

Recent advances in the prevention and treatment of blowfly strike in sheep : supplement to report no. 2 / by the Joint Blowfly Committee (Appointed by the Council for Scientific and Industrial Research, the New South Wales Department of Agriculture, and the Queensland Department of Agriculture and Stock).

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OF AUSTRALIA

Council for Scientific and Industrial Research

BULLETIN No. 174

Recent Advances in the Prevention
and Treatment of Blowfly
Strike in Sheep

Supplement to Report No. 2

By the

JOINT BLOWFLY COMMITTEE

*(Appointed by the Council for Scientific
and Industrial Research, the New South
Wales Department of Agriculture, and the
Queensland Department of Agriculture
and Stock)*

MELBOURNE, 1943

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FOREWORD.

It is three years since the issue of Report No. 2 by the Joint Blowfly Committee. In this period, despite the state of war and the removal of so many members from the research teams, some advances have been made in several of the methods recommended for the prevention or for the treatment of fly-strike in sheep, and it is desirable that these should be brought to the notice of flock masters.

Report No. 2 is now out of print. Owing to the shortage of paper and of man power a revised edition cannot be attempted, but in this supplement an attempt is made to add to what has already been said, with special emphasis on what is practical and most labour-saving for flock masters under present conditions.

As was the case with Report No. 2, this report was prepared by the Joint Blowfly Committee. At the present time the members of the Committee are as follows:—

- L. B. Bull, D.V.Sc., Chief, Division of Animal Health and Nutrition, C.S.I.R. (Chairman).
- A. J. Nicholson, D.Sc., Chief, Division of Economic Entomology, C.S.I.R.
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- H. G. Belschner, D.V.Sc., Senior Veterinary Surgeon, Department of Agriculture, New South Wales.
- T. McCarthy, Chief Entomologist, Department of Agriculture, New South Wales.
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- F. H. S. Roberts, D.Sc., Department of Agriculture and Stock, Queensland.

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II. MEASURES TO REDUCE INHERENT PREDISPOSITION.

1. Selection and Breeding.

It has been shown that wrinkliness of the breech is inherited, and than plain-breeched rams will produce a greater percentage of A class (plain-breeched) progeny than will more wrinkly rams, or in other words, the greatest percentage of the more wrinkly progeny are sired by the more wrinkly rams. By avoiding the use of the C class parents, it is possible to reduce considerably the number of more wrinkly progeny, and this generally will render the flock less predisposed to fly strike.

In Report No. 2 were given the results of breeding trials conducted by the Department of Agriculture in New South Wales, which showed that 55 per cent. of the progeny of A class parents were themselves A class. The conclusions drawn were that by selecting parents for plainness of the breech region, the predisposing factor to breech strike might be largely bred away from, and that with adequate culling a flock of sheep considerably less predisposed to breech strike could be maintained.

More recent work has shown that it is not always possible to obtain so high a percentage of plain-breeched progeny by the use of A class rams and ewes, and that rams vary considerably among themselves in the proportion of plain and wrinkly-breeched progeny which any one will produce. The success to be expected from a plain-breeched ram will depend largely on its being genotypically plain, i.e., it does not carry the factor for wrinkliness. The present indications are that unless a ram has actually been progeny-tested it is not possible to evaluate its ability to produce A class progeny. The following table showing the classification of progeny by A class rams from plain ewes will illustrate this point:

	Total Progeny.	A Class Progeny.	B Class Progeny.	C Class Progeny.
		%	%	%
Group mating (quoted from Report No. 2)	119	55	43	2
Single ram (No. 5·6)	45	38	58	4
Single ram (No. 4·30)	56	41	48	11
Group mating (3 rams)	68	25	71	4

The recent work also suggests that even with the next generation, although the low percentage of C class sheep is still maintained, the percentage of A class progeny is not greater than that of the first generation, provided non-related animals are mated. In other words, the progeny of plain rams from plain ewes which themselves were from A class parents, did not show a greater percentage of A class animals than did the first generation.

This later information suggests that in breeding towards plainness of breech the mere selection and use of plain parents will not be sufficient to obtain a high percentage of A class sheep, and that the use of progeny-tested rams will at least be necessary. Further experimental breeding work in this connection is being undertaken. It is pointed out that in the work so far undertaken in breeding towards plainness of the breech, there has been no loss in quality and weight of wool produced.

2. The Docked Tail: Optimal Length for the Prevention of Crutch Strike.

Observations quoted in Report No. 2 of the Joint Blowfly Committee showed that when lambs were docked close to the butt of the tail the crutch and the tail were much more frequently struck than when the tail was left longer. The Report stated that further experiments were necessary to ascertain the length of tail which gave the best results, but recommended that, in the meantime, tails be docked at a length of about 4 inches.

