DEPARTMENT OF AGRICULTURE
CANADA
HEALTH OF ANIMALS BRANCH

BULLETIN No. 16

WARBLE FLIES

THE ECONOMIC ASPECT

AND

A CONTRIBUTION ON THE BIOLOGY

BY

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THE ECONOMIC ASPECT OF WARBLE FLIES

By Seymour Hadwen.

During the summer of 1912 while conducting an investigation on Hæmaturia (Red Water) in cattle at Agassiz, British Columbia, I had an exceptional opportunity for studying warbles in the experimental animals under observation. When discussing my work with Dr. F. Torrance, Veterinary Director General, under whose authorization the work was done, he suggested that it would be well to find out what damage was caused by warble flies throughout the country, and with that end in view to communicate with the tanners in the different provinces. A circular letter was sent out from the head office and as a result thirty-six letters were received in answer. These letters have been abstracted and the results are tabulated below.

The evidence collected shows that warbles damage hides to a very great extent in the Dominion; it also clearly demonstrates that the investigation which has been conducted in a small way at Agassiz should be continued and extended.

There is no doubt that the abstracted information is most accurate, the letters coming from a class of sound business men, who have no interest in the matter save to get hides free from warbles.

The man who undoubtedly loses is the farmer; the tanner does not want warbled hides at any price, and several of them testify that they only buy hides during the season when hides are not grubby (the autumn).

The uses a grubby hide can be put to are very limited, and for some purposes appear to be useless; for instance in the manufacture of belts for machinery.

Several interesting facts are brought out concerning the grades of hides most affected with warbles, some of these can be explained by a knowledge of the life history of the parasite. Another point made clear is with a little care on the part of the farmer, certain classes of cattle would be kept comparatively free from warbles.

The class of animals which are the worst affected are 'range' cattle and here lies the most difficult problem, as no method of any sort has been found to prevent the ravages of the fly among semi-wild animals.

The economic loss caused by worry, loss of milk, etc., has not been dealt with, as no new facts have been ascertained.

STATISTICS COLLECTED FROM THIRTY-SIX LETTERS RECEIVED FROM CANADIAN TANNERS AND HIDE DEALERS IN ANSWER TO CIRCULAR OF VETERINARY DIRECTOR GENERAL. THREE LETTERS FROM NEW BRUNSWICK, TWO FROM NOVA SCOTIA, FOURTEEN FROM QUEBEC, SIXTEEN FROM ONTARIO, AND ONE FROM BRITISH COLUMBIA.

PERCENTAGE OF GRUBBY HIDES IN WARBLE SEASON.

New Brunswick	Tanner	No. 1	75 %	in Grubby Season.	75%	75%
Nova Scotia	"	1	55 to 65%	"	60%	60%
Quebec	"	9	75	"	75%	
	"	11	33 to 50%	"	41·50%	
	"	13	25%	"	25%	47·16%
Ontario	"	2	30 to 40%	"	35%	
	"	4	50%	"	50%	
	"	5	50%	"	50%	
	"	6	25 to 75%	"	50%	
	"	7	25%	"	25%	
	"	9	50 to 60%	"	55%	
	"	12	25 to 75%	"	50%	
	"	14	25 to 50%	"	37·50%	44·06%

Average percentage for the four provinces..... 56·55%

ANNUAL PERCENTAGE OF GRUBBY HIDES.

New Brunswick	Tanner	No. 1	35%		
	"	2	40%	37·50%	Annually.
Quebec	"	1	25%		
	"	6	35%		
	"	14	12·50%	(10 to 15)	
	"	13	25%	24·37	Annually.
Ontario	"	8	50%	(one letter only)	
					50%
British Columbia	"	1	25%	25%	

Average percentage for the four provinces..... 34·22%

This figure may be somewhat high and should probably be nearer to the one given for the percentage of annual damage to hides.

NOTE: The information abstracted from the letters is given in full, so that a better idea may be gained as to the value of the averages.

Percentage of Annual Damage to Hides.

New Brunswick	Tanner	No. 1	25 to 30% loss to all hides during season.				22·50%
	"	2	10 to 25% no specified time.				
Quebec	"	6	Annual damage to hides			12·50%	12·50%
Ontario	"	5	"	"	"	25%	
	"	9	"	"	"	10%	
	"	12	"	"	"	17·50%	
	"	13	"	"	"	25%	
	"	15	"	"	"	10-20%,	15%
							18·5%
British Columbia	"	1	"	"	"	25%	25%
Average annual percentage							19·62%

Damage done to Hides by Warbles Expressed in Grades.

