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STOMACH WORMS IN SHEEP

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STOMACH WORMS IN SHEEP

By JOHN E. GUBERLET
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One of the most serious pests of the Oklahoma sheep raiser is the stomach worm (*Haemonchus contortus* Rud). It is also commonly known as the "wire worm," "twisted wire worm," and "striped worm". The presence of these worms in considerable numbers in the fourth stomach of sheep, goats or cattle causes a disease known as "verminous gastritis," "gastro-intestinal strongylosis," "wasting disease," or "stomach worm disease." Worm infestations occur most frequently during or immediately following warm wet seasons, or where the animals are pastured on low swampy land. Lambs are generally more severely affected than older sheep, although the older animals may show marked symptoms when severely infested. It is not an uncommon occurrence for sheep raisers in infested regions to lose from five to fifty per cent or more of their flocks from the ravages of the stomach worm.

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HISTORY AND DISTRIBUTION OF THE STOMACH WORM

The stomach worm disease has been known among sheep raisers for many years. It has been reported many times from various countries throughout the world. There have been some especially severe outbreaks at intervals in parts of Germany for nearly a hundred years. Similar reports have come from Northern France, also parts of England and Scotland. A great deal of trouble has been experienced with this malady in South Africa, Australia, and in parts of South America. In the United States it has appeared at intervals in nearly every state in the union in more or less severe outbreaks. It has been so severe in some sheep raising localities that the sheep owners have become discouraged and discontinued the raising of sheep.

EFFECT UPON THE HOST

The stomach worms cause injury to sheep in two ways: First, these worms are blood suckers of the very worst type and consequently, when numerous, extract a large amount of blood from the host; second, they secrete a poisonous substance which is absorbed by the blood and destroys the red blood cells. Older and stronger animals, and also well fed animals, are better able to withstand the loss of blood and absorption of the poisonous substance than lambs and under nourished sheep.

SYMPTOMS AND DIAGNOSIS

Lambs or sheep may be affected by stomach worms at any time of the year. The greatest trouble generally occurs first in lambs in the late spring or early summer and continues with more or less severity until autumn. This of course depends upon

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the temperature and the amount of moisture that is present during the season. Less infestation occurs during a dry season than during a comparatively wet one.

Very often the first indication of stomach worm disease is realized through the death of several lambs. However, flocks that are carefully observed will show symptoms at a much earlier date. The animals affected become dull and unthrifty and later may have diarrhea. These conditions may be the result of other causes, but when due to stomach worms the animals also show a pale, bloodless appearance of the skin and of the mucous membranes of the eyes and mouth. This paleness of the skin is often known as "papery skin." When diarrhea is present it is usually black and often contains a large amount of soil. The affected animals will often eat large amounts of soil when turned out to pasture in the morning. In severe cases of stomach worm infestation there is often a watery or dropsical swelling under the jaws, and sometimes it may also occur on the sides of the nose, on the cheeks, and on the brisket.

When death occurs from stomach worm disease it often comes on slowly and the animal, unable to rise, may linger at the point of death for a day or more. In case there is doubt, as to the cause of the trouble, it can be removed by examining the fourth stomach of the dead animal. In case where none have died and a large flock is affected, from an unknown cause, one could well afford to kill an affected lamb in order to make an examination. The fourth stomach is one of the four divisions of the stomach and is continuous with the intestine. If one is in doubt as to the location of this part of the stomach it can easily be located by taking hold of the small intestine and following it forward to the stomach.

The fourth stomach should be opened almost its entire length, being careful not to lose its contents, where the stomach worms, if present, can be seen, wriggling around in the fluid. The worms are rather small and may easily be overlooked, being from one-half to one and one-fourth inches in length and as thick as a medium sized needle. They are spirally striped with red and white. On emptying the contents of the stomach some of the worms will be seen attached or adhering to the inside walls. Occasionally, a few of the worms may be found in the small intestine but these are so few in number that as a rule they are of little consequence.