If tails are cut 4 inches long at lamb-marking irrespective of the age or size of the lamb, some of the younger lambs will have tails 6 inches or even 8 inches in length at maturity, and under these circumstances tail strike and crutch strike may be more prevalent. This is probably due in many cases to the difficulty of shearing so long a tail properly, with the result that a tuft of wool is left on the side of the tail, which becomes soiled and, in turn, soils the crutch.

Some confusion has arisen over the use of the term "4-inch tail," and the main purpose of this section is to correct this.

The relationship of the tip of the tail to the tip of the vulva is the most useful and important guide in obtaining the correct length. The best result appears to be obtained when the docked tail is of such a length that its tip rests just below the tip of the vulva. Further experiments under several climatic conditions are in progress, but results cannot be available for several months.

When docking lambs, therefore, the aim must be to cut the tail at a level which will bring the *tip about $\frac{1}{4}$ to $\frac{1}{2}$ -inch below the tip of the vulva*. As the lamb grows this relationship of tail-tip to vulva-tip will be closely maintained, and the tail, although somewhat longer than has been customary in many flocks, will not be difficult to shear clean.

When docking a large number of lambs, a careful worker quickly learns to gauge the proper length. Docking is an important operation, and none but careful workers should be allowed to do it. Until the docker has "got his eye in," and in any case of doubt, the tail of each lamb should be held against the crutch, the knife edge being then placed at the correct point on the tail, in relation to the tip of the vulva. This method is illustrated in Fig. 1. The hand grasping the knife is held palm uppermost. The correct length of the docked tail is shown in Fig. 2.

Under no circumstances should the cut be made below the bare skin on the under surface of the tail.

Since Report No. 2 was published, further experiments have fully confirmed the advantage of the longer tail, and they emphasize the fact that *prevention of crutch and tail strikes commences at docking*. The value of the longer tail, even with the Mules operation, is clearly seen in the following figures from "Gilruth Plains" experiments, in which the results are expressed as *percentage incidence of strike*.

PERCENTAGE INCIDENCE OF STRIKE IN SHEEP, CORRELATED WITH
TAIL LENGTH.

Sheep Treated by the Mules Operation.

Group.	Length of Docked Tail—		
	"Long."	Medium.	Short.
M. 39	2	4	20
M. 40	1	..	9

Sheep Not Treated by the Mules Operation.

Group.	Length of Docked Tail—		
	"Long."	Medium.	Short.
N.M. 38	14	33	51
N.M. 39	21	59	90
N.M. 40	19	..	56

In addition to experiments on tail length, detailed observations on the actual technique of docking have been made. Results having a definite bearing on the prevention of tail strike in lambs immediately after docking are briefly mentioned as follows:—

The younger the lamb when docked, and the longer the stump left, the more quickly does the wound heal. Further, the wound heals more quickly if the skin is pushed forward with the knife before cutting, so that the severed skin slightly overlaps the bone. Whether the cut is made through a joint or through a tail bone does not appear to affect the rate of healing. When lambs are docked short a considerably larger wound results, healing is delayed, and the wound is much more likely to become infected. It is under these circumstances that the tails of recently docked lambs are most likely to be struck. There is this further advantage, therefore, in the longer tail.

The advice may be summarized as follows: Pay particular attention to tail length at marking. Cut the tail so that the tip of the healed stump will rest just below the tip of the vulva. On no account should lambs be docked short. Tail length affects the sheep's liability to crutch and tail strike throughout the whole life of the animal.

The two most important methods for the prevention of crutch strike in the pre-disposed Merino sheep are tailing at the proper length and use of the modified Mules operation now to be described.



FIG. 1.—Showing the method of obtaining the correct tail-length in relation to the tip of the vulva by placing the back of the knife below the vulva and bending the tail back on to the edge. In the illustration the knife has been brought forward in the act of cutting.

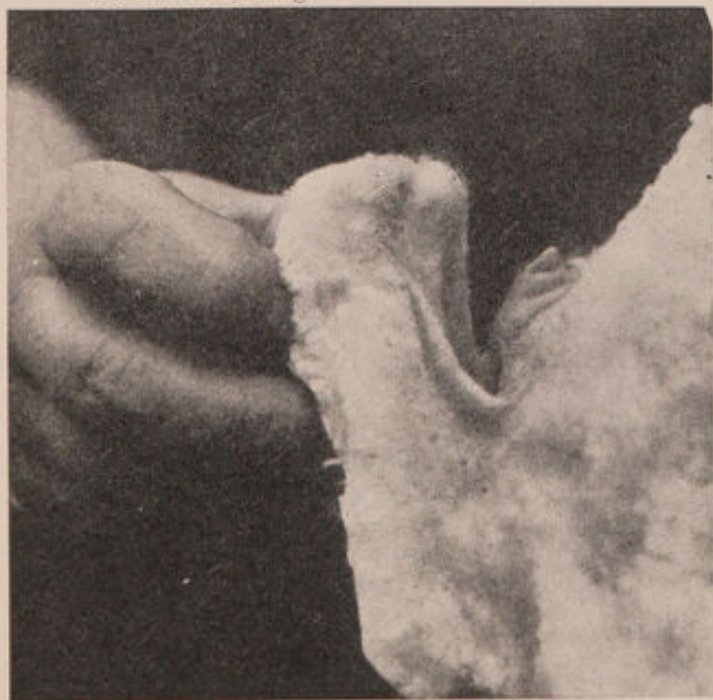


FIG. 2.—Showing a docked tail of the correct length. Note the relationship of tail-tip to the tip of the vulva.

