THE NUTRITIVE VALUE OF NEW ZEALAND LAMB AND MUTTON.

by

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During the past few months we have been involved in an intensive investigation into the nutritive character of all the many grades of New Zealand export quality lamb and mutton. The work has been carried out on behalf of the British Ministry of Food and is part of an intensive project initiated in Great Britain for the purpose of assisting in the solution of food rationing problems now confronting that country.

Briefly we were asked to provide accurate data upon the make-up of the carcase and its different joints in terms of the amount of bone, muscle and fat tissues; upon the chemical composition of the edible tissues; and upon the calorific and protein yield. The use of such data in the effective organisation of food rationing and the determination of food import policies will be apparent from the fact that such information existed only in respect to what the text books term ' a typical lamb chop' or 'a beef steak ' insofar as our most important meat animals are concerned. Practically no information existed as to the makeup of the carcase as a whole or of its component parts.

Thirteen grades of lamb, twelve of ewe mutton and twelve of wether mutton have been dealt with. The sample comprised ten lambs, five ewes, and five wethers in each grade, and covered the complete weight range in each. North and South Island carcases were handled separately. The carcases were selected at random from graded lots that had been in cool store at least three months.

The urgency and magnitude of the project made it essential to secure all possible assistance. We would here like to express our appreciation of the splendid co-operation which the work brought into being. For perhaps the first time on record, the Departments of Agriculture and Scientific and Industrial Research, together with the two Agricultural Colleges pooled their resources wholeheartedly toward a common end. We would emphasise that without this co-operation the completion of the task in the short time available would have been impossible. We would further emphasise that while we are assuming the responsibility for this present communication, the names of the more than fifty workers involved should head this paper along with our own. In particular we would thank Mr R.E.R. Grimmet, Dr. F.B. Shoreland, Dr. C.R. Barnicoat, and Miss P. Bartrum for the chemical aspects of the work.

The investigation has naturally yielded an immense array of data. Apart from their value in relation to the immediate objective, much information has been obtained which will prove of considerable assistance in the general field of meat production studies. In this paper we are confining our attention to the bearing of a few of the more pertinent facts upon current wartime problems of food production and supply. In doing so we realise that neither our data nor our point of view may be welcome in official quarters. We beleive however that those responsible for production supply, and distribution of food both here and in the United Kingdom, should be armed with all relevant information. Without this information sound decisions directing our meat production in New Zealand cannot be expected. The responsibility for direction lies in official quarters, but we feel that we have a responsibility for presenting the facts and deductions as we find them.

COMPOSITION AND NUTRITIVE VALUE OF A PRIME QUALITY LAMB.

Table 1. shows the percentage bone, muscle and fat tissues in one

of the highest priced grades of export quality lamb. Representing the mean results from ten lambs of the Canternury Prime 2 grade, and ranging in weight from 25 to 36 lbs. in weight, it also shows the general method followed throughout the work. Each joint was dissected into its three main tissues, yielding the data of Table 1. Large differences exist between the different joints in the proportion of edible tissue to bone and in the proportion of muscle to fat.

TABLE . 1.

PERCENTAGE COMPOSITION OF PRIME CANTERBURY 2's.

(Weight range; 24 - 36 lb.)

Joint.	Bone. %	Muscle. %	Fat. %
Neck.	11.2	49.6	36.0
Shoulders.	13.8	53.9	28.1
Thorax.	12.6.	46.1	37.9
Loin.	8.3	52.7	38.2
Legs.	12.3	65.9	17.6
Pelvis.	9.8	42.0	44.4
Total Carcase.	11.7	52.5	32.4

These differences along with related chemical differences - fat tissue contains approximately 20 per cent water and muscle tissue approxiamtely 72 per cent for example - are responsible for the very wide range in the calorific and protein yield of the different joints illustrated in Table 11.

TABLE. 11

THE NUTRITIVE VALUE OF PRIME CANTERBURY 2's.

