THE GRADING OF NEW ZEALAND LAMB AND MUTTON CARCASSES

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In New Zealand, all sheep and lambs slaughtered are graded "on the rail" under one or other of two systems, namely local consumption grading or export grading. There are differences between the two systems in standards and in the authority responsible for their control.

GRADING CARCASSES FOR LOCAL CONSUMPTION

The grading of carcasses for local consumption is carried out by meat inspectors of the New Zealand Department of Agriculture. They inspect each carcass for disease and those that pass this examination are stamped on the leg, loin, and shoulder regions on each side of the carcass. The inspector then grades the carcass and applies the appropriate grade stripe down the full length of both its sides.

The grading standards were brought into force in 1943 by the New Zealand Standards Institute of the Department of Industries and Commerce working in collaboration with a large number of interested parties. The aim of the specification is to ".....establish grades of meat for sale on the local market and define joints and cuts which interpret the relative quality in meat in terms having a common meaning to buyer and seller. It thereby provides an equitable basis for competitive trading.... The provisions of the specification give an indication of the purposes for which the different classes of meat are most suitable. This should assist to ensure the satisfaction of customers' preferences, with a minimum of inconvenience or difficulty on the part of either the purchaser or the supplier. Moreover, by relating quality to quantity and price, the specification will assist to make price-fixation effective and equitable and thus help to maintain a stabilized economy." (Anon. 1949)

The specification contained the following definitions relating to sheep carcasses:

Ewe: a female which has lambed.

Maiden ewe: a female which has not lambed.

Wether: a castrated male showing no ram characteristics.

Lamb: a sheep of either sex under twelve months: Provided that all sheep lambed (born) during any year shall be hogget as from September 30 in the following year in the North Island, and October 31 in the following year in the South Island.

Hogget: a sheep, either maiden ewe or wether, showing not more than two permanent incisor teeth.

The details of the grades for lamb, hogget, and mutton have been published elsewhere (Anon. 1949).

GRADING CARCASSES FOR EXPORT*

Carcasses which are to be exported are graded by employees of the freezing works (meat packing plant). Their work is checked by Supervising Meat Graders who are employees of the New Zealand Meat Producers' Board--a non-governmental body.

One of the first tasks undertaken by the Meat Producers' Board when it was established by Act of Parliament in 1922 was to regularize throughout the country the grades for export meat. It proceeded to standardize grades by appointing supervisors to visit each freezing works at frequent intervals. From the outset the Board firmly believed that uniform grading, set at a high standard, would result in buyer satisfaction so that in time New Zealand's meat would develop a name for its trueness to grade and as a consequence buyers would order without personal inspection.

There are 33 freezing works in New Zealand (17 in the North Island and 16 in the South Island) and their collective throughput last season (October 1, 1958 through September 30, 1959) was 17.4 million lamb carcasses for export or 241,415 tons. The average carcass weight of these lambs was 31.14 lb., which was an all time low, being about 2 lb. below the long run mean. Wether mutton killings for export totalled 958,000 carcasses or 22,077 tons with an average carcass weight of 51.65 lb. which was also 2 to 3 lb. below the long term mean. Ewe mutton killings for export totalled 2.6 million carcasses or 58,722 tons. These carcasses had a mean weight of 52.39 lb. and this too was 2 to 3 lb. below the average figure. On a tonnage basis, 98 per cent of the lamb, 95 per cent of the wether mutton and 67 per cent of the ewe mutton last season was exported to the United Kingdom market. This is the normal pattern of disposal and consequently carcass grading is designed primarily to meet the needs of that market.

There are 46.9 million sheep in New Zealand, of which 31.8 million are breeding ewes, 11.3 million are hoggets, and 3.8 million are wethers, rams and dry ewes. Something like 54 per cent of the lambs tailed (docked) are slaughtered as lambs for the export trade. The predominant breed of sheep is the Romney and it comprises 71.4 per cent of the total sheep. Generally the Romney aged ewe is mated to the Southdown to produce the bulk of the export lamb carcasses. Romney wether lambs produced by ewes of all ages would provide the next largest proportion of lambs for slaughter. Small numbers of lambs are sired by the larger Down breeds (Suffolks, Oxford Downs, etc.) which are mated to Romney, Corriedale, and Merino X

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* Full details of the grades of export lamb have been given previously by Barton (1947) and of lamb and mutton by Smith-Pilling (1959).

