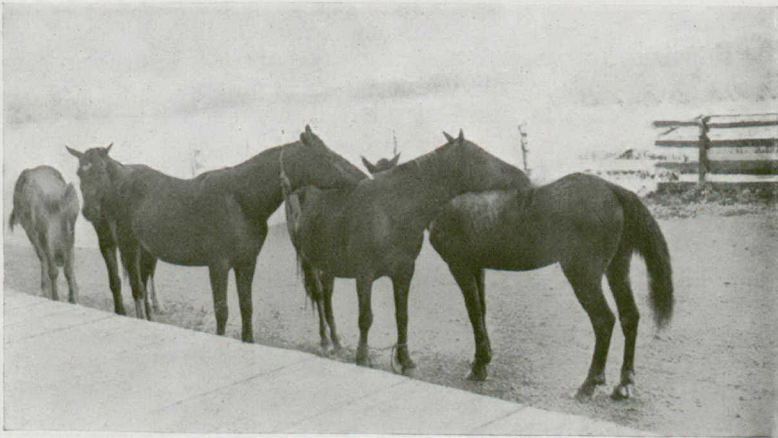


Fig. 7—Horses protecting themselves from bot flies. By resting their heads on each other's backs, horses can avoid the attacks of both the chin bot and the throat bot flies. (Original photograph by Ronald Buckell).

may often be seen hovering between a horse's fore legs, waiting for a chance to dart up and affix its eggs. It operates so quickly that it has time to attach its eggs even before the horse is aware of its presence. Just as soon as the animal feels the fly it immediately draws its head into its neck, and it is for this reason that horses are perpetually nodding their heads during the bot fly season. Horses

adopt a peculiar attitude at this season which is a sure sign that flies are about. They rest their jaws on each other's necks. Many people think it is a friendly attitude on their part, but in reality it is a mutual effort for protection.



Fig. 8.—Egg of throat bot (*Gastrophilus veterinus* Clark). Colour yellowish white. The eggs are attached principally to the hairs between the jaws. Greatly enlarged. (After Hadwen and Cameron.)

The eggs are of a different shape to the common bot fly, being attached to the hair by a groove containing a sticky cement which runs along for nearly the whole length of the egg. In the common bot the egg is only attached to the hair for about two-thirds of its length. The difference is significant because the eggs are able to hatch without friction. The larva on emerging from the egg will be in a straight line with the hair and in a good position to follow it down to the skin. There is no direct evidence that the larvæ do burrow through the skin, but the writer believes that they do so. In the first place the eggs are laid in such a position that the horses cannot lick them; secondly, they are able to hatch unaided; and thirdly, he has seen scabby or pimply spots on the skin between the jaws of horses underlying empty egg shells. It seems most probable, therefore, that the throat bot gets into a horse by boring through the skin. As to the way by which the young bots reach the stomach, nothing of this is known at present.

The bots remain in the stomach until the following spring or summer when they release their hold and pass out in the manure, to turn into flies at a later date.

THE NOSE BOT (*Gastrophilus haemorrhoidalis* L.)

The nose fly is the smallest of the bot flies but causes the most annoyance. It is a dark-looking insect with a reddish-coloured tail and clear wings. The eggs are coal black with a grooved stalk which fastens them securely to the hair. They are attached to the short hairs around the lips and are difficult to



Fig. 9—Egg of nose-fly (*Gastrophilus haemorrhoidalis* L.). Colour almost black. The eggs are attached to the lips of horses. Greatly enlarged. (After Hadwen and Cameron).

find, especially on horses which have dark skins. Many people are still under the impression that the fly stings horses. This belief arises from the fact that they have seen a fly strike at the lips of the horse, the effect upon the animal being so startling and rapid that they cannot believe that it has not been hurt. That the insect has no weapons with which to inflict pain can easily be verified by examining the fly. The only reason the insect has for striking at the lips is to affix its eggs to the hairs, but why a horse should exhibit so much alarm at this apparently simple and harmless action is not easy to explain. The skin around a horse's lips is very velvety and soft. It is also very sensitive to the touch. When a bot fly strikes, it does so roughly and suddenly, besides which it grasps the hairs with its feet when it is attaching its eggs; this is what worries a horse. If the insect only did it once, or twice, the horse would not per-

haps mind it at all, but when the act is repeated many times in succession, each time without warning, it is quite natural for the animal to get very nervous and to lose its head. The eggs are able to hatch without friction just like the throat bot. Being so close to the mouth it is an easy matter for the larva to penetrate, especially as after each attack made by the fly a horse will rub his lips on the ground, or on anything else he can reach. Nose fly grubs are never so numerous in the stomachs of horses as the other species of bots. However, they apparently have a very similar life history.

Injury caused by bot flies.—Most of the damage occasioned by bot flies is self inflicted by the animals they attack. The common bot does not as a rule annoy horses very much. It simply worries them and prevents them from resting. The throat bot is responsible for the continual nodding of the head, and of the tightening of the jaws against the neck. It also makes horses difficult to manage in harness. The nose bot irritates to such an extent that horses injure their lips and mouths by rubbing, and this makes many animals unsafe in harness. When the three flies are pestering the horses at once, the animals are unable to accomplish their work properly in the fields. They are worn out with the flies

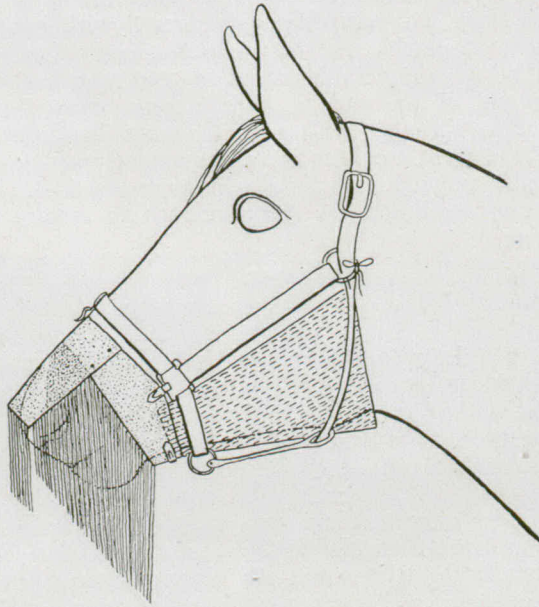


Fig. 10.—This leather fringe has been improved by the addition of a leather flap which covers the horse's nose. The ordinary fringes have a tendency to fall away on either side leaving the nose unprotected. The fringe is continuous all round the mouth. The canvas cover protects the region between the jaws. (After Hadwen and Cameron).

as well as by the work. Though there is little experimental evidence against bots in the stomach, they are certainly not there for any good purpose. When they are present in very large numbers they mechanically obstruct the passage of food. One interesting fact has been learned through experimentation, which may lead to a further understanding of bots, this is, that the juices contained in their bodies are very poisonous to horses. If a few drops of this juice are injected under the skin, the most alarming symptoms often arise, such as shortness of breath, diarrhoea, and other manifestations. Death may ensue in less than half an hour. It is unnecessary to explain here what all this means, but it shows that the bots in a horse's stomach are dangerous to their host.

