No. 115. Issued April 15, 1910.

United States Department of Agriculture,

BUREAU OF ENTOMOLOGY.

L. O. HOWARD, Entomologist and Chief of Bureau.

THE HORN FLY.

(*Hæmatobia serrata* Rob.-Desv.)

By C. L. Marlatt, M. S.,

Assistant Entomologist and Acting Chief in Absence of Chief.

INTRODUCTION AND SPREAD.

The horn fly is one of the worst of the European biting flies that attack cattle, but, curiously enough, it failed to reach this continent until a comparatively late date, notwithstanding abundant importations of live stock from Europe during nearly three centuries. It

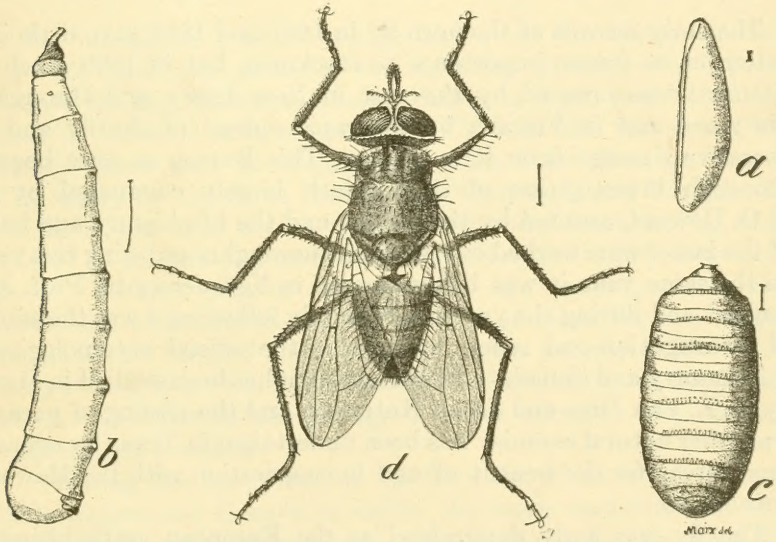

Fig. 1.—Horn fly (*Hæmatobia serrata*): *a*, Egg; *b*, larva; *c*, puparium; *d*, adult in resting position. Much enlarged. (From Riley and Howard.)

was first discovered and reported to this Bureau in the fall of 1887 as occurring near Camden, N. J. The following year it appeared in Maryland and Virginia, and thereafter spread rather rapidly, and by 1891–1892 it was found over the continent from Canada to Texas

The horn fly exhibits a certain preference for red or other dark-colored cattle, and that such animals are more thickly infested has been frequently noted. When the insects are abundant, however, this preference is not so strongly marked. Occasionally sores are formed on the animals, which in the South and West may become infested with the screw worm (*Chrysomyia macellaria* Fab.). These wounds or sores are, as a rule, only indirectly the result of horn-fly attacks, but are commonly produced by the rubbing of the cattle in efforts to allay the irritation from the bites.

The loss occasioned by the horn fly to other animals is, as a rule, inconsiderable. Sometimes horses are attacked, and especially cow ponies, and injury to sheep, as pointed out by Norgaard,[a] is complicated with sheep scab.

LIFE HISTORY AND HABITS.

The appearance and abundance of the flies is governed by temperature and rainfall. In the latitude of Washington they are first noticed in May, and become most abundant in July, gradually dwindling to November or until sharp, frosty nights become frequent. Farther south they appear earlier and remain in evidence later. The study of this insect in Texas by agents of this Bureau, notably Mr. J. D. Mitchell, at Victoria, indicates that the fly reaches its first maximum of abundance in May. During the subsequent dry period the fly decreases in numbers until fall rains begin, when a second maximum is reached in late September, which is checked by the frosts of the latter part of October. Continuing on from then until March the fly is kept down to comparatively small numbers by low temperatures. The reduction of the numbers of the fly in Texas by a dry, hot summer is sometimes as great as 95 per cent from the maximum of May.

The characteristic habit of the fly in clustering about the base of the horn is developed only when the flies are abundant. When they average only 100 or so to an animal, comparatively few will be found on the horns. The horn-clustering habit is more noticeable in the spring and early summer than in autumn. The horns are not the only resting places, and many of the flies cluster upon the back, between the head and the fore shoulders, where they can be reached by neither head nor tail. When the cattle are feeding, the flies are found over the back and flank and on the legs, and during a rainstorm they flock beneath the belly. When the animal is lying down, a favorite place of attack seems to be under the thigh and back belly around the udder. The characteristic appearance of the flies on the horn is indicated in the accompanying illustration (fig. 2).