Romney ewes. The Romney almost exclusively provides the wether and ewe mutton carcasses for export.

Because only a small number of breeds produce most of the sheep meat, it follows that few grades are needed. This is especially the case when it is considered that a very high proportion of the lamb carcasses fall within a narrow weight range (Table 1) and they are the products of either the Southdown X Romney or the Romney.

Table 1 Carcass Weight Distribution -- N.Z. Lamb
(Mean of two seasons 1956/57 and 1957/58)

Carcass Weight (lb.)	28 and under	29 to 36	37 to 42	43 to 50	51 to 56	Y's 20 & over
Per cent of total	7.2	43.9	14.0	2.2	0.2	32.7

Grading of Lamb Carcasses for Export

A lamb for export purposes is a sheep under 12 months of age in the period October 1 through September 30. A lamb carcass for export must not weigh less than 20 lb. nor more than 56 lb. Carcasses heavier than 56 lb. are allocated to the wether mutton grades but very few lamb carcasses reach this weight.

The allotment of lamb carcasses to various grades is based almost entirely on two factors, namely, quality and weight. Within the various standardized weight ranges quality grades are made and these are based essentially on conformation and fat finish.

Lamb grading differs slightly between the North and South Islands as is seen in Tables 2 and 3 respectively.

Table 2 North Island Grades of Lamb

Carcass Weight Range (Lb.)	Grade Mark	Quality Grade Name	Price cents/lb. carcass weight
20 - 28	D	Prime Down Cross	19.4
20 - 28	D	Prime Crossbred	19.4
20 - 28	YL	YL	17.7
29 - 36	2	Prime Down Cross	17.4
29 - 36	2	Prime Crossbred	17.4
29 - 36	YM	YM	16.3
37 - 42	8	Prime Crossbred	16.0
37 and over	YH	YH	15.5
43 - 50	4	Prime Crossbred	14.9
51 - 56	T (Tegs)	Prime Crossbred	13.2

Table 3 South Island Grades of Lamb

Carcass Weight Range (Lb.)	Grade Mark	Quality Grade Name
20 - 28	D	Prime Canterbury
20 - 28	YL	YL
29 - 36	2	Prime Canterbury
29 - 36	YM	YM
37 - 42	8	Prime Canterbury
37 and over	YH	YH
43 - 50	4	Prime Canterbury
51 - 56	T (Tegs)	Prime Canterbury

Description of the Lamb Grades - North Island

1. Prime Down Cross Grade

This grade consists of lamb carcasses which show considerable meatiness and have plump legs and well-developed loins. Their fat finish must also be sufficient to cover completely the underlying muscular tissue. The carcasses must show the conformation characteristics of the Southdown even though they will normally be from the progeny of the cross between the Southdown and the Romney. A small proportion of straight Romney lambs of exceptional conformation may also be allocated to this grade.

2. Prime Crossbred Grade

This grade is made up of carcasses showing a deficiency in conformation and having longer legs and less well-developed loins and often less fat cover than carcasses in the Prime Cross grade. Carcasses in this grade are mainly the poorer specimens of the Southdown X Romney together with most of the straight Romney lambs slaughtered for export.

3. The Y Grade

This grade is composed of all lamb carcasses poorer in conformation than those in the two above mentioned grades and especially those lacking in fat cover. The carcasses are not thin but they lack development in terms of muscular and fatty tissues. Thin carcasses are rejected for export. Most of the Y grade lambs will be straight Romneys but a proportion will be Southdown X Romney lambs slaughtered before they are prime.