(Weight range; 24 - 36 lb.)

Joint.	Total Calories.	Total Protein.	Calories per Kilo.	Protein per Kilo.
Neck.	4387	162	3274	121
Shoulders.	6800	331.	2661.	130
Thorax.	12714	390	3533	108
Loin.	6296	232	3527	130
Legs.	5953	455	1938	148
Pelvis	6633	190	3834	109
Total Carcase.	42783	1759	3038	125

The yield of approximately 3000 Calories and 125 grams of protein per kilogram of carcase illustrates the type of data specifically asked for from Great Britain. Our work has provided such information for every weight and grade exported.

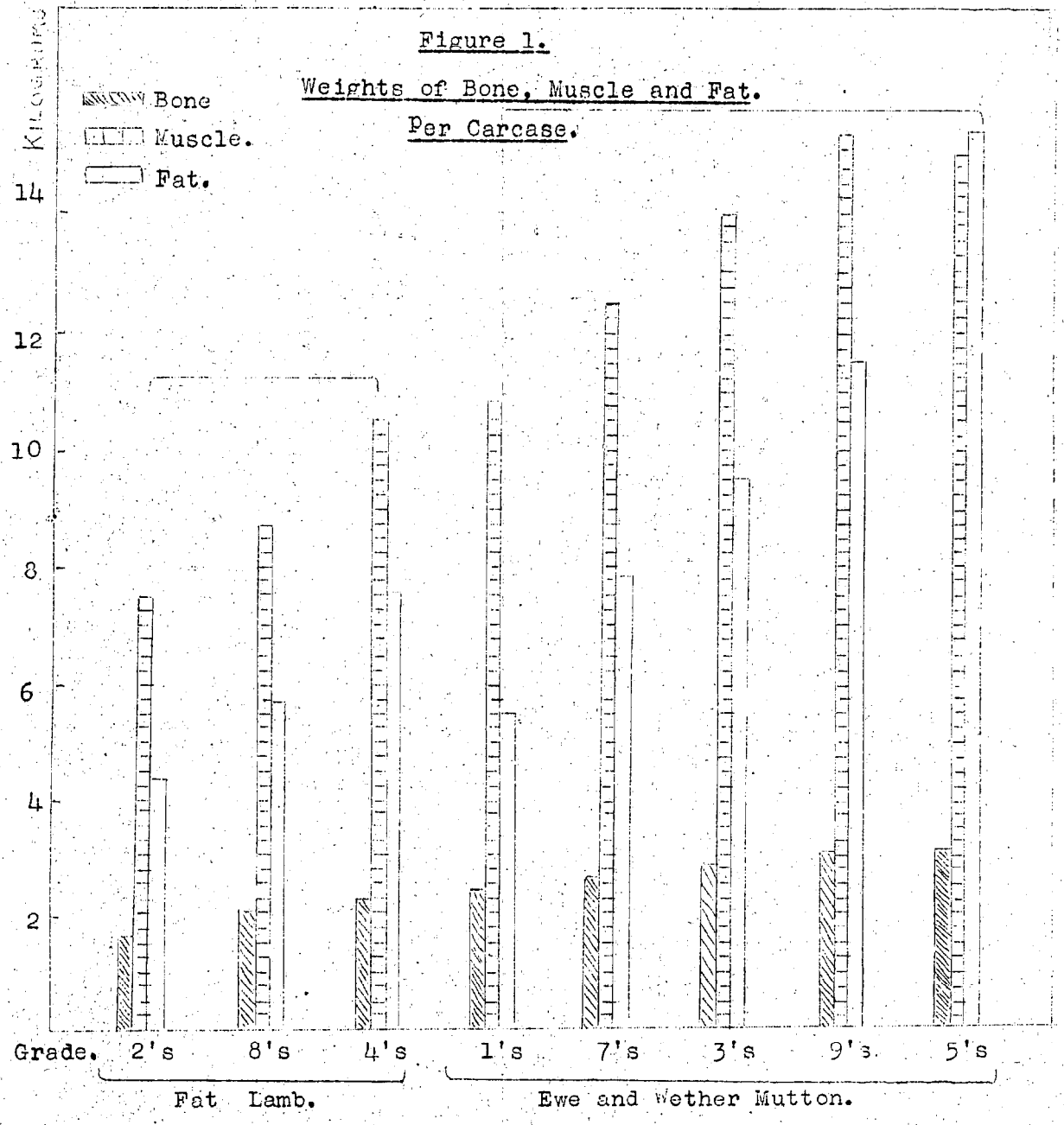
RELATIVE COMPOSITION AND NUTRITIVE VALUE OF THE CHIEF GRADES.

