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DEFECTS OF NEW ZEALAND WOOLS

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D.J. SIDEY.

The following statements give a fairly full account of the various defects found in New Zealand wools. It is somewhat difficult to assess the economic importance of each defect since it has to be remembered that the first essential of wool is that it shall act as a protective covering for the sheep, and that other factors, for example, the demand for early maturity and shape of carcass, in the case of the fat lamb, are of more importance than the wool produced by the lamb. As already has been pointed out, a wool that through some peculiarity or defect may be unsuitable for one trade may be quite suitable for some other trade, and, in consequence, is not very much penalised in price by reason of its defect. There is, therefore, not much incentive to the producer to eliminate the defect, in fact, in some cases in the past it has paid him to ignore the criticisms and aim at producing maximum weight instead of maintaining a balance between quantity and quality.

1. Presence of Irregular Fibres:

This is probably the most outstanding defect in New Zealand wool, of which complaint is made, and the irregularity may take a number of different forms:-

- (a) Fibres of widely different size in the same staple, in most cases the larger fibres being medullated for part, if not all, of their length, while the finer ones are true wool.
- (b) Fibres varying in diameter along their length, in many cases due to medullation at the tip, which results in thickening of the latter, while in other cases it may be due to a period of semi-starvation, especially during the late winter and early spring periods.
- (c) Fibres considerably varying in length in the same staple, which, while to a greater or lesser extent present in all wools, often is a decided characteristic of wools resulting from crossing of two breeds of sheep.
- (d) Fibres, although of true wool, varying in size and shape, but not to the extent of those outlined in (a).
- (e) Presence of kemps in the wool.

The factor of varying fibre diameter, especially when due to medullated fibres, has been the cause of the outcry against New Zealand wools by Bradford wool-buyers; and in the case of some of our cross-bred wools, especially those from part of the Wanganui, Taranaki, Hawke's Bay, and Auckland districts, there appears to be ground for the complaint. The eradication of this defect presents a serious problem. The major difficulty in this connection is to know the exact cause or causes of the appearance of these medullated fibres, and why they should be in evidence to a greater extent in one year than they are in the next. Undoubtedly, one of the predisposing causes is a genetic factor or factors, apparently not confined to any single breed. However, nutritional and climatic conditions appear to play their part. That this is so is shown by the remarks of one Bradford buyer of large quantities of New Zealand cross-bred wool, who in conversation with the writer on this particular point, stated that even in some of the best Southland Romney clips a variation in the amount of medulla and thickened tip occurred from year to year. In one year a clip might be moderately free from it; the next year fairly bad, and the following year fairly free again, showing that factors other than those of genetics are at work; but it is difficult to determine how much of this difference is due to genetics and how much may be due to some other cause.

In private correspondence with the writer, J.F. Wilson, of California, has carried out considerable work on medullated fibres in the Romney and other breeds states that after several years of work on the subject he still

is in the dark regarding all the causes of medullation. He states that in one case at least that he has observed, only a change of nutritional and climatic conditions could account for a greatly increased percentage of medullated fibres in one flock. He states, further, that in actual feeding experiments he has not been able to reproduce similar effects. He suggests that the reason why it usually is the coarser fibres that are medullated probably is that in the stronger woolled breeds the tendency to produce a hairy outer coat has not been so completely bred out as it has been in the finer-woolled breeds. This fact, combined with a certain set of nutritional, climatic, and breeding conditions, may bring out a characteristic which under more favourable conditions is masked. It may be that a contributing cause of so much medullated fibre in some of the cross-bred wools from certain districts in New Zealand is the extensive use of cross-breeding, which has been practised in the past, bringing out latent characters.

Barrit and King² have shown that medullated fibres are low in sulphur and my own and other work has shown that, as a rule, Romney wool is low in sulphur content as compared with other wools. It is possible, therefore, that there is some direct connection between these two factors, combined with a low percentage of organic sulphur in the pasturage on which the sheep have to live, that is a predisposing cause to the production of medulla. If there is a natural short supply of protein sulphur in the blood stream, then it is likely that the larger-sized and quicker-growing fibres will be the first to suffer from this deficiency, and so produce medulla, which theory is in accordance with Wilson's work. It here may be pointed out that Aitken,⁷⁽³⁾ in New Zealand and Woodman and a co-worker, at Cambridge, have been unable to isolate cystine (the sulphur-rich amino-acid found in wool) from ordinary pasture grass, but both have found about equal proportions of inorganic and organic sulphur. The Cambridge workers, however, have found about twice the total amount of sulphur that Aitken has found in New Zealand grass. How much this is due to the stage at which the grass was cut for analysis, and how much of it is due to the real differences in the sulphur nutrition of the New Zealand grass, or to differences in the technique of estimation, it is difficult to say. It may be, however, that this low sulphur percentage in New Zealand grasses is one of the contributing causes of our medullated wool; and it is a point worthy of further investigation when funds are available. If it is found that in certain localities the grass is naturally low in sulphur, then manuring with ammonium sulphate may improve the position, as Mr. Godden, of the Rowell Research Institute, pointed out that in his experiments this manure had increased the percentage of total sulphur in the herbage, but he could not say whether the increase was in the organic or inorganic sulphur compounds.