LIFE HISTORY OF THE WORMS

The adult stomach worms can live only in the alimentary canal of sheep, goats, cattle, or other ruminants, occurring in largest numbers in the fourth stomach, or abomasum. The female worms deposit hundreds of eggs daily into the stomach, or intestine, which pass along with the contents and are eliminated from the host with the feces. The eggs are microscopic in size and do not hatch until after they have reached the ground. If the eggs have been deposited under favorable conditions of temperature and moisture they will hatch out into tiny embryonic worms. The length of the incubation period depends upon the temperature. In real warm weather the eggs may hatch in a few hours but in cool weather it may require several days, or even weeks. During freezing or very dry weather the eggs are destroyed and will not hatch. After hatching the larval worms live in the feces or soil and grow rapidly and develop into the infectious stage. This requires from four or five days to two or three weeks, depending upon the temperature and moisture. This development requires a longer time in cool and dry weather than in warm wet weather. During

this period of growth the larval worms may be killed by freezing or drying. After the infectious stage is reached the small worms can withstand severe drought as well as prolonged freezing.

During the infectious or mature larval stage, the larvae have a tendency to migrate upward and in doing so crawl up onto clods of earth, blades of grass, or any upright object with which they may come in contact. The tiny worms make their ascent up the blades of grass during the night or early morning when the grass is sufficiently moist from dew, fog, or rain for them to be active. This may also occur during rainy, cloudy weather. During the ascent when the dew or moisture dries up the larval worms coil up wherever they happen to be and remain there until the next night or until there is sufficient moisture to enable them to continue their migration on the grass.

When larval worms are located high up on the grass they are in a much more favorable position to be eaten by sheep or cattle than if they were on the ground. Thus their chances for reaching maturity are very much increased. After being taken into the stomach they continue their development and reach the adult stage within the host in about three weeks (18 to 25 days).

EFFECT OF LIGHT AND MOISTURE ON THE DEVELOPMENT OF THE PARASITES

According to Veglia (1915: 412, 413, 420), the embryonic stomach worms are more active in migrating at night or during a diffuse light, such as is observed during cloudy, rainy weather. He has also noted that when the light becomes bright the larvae coil up on the grass, or if there is sufficient moisture they migrate downward on the grass and may go into the soil until favorable light and moisture conditions reappear. This shows that animals are more likely to become heavily infested when grazing at night or during cloudy rainy weather.

Moisture, however, is one of the chief factors in the development of the young stomach worms from the time of hatching until they are taken up by the adult host. If the eggs are deposited in an area where there is very little moisture they will not hatch, or, if they do hatch, the embryos will die. When the larval worms have reached the infectious stage, and there is no moisture, they cannot migrate onto an upright object, and consequently, their chances for gaining entrance to the adult host are very slight.

It is a commonly known fact that very little trouble is encountered with stomach worm disease during dry seasons, or on high and dry land. The greatest trouble from these parasites occurs during cloudy, rainy seasons, or on low swampy lands, where the conditions of moisture are favorable for their development. The larval worms can live also in shallow pools and along the edges of ponds where cattle and sheep come to drink.

RESISTANCE OF EMBRYOS

The embryos of stomach worms, before developing to the ensheathed or infectious stage, show but slight resistance to cold and dryness. After reaching this stage they show remarkable resistance to adverse conditions. Larval worms have been demonstrated to live in soil, feces, and on blades of grass for long periods of time during which they have been in a dried-up condition, frozen and moistened at

intervals. Ransom (1908) found living larvae in feces in laboratory cultures after nearly nine months. He showed also that infectious larvae may live at temperatures continuously below freezing for two or three months. Some of his cultures were repeatedly frozen and thawed a large number of times without destroying the larval worms (1906). Powers (1909) kept an infested lot vacant for ten months and then he turned a calf into it. This animal became infested with stomach worms. Veglia (1915: 395) found that mature larvae live for five months in water.

In this laboratory, larval worms have often been kept alive on grass in cultures of feces and soil for four or five months, and for a much longer time in soil. A few were observed on two occasions to live in soil and feces for over eight months. In one extreme case two living larvae were found in a mixed culture of sterile soil and feces after a period of nearly sixteen months. The eggs in this case were placed in the culture on July 23, 1919, and the two living larvae were found November 18, 1920. In this instance the larvae were so sluggish and in such a distorted condition that they undoubtedly would not have been able to continue development even if they had gained entrance to an adult host.