3. The Modified Mules Operation for the Prevention of Crutch Strike.

(A) Results of the Mules Operation.

Crutch strike in ewes, which is the major blowfly problem in Australia, is nearly always due to the crutch becoming wet with urine and the consequent "scalding" of the skin.

In plain-breeched sheep (A class) the wool must be fairly long before it interferes with the free passage of urine, but in very wrinkly sheep the folds of skin, which run from the base of the tail down the inside of the thigh, may be constantly wet even when thoroughly crutched.

The modified Mules operation reduces the tendency to crutch strike, partly by removing the wrinkles beside the vulva, but chiefly, it would appear, by stretching and enlarging the area of woolless skin around the vulva, i.e., the so-called "bare area," so that the wool is drawn away from the mid-line and from the stream of urine. This increase in the size of the "bare area" is of great importance. The operation as it is now practised aims at producing the maximum stretching of the "bare area."

Treated sheep are actually less liable to crutch strike than naturally plain sheep, as the following experiment shows. In a trial carried out in 1940, the incidence of fly strike in three groups, each of approximately 600 Merino ewe weaners, was recorded. All the sheep were shorn in June and were crutched once, viz., in the following February.

Group 1, selected off shears, consisted of particularly plain-breeched sheep which showed no crutch wrinkles at all; *Group 2* consisted of wrinkly sheep which were treated by the Mules operation; *Group 3* consisted of untreated, wrinkly sheep.

All three groups were run together. During the succeeding twelve months the crutch strikes per 100 sheep in the three groups were: plain sheep 14, treated wrinkly sheep 1, and untreated wrinkly sheep 86.

The Effective use of the Mules Operation by Graziers.—The Mules operation has gone beyond the stage of field trials. Some hundreds of thousands of treated sheep are at present being run by graziers who have treated their flocks, and the following examples of the excellent results being achieved are of interest:—

(a) Only 120 strikes were recorded among 10,000 young treated ewes, i.e., 1.2 per cent. of strikes, from shearing in September, 1939, to September, 1940. These sheep were crutched once, viz., in February. Among 8,000 old untreated ewes on the same property there were 10,800 recorded strikes, i.e., 135 per cent. of strikes, over the same period, in spite of their being crutched in the autumn for a second time.

(b) During the spring of 1942, 0.08 per cent. of strike, i.e., 6 strikes, occurred among 7,000 treated ewe weaners compared with 3.0 per cent. among untreated wether weaners.

(c) Among 1,600 ewe weaners, treated in the winter of 1942, only 1 was struck, i.e., 0.06 per cent. of strike, during a period from February to May 1943, whereas among 3,000 untreated adult ewes there were 300 strikes, i.e., 10 per cent. of strikes during the same period.

Comparable results can be expected with well-treated sheep in the average season, but it must be remembered that the Mules operation does not eliminate the necessity for a mid-season crutching.

(B) *Application of the Modified Mules Operation.*

A description of the operation is given here, but it is desired to emphasize that much more can be learnt by watching a competent operator at work, and by practice, than from any description. *The operation, as it is now practised, differs from that described in Report No. 2 of the Joint Blowfly Committee. It now aims not only at removing the folds of skin from the centre of the breech, but at producing the maximum expansion, by stretching, of the "bare area."*

The following notes, which are based on field experience, will serve as a guide to graziers, but instruction by a competent operator and experience are essential for success.

(a) *General considerations.*

(i) As treated sheep are less predisposed to strike than naturally plain-breeched sheep, all sheep in the flock should, as a rule, be treated.

(ii) If lambs are marked in two or more lots during the lambing, the operation can be efficiently carried out in conjunction with marking. In most cases, however, the length of wool on the breech of the older lambs makes the operation difficult and slow at this time.

(iii) If the operation is to be performed on weaners or older sheep it is essential to carry it out soon after shearing or crutching. In practice it is found that freshly shorn sheep are easier to operate on than crutched sheep.

(iv) Weaning is a popular time for treating sheep as they are light to handle and can be crutched or shorn in preparation for the operation without much trouble.

(v) Adult sheep are more difficult to handle, but this should not deter owners from treating at least the susceptible ewes which show urine-stained breeches. Methods of handling are mentioned under (vii).

