OUR DAIRYING AND CATTLE INDUSTRIES.

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" Statistics of overseas trade show that New Zealand exports by far the highest value of commodities per head of population. Ninety-seven per cent. of our exportable wealth consists of livestock products, and these in their turn are very largely the concentrated elaboration of grass. Herbivorous or grazing animals are most naturally supported on grass. We have found that pasture is the cheapest and most nutritious food for livestock, provided the pasture is young, leafy and vigorous, composed of mineral rich perennial rye grass, and intertwined with large-leaved persistent white clover."

This quotation is from *Revolution in Agriculture,* by Mr. G. A. Holmes a New Zealand agricultural expert, who spent some years in England during the war. In this country, of the 11·6 million acres of agricultural land, before the war about 10 millions were under grass. While in the future the cultivated area may not sink to the 1939 level, there is no doubt that in the future, as in the past, grassland will be the main feature of our agriculture. It is not necessary to stress the importance of its efficient exploitation. Because of climatic conditions there are few countries so favourable to high output from pastures. A comparison with New Zealand is of importance because of the enormous development in that country in the production of livestock products during the 20 years before the recent war. Climatic conditions in the two countries have a considerable degree of similarity. There is a high rainfall, fairly uniformly distributed throughout the year, the range of precipitation being much the same. In the North Island, where 86 per cent. of New Zealand's dairy production takes place, the winter climate is milder than in Ireland. As a result of mild winter climate, but probably still more because of the free draining nature of the soil, cows are not housed but remain in the fields protected by rugs. It is not true, however, as is sometimes suggested, that there is no winter feeding problem. " In an average season 50 per cent. of pasture production occurs in the period October–December, while only 30 per cent. of the feed requirements of a dairy herd fall in the same period."[1] Experiments on high-class pastures have shown that 66 per cent. of the output is produced in four months and 85 per cent. in eight months. To maintain the cows during the winter very considerable quantities of hay and silage are necessary. According to a recent report made to the Australian Dairy Board, " it is the general practice to utilise from 25 per cent. to 30 per cent. of the farm area for ensilage and haymaking."[2] In surveys made it has been ascertained that the amount of hay and silage made " seems to foreshadow the trend of the following year's dairy production. It would seem as though adequate winter feed may be even more important than lavish top-dressing in increasing production, though of course the two (top-dressing and fodder conservation) are interrelated."[3] If and when grass production in this country is modernised, one of the results will be a much longer grazing period. In these circumstances, the advantage of the milder New Zealand winter would not be important and would probably be neutralised by the more frequent incidence of summer droughts in that country. The capital cost of proper housing in Ireland is more important, but in this we are in no different position from Denmark and Holland.

Because of the extraordinary development of production, an idea has become prevalent that New Zealand is quite exceptional as regards soil fertility. The opinion of an English grassland expert, who spent two years in New Zealand, is that there is very little really first-class land there. In his book, Mr. Holmes says: "The soils are for the most part naturally poor, light sand or gravels, or stiff clay deficient in lime and phosphate. Their present fertile-seeming surface is due to the hard toil and scientific treatment by which the farmers have sought to improve them." And again: "Apart from coal and gold we have few mineral assets and so it is to the surface of the land we must look for our exportable wealth. We are farming steeper land, lighter soils and heavier clays than anything I have seen in Britain, and farming these marginal lands successfully, although we are 14,000 miles from our markets." A series of articles entitled, "Studies in Farm Management", have appeared in the *Journal of Agriculture*, published by the New Zealand Department of Agriculture. A study of these articles leaves the very definite conviction, that in regard to what might be described as "natural fertility," New Zealand has no advantage over this country. One important dairy district, where farming was at first unsuccessful because of "bush sickness" in cattle, due to cobalt deficiency, is described as follows: "The open tussock and scrub covered hills and plains were long looked upon as useless for farming, but with the advent of certified perennial strains of rye grass and white clovers it was demonstrated that high-class dairying and fattening pastures could be established and maintained, provided adequate phosphate top-dressing was applied."[4] New Zealand land has been man-made, and stock-made. The bush had to be cleared and burnt and the seeds sown. The soil was in most of the country very deficient in lime and phosphates. The State assisted by a subsidy on the transport of phosphates, amounting in 1938 to £184,000, and by the free rail transport of ground limestone up to distances of 100 miles at a cost in 1938 of almost £120,000. The spectacular increase in output came as a result of the application of the new ideas of the production, management and utilisation of grass. I have no doubt whatever that similar and even more spectacular results can be obtained in this country by the same methods modified in the light of research to suit our particular conditions, for every country has its own grassland problems.