Under present circumstances we are more interested in broad differences between the major weights and grades than in the

Figure 1.

Weights of Bone, Muscle and Fat.

Per Carcase.

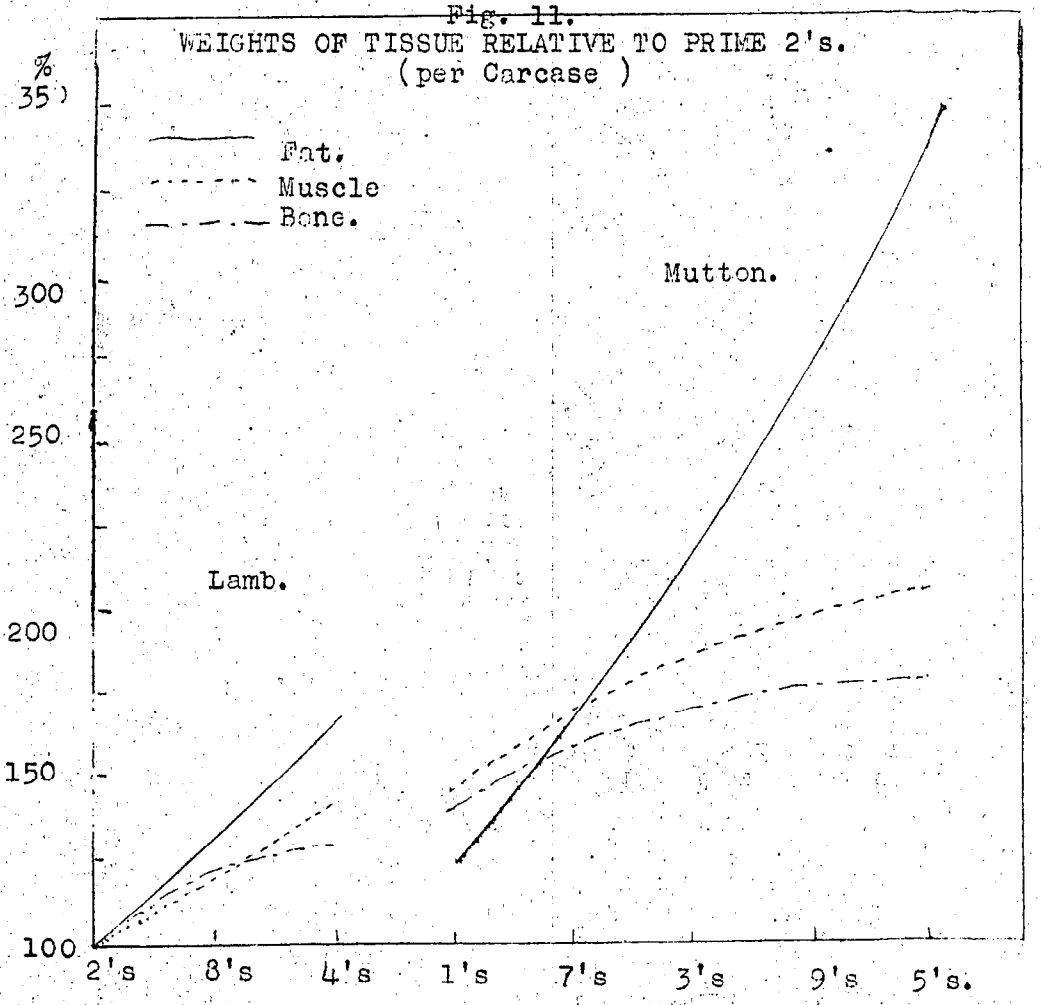


individual attributes of each. We have attempted to provide this in graphical form in the following text figures. In all cases these represent the combined North and South Island data for prime quality carcases only. The data for mutton have been obtained by combining figures of both wethers and ewes. Lamb curves are thus based upon thirty carcases per grade and mutton figures upon twenty carcases per grade.

Fig. 1. presents the yield of bone, muscle and fat tissues on a per carcase basis, with the different grades arranged in order of increasing weight. Thus the weight range of each grade is as follows; 2's, 24 - 36 lbs; 8's, 37-42 lbs.; 4's, 43 - 50 lbs; 1's, 38 -48lbs; 7's,49-57lbs; 3's, 58-64lbs;9's,65-73lbs.;5's74- 80l

The change in composition with weight of carcase is clearly demonstrated. While all tissues increase, it is obvious that they do so not equally but differentially. Thus the amount of bone shows the least change, increasing from 1.75 kilo. in the lightest lamb grade to 3.0 kilo in the heaviest mutton grade. Over the same range, muscle increase from 7.5 kilo. to 15.2 kilo., and fat from 4.4 kilo. to 15.2 kilo. These relative changes in proportion of bone, muscle and fat more clear apparent from Fig. 11. where the weight of each tissue in each grade has been expressed as a percentage of the weight of the corresponding part in the lightest grade of lamb.

Fig. 11.

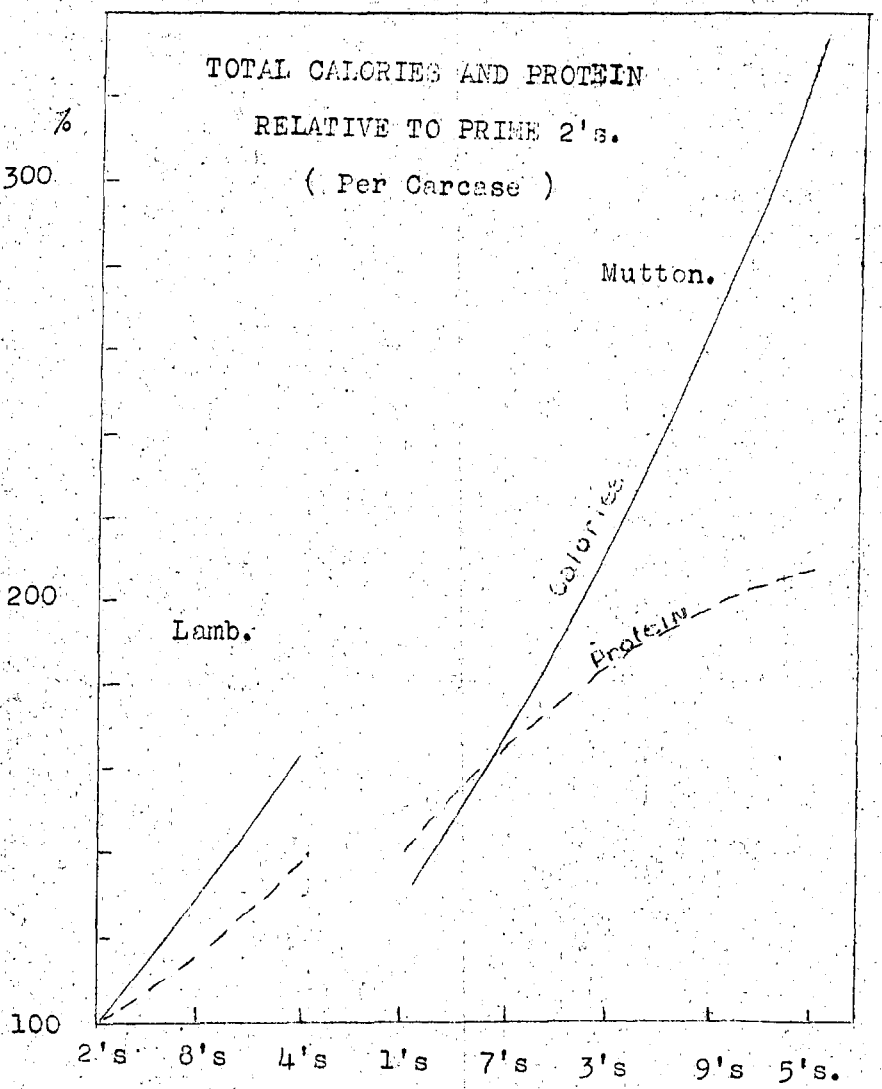


It is clear that the changes with weight are in accord with our knowledge of the laws of differential growth of the animal body. Bone, as the earliest developing tissue shows the least increase; fat, as the latest developing tissue makes the most growth. As weight of carcase increases over the complete range from lamb to mutton, the proportion of edible meat increases very rapidly. This is composed of an increasing proportion of fat relative to muscle. Relative percentage increases over the complete range are 80%, 100%, and 240% for bone , muscle and fat tissues respectively.

The apparent anomaly in the fact that the heaviest grade of lamb contains more fat than the lightest grade of mutton, producing thereby a break in the curves, needs explanation. This situation is due to the different methods of grading used in lamb and mutton. Lambs are graded on a basis of weight and degree of fatness, while mutton carcases are graded mainly on a weight basis. Only very lean ewes or wethers which are light because they carry little condition, come into the lightest grade of mutton. Each weight grade of mutton is accordingly made up of a mixed sample of animals so far as degree of fatness in concerned, while each grade of lamb tends to be composed of uniformly fat animals. It might be added here that the dissection results as a whole testify to the skill of the grader in judging degree of fatness by eye.

The importance of these relative differences in composition is reflected in the relative changes in Calorific and protein yield per carcase, illustrated in Fig.111.

Fig.111.



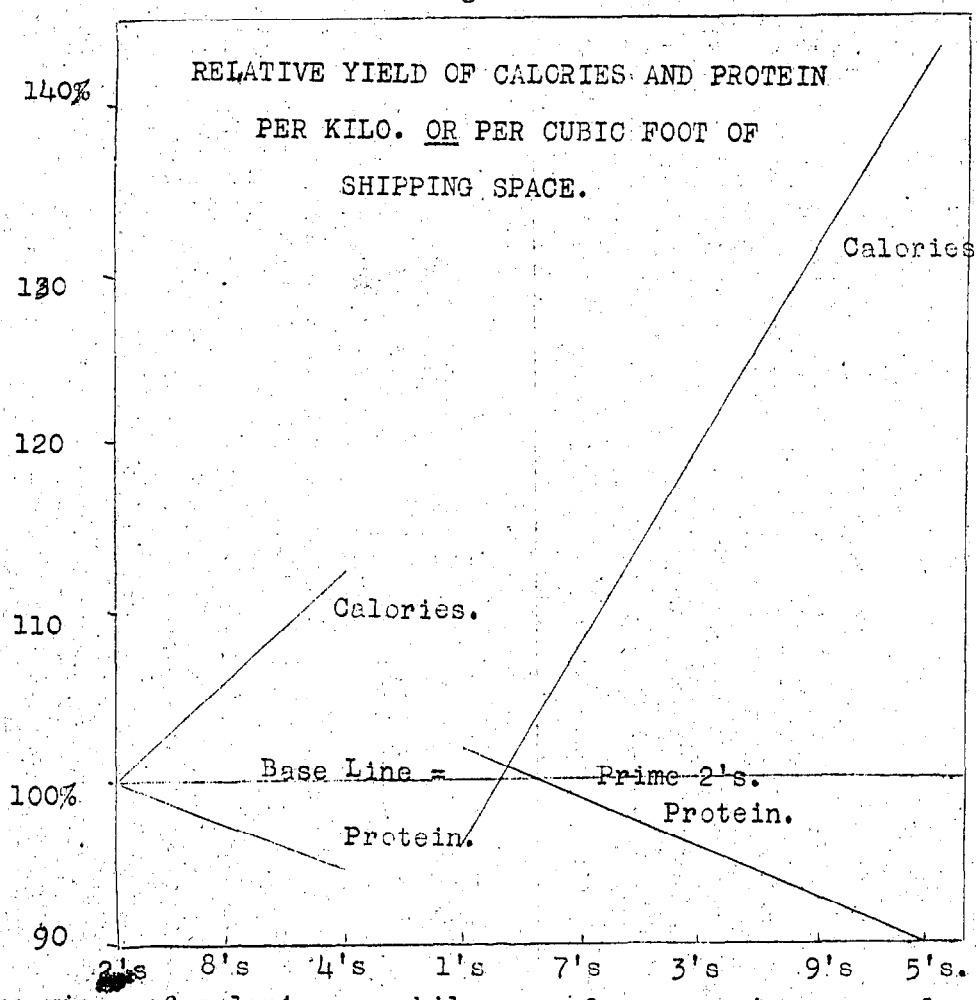
Both the calorific value and the protein yield increase with increasing weight to the extent of over 250 % in calories and 100 % in protein over the complete lamb-mutton range.

Within lambs, the increase in calorie content per carcase from the lightest to the heaviest weight grade is 65 ... ; the comparable figure for protein is 40 %. Within mutton, the heaviest grade yields over 200% more calories and 65 % more protein per carcase than the lightest grade. The greater increase in the calorie than in the protein yield is due of course to the relatively greater proportion of fat compared with muscle as weight of carcase increases.

Thus both on quantitative and qualitative grounds, the nutritive value of lamb and mutton carcases increases with increase in weight. Heavier lambs and heavier ewes and wethers provide both more energy and more protein for human consumption than lighter animals. There is of course nothing new in this fact, but our data provides a measure of this increase in food value.

In relation to current transport difficulties arising from restricte shipping, differences in nutritive value per kilogram or per cubic foot of shipping space are probably more important than are the differences discussed above. The position is illustrated in Fig. 1V.

Fig. 1V.



The yield of calories per kilogram of carcase increases from light to heavier grades. Within lambs, Prime 4's yield 12 % more calories per kilogram or per cubic foot of shipping space than the lightest grade, the Prime 2's. Increases in the mutton group relative to Prime 2's range upwards to 43 %.

With protein yield, the situation is reversed. The amount per kilogram or per cubic foot decreases with increasing weight of carcase. The reduction is not great, amounting to 5 % as between the lightest and heaviest mutton grades, and 10 % as between the lightest and heaviest mutton grades. The reason will be clear from what has already been said; the amount of muscle which contributes the protein portion, does not increase as rapidly as does total carcase weight which is made up of a greater proportion of fat which contributes most of the calorific value.

RELATIONSHIP OF RESULTS TO CURRENT PROBLEMS.

Apart from the special usefulness of the data to British food rationing procedure, it will be apparent that the general picture presented, challenges attention in relation to New Zealand problems of production and supply.