(vi) The sheep to be treated are generally held on a rail as for lamb-marking. The hind legs, however, should not be pulled back too far, as this tightens the skin on the breech, making it harder to lift and cut.

(vii) One operator and three catchers, working on shorn weaners, can treat about 1,200 sheep per day. The number which can be treated is increased and the labour greatly lightened by use of Shannon lamb-marking cradles (Fig. 3) to hold lambs or weaners, and the special Noondoo or M-V cradle designed to hold weaners or older sheep (Figs. 4 and 5). In addition, simple methods and home made devices to assist the holder and to avoid the necessity of lifting the sheep have been used by pastoralists. A device known as the Bundy Crush has been used in the Moree district of N.S.W., and particulars can be obtained from the Department of Agriculture, N.S.W. Crutched sheep take slightly longer to treat than shorn sheep unless they have been crutched widely. The speed and efficiency of the operation is appreciably reduced if there is more than $\frac{1}{4}$ to $\frac{1}{2}$ inch of wool on the breech.

(viii) The operation should be carried out in a clean yard, and the sheep should be let out as soon as possible after being treated. If they have to be driven to a distant paddock this should be done on the day of the operation, before the scab has formed on the wounds. If possible, sheep should not be driven more than 1 to 2 miles, and they must be taken slowly.

(ix) The time for the operation must be carefully chosen, when bush flies and blowflies are not active, otherwise much trouble and losses may occur.



FIG. 3.—Showing a number of weaners being operated upon in a "battery" of Shannon lamb-marking cradles.

(b) *The operation.*

(i) The operation consists of removing a single strip of skin from each buttock. This strip usually includes the medial fold, but actually the strip is removed from the same site in all sheep irrespective of the position, distribution, and size of the fold. The operation leaves two crescent-shaped wounds; *starting about an inch above and to the side of the butt of the tail, they pass along the edge of the "bare area" to between one and two inches below it, then turn slightly outwards and continue on to finish on the inside of the leg just above the top of the hamstring as shown in Fig. 6* The wound should reach its greatest width, of about 2 to 2½ inches, on a level with the vulva. The size and position of the wounds are illustrated in Fig. 6.

(ii) It is a useful guide, and a means of ensuring the maximum stretching of the "bare area", to remember that the two wounds should be from one to two inches apart, one to two inches below the



FIG. 4.—Showing sheep in the Noondoo or M-V. operation cradle. Pressure by the fingers on the release bar, as shown, releases the leg grips.



FIG. 5.—Showing sheep being tipped from the Noondoo or M-V. cradle after treatment.

"bare area", depending on the age at which the sheep is treated (see Fig. 6). Fig. 7 shows the end result of a satisfactory operation with an increase or stretching of the "bare area" around the vulva. Fig. 8 shows the unsatisfactory result of an imperfect operation in which the cuts were not brought close enough to the edge of the "bare area" and did not approach one another within about an inch below this "bare area" but extended outwards towards the hamstring too early; the result is that there is little stretching of the "bare area" particularly below the vulva.

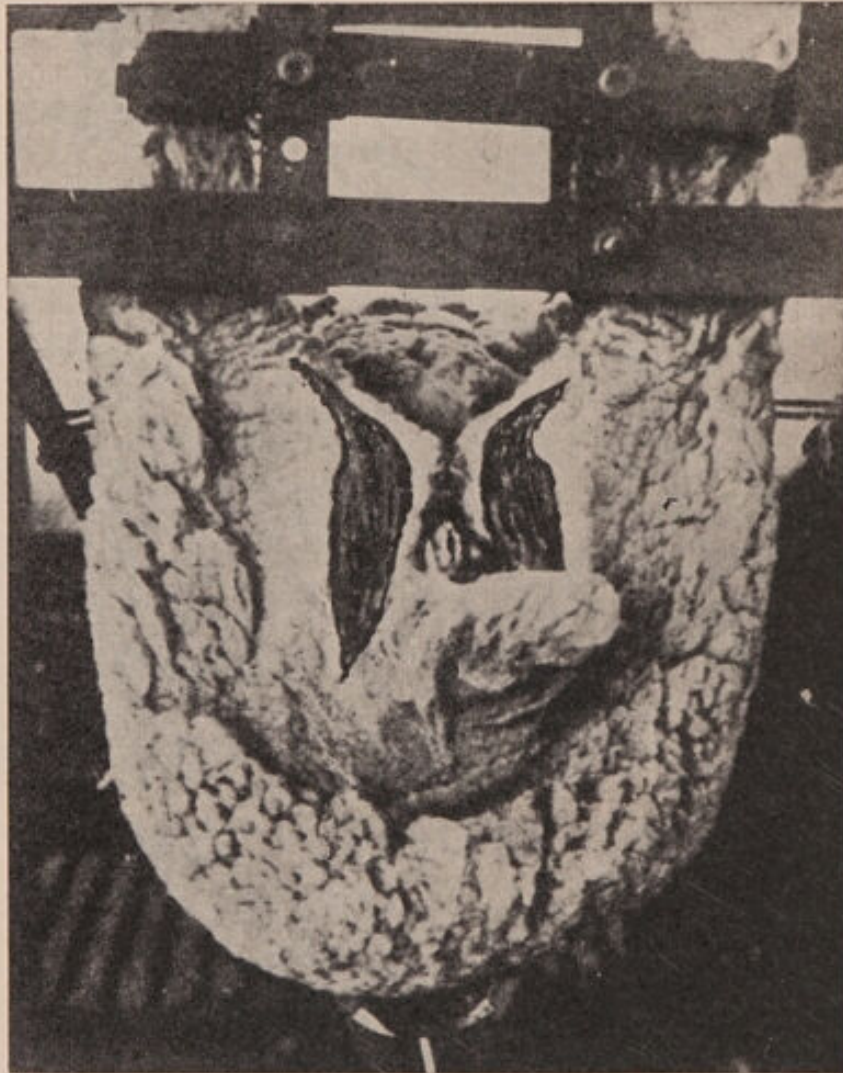


FIG. 6.—Showing the position, shape and extent of the two wounds after removal of the strips of skin in the modified Mules operation.

(iii) To leave a wound of the right width it is necessary to remove more loose skin from a wrinkly sheep than from a plain sheep, and the most difficult part of the operation is to remove sufficient skin with a continuous cut. To accomplish this the shears must be held flat on the sheep, as for shearing, and the skin be gathered in with the points of the shears. The cutting must be done with the heel of the blade, using the points solely to gather up the skin and to guide the cut as it proceeds (see Fig. 9).

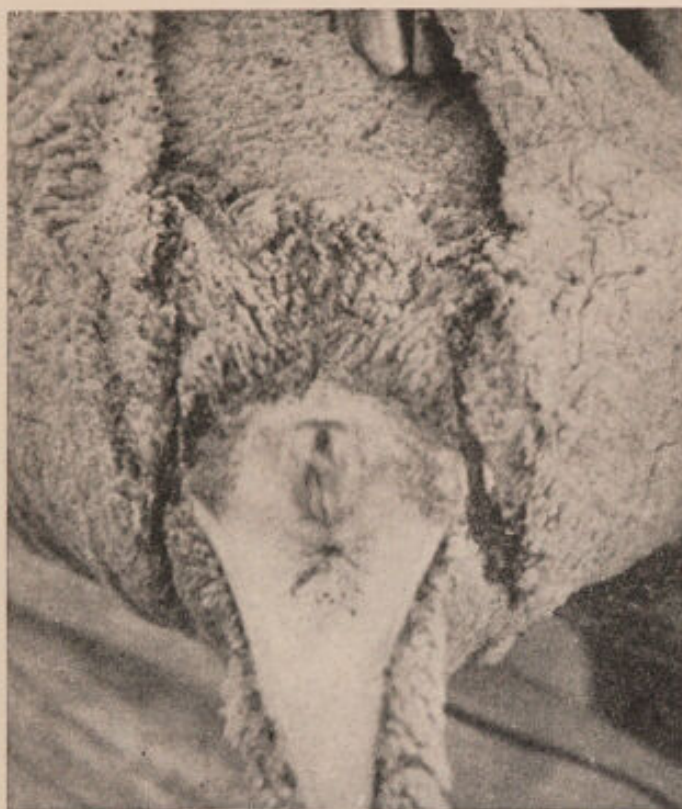


FIG. 7.—Showing satisfactory stretching and enlargement of the "bare area" one month after operation.



FIG. 8.—Showing the unsatisfactory result of an imperfect operation in which the cuts were made too far from the bare area and did not approximate one another below the area. There is little stretching of the skin of the bare area, particularly along its lower margin.

(iv) The commencement of the wound must be narrow and V-shaped as this allows more rapid healing. To achieve this the skin must be only lightly pulled up into the blades, and the heel of the shears must be kept well down on the sheep.

(v) There is a certain knack in performing the operation cleanly and quickly, and this can best be acquired by watching and being instructed by a competent operator.

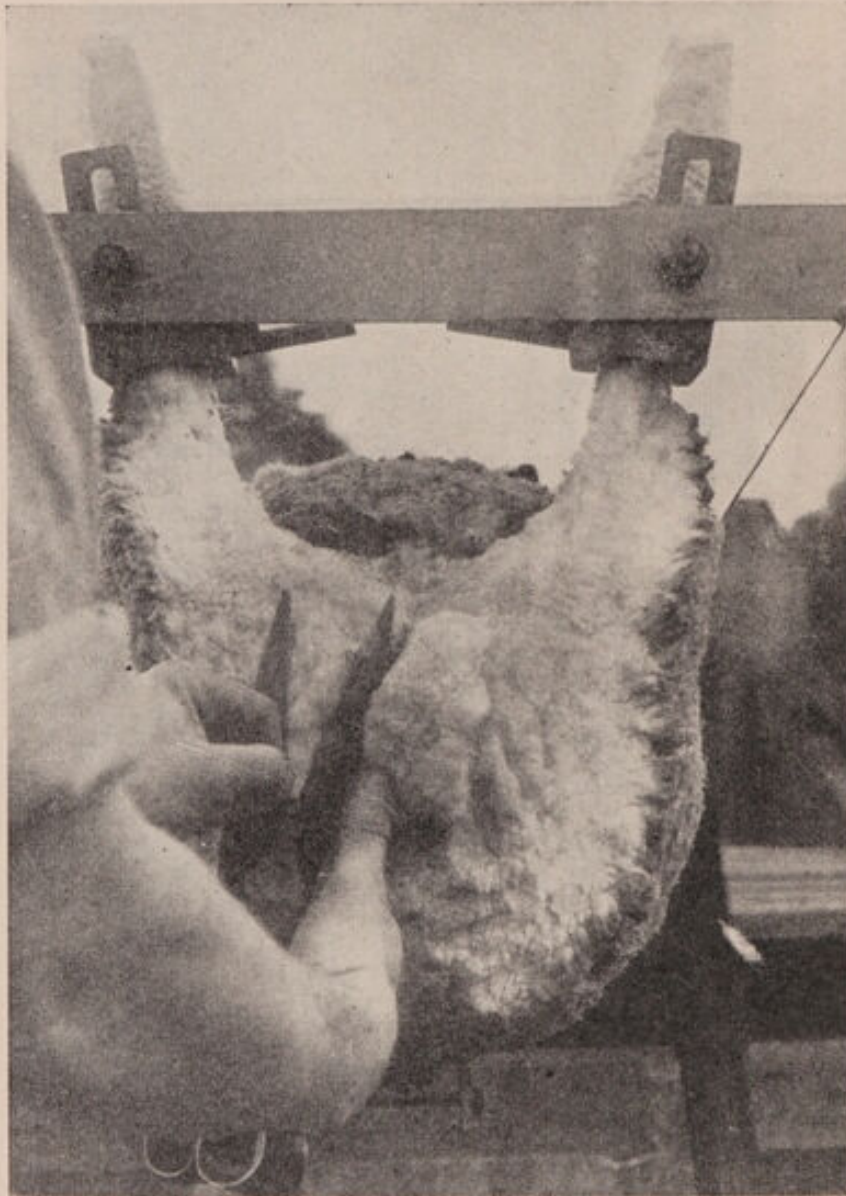


FIG. 9.—Illustrating the commencement of the cut for the modified Mules operation. The sheep is held in the Noondoo or M-V. box or cradle.

(c) After-care of treated sheep.

(i) *No dressing is used and the wounds usually heal quickly.* The edges start to come together in two or three days and healing is usually complete in about three weeks. During healing the sheep should be left undisturbed. Stiffness and disinclination to move is usually exhibited by the sheep for two or three days.

(ii) Occasionally healing is delayed. This is generally due to the wound being irritated or infected from a variety of causes such as: (1) the attack of the small bush fly (*Musca vetustissima*)—this looks like a house fly and if it is very prevalent sheep should not be treated; (2) long wool being stuck to the wound by dried blood; (3) inflammation due to fly strike before treatment; (4) the use of dressings—even dressings which are generally considered to be non-irritant have been shown to delay healing.

(iii) The wounds as a rule are not attractive to blowflies unless they become infected. If this occurs and strikes result, it is usually better to leave the sheep undisturbed than to dress the strikes. Driving or yarding tends to re-open the healing wounds whereas the strikes usually clear up themselves, especially if the sheep have just been shorn or crutched. If it is necessary to treat the wounds for fly-strike, a 5 per cent. solution of copper sulphate in water can be recommended for its drying effect on the wound.

(iv) When the wounds have healed, the crutch of well-treated sheep has the appearance seen in Fig. 7. Buyers wishing to purchase sheep rendered almost immune from crutch strike by the modified Mules operation can identify them by the stretched "bare area" (see Fig. 10).



FIG. 10.—Showing the result of the modified Mules operation, correctly carried out at marking, one month later and compared with an untreated lamb of the same age. The diameter of the bare area is increased to 4 inches in the treated lamb.

That the Mules operation is practicable even for large flocks is shown by the fact that many stations treat 4,000 to 5,000 sheep in less than a week of working time, and some are treating as many as 20,000 sheep during the year. In small flocks rarely more than a day's work is involved.

To obtain the maximum protection against crutch strike it is necessary to dock the lambs at the correct tail-length. This has been dealt with in the preceding section and should be read in conjunction with this discussion of the Mules operation.

III. TREATMENT OF STRIKE: STRIKE DRESSINGS.

In Report No. 2 it was stated that glycerine diborate and camphor-boric-acid emulsion (C.B.E.) were valuable but were impracticable under war-time conditions, and that other boric acid dressings were being tested.

The zinc sulphate compound described in the Report was found to be less valuable than earlier tests indicated and is no longer recommended.

The purpose of this section is to describe two improved boric acid dressings which have been devised by the Council's Division of Economic Entomology. These are known as B.T.B. (boric acid, tar oil, and bentonite) and B.K.B. which is a modification of B.T.B. having more rapid killing effect on the maggots in the struck area. B.T.B. has been in commercial production for about two years. It has proved highly satisfactory, but owing to its delayed action on the maggots sometimes in sheep carrying less dense fleeces, such as crossbreds, some maggots are able to migrate from the dressed area and establish themselves nearby.

B.K.B. has been devised to overcome this difficulty. It has been tested carefully under insectary conditions and, to some extent, under field conditions and has proved to be an excellent dressing. At recent prices, the ingredients cost 1/3d. per gallon more than those of B.T.B. and rather bulkier containers are required. Certain ingredients of B.K.B. are available only in limited quantities under present circumstances. The dressings may, therefore, not be available for general use under war-time conditions.

B.T.B. is now prepared and sold by a number of manufacturers under various trade names. Graziers who desire to do so can purchase the ingredients and prepare B.T.B. or B.K.B. for their own use.

Formulae and Preparation of B.T.B. and B.K.B.

The formulae of these two dressings are as follows:—

<i>B.T.B.</i>				<i>Percentage.</i>
Boric acid	..	..	..	15 by weight.
Creosote and Kerosene (equal parts)				2 ..
Bentonite	..	..	..	3 ..
Agral 2	..	..	..	0.5 ..
Water	..	..	..	79.5 ..
<i>B.K.B.</i>				
Boric acid	..	..	..	15 by weight.
Kerosene	..	9.3	}	20 ..
Lysol	..	5.3		
Orthodichlorbenzene	..	5.4		
Bentonite	..	..	..	3 ..
Agral 2	..	..	..	0.5 ..
Water	..	..	..	61.5 ..

Bentonite—So far, unprocessed bentonites from Australian sources have been found unsatisfactory for this purpose, and processed bentonites of American origin should be used.

Agral 2 is a wetting agent which has been found particularly satisfactory for making easy the mixing of the dressing and also for assisting penetration of the dressing through the wool. The source of *Agral 2* used in Australia is Imperial Chemical Industries of Australia and New Zealand.

Kerosene—Lighting or power kerosene may be used.

Creosote—"Creosote 259," having a distillation range of approximately 240°-330°C. was used in experimental work after many different tar oils had been tried. When B.T.B. is prepared with tar oils from different sources it varies appreciably in stability, i.e. the extent to which the ingredients separate out on standing, and in ability to penetrate the fleece, even though the tar oils used are of similar distillation range. Creosote is, of course, a tar oil. "Creosote 259" was obtained from Messrs. Timbrol Ltd. of Sydney.

Lysol can be obtained from the usual commercial sources.

Orthodichlorobenzene is a by-product from the preparation of paradichlorobenzene. Supplies are limited and it is only available from one firm in Australia at present, namely Messrs. Felton Grimwade & Duerdins Pty. Ltd. Other sources are likely to be developed shortly.

For the convenience of graziers who may wish to prepare either of the above dressings for their own use, the quantities required per two gallons of dressing and the method of preparation may be set out as follows:—

To make two gallons of B.T.B.—

1. Mix together { boric acid (powdered) .. 3 lb.
 bentonite .. 9½ oz.
2. Stir in *Agral 2* .. 1½ oz.
3. Of the total quantity of water* required, namely 12¾ pints, stir into the powder sufficient to make a smooth thin paste.
4. Now add 7 fl. oz. of a mixture of equal parts kerosene and creosote.
5. Stir thoroughly for several minutes until the oil is thoroughly incorporated in this paste.
6. Add the rest of the water slowly and with constant stirring.

To make two gallons of B.K.B.—

The steps in the preparation of the dressing are the same as for B.T.B. The quantities of the ingredients are:—

Boric acid	..	..	..	..	3 lb.
Bentonite	..	..	..	..	9½ oz.
<i>Agral 2</i>	..	..	..	..	1½ oz.
Water*	..	..	..	..	10 pints.
Kerosene, 37½ fluid oz. (11 parts by volume)	..	..	..	..	68½ fl. oz.
Lysol, 17 fluid oz. (5 parts by volume)	..	..	..	..	(approx.
Orthodichlorobenzene, 14 fluid oz. (4 parts by volume)	..	..	..	..	3½ pints).

Before using these dressings *shake the bottle or can thoroughly*, shear the struck area to ensure that the full extent of the strike is

* Tank water or other soft water should be used.

exposed, and pour on sufficient of the dressing to saturate the whole area thoroughly. Ensure thorough penetration by lightly dabbing the dressing in with the hand or a brush. Do not merely spray the dressing on to the area.