Some form of thyroid activity also may be a contributing factor, as is shown in the experiments carried out at the Animal Breeding Research Station, Edinburgh.⁽⁴⁾ When Scotch Blackface sheep have been thyroidectomized their coarse, medullated fibres lose most if not all of their medulla, and appear to take on some of the characteristics of normal wool.

The most hopeful means of improving this class of wool seem to be in the direction of improving the nutritional conditions of the sheep, especially in the direction of evening-up the food supply during the different seasons and at the same time selecting within the flocks already existing in these districts, sheep - both rams and ewes - with the desired type of wool. The necessity of selecting within the already existing flocks is because the sheep have become acclimatized to the conditions, and a certain amount of natural selection will have taken place. The necessity for this procedure is pointed out by Hammond⁽⁴⁾. However, the whole question of nutritional effects on the production of medullated and irregular wool probably is one of the most important facing some of the producers of cross-bred wool at the present time. The area from which comes the bulk of the wool of which complaint is made includes much of the land that comes under the Deteriorated Land Board. It is a well-known fact that no matter how wellbred any class of animal may be, given poor nutritional conditions it soon will deteriorate. Therefore, if nutrition does play a part in the production of this bad wool (and there appears to be every ground for assuming that it does play some part), it may be futile to attempt to improve the wool produced on this class of country by the introduction of good-woolled sheep, since these would deteriorate during the course of a generation or so.

Where, however, indifferent wool is being produced under what should be normal conditions of nutrition, then selection of suitable breeding stock with

Desirable wool is the first essential. However, much improvement need not be expected for a number of generations, since the genetic factors for producing this indifferent wool must be involved and well-distributed throughout the flocks. Although it may not show itself externally, in the form of bad wool, it quite likely may be present in the germ plasm, and require only a suitable mating to bring it out. For the work to be effectively carried out it will be necessary to select both rams and ewes with wool as near the ideal as possible, breed these together, and then inbreed the progeny, always selecting those with desirable wool and culling undesirables. The work, however, will be slow, since there are many difficulties in the way, such as a sheep producing a desirable fleece one year and a bad one next. Speeding-up may be effected, however, by using stock from a flock that is as near as possible to being free from the trouble.

The second defect mentioned, i.e., variation in diameter along the length of the wool fibres, is another that the Bradford manufacturers have strongly stressed. The presence of a medullated or thickened tip would appear to be largely bound up with the question of genetics and climatic and nutritional conditions soon after shearing; and from the producer's point of view, they would be very difficult to control. In some quarters it is thought that the trouble is an hereditary one, but it is questionable whether it can be wholly accounted for in this way, as the trouble considerably varies from year to year, and is not confined to any particular breed. From the manufacturer's point of view the trouble is important for three reasons, the first being that it results in a larger percentage of noil to top, this being wasteful. The second is that all of the thickened tip is not removed in the combing process, and when the subsequent yarn is manufactured into cloth, these ends of thickened fibre stand out from the cloth and give to it a roughened surface. The third reason is that any medullated fibres mixed with ordinary wool dye a different shade so that uneven colouring usually results, which in some cases is undesirable, but which in others may be useful.

The eradication of this defect will not be a simple matter, because, as has been pointed out above, it is not confined to any one breed, and climatic and nutritional conditions, over which the farmer can have little control, probably are the chief causative agents. However, a certain amount of selection along the lines of culling sheep that continually produce too much thickened tip should be helpful, although any culling based on a single year's fleece may mean the elimination of what might be a quite useful sheep.

The problem of long and short fibres in the same staple to some extent is bound up with the defect of coarse and fine fibres occurring together, since, as a rule, the coarse fibres are much longer than the fine ones. From the manufacturer's point of view it means that when the defect is present to any marked extent there is an uneven behaviour of the fibres during the drawing and spinning processes which results in the final yarn not being as level and as smooth as it should be. Here, again, is a problem that will not be very easily solved; but an attempt to improve matters can be made by carefully examining the wool of selected sheep by drawing out the fibres in a sample of wool over a black background. By this means samples of wool showing excessive variations in length and in fibre diameter soon will be evident. There is a little doubt that this type of fibre irregularity is due in part to indiscriminate cross-breeding, which could be remedied by selecting a type and keeping to it.