Description of the Lamb Grades - South Island

1. Prime Canterbury Grade

The Prime Canterbury grade consists of lamb carcasses which if they were graded in the North Island would be allocated to either the Prime Down Cross or the Prime Crossbred grades. Their breeding in most cases would not differ materially from the lambs of the North Island, but there would be a proportion of lambs by Down sires out of Corriedale or Halfbred (Romney X Merino) ewes.

2. The Y Grade

The Y grade carcasses would approximate those of this grade in the North Island. A number would be straight Corriedale and Halfbred lamb carcasses, but the remainder would be of similar breeding to lambs in the Prime Canterbury grade.

Apart from conformation and fat finish, there are other factors taken into account in the grading of lamb carcasses in New Zealand. The more important additional factors considered are as follows:

(a) Fat colour The accepted range of fat colour for the Prime grades is white to light yellow. Carcasses with fat of a deep yellow colour are allocated to the Y grade; if, however, the fat colour is greenish-yellow, the carcass is rejected for export.

(b) Stagginess. Lambs which have been faultily castrated or are rigs will often show masculine characteristics in their carcasses. When this is the case the carcass is placed in the lower grade.

(c) Bruises. Light, superficial bruises which can be readily trimmed off the carcass do not affect its grade. More extensive bruising will result in the carcass being allocated to the Y grade after the bruise has been trimmed, while in a very serious case the carcass is rejected for export.

(d) Dressing faults. Carcasses which have been severely mutilated in dressing are rejected for export as are those which become soiled through leakage of the rumen contents.

(e) Disease. There is an ante-mortem inspection of all sheep and lambs in the slaughtering pens and a rigid post-mortem examination of all carcasses. No carcass is exported if found to be diseased.

The examination of all carcasses and edible offals is carried out by meat inspectors of the Department of Agriculture. Once the carcass has been passed as being fit for human consumption it moves along the chain where it is weighed and graded by employees of the freezing works. It is then ticketed with a manilla tag affixed to one leg of the carcass. A veterinary certificate is printed on one side of the tag, together with the registered number of the meat export slaughterhouse. The grade of the carcass and the name of the meat export firm are printed on the other side. Thus the tag certifies that the meat is free from disease and records its origin and its grade.

Following these procedures the carcasses pass to the "cooling floor" where they are drafted, according to grade, on to rails and again checked for trueness to grade. They are then bagged in stockinette, which also bears the grade details, are moved to the freezer and finally stored in the frozen state until shipped overseas.

Description of Hogget Grades

For export grading a hogget is either a wether or a maiden ewe which does not show more than two permanent incisor teeth. The carcass must also have the characteristics of a young animal and must not exceed 56 lb. in dressed weight. Hogget carcasses are graded as Prime and HX on the basis of fat finish and quality. The Prime grade consists of two weight ranges, namely, 48 lb. and under, and 49 to 56 lb. There is only one weight range for HX grade, that is, 56 lb. and under.

Description of Wether Mutton Grades

Wether mutton carcasses are allocated to two quality grades on the basis of fat finish. The grades are known as Prime and X. There are six weight ranges in the Prime grade: 1's - 48 lb. and under; 7's - 49 to 56 lb.; 3's - 57 to 64 lb.; 9's - 65 to 72 lb.; 5's - 73 to 80 lb. and 0's - 81 lb. and over. There are only two weight ranges in the X grade - 56 lb. and under and 56 lb. and over.

Genuine maiden ewes are allocated to the wether mutton grades. The condition of the udder and the appearance of the pelvic region are taken into account in determining whether the carcass qualifies as a maiden ewe and hence entitles the producer to the higher price it would yield if graded "as a wether".

Description of Ewe Mutton Grades

The grade standards for ewe mutton are the same as for wethers, that is, there are two quality grades made on the basis of fat finish. These grades are known as Prime and EX and they are subdivided into weight ranges as for wethers.

Ewe and wether mutton carcasses which exceed 80 lb. in weight may not be exported in carcass form, in which case they are boned out and the meat is used for manufacturing purposes. Thin carcasses of either sex may be exported for manufacturing purposes or they may be boned out before export. Overfat carcasses of any weight may be boned out and thus not exported in carcass form.