New Brunswick	Tanner	No. 2	Warbly hides classed as No. 2 or 3 grade.
Quebec	"	2	1 to 3 warbles in hide classed as No. 1. 3-12. No. 2 grade. Badly warbled classified as No. 3.
	"	3	Healed scars if large make No. 2.
	"	4	Healed scars make No. 2 or 3 quality.
	"	5	Warbles make No. 2 quality.
	"	7	Deduction on warbly hides 1 to 2c. per pound.
	"	8	Warbles cause loss of 50c. per hide all through year.
	"	9	Warbly hides damaged to the extent of 50c.
	"	10	Warbles damage finished hide 3–4c. per pound.
	"	11	Warbles damage hide 1 to 2c. per pound.
	"	12	Warbles damage hide 1 to 3c per pound.
	"	14	Warbles damage hide 1 to 3c. per pound.
Ontario	"	1	Fifty thousand dollars annual loss to Canada through warbles.
	"	2	Loss through warbles 50c. to $1 per hide.
	"	4	Depreciation in value of hide 2-6c. per pound.
	"	6	Grubby hides classed No. 2 or 3 quality to 2c. per pound loss.
	"	9	10% loss per annum i.e. 60c. per hide. Out of 300,000 hides the loss was $180,000.00.
	"	10	Grubby hides classed No. 2 or 3, loss 1 to 3c. per pound.
	"	11	1 to 3 warbles classed No. 1, over 3 No. 2 and 3 grades.
	"	16	2 to 5 warbles 1c per pound that is 60c. per hide. 5 or more 2c. per pound.
British Columbia	"	1	1/3 off for 5 or more grubs.

MONTHS IN THE YEAR DURING WHICH HIDES ARE MOST WARBLY.

New Brunswick	Tanner No.	1	Early February to late July.
Nova Scotia	"	2	First of March to latter end July.
Quebec	"	3	Latter part December to early June.
	"	4	Worst March, April and May.
	"	6	January, February, March and April worst.
	"	9	February, March and April worse.
	"	11	April, May and June, slightly July.
	"	12	February, March, April and May.
Ontario	"	2	April, May and June.
	"	4	January to June.
	"	5	First of February to first of June.
	"	6	Middle of January to end of June.
	"	9	First of April to 15th of June.
	"	10	February to early July.
	"	12	February to June.
	"	15	Affected late October to early May, worst January to April.
	"	16	March to June.
British Columbia	"	1	January 1 to June 1.

The length of the warble season from the tanners' point of view extends from late January to early July, the worst period being during the month of April. From my notes made at Agassiz I find that the first larvæ emerged on April 10, and that the last were ready to come out on July 2; so that the table tallies absolutely with what I have found. The larvæ were naturally very prominent under the hides before April 10 and had perforated the skin some time before.

Nearly all tanners are agreed that the rough, long-haired, ill-kept animals are most warbly and that on the other hand well fed sleek animals are not so badly affected. Of course weak animals are always more parasitized than the strong, and cannot fight the fly as well as the more robust; but I believe that it simply means that they are at the mercy of the fly all day long whereas dairy cattle and well-bred animals are often housed during the heat of the day. Another reason is that cattle kept in or near towns will naturally be less exposed to the attacks of the fly, as there will be fewer about. Reasons for this are given later. Some of the tanners mention the fact that a wet season is beneficial in keeping down the number of grubs. The answer to this is simple. Warble flies are never seen in cold or cloudy weather. The hides coming from certain districts are mentioned as being comparatively free from grubs especially in Ontario. I am not familiar with all the places mentioned, but some of them I know are dairy centres, and the above arguments will apply to these.

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PLATE I.

Fig. I. Warble Hides.

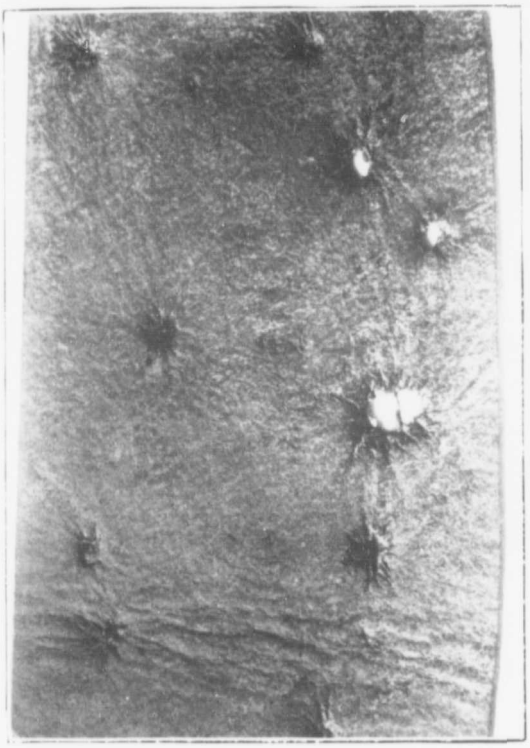


Fig. I.—Actual size of leather, $3^1/_4$ in. x $3^3/_4$ in.