The presence of irregular-sized and shaped fibres in the same lock, even when they are not medullated, is another defect, but one not so important as that of the presence of medulla. In the presence of these irregularities it is not possible to produce an even, flat-finishing yarn so desirable for the production of most high-grade materials, especially for the single-yarn and lustre goods trade. With two-fold yarns, however, the irregularities to some extent are covered up, and in the case of some yarns, especially for the hosiery trade, are not very important. When these uneven fibres are spun and processed, uneven strains are set up which are undesirable, especially if wool is to compete with artificially-produced fibres. It is necessary, therefore, to endeavour to breed out these irregularities to as great an extent as is possible so that manipulation of the fibres may be made easier, and so that more economic production may be assisted.

It has been shown by Barker and Burgess⁽¹⁾ that fibre irregularity probably is one of the contributing factors in the production of harsh-handling

wool. The writer already has pointed out (appendix 3) that in some cases where, in the trade report on the New Zealand wools, a particularly soft handle was noted, it was subsequently found that the wools were moderately round and even in fibre diameter. It would seem, therefore that by paying more attention to breeding wool with a soft handle, especially when accompanied by a certain amount of lustre, an even and rounder-fibred wool will result. There is no doubt that a number of our best Romney stud breeders already are producing wool that is fairly free from medullated fibres, and meets the manufacturer's requirements. In many instances, however, this class of wool could be further improved if the aid of the scientist could be enlisted to assist the producer in selecting moderately even and round-fibred wools.

This factor of fibre irregularity without medullation probably is one of the most outstanding defects of New Zealand Corriedale wools, which, as a rule, fairly satisfactorily meet the requirements of the manufacturer. Improvement in this respect, however, should mean new and better uses for this class of wool, and improved fabrics which would be more readily able to compete with synthetic fibres.

A few years ago there was considerable discussion concerning the amount of kemp in New Zealand wools, especially in that from some of the Romney flocks, but while in England I seldom if ever heard a manufacturer use the word. Very few wools, especially those of the cross-bred types, are entirely free from kemp of some sort, although the percentage may be very small. The question of kemps very well illustrates how a wool, useless for one trade, may be quite satisfactory for another. An otherwise good wool containing a moderate amount of kemp may be useless for the manufacture of good serges and similar goods, and yet be quite satisfactory for a Harris or other rough tweed where their uneven dyeing helps to lend variety and with the increase in plus-flour suits there has been a demand for this class of material. So far as New Zealand is concerned the problem does not appear to be serious, although in any flock where kemps occur, immediate steps should be taken, by selective breeding, to breed out the defect. Careful work by Show-yard judges and by the stud sheep inspectors appointed by the Breed Societies, in disqualifying any sheep showing even a moderate amount of kemp in the wool, should be helpful.

11. Harsh-handling Wool.

This question has been partly dealt with above; but there are other contributing causes besides fibre irregularity, namely, size and shape of scales or scales on the wool, dryness due to insufficient wool grease, faulty dipping of the sheep, and, in all probability, the plasticity and elasticity of the fibres. These factors, with the exception of dipping, probably are partly genetic and partly nutritional in character, and to a certain extent can be eliminated by selection for soft-handling wool and more regular feeding of the sheep.

It here should be pointed out that Speakman, of the Textile Department of the Leeds University, has worked out a method of testing the scaliness of wool fibres by measuring the resistance to sliding when the fibres are stretched out like a violin bow. To use this method for selection work with sheep, however, would be a very long and laborious task.

The whole question of the amount of yolk or wool grease present in the wool is a very involved one. The wool buyer invariably penalizes wool heavy in grease, yet in so doing he probably is working against his own ends. Knowing that wool heavy in grease is penalized by the buyer, the breeder naturally is inclined to select away from this condition. However, Winson⁽⁵⁾ has shown that, as a rule, wools heavy in grease are better spinning wools than are those lighter in grease but of the same spinning count, the reason being that the latter are not so regular and round in the fibre as are the former. This probably is due at least in part to the fact that the presence of the grease keeps the skin soft, and prevents irregularities in the wool as it is pushed up through the openings of the wool follicles. The wool grease also plays a part in lubricating the wool fibres, and in doing so preventing the lifting by friction of the surface scales, the tendency being to produce a softer-handling wool.

Faulty dipping also may cause what may be an otherwise soft wool to become harsh to the feel, especially towards the tip end; but this can be remedied by more careful attention to the whole procedure of sheep dipping.