Under field conditions in Oklahoma where there are many factors entering, such as sudden climatic changes, high summer temperatures, and the rapidity with which the moisture on the grass dries up, it is probable that most stomach worm larvae do not ordinarily survive much longer than eight or ten months, and still retain enough vitality to continue development, if taken up by an adult host.

SOURCES OF INFESTATION

The question of the source of the infestation of sheep with stomach worms naturally comes up at this point. We may ask how do the sheep get these worms? Where do they come from? Is there a reservoir or supply of worms for infestation?

There are several sources or reservoirs where the larval worms may be held in reserve for some months and sheep be thus infested. If sheep, or other ruminants, harbouring stomach worms are brought into a locality they will scatter the eggs of these parasites. Some of the eggs will be dropped in favorable conditions and will hatch and develop into infectious or mature larvae. A portion of these mature larvae will migrate immediately onto the vegetation and will remain there for a period of time ranging from a few days to perhaps two or three months. During this time if these larval worms are eaten by sheep, or other ruminants, they will continue development in the stomach. Another portion of the larval worms will remain in the soil and feces for several months and then during a period of high humidity or rainy weather they may migrate onto the grass or vegetation and there be eaten by grazing animals. Some of the eggs or larval worms may be carried in drainage water to ponds or pools where they develop to the infectious stage. The embryonic worms may live in the water for several weeks where they may be swallowed by sheep, cattle or goats while drinking. Thus we have grass, soil and water as the important sources for infestation of sheep with stomach worms. The length of time the larval worms may live under various conditions is discussed under "Resistance of Embryos."

PONDS AND STAGNANT POOLS

Ponds and stagnant pools no doubt play an important part, both directly and indirectly, as a source for the transmission of stomach worms to sheep. Ponds or

pools which are frequented by such animals, harbour large numbers of larval stomach worms. These embryonic worms ordinarily remain on the bottom of the pond but apparently are more numerous in shallow water near the edge.

Samples of water were taken from a pond in an infested pasture. Some of these samples were taken at the edge of the pond from shallow isolated pools caused by tracks from larger animals. From two such isolated little pools nearly a pint of water was taken which was the entire content of the pools. When the water was examined with a microscope at the laboratory 30 larval stomach worms were found. Surface water taken at a point where there was a depth of eight to ten inches showed no worms.

Sheep have a peculiar habit of drinking from the very edge of a pond and will drink the water from the tiny isolated pools around the border. Thus, in this manner, they may swallow numerous worm larvae. Cattle in drinking from a pond usually walk out into the water for some distance and drink water free from worms.

Ponds and pools are also of importance indirectly in the transmission of stomach worms, in that the moist soil on their borders is favorable to their development, and the high degree of humidity of the atmosphere in the vicinity favors the migration of the larval worms onto the grass and other vegetation. In this connection it must be stated that wet or marshy low-land pastures should be avoided as far as possible because such areas afford excellent conditions for the development of embryonic stomach worms.

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TREATMENT

In most cases, the stomach worm disease can be treated successfully if taken before too far advanced. Treatment has been tried with several remedies with varying degrees of success. At present the most successful method seems to be that of the copper sulphate treatment, either alone or in combination with tobacco.

The use of copper sulphate as a treatment for removing stomach worms from lambs was first used by Hutcheon (1892, 1895) in South Africa, who reported its successful use in many cases. Later, copper sulphate was used by Stiles (1901), Ransom (1907), Hall and Foster (1918), and others with comparatively good results.

Several kinds of treatment for the removal of stomach worms from sheep were tried at this laboratory. The two most successful remedies were the use of a 1% solution of copper sulphate, or a solution containing 1% of copper sulphate and 1% of tobacco infusion. Large numbers of sheep were treated with the above remedies. The copper sulphate alone removed 75% to 97% of the worms, while copper sulphate and tobacco used together removed 90% to 100% of the stomach worms. Some of the results were based on the number of eggs in the droppings before and after treatment, as shown by microscopic examination. The most of the data were obtained by observing the number of worms passed in the droppings after treatment and later finding the number still remaining by autopsy.