Hadwen, S. and Cameron, A. E., 1918. A contribution to the Knowledge of the Bot-flies, *Gastrophilus intestinalis*, *De G.*, *G. haemorrhoidalis*, *L.*, and *G. nasalis*, *L.* Bull. Entomological Research Vol. IX, Pt. 2.
Cameron, A. E. (1922), Bot Anaphylaxis. Journal Am. Vet. Med. Ass., December, 1922.

Treatment.—Prevention should be spoken of first, and fortunately there are several different ways of protecting horses from the attack of bot flies. Work-horses can easily be safeguarded against two of the species by the use of protectors. For the nose fly a leather band cut into strips encircling the nose answers very well. Such leather fringes have been in use for a long time. They generally have the following defects; the fringe is apt to part over the nose, leaving it uncovered, and on the underside of the band, the fringe is missing. Fig. 10 shows a properly constructed nose fringe which does not suffer from these defects. The under side of the mouth is the most important place to protect as the bot fly generally strikes from below. For the throat bot a piece of ordinary canvas attached to the nose band and tied to the head stall will completely cover the region between the jaws. For the common bot fly there is no good means of protecting a horse from its attack because the eggs are attached to the legs and other parts of the body which cannot easily be clothed. For horses out on grass pasture, darkened sheds or brush shelters will afford them all the protection they need. The question of fly shelters has been discussed on pages 2 and 3. The writer wishes to emphasize again the need for providing shelters for the reason that, if animals are left out all day at the mercy of the flies, they will naturally get covered with bot eggs, and the following winter their stomachs will be correspondingly full of bots. Shelters, therefore, should be of appreciable value in lessening the number of bots in horses. The removal of the eggs is worth doing when numerous. Clipping the hair and scraping the eggs with a knife is the best way to remove them.

The medicinal treatment for bots is recommended with caution. Carbon bisulphide is a valuable remedy, it is usually given in capsules. It must be administered carefully and stockmen are recommended to employ a veterinarian to administer the drug.

Warble Flies (*Hypoderma lineatum* de Villers)

The common "heel fly" of the ranges is a bee-like insect, dark in colour, with four conspicuous lines on its back and an orange-red coloured tail. The eggs are laid on the lower parts of the body and *not on the back* as many people still believe. When cattle are standing the fly attaches its eggs low down on the legs. If the animals are quiet the insect has a cunning habit of settling on the ground in the shade of the heels of a cow and reaching up with its long egg tube, attaching its eggs to the hairs around the coronet. At other times it darts up swiftly, alights on the fetlock or above it on the cannon bones. When cattle are lying down, the heel fly deposits its eggs quietly, on those parts of the animal's body which come close to the ground. The line runs from a point six inches below the pin bones, along the flanks to the elbow and the sides of the brisket. The insect seems to prefer laying its eggs in the shaded parts of the body, which often makes it difficult to see it at work. Heel flies are on the wing quite early in the season in comparatively cool weather. In British Columbia they have been taken as early as April 15. They usually appear sometime before the horse flies and other biting insects. The egg takes from four to seven days to hatch. As soon as the larva comes out of the egg it crawls down the hair and enters the skin through the hair follicle. Adult cattle resist the penetration of the grubs by a reaction which takes place in the skin. A swelling occurs where the grubs have gone in and watery matter comes from it. In a day or so a scab is formed which can be lifted off leaving a conical pit filled with pus. The rash and swellings on the skin may be mistaken for mange or cow pox. Doubtless this defensive reaction destroys many

grubs, because full grown cattle always have fewer grubs in their backs than the young animals which do not show any reaction following the penetration of the grubs. There is no certainty at present as to the route taken by the grubs after they enter the body, but it is known that they eventually reach the walls of the gullet where they remain for a lengthy period. The grubs can be found in the gullet as early as June, and the last individuals to leave this situation do so in March. The larvæ leave the gullet at its lower end near the paunch and find their way up to the back bone by the diaphragm or skirt and in some cases along the back of the ribs. They enter the spinal canal and pass along it until they reach the region of the loins, there they leave it and ascend to take up their position under the skin. A short time later they bore through the skin with the aid of circular plates which are situated at the tail end. Warble larvæ may penetrate the skin as early as December 15. Their stay in the skin lasts for a considerable period. When mature, the grubs emerge, fall to the ground, and shortly afterwards their skin hardens and they turn black in colour. About a month later the fly emerges, ready to lay eggs. Cattle greatly fear the heel fly's attack, that is when the insect alights on their bodies. They will kick, run and stampede, and the fear is contagious among them. When the heel fly attaches its eggs (as explained above) without actually alighting upon the animals then they do not appear to notice anything except perhaps a little tickling sensation at times. This fact disposes of any idea that it inflicts any pain when it is attaching its eggs. The writer has shown by experiments that the reason cattle run as they do, is because the insect is so persistent and irritating in its attentions that they finally become frightened and endeavour to escape from it by running away.* For treatment, see page 20.

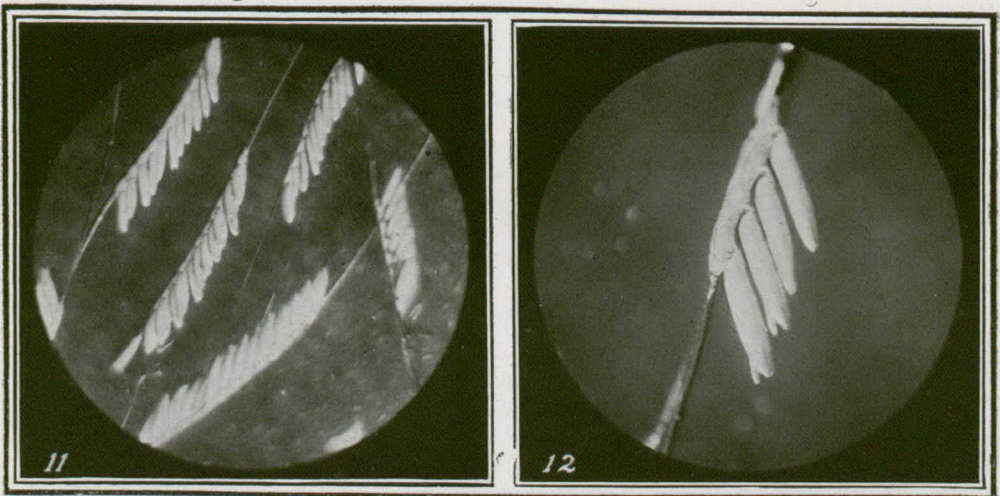


Fig. 11—Heel-fly eggs (*Hypoderma lineatum*) attached to hairs. On a single hair as many as fourteen eggs may be seen. Slightly enlarged. (After Hadwen).

Fig. 12—Heel-fly eggs. Two of them are split at the end showing that the grubs have emerged. Greatly enlarged. (After Hadwen).