Fig. II.

Fig. II.—Actual size of leather, $2^3/_4$ in. x $1^3/_4$ in.

A CONTRIBUTION ON THE BIOLOGY OF HYPODERMA BOVIS (DE GEER.)

By Seymour Hadwen.

The species of Warble-fly which is recorded here for the first time in Canada, and probably for North America, is *Hypoderma bovis* (De Geer).

Seeing that numbers of cattle are being imported yearly from Europe, it is strange that there seem to be no records of any previous captures, and in consequence no work has been done previously in Canada on the life history of this destructive insect. Owing to the kindness of Professor Carpenter of Dublin who sent me a specimen of *H. bovis*, I have been able to confirm the determinations I had made by descriptions alone. To show the rarity of these insects in entomological collections, I may mention the fact that none are to be found in the Departmental collection at Ottawa, and that a request for a specimen of *H. lineata* from the Bureau of Entomology at Washington, D.C., could not be granted owing to a scarcity of specimens. My thanks are due to Dr. L. O. Howard for specimens of the larvæ of *lineata*, which enabled me to still further

confirm my opinion that I was dealing with *H. bovis*. Whether *H. lineata* is the common form in Canada I do not know, but it should not be a difficult matter to decide, as accurate determinations can be made by the aid of the spiny armature of the larva itself, and these at any rate are common. For the benefit of those who are not cognizant with the previous works on these insects, I may say that up to now *Hypoderma lineata* has been considered to be the Warble-fly of North America. All the observations recorded in this paper at Agassiz refer to *H. bovis*.

I will not go into many details or describe the fly fully, as I have prepared a coloured drawing: suffice it to say that compared with *H. lineata*, *H. bovis* is a more robust insect and has yellow coloured hairs in the anterior part of the thorax (at the back of the head). The central part of the thorax is black and shiny. In *H. lineata* the thorax is nearly entirely covered with whitish and black hairs except for the lines from which it gets its name; in *H. bovis* the tail end is covered with orange yellow hairs, in *H. lineata* the hairs are lemon yellow.

Through the courtesy of Mr. Ruggles of the Minnesota Agricultural College, I examined the collections there and found two females of *H. lineata* which compared with the above descriptions.

PLATE 2

Fig. 1.

Fig. 1.—Hypoderma bovis (De. Geer) ♀

(See also Frontispiece.)

Photo S. Hadwen

TABLE SHOWING AVERAGE TIME FOR EMERGENCE OF FLIES FROM PUPA.

			Days.
May	7 Larva pupated.	Fly emerged June 16	40
	19 Larva pupated.	Fly emerged June 20	32
	20 Larva pupated.	Fly emerged June 23	34
	27 Larva pupated.	Fly emerged July 2	36
	28 Larva pupated.	Fly emerged July 2	35
June	5 Larva pupated.	Fly emerged July 11	36
	19 Larva pupated.	Fly emerged July 19	30
		Average number of days	34·7

The first fly captured out of doors was on June 8. Six in all were caught outside. The season was very wet, and as warble flies only appear in the finest weather, observations could only be conducted on those days. The last time cattle were seen to gad was on August 2, on which date flies were captured. On looking up the weather record, I find that there were 5·95 inches of rain in June, 5·09 in July, and 7·84 in August, there were 39 days, on which it rained, and of course many cloudy days, so that it seems fairly safe to predict that in this section of the country, warbles will not be as plentiful as usual next spring.

EXPERIMENTS ON OVIPOSITION.

On June 19, a Warble fly was caught, and its wings clipped, the fly was put on to a cow's back. The ovipositor was thrust out several times and a white, milky substance deposited. After a time an egg was extruded, it was quite loose, but was pushed under the hairs. No more eggs were laid.

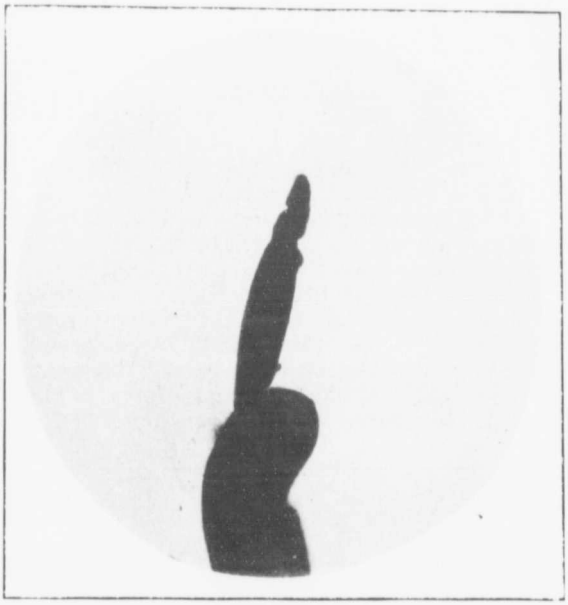
Another fly was captured, and its wings clipped. it did not try to oviposit, but kept feeling round with its ovipositor, and a milky substance was deposited several times. As the fly would not lay, a little pressure was applied to the abdomen, and an egg expelled. The fly was let loose again on the cow's back, where it shortly afterwards laid an egg, it was loose, and not attached to a hair.