When copper sulphate is used alone it does not seem to remove the worms as quickly as the combination of copper sulphate and tobacco. It has also been observed that copper sulphate and tobacco are somewhat more effective than copper sulphate alone in removing tapeworms (*Monezia sp.*) and hookworms (*Bunostomum trigonocephalum*) in addition to the stomach worms. With a single exception, every

case known to be infested with tapeworms that was treated with copper sulphate and tobacco and later autopsied showed none of these worms to be present. In that case all of the worms were detached and some of them might have passed out had the animal lived longer. Death was produced from screw worm infestation along with the weakened condition brought on by stomach worms.

The results of the experiments with the foregoing treatments on animals that were autopsied are shown in the accompanying tables. Table I shows the results of treatment with a solution containing 1% copper sulphate and 1% of tobacco infusion. Table II gives the results of treatment with 1% of copper sulphate. Table III shows results of treatment with tobacco infusion alone, using a solution of 1 to 1½%. The results with tobacco alone are varied. Several other animals were treated with tobacco and microscopic examinations of the droppings made for eggs before and after treatment showed similar results to those given in the table. The microscopic examinations showed that the eggs were reduced from 15 to 75%. This shows that tobacco used alone is not very satisfactory in removing stomach worms. However, tobacco possesses valuable anthelmintic properties when combined with copper sulphate.

TABLE I

Results of treatment with copper sulphate and tobacco:

No. of animal	Number of treatments	No. of stomach worms passed	No. of tapeworms passed	No. of hookworms passed	Stomach worms on post mortem	Tapeworms on post mortem	Hookworms on post mortem
225	1	3119	31	317	1	0	0
223	2	300*			0	0	0
226	1	2500*	20	30	100*	10	0
294	2	500*			0	0	0
293	2	300-400			0	0	0
297	2	100*			0	0	0
299	2	1200*	**		2	0	0
1382	1	225	5-6	9	0	0	0
1394	2	200-225	8-10	0	0	0	0
1391	2	225	11	0	0	0	0
263	2	2300	5-6	21	0	0	0

*Approximately **Several

TABLE II

Results of treatment with copper sulphate alone:

209	1	2000*			700-800	15	25
212	2	1200*	**		385	6	38
218	2	75*			2	0	0
2029	1	195	2	0	30	9	0
2034	1	850	0	0	135	0	15

*Approximately **Several

TABLE III

Results of tobacco alone:

1377	1	140*	0	0	18	0	0
1390	1	110	0	0	430	0	0
304	1	125	0	0	32	0	0

*Approximately

The copper sulphate should be made up into a 1% solution for drenching according to the directions as given in the United States Department of Agriculture Circular 47, which is as follows:

Dissolve one-fourth pound (avoirdupois) of the powdered crystals of copper sulphate (bluestone) in 1 pint of boiling water, using a porcelain, or enamelware dish, as the bluestone corrodes most metals. Then add cold water enough to make the solution up to 3 gallons, using wooden, earthenware, or other non-metallic receptacles. This will make aproximately a 1% solution and will be enough to dose 100 adult sheep, allowing 10 percent waste. In the preparation of the dose use only clear-blue crystals of copper sulphate. Crush the crystals to a fine powder when ready to make the solution.

The copper sulphate and tobacco should be made up into a solution containing 1% of copper sulphate and 1% of tobacco. It should be made as follows: Dissolve one-fourth pound (avoirdupois) of the powdered crystals of copper sulphate (bluestone) in one-half gallon of boiling water, using porcelain or enamelware dish. Put one-fourth pound of finely ground or powdered tobacco (tobacco snuff) into one-half gallon of boiling water, cover and let stand over night. In the morning mix the two solutions in a wooden, earthenware, or non-metallic receptacle and add 2 gallons of cold water. This makes a solution of proper strength to use and will be enough to dose 100 adult sheep, or 200 lambs, allowing 10 percent waste.

For treatment of small flocks where a smaller amount of the solution is needed, it may be made up as follows: Dissolve 1 ounce of copper sulphate in 1 quart of boiling water, 1 ounce of tobacco in 1 quart of boiling water; cover and let stand over night. In the morning mix the two solutions and add 1 quart of cold water. This makes a solution of the proper strength and is enough for 25 adult sheep or 50 lambs, allowing some for waste.