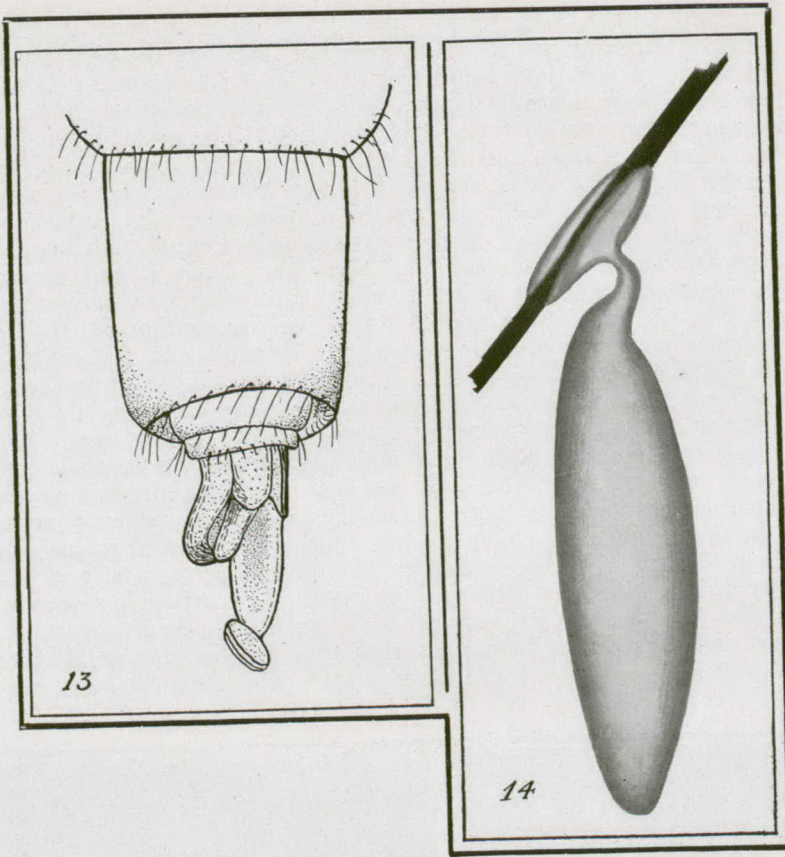


Fig. 13—Egg tube of large warble fly showing emergence of egg. The clasping arrangement at the end of the tube is for attaching the eggs to the hairs. (After Carpenter and Hewitt).

Fig. 14—*H. bovis* egg much enlarged to show method of attachment to a hair. The eggs are laid singly. (After Hadwen).

The Large Warble Fly (*Hypoderma bovis* De Geer)

The large warble fly is, as the name indicates, a larger insect than the heel fly. It has a quantity of yellow hair behind the head, and the tail end is orange-yellow. The eggs are mostly laid on the legs, round the knees, hocks, and stifle joints. They are rarely laid when the animals are lying down. They are attached one at a time and are not in rows like the eggs of the heel fly. The insect is a swift flyer and only annoys animals in the hottest weather. It appears late in the season and is on the wing at the same time as the horse fly, being at its worst in July. The eggs take from four to seven days to hatch, and as soon as the larva emerges it bores into the skin. Following the penetration of the grubs, swellings appear; they are not as severe as those caused by the heel fly,

and only the older cattle show them. After the grub enters the body it goes through a very similar life-cycle. The large warble fly frightens cattle much more than the heel fly. This is owing to its rough method of attack. A single fly in a barn yard may create an indescribable commotion among the animals. It darts at one, then at another, until they all become frenzied. Animals will be seen running with their mouths open and their tails erect, totally regardless of where they go, if only they can escape from the fly. The writer has on several occasions captured the fly which was causing the commotion (because it is rare that there are more than one or two at work) and in a few minutes the animals have become quiet again. If the captive fly is released the tranquil scene is at once upset. All this terror and fear is in general similar to that caused by the heel-fly, only it is greater because in the case of the large warble fly, which only lays one egg at a time, it naturally strikes the animals much oftener. It also attacks them higher up on the legs than the heel fly.

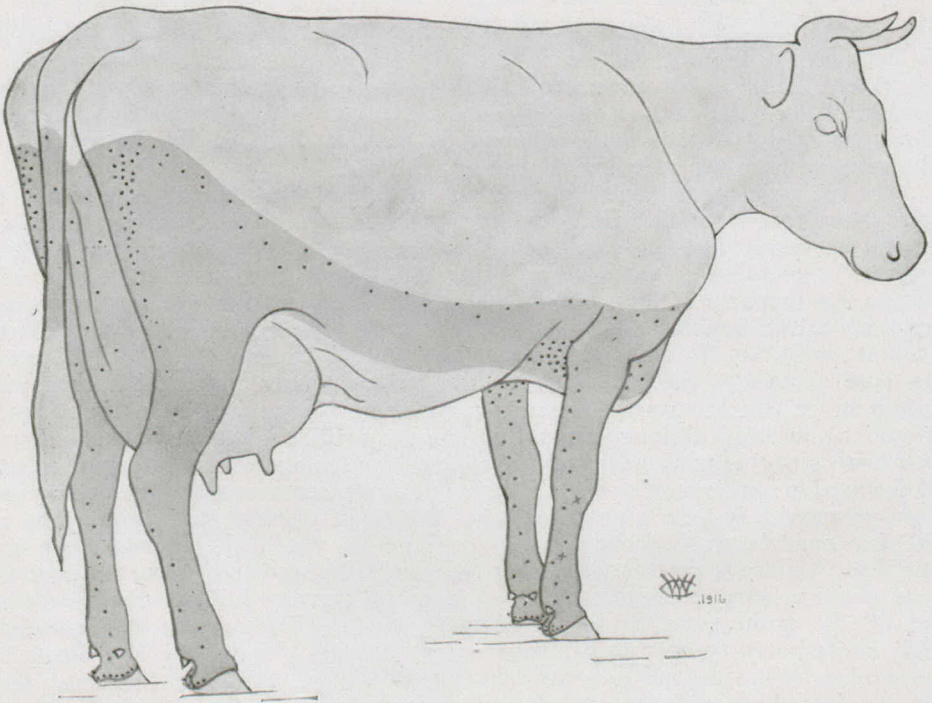


Fig. 15.—This figure shows the regions where warble-fly eggs are deposited. The black spots indicate the places where most eggs have been found, and the shaded parts the whole area where eggs may be deposited. The figure is for both species of warble flies. See text for an explanation. (Original).

Damage caused by warble flies.—During fly time warble flies effect their principal damage by causing cattle to run. Milch cows give less milk, and lose flesh, when they should be putting it on, and the same applies to young cattle.

The boring of the newly-hatched maggot through the skin in adult cattle often damages the hide by causing a scabby condition. This spoils the surface

of the leather, but fortunately it occurs in the poorer parts of the hide. The exit holes made by the grubs when they are ready to leave the body make irreparable injuries and ruin hides for many purposes. As regards the health of animals, warble grubs do less injury than one would expect. Nevertheless, they contain a violent poison for cattle which may cause sickness if it is liberated suddenly in the tissues. The reaction which this occasions is in the nature of a sudden shock. Cattle froth at the mouth, the skin becomes wrinkled, especially around the eyes and anus and there is diarrhoea and shortness of breath. During the spring months, cattle are occasionally seen showing these symptoms. It is probable that in most instances the animals have injured or crushed the grubs in their own backs through some accident such as breaking through a fence. In other cases it may result from the improper and careless extraction of grubs from the back. In Denmark there have been numerous cases reported among dairy cows subsequent to the visits of men employed to extract the grubs.

Prevention and treatment.—Warble flies do not attack animals in stables or in darkened sheds or shelters, nor do they annoy them when they are standing in water. These facts, then, are valuable for the protection of stock. In the paragraph on "the care of animals during fly time" (pages 1-3) recommendations are made for the construction of fly shelters, both on the farms and on the ranges, wherever standing timber is available.