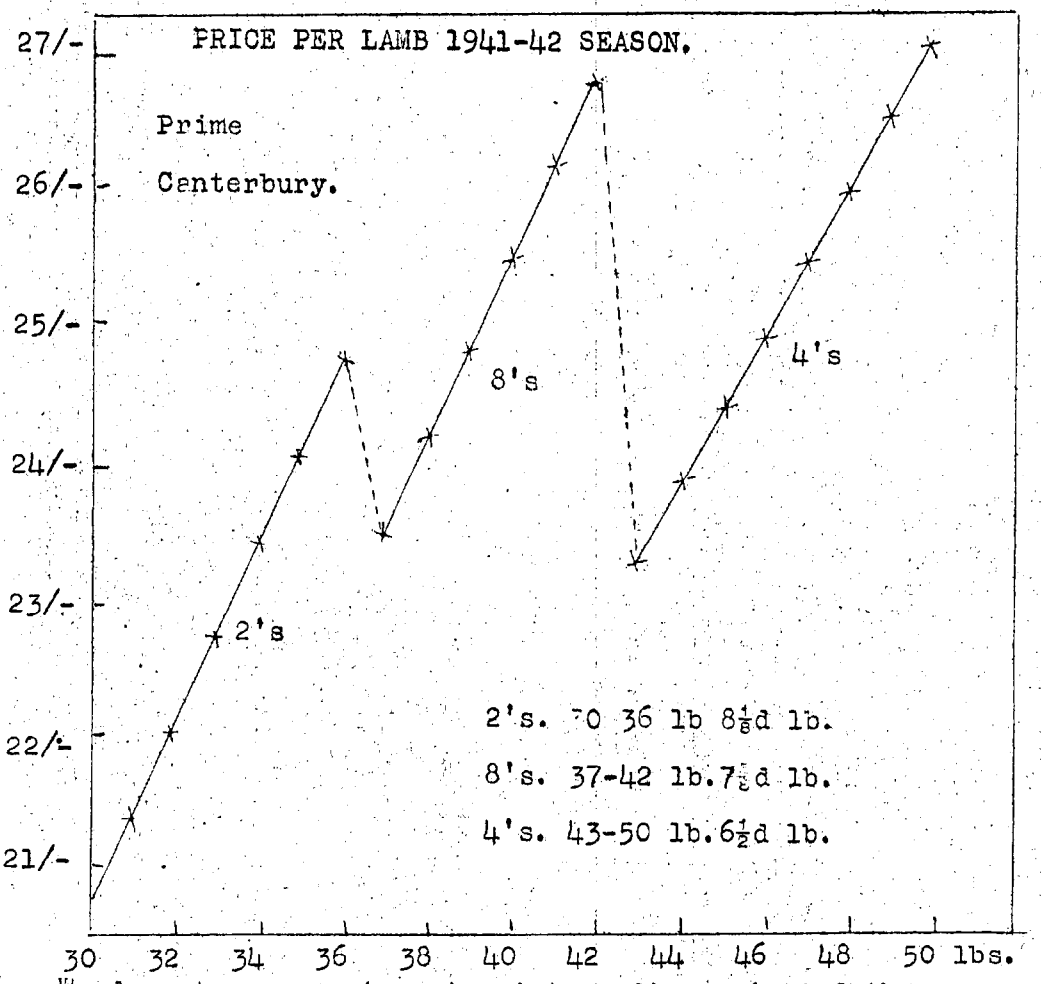
Throughout the war, our national policy has been one of lambs first and mutton second; on light lambs before heavy lambs. Since this is precisely the reverse order of the respective gross nutritive values of these classes of meat considered on a per carcase , per kilogram, or per cubic foot of shipping space basis, such a policy can hardly be described as designed to provide the people of Britain with the maximum amount of food.

Throughout the war, lamb has had priority over mutton in Government purchase policy and in shipment. Mutton has had to be canned, boned at great loss, or held in store against eventual shipment. The heaviest grade of mutton has been unexportable under any circumstances.

Because of its last place on the priority list, mutton is also regarded as the most suitable type of sheep meat for the production of dried meat.