---

[a] Rep. Agr. and Forestry, Hawaii, 1905, pp. 171, 211, 212.

In the feeding position the wings are slightly elevated, and are held out from the body at an angle of 60° from the abdomen; the legs are held out widely, and the beak, inserted beneath the skin of the animal, is directed almost perpendicularly (see fig. 3, *c*). Before inserting its beak the fly works its way through the hair close to the skin, but is able at the least sign of danger to rise instantly in flight, to return as quickly. The characteristic appearance of the fly is shown in the accompanying illustration (fig. 1). It is about half the size of the house fly, which it closely resembles, but is much less robust.

Differing from other biting flies, the horn fly normally stays on the cattle night and day, and when not feeding rests on the cattle as already described.

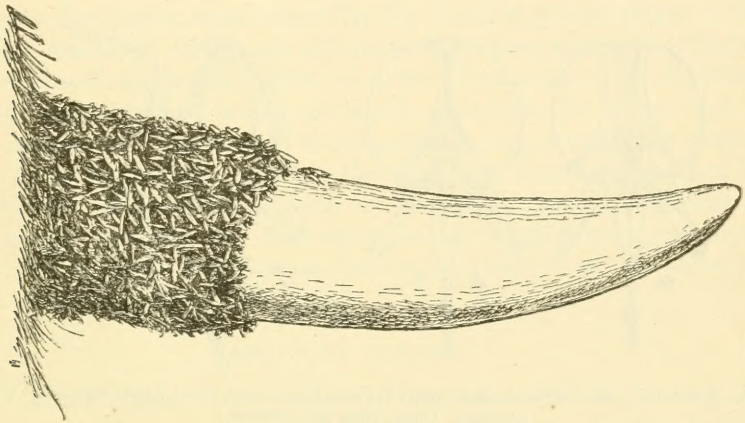

FIG. 2.—Cow-horn showing band of resting horn flies. Reduced. (From Riley and Howard.)

The egg-laying habit of the insect was not easily discovered and is somewhat peculiar. The eggs are laid singly and usually upon their sides upon the surface of wet dung. The moment the latter is dropped, a swarm of flies dart from the animal to the dung and remain there a few seconds, or a minute at the most, during which time many eggs are deposited. Egg laying is chiefly during daylight, between 9 a. m. and 4 p. m., and most abundant during the warmer morning hours. So far as we know, they are laid upon no other substance, and never upon old dung.

The larvæ upon hatching descend into the dung, remaining, however, rather near the surface. When full grown they are about two-fifths of an inch in length and of the normal color and form of the related dung maggots. The puparium is formed in the ground beneath the dung. The time elapsing from the egg to the adult is from ten to seventeen days, and there are probably seven or eight generations annually in the latitude of Washington, with more in the South,

and continuous breeding in a tropical region like the Hawaiian Islands. The winter habits as studied near Washington, D. C., indicate that hibernation normally takes place either in the adult stage or as puparia below the surface of the ground.

PARASITES AND NATURAL ENEMIES.

The natural enemies of the horn fly, like those of most other dung-breeding flies, are destructive to the insect in its larval and pupal stages. Therefore the bringing over of the insect from Europe in the adult stage with cattle resulted necessarily in its freedom for a time from the control by such natural enemies. The similar enemies of other dung flies in this country, however, undoubtedly very soon began to exercise a certain degree of control, and this may account

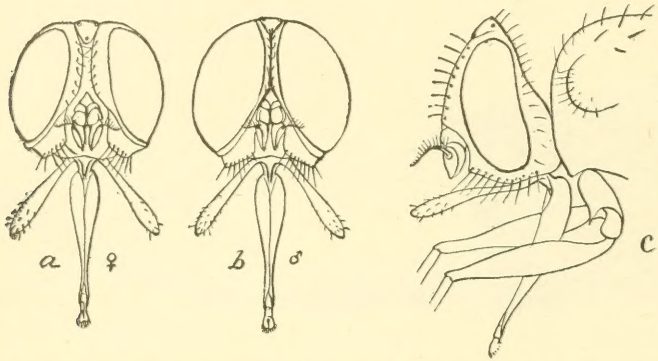

FIG. 3.—Horn fly: *a*, Head of female, front view; *b*, head of male, front view; *c*, head from side. Greatly enlarged. (From Riley and Howard.)

somewhat, at least, for the much greater damage occasioned by the horn fly in the first years of its occurrence in the different zones of its spread across the continent than was the case during subsequent years. Very early after the appearance of the horn fly it was noted by Mr. F. M. Webster that in Ohio fully 20 per cent of the flies were infested by one of the scarlet mite fly parasites (Gamasidæ). This mite was not determined, but was probably one of the native species commonly seen on other flies.