In the prevention of warble grubs in cattle the most important measure to take is to prevent the flies from laying eggs upon them. If shelters are provided it will be found that the cattle will "make for them" the minute warble flies appear. Squeezing or extracting warble grubs from the backs of cattle, will reduce the numbers of flies, and should be attended to whenever the cattle are quiet enough to handle. This would appear to be an easier operation to perform than it really is. In thick-skinned or hide-bound animals it is hard to exert pressure enough to force out the grubs. In such cases wetting the skin will soften it, or else the warble opening may be enlarged. The point of a knife should be inserted obliquely into the opening with the back edge held down, then with a prying motion the cutting edge of the knife is raised severing the rim of the warble opening. Usually the grub is easy to remove once the opening has been enlarged. In case a grub has been broken in its extraction, the cavity in the skin must be washed out quickly to dilute the warble juices and other impurities. Failure to do this may cause the animal to become ill from the absorption of the poison, or else swelling and suppuration may follow. By squeezing out all the grubs from the backs of cattle warble flies may be exterminated. This necessitates co-operation among cattle owners. While this is difficult to accomplish, it has nevertheless been done successfully. Professor Carpenter and his associates have recently succeeded in completely eradicating warble flies from a small island off the coast of Ireland. An old method of treatment to kill the larvae has been revived recently, namely, the application of ointments to the warble holes such as iodoform and vaseline, and derris. The author has no personal experience with these, but they are said to be efficacious. Generally speaking it is unwise to kill parasites and to leave them under the skin, especially if they are of large size. The only period of the year in which ointment can be recommended is just at the moment when the warble larvae have perforated the skin. At this time they are small and their skins are not tough. Later in the season the larval skin is thick and tough and it is made of an indestructible material. In abattoirs it is common to find the skins of warble grubs under the hides, which have remained there unabsorbed, perhaps for years. Dressings for the prevention of egg-laying applied to the hair have not so far proved satisfactory, and many of them injure the skin. The

results of this form of treatment are often spoken of as good, when in reality they are not so. This is, for the reason that cattle develop an immunity to warble flies as they grow older, and it is usual to find fewer grubs in a cow's back year by year until old age is reached, at which latter period the immunity may decrease again. Besides the doubtful efficacy of fly dressings, they do not prevent the flies from making the cattle run.

Cattle should not be driven or put into a corral during the warble fly season. They are unable to protect themselves from flies when in an enclosure. Consequently, the animals which have been subjected to much handling will have a larger share of warble grubs in their backs the following spring than they would otherwise.

There is more hope for the discovery of some agent which will either kill the maggots inside the egg, or else just as soon as they hatch. Recently Imes and Schneider have been experimenting, and report that a 2 per cent solution of coal tar creosote in water kills the newly-hatched maggots. Cattle were driven through wading troughs filled with the solution. The following year the animals had fewer warbles than untreated cattle. It is to be hoped that the experiments will lead to practical results. (Imes, M. & Schneider, F. H., Am. Vt. Med. Ass. Vol. 6, 1921.)

The Sheep Nostril Fly (*Oestrus ovis* L.)

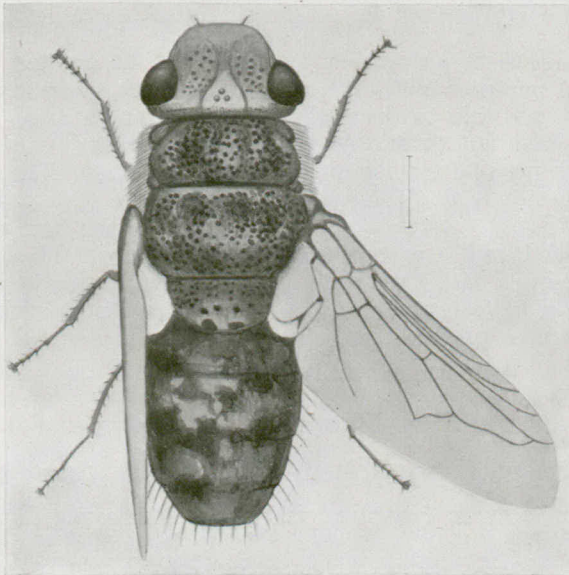


Fig. 16—The sheep nostril fly, *Oestrus ovis* L. Greatly enlarged. (After Portchinsky).

The nostril fly is a small insect about half an inch in length. It is dark coloured with a peculiar spotting of the body and has clear wings. Instead of laying eggs the fly deposits larvæ in the nostrils of sheep. They crawl up the nose until they reach the sinuses or open spaces in the forehead. How long the larvæ remain in the head is not exactly known. The writer has taken out both small and mature maggots from the heads of sheep during the winter as well as in the summer, so it seems probable that the grubs may stay in the head for

more than a year. When the grubs are full grown they release their hold and are sneezed out by the sheep. They fall to the ground, harden, and turn black in colour. Later, in from 21 to 60 days (according to Hall), the small cap at the end of the pupa is pushed off by the fly inside and it emerges ready to attack the animals.

Sheep are very much afraid of the fly and usually crowd together with their heads held low. The nose is protected from the fly by keeping it close to the ground, generally in bare dusty places. This is for the reason that the sheep are better able to watch for the insect on bare ground. As a result of pawing up the dirt and rubbing their noses in it, sheep naturally inhale large quantities of dust. Their faces become very dirty and they suffer from catarrh. In addition to the irritation produced by gritty particles of dust, the nose fly grubs which have been deposited in the nostrils increase the nasal discharges, and the irritant effect of the grubs already in the head contribute also. The sufferings of the sheep are augmented by heat, as it is only on hot sunny days that the nostril fly is on the wing. Besides the discomfort and worry brought about by the flies, sheep suffer at times from a form of vertigo often called "false gid." They stagger about with their heads in the air, and step high. This is accompanied by sneezing and distressed breathing.

Treatment.—Remedies are of little use, because once the maggots have entered the cavities in the head they cannot be reached by fluids injected up the nostrils. Shepherds commonly smear the sides of narrow salt troughs with tar, so that the sheep will be forced to rub their noses in it to get at the salt. The tar is believed to repel the fly or to prevent it striking at the nose.

Prevention.—It is in prevention that there is the greatest hope for relief. Rapid rotation of pastures is always good policy with sheep and with "range" flocks, it is often possible to drive them long distances away from the place where the grubs have left them. As it takes some weeks for the grubs to turn into flies the flock may be too far away for them to find. The flies only live a short time and do not feed. Their sole purpose in life is to deposit their grubs in the nostrils of sheep. With small flocks of sheep the best way of all is to provide a dark shed with a curtain hung over the door. The animals will run for shelter the minute the flies appear, and it can undoubtedly be predicted that the sheep will have fewer grubs in their heads the following year, if they have had a chance to protect themselves.*

Blow Flies (screw-worms)

(*Calliphora*, *Chrysomyia*, *Phormia*, *Lucilia*, *Sarcophaga*)

Blow flies are easy to recognize, most of them having dark blue or green metallic colours. These flies breed as a rule in the bodies of dead animals, but sometimes they lay their eggs or larvæ in wounds of live animals, and also in the natural openings of the body. In sheep, the soiled parts of the wool attract the flies. The maggots after living in the wool for a time, work their way into the flesh and cause serious injury and even death. Evil smelling wounds attract them most, but they will also infect comparatively small abrasions in the skin such as openings made by warble larvæ. Blow flies are most abundant in hot weather. In man there are numerous records of infection. According to Ransom the flies deposit their young or eggs in the nostrils, especially of persons with nasal discharges.