It should be mentioned that owners of sheep and lambs are paid a predetermined price per pound dressed carcass weight at slaughter. The price is based on the value of the first fat (omental fat), the pelt, the wool removed from the pelt, and the grade and weight of the dressed carcass. The remainder of the sheep at slaughter becomes the perquisites of the freezing works. Charges against the price paid to the owner of the stock include such items as processing, administration, insurance, placing to F.O.B. etc. Carcass weight is equal to the weight of the hot carcass less 4.5 per cent. for shrinkage. Kidneys remain in lamb carcasses weighing less than 43 lb. but they are removed, together with some kidney fat, from the heavier lamb carcasses and from all hogget, wether and ewe mutton carcasses. The metacarpal and metatarsal bones (cannon bones) are severed from all carcasses during the dressing process and thus do not contribute to carcass weight.

Some Factors Affecting the Grade of Lamb Carcasses

1. Effect of Carcass Weight

Prominent among factors known to affect the grade of a lamb carcass is its weight. Heavy lamb carcasses stand a better chance of being allocated to the Prime Down Cross grade and conversely they are seldom found in the Y grade. A correlation of 0.7524 was found between the meat grade of North Island lamb carcasses and their mean weight for an 18-year period (1940/41 to 1957/58). The relationship is also shown graphically in Fig. 1 where the percentage of Prime Down Cross carcasses to the total for the 18 seasons is plotted against the mean carcass weight for all North Island lambs. The curves show that in recent seasons (from about 1953/54 onwards) the relationship has not been so strong and indeed in the last two seasons recorded there is evidence that the relationship has become negative due possibly to a slight tightening up of grading standards. It will be recalled from Table 2 that there is now no price differential between Prime Crossbred carcasses and thus there is no hardship to the producer if his slaughter lambs do not have a high proportion in the Prime Down Cross grade.

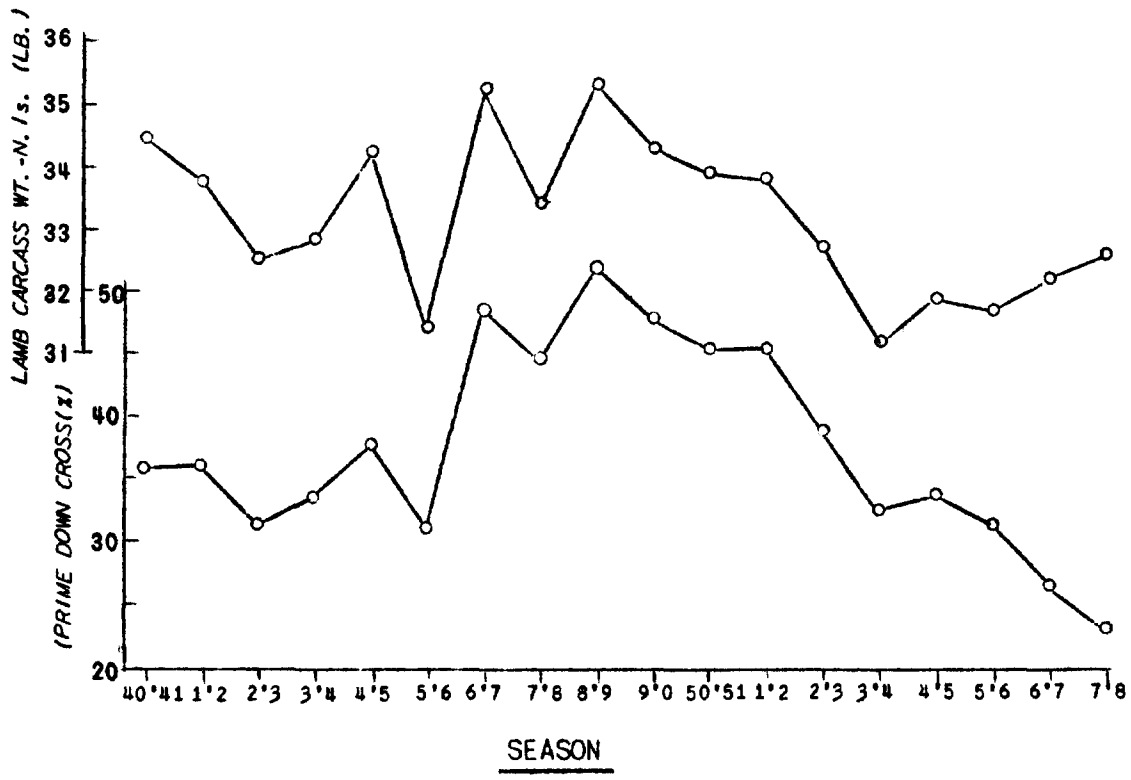

Fig. 1. Relationship between grade and lamb carcass weight.

2. Effect of Season on Carcass Grade

The main factor thought to affect carcass weight is season. In seasons characterized by climatic conditions which result in adequate pasture and crop growth for lamb fattening, the carcass weights will be higher and consequently a higher proportion of lambs will be placed in the Prime Down Cross grade and fewer in the Y grade (see also Fig. 1).

3. Effect of District on Carcass Grade

The North Island is divided into three districts for the compilation of meat statistics. From these published data (N.Z. Meat Producers' Board Annual Report, 1959) it is seen that one district (Hawke's Bay - East Coast) in the 1957/58 season, for instance, had only 19.9 per cent. of its lamb carcasses in the Prime Down Cross grade, while a second district (Auckland) in the same season had 26.3 per cent, of its carcasses in this grade. The first district had 43.9 per cent. of its carcasses in the Y grade and the second district had 27.0 per cent. in this grade. The third district (Wellington - West Coast) had grading figures which were approximately intermediate between the first and second mentioned districts. Some of this difference between districts can be explained in terms of carcass weight and in differences in breeding of the lambs but most of the variation is due to unidentified factors.

4. Effect of Sire on Carcass Grade

The trials of Walker (1949) and of Coop and Clark (1957) have indicated that there can be differences in grading due to breed of sire used. The Southdown ram when mated either to Romney or Corriedale ewes produced lambs whose carcasses graded better than those of the progency of other breeds of ram which were compared (e.g. Suffolk, Ryeland, Dorset Horn, Border Leicester, English Leicester, Cheviot, Romney, or Corriedale). Barton, Phillips and Clarke (1949) and Barton and Phillips (1950) presented evidence to show that some Southdown rams when mated to Romney ewes sire offspring whose carcasses graded significantly better than those of other Southdown rams. Differences between sire groups of up to 30 per cent. in the proportion of carcasses graded Prime Down Cross were reported by these workers.

5. Effect of Dam on Carcass Grade

Romney X Cheviot ewes when mated to a Southdown ram gave offspring which graded better as lamb carcasses than the progency of Romney ewes mated also to the same ram (Phillips 1951). Coop (1957) presented some evidence to show that Border Leicester X Corriedale ewes mated to Southdown rams gave offspring whose carcasses were better than those from Corriedale ewes mated to Southdowns. McMeekan and Walker (1951) compared the Southdown X Romney lamb progeny of two groups of ewes; the ewes in one group were leggy and lacking in conformation while the other ewes were of good conformation from the standpoint of meat production. The progeny of the good type ewes when slaughtered as lambs were found to have on an average of three years about 8 per cent. more carcasses in the Prime Down Cross grade. However, in one season the progeny of the poor type ewes had 14 per cent. more carcasses in the Prime Down Cross grade than the progeny of the good type ewes.

Physical Description of North Island Lamb Carcasses

A number of measurements on the carcasses of 739 Southdown X Romney lambs killed at a liveweight of approximately 72 lb. (Clarke, Barton and Wilson 1953) have been analysed by the least squares technique to obtain estimates of the size of sex and grade effects. The results of this analysis are presented in Table 4.

