

Further Notes on Lumpy Wool in South Africa.

By

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BULL (1929) reported the isolation of a micro-organism, *Actinomyces dermatonomus*, from the natural lesions of a skin disease of sheep designated by him as *Actinomycotic dermatitis* and popularly referred to as "Lumpy wool". Bull described the morphological, cultural and pathogenic characteristics of this organism and assigned to it the causative rôle in the production of the condition. Albiston (1933) described the natural occurrence of this disease in calves. He was able to isolate an organism similar to that described by Bull and to transmit the condition to sheep and calves.

THE OCCURRENCE OF THE DISEASE IN SOUTH AFRICA.

In some localities, e.g. in the Humansdorp district, the disease assumes serious proportions during certain seasons. However, in most other areas only one or two cases occur in the flock and under these conditions there is no evidence to show that the disease is very contagious. There appears to be no doubt that rainfall and humidity are very important in connection with the occurrence of this disease. The following points with regard to the incidence of the disease in South Africa illustrate this:—

1. Hitherto only isolated outbreaks have been noted in the Karoo districts. This tract of country is an important sheep-raising area and is arid or semi-arid.
2. Most of the outbreaks which have been reported have occurred in East Griqualand and the eastern, south and south-western districts of the Cape. The rainfall in these areas is relatively high.
3. In the Humansdorp district (southern Cape) a large number of cases occurred in 1932 when the district experienced abnormally heavy rains. However, in 1933 when much less rain fell and droughty conditions prevailed, no fresh cases were reported and most of the sheep which developed the disease in 1932 recovered spontaneously after shearing.

TYPE OF ANIMALS AFFECTED.

As far as it has been possible to ascertain the disease has been noted in Merino sheep only. However, the fact that Merinos preponderate in South Africa may account for the apparent non-susceptibility of other breeds. It would appear that lambs are particularly susceptible, although cases in older animals are not uncommon.

THE ISOLATION OF THE CAUSATIVE ORGANISM.

It was possible to isolate the organism, *Actinomyces dermatonomus*, from two affected sheep (D.O.B. Nos. 32922, 33501). These sheep were sent to the Onderstepoort laboratory from two widely separated districts of the Union.

In these animals the presence of the organism, in the form of mycelia, could readily be demonstrated in smears prepared from the diseased skin.

To obtain material for culture a lump of matted wool was gently peeled away from the skin and from the exposed raw surface some exudate was sown on serum agar, and this incubated at 37° C.

The cultural and morphological characteristics of the organism are like those described by Bull.

MORPHOLOGY.

Depending upon the age of the culture the morphology varies greatly. The growth on blood or serum agar after 24 hours incubation consists of branching mycelia with an occasional condium. The mycelia vary greatly in size, being usually 2-6 μ long and 0.5-1.0 μ thick.

Frequently protruberances are present in the course of a filament and very often the mycelia terminate in knob-like enlargements. After 48 to 72 hours the mycelia are less numerous and appear to be broken up. The culture now consists chiefly of conidia. At this stage mycelia are found which terminate in a series of coccus-like bodies. After a further 4-6 days incubation the smears from the culture resemble those of a pure culture of a small coccus.

The organism stains readily with the usual aniline dyes and is Gram-positive.

CULTURAL CHARACTERISTICS.

The organism grows easily and well on the usual laboratory media. The addition of serum or blood leads to a more luxuriant growth. At 37° C. optimum growth is obtained, but even at ordinary room temperature (20-26° C.) growth occurs, and after 4 or 5 days satisfactory cultures are obtained. The organism is strictly aerobic. On serum- or blood-agar and at 37° C. a dirty white, somewhat raised and rough growth is obtained after 24 hours. The growth increases with further incubation and becomes wrinkled or corrugated and slimy. Individual colonies are roughly round, with an undulating but entire border and the surface is wrinkled. The colour varies from dull white, grey to yellow. The surface is occasionally mucoid in consistency. Colonies aged 48 hours to 4 days are buried in the medium and can be removed *in toto* only with difficulty. On blood agar (particularly in poured plates) definite although not marked haemolysis is present around each colony.