Very full and detailed information on New Zealand dairying is available as a result of a number of surveys and reports in connection with the Government's price stabilisation scheme and otherwise. The total output of butter fat increased from 124·45 million pounds in 1918/19 to 448·82 million pounds in 1941/42. The export of butter was 17,291 tons, and of cheese 78,615 tons in 1919. In 1942 the amounts were 117,201 tons of butter and 134,461 tons of cheese. The total area used for dairying is estimated to be 3,814,000 acres, about 90 per cent. of the agricultural area of Munster.

Excluding farms where dairying is merely subsidiary to the main farming enterprise, the average production per cow is 240 lb. of butter-fat. Production per acre is about 120 lb. of butterfat or about two acres to the cow on the average. The most intensive dairying area is the Waikato, which was originally land of low fertility. " In that district the common sizes of dairy farms fall into three groups, one-man blocks of about 60 acres carrying up to 40 cows, two-man farms of 70 to 100 acres with 60 to 80 cows, and larger areas which may amount to two-unit farms. Except on peat soils, the carrying capacity on dairy farms is about a cow to 1½ acres, with variations according to soil type and management efficiency."[5] In Mr. Murphy's 1937/38 survey in North Cork, under conditions not appreciably dissimilar, production per cow was about 160 lb. of butterfat and production per acre about 40 lb.

Production per acre depends in the first place on the output of food nutrients, and secondly on the productive capacity of the cow, which determines the proportion of the food used for production as compared with that used for maintenance. In New Zealand milk production is almost entirely derived from grass. The feeding of concentrates is negligible, and the growing of supplementary crops is on a very limited scale. A Jersey cow yielding 240 lb. of butterfat needs a food intake of about 3,400 lb. of starch equivalent. At two acres to the cow, that means a food output of 1,700 lb. starch equivalent per acre. In the Waikato at 1½ acres to the cow it means an output of 2,270 lb. It would actually need to be somewhat higher as replacements are normally raised on the farms. There is unfortunately very little information on the possibilities of grass output in this country. Stapledon and Davies in their book, *Ley Farming,* give some results under conditions more unfavourable than the average here. " A well constituted young ley will produce over the first four or five years of its life an average annual output of from two to four tons of dry matter. We have actually obtained yields of over three tons from leys in the Welsh hills. The dry matter of grass on the basis of a yield of three tons, if properly utilised in terms of grazing, will provide at least 60 per cent. starch equivalent and 12 per cent. protein equivalent representing 36 cwt. (4,032 lb.) starch equivalent and 7·2 cwt. protein equivalent." In 1945 and 1946 controlled experiments were made by the Northern Ireland Ministry of Agriculture on the farm of Messrs. A. A. McGuckian, Ltd., at Massereene Park, near Antrim, on the shores of Lough Neagh. The farm had been neglected for generations. Before it was taken over in 1940 by its present owners it had been let at 10/- per acre. It was exceedingly deficient in lime and phosphate. Before being laid down to grass the experimental areas, covering 66 acres in 1945 and 102 acres in 1946, had produced three crops of oats. The measured output was 2,755 lb. starch equivalent per acre in 1945 and 3,136 lb. in 1946. The grass husbandry practised was essentially the same as that which has been found practicable and profitable in New Zealand. In this case it has to be emphasised that the land is only in the initial stages of development after generations of neglect, and that considerably higher yields can be expected in the future as a result of rising fertility due to the heavy stocking application of fertilisers, and the fixation of nitrogen by the nodule bacteria of the clovers. In considering the winter feed requirements of the cow, such direct evidence as there is indicates that yields of grass and clover for silage making can be assumed to be such as to produce food units of the same order. In the Scandinavian countries, less favourably situated, a dry matter output of 3 tons of protein rich fodder is easily attained by modern methods of husbandry. The possibility of preserving clover rich fodder by the AIV silage method, with a loss of only about 10 per cent., is no longer open to argument. The experience and practice of thousands of Scandinavian farmers should remove any doubts as to the practicability and economy of the process. Its use has created a new interest in the growth of clover crops, and in the provision of the most vigorous strains of nitrogen fixing bacteria for inoculation of the clover seed. A similar service is needed here. With our much longer growing season and higher rainfall there can be little doubt that higher yields can be obtained in this country. From these considerations—assuming an equally efficient dairy herd, the conclusion can be drawn that there should be no technical difficulty in reaching—and indeed in exceeding—the present New Zealand standards of output per acre. The scope of this paper does not permit of a discussion on the modern technique of grass production and management. It is, however, permissible to refer to two essential elements. The first is an adequate and cheap supply of ground limestone essential over the greater part of the country and even on soils overlying limestone in the Golden Vale. The second is the supply of fertilisers at the lowest possible cost.