Table 4. Physical Differences between Grades between Grades and Sexes of 739 Southdown X Romney Lamb Carcasses.
(All lambs slaughtered at an approximate live weight of 72 lb.)

Measurement	General Mean	Wether lambs minus ewe lambs	Y grade minus Prime Down Cross grade	Prime Crossbred minus Prime Down Cross grade
F (crutch to hock) cm.	21.41	-0.10	+1.12	+0.72
T (length tibia tarsus) cm.	16.77	+0.15	+0.47	+0.28
C (fat over eye muscle) mm.	5.12	-0.68	-2.00	-1.20
A ("length" eye muscle) mm.	52.87	+1.07	+1.24	+0.86
B ("depth" eye muscle) mm.	31.12	-0.42	-1.34	-0.76
Cold carcass wt. lb.	34.52	-0.22	-2.30	-1.25
Metacarpal wt. g.	27.84	+2.33	+2.77	+1.40
Metacarpal length cm.	10.08	+0.12	+0.37	+0.21

It was found that all differences between grades corrected for sex were highly significant. Thus carcasses in both the Y grade and the Prime Crossbred grade were longer in the leg, had less subcutaneous fat over the "eye" muscle (m. longissimus dorsi) at the junction of the last thoracic and first lumbar vertebrae, were "longer" in the eye muscle, had less "depth" of eye muscle and had longer and heavier cannon bones (metacarpals) than lambs whose carcasses were allocated to the Prime Down Cross grade. The cannon bones as mentioned before are not part of the carcass under New Zealand slaughtering practice and can thus be used for study without interfering with the carcass. An analysis of the dimensions of these bones can give some estimate of the weight of bone in the carcass and the length of its long bones.

Walker and McMeekan (1944) have also examined the relationships between carcass measurements and quality. They worked with South Island lambs.

The Physical Composition of North Island Lamb Carcasses

During the last war a large number (120) of representative lamb and ewe and wether mutton carcasses was dissected by anatomical joints into their three primary tissues - bone, muscle and fat (Clarke and McMeekan 1952). These data have been re-analysed recently to determine whether differences between grades for the three tissues are statistically significant. The analyses for North Island lambs are presented in Table 5.

The results given in Table 5 show that there is a significant difference in mean weight of bone between carcasses in some of the grades. For example, carcasses in the Prime Down Cross grade in the weight range 23 to 36 lb. have significantly lighter bone than the carcasses in all other grades. The mean weight of bone of the carcasses in the Prime Crossbred grade in the range 37 to 42 lb do not differ significantly. Similarly there is no difference in the mean weight of bone of Y grade carcasses weighing between 23 and 36 lb., or Prime Crossbred carcasses weighing 37 to 42 lb. or Prime Down Cross carcasses in the weight range 43 to 50 lb.

Table 5. Composition of Lamb Carcasses-- North Island
(10 carcasses dissected in each grade)

Weight of Bone

Grade	Prime Down Cross	Prime Crossbred	Prime Down Cross	Y	Prime Crossbred	Prime Down Cross	Prime Crossbred
Carcass Weight Range(lb)	23-36	23-36	37-42	23-36	37-42	43-50	43-50
Mean (lb)	3.45	4.00	4.10	4.40	4.68	4.74	5.31

Standard error of the mean of a grade = 0.12 lb.

Table 5 - Continued

Weight of Muscle

Grade	Prime Down Cross	Y	Prime Crossbred	Prime Down Cross	Prime Crossbred	Prime Down Cross	Prime Crossbred
Carcass Weight Range(lb)	23-36	23-36	23-36	37-42	37-42	43-50	43-50
Mean (lb)	15.94	16.99	17.87	19.99	20.53	22.71	23.99

Standard error of the mean of a grade = 0.45 lb.

Weight of Fat

Grade	Y	Prime Cross-bred	Prime Down Cross	Prime Crossbred	Prime Down Cross	Prime Crossbred	Prime Down Cross
Carcass Weight Range (lb)	23-36	23-36	23-36	37-42	37-42	43-50	43-50
Mean (lb)	6.53	8.33	10.62	11.42	11.93	14.05	16.03

Standard error of the mean of a grade = 0.47 lb.

NOTE: Any two means not underscored by the same line are significantly different.
Any two means underscored by the same line are not significantly different.

In terms of muscle weight it is apparent from an inspection of Table 5 that there is no statistically significant difference between Prime Down Cross and Y grade lambs of the same weight range nor is there a difference between Y grade and Prime Crossbred lambs also of the same weight range, namely 23 to 36 lb. It is of some interest to note that carcasses in the Prime Down Cross grade, irrespective of weight ranges, have the least amount of muscular tissue of all grades. Lambs of this grade, it will be recalled, are of superior conformation.

The figures for dissectible fat content given in Table 5 indicate, in general that the Prime Down Cross carcasses have more fat than the carcasses in other grades. The high fat content of the Prime Down Cross carcasses in the weight range 23 to 36 lb. is notable; indeed the mean does not differ significantly from the mean fat content of Prime Crossbred and Prime Down Cross carcasses in the next higher weight range, namely 37 to 42 lb.

Bone was the only tissue which differed significantly in weight between the two sexes of lambs.

The Physical Composition of North Island Ewe and Wether Mutton Carcasses

Representative ewe and wether mutton carcasses of each weight range were also completely dissected into bone, muscle, and fat. The means of the weights of various tissues by weight ranges are given in Table 6, together with the standard errors of the means of the grades.

Table 6. Composition of Ewe and Wether Mutton Carcasses - North Island. (10 carcasses dissected in each grade)

	Weight of Bone			
Carcass Weight Range (lb)	7's 49-56	3's 57-64	9's 65-72	5's 73-80
Mean (lb)	5.73	6.44	6.82	6.96

Standard error of the mean of a grade = 0.16 lb.

	Weight of Muscle			
Mean (lb)	27.18	31.06	32.94	33.90

Standard error of the mean of a grade = 0.68 lb.

	Weight of Fat			
Mean (lb)	17.18	19.81	25.59	31.53

Standard error of the mean of a grade = 1.04 lb.

NOTE: Any two means not underscored by the same line are significantly different.
Any two means underscored by the same line are not significantly different.

The results presented in Table 6 show that there are differences between the means of a number of the carcass weight ranges for bone, muscle, and fat. The means of some adjacent weight ranges, however, fail to differ significantly because there are large variations in the weights of tissues within weight ranges. Of the three tissues, only bone differed significantly in weight between the two sexes. This is in agreement with the result obtained with the lamb carcasses.

In this paper an attempt has been made to present an outline of the grading system in operation in New Zealand as it applies to the export trade in lamb and mutton. Data have been collected and analysed to give a preliminary objective description of the grades but a good deal more needs to be done before satisfactory specifications can be laid down. The requirements of various markets in terms of weight and quality of carcasses must also be determined and reassessed regularly so that new grades can be established if need be. It is conceivable too that the present grades of lamb and mutton carcasses do not yield the quality and quantity of meat wanted by consumers. However, any substantial change away from the present quality and pattern of production, especially for lamb, would seriously interfere with farming operations and accordingly producers would be reluctant to make a change. They are fully aware, however, that markets everywhere do not have the same demands and they are thus conditioned to the possible need for new types of meat and even different grading standards if their product is to sell readily at profitable prices.

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CHAIRMAN KEMP: Thank you, Professor Barton. From the numbers of lamb they produce in New Zealand, I think he said 17.4 million, you can see there is a great need for lamb carcass research and they are doing quite a bit of it in New Zealand. And Mr. Barton and his colleague, Alan Kirton, who is now at Michigan State University doing graduate work, have prepared a paper entitled, "New Zealand Lamb and Mutton Carcass Research." And now I will introduce Mr. Alan Kirton, who will present this paper. Mr. Kirton.

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