On 1 per cent. glucose agar the appearance is similar to that on serum agar, but the growth is less profuse. In beef infusion peptone broth good growth occurs in 24 hours in the form of small floccules. After 4 days a flocculo-stringy deposit is obtained. A similar, though not so profuse growth is obtained in 1 per cent. glucose broth. In 5 per cent. serum (sheep) broth better results are obtained; a heavy

flocculent turbidity with, later, a slight scum-like pellicle forms. The organism grows very poorly in meat broth, i.e. broth plus meat particles.

Inspissated serum (horse) medium becomes softened and semi-solid.

Litmus milk is completely digested after 7-14 days incubation. Gelatin is liquefied.

FERMENTATION REACTIONS.

(NOTE.—The various carbohydrates were added to make up 1 per cent. solutions in 1 per cent. peptone water. The inoculated tubes were incubated for 14 days at 37° C. before readings were taken). It was found that acid but no gas was produced in glucose, laevulose, maltose and dextrine. No fermentation was observed in galactose, salicin, lactose, mannite, adonite, xylose, sorbite, inulin, raffinose and in inosite.



Fig. 1.—An advanced case of dermatomycosis; note lesions around the mouth and on shoulder region.

In Clark and Lubs phosphate medium a doubtfully positive methyl-red reaction was obtained; the Voges-Proskauer reaction was negative. The production of neither indol nor ammonia could be demonstrated in peptone water. Nitrates were not reduced to nitrites.

PATHOGENICITY.

(a) *Laboratory animals.*—The results are in entire agreement with those of Bull.

The application of either culture or ground up material from natural cases to the skin produces in the rabbit, guinea pig and mouse a lesion resembling that got in sheep.

In the guinea pig and mouse the lesion is mild; after 24 hours a reddening of the scarified area appears, followed by the formation of a superficial crust. The crusts peel off after 4 or 5 days leaving a completely healed skin.

The rabbit reacts in a more satisfactory manner, particularly, as Bull pointed out, if the hair is plucked out. The crust formation may be of considerable extent and thickness, but when this peels off the underlying skin is completely healed as in the case of the guinea pig and the mouse.

The application of emulsified material from natural lesions to the scarified or plucked skin of the rabbit has proved to be a suitable method for demonstrating the presence of the organism. From the lesions, practically pure cultures of the organism may be obtained.

(b) *Sheep*.—It was possible to set up reactions in sheep in the following ways:—

- (1) With culture material applied to the intact skin and to slightly scarified areas;
- (2) with emulsified lumps from natural cases applied to lightly scarified areas.

Lesions on the intact skin could be provoked only by using a large amount of culture and keeping the wool moist for a few days.

The development of the lesions are most easily followed on woolless portions of the skin, e.g. inside the thighs. On such sites a distinct hyperaemia of the scarified area is first noted, this being accompanied by a thickening of the skin. Soon small papules (filled with yellow material) appear. These enlarge and coalesce, and later rupture, the purulent material drying to form scabs. In experimental cases the lesions are usually of a transitory nature, this being especially the case on woolless areas. After about 3 weeks, healing commences and the scabs, which are now about $\frac{1}{8}$ inch to $\frac{1}{4}$ inch thick, peel off. The underlying skin heals completely and no cicatrices are formed. In one sheep where a large amount of broth culture was applied to a portion of intact skin along the side of the body, and which was covered with about 6 months' growth of wool, a chronic lesion developed. After three months this lesion was still active and in all respects resembled that of a natural case.

THE PROBABLE METHOD OF INFECTION UNDER NATURAL CONDITIONS.

As has been mentioned, outbreaks of the disease occur sporadically, and in South Africa the condition can definitely be associated with the rainfall. It is possible that Bull's theory of the normal saphrophytic nature of the organism is correct, and that it becomes pathogenic and invades the skin when the latter is in some or other way injured, as, for example, after prolonged wetting during a very rainy spell of weather.