Both flies were put into a vial together, they began at once to tumble over one another, they extended their ovipositors at intervals, in all they laid twenty-five eggs, no milky substance was extruded. This dry method of egg laying, if one may call it so, seems to be peculiar, as will be seen later, for when a fly deposits an egg in nature on a hair, it is cemented on firmly. These eggs did not seem to be sticky at all, but the grooved end of the egg was closed, which may account for it. To ascertain more about this, pressure was applied to the abdomen of a female and the ovipositor extruded, when an egg slowly appeared. As soon as it was partly out, the ovipositor was cut off, and mounted on a slide. The egg comes out of the ovipositor with the grooved end first; so that the ovipositor must in some way open out the groove of the egg, adjust it to a hair, surrounding it with the gummy substance before it fully comes out. I do not mean that the gummy substance is necessarily secreted at the time the egg is laid, but probably what happens is this:—the groove is opened and fitted on to a hair, and a certain amount of the gummy material within the groove displaced by the hair; this accounts for the surplus found at the point of attachment. The accompanying photographs illustrate this.

FIG. I. PLATE 3.

Ovipositor with egg.

FIG. II. PLATE 3.



Tip of ovipositor and egg enlarged. Photo S. Hadwen.

One peculiarity worth noting and which I have not seen mentioned before is that the egg is attached to the base of the hair, it was often quite difficult to pass a thin pair of scissors between it and the skin. The accompanying photographs also show this.

FIG. I. PLATE 4.

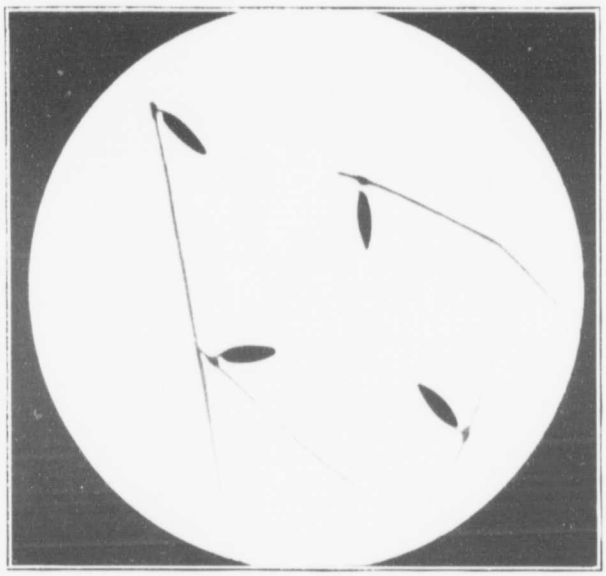


FIG. I.—Warble-fly eggs attached to hairs. Note attachment near base. Slightly enlarged.

FIG. II.

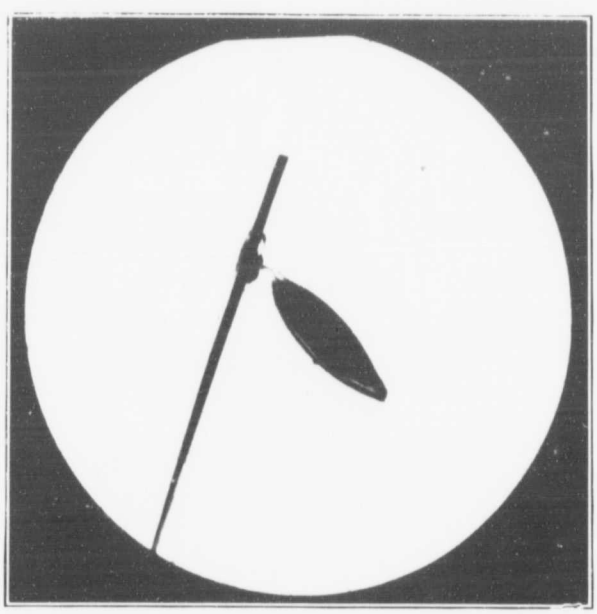


FIG. II.—Warble-fly egg attached to hair, Much enlarged. Photos S. Hadwen

Thus the egg cannot be licked as easily for instance as Gastrophilus eggs. (Horse Bot-fly). Some of the eggs were laid also in places which seem difficult for an animal to reach with its tongue, or at any rate difficult for it to exert the full force. I know that Bot-fly eggs are often laid in inaccessible places, and if I can make an analogy there may be many eggs laid in like places, but I cannot agree with Jost's theory (quoted by Carpenter) who says that the eggs are licked up at once, as soon as laid, which does not seem to me to be tenable; although some may be licked up, hair and all. In the first place the eggs are under the hairs, secondly they are well attached to the hairs, and thirdly I found four eggs

FIG. I. PLATE 5.

