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### White muscle disease of sheep : symptoms and pathology

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## White muscle disease of sheep : symptoms and pathology

### Cover Page Footnote

The author wishes to acknowledge, with thanks, the contributions which have been made to our understanding of the disease in Western Australia by Mr. J. Armstrong, B.V.Sc, Albany, and Mr. P. Lewis, B.V.Sc, Manjimup.

# White Muscle Disease

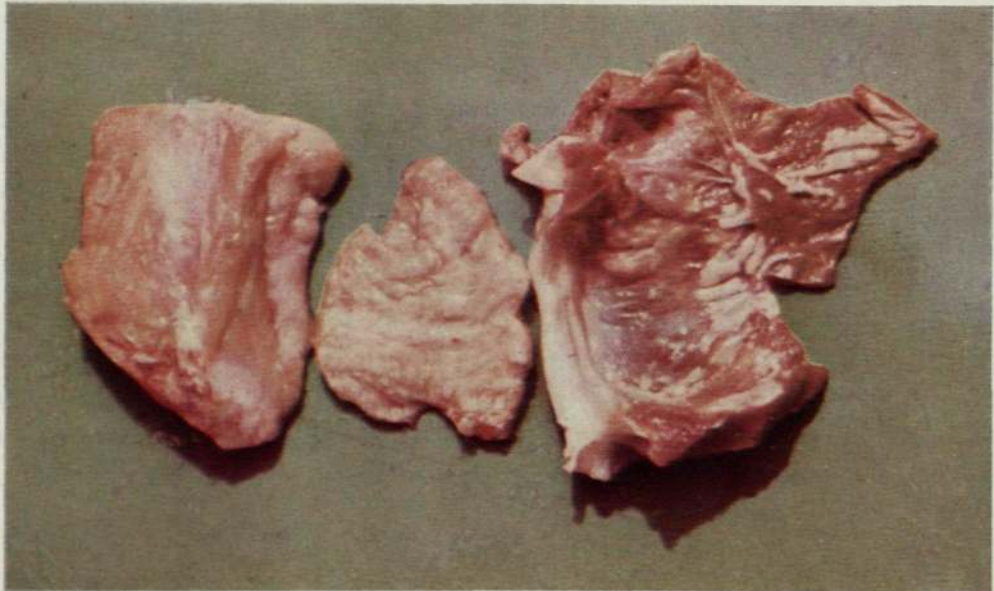


Fig. 1: Inside wall of the heart (right) and two pieces of skeletal muscle, showing white streaks of degeneration caused by the disease. The colour picture was taken during post-mortem examination of an affected lamb at the Animal Health Laboratory last winter.