*Portchinsky, J. A. (1913), *Oestrus ovis*, sa biologie et son rapport à l'homme. Mem. Bureau of Entomology and Sci. Committee of Central Board of Land Administration and Agr., St. Petersburg, X, No. 3, pp. 63, 28 figs.

Treatment.—Ransom recommends anointing deep wounds with glycerine, which causes the maggots to become active and to come up to the surface. They are then sprayed with carbon tetrachloride or chloroform which kills them. The dead bodies of the maggots must be removed after treatment and the wound thoroughly cleansed. For the protection of wounds in animals pine tar is the best preventative to use. In addition to this the British Board of Agriculture recommends a mixture of flowers of sulphur and oil.

Prevention.—Dead animals must be disposed of without delay in warm weather. Burning is by far the best method. To consume a large carcass by fire it is essential to place it in such a way that there will be a draft underneath. Therefore, a narrow trench should be dug and the carcass rolled on top, then fuel piled underneath. Burial is not recommended unless the grave is deep. At least two feet of soil should cover the carcass. When burial is not practicable, the carcass may be soaked in coal tar creosote oil. Graham-Smith has found that carcasses treated thus will not become fly-blown.

Trapping blow flies around buildings is a useful measure, and as other flies such as the house fly will also be taken in the same trap, this method is recommended.

Operations on animals should never be performed in hot weather unless absolutely necessary. Dehorning cattle or the castration of horses must be done either before or after the summer season. In the case of sheep it is well to examine the flock occasionally to see that the wool keeps clean and does not become dirty. When sheep suffer from diarrhoea this is apt to occur. The soiled parts should be washed and the "tags" clipped off.

Fleas

Pulex, Ctenocephalus, etc.

Under favourable conditions fleas take from one to four weeks to complete their life-cycle. The different stages are egg, larva, and pupa. Adult fleas live for long periods if they can obtain food. Bacot (quoted by Bishopp) found the human flea to live 125 days and the dog flea 58 days. During the larval stages fleas live in dusty places, and their food consists of small particles of vegetable and animal matter. The commonest breeding grounds for fleas are in dog kennels and other places frequented by cats, dogs, pigs and poultry. To control fleas, Bishopp* has found that thoroughly scraping and clearing away all debris, then spraying the surroundings with coal tar disinfectant will kill the larvæ. The animals must be washed in a 3 per cent solution of creolin in water. In treating cats it is well to wash off the solution with soap and water to avoid burning the skin. Wood sheds appear to be especially attractive places for fleas; when clearing them out it is well to wet the debris before scraping it up. Frequent wetting of the ground has a beneficial effect in keeping them down.

In houses a thorough sweeping and washing followed by a spraying with gasoline or kerosene emulsion are recommended. Flaked naphthaline is a useful remedy sprinkled over floors. It is left for a few hours before it is swept up. Floor oils are valuable in the prevention of fleas.

Diseases transmitted by fleas.—Fleas are more dangerous in the tropics than they are in the north, nevertheless, they are not harmless in northern latitudes. Some species of tapeworms pass a portion of their life-history in insects. One in particular, *Dipylidium caninum* L., which is a very common parasite of dogs, has an intermediate stage in the dog flea. Quoting from Ransom, "infection of the final host, dog, cat, or child, occurs as a result of swallowing an infested flea or dog louse. The louse or larval flea becomes infested as a result of swallowing the eggs of the tapeworm." Several cases of infestation with the

* Bishopp, F. C., 1921, Sanitary Entomology, Edited by Pierce, W. D. The Gorham Press, Boston, Mass.

dog tapeworm have been recorded in America. The fleas of rats and mice and other insects more or less associated with them may carry (*Hymenolepis*) tapeworms to man. Ransom recommends the following rules for prevention: "Care should be taken to avoid the contamination of food or drink with the feces of rats and mice, in view of the possible transmission of the tapeworms of those animals to human beings. Prevention consists in excluding dogs and cats from human habitation, especially where there are children in the family; in keeping dogs and cats free from fleas and tapeworm, and in keeping the floors clean and free from dust and debris favourable to the propagation of fleas."*

Dung Beetles as Carriers of Worms

Our knowledge of insects as carriers of worms has lately been summarized by Ransom. Among the most important worms which pass certain of their stages in dung beetles are the following:—

Gongylonema scutatum (Mueller 1869) Railliet 1892, a round worm which lives in the oesophagus or gullet of cattle, sheep, and horses. The worm eggs are passed out by the animals and are eaten by dung beetles, several species of which act as intermediary hosts. The beetles are swallowed by stock while grazing.



Fig. 17—*Gongylonema scutatum*. A worm commonly found in the gullets of cattle, sheep and horses. Animals become infected by swallowing certain species of dung beetles. (Original).

Stomach worms in pigs, *Arduenna strongylina* Rudolphi and *Physocephalus sexalatus* (Molin 1860) Diesing 1861. These are two species of stomach worms in pigs which are very harmful to them. They pass certain stages of their life-history in beetles, such as Scarabs and other species.

The giant thorn headed worm of pigs, *Macracanthorhynchus hirudinaceus* (Pallas 1781) Travassos 1916. This is a large white worm which lives in the small intestine of pigs and causes large sores or ulcers on the walls. The eggs which pass from the pigs are swallowed by the larvae of dung beetles (white grubs). They hatch out and develop in the grubs, and are in turn eaten by their host the pig, in whose body they reach maturity.

Prevention.—Dung beetles, as their name indicates, live in manure, so that the recommendation made for the control of the horn fly will be found useful (see page 10), the principal requirement being to haul out the manure frequently or else to scatter it thinly and dry it out. Permanent hog

*Ransom, B. H., 1920. Nelson Loose-Leaf Medicine, New York, N.Y.

yards on bare ground, soon get badly infested with all sorts of parasites and it is especially in such places that pigs pick up beetles. Digging or ploughing under the surface soil is a good measure but cannot be repeated often as some kinds of worm eggs are very resistant and when they are turned up again, are still capable of hatching.*

Cattle Lice

Three species of lice commonly attack cattle, *Haematopinus eurysternus* Nitzsh, the short-nosed louse, *Haematopinus vituli* L, the long-nosed louse, and *Trichodectes scalaris* Nitzsh, the biting louse.

Lice multiply most rapidly in dry cold weather, on poorly fed, long-haired or old cattle. Anything which tends to debilitate animals favours the spread and multiplication of lice. As soon as the grass comes in the spring lice cease to be troublesome. This is for the reason that animals always improve in health and strength when the grazing is good and are better able to resist the attacks of parasites. Though the lice seem to disappear in summer and cause no appreciable effects, a small number continue to survive, because as soon as winter weather returns and the animals become run down through exposure or lack of food, the parasites come back in numbers.