The introduction of the horn fly into the Hawaiian Islands and the heavy losses there occasioned by it led to an active investigation on the part of the island authorities of parasites and predaceous enemies. Mr. Albert Koebele imported, in 1905, from New South Wales, quantities of material from which dung beetles were reared and introduced into the islands. In 1906 Mr. Koebele came to the United States and made extensive collections of material in California and Arizona, and from this material at least six or seven species of dung beetles were introduced into the Hawaiian Islands, and two species of true parasites.

The beetles in question are those which habitually live in cattle dung and feed upon living maggots therein, or are of the tumblebug variety which disintegrate the dung shortly after deposition, thus preventing or checking the breeding of the flies.

The true parasites reared from material sent by Mr. Koebele from Arizona proved to be *Eucolia impatiens* Say, styled "the Arizona dung-fly parasite," and a species of Eutrias, styled "the lesser dung-fly parasite." These two minute four-winged flies are undoubtedly normally enemies of native dung-breeding flies, but take readily to the horn fly. They were reared in considerable numbers and distributed among the ranchmen on the islands. It is too early yet to determine whether these importations will be of much practical value in controlling the horn fly.

Two other similar minute Hymenopterous parasites, belonging to the genus Spalangia, were reared by Mr. Kotinsky from pupæ of the common stable fly (*Stomoxys calcitrans* L.), from material collected on the Island of Hawaii. One of these, *Spalangia hirta* Haliday, confined with horn-fly pupæ, promptly attacked the latter, and in three or four weeks a brood of these parasites was successfully reared. Later, horn-fly pupæ collected in the field were found parasitized by this species. The other parasite, *S. lanaiensis* Ashm., supposed to be a native species, was also again reared from Dipterous pupæ. That both of these will become important enemies of the horn fly seems to be established.

MEANS OF CONTROL.

The simple means of prevention of abundance of the flies by the destruction of larvæ in the dung and the protection of animals from the attacks of the adults, suggested in the earlier investigation of the subject by this Bureau, have remained the standard means of control, with some improvements and amplification enabling them to be carried out on a larger scale and at less cost. There are two principal methods of control—one, the destruction of the larvæ and pupæ in the cattle dung by direct measures or by the action of natural enemies already discussed; and the other, the protection of cattle either by the use of repellent ointments or by the actual capture and destruction of the adult flies.

Repellents.—Almost any greasy substance will keep the flies away for from a few hours to several days. A great many oils and fats have been experimented with, and the commercial product known as fish or train oil, first suggested, remains the best easily available ointment. The protection by the use of this mixture varies in different regions. In the dry, hot area of the West and Southwest protection lasts only two or three days; in the more moist and cooler regions of the

East and North, five or six days. This oil costs from 50 to 75 cents a gallon. The addition of a little sulphur or carbolic acid is of benefit, the latter making the application somewhat healing if any sores have been formed. Where only a few animals are to be treated, as a home supply of dairy cattle or a dairy herd, the application can be made with a common painter's brush. It may be unnecessary to attempt to protect the entire animal, but only those parts not reached by the head or tail, although the more completely the animal is covered the greater will be the reduction of loss.

In Virginia Prof. W. B. Alwood found that animals could be treated with the standard insecticide, kerosene emulsion, applied with a small hand-spray pump. This application killed all the flies that were actually wetted by it and gave protection to the treated animals for two days. With a little tobacco water added he found two applications a week sufficient, using from 1 to 2 pints for each animal. The application was made just after milking, and was only tested on dairy animals.

Kerosene emulsion is prepared after the following formula. The crude oil yields a stronger and more lasting product:

Petroleum, refined or crude	gallons	2
Whale-oil soap (or 1 quart soft soap)	pound	½
Water (soft)	gallon	1

The soap, first finely divided, is dissolved in the water by boiling and immediately added boiling hot, away from the fire, to the oil. The whole mixture is then agitated violently while hot by being pumped back upon itself with a force pump and direct discharge nozzle throwing a strong stream, preferably one-eighth inch in diameter. After from three to five minutes' pumping the emulsion should be perfect, and the mixture will have increased from one-third to one-half in bulk and assumed the consistency of cream. Well made, the emulsion will keep indefinitely and should be diluted only as wanted for use.