The standard taken for production per man in New Zealand is 6,000 lb. of butterfat. This means one man to 25 cows. On very many farms the output is much higher. It is made possible by the almost universal use of the machine ; 86 per cent. of all dairy cows are milked by machine. The high output has resulted in high gross return per man even when prices were low. In 1937/38 at a price of 14·812d. per lb. butterfat the gross return per man from butterfat was about £370. In the 98 farms in North Cork surveyed by Mr. Murphy in 1937/38, after deducting the cost of purchased concentrates, the gross output was £29,073, or approximately £109 per unit of labour. The return from butterfat was £16,867, or about £63 per labour unit, at a somewhat higher price per lb. The average gross return per acre for butterfat on New Zealand farms was £7 8s. 0d., so that on the basis of New Zealand standards of production per acre, the total return from butterfat from the North Cork farms would have been over £50,000. In a survey of " Standards of Life of New Zealand Dairy Farmers," carried out by the Department of Scientific and Industrial Research, 413 representative farms were examined in the North Island. Of these 78 per cent. were within the range of size of the farms surveyed in North Cork. The introduction of the machine is obviously of paramount importance in our dairying districts, from the point of view of increasing output and income per labour unit, and of counteracting the tendency to reduce the size of the herds on the larger farms through the difficulty of securing reliable labour for milking. The rural electrification programme will facilitate the introduction of the machine.

The New Zealand standard of 25 cows per labour unit means 50 acres on the average for the one-man farm, and 37½ acres in the Waikato, with 1½ acres to the cow. In a survey of production and employment on dairy farms in 1936 made by the Census and Statistics Department figures are given for 91 farms averaging 43·7 acres, where the production of butterfat per cow was 360 lb., and the production per acre 187 lb. At the 1937/38 price this would represent on the average a gross return of over £500 per farm for butterfat. There are somewhat exaggerated ideas current on the size of New Zealand dairy farms. The important point is the size of the economic one-man farm. In this country for the same gross return it can be somewhat smaller than in New Zealand because of the higher value of skim milk for pig and poultry production. On still smaller farms the importance of farmyard industries is accentuated, and for their development cheap or cheaply produced supplies of food other than skim milk are essential.

In discussing output per man there is one important difference in Irish as compared with New Zealand conditions, namely, that in this country cows have to be housed in the winter. This raises the question of the importance of adequate housing, suitably designed for economy of labour in feeding and in disposal of manure. If dairy farming is to develop its possibilities, great capital expenditure will be needed for the construction of new byres and related facilities, which are very badly needed on most farms. In order to effect economy in this expenditure there is much need for experiment in design and layout.

The factors responsible for the increase in the volume of New Zealand's dairy industry have been analysed. Of the total increase 57·4 per cent. is attributed to better feeding—that is, better pastures and more food conserved for winter use—and 26·2 per cent. to "change in breed composition, including grading up through use of pedigree sires."[6] While the limiting factor in milk production in this country at present is undoubtedly lack of adequate and nutritious food, improvement of yield per cow is essential to a progressive and prosperous industry. The change of breed in New Zealand during the period of expansion is very significant. Jerseys increased from 29·6 per cent. of all dairy cows in 1921 to 75 per cent. in 1938, while Shorthorns in the same period decreased from 56 per cent. to 5·6 per cent., the other breeds in 1938 being Friesians, 7·9 per cent., and Ayreshires, 7·8 per cent.