Lice are found on various parts of the body. They are most numerous on the sides of the neck, the head, the back, and around about the tail head. The affected animals rub and scratch a great deal, eventually large scabby patches are produced. In some instances the lesions are so severe that they may be mistaken for mange.

In Eastern Canada the worst time for lice is just before spring in March and April. It must be remembered that animals which are in stables suffer more annoyance from lice than those which are loose. Being tied they are not free to rub themselves, and if they are carefully watched it will be noticed that their bodies are twitching continually and that they are unable to get any rest.

Treatment.—Range cattle should be dipped before the cold weather sets in with the official Canadian Government mixture of lime and sulphur. Fall dipping is an excellent practice as it kills off the lice that are present on the cattle, which are always ready to multiply when the resistance of the animal lowers. A second dipping two weeks later is always necessary to insure the best results.

For stabled animals kerosene emulsion has been found very satisfactory. It is prepared as follows:—

Soft soap	1 quart
Hard soap	$\frac{1}{4}$ pound
Kerosene	1 pint
Water	2 quarts

Mix with boiling water and add one gallon of warm water before using. Care must be taken to mix thoroughly, otherwise the skin may be scalded. The mixture can be applied with a brush. The treatment must be repeated in ten days to two weeks.

Raw linseed oil may be rubbed in with a cloth over the affected parts. Clipping the hair is beneficial in mild weather as it deprives the lice of protection and makes it easier to treat the animals. In cold weather when it is not safe to either wet the skin or clip the hair off, pyrethrum powder is a useful remedy. It is dusted over the skin and a blanket strapped on.

There are many proprietary dips sold for the treatment of lice, most of which are satisfactory. In addition to treatment, brushes, blankets, etc., or anything which has been in contact with the animal must be disinfected.

* Ransom, B. H., 1918. Relation of Insects to the Parasitic Worms of Vertebrates. Sanitary Entomology. Edited by W. D. Pierce, The Gorham Press, Boston, pp. 50-96.

Horse Lice

Horse lice are suctorial (*Haematopinus asini* L.) and biting (*Trichodectes parumpilosus* Piaget). The suctorial lice are the larger of the two. Healthy horses which are well fed and cared for are rarely troubled with lice. It is towards spring that lice become a nuisance and they are generally found on the animals which have wintered badly. The parts usually attacked are the withers, neck, head and the tail regions. Horses bite, scratch and rub their bodies against the sides of their stalls and become very restless. The skin becomes dry and scurfy, the hair falls off in patches, and scabby areas occur in regions which the animals can rub or bite.

Treatment.—Clipping the hair first, then giving it a good brushing is a good preliminary step towards treatment in broken horses, then an oily rag may be rubbed over the affected parts of the skin. Raw linseed oil is popular as it does not burn the skin. Kerosene emulsion is also good. In cold weather pyrethrum powder or sodium fluoride may be dusted into the skin, then a blanket strapped on top. The treatment must be repeated in two weeks time.

Pig Lice (*Hæmatopinus suis* L.)

The louse of the pig is the largest of the louse family. It is very easy to see. Consequently, a farmer has no excuse for neglecting to treat his pigs. The lice infest ill-fed animals, and if they are numerous it is generally a sign that the pigs are being kept in dirty pens. The constant worry and uneasiness from lice causes the pigs to lose flesh instead of putting it on, so that their bodily health suffers in proportion to the increase of the lice. The skin thickens and becomes scabby on account of the constant rubbing which takes place.

Treatment.—Raw linseed oil rubbed on with a brush is efficacious as is also kerosene emulsion. Pigs must not be left out in the sun after treatment as their skins are apt to scald.

Poultry Lice (*Mallophaga*)

Several species of lice affect poultry. They do most of their damage by irritating the birds so that they lose in weight or stop egg laying.

Treatment.—Flowers of sulphur will destroy lice if dusted into the feathers. An old and useful remedy is to keep a large shallow box in the hen house partly filled with a mixture of sulphur, slacked lime, and fine soil or ashes. The fowls will dust themselves in such a mixture, and it is an excellent way to keep them clean. Bishopp recommends sodium fluoride very highly. His method of treatment is as follows:—

“In full grown birds, about twelve pinches of powder are placed on different regions of the bird at the base of the feathers and distributed as follows: One pinch at the head, one below the vent, one at the tail, one on either thigh, and one scattered on the under side of each wing when spread.” One pound of sodium fluoride is sufficient to treat one hundred birds. Lice spread mostly by contact. After a flock has been freed from lice the introduction of infected birds should be guarded against.

Sheep Ticks or Keds (*Melophagus ovinus* L.)

Keds are six-legged insects which do not lay eggs but give birth to their young (pupae) enclosed in a membrane or sack. Only one larva is expelled at one time. According to Imes* the young ked emerges from the sack in 19 to 24

*Imes, Marion, (1917) The Sheep Tick, Farmers Bulletin, 1798, U.S. Dept. Agr., Washington, D.C.

days after birth, and fourteen days later may give birth to its first pupa. Flock masters generally know that keds cause sheep to bite and scratch at their wool which is, of course, very bad for the fleece, and that lambs become stunted as a result of tick worry, but strange to say they will allow their flocks to remain infested year after year. The treatment for keds is comparatively easy and cheap, so that no flock should be allowed to go undipped.

Treatment.—Proprietary dips are sold everywhere and the instructions given with them should be followed closely. These proprietary dips are very useful for small flocks where the dipping is done by hand. They are usually made from coal tar or from cresol preparations. The official Canadian Government dip of lime and sulphur, or the arsenical dips may be used if the flocks are large. A swimming vat is necessary for these dips. According to Imes the sheep should be dipped twice, with an interval between of 24 to 28 days. The corrals or yards to which the sheep have had access must be closed for 60 days after dipping to prevent the sheep from being reinfested.

Mange in Cattle and Horses

(*Psoroptes, Sarcoptes, Chorioptes, Demodex*)

There are several species of mites which attack both cattle and horses, and it is unnecessary here to describe each one in detail. In cattle, scab or mange, has caused severe losses in Western Canada. Most mites become mature and lay their eggs in about 10 to 12 days. All forms of treatment are based on this fact and are performed at a 10 to 14 days interval. Mange usually starts on the neck or at the root of the tail. Through scratching and rubbing the mites are extended over the body. After a time the skin thickens and becomes denuded of hair. Some forms of mange affect the legs and tail. In the prairie provinces stockmen often refer to mange as wet or dry. As a rule, horses have the dry form and cattle the wet. The dry variety generally begins on the neck and withers. Mange is at its worst in cold weather when the animals have become weakened by lack of good food and through the hardships of the winter. As soon as the grass comes back in the spring there is an immediate amelioration in the condition of the animals, the skin becomes normal again and the disease disappears, but the cure is only apparent. A few mites survive in some mysterious way and begin to multiply again when the conditions are favourable.

Several skin affections look like mange. Cattle and horse lice sometimes bring about so severe an inflammation of the skin, that it is mistaken for it. The surest method of deciding whether an animal has mange or not is to examine the skin scrapings under a microscope, and if the mites are found the diagnosis is certain.

Treatment.—Cattle and horse mange are classed as a contagious disease and come under the Dominion Quarantine Regulations. In well broken animals the treatment recommended is to clip the hair first, then to wash the skin with soap and water. This is followed by rubbing in a solution of:

Sulphur	2 pounds
Oil of tar	8 ounces
Raw linseed oil	1 gallon

The mixture is heated but not boiled, and applied hot. The preparation is kept on the skin for ten days, then washed off and the treatment repeated.