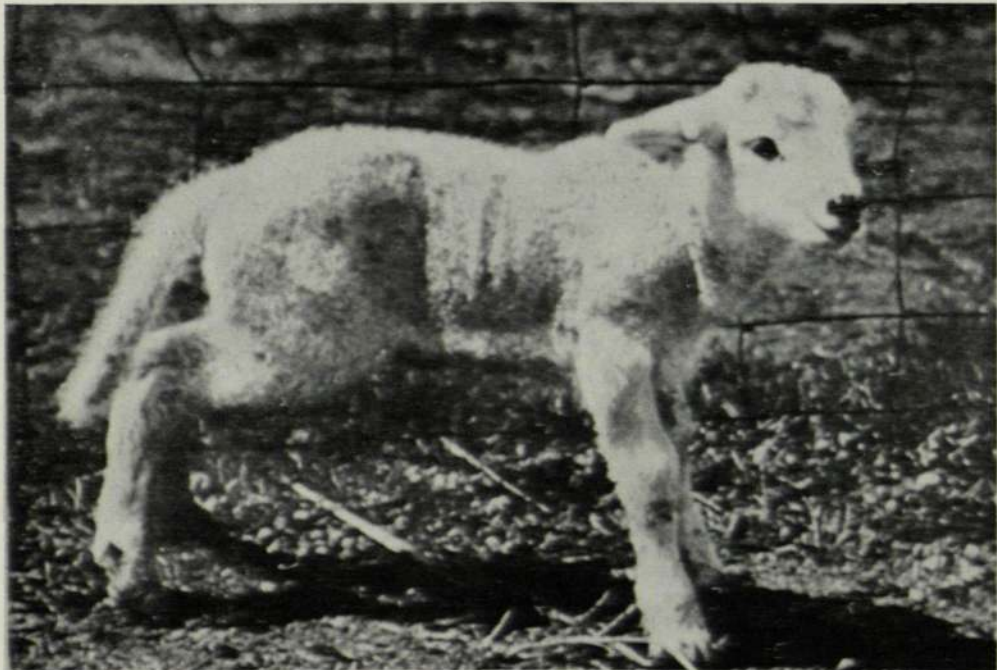


Fig. 2: Lamb with muscular dystrophy caused by white muscle disease, showing posture with feet widespread, and prominent shoulder blades. (From Marsh: *Newsom's Sheep Diseases*.)

# WHITE MUSCLE DISEASE OF SHEEP

## *Symptoms and Pathology*

By M. R. GARDINER, B.S., V.M.D.,  
Chief Veterinary Pathologist

**W**HITE Muscle Disease (WMD) was recognised for the first time in Western Australian sheep during the winter of 1960. The first outbreak occurred on a property in the South Stirling district in the middle of July and this was followed by outbreaks in August, September and early October, at Mayanup, Kendenup, Mt. Barker, Duranillin, Kojonup, South Stirling and Pinjarra.

In each case, the disease was confirmed by pathological studies at the Animal Health Laboratory. Veterinary field officers of the Department of Agriculture have reported additional incidents of WMD during the same period mainly from the South Stirling, Mt. Barker, Albany area and one isolated confirmed occurrence was found on a property south of Kojonup, in early January, 1961. This confirmation of the disease in several districts of the South-West Division strongly suggests that it probably caused lamb losses on many more properties than the 12 or 15 where investigations were carried out, either being not reported, or, more likely, not recognised as the cause of death.

Before going further into the circumstances which were operating on these properties to cause, or to pre-dispose to, the disease, it may be of interest to readers to have some background information on which an understanding of the nature of WMD may be attained.

Two other names—Muscular dystrophy and Stiff lamb disease—have been commonly used overseas to describe this condition of the young lamb characterised by breakdown (or necrosis) of skeletal

muscle in all parts of the body and of heart muscle. First recognised as a clinical entity in Germany in 1925, it was reported during the next few years in the United States, in several European countries, in South America, in Japan and in New Zealand.

The symptoms appear most frequently in the first month of life but lambs as old as five or even six months may occasionally be affected. As far as we know lambs older than this are not susceptible. In some outbreaks, neonatal lambs may be affected and it is suspected that unborn lambs may sometimes develop the disease and be stillborn. Losses may be few, or a high percentage of the lambs of a flock may die.

It is important to realise that WMD outbreaks may run a rapid limited course with an abrupt cessation of new cases and with the recovery of many sick animals even though there has been no change in management, or in feeding, and no treatment has been instituted. Therefore, great caution must be used in the interpretation of the effect of any therapeutic method. This point is discussed below more fully in connection with specific remedies.

## SYMPTOMS

The sick lamb has a stiff stilted gait and can rise only with difficulty. He stands with legs spread apart and head down, and the thorax appears to sag between prominent shoulder blades. Similarly the hindquarters are weak, and, if the heart is involved, the animal will show a markedly increased respiratory rate. Careful examination of these cases will reveal a fast weak heart action. A typically affected lamb is shown in the photograph.

There is no loss in appetite but ability to suckle is often impaired unless the lamb is carefully shepherded. Death may occur in 1 or 2 days following the appearance of the initial signs; it may be early and sudden due to heart failure, or, as mentioned before, the lamb may recover after a short period of muscular weakness. Survival is much more likely in those cases with little or no heart involvement.