111. Coloured Fibres in New Zealand Wool.

This is another fault of New Zealand wools of which complaint is made, especially in the slipe wools from the Freezing Works. In this case, as a rule, the coloured fibres are brown or black, owing to the influence of the South Down and Shropshire sires of the fat lambs, and the trouble, naturally, is on the increase, owing to the more extensive use of the South Down. We have here a case where a Showyard requirement - in this case brown-coloured face and legs - may be in the best interests of the breed when production is considered. In order to overcome this defect the manufacturers have suggested the use of the Corriedale, Dorset Horn, and Ryeland rams in place of the South Down, as they have no brown hairs in their wool. This is a case where mutton and wool interests are in conflict; and it is a question whether it is an economic proposition to lose the early maturity and prepotency for carcass shape of the South Down in order to produce wool free from brown fibres. The Corriedale, good sheep as it is for certain localities, can have little claim for use as a fat lamb producer in place of the South Down, because, bred as it is at present, it is not better than a dual purpose breed, and in the production of ideal fat lambs it is necessary to use a purely mutton type of ram on the predominating mating dual purpose ewes. The Dorset Horn has been tried as a fat lamb producer in New Zealand and in other countries, but has no claim to superiority over the South Down. The Ryeland certainly is the most hopeful of the three breeds mentioned; and it becomes a question whether a little higher price for the wool will compensate for slightly slower maturity and not quite so good a carcass. While in England I made careful enquiries concerning the Ryeland, and the general opinion there was as it is in New Zealand, i.e., that the South Down was superior as a crossing sheep for fat lamb production: as it conferred earlier maturity and a more desirable mutton carcass.

As with most other wool improvements, it is doubtful whether the wool-buyer will pay a premium for wool without brown fibres that will compensate the producer for losses in other directions. As has been previously pointed out it is not always the fault of the wool-buyers that they cannot pay this premium as the wool may be quite useful for certain sections of the coloured goods trade, while it is useless for whites or creams. The most obvious way in which to combat the trouble without the fat lamb producer being the loser, would be to select and breed South Downs with little or no face and leg colouring, and in so doing breed a strain of South Downs with no coloured fibres. Of course, the Breed Society probably would object, although there is no reason why a white-nosed and legged South Down should not be as good as a brown-coloured one, with the possible exception that training to produce the ideal colour means more careful breeding methods. Since the coloured fibres in a Down cross fleece usually are concentrated near the extremities, i.e. legs and head, the Freezing Works and fellmongeries probably could improve the grading of their slipe wools if they were to take care when "pulling" the wool to place wool from these regions in separate lots.

The manufacturers also make complaint of coloured fibres which they describe as grey, often occurring in bunches in some of the Hawke's Bay clips of Romney-cross wool. The writer was unable to obtain a sample of this defect, and is at a loss to explain the occurrence of these fibres; but the defect probably is due to an admixture of black and white fibres. As a rule Romneys are particularly free from coloured patches in the wool or black lambs in the flock, although the writer has observed a Romney ram lamb that had a few fibres in its fleece which were partly coloured, but, as the sheep grew older, the bases of these fibres became white, and there was no sign of coloured fibres in the second-year fleece. The trouble, however, may be due to some trace of the English Leicester blood in the cross-bred, since with this breed black lambs occur fairly regularly, and, less frequently, black patches in the wool also may be found. It also may be due to keeping, for breeding purposes, South Down cross it should be eliminated, as it can have no bearing on the mutton question, and can be only a defect in the wool.

IV. Presence of the Extraneous and Deleterious Matter in the Wool.

Under this heading we have the presences of such materials as (a) jute and kemp fibres; (b) Burrs; (c) Sheep-branding materials that will not scour out; (d) pieces of skin; (e) Pieces of hay or straw, etc.

(a) The first of these defects may be due to one or both of two causes from either pieces of string, etc., picked up in a dirty shearing shed, or jute fibres from the wool bales. The former seldom is the cause of the trouble and is easily regulated by a thorough cleaning of the shearing shed before and during shearing; the latter, however, is more serious, and, despite several attempts to produce new types of wool-packs, the matter does not appear to be much nearer solution. So far, all of the new packs that have been experimentally tested have been found wanting in one respect or another. The packs that have been made from paper, string, wool, or other material will not stand up to the dumping, or else will tear badly when hooks are used. The use of a paper lining inside a jute pack was thought to be a solution, and probably would be except for two factors, one being the liability of the paper to tear away from the side of the pack during the pressing, and the other that so long as jute in any form is used, and the packs are unmercifully cut about in the wool-stores, the jute fibres must find their way into the wool. This question of cutting the bales is a serious matter in the London Wool-stores, which latter I visited for three different sales. The packs are not only indiscriminately cut to display the wool, but, owing to the indifferent shape of the bales after dumping has taken place, in some cases they are cut about in order that they may be tied to supports to allow of safer stacking. The indiscriminate cutting of the bales is not confined to store workers, as some of the buyers, themselves, are guilty of the practice, as during every visit paid by me to the Stores I observed one or more buyers cutting the bales. One lot of bales, in particular, was a remarkable object lesson; evidently the bales had been on display at about four previous sales as they had been cut open and sewn together in four different places, and on each occasion a different lot of sewing twine had been used, two lots being somewhat similar to binder twine used for harvesting and condemned by wool-buyers for sewing wool-bales. Why the bales would not have been opened at the same place each time, and sewn up with seaming twine, is a mystery, unless, it is that it is easier to slash a bale with a sharp knife than it is to cut the string of a previous sewing. So long as practices such as these are permitted in the Wool-stores, and participated in by the buyers themselves, it does not appear to be very helpful to the wool-producer in his attempts to place his wool on the market as free as possible from defects, and reveals a lack of foresight on the part of the wool-buyer in encouraging the producer to use better packs. When the Prime Minister, the Rt. Hon. G.W. Forbes, during his inspection of Torridon, asked the manufacturers' representatives the direct question as to whether if the producers used the improved packs they would receive more for their wool, the reply was in the negative. All the new types of packs so far produced are more expensive than are the jute packs used at present; so the producer is not to be encouraged to use them.