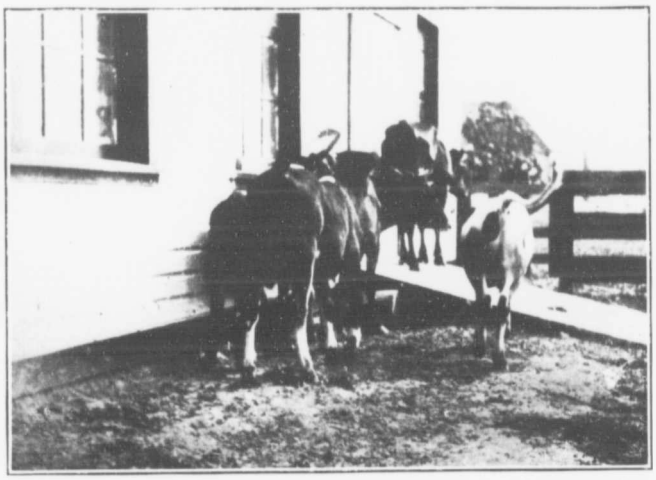


FIG. I.—Calves just after the fly had left them.

FIG. II.

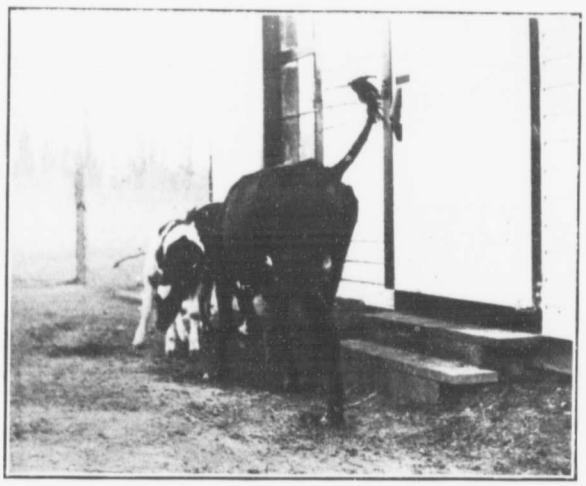


FIG. II—Calf has just seen fly and is on the point of running away.

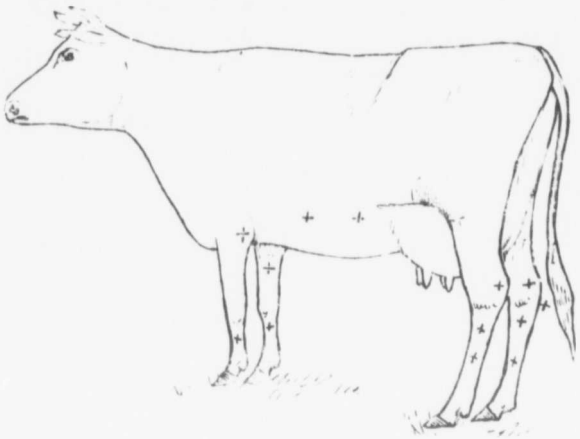
FIG. III. PLATE 5.

FIG. III.—Cow being chased by fly. Note terrified look of eyes.
Photos S. Hadwen.

on a calf's legs which had been at least eighteen days in that position, as the calf had been shut up for that period. The eggs were invariably found singly on the hairs (twenty eggs in all were collected). This does not agree with what Riley says for *H. lineata*, the fly cannot well see where the egg is put, and as it only lays one at a time, it would be difficult for it to find the same place and hair again. This is quite different with the Bot-fly, which lays at the ends of the hairs, and where the egg remains in full view. When a warble fly strikes, it hangs on for a second, evidently holding on with its legs while it fits on an egg.

Egg laying was observed a number of times, and whenever witnessed never occupied more than a few minutes. It may be described as a frenzied sort of process, the fly striking twenty or thirty times rapidly (no accurate account kept) then leaving the animal for fifteen minutes or so, when the process would be repeated. Neumann says that the fly planes over the animal for a time, then darts down, planes again, and so on. I have never observed this, the fly simply attacks the animal with a bull-dog pertinacity as long as it can, unless brushed off, when it may take to another animal. The following notes illustrate this point.

On August 2, at 11.45 a.m., a cow was tied securely to a fence, a warble fly which had been caught a short time before liberated, the net was opened gently, and the fly, after sunning itself for a minute, attacked the cow, It struck several times and was then recaptured. A search was made for eggs in places where the fly was seen to strike, and five eggs were found attached to hairs. At 2.00 p.m. a calf was tied up, the same fly was again liberated, after allowing it to strike a number of times it was caught. Nine eggs were found attached to the hairs in places where it had been seen to strike. The fly was again liberated later, but after striking a few times disappeared.



REGION WHERE EGGS ARE LAID.

PLATE 6.

Eggs were collected on the legs in positions marked X

The favourite places for the fly to strike seemed to be in the region of the hock in particular, and the back of the knee, occasionally striking as high as the stifle (where eggs were found) and along the flanks to about the same height. Once a fly was observed to strike at the jaw, whether this was accidental or not cannot be said, no egg being found there. *H. boris* seems to be a clumsy sort of a fly, and I believe that when it is seen high up on the flanks, it is often merely bumping into the animal in its endeavours to reach the opposite side. It is this clumsy, persistent attack, which, I believe, frightens the cattle, and I would suggest that probably it is this cause which makes cattle stampede, or 'gad.' When the Tabanidæ attack cattle, and cause annoyance, the cow simply flicks her tail, or brushes off the fly with her tongue, and feels that she has control, or can get away from the insect, but a warble fly comes buzzing along, strikes a time or two, and when the animal it is attacking kicks or stamps, it comes back, and goes on striking just the same. Then the animal begins to lose its head and runs away, and when it still finds itself followed becomes wild with terror. I have observed all these phases in the cattle I have been making observations on. The fear is contagious and spreads rapidly to other cattle, resulting in a stampede. An interesting occurrence was observed in this connection. The place where the observations were made this summer consisted of a barn, with a corral surrounding it, the barn was well lighted low down, giving the cattle inside a chance to see and hear those outside quite well. I have seen the inside cattle, which were tied up, lift their tails and get uneasy when those outside were being chased by a fly. On only two occasions were two warble flies seen attacking the cattle during the same day. I believe that the main reason, why more notes have not been made on oviposition, is simply because animals run and the fly follows, also that the flies are necessarily few in numbers, and even when the animals are in a small enclosure, it is not a very safe place for making observations. It is also difficult to tie an animal up, so that it will not injure itself. In the experiments in which the fly's wings were cut, an attendant simply held the cow's head, she was a small diseased animal, and therefore not hard to hold. When the fly remained quiet so did the cow, but when it tried to fly and buzz, the cow would look around, and if she saw it, would kick and endeavour to get away, then the attendant and I had difficulty in controlling her. That there is no pain attached to oviposition, I feel sure, as on more than one occasion, I have seen the fly strike a time or two before it was noticed. This was at a time when the Tabanidæ were numerous so that the animal did not notice the difference

en these and the Warble fly for a second or two.

The first time I became interested in Warble flies was in 1905 when I went to live on the prairies of Alberta. The 'cowboys' frequently spoke about the 'Heel Fly', and it was surprising the number of theories they had concerning it. Some of them were even inclined to be superstitious about it. All this is not to be wondered at and the inconvenience and damage the insect does on the prairies is enormous; for instance, a herd is being driven, or cattle are being 'cut out,' and in the middle of the operations they suddenly lift their tails and stampede. I have seen a herd quietly feeding when a little calf perhaps began capering about, then another lifted its tail, finally the whole band was running. The station I was in charge of was close to a river, it was here that the cattle made for when Warble flies were about. Once they were standing in the water, they seemed to be safe. I remember one day meeting a cowboy who seemed to be vastly amused about something; on inquiring the cause he said 'Well; I came riding by a little lake just now, and I saw some cattle standing in it with their yokes on, a disconsolate settler was sitting on the bank, who said that he was waiting for them to come out with the plough, and that he would not get much ploughing done if the flies did not stop chasing his cattle into the water.' It seems strange that there should be any doubt about these questions. Neumann, for instance, wonders if really *H. bovis* causes cattle to gad, or if the Tabanidae Mosquitoes, Simulidae, etc., are responsible. Personally, in all my experience, I have never seen cattle stampede or gad from any other cause but the Warble fly. I have frequently seen cattle and horses so plagued with flies, mosquitoes, etc., that they could apparently stand it no longer. They would then run into bushes, or dust themselves, but it always seemed to me to be more an expression of anger than fear. The fear is also not contagious as only one or two at a time will run away. Another argument against other insects causing cattle to gad, is that cattle only stampede in bright sunshine, whereas they are often more plagued by mosquitoes and other insects during the night. All these questions, however, are in my opinion more in the realm of Comparative Psychology than of Entomology.

Hatching of Eggs.

Out of twenty eggs collected on the hairs, only one was found with the end split open, twenty-five other eggs, laid by flies in captivity, were kept in vials supplied with moisture, but none hatched.

PLATE 7.

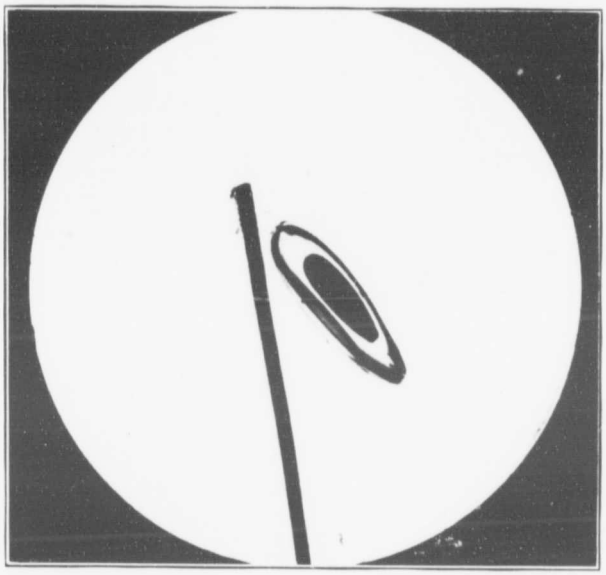


FIG. I.—Larva inside egg much enlarged. Photo S. Hadwen.

LARVÆ.

Five larvæ were found under the mucous membrane of the œsophagus on August 15, these were secured from a calf which had been tied up inside since July 29. The measurements are as follows:

3·4 m.m.
4·4 m.m.
4·8 m.m.
3·8 m.m.

The larvæ are similar to those mentioned by Carpenter as being observed by continental writers. They are however quite different from the second stage, described by several writers, in having rows of minute spines on the segments, but, as Carpenter has observed, the spines are small and might readily be overlooked. Four larvæ were secured from the œsophagus of one of the experimental cows on November 14. The last time Warble flies were seen near this cow was on August 2, so that the larvæ would be in the neighbourhood of four months old, certainly not more than five. The first time the cattle were chased by flies was on June 8. The measurements of the larvæ are as follows:—

11·5 m.m.
9·3 m.m.
8·8 m.m.
10·3 m.m.

The immature larvæ recorded here are presumably those of *H. bovis*, as no specimens of *H. lineata* were captured, nor were any mature larvæ of this species found at Agassiz.

METHOD OF LARVÆ REACHING OSEOPHAGUS.

With regard to this problem nothing definite has been ascertained, but I believe that a continuation of the study of the egg-laying habits of the fly, and of the eggs 'in situ' on the animal, will yield results. The other stages of the larva have been so fully described by many authors,* that I have nothing to add, except some remarks to make about the mature larva.

PLATE 8.

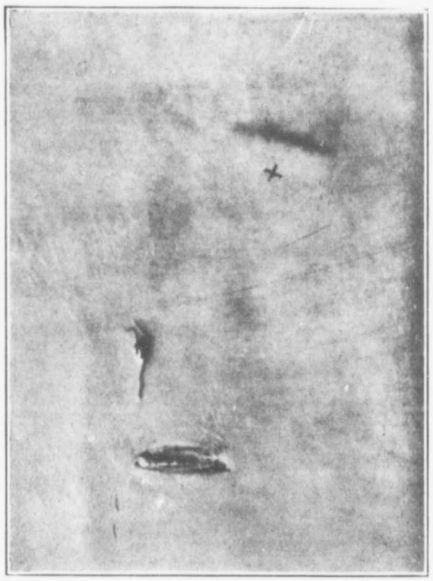


FIG. 1—Larvæ in œsophagus. Mucous membrane incised to show larva. The shadowy outline of another larva may be seen at the point marked +

A number of larvæ were secured from the animals. The method followed was to glue a piece of gauze over a warble, from which the larva looked about ready to emerge. Some powdered aloes was mixed with the glue, and a little dusted over the patch. The aloes prevented the cattle to a certain extent from licking the patches, and as they were not put on until the grubs were about ready to emerge, there was generally no very long wait. The emerged larvæ were usually found in the morning, this peculiarity has already been noted by Miss Ormerod and others. The fact is of some importance for stabled animals. Many of the grubs are no doubt carried out in the manure, where a number must perish; this would not apply to such an extent in old badly kept stables, where there would be an opportunity for the grubs to crawl into cracks and crevices. The first larva was seen to emerge on April 10, the last were found ready to come out on July 2. (One out of four native cows and two out of eighteen cows imported from Ontario the previous autumn.) Thus the season in Eastern and Western Canada seems to be about identical. It is reasonable to suppose that the period the larva spends within the body must equal the world over, seeing that an animal's temperature does not vary in different countries. The time of emergence of the larva is however bound to vary owing to climate,

* See references, page 20.

as egg-laying coincides with warm weather. It has been said that squeezed out larvæ do not hatch, but one out of three squeezed out larvæ gave rise to a normal puparium, and a male emerged in thirty days. However, these three larvæ were as far as one could judge, quite ready to come out, they were squeezed out for fear they would be lost.

The part of the animal in which the larvæ elect to go through their last stages is in the back. It is easy to see the reason for this, they are comparatively safe from injury themselves, and the animal receives a minimum amount of injury also, which is characteristic of nearly all parasites.

FIG. I. PLATE 9.

FIG. I.—Puparium enlarged.

FIG. II.

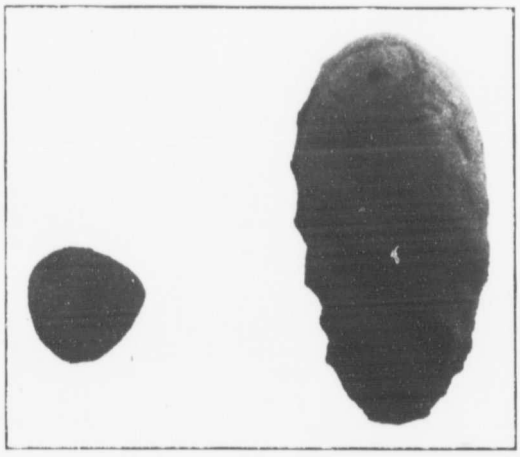


FIG. II.—Puparium with cap attached showing method of emergence of fly.

Photo S. Hadwen.

REMEDIES.

Many remedies are recommended for killing or extracting the grubs. As for the practice of killing the larvæ under the skin by injecting petroleum or applying mixtures to the back, I consider it unscientific, for when the larva dies, its body has to be absorbed. This is likely to take some time, and do the animal harm. The best method, undoubtedly, is to squeeze out the warble as early as possible, softening the skin first, in this way the wound will heal up rapidly. Moussu says that in Denmark the various agricultural societies engage men to go around and squeeze out the warbles early in the year; using a small knife to enlarge the opening when necessary. I do not know how tanners would view this, but should imagine the slight extra injury to the hide would be small, and that the resulting scar tissue would be less than is the case when the larvæ are left to come out by themselves. Of course in a small sea-girt country like Denmark, it is theoretically possible to eradicate the fly in this way, but I am afraid that in Canada, under present conditions, it would be an impossibility. Mixtures applied to prevent the fly laying, are according to all authorities, useless, and many of them are said to be injurious to the hides, and to the animals themselves.

In this country cattle are the favourite hosts of warbles, the only other animals I have seen affected are horses, but rarely so. Railliet records them also for sheep and man, but remarks that they do not seem to be found in any special part of the body, but wander about and do not reach maturity.

In the Southern States where dipping of cattle is extensively practised for the eradication of ticks, it has been found to result in preventing grubby hides, the dip evidently destroying the eggs or the newly hatched larvæ.

SPECIES OF WARBLES FOUND.

All the full grown warble maggots collected at Agassiz, proved to be those of *H. bovis*. Some of these came from cattle which originated in Eastern Ontario, and arrived here last December, so that this species should be found there also. Two larvæ collected at Mount Lehman, B.C., proved to be those of *H. lineata*. The two species are easy to differentiate by the aid of the spiny armature. In *H. bovis*, the segment in front of the tail (at which end are found the spiracles) is unarmed. In *H. lineata* the last segment is fully armed. There are other differences between the two species, which can be found in the various descriptions.

SUMMARY.

The annual loss to hides through warbles in Canada is between 25 and 30%. The percentage is based on the following:—

Percentage of grubby hides in warble season 56·55% (January to July, 6 months). This figure makes an average of 28·27% for the 12 months
The annual percentage of grubby hides is 34·22% .... 34·22%
The percentage of annual damage to hides is..... 19·62%
} = 27·4%

The warble-fly described here, for the first time in Canada, is *Hypoderma bovis* (De Geer.)

The egg is laid close to the skin at the base of the hair, and is cemented on by the ovipositor.

The eggs are laid on the legs.

These facts are of some importance, as for a remedy, some solvent material may be found for the cement, or as a repellant for the fly.

The terror which the fly inspires in cattle is probably due to the insect's persistence, and indifference to the kicks and stamps of the animal.

The first larvæ were found in the œsophagus on August 15, they were under 5 m.m. in length, and were provided with minute spines on all segments.

It is recommended that cattle be housed during the heat of the day, and that the grubs be squeezed out early in the season.

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