In limestone regions, or where the water is very hard, some of the soap will combine with the lime or magnesia in the water, and more or less of the oil will be freed, especially when the emulsion is diluted. Before use, such water should be broken with lye, or rain water should be employed.

It may be used pure or diluted with one part of water for local applications with a brush, or with two or three parts of water as a spray.

A mixture recommended by the Kansas Experiment Station,[a] claimed to be as satisfactory and considerably cheaper than fish oil, is made after the following formula: Pulverized resin, 2 parts, by

[a] Press Bul. No. 65, March 20, 1900.

measure; soap shavings, 1 part; water, ½ part; fish oil, 1 part; oil of tar, 1 part; kerosene, 1 part; water, 3 parts. Place the resin, soap shavings, ½ part of water and fish oil together in a receptacle and boil till the resin is dissolved. Then add 3 parts of water, following with the oil of tar mixed with the kerosene. Stir the mixture well and allow it to boil for fifteen minutes. When cool the mixture is ready for use, and should be stirred frequently while being applied. This mixture costs about 30 cents a gallon, and from one-eighth to one-half pint is sufficient for one application with the brush method.

The methods just described are not applicable to large grazing herds or cattle on the range.

Fly control on the range.—For the control of the horn fly on range cattle on a large scale the dipping-vats system employed for the control of the cattle tick or other skin parasites offers the best solution of the problem. The oily dips used for the Texas-fever tick, described in a publication of the Bureau of Animal Industry of this Department[a] can be made to serve as a very effective means of controlling the horn fly. It was early discovered that dipping cattle in these oily mixtures in the ordinary way was of little service in destroying the horn flies. The cattle dips were repellent to the horn fly for a very short period, and the percentage of the flies killed by the operation was inconsiderable. During the last three years, however, Mr. J. D. Mitchell, an agent of this Bureau, working with Mr. W. D. Hunter in Texas, has, in a study of the requirements for horn-fly control, found that by a very simple modification of the ordinary dipping vat a very large percentage of the flies on the cattle can be destroyed, with the consequent very notable limiting of the loss from this fly pest. With the vats as ordinarily constructed, most of the flies abandon the animal at the moment it plunges into the dip and escape, and go to other animals, and ultimately with the drying of the dipped animal return to it. Mr. Mitchell found, however, that by putting a splashboard near the top of the vat on either side, about 4 feet above the level of the dip, the water thrown up violently as the animal plunges in is caught by these splashboards and is thrown back as a spray, filling the air space above the animal and drenching and destroying the flies in their effort to escape. The few of the horn flies that may escape, together with those which abandoned the animal at the entrance to the vat, were observed to hover or settle on the chute fence, and many would alight on the next animal coming along. He also found that where the animals have been heated in corralling and getting them into the chute the flies stick much closer and are much less apt to take quick flight, thus insuring the capture of a larger percentage of them by the dip and spray.

---

[a] Farmers' Bulletin 378, October, 1909.

The first suggestion of splashboards was not as a means of controlling the horn fly but to keep the fluid from wasting over the sides of the vat and to protect the men who were working near the vat. When a large animal strikes the fluid the splash will fly as high as 6 feet, and the spray will scatter widely.

The accompanying detailed sketches illustrate two vats equipped with splashboards which have been used very successfully for a number of years in Texas. The first sketch (fig. 4) is a cross section of the vat constructed by Mr. J. J. Welder, Victoria County, Tex. A ground plan of the entrance is illustrated in figure 5. Mr. Welder's vat is a rather large one, having a surface level of the dip 5 feet wide but with an entrance chute to the vat of only 3 feet and 9 inches. The splashboards are 2 feet wide and 20 feet long, extending from the termination of the entrance chute. In the case of this dipping vat the animal is confined to the middle of the vat and entirely away from the splashboards by the narrow entrance chute.