Another point to be noted in this connection is that some bales of wool, after leaving the wool-stores in New Zealand, do not receive sufficient attention as regards the proper sewing-up of openings, or else it is that the bales have burst along a seam during dumping. These openings will allow jute, kemp, and other deleterious materials to gain access to the wool during handling and transport. This could be remedied by New Zealand brokers seeing that all such openings are fastened up before despatch of the bales.

For the sewing-up of woolpacks, and for tying-up of fleeces, the United States Department of Agriculture now recommend a twine made from paper material, as this has the advantage that, if it does get into the scouring bowl, it disintegrates and comes out during manufacturing processes. However, the samples so far produced look rather too thick for quick and easy sewing, and, since we do not tie up our fleeces, any seaming twine gaining access to the wool from New Zealand must do so as a result of faulty opening of the bales at mill.

(b) The burrs of which complaint chiefly is made usually are the seed containers of the Burr Clover, Medicago hispida; but the burrs of Burdock, Arctium lappa, also may cause trouble, especially in some Poverty Bay ships. Apparently, the manufacturers are not so particular about the seeds of

Piri Piri, or, as it is commonly known, bidi bidi, since these are more easily removed by crushing and carding, although, of course, they would prefer to have wool free from them. When in England I communicated to the Director-General of Agriculture the opinion that certain Bradford merchants hold, that it should be a criminal offence to have burr-producing plants on a farm. This, of course, may be impracticable; but with the advent of improved grazing practice it should be possible to control the trouble to at least a certain extent.

(c) The presence of sheep-branding materials that will not scour out has long been the complaint of the manufacturers, and usually, it is attributed to the use of tar, paint, or other similar material. Tar seldom if ever is used as a branding material in New Zealand at the present time, but paint is used in the cases of some stud breeders who require a number of different colours to distinguish mobs of ewes mated with different stud rams. However, it seldom should be necessary to use paint as at least twenty-five mobs can be marked by using a series of dots on different parts of the sheep, utilizing the four colours of branding fluids most commonly available namely, black, blue, red, and green. The Wool Industries Research Association has carried out considerable work in an endeavour to perfect a new branding fluid that will remain visible on the sheep from shearing to shearing, and yet scour out, if not in the ordinary scouring liquors, in a special piece-scouring solution. These efforts have met with a certain measure of success, as favourable reports have been received from South Africa, where a dry season was experienced. However, reports from Australia are hardly so favourable from either the point of view of lasting properties on the sheep, or from that of scouring out. The two different sets of samples experimentally tried out in New Zealand have not proved very satisfactory, and from present observations it would appear that this branding fluid, as distributed by a commercial firm last season, already is beginning to show signs of being washed off the fleeces. However, the writer has a further series of experimental samples to try out this season, which may be productive of good results. It is expecting rather much of any branding material to expect it to withstand the variations of temperature and rainfall that are experienced in different parts of New Zealand, and still scour out in the mill, although it is just likely that it may be possible.

(d) The pieces of skin left adhering to the wool are the result of the cutting of the sheep by the shearers, and it is a matter demanding a better standard of shearing. While not a really serious matter, improvement in this respect should permit of better economic use of the wool and less damage to the manufacturers' machines.

(e) Pieces of hay, straw, etc., also cause trouble to the wool-manufacturer as they not always are removed in the manufacturing processes and a considerable amount of labour, therefore, is entailed in examining the finished goods to pick out small pieces of fibre, and in darning-up the holes.

Discoloured Wool:

There are a number of discoloration defects of wools that vary in their economic importance, some of them being dead-yolk stain; dip-stain; tick or red stain; blue, red, and green colorations brought about by bacteria; or dirty-yellow discoloration, which, according to manufacturers, has increased in New Zealand during the last few years; discoloration brought about by pressing damp wool, and lime stains on ripe wools.

The dead-yolk stain is more or less common, depending chiefly on climatic conditions during the growing season, and is well-known to most wool producers. This really is not a serious trouble because as a general rule, the wool will scour quite clean and white; but the discoloration detracts from the appearance of the wool when the latter is displayed for sale. Recent work at Torridon by Rimington and Stewart has shown that this ordinary dead-yolk discoloration is not harmful to the wool, and frequently is not associated with excessive amounts of yolk in the wool, but more frequently with lack of air and high percentage of suint. In fact, the whole trouble appears to be brought about by changes in the colouring matter in the suint. We here have a case where the buyer penalizes the wool-producer by paying a lower price for wool that has not been harmed, and which, as a rule, is as high yielding as is normal wool.