## DIAGNOSES

It is easy to diagnose a typical case of WMD post-mortem, provided that one

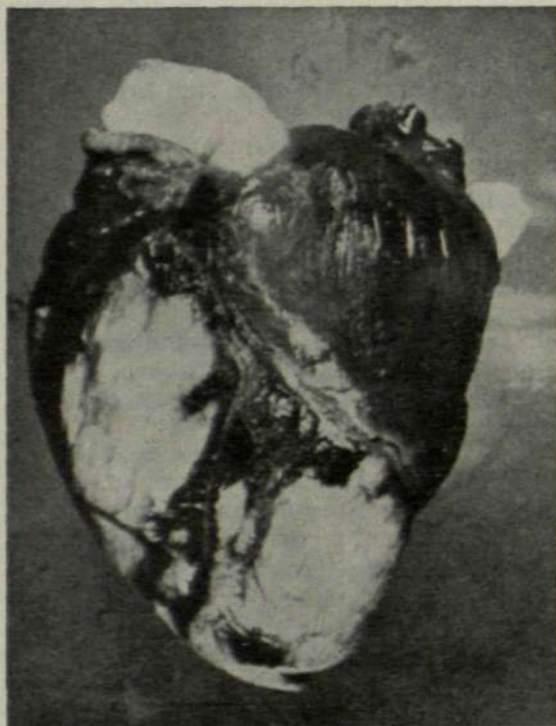


Fig. 3.—Lesions of white muscle disease on the heart  
(From Marsh: *Newson's Sheep Diseases*)

takes care to examine the heart and skeletal muscles. The author believes that the disease may have been missed in Western Australia, in the past, due to failure to open up the heart or to slice the muscles of the hind legs or the shoulder girdle. Hearts affected with WMD, are shown in the accompanying photographs. The white, or nearly white, linear streaks of necrosis can be readily seen especially on the inside wall (endocardium) of the right ventricle. This is the smaller of the two main cavities of the heart. Sometimes the necrosis appears in the left ventricle or even in the auricles which are the two small cavities at the base of the heart. Typical necrosis may occasionally be seen on the outside wall (epicardium). The entire organ seems flabby and lacks normal tone.

The lesions in the skeletal muscles appear as pale white circumscribed streaks which contrast strongly with the reddish colour of adjacent normal muscle bundles. If enough muscles are sliced this contrasting picture of linear streaking and normal muscle fibres can almost always be found (see Colour Plate). Sometimes a paler edition of normal muscle may be mistaken for necrotic muscle.

The heart changes usually lead to disorders in other parts of the body. Perhaps the most frequent of these is congestion of the lung and the observer may be misled into thinking the animal has died of pneumonia. Of course pneumonia may actually be the terminal event but the basic cause—heart failure due to WMD—is the important one.

*This description of symptomatology and pathology has been given as a guide to the livestock owner. Wherever possible confirmation of WMD should be obtained by a veterinary surgeon. Other diseases may occur in conjunction with WMD and may be important predisposing causes.*

## POSSIBLE CAUSES

It is a mistake to look upon this condition as a simple deficiency disease. The causes of WMD are complex and even today are not fully understood. In those parts of the world where it has been most completely investigated certain combinations of factors have been found to occur. Thus in U.S.A., feeding pregnant ewes on diets rich in lucerne or clover hays,

especially if grown on irrigated land, results in a high incidence of the disease in their lambs. For years this was thought to be due to a deficiency of Vitamin E in these hays, and, in fact, there have been many reports indicating that ewes supplemented with this vitamin (wheat germ is a good source) during late pregnancy will produce lambs much less likely to develop WMD. However, legumes associated with the production of WMD often have quantities of Vitamin E, on chemical analysis, as great as non-WMD feeds. Obviously then the condition is not an uncomplicated Vitamin E deficiency disease.

Recently, there have been some research reports which indicate that some legumes may synthesize agents which inhibit the normal metabolism of muscle

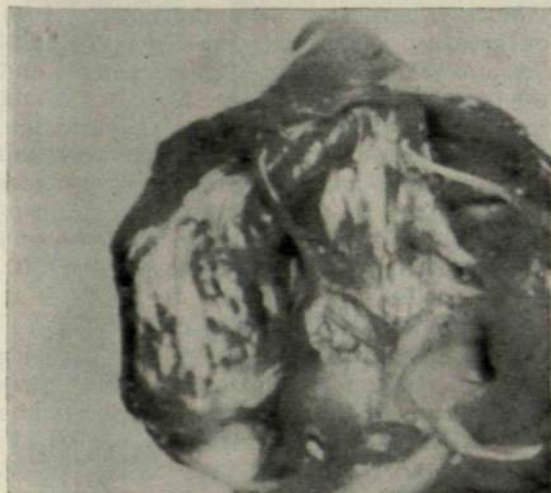


Fig. 4.—Heart opened to show lesions in the right ventricle

(From Nisbet, Butler and Macintyre: Muscular Dystrophy in Experimental Lambs)

cells, even though ample amounts of Vitamin E may also be present. It seems that cool weather combined with much rain favours the production of the inhibitor which may be one of the primary factors leading to outbreaks of WMD. The nature of the inhibitor is unknown although a number of substances are known which can experimentally induce the disease. Thus unsaturated fatty acids in the form of cod liver oil will often cause WMD. This form of the disease has been known for years in Scotland in calves given supplementary cod liver oil as an

anti-rickets agent. It also appears that the natural inhibitor which is present in many WMD-inducing rations can itself be counteracted by substances present in other feeds. As neither the metabolic inhibitor present in the legume or the counteractant in the preventive feeds have yet been identified, further comment on this line of research is probably not profitable at present except to say that in the author's opinion, this approach is one of the most promising for future investigation.

Thinking on the fundamental nature of WMD took a new turn several years ago when it was shown, in New Zealand, that selenium could prevent or cure the disease in many districts where it was prevalent. This finding has been confirmed in other parts of the world where this trace element is deficient in the soils. Furthermore, it has been found that the added selenium will promote growth and improve fertility but probably only on properties where WMD actually occurs.

It appears, therefore, that there are at least three factors involved in the cause of WMD. These are:

- (1) Deficiency of Vitamin E.
- (2) Deficiency of selenium.
- (3) Presence of a metabolic inhibitor in certain feeds.

To prevent the occurrence of the disease, *both* Vitamin E and selenium are probably needed in adequate amounts by the ewe for several months before lambing, and there must be an absence of the metabolic inhibitor in the ration of the lamb. Thus if the former are adequate and the inhibitor is present, WMD may develop. There is some evidence also that other minerals such as iron, cobalt and copper must be present in balanced quantities in the soil in order to prevent the disease. For instance, WMD is much more frequent in parts of Finland where cobalt and copper deficiencies are common.

#### WEST AUSTRALIAN OUTBREAKS

With regard to the Western Australian outbreaks, we have little or no information on the contributing factors, or on the presence or absence of essential vitamins, minerals or enzyme inhibitors in the maternal diet. The very few chemical

analyses done so far tend to show that both selenium and Vitamin E are probably supplied in adequate amounts on properties where WMD has been diagnosed. *But we emphasise that these findings are very preliminary and results of surveys now in progress should be awaited for more valid evaluation of these points.*

At present we can only speculate on the presence of a metabolic inhibitor, a view which receives some support in view of the occurrence of almost all our outbreaks in the three winter months in districts which were both wet and cold. With regard to the overall mineral balance on affected paddocks, we have little knowledge as yet.