In the preparation of the solution only clear-blue, crystals of copper sulphate should be used. Crystals which contain soft white patches should not be used. Any kind of tobacco may be used provided that it has not been exposed too long. Plug tobacco may be used but in that case it must be finely chopped and before it is mixed with the copper sulphate solution, it must be strained through a cloth and all of the juice pressed out. Tobacco snuff is very satisfactory as it is not necessary to strain it before mixing with the blue-stone solution.

Great care should be taken that the solution be made the right strength. If the solution be made too strong serious results may follow. A solution that is not strong enough will not destroy the worms. It is absolutely necessary that all materials be weighed and measured accurately in making up the solution for drenching.

The doses to be given to lambs or sheep for either copper sulphate or copper sulphate and tobacco are the same as recommended by the United States Department of Agriculture, which are:

For lambs under 1 year of age, 1¾ ounces (50 cubic centimeters).

For sheep past 1 year of age, 3½ ounces (100 cubic centimeters).

The treatment should be given on an empty stomach, if possible. As a rule it is best to keep all feed and water away from the animals the evening before the treatment is given and then administer the dose in the morning while they are empty. Feed and water should be kept away for at least 2 hours after treatment.

It is very important that the dose be administered very carefully. Carelessness

may bring serious results. Care must be taken to see that the proper size dose is given. An over-dose may cause death, while too small a dose will not produce results. Copper sulphate is poisonous, and like all medicines, is safest and best results are obtained when in the hands of a competent veterinarian.

It is advisable to administer two treatments, three or four days apart. The observations at this laboratory have shown that in most cases a single treatment removes the most of the worms, but there are always a few animals in a flock that do not respond to treatment as readily as the rest. The second treatment should be given to get the few worms that are not removed by the first dose. The foregoing results show clearly that copper sulphate and tobacco are most effective in the removal of worms from sheep and should be used according to directions. The treatment is inexpensive and can be administered very easily with a small expenditure of time and labor.

Animals that are very weak and emaciated may not be able to withstand a full dose. The treatment is severe and such animals may succumb as a result of the action of the drugs. In such cases it is advisable to administer smaller doses and repeat them several times at intervals of three or four days. Each succeeding dose

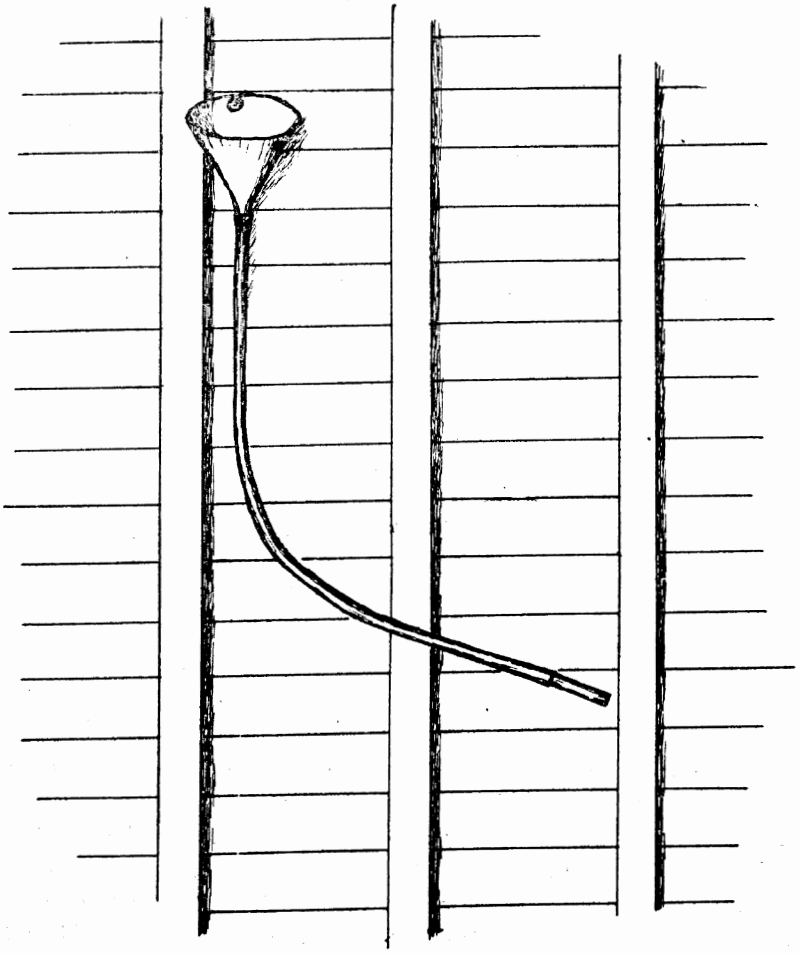

Fig. 1. Drenching tube attached to wall

may be slightly increased. Along with the treatment a stimulant should be given, especially in very weak animals.

