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TREATMENT FOR ROUNDWORMS IN SHEEP, GOATS, AND CATTLE.

Sheep, goats, and cattle suffer from the effects of roundworms. This is especially true during wet years. These parasites are found particularly in the lungs, the fourth stomach, and the bowels, and, when present in large numbers, they may result in the death of 5 to 50 per cent of the flock. For some of these parasites, treatment is possible; but for others, treatment has not been found altogether satisfactory.

TREATMENT.

Roundworms which live free in the fourth stomach or in the bowels may be expelled by using various drugs in drenches. A long list of medicines might be mentioned, but many of the drugs most highly recommended frequently fail to effect a cure. Failures are due to several causes: The drug itself may be of little or no value; it may not be administered in the proper dose; it may not be administered in the proper way.

One of the most commonly used drenches is turpentine, but more satisfactory results are obtained from the use of coal-tar creosote, or coal-tar creosote and thymol, or gasoline, or bluestone.

COAL-TAR CREOSOTE.

I have had excellent success in treating sheep, goats, and cattle for the twisted wireworm (*Strongylus contortus*) with a 1 per cent solution of coal-tar creosote. The medicine is easily prepared and quite inexpensive. It may be purchased of the druggist in small quantities of one ounce or in pound bottles. One ounce is sufficient for about 20 adult sheep, and the cost of the treatment is less than one-half a cent per head; if creosote is purchased by the pound, the cost is reduced to less than one-quarter of a cent per head. If creosote is called for at a drug store, *beechwood* creosote will usually be dispensed. This is more expensive than the *coal-tar* creosote and not so satisfactory in expelling worms.

A 1 per cent solution of coal-tar creosote is made as follows:

Coal-tar creosote	1 ounce.
Water	99 ounces. ¹

¹ 99 ounces = 6 pints and 3 ounces.

Twisted wireworms (*Strongylus contortus*) taken directly from the stomach of sheep or cattle die in one-half to one and a half minutes when immersed in this solution.

If, in dosing, this liquid enters the lungs the animal may succumb in a few minutes. If the dosing is performed carefully, as much as 6½ ounces may be given to a full-grown sheep without fatal results. In some cases, however, the animal shows ill effects, from which it usually recovers within half an hour. Six ounces were given to a number of sheep without the slightest ill effects. The following table gives the doses of the 1 per cent mixture which were used in about 400 cases without ill effects:

Lambs 4 to 12 months old....	2 to 4 ounces (about 60 to 120 c. c.).
Yearling sheep and above....	3 to 5 ounces (about 90 to 150 c. c.).
Calves 3 to 8 months old....	5 to 10 ounces (about 150 to 300 c. c.).
Yearling steers.....	1 pint (about 480 c. c.).
Two-year-olds and above....	1 quart (about 960 c. c.).

Sheep, goats, and calves which received this treatment showed a marked improvement a few days after receiving a single dose.

In experiments with creosote at Washington, D. C., sheep were drenched with a 1 per cent solution and killed immediately afterwards. Upon opening the fourth stomach, it was found that the wireworms present were dead. In some cases where this was tried later, the wireworms were found to be still alive; but it is believed that the explanation of this fact has now been discovered (see below, page 7). Creosote does not appear to have much effect upon the worms below the stomach.

If an overdose is given by mistake, and if the sheep appears severely affected by it, the animal should be placed in the shade. Even in some cases of very severe overdoses, where the animal is given up for dead practically, it may entirely recover within an hour or so.

COAL-TAR CREOSOTE AND THYMOL.

If, in addition to the stomach worms, the animals were suffering from severe infection of bowel worms, such as the hookworms, better results were obtained in the treatment when powdered thymol was added to the creosote. In cases of this kind, the creosote solution is prepared, as directed above (page 1), and 30 to 80 or even 100 grains of thymol added to each dose *after it has been measured*.

Thymol is expensive, the price varying in different parts of the country. It may be purchased by the ounce, but it is considerably cheaper if purchased by the pound. Avoid using thymol which has become yellowish or reddish and which has run together in the bottle so as to form a solid mass. Powder the crystals and have the druggist measure 30 grains. Give 30 grains to a lamb, about 50 grains to a yearling, and 70 to 80 or 100 grains to older sheep, according to size.

In experiments I have had excellent results with a single dose of the creosote and thymol mixture. If necessary, however, the dose could be repeated after a week.

BLUESTONE.

In the recent experiments with bluestone by Hutcheon, in South Africa, against wireworm disease in sheep, it has been claimed that the same treatment expels tapeworms.