Finally, the influence of other diseases on the development of WMD cannot be ignored. A survey of the outbreaks of the disease last winter shows that at least one was associated with giving an arsenic-carbon tetrachloride drench, two with facial eczema hepatitis, one with a multiple deficiency syndrome and several with thyroid abnormality.

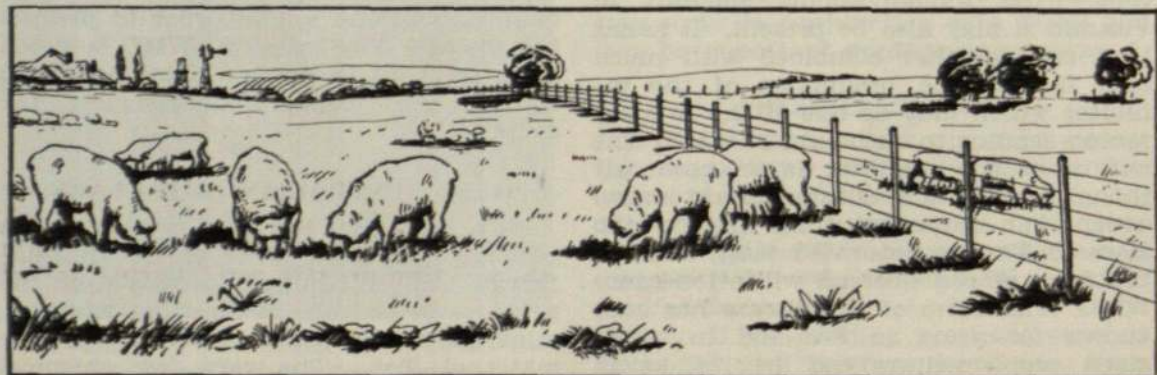
Enough has been said to indicate the great complexity of the WMD problem. *Graziers are urged to approach with great caution the promiscuous use of selenium, a substance of tremendous toxicity.* Even if selenium should prove to be deficient in the soils of this State, the most rigid control should be exercised in its use. On the other hand, it will probably be shown that there is no simple solution to the problem and therefore, it will be to the ultimate advantage of primary industry in Western Australia for sheep growers to

bring unexplained lamb mortalities to the attention of veterinary field officers. It is very important that the facilities of the Department of Agriculture be enlisted so that co-operative research can eventually provide the information we must have, not only to control WMD, but also to determine the relationship, if any, between the factors giving rise to the disease and those involved in the more widespread condition of ewe infertility and unthriftiness of lambs.

*A comprehensive programme is being set up this year in co-operation with the Veterinary Field Officers, the Animal Nutrition group and the Government Chemical Laboratories, the object of which is the study of selenium and Vitamin E content in the pastures, during the entire growing season, on properties where WMD has been previously diagnosed. Furthermore, when outbreaks occur, pasture samples will be collected for similar studies and affected animals will be sent to the Animal Health Laboratory for examination. Several drenching trials have already been carried out by veterinary officers with a view to determining the value of selenium in improving ewe fertility and lamb marking rates and preventing WMD.*

#### ACKNOWLEDGMENTS

The author wishes to acknowledge, with thanks, the contributions which have been made to our understanding of the disease in Western Australia by Mr. J. Armstrong, B.V.Sc., Albany, and Mr. P. Lewis, B.V.Sc., Manjimup.





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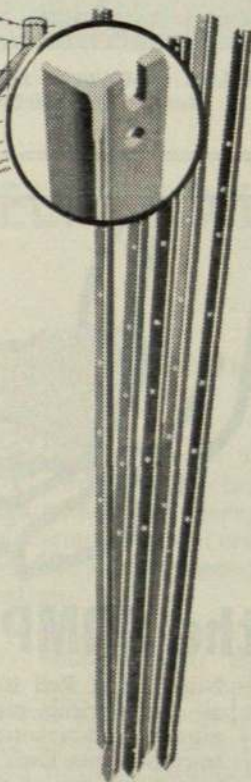
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