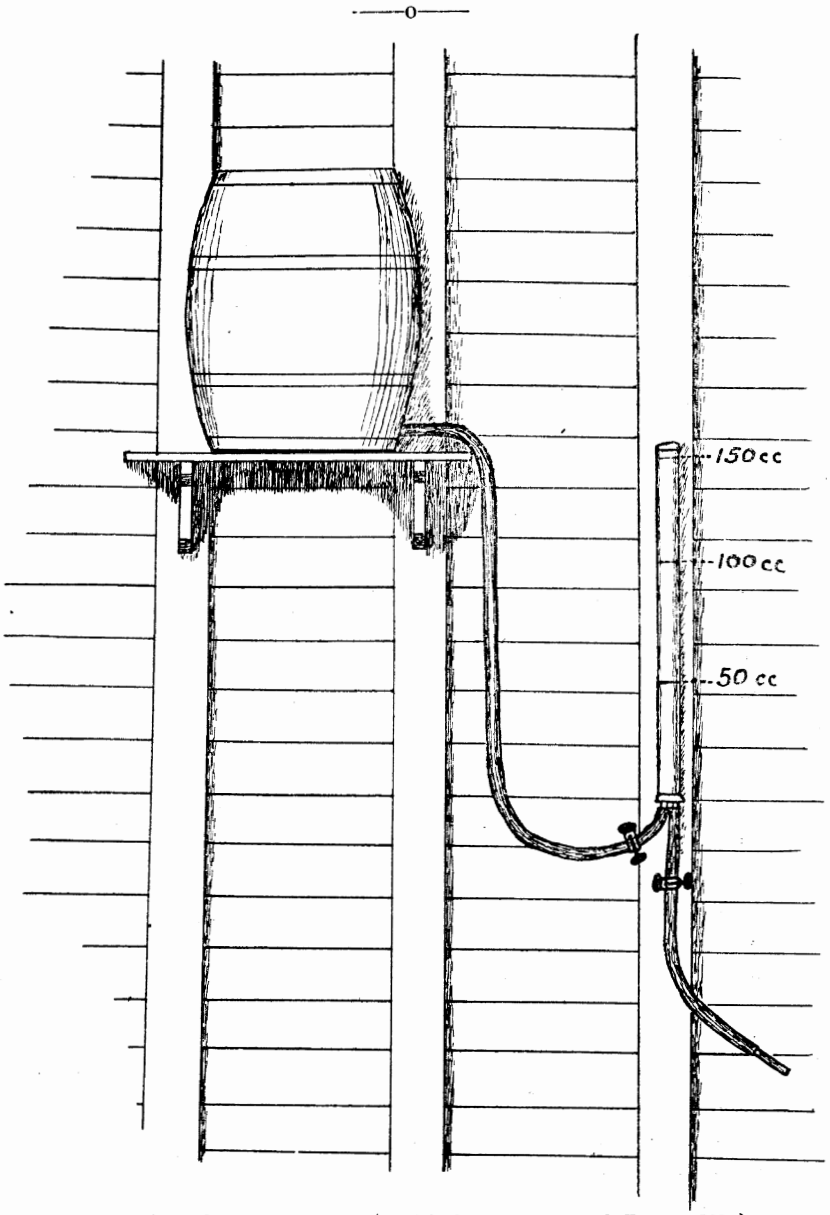

Fig. 2. Drenching apparatus. (Modified after Hall and Foster, 1918).

METHOD OF DRENCHING SHEEP

If only a few animals are to be treated it may be done with a bottle. In this case the proper sized dose may be poured into the bottle and the point marked or scratched on the side of the bottle by means of a file. This would aid in measuring out the proper sized doses and thus save time.

When a large number of sheep are to be treated it may be done much more rapidly by means of a drenching tube (Fig. 1), or a drenching apparatus (Fig. 2).