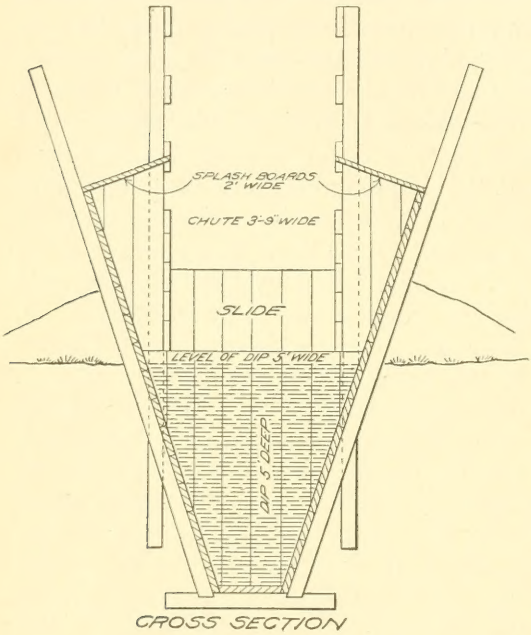

FIG. 4.—Cross section of dipping vat used by Mr. J. J. Welder. (Original).

Another similar vat is illustrated in figure 6. This vat was constructed by Mr. A. P. Borden on the Pierce Ranch, Wharton County, Tex. The splashboards are 1 foot wide and extend the full length of the vat, and can be used, if necessary, as a walk in assisting cattle in trouble. The ends of the splashboards next to the entrance are rounded off in the case of this vat; but the entrance slides, as illustrated in the ground plan of the Welder vat (fig. 5), and the height of the splashboards above the dip level, have in the actual treating of hundreds of cattle prevented any difficulty of catching or colliding of the animals with the splashboards, and were used on a number of vats in Texas most successfully during the years 1907 to 1909.

With vats equipped like the above, from 75 to 80 per cent of the horn flies on the cattle are destroyed.[a]

Mr. Hunter experimented with a small model of a dipping vat, and found that if the splash were received on a slightly curved galvanized-iron sheet instead of a board it was considerably more effective in distributing the back throw of the water in the form of an efficient spray.

The arsenical dips used for the cattle tick would have comparatively little value for the horn fly except that very likely a good many flies might be caught and destroyed by merely being wetted with the dip.

A similar treatment has recently been the subject of experiment in the West. An apparatus has been constructed, designed more particularly for the destruction of skin parasites of cattle, to supplant the old method of dipping in a vat. It has been suggested that this apparatus will furnish a very good means of control in the case of the horn fly. The probabilities are, however, from the experience with the horn-fly traps referred to below, that most of the flies would abandon the cattle at the moment of entrance to the cylinder, and its efficiency as a means of horn-fly control is very problematical.

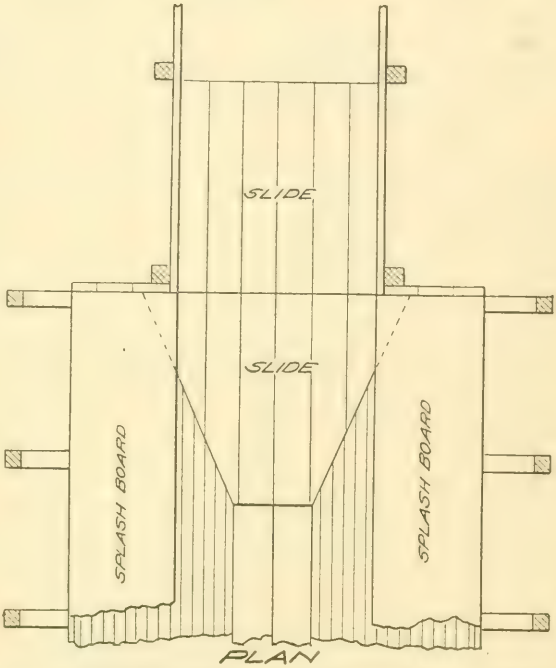

FIG. 5.—Ground plan of dipping vat used by Mr. J. J. Welder. (Original.)

The process consists in driving the animals through a large cylinder through the sides of which a powerful gasoline pump causes sprays of the insecticide to strike the animals from all quarters and thoroughly wet them. This machine is patented and is sold at a rather excessive price. The liquid used is an emulsion of crude petroleum

[a] For further details of the construction of dipping vats see Farmers' Bulletin 378, "Methods of Exterminating the Texas Cattle Tick," by H. W. Graybill, Bureau of Animal Industry. In the case of the vat there described, to successfully use the splashboard it may be necessary to increase the height of the sides of the vat so that the splashboards can be placed 4 feet or a little more above the level of the dip.

in water in the proportion of 20 gallons of oil to 80 gallons of water, with the addition of 5 pounds of soap. This apparatus is claimed to be able to take care of from 3,000 to 4,000 head of cattle per day. With this or some similar device the control of the horn fly on a broader scale may prove practicable.