Not only has lamb received priority over all other meats, but our policy has been one of encouragement of light rather than heavy weigth of lamb. This has been aimed at through the price mechanism, the device which has been used so successfully for many years in the encouragement of lighter and lighter lambs under peace time conditions. As seen in Fig. V. the differential price schedule has never operated so drastically against the heavy lambs as during the past season. Lambs of 37 -39 lbs. and 43-46 lbs brought the same cash return per head as did lambs of 34-36 lbs. Lambs from 43- 49 lbs yielded the same cash return as lambs of 37-42 lbs.

Fig. V.



We do not propose to enter into a discussion of the reasons underlying a policy where political and economic considerations have played a dominant part. Nor is it our function to either justify or attack such a policy. We are interested however, in its nutritive aspects.

If the problem of supply has been one of proteins rather than calories our policy from the nutritive viewpoint is essentially sound. We have been restricted in our total meat exports by shipping space. Under these conditions, priority must be given to meat supplying the gighest yield of protein per pound or per cubic foot of shipping space. Insofar as the meats examined by us are concerned this means the lightest grade of lamb. There have been many indications that Britain has been relatively more short of proteins than calories; that the provision of high quality proteins of animal origin has been more essential than the supply of energy foods. This is well illustrated by the demand for cheese from New Zealand at the expense of butter during the early years of the war. While the case for lamb asvs against mutton can thus be justified on nutritive grounds, it is difficult to carry the argument to the stage

of supporting the discrimination against heavy weight lambs. The reduction in protein per cubic foot of shipping space is not great as between the lightest and heaviest grade of lamb. Heavier lambs would have considerably added to the calorie export without any serious loss of protein, and the strain on Great Britain's food production difficulties would have been proportionately reduced.

Recent indications however point to a change in the relative emphasis on proteins and fats. This is not difficult to understand in view of the probably depletion of pre war stocks of margerine oils; the recent loss to the United Nations of Malayan and East Indies sources of vegetable oils; and the demonstration by the United States of her capacity to meet the cheese requirements of Britain. Along with a growing shortage of Vitamin A. these factors have probably been responsible for the recent change back from cheese to butter in this country.

Under these circumstances the superiority of the heavier carcases of lamb and mutton in relation to the fat-calorie supply might become a factor of major importance. It should be clear that whether shipping is restricted or not, the nutritive superiority of the heavier carcase is outstanding. Either per cubic foot of shipping space under restricted shipping, or per carcase under unrestricted shipping, our contribution to the energy food supply of Britain would be substantially increased by increasing carcase weight. This would be much greater in the latter event, though substantially worth while in the former.

For example, concentration upon the production of 'fours' rather than 'twos' would increase the gross nutritive value by twelve per cent per pound and sixty five per cent per carcase.

We are fully aware that such a policy would raise many problems. Our main point is that, at the very least, the nutritive argument must receive careful consideration in relation to the whole and in particular to the primary need of feeding the people of Britain whatever the cost.

Lest we be accused of neglecting such important factors as 'quality'; the desirability of maintaining established trade relat onships; the dangers of ruining the reputation of the 'best fat lamb' in the world;- all arguments which the writers have strenuously employed in peace time to advocate the production of lighter and still lighter lambs - it seems desirable to emphasise that there is a marked difference between marketing in time of war and time of peace. Consumers are no longer able to exercise preference. To a considerable degree the people of Britain have to take what they can get. Ration tickets are for a pound of meat and not for a pound of N.Z. Prime Canterbury 2 loin chops. With the people at present rationed at the rate of ninepence per person per week for meat, the price of which is much higher than in N.Z., it surely cannot be argued that normal quality considerations are of much importance today. Since preference cannot be exercised, quality must be subordinated to the overwhelming need for food irrespective of its shape, degree of fatness, tenderness or taste.

The problem might be stated by posing the question; 'Can we afford to indulge in luxury foods in war time'?