Fig. 3. Correct position for drenching sheep.

The drenching tube consists of an ordinary funnel and a rubber tube, 3 feet long and ½ inch in diameter, and a piece of brass or metal tubing, 4 to 6 inches in length. One end of the rubber tube is attached to the funnel and into the other end is inserted the metal tube. The metal tube is placed between the animal's back teeth while drenching. The liquid can be measured out in a cup or glass, which has the dosage properly marked, and poured into the funnel. In this way drenching can be rapidly and easily done.

The drenching apparatus (Fig. 2) consists of a container, such as a wooden keg, stone jar or glass bottle (metal containers should not be used). At the side of the keg near the bottom, an auger hole should be made. In this hole is inserted a perforated cork with a glass tube through the perforation. The keg or jar should be placed on a high shelf and one end of a half-inch rubber tube is attached to the glass tube at the bottom of the keg. The other end of the rubber tube is attached to one of two glass tubes which perforate a rubber cork in the bottom of a graduate glass cylinder. The top of the cylinder should be on a level with the bottom of the container on the shelf. The graduate glass cylinder should be fastened to the wall and held in a vertical position. A second rubber tube, ½ inch in diameter and 3 feet long, is attached to the other glass tube in the cork in the bottom of the cylinder. This tube terminates in a metal tube which is inserted into the sheep's mouth during drenching. The glass cylinder is graduated or marked showing the proper dosage that may be given to an animal. Pinch controls should be placed on the rubber tubes near the cylinder. By pinching the control on the tube between the container and cylinder, the solution flows into the cylinder until the desired dose is reached. By closing this pinch control and opening the other the solution passes out of the cylinder to the metal tube at the end of the rubber dosing tube. The metal tube is placed between the back teeth in a sheep's mouth and should be gently rotated to make the animal swallow readily.

Drenching with the above apparatus can be very quickly and conveniently done with only a small expenditure of time and labor. On one occasion at this station two men drenched 57 sheep (ewes and lambs) in one hour. At another time they drenched 99 ewes and lambs in 1 hour and forty minutes. In each case it required about one minute to the animal. The animals were confined in a small pen where they could be easily and quickly caught. One man measured out the dose while the

Fig. 4. Incorrect position for drenching sheep.

Fig. 5. Incorrect position for drenching sheep.

other caught the sheep, and during drenching, one held the animal while the other administered the dose.

The drenching should be done while the animals are in the natural standing position with the nose raised to the level of the eyes. The correct position is shown in Figure 3. The animals should not sit on their haunches or have the head and neck in a twisted or a too elevated position, as shown in Figures 4 and 5. If the animals are kept in the correct position, while being treated, there is very little danger of any of the liquid passing into the lungs. When animals are drenched with the nose in an elevated position or the neck twisted there is a greater possibility of the liquid passing into the lungs and causing death. Furthermore, experiments have shown that if an animal is drenched in the correct position the most of the liquid goes directly to the fourth stomach, where it is most effective. Animals treated while sitting on their haunches do not receive all of the liquid directly into the fourth stomach, but part of it first goes to the paunch where it is somewhat diluted before going into the compartment of the stomach where the worms are located.

The writer has personally made over 2200 drenchings of sheep and has lost only one animal as a direct result of drenching. That particular animal struggled a great deal while being treated and a part of the liquid passed into the lungs and death resulted from pneumonia, a day or two later. Great care must be taken in drenching the animals to see that they are properly held and that the liquid is not given more rapidly than they can readily swallow.

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PREVENTION

A prevention of losses from stomach worm infestation in sheep has been a difficult problem on account of the life history of the parasite and the great resistance to climatic conditions of the larval worms. It appears that the only method to make sure that lambs may not become infested, in areas where stomach worms are common, is to remove them from their mothers as soon as born and raise them by hand. This method is so impracticable that it cannot come into general use. The rotation of pastures would be very satisfactory providing that there are enough pastures so that the sheep could be placed into a clean pasture every two weeks and not be given the same pasture twice during a period of ten or twelve months. This plan would not work out for most sheep raisers as it would require too many pastures during the course of the season. However, the pastures could be used by animals that are not subject to stomach worms, such as horses, mules and hogs. Cattle and goats also would have to be kept off as they are affected by stomach worms almost as readily as sheep. Forage crops can be sown and used for pasturing sheep for a time and then the field plowed and sown to another pasture crop. In this way the number of fields can be lessened and the stomach worm infestation can be kept down fairly well.

Rotation or change of pastures will not keep the stomach worm entirely under control unless the pastures are changed often and the sheep are reasonably free from worms to start with. Under the usual farm conditions it would be very impractical to move sheep from one pasture to another often enough to avoid the possibility of infection from pastures. Therefore, a plan must be devised by which the amount of infestation can be reduced and controlled. This may be done by an occasional change of pasture and medical treatment.

Stomach worm infection can be held in control if sheep raisers would have their lambs come early and feed them well, so that they would get a good growth before turning them on pastures. Just before turning the sheep into a pasture the entire flock should receive treatment to remove as many as possible of the stomach worms. If a clean pasture is available very little trouble will be experienced during an ordinary season. If a clean pasture is not available, an infested one must be used but in that case the animals should be treated with copper sulphate and tobacco, or some other good remedy, every four to six weeks throughout the summer months. It is advisable to change to another pasture after treatment, if possible. A pasture such as stubblefield, or some forage crop, would be excellent. The entire flock of sheep should receive another treatment when removed from the pasture in the fall. This procedure may not check the stomach worm disease entirely, but if carried on in the proper way will tend to hold it down to a minimum.

The use of low land and swampy pastures should be avoided as far as possible. Ponds and stagnant pools should also be avoided as far as possible and drinking water should be provided from wells or running streams. Pastures should not be overstocked as much depends upon this factor in controlling the stomach worm disease. When the pasture is closely grazed the sheep are liable to pick up more larval stomach worms, and also may not receive sufficient food and thus become less resistant to parasitic infestation. The importance of sufficient nourishment cannot be over estimated in this respect. It has been repeatedly observed that animals receiving a sufficient amount of nourishing food are far more resistant to parasitic infestation than are animals which are poorly nourished. Sheep which are poorly fed succumb to stomach worms much more readily than animals which are well fed. Salt should be supplied at all times as it may act to some extent as a preventative against stomach worms. It is also a necessary element in the diet of animals.

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SUMMARY

1. The stomach worm (*Haemonchus contortus*) is a serious pest and causes great losses to the sheep industry.

2. This disease has been known among sheep raisers for many years and is generally distributed throughout the world.

3. Sheep or other animals affected with stomach worms suffer from the loss of blood and also from the destructive action of toxins which are secreted by the parasite and absorbed by the blood.

4. The life history of Haemonchus contortus is direct. The larvae hatch out on the ground and moult in a few days after which they reach the infectious stage when they migrate upon blades of grass and other vegetation. They may be eaten by grazing animals and reach maturity in about three weeks after reaching the stomach.

5. The larval stomach worms migrate upon grass when wet with dew or rain especially at night, or during diffuse light. When light becomes bright and moisture dries up the larvae go back to soil or coil up on grass, consequently there is a greater chance for infestation to take place when animals graze at night or during rainy cloudy weather.

6. Larval worms, after reaching the infectious stage are very resistant to cold

and dryness. They may live for several months and withstand various adverse weather conditions, such as freezing, thawing and drying without much injury.

7. In areas where the stomach worm is prevalent, animals may become infested from grazing, or drinking from ponds. Larval worms may live in soil for many months and during favorable conditions may migrate onto vegetation.

8. Stomach worms may be removed by treatment with copper sulphate, or copper sulphate and tobacco. The latter appearing more effective, not only for stomach worms, but also for tapeworms and hookworms.

9. The best preventive measures are those of having the lambs come early, always feed well, provide a rotation of pastures or pasture crops and occasionally administer medical treatment.

Sheep probably suffer more from parasitic diseases than do any other kind of livestock. It is the sheepman's business to prevent disease of this kind. When disease is present it is advisable to call in a competent veterinarian. Act promptly to find out the cause when sheep begin to show a lack of thrift from unknown causes. It would be well for every sheep raiser to have a copy of Farmers' Bulletin 1150, U. S. Department of Agriculture, entitled "Parasites and Parasitic Diseases of Sheep," by Hall.

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