On the otherhand, dip-stained wools not only have an unattractive appearance, but in some cases scour a bad colour, and, in extreme, cases, the fibres may be damaged so that a bad spin results. The harmful dip-stains usually are brought about by improper mixing of dips containing carbolic derivatives, although arsenical dips also may cause the trouble, which has been somewhat prevalent of late years as some farmers have experienced difficulty in correctly mixing the paste dips that recently have become popular. Only recently, Mr. Leslie, who is the Veterinary Surgeon to Lincoln College, had a case where a big flock of rams were so badly affected by dipping that their wool came off in patches, and the skin was burned. The trouble may not be always due to faulty work on the part of the farmer, but may be due to improper mixing of the ingredients of the dip.

Tick or ked-stained wool is harmful chiefly because of its unattractive appearance, as the wool usually, but not always, will scour quite clean. However, there often is an indirect effect on the wool, due to excessive ked numbers lowering the vitality of the sheep so that less wool is produced, and, in extreme cases, a tender wool may result. More careful attention to dipping the sheep soon should remedy this defect.

A number of coloured wools have been traced to the action of bacteria; blue, red, green, and one yellow discoloration have been traced to this source. The light red discoloration noticed on the tip of some wools, in some instances may be due to bacterial action. However, as the trouble usually is confined to small areas of the wool, and to a very few sheep, it seldom is very harmful. After the heavy snowfall of 1918 one flock of Corriedales in which the writer was interested showed quite a few fairly large patches of blue-coloured wool.

Canary-yellow-stained wools, however, probably are a more serious matter, as the Bradford merchants claim that there has been an increase of this trouble in New Zealand during the last few years. Previously the trouble was prevalent mostly in Queensland and North-West Australian clips; but whether the trouble in these parts is due to the same origin as that of New Zealand wools is not known. The name probably is self-explanatory; but it might be pointed out that the trouble does not appear to have any relationship to the dead-yolk discoloration, in fact, in the case of canary-yellow wool, the actual wool fibres are dyed, and the colour does not scour out. Therefore, any wool having this defect cannot be used for the white or cream goods trade; nor can it be used for high-class dyed goods. There are at least four, and probably more, possible explanations of the cause of the trouble, but so far it has not been possible to prove that any particular one is the causative agent. The first and most likely of the four is that the trouble probably is due to a bacterial action on some portion of the wool grease or the suint, but so far no bacteria that will reinfect other wool under laboratory conditions have been isolated at Torridon from specimens of this canary-yellow wool. However, my reason for saying that this is the most likely explanation is because blue, red, green, and one yellow discoloration have been traced to bacterial action, and, as several colour-producing bacteria may be obtained from canary-yellow wool, it is possible that under a certain set of field conditions they would reinfect ordinary wool.

The second probable explanation is that it may be due to a chemical change in the colouring matter in the wool suint; and that there is a possibility in this is shown by the fact that the trouble usually is worst when a wet season is followed by hot weather. Canary-yellow stain usually is to be most abundantly found on the lower extremities of the fleece, such as the belly wool and the shanks, particularly the hind legs, these being the last parts of the fleece to dry, and probably are richer in suint salts owing to their being carried down the sides of the sheep when the wool is wet, and left there when the water evaporates.

A third explanation is that the trouble is due to the suint or sweat glands, which in action are somewhat akin to the kidney, secreting a dyestuff which has been elaborated in the body or extracted from some of the food the sheep has eaten. While at the Animal Breeding Research Department at Edinburgh, I tried an experiment to ascertain if such a secretion were possible, by giving to some sheep, per month, doses of Methylene Blue, which normally is secreted by the kidneys. However, the time of year - February - was not very opportune for such an experiment, because of the cold, and despite rugs on the

sheep and housing at night, there appeared to be little or no secretion of sweat. Probably, however, it will be worth while repeating the experiment, with certain modifications, in the late Spring in New Zealand (N.B. In Hali-burton's Handbook of Physiology 15th Edition, 1920, Pages 610-611, it is pointed out that it is possible for colouring matter, notably bile pigments, to be secreted through the suint glands. There may be some connection between this fact and Canary-yellow wool.)

It has been suggested that sheep-dip may be a possible cause of the trouble, but it cannot be the immediate cause, since the wool usually is stained right down on to the skin, and it is very unlikely that any dipping would have been carried out as late as such a condition would indicate. It is a remote explanation that the trouble may be due to chemical interaction between remnants of a coal-tar dip left in the wool and the salts of the wool suint.

As already has been pointed out, it has not been possible as yet to trace the actual cause of the discoloration, and until this is ascertained control measures cannot be applied. On the surface it does not appear that it will be easy to adopt control measures unless the trouble can be traced to a particular sheep-dip, when one would expect it to be of commoner occurrence than it is at present. If this were the case a change of dip would remedy matters. If bacterial action or chemical change are the causative agents, then it is difficult to foresee any methods of preventing the discoloration.

The baling of wool when it contains excessive moisture causes heat to be generated, and when the temperature sufficiently rises the wool may be slightly charred, and show a brown discoloration; and, if the temperature sufficiently rises the wool actually will burn. The brownish discoloration brought about by moderate rises of temperature in some cases is quite serious, as the wool does not scour a clean, bright white; and trouble also may be caused by irregular dyeing. The heat generated also causes the wool to develop a tendency towards brittleness and harshness, which defects do not permit of the wool being used to the best advantage.

In many cases the farmer has no option but to shear his sheep before they are properly dry, but if this course is necessary he should make every endeavour to see that the wool is not pressed too soon after shearing, and where possible, it should be left in the bins, as open as is practicable, to give it every opportunity to dry. This question of shearing sheep while they are wet opens up another problem that has been worrying Bradford and Continental wool-buyers, particularly of late years, and that is the loss in weight in certain cases between the New Zealand stores and the English warehouses or mills. As it is scarcely likely that all of the trouble is due to inefficient weighing in the New Zealand stores, the only other likely cause is that the raw wool loses some constituent during the voyage to England. The only two possible losses are the wool grease and wool moisture; and even if the former is squeezed out during dumping, it will be absorbed by the bales and so will not be lost in the weight. The other alternative is that the loss is due to evaporation of moisture, and since wool is notoriously hygroscopic, i.e., very readily takes up and sets free moisture, it is quite conceivable that the wool shorn and weighed with excessive moisture in New Zealand may lose some of this excess on the voyage to England.

This problem, however, illustrates the tendency to bias on the part of the manufacturer. He expects to gain weight owing to the percentage humidity of the English atmosphere usually being higher than in New Zealand; so the wool gains weight. The manufacturer never offers to pay for this increased weight because he says he purchased the wool in New Zealand on his estimation of the clean ^{scoured} basis of the wool, and a gain in moisture is of no use to him. When it comes to a loss in weight, however, he forgets that it is just as easy for wool to lose water as it is for it to gain it, and that there are equal chances of any mistake in weighing being in his favour as often as it is in favour of the New Zealand store. Since the only loss can be moisture, the manufacturer has lost nothing of value, in fact, he has gained something, as he will have less rail freight to pay in England. The remedy seems to be for every wool-broker in New Zealand to install up-to-date, Government-inspected, dial-recording scales for weighing the wool, and then to refuse to

make an allowance for loss in weight unless the manufacturer, on his part, is prepared to allow for any increase in weight.

Yet another complaint made by some manufacturers is that, occasionally, New Zealand shipe wools are not as carefully treated as they might be, and there is a tendency for a slight, and sometimes a marked, discoloration which may be accompanied by a harsh handle. This trouble probably can be traced to the Sodium Sulphide and lime process used for removing the wool from the skins, and the subsequent use of acid to neutralize the lime, the use of either excess lime or acid being detrimental to the wool, especially when it is not completely washed out. However, it is doubtful if any other depilatory process would prove economical under the particular conditions existing in New Zealand Freezing Works; so it is a matter of being particularly careful in all of the processes of handling the pelts and wool so that as little damage as possible is done to the latter.

V1. RATIO OF LENGTH TO SPINNING QUALITY:

Yet another demerit of some New Zealand wools which the manufacturers have pointed out is that in some instances, especially with the finer half-bred and Corriedale wools, such as 56's, 58's and some 60's, there is a tendency to produce a wool that is too long for the spinning count. It here might be pointed out that cross-bred wool is roughly classified into two classes with regard to length; (1) "preparing wools", which are long shaft wools usually six or more inches in length; but the length may depend to some extent on the count; and (2) "Carding wools" which are too short to go into the former class. After scouring, the preparing wools go through preparing machines in order to disentangle the fibres from their staple formation, and to lay them more or less parallel ready for combing and spinning. After scouring, carding wools are put through the carding machine in order that the fibres may be arranged parallel to one another. While the writer was in England, preparing wools of any description were difficult to sell as compared with carding wools; but especially was this the case with the finer cross-breeds; in fact, at that time, very little was being done in preparing wools of 50's count or finer. Thus, all wool of this description has to be either carded with its own quality, when, if the wool is too long, there is excessive breakage, and, therefore, higher losses in the combing process, which means uneconomic production, or else the wool has to be put down a quality or so, which means that the former does not receive the same price as he would if it were shorter. At the Wellington meeting with Lord Barnby, the newspaper report of the proceedings contains, among other things, the following statements; (a) "That once the fleeces reach a 48's count, or finer, length was of relatively little importance." (b) "In the case of fleeces where the average fibre would be classified as of a 46's quality, or below that, length of staple and lustre should predominate."