Caution.—Repeated accidents have happened from using too strong a solution or too large doses, or in giving it in such a way that the medicine gained access to the lungs. Dr. Hutcheon's method of procedure, which is here given in detail, is safe in the hands of the average farmer if the directions are followed. The person who gives stronger doses than indicated, or who is careless about the measurements, must take the entire responsibility of the miscarriage of the treatment. It is a good plan to make up a smaller quantity of the solution and try it upon a few sheep before attempting to dose the entire flock.

(a) *To prepare the mixture.*—Hutcheon has changed his formula slightly from time to time. On February 21, 1895, he gave the following proportions:

Dissolve 1 pound *avoirdupois* (1 pound = 16 ounces) of good commercial powdered bluestone (sulphate of copper) in 2 *imperial* quarts (= $2\frac{2}{3}$ quarts U. S.) of boiling water; when the bluestone is *thoroughly* dissolved, add $6\frac{1}{2}$ *imperial* gallons (= 26 imperial quarts = $7\frac{1}{3}$ U. S. gallons = $31\frac{1}{2}$ U. S. quarts) of cold water, making in all 7 *imperial* gallons (or $8\frac{2}{3}$ U. S. gallons) of water.

In 1897 he changed the strength of the solution to 1 pound of bluestone to "40 whisky bottlesful of water." This is practically 1 pound to $7\frac{1}{2}$ *imperial* gallons (= 9 U. S. gallons = about 34 liters, *metric*) of water.

Use only bluestone which is of a uniform blue color; avoid that which is in conglomerate lumps with white patches and covered with a white crust.

The *equivalents* of 1 pound *avoirdupois* and of 7 *imperial* gallons in other weights and measures are as follows: One pound *avoirdupois* = 1 pound 2 ounces 280 grains of *apothecaries'* (also is equal to 453.59 grams of *metric*) weight. Seven *imperial* gallons = 8 gallons 3 pints 3 fluid ounces 3 fluid drams 56 minims (or practically 8 gallons $3\frac{1}{4}$ pints, or $8\frac{2}{3}$ gallons) of *apothecaries'* (also equal to 31.804409 liters, *metric* system).

The farmer is cautioned against guessing at the weights and measures, for this is sure to result either in too strong a solution, which will kill his animals, or too weak a solution, which will fail to be effective. Scales and measures should be tested before they are used. If reliable scales are not at hand, buy the bluestone

already weighed and have the exact weight in avoirdupois, apothecaries', or metric system marked on the package.

If a smaller quantity than the above is desired, this can be made upon the proportion of 1 ounce avoirdupois of bluestone to $4\frac{1}{2}$ U. S. pints of water.

(b) *Preparation of the animals.*—Fast the sheep or cattle 20 to 24 hours before dosing. If the fast is 30 hours (longer fasts are dangerous), an extra half gallon or a gallon of water should be added to the solution, as animals are more liable to suffer after a long fast.

(c) *Size of the dose.*—Hutcheon has several times changed the size of the doses he advises, in some papers basing it on the imperial fluid ounce and in others on the tablespoon. The doses for sheep (in imperial ounces and in tablespoons) given below are his most recent (January 10, 1895) recommendations, and, though based upon a solution with 5 per cent less water than the first solution given above, they may be used for the weaker mixture.

I have given the metric doses to a number of sheep and goats, and the animals showed no ill effects; on the contrary, they gained in weight.

Size of dose for animals at several ages.

Age of animals.	Approximate equivalents.			
	Tablespoons. ^a	Imperial.	United States apothecaries.	Metric.
For a lamb 3 months old.	1	About $\frac{1}{2}$ fluid oz.	About $\frac{1}{2}$ fluid oz.	About 20 c. c.
For a lamb 6 months old.	2	About $1\frac{1}{4}$ fluid oz.	About $1\frac{1}{4}$ fluid oz.	About 40 c. c.
For a sheep 12 months old.	3	About $2\frac{1}{4}$ fluid oz.	About 2 fluid oz.	About 60 c. c.
For a sheep 18 months old.	4	About 3 fluid oz.	About $2\frac{3}{4}$ fluid oz.	About 80 c. c.
For a sheep 24 months old.	$4\frac{1}{2}$	About $3\frac{3}{4}$ fluid oz.	About 3 fluid oz.	About 90 c. c.
For a calf 3 months old.	$4\frac{1}{2}$ to 5	About $3\frac{1}{2}$ to $3\frac{3}{4}$ fluid oz.	About 3 to $3\frac{1}{4}$ fluid oz.	90 to 100 c. c.
For a calf 6 months old.	5 to $5\frac{1}{2}$	About $3\frac{1}{2}$ to $4\frac{1}{4}$ fluid oz.	About $3\frac{1}{2}$ to $3\frac{3}{4}$ fluid oz.	100 to 110 c. c.