In all progressive dairy countries dairy cows are bred for milk and for milk only. In Canada and the U.S.A. the breed is mainly Friesian, with considerable numbers of Ayreshires in both countries, and Jerseys and Brown Swiss in the U.S.A. In New Zealand the Jersey predominates. In Australia the dairy breeds are the Jersey and the Illawarra Milking Shorthorn, bred for milk for generations. Holland is the home of the Friesian. In Denmark the cattle are the Red Danish, a purely milk breed. In Sweden, Friesians are used in the South, red and white cattle derived from the Ayreshire in the centre, and a polled dairy breed in the North. In Finland the Ayreshire is predominant in the South, with native polled breeds elsewhere. In Scotland Ayreshires are the main dairy breed with some Friesians. Even in England, the home of the Shorthorn, there has been a significant change to Friesians and Ayreshires. One of the recommendations of a recent mission from Great Britain to investigate milk production in the United States was "that cattle breeding policy should be reviewed so as to establish more rapidly single-purpose dairy breeds on farms where milk production is a main enterprise." In this country, cattle breeding policy is governed by the consideration that progeny surplus to herd replacement must be capable of producing high class beef carcases. Bulls are selected for premiums on beef conformation, with a minimum and very low milk history in their ancestry. The Live Stock Breeding Act is administered on the basis of inspection, which, in the general absence of milk records, again can only mean judgment on beef points. There is no doubt that this has led to a great improvement in the beef qualities of store cattle. For that purpose it is a very perfect system. But it is not a system for the development of high milking qualities. Inasmuch as it is generally accepted that breeding for very high milk yields results in a departure from beef type, and vice versa, the success of the present practice in promoting beef quality would a priori lead to the expectation that milking qualities would deteriorate. That they have in fact deteriorated is an opinion very widely held by dairy farmers. The very vocal beef interests are quite happy with the present position in which beef characteristics are in practice the primary consideration. It is obvious that the dairy farmer needs a breeding programme with a conscious and active direction towards high milk yields. Otherwise his dairy enterprise cannot be made profitable. It is impossible to develop a prosperous dairy industry on low yielding cows. There is a serious waste of food. A Shorthorn cow yielding 400 gallons uses only about 30 per cent. of the food intake for milk production, a 600 gallon cow uses about 40 per cent. and an 800 gallon cow uses about 50 per cent. The rest is used to maintain the cow and the maintenance required is the same for a good and a bad cow of the same size. There is a waste of labour. The work of caring for and milking a bad cow is not very different from that required for a good cow. There is a waste of capital. Costs of rearing and accommodation are the same whether the cow is good or bad.

There has been a vagueness of definition of the so-called dual-purpose cow. A noted expert, Dr. Hammond, writing on the subject, recently says:

> "Our ideas of what are dual-purpose cattle will need to be changed; in order to be dual-purpose to-day we need not only cows which will breed good beef steers, but also cows which will yield at least 8,000 lb. of milk per year and breed consistently at that level."[7]