B.K.B. will quickly drive out the maggots and many will be killed before they can drop off. B.T.B. acts similarly but much more slowly.

Both these dressings are non-irritant and leave a deposit of boric acid on the dressed area which will protect against re-strike while the wound is healing.

B.T.B. is not a repellent and flies may alight and lay their eggs on the dressed area shortly afterwards. This is probably an advantage, since any larvae emerging from such eggs are poisoned when they commence to feed.

Since recent work has shown that the struck sheep is the main breeding ground of the principal primary sheep blowfly of Australia, *Lucilia cuprina*, the importance of using a good contact poison in fly-strike dressings has become more evident. By rapidly killing the maggots in the strike, B.K.B. not only prevents them from crawling on to nearby areas and re-establishing themselves there, but it so affects most of the grown maggots that, even if they are able to drop off the sheep, they cannot complete their development into flies.

B.T.B. and B.K.B. are recommended by the Joint Blowfly Committee, although supplies of B.K.B. may not become available for some time.

IV. GENERAL STATEMENT AND SUMMARY OF RECOMMENDATIONS.

1. In selective breeding for wool production, care should be taken, so far as possible, to select against inherent predisposition to crutch strike and body strike.

Sheep predisposed to *body strike* show one or more of the following faults: slack open fleece, especially over the withers; wool lacking to some extent in "quality" as indicated by handle, character and yellow colouration of yolk; faulty conformation, as shown by "pinch" behind the withers, high shoulder blades, broad withers with depression between the shoulder blades.

Sheep predisposed to *crutch strike* show excessive loose skin and wrinkles in the breech. The most predisposed, the so-called C class, are mostly undesirable for other reasons, such as lack of uniformity, poor quality of the fleece, and poor constitution. The occurrence of these several defects can be prevented only by strict attention to breeding. The necessary quantity and quality of wool can be obtained from sheep less predisposed to fly strike. The present indications are that unless a ram has been progeny-tested it is not possible to evaluate its ability to produce the desired type of progeny.

2. The majority of Merino sheep are moderately predisposed to crutch strike, the so-called B class. To remove or reduce the predisposition in these and in the more predisposed ewes, the skin of the breech can be tightened and smoothed by the removal of excessive

loose skin which also increases the extent of the "bare areas." This modified Mules operation may be carried out at marking-time or at weaning-time, as well as on adult sheep. The results obtained are permanent, and subsequent crutching can be carried out more easily without injury to the skin of the sheep.

3. Excessively short tails increase the predisposition of sheep to crutch strike. In docking, attention should be given to the leaving of adequate skin flaps, and short docking should be avoided. A tail left long enough to reach to the tip of the vulva or just a little lower affords a definite measure of protection against crutch strike.

4. A complete programme of jetting with arsenical preparations can be used to keep crutch strike under control. The method, however, should not be used to the exclusion of others designed to reduce the primary predisposition of sheep to crutch strike. It may be of great value in supplementing the primary methods, particularly to give protection during severe "fly waves" when all classes of sheep may be struck.

5. In any programme of work designed to prevent fly strike, shearing and crutching play an essential part.

6. Special precautions usually have to be taken to protect the heads of Merino rams from strike. Removal of the wool from around the horns is valuable, and dressings containing boracic acid or arsenic can be used to supplement this removal.

7. The limitation of bacterial infection of wounds is desirable at all times, especially during a "fly wave," if strike is to be avoided.

8. Lambs should be marked as early as possible, short docking should be avoided, cleanliness should be rigidly enforced, and a repellent dressing containing oil of citronella* can be applied. If these precautions be taken, strikes in tailing and castration wounds can be reduced to a minimum.

9. Reduction in the abundance of the primary sheep blowfly, *Lucilia cuprina*, will assist in reducing the incidence of strike. Fly abundance can be reduced by preventing the breeding of flies on live sheep, that is by the removal of predisposition and susceptibility in sheep, and by the early treatment of all strikes with a dressing that kills the maggots. The present trapping methods have little value in reducing strike incidence. Efficient disposal of carcasses should receive attention on strictly sanitary grounds.

10. When a strike occurs, it must be treated as early as possible with a non-irritating dressing which penetrates readily and quickly, and contains a substance which will kill the fly maggots.

* The citronella dressing is prepared as follows. Take 10 parts by weight of oil of citronella, 10 of soft soap, and 80 of water. The soft soap is dissolved in 50 parts of water by mixing thoroughly and heating almost to boiling. The citronella is then added *slowly* to the hot soap solution with continuous stirring: if added too quickly the solution may boil wildly and froth over. A cover is placed over the vessel to prevent loss by volatilization, and warming is continued for several minutes until the preparation becomes uniformly transparent and syrupy. The remainder of the water is then stirred in and the solution allowed to cool.

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