^a "The tablespoon I refer to is the modern, full-sized tablespoon (16 fluid drams). The medicinal tablespoon contains exactly half an ounce."—*Hutcheon*.

Be careful not to give a two-toothed young sheep as much as a full-grown, four-toothed sheep. Mistakes may occur in judging the age unless the teeth are examined.

The doses should be measured off in bottles and the point of each dose plainly marked with a file.

(d) *Dosing.*—In dosing, use a long-necked bottle—as castor-oil bottle; Worcester-sauce bottle, or anchovy-sauce bottle—or, better still, a drenching tube.

Let one person set the sheep on its haunches and take its fore legs in his left hand while he steadies the head with the right. Another person inserts the neck of the bottle into the mouth. The head of the sheep should not be raised too high, as in that case the solution may enter the lungs and kill the sheep. A safe rule is to raise the nose to the height of the animal's eyes.

(e) *Overdose*.—If, after dosing, any of the sheep seem to be suffering from an overdose—indicated by lying apart from the flock, not feeding, manifesting a painful, excited look and a spasmodic movement in running, walking with a stiff gait, purging, the discharge being a dirty brownish color—take them away from the flock to a shady place and dose with laudanum and milk as follows: For a lamb 4 to 6 months old, 1 teaspoonful of laudanum in a tumbler of milk; for a sheep 1 year old, 2 teaspoonfuls of laudanum in a tumbler of milk. Repeat half the dose in two to three hours, if necessary.

(f) *After-treatment*.—The animals should not be allowed water for several hours after receiving their dose.

I have used bluestone on several occasions and, although it proved more or less successful, it was not so satisfactory as creosote or as gasoline.

GASOLINE.

Gasoline has recently gained considerable reputation as a vermifuge. I have used it in a number of cases and have found the claims made for it to be more or less justified. Three objections, however, arise to its use, and I can not, therefore, consider it an ideal treatment. These objections are:

(1) Not less than three doses, and usually four to six, are required to expel the worms. Its use involves a great expenditure of labor, and it is therefore impracticable on the large ranches.

(2) While several doses are not necessarily injurious to the stock, still, if the doses are large, repeated drenches cause a more or less severe congestion of the bowels. Not only that, but repeated handling of range sheep, with the necessary preliminary treatment of withholding food, is injurious to the animals.

(3) If used on animals suffering from pleurisy, it is likely to be fatal. I have had several fatal cases of this kind.

Nearly all vermifuges are, however, more or less poisonous in one way or another, and gasoline, if properly used, is not particularly dangerous. The necessity of repeating the dose from four to nine times in order to effect a complete cure will, however, militate against its general adoption.

If gasoline is used, ammonia also should always be kept on hand. If an animal is suddenly overcome by the effects of gasoline, a small amount (a teaspoonful or so) of aromatic spirits of ammonia may be given in water as a drench, to be repeated if necessary, and will usually result in the recovery of the patient.

The usual doses of gasoline for stomach worms are:

Lambs	$\frac{1}{2}$ ounce.
Sheep	$\frac{1}{2}$ ounce.
Calves	$\frac{1}{2}$ ounce.
Yearling steers.....	1 ounce.

I have used these doses repeatedly without any serious effects. *Each dose is mixed separately* in linseed oil, sweet milk, flaxseed tea, or an egg, and given as a drench. If given directly in water, it is more severe on the patient.

An ounce and a half of gasoline has resulted in the immediate death of a full-grown ewe, but in some cases I have given to full-grown sheep as high as 2 to 3 ounces without serious results. I have also given as much as 3 ounces to a yearling steer, and 7 ounces (within an hour) to a horse without causing serious symptoms. I have also given 3 ounces to a full-grown chicken; the animal became very stupid for a time, but eventually recovered. On the other hand, in one case, a yearling steer, in apparently quite healthy condition, succumbed within two minutes after a dose of $1\frac{1}{2}$ ounces. These large doses were given experimentally to determine the danger point, and they should never be used by farmers in treating stock.

In one instance a steer was suddenly overcome because the man who was administering the dose for me accidentally held the head too high and the medicine entered the lungs. The animal fell immediately and appeared to be almost dead. I happened to have a hypodermic syringe with me and some tablets of sulphate of strychnine. A hypodermic injection of this substance was immediately given and within five minutes the animal was feeding as if nothing had happened. This incident led me to overdose several animals with gasoline and then to try to revive them with hypodermic injections of strychnine. In all cases the treatment was successful. It is thus seen that injury from gasoline may be counteracted by either aromatic spirits of ammonia or by strychnine.

METHODS OF DRENCHING ANIMALS.