The above mixture will kill lice and is valuable to use for that purpose. For large herds of animals swimming vats are used, filled with the regular lime-sulphur dip.

MANGE IN PIGS.

The disease occurs occasionally in pigs. The skin becomes thickened and rough. As a remedy the treatment recommended for cattle and horses will be found satisfactory. Another remedy consists of a mixture of half a pint of kerosene to a pound of lard. A thin coating may be applied with a cloth over the entire body. The pigs must be kept away from sunlight.

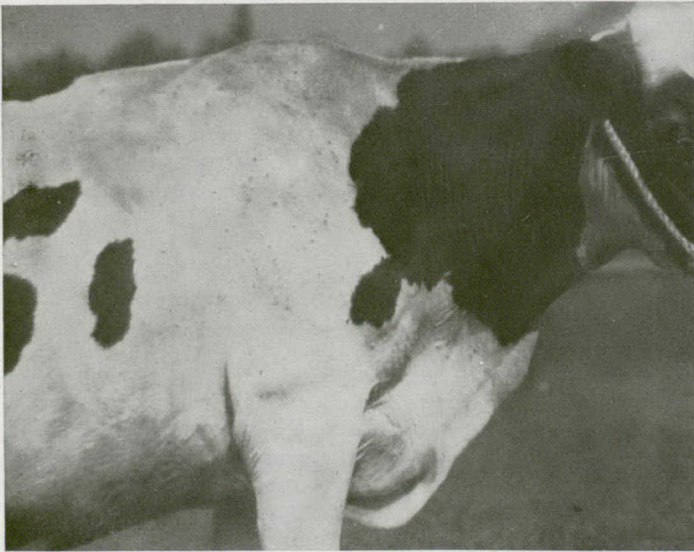


Fig. 18—Follicular mange in cow; note spotting over shoulders. (Original).

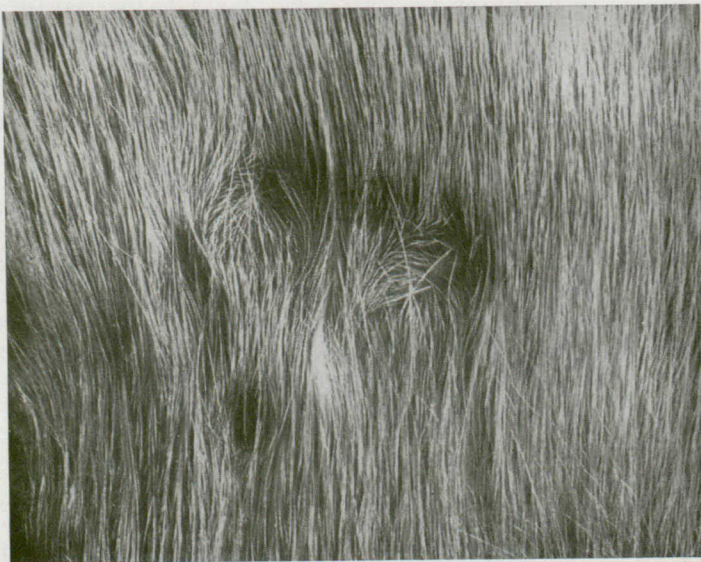


Fig 19—Near view of nodules. When cut into, thick yellow pus is found containing the mites. (Original).

FOLLICULAR MANGE (*Demodex*).

Follicular mange causes a disease which does not necessitate quarantine though it occasionally affects several animals in a herd. It is caused by small elongate mites called *Demodex folliculorum*, which live deep down in the skin. In cattle it makes small round raised lumps, which are filled with a yellowish cheesy substance. The lumps may be seen over the shoulders and sometimes spread to other parts of the body, such as the udder. As the parasites are too deep down in the skin to be reached by ordinary mange dressings the treatment is not satisfactory. The skin may be injured to such an extent that it becomes useless for tanning purposes. It is best to get rid of badly infected animals. (Figs. 18-19.)

SHEEP-SCAB MITE (*Psoroptes ovis* Hering).

Scab mites are just visible to the naked eye, but if placed on a dark background, they are readily discernible especially with the aid of a lens. In searching for them it must be remembered that they are slow-moving parasites, and unless they are warmed they progress very slowly. Hall states that the female mite lays from 15 to 24 eggs during her life. They hatch in from three to four days and become full grown in from seven to eight days. Scab, as its name indicates, begins with an itchy spot from which a watery matter exudes. A sore is formed which is later covered with a scab. By scratching, rubbing, and biting the fleece becomes ragged and soiled. As scab is very contagious the appearance of an increasing number of scabby sheep in a flock is a suspicious sign and should be investigated immediately. Lice or "keds," if numerous, may produce somewhat similar effects to scab, but if the sheep are carefully examined and lice are found to be very numerous it is most likely that they alone are responsible for the trouble. If, however, very few lice are found then the disease may prove to be scab. In this event flock-masters must lose no time in notifying the Government authorities who will look into the case and deal with it.

Treatment.—The official Government dip of lime and sulphur is generally used throughout Canada. Two treatments are required at 10 to 14 days' interval.

Parasitic (Mites of Animals)

THE CHICKEN MITE (*Dermanyssus gallinae* De Geer).

The chicken mite is a blood sucking parasite of night-feeding habits. Though small the mites are not hard to find, owing to their habit of congregating in large numbers in cracks and crevices of boards near hen roosts. Round about the entrance to these retreats, the mites deposit their excrement which is black and white, and which will serve as a guide in finding them. Wood, has found that the entire life cycle from egg to adult may take place in seven days. Mites will survive in an empty hen house for several months. As the mites are nocturnal feeders they leave the bodies of birds almost entirely during the day time, hence poultrymen have an advantage in getting rid of them.

The hen house must be thoroughly scraped and cleaned, before spraying, and badly fitting boards adjusted. After this the walls and ceilings must be well sprayed with crude petroleum or ordinary kerosene. Wood states that a mixture of the two is best. A second treatment a month after the first is recommended.

THE SCALY-LEG MITE (*Cnemidocoptes mutans* Robin).

This mite burrows under the leg scales, causing an inflammatory itching of the scales. Besides making the legs rough and unhealthy looking, the mites owing to the irritation they cause have some effect on the health of poultry.

The treatment consists in oiling the legs with crude petroleum or a mixture of carbolic acid sulphur and lard. To prevent contagion the diseased birds should be isolated from the healthy ones and the perches in the hen house sprayed with oil.

THE DEPLUMING MITE (*Cnemidocoptes gallinae* Railliet).

Causes fowls to pull out their feathers.

Treatment.—Sulphur ointment rubbed in well.

THE AIR SAC MITE (*Cytolichus nudus* Vizioli).

This mite is quite common in Canada and is found in the air passages. No form of treatment has as yet been found for this mite.

Ticks

There are seventeen different species of ticks known in Canada, five of which are of sufficient economic importance to be included here. These are eight-legged animals which in an unfed condition somewhat resemble the common bedbug. Ticks live entirely on the blood which they suck from their victims, and without blood they cannot survive. When fully fed a tick grows to about the size of a small bean and is generally of a bluish-grey colour. Ticks anchor themselves to the skin by a barbed sort of dart, and when they are forcibly removed this usually breaks off and remains embedded in the skin. In their life-histories ticks differ from one another in an extraordinary manner. Very few have similar habits, so that it will be necessary to describe each one separately.