These statements serve to clearly demonstrate that even manufacturers interested in various divisions of the trade do not always agree. With regard to (a); I was informed by a number of wool experts and manufacturers in Bradford in the case of our finer New Zealand wools, there was necessity for attention to the question of length because of the tendency to produce wool too long for its spinning quality. This is not confined to the Corriedale and half-bred wools, as the manufacturers stated that there was a tendency to produce Romney wool of a 50's count or finer, which undoubtedly was too long. With regard to (b) it should be pointed out that it is irregularity of size of fibre in this class of wool, of which the Bradford manufacturers make complaint, and while length of staple and lustre may be important in some cases, in others, length of staple is of decidedly secondary consideration. The whole question of varying demand, of course, is wrapped up in this problem, as was demonstrated in Bradford last season, when at one period there was an equal, if not better, demand for the shorter carding wools than for longer preparing wools of the same quality. Since there always will be a fairly steady demand for carding wools of our Romney type, it would not be wise for everyone to concentrate on the production of lustrous preparing wools. If the policy of growing long half-breeds and fine cross-breeds is persisted in, it must mean uneconomic production; and with this class of wool it would be better to aim at slightly shorter but denser wool, if the same quality must be kept; or else grow the same length but of a stronger quality. While dealing with the question of length and quality it might be advisable to point out that the Bradford system of spinning counts is at least a point, if not more, finer than

the designation given to his wool by the average wool-producer in New Zealand, i.e., the wool that a New Zealand producer would designate^a 48's, the Bradford trade would designate a 50's; and a New Zealand 50's would be a 56's and so on. This difference, no doubt, accounts for one of the causes of this tendency to produce a wool too long for its quality. An article by Rose on "FINENESS AND LENGTH IN WOOL", in the Journal of the Department of Agriculture, South Africa, Vol. 5 No. 5, deals with this point.

In an endeavour to assist in overcoming this difficulty, the writer approached the Secretary of the British Wool Federation, Bradford, to ascertain if the Federation could supply the New Zealand Government with a set of samples of the various grades of wool, showing what they considered the correct length for each quality and type.

This appears to be a very formidable list of defects; but it must be remembered that all New Zealand wools do not suffer from many, if any, of them; in fact, it may be safely stated that, when all things are considered, the wools from our best stud flocks reasonably meet the manufacturer's present requirements; and it is with other crossbred flocks that most of the trouble is to be found. This does not imply that improvement could not be brought about so that new and better uses could be made of the wool; but it has to be remembered that in seeking for better quality wools the question of quantity must not be lost sight of. This question of attempting to produce more wool per sheep will be dealt with later, as also will the question of whether or not the New Zealand producer should endeavour to produce a long, strong, lustrous type of Romney.

In Bradford, the general opinion seems to be that New Zealand wool has definitely improved during the last few years, and that if it is possible to continue these improvements there will not be much reason for future complaint with the larger portion of New Zealand wools.

USES OF NEW ZEALAND WOOLS.

It already has been pointed out that it is a difficult matter to ascertain what are all the uses of New Zealand wools, owing to vagaries in the trade; but so far as the United Kingdom is concerned it can be safely stated that the greater proportion of present-day New Zealand wools goes into the hosiery trade. This is in direct contrast with the state of affairs existing about 30 years ago, when New Zealand produced so much lustre wool of the Lincoln and Leicester type that was used in the single yarn or lustre goods trade; also Merino or fine half-bred wool that went into the worsted trade. These facts, for a number of reasons, should be borne in mind, the chief of these reasons being that it is from people interested mainly in the single yarn that the complaints about New Zealand wool have originated, and that in recent years there has not been a corresponding increase in the amount of cross-bred wool produced, compared with Merino wool. It also should be realized that the single yarn or lustre goods trade has been badly affected by the artificial silk industry, and in consequence has fallen off in production during the last few years. The Bradford manufacturers who have been loud in their condemnation of New Zealand Romney wools have recommended that New Zealand producers should go back more to the Lincoln and Leicester types of wool, assuring them that if they did so they would receive a price that would more than compensate them for this action. That they have not put their precepts into practice is demonstrated by the following figures of weights of wool, and prices received for the Canterbury Agricultural College for the last two years:-

YEAR	ENGLISH LEICESTER			ROMNEY			IN FAVOUR OF ROMNEY
	Average weight clipped per sheep	Price per lb. at auction	Return per sheep	Average weight clipped per sheep	Price per lb. at auction	Return per sheep	
1929	10.691 lbs.	10½d	9/1d	12.06 lbs.	11d	11/0½d	1/11½d per head
1930	9.131 lbs.	3¾d	2/10½d	11.051 lbs.	4½d	4/1½d	1/3½d " "