The popular method of drenching is with a bottle. The use of a *drenching tube* is, however, far more satisfactory. A drenching tube may be made by taking an ordinary tin funnel, which may be purchased for five or ten cents, and inserting the narrow end into one end of a rubber tube or hose, say three feet long and three-eighths or one-half inch in diameter; into the other end of the rubber tube is inserted a piece of three-eighths-inch brass or iron tubing about 4 to 6 inches long.

The metal tube is placed between the animal's back teeth, and the sheep or calf is allowed to bite upon it. The water or drench is poured into the funnel, which may be held by an assistant or fastened to a post at a convenient height. The man who holds the metal tube between the animal's teeth can control the animal's head with the left hand, and by holding the tube in the right hand, near the point of union of the rubber and metal tubes, he can easily control the flow of the fluid by pinching the rubber hose. Care must

be taken not to hold the patient's nostrils closed, otherwise the dose will enter the lungs.

It is usually advisable to fast animals 12 to 16 hours before dosing.

POSITION OF THE ANIMAL DURING DRENCHING.

Different persons prefer to hold the animals in different positions during drenching. Thus (1) the animal may be left standing on all four feet; or (2) it may be placed on its haunches, one man holding its back up against his own body; or (3) it may be placed directly on its back on a sloping piece of ground, its head being in a direct line with its back, and higher than its rump; or (4) it may be placed upon its side, the head being brought around so that the horns are squarely on the ground; the operator may then place one foot on one of the horns (especially in the case of semiwild cattle) and thus aid in holding the animal still.

So far as administering the dose is concerned, the position on the back (3) is by far the easiest in the case of sheep, and the side position with head down (4) is the easiest in dosing cattle; furthermore, in these positions there is much less danger of an accident by getting the dose in the lungs. If animals are dosed standing or on their haunches, the nose should never be allowed to go above the eyes; otherwise the drench may pass down the windpipe into the lungs.

By dosing sheep with water colored red and blue with dyeing material, and killing the animals immediately after the liquid was swallowed, the following results were obtained:

If the dose was given with the sheep standing (1), almost the entire quantity went directly into the fourth stomach; if the sheep was placed on its haunches, the fluid passed in part into the fourth stomach and in part into the first (the paunch); if the sheep was placed directly on its back (3), or if a steer was placed on its side (4) with head down, almost the entire dose passed into the first stomach (the paunch). If the animal, even when standing (1), struggled to a considerable degree, a portion of the fluid passed into the paunch.

It will be immediately apparent that these facts are of practical importance in dosing. If, for instance, gasoline, turpentine, or creosote is used, *better results may be expected if the sheep is dosed standing* (1).

PREVENTIVE MEASURES.

First. Every ranch should have a hospital pasture situated on high, dry ground, well drained, and without any pools or ponds; this should be supplied with raised troughs for watering and feeding, and the water supply should come from a well. This pasture should not drain into any pasture in which healthy stock are feeding.

Second. As soon as any sick animal is noticed in the large pasture it should be immediately separated from the healthy stock and taken to the hospital pasture. To allow sick animals to run at large with healthy stock means to deliberately permit the spread of infection in the pastures and thus endanger the uninfected animals.

Third. Proper watering places should be supplied in the large pastures by digging wells and erecting windmills to pump the water into tanks. These tanks should be raised above the ground so that they can not become contaminated with the animals' droppings being washed into them by rains and floods.

Fourth. Select high, sloping ground for pasture when this is possible. Low pastures should be properly drained.

Fifth. When practicable, burn the pastures regularly, thoroughly, and systematically. The heat from the burning grass will kill many of the eggs and young worms on the grass, ground, and in the droppings.

Sixth. As parasites are more fatal to young animals than to old, a liberal supply of oats or some similar food will aid in giving to young animals strength which will enable them to withstand the infection. A daily allowance of, say, half a pound of oats per lamb ought to reduce the mortality. At first they may not be inclined to eat it, but they will soon become accustomed to it. This simple precaution is reported as very effectual in New Zealand.

Seventh. Keep plenty of salt accessible to the animals. Some men add slaked lime to the salt; others add 1 part of sulphate of iron to 100 parts of salt. As a matter of experience, salt kills many young worms.

For the minute worms encysted in the fourth stomach, and also for those forming nodules in the bowels, no treatment is known.

For worms in the lungs, numerous methods of treatment have been suggested, and success has been claimed for certain remedies. None that I have tried, however, has proved satisfactory.

No practical medicinal treatment is known for the flat worms of the liver, and the treatment for tapeworms in the bowels of ruminants is frequently unsuccessful.

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Approved.

JAMES WILSON,
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