THE MANITOBA TICK (*Haemaphysalis cinnabarina* Koch.).

This species occurs in Manitoba and is found in the adult stages on cattle during the latter part of the summer. This is a three host tick. It feeds on three separate animals; during its larval or seed tick stage, in its nymphal or second period, and finally as an adult. After fully engorging with blood it drops off onto the ground and lays eggs. Though very few complaints have been made about this tick, it may at some future time cause trouble if its numbers increase. The tick is not known to convey any disease, and if it occurs in small numbers, may do little damage. In the care of animals which are heavily infested, it will be well to oil the ticks with some thick oil which will smother them and force them to relinquish their hold on the skin.

THE DOG TICK (*Dermacentor variabilis* Say).

In Manitoba and Saskatchewan this tick occurs in very large numbers just as soon as the snow leaves in the spring. It is a whitish-grey parasite and attaches itself commonly to dogs, but also to other mammals, including man. It is generally found sucking blood in the region of the head, but may attach itself to any other part of the body. The dog tick requires three different animals for its development which it takes a year or more to accomplish. It is a common practice to pull the ticks off dogs, but oiling is a better way. If a tick's mouth parts are left in the skin suppuration is very likely to follow, and a persistent irritation results which may last for months.

THE ELK TICK (*Dermacentor albipictus* Packard).

This tick is distributed all over Canada. It is found on the various kinds of deer and is a troublesome parasite of cattle, but especially of horses. It is common in wooded districts and infests animals which graze therein. On the cultivated lands it is unknown. No doubt it will disappear as cultivation advances, but at the present time it is increasing under range conditions in some localities. The elk tick is also known as the winter tick because it does most

of its damage during the winter months. Reports of injury to stock have been received from Nova Scotia, New Brunswick, Saskatchewan, and British Columbia. The season for this tick when it is most apparent, is during February, March and April. The engorged females drop off and lay eggs. The young ticks which issue from them do not seek the animals until the autumn, they remain on their hosts after feeding and then change their skins and become nymphs, re-attaching themselves, and later issuing as adults. In other words, the tick is what is called a one host-tick, and lives entirely on one animal.

The favourite place of attachment on horses is at the root of the mane all along the neck and down the back, in between the hind and fore legs, and on the belly. In some instances animals may be so heavily infested that they become thin and worthless. The writer has shown that outbreaks of "poll evil" and fistulous withers are common in unbroken range horses during the early spring months. It seems probable that these outbreaks are connected with the bites of both *D. venustus* and *D. albipictus**. In British Columbia there are occasional deaths among horses which have been attributed to "tick poverty". It is not known that the elk tick transmits any special disease but further research may show us that the tick is not entirely harmless in this regard. The tick has been blamed for deaths among wild animals but this needs further confirmation. As the parasite is a one host-tick it could most likely be reduced or got rid of on the ranges by dipping the animals regularly in arsenical solutions just like the cattle tick in the Southern States, but as it only infests animals during the winter dipping cannot be advised. Oiling the ticks is the best way of getting rid of them. A little pine tar mixed with raw linseed oil applied to those parts of the body to which ticks usually attach will make them loose their hold, or prevent new ones attaching. In very cold weather it is not advisable to put on too much oil as the animals are likely to suffer from exposure.

THE CASTOR BEAN TICK (*Ixodes ricinus* (L.) Latreille).

Is found most commonly in British Columbia. It attaches itself to deer, dogs, and occasionally to other domestic animals and is not uncommonly recorded on man. It is a small greyish parasite with dark markings; when fully gorged it resembles a castor bean—hence its name.

Oiling the ticks when they are found is the best thing to do. They must never be roughly removed, otherwise harm results. In the case of man, the tick may be gently pulled and the small piece of skin in which its head is embedded cut off with a sharp pair of scissors.

THE WOOD TICK (*Dermacentor venustus* Banks).

Also called the spotted fever tick in Montana. It occurs principally in dry regions of British Columbia and is not found far east of Alberta.

This is the most harmful tick known in Canada. In the United States it is the carrier of spotted fever in man, but in Canada it is not known to do so.

This parasite is a three-host tick and feeds on three different animals during its life cycle. In its larval and nymphal stages it feeds on small rodents, such as squirrels, and in its adult form it attacks horses, cattle, sheep and human beings. The worst season for wood ticks is during the spring months. As the warm season advances it may be found higher and higher up the mountains.

It has been proved experimentally that wood ticks may cause "tick paralysis" in animals, lambs being the chief sufferers. Dogs may also become paralysed and it is also probable that the other domestic animals are not immune to its attack, though direct experiments are lacking to prove it. There are many cases on record where children have become paralysed from tick bites in some instances with fatal results. Wood ticks have a decided preference for

*Hadwen, S. (1919), Parasitic diseases. H. Am. Vet. Med. Ass., No. 6, Feb., 1919, pp. 639-642, 3 figs.

attaching along the back bone. In sheep they do so because the skin is not greasy and there is often a parting of the wool along the back. In man a favourite point of attachment is at the nape of the neck. Wood ticks take about six days to feed and when symptoms of paralysis manifest themselves it is usually just before the tick falls off fully gorged. It is most probable that the tick injects some poisonous material which brings on the paralysis. The symptoms disappear rapidly as a rule after the tick is removed and there seem to be no bad after effects. If the tick or ticks are allowed to remain on a paralysed animal the symptoms may get more and more severe, and, if the heart and respiration become involved, death may ensue. As a general rule, "tick paralysis" affects young animals, though older ones may become paralysed. Adult animals appear to have an immunity which the young have not. Besides inducing paralysis in animals the bite of wood ticks often causes sores which are difficult to heal. The flesh dies at the point of attachment and finally a slow-healing sore is formed. Usually there is intense itching around the sore and in man it may last for months. The sores are generally the result of removing the tick too roughly, so that the head is left embedded in the skin. Oiling the ticks as recommended in the previous paragraphs is the most satisfactory way of controlling them where only a few are found. When ticks are numerous, lambs must be captured and examined if they show the slightest difficulty in walking. If only one or two ticks are found attached they may be removed by snipping off the small portion of skin in which the head is embedded. As a preventative measure oil and tar may be applied along the back of sheep to keep the ticks from attaching themselves.

The other varieties of ticks are found on small animals such as rabbits, coons, birds, etc. As a general rule, the ticks affecting one animal do not attack others, or only occasionally, but the five ticks described above differ in this particular. In Canada, ticks have not received much attention on the part of investigators and they deserve further study.

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PUBLICATIONS ON INSECT PESTS

The following publications of the Department of Agriculture relating to Insects are available on application to the Publications Branch, Department of Agriculture, Ottawa:—

Pea Weevil, The.....	C.P.L. No. 9
Lime, Arsenate of.....	C.P.L. No. 10
Corn Borer, The Control of the European.....	C.P.L. No. 16
Tent Caterpillars	Circular No. 1
Flea Beetles and Their Control.....	Circular No. 2
Chinch Bug in Ontario, The.....	Circular No. 3
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