Horn-fly traps.—Various attempts have been made to collect horn flies from cattle by means of traps, the general plan being to pass the

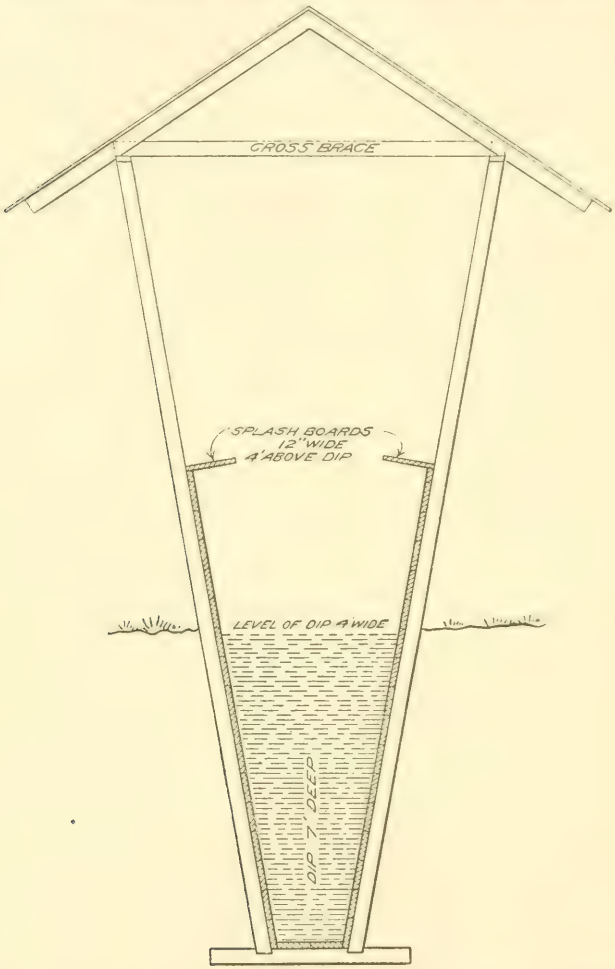

FIG. 6.—Cross section of dipping vat used by Mr. A. P. Borden. (Original.)

cattle through a dark room or chamber arranged with brushes at the exit to drive the flies from the cattle and retain them in the chamber, where they may be attracted to a lighted cupola, captured, and destroyed. Mr. P. J. Parrott, while connected with the Kansas Experiment Station, conducted elaborate experiments in this direc-

tion,[a] but the results were most unsatisfactory, the great majority of the flies abandoning the cattle at the moment of entrance, so that only about 5 per cent of the flies were captured.

Destruction of larvæ and pupæ.—The destruction of larvæ and pupæ in the dung by direct measures and consequent reduction in the numbers of the adult insects is a possible means of control, not, however, always practicable, and having little utility in the case of range animals. Two methods of locally destroying the flies in the dung have been shown to be fairly effective. A spadeful of lime thrown on cow dung will destroy the larvæ living in it, and in small pastures such treatment of dung, especially at points where the cattle are more apt to congregate, may be feasible. This treatment is especially useful if carried out during May and June, as every larva killed of the early broods means a very large reduction in the number of flies for midsummer and later in the season.

Prof. J. B. Smith suggests another means of control, namely, the spreading out of the fresh dung with a shovel, which causes the rapid drying of the dung and the destruction of the Dipterous larvæ contained in it. This method also is feasible only in the case of small pastures and in dry weather. An inexpensive method, suggested by Mr. D. L. Van Dine, of scattering the dung in yards and pens and causing it to dry quickly is to allow a number of pigs to run with the cattle. In their efforts to obtain undigested particles of food the pigs will effectually destroy the dung as breeding places for the fly, at least during dry periods.

A dairyman in Texas, as reported by Mr. Hunter, has followed an analogous method of control which has given him very considerable protection from the horn fly. He makes it a practice to collect daily the dung in and near the dairy barns, and every few days this collected material is taken out and distributed with a spreading machine on the pasture, so that it promptly dries up and the breeding of larvæ in it is prevented. Wherever this practice is feasible it is to be strongly recommended, and has the important additional argument in its favor of conserving the valuable manurial material which might otherwise go to waste.

In the same way, as observed by Mr. Mitchell, during the dry period of July and August in western Texas the horn fly is very much reduced in numbers by the rapid desiccation of the cow droppings.

Approved:

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *November 17, 1909.*

---

[a] Kansas State Agr. Coll. Exp. Sta., Press Bul. No. 49, November 7, 1899.