In view of this an attempt was made to isolate the organism from the skin and wool of 12 normal lambs, aged about 12 months. The skin of each sheep was scraped in three different sites with a blunt knife, the scrapings shaken up in a small quantity of saline, and poured serum agar plates prepared from this material. The plates

were incubated at 37° C. and examined daily for four days. Colonies in any way resembling those of *Actinomyces dermatonomus* were picked and replated. It was impossible to demonstrate the presence of the organism on the wool or skin of these animals.

METHODS OF TREATMENT AND PREVENTION.

Steyn (1931) has advised treatment with a mixture of tincture of iodine and linseed oil. Good results were obtained with this in those cases where the lesions were not very extensive and of fairly recent origin. Where, however, very extensive lesions were present the application of this mixture did not yield the desired results. From the point of view of economy it would hardly seem justified to treat by this method, ordinary flock sheep which have such extensive lesions; indeed, Steyn advises that such animals should be destroyed. Where the lesions are well developed and firmly adherent to the skin, it is difficult to conceive of a fungicidal preparation having sufficient penetrative properties to effect a cure. Such cases must be treated surgically and the hard lumps carefully removed and the exposed skin treated with a suitable fungicidal preparation, such as a solution of copper sulphate. Previous softening of the crusts with any oily preparation can be recommended.

The general experience of farmers is that when infected sheep are shorn most cases recover without any special treatment. During the shearing operations the hard lumps are usually removed and the lesions which are found mostly on the dorsal regions of the body, become exposed to the sunlight. Apparently this is quite sufficient to bring about sterilisation of the wound and ultimate healing.

An experiment was planned in collaboration with Government Veterinary Officer E. T. Clemow, with a very badly infected flock in the Humansdorp district to ascertain the value of certain dips for preventing and curing the condition. The infected sheep were marked at shearing time. Infected and clean sheep were dipped in lime and sulphur and in Cooper's Double Dipping powder. Suitable control groups were retained. The results are summarised in the following table:—

Group No.	October, 1932, No. of Sheep in Group.	Dipped in.	Result, i.e. Percentage Found Infected, October, 1933.
A ₁ (clean).....	100	Cooper's Double Dipping Arsenical Powder	9.0
A ₂ (infected).....	200	“ “ “	8.5
B ₁ (clean).....	653	Lime and sulphur (Capex)	4.0
B ₂ (infected).....	354	“ “ “	3.4
C ₁ (clean).....	100	Not dipped (controls)....	4.0
C ₂ (clean).....	100	“ “	4.0

It will be noticed that:—

- (1) During the season 1932, 654 sheep out of a total of 1,507 in this flock, or about 43 per cent., showed infection. The lesions were of varying extent and degree.
- (2) The dipping of clean and infected sheep in two commonly used dipping preparations had very little effect on curing or preventing the disease.
- (3) The incidence of infection during the season 1933 was 43 per cent. and during 1932, 6 per cent. During these two seasons the rainfall was 40·85 inches and 25·54 inches respectively, clearly indicating that the occurrence of the condition is associated with conditions of moisture.

A solution of copper sulphate, as advised by Bull, for preventing this condition, was not tried. It should be remembered that when sheep are dipped in an aqueous solution of copper sulphate there are materials such as carbonate, etc., in the suint, which will form insoluble copper compounds, with the result that the first few animals dipped tend to carry down the greater proportion of the copper and the dipping solution will then have less fungicidal effect.

SUMMARY.

- (1) The occurrence of further outbreaks of lumpy wool in South Africa is reported.
- (2) The isolation and morphological and cultural characters of *Actinomyces dermatonomus* are described.
- (3) The production of the lesions of lumpy wool in laboratory animals and in sheep by the use of cultures and material from naturally infected sheep is recorded.
- (4) The probable method of natural infection, and curative measures are discussed.

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