Dr. Hammond is an advocate of dual-purpose cattle to provide stores in the general interests of British Agriculture. His definition raises two questions. The first is whether, assuming the second element in his definition is practicable, the beef cattle raised thereby will be acceptable to beef interests. The second is whether it is possible to have consistent breeding at the assumed level of beef and milking characteristics. In the Report of the Committee of Inquiry on Post-Emergency Agricultural Policy on the Cattle and Dairying Industries the statement is made that: "There is no evidence pointing to incompatability between reasonably high milk inheritance and good beef producing characteristics in the Shorthorn breed." Surely something more than this is needed. One is entitled to ask what is the meaning of "reasonably high milk inheritance." There is plenty of evidence that in general as milking capacity is increased, beef quality deteriorates, and in this there is no reason to believe that there is anything exceptional in the Shorthorn breed. It is no insignificant achievement to raise the average of a breed to 800 gallons. The task becomes infinitely more complicated when the hereditary factors for beef quality have to be combined with those for such a standard of milking capacity. All one can say is that while it may be possible to evolve what would virtually be a new breed to fulfil such a dual requirement, the fact is that there is no evidence that the object has ever actually been achieved. It is of course possible to give examples of individual animals of high milking quality and good beef characteristics, but such individual examples are useless in the absence of data as to consistency of breeding. From the dairy farmer's point of view culling of low producers is a very expensive business. The examples of Denmark, Holland and many other countries have shown that it is possible to maintain high yields by concentration on milk alone. It is possible and easy to breed for beef qualities only. It has yet to be proved that it is practicable in a breed as distinguished from individuals in the breed to combine both qualities in a high degree. From the dairy farmer's point of view, if and when the necessary steps are taken to provide adequate food of high nutritional value, high yields are essential to high returns. High yields can most easily be secured by breeding for milk only, and that object can most readily be achieved by using those dairy breeds, which because of consistent breeding policy for many generations have developed a high degree of homozygosity for the production of milk and butter fat. Under present conditions the dairy farmer is definitely placed at a serious disadvantage, which could only be offset if his production of good beef steers compensated him for low milk yields. That the disadvantage is not imaginary would appear from consideration of a simple example. Consider two herds A and B of 20 cows each. A consists of cows of a high-yielding dairy breed, and B of cows bred as at present in the dairy districts, and both fed rationally so as to reach the limit of their productivity. It is not an exaggerated assumption to suggest that herd A would average 200 gallons more than B. At 1/- per gallon this would amount to £10 per cow. The cow in herd A would require more food, mainly grass and silage, and it may be argued that there would be a higher rate of depreciation. Both extra costs will be more than covered by £3. The milk return in herd A will be £7 per cow more than in B, or £140 in all. It will be assumed that 18 calves are reared in herd B, and 9 heifer calves in herd A, the male calves being slaughtered at birth. It is a reasonable assumption that these heifer calves, of high-yielding milk ancestry, will be at least as valuable as the average in herd B. In order that the returns from both herds should be equal the extra 9 calves in herd B should *at birth* be worth £140 or nearly £16 each. While in detail the figures in this argument may be questioned, there can in my opinion be no answer to the general conclusion that there is no adequate compensation to the dairy farmer for low milk yields, and that the perpetuation of the present system implies acquiescence in a hidden subsidy of quite enormous dimensions to the beef industry at the expense of the dairy farmer, who is in no position to bear it. There are the further considerations that the dairy farmer has to provide the labour for raising the beef animals at the most difficult period of their life, to undergo the risks of casualties at the age when these are highest, and to supply the most expensive foods in the form of milk and meals—which could normally be more profitably employed in the raising of pigs and poultry. At the other end is the landowner on the rich pastures, who finishes the animals on the cheapest of all foods, grass. I think a statistical analysis of prices over a number of years would support the contention that on the average he buys at a rate per cwt. not less than the rate at which he sells, which means that there is a disproportionate reward for his services in comparison with the farmer who reared the animals. The disproportion is aggravated by the expenses involved in the many intermediaries between the farms on which the animals are reared and finished, and by the cycle of summer plenty and winter scarcity in feed, as a result of which the beast is a year to two years older when finished than would be necessary in a rational system of beef production. There is a generally accepted view that the rearing farms in the dairy districts and the grazing farms in the midlands are complementary; that they have a mutuality of interests. The arguments put forward herein suggest that the advantage is extremely one-sided. Whenever the question of dairy breeds is raised—and unfortunately it is raised much too seldom—the query is put as to where the beef cattle are to come from. The dairy farmer might fairly reply that that problem is not his worry. He has to use every effort to make his own industry of milk production economic, and high yields per cow, affecting as it does production per acre and per labour unit, is one of the most essential factors. In the interests of the general economy, however, the question has to be answered. The great importance of the export trade in beef cattle cannot be ignored. The total cow population is about 1,250,000. Of these about 500,000 are in creamery areas, and possibly a further 100,000 are used for supplying liquid milk to cities and large towns. The remainder are scattered in small units on farms all over the country and are kept mainly to supply milk and some home-made butter to the farmers' households. On the vast majority of these farms milk production is a subsidiary enterprise. There is not the same urgency to increase yields as on dairy farms and consequently there is no need to make any drastic change in the present breeding policy. It is reasonable to assume 600,000 cows in this category, from which a yearly production of 500,000 calves may be expected. Allowing 100,000 for replacements, there would be available 400,000 for beef production. The annual requirement for home consumption is about 200,000 beasts. The average number of cattle exported in the years 1924–1930 was 757,000, of which an average of 55,000 were milch cows, and an average of 130,000 were store heifers, of which an unknown percentage were used for milk production. Even if all store heifers exported were fattened for beef, the total requirements for home and export beef cattle would be about 900,000 animals. There would have to be provided 500,000 beasts over and above those now derived from cows in the non-dairying districts. It is taken for granted that these can come only from the dairy districts. To quote the Majority Report of the Committee of Inquiry on Post-Emergency Agricultural Policy: "This economy of mutual dependence has grown up naturally and any drastic change in this respect would be revolutionary in its effects." Because of this assumption bulls are licensed primarily on the basis of beef conformation. It is assumed that in this way calves for beef purposes are cheaply produced and cheaply reared. The factors already considered indicate that the underlying assumptions are not founded on fact. It has been shown that in the dairy districts there is a wide field for improvement of production by better pastures and better grass management and utilisation. There is at least as wide a scope for improvement in the rest of the country. There is no longer any mystery about fattening pastures. It has been shown already in this country that by modern grass husbandry, very poor neglected land can be turned into fattening pastures. The scope for higher output per acre is probably greater in the rich grazing areas than elsewhere. It is hoped to establish by the following considerations that it would be quite practicable and economic to produce beef animals from beef cows on the areas where beef cattle are of primary interest, that these cattle would be of the highest quality because of their breeding, and because of a continuity of high nutrition as contrasted with the present alternation between live-weight increase and semi-starvation, which seriously affects the quality of carcases from animals well-bred for beef.

I am indebted to Prof. E. J. Sheehy for the estimates of food requirements of beef animals bred from beef cows as set out in the Appendix. The food will be assumed to be first-class pasture from 1st April to 30th September and during the winter, kale, first-class AIV silage and a little first quality hay made on tripods. In practice the grazing period for the cow would be much longer. The silage is assumed to contain 50 per cent starch equivalent in the dry matter and adequate protein. There is ample evidence from Scandinavian countries that this standard is feasible. In the first case the calf is assumed to be born on 1st August and sold at 22 months old. The food requirement of the fat beast weighing 1,200 lb. is 4,094 lb. starch equivalent, to which has to be added 2,700 lb. S.E. for the cow or 6,794 lb. S.E. (5·6 lb. S.E. per lb. liveweight) derived from grass and fodder crops with 1½ cwt. of meals.

In the second case the calf is born on 1st April, and the total food consumption of the fat beast weighing 1,304 lb. is 5,723 lb. S.E. to which has to be added 2,700 lb. for the cow, or 7,823 lb. in all (6 lb. S.E. per lb. liveweight) derived from grass or fodder crops with 1½ cwt. of meal.

The average price for fat cattle on the Dublin market in the years 1927/29 was approximately 45/- per cwt. These years are taken as representing a period of some stability in the price level. I am informed that cattle of the highest quality command a premium of about 15 per cent. over the average, so that the selling value will be assumed to be 51/9d. per cwt. No account is taken of the special price advantage in avoiding the normal drop in price in the late autumn. In the first case the selling price would be £27 14s. 0d. The cost of the meals will be taken as 18/- and depreciation of the cow at £1 10s. 0d. per annum. Deducting these amounts the gross return from grass and fodder crops would be £25 6s. 0d. or ·894d. per lb. S.E. Making the same deductions a similar calculation in the second case gives a gross return of ·865d. per lb. S.E. The gross return per acre will depend on the output of food units. From the evidence available it would seem that the average live-weight produced per statute acre on good land in Co. Meath is about two cwts. On the farm in which the experiments, already referred to were made in Northern Ireland the live weight increase was 3·86 cwts. per acre. An increase of 2 cwts. in the years considered would at an average beef price of 45/- give a return of £4 10s. 0d. per acre. In fact the figure would be somewhat less because under actual conditions the beasts would to a considerable extent be marketed in the autumn when the price would have been substantially under the average. At two cwts. to the acre the feed output would be about 1,600 lb. S.E. per acre. The experience of Prof. Stapledon and the Northern Ireland experiments already quoted indicate that this yield is far removed from the possibilities afforded by modern grassland husbandry on land of that quality. To quote again from Mr. Holmes' book, " Pastures, grown from locally selected or pedigree-bred seed, have in their first year yielded as high as six tons of dry matter per acre, and in their second year eight tons, the latter representing a yield of approximately 40 tons of green herbage. These were the figures obtained on rich alluvial flats under official trials by the Grasslands Division. In temperate climates with reliable summer rainfall such pasture is the ideal, and is attainable on any soil of reasonable depth and moisture-holding capacity." Six and eight tons of dry matter would represent about 7,000 lb. and 10,000 lb. S.E. respectively. Meath lands and climate would seem to have the inherent characteristics for comparable output. It should certainly be an easy matter to increase production to 3,600 lb. S.E. per acre. At the mean of the figures given above, namely ·88d. per lb. S.E. this would give a gross return per statute acre of £13 4s. 0d., an increase of £8 14s. 0d. on the actual return based on two cwts. live weight increase. It is not possible in this paper to attempt an estimate of the extra costs per acre involved in labour, capital, fertilisers, etc., but the margin is so great that the conclusion may fairly be drawn that it is not only practicable, but that it would be more profitable to produce beef cattle in the manner outlined. The argument has referred to finished cattle. In practice it may normally be more profitable to dispose of a considerable proportion of the animals as store cattle of the highest quality. The argument has also been based on the best pastures. It is equally applicable to arable farms, where considerable quantities of farmyard manure are needed, and where the indoor feeding of beef cattle has not been remunerative on the systems usually practised. Short duration leys provide high outputs of grass and clover for grazing, leaving the land in excellent condition for cropping. High yields of clover can be obtained for silage, and of kale for direct consumption. Breeding of beef cattle should fit in admirably with arable farming outside the dairying districts. There should be possibilities on inferior hill land of producing first-class beef calves, which sold from the cow should leave a better return than the half-starved store cattle which are common in these areas at present. There is another interesting possibility, namely, the breeding of beef cattle in connection with the intensive production of fat lambs. In New Zealand "the intensive grazier carries four to six ewes per acre and in the North Island relies almost entirely on grass for feeding the flock."[8] To control the pastures cattle are needed and "the intensive fat-lamb farmer in the high rainfall areas runs one cattle head to every 15 sheep."[9] On a farm of 357 acres described in "Farming in New Zealand," on which over 80 acres are mown for rye-grass seed, 1,500 ewes are purchased each year. Lambs and ewes are sold fat, and dry sheep bought for fattening according to the feed available. In 1945 "about 5,700 sheep and lambs and 200 head of cattle in all were fattened."[10] This was in a district of fertile soil, but where climatic conditions are not favourable, the rainfall being capricious and summer droughts usual.

The food requirements as estimated by Prof. Sheehy for a beast fed according to existing practice and fattened on grass at 3½ years old are also set out in the Appendix. The same quantity of meals is required as in the other two cases. In addition substantial quantities of whole and separated milk are needed, and the consumption of food derived from grass and fodder crops is actually greater per lb liveweight than in the examples of the beasts bred from beef cows, the figures being respectively 5·6, 6 and 6·5 lb. S.E. per lb. liveweight. Because of the low output from grass under existing practice the land needed for the production of the beast is more than double what would be needed for the beef animals bred from beef cows on land managed in accordance with the present knowledge of grassland husbandry.

These considerations are put forward as the answer to the question as to where beef cattle are to come from if and when dairy farmers elect to produce milk from dairy breeds. I submit the view that with modern grassland husbandry it is quite practicable to produce beef animals from beef cows, that that system would result in beef animals of the very highest quality, that it would allow of a far greater production of beef animals from the land devoted to that purpose, and that it would enable dairy farmers to concentrate on breeding for high milk production without considering its effect on beef conformation.

Improvement in the economy of the dairying and cattle industries depends primarily on the better production, management and utilisation of the cheapest of all foods, grass, for which our climatic conditions are so favourable. Modern grass husbandry is far removed from "ranching." It needs the plough, it needs lime and fertilisers; it needs the production and utilisation of persistent strains of grasses and clovers. It involves more employment. To bring the possibilities to realisation there is an enormous field for research and demonstration. In any endeavour for better production based on grass, we are not, however, venturing into the unknown.

If circumstances in the future make it incumbent to grow more crops for human or animal nutrition, there is no better foundation than the fertility built up by the excreta of the grazing animals, the herbage roots and the nitrogen fixing nodule bacteria of the clovers.

But the economy of the dairying and cattle industries depends also on the efficient conversion of available food by animals suited to their respective purposes.

A great dairy industry is possible in this country. In my view in the long run dairying can only be made profitable to the farmer, and of the maximum advantage to the country by more production per cow, per acre and per man. Production per cow is a primary factor in the problem. That involves breeding for milk.

APPENDIX.

1. Food requirements of a beef animal born on 1st August from a beef cow, reared on its dam and sold fat at 22 months old—

1st August—31st March :

Dam's Milk	200 gallons.
Hay	7 cwts.
Silage	10 ,,
Meals	1½ ,,
Weight at 1st April	448 lb.

From 1st April to 30th September the beast is on first-class pasture :

Food consumed	1,361 lbs. S.E.
Gain per day	1¾ ,,
Weight at 1st October	763 ,,

From 1st October to 31st March the animal is housed and fed on silage and a little hay :

Food consumed	1,652 lb. S.E.
Gain per day	1¾ ,,
Weight at 1st April	1,078 ,,

From 1st April to 1st June the beast is on first-class pasture :

Food consumption	713 lb. S.E.
Gain per day	2 ,,
Final weight	1,200 ,, =10·7 cwts.

The total food derived from grass and other fodder crops would be, 4,094 lb. S.E. The food requirements of the cow will be taken as 2,700 lb. S.E. all derived from grass or fodder crops. The total food would therefore be 6,794 lb. S.E. derived from grass and fodder crops with 1½ cwts. of meals.

2. Food requirements of a beast bred and reared as in (1) born on 1st April and sold fat at 24 months old—

1st April—1st October :

Mother's milk—200 gallons	346 lb. S.E.
Grass	200 ,, ,,
Weight reached	345 ,,

1st October—1st April :

Silage and hay	1,237 lb. S.E.

Increase, 1½ lb. per day—Weight, 345+274=619 lb.

1st April—1st October :

Grass	1,620 lb. S.E.

Increase, 1¾ lb. per day—weight, 619+320=939 lb.

1st October—1st April :

Hay and silage	2,066 lb. S.E.

1½ cwt. meals (in last two months).
Increase per day, 2 lb.—weight, 1,304 lb.

The total food would be 5,123 lb. to which has to be added 2,700 lb. S.E. for the cow, or 7,823 lb. in all, derived from grass and fodder crops with 1½ cwts. meal.

3. Food requirements of a beast bred, reared and fed according to common practice at present, born 1st April, fattened on grass at 3½ years old—

Weight at 6 months—336 lb.

Weight Increase	6–12 Months	at ¼ lb. per day	—	45½.
,, ,,	12–18 ,,	,, 1¼ ,, ,, ,,	—	222.
,, ,,	18–24 ,,	,, ⅜ ,, ,, ,,	—	68½.
,, ,,	24–30 ,,	,, 1½ ,, ,, ,,	—	274.
,, ,,	30–36 ,,	,, ½ ,, ,, ,,	—	91.
,, ,,	36–42 ,,	,, 2 ,, ,, ,,	—	365.
				1,402 lb.

Food Consumption.

1st 6 months—	Whole milk	35 gallons	504 S.E.
	Separated milk	105 ,,	
	Meals	1½ cwts.	
	Grass	230 S.E.	

2nd 6	Months at 4 S.E. per day	— 736 lb. S.E.
3rd 6	,, ,, 7 ,, ,, ,,	—1,280 ,, ,,
4th 6	,, ,, 6·8 ,, ,, ,,	—1,248 ,, ,,
5th 6	,, ,, 10 ,, ,, ,,	—1,840 ,, ,,
6th 6	,, ,, 7·9 ,, ,, ,,	—1,445 ,, ,,
7th 6	,, ,, 13 ,, ,, ,,	—2,365 ,, ,,

The total food is 9,144 lb. S.E. derived from grass and fodder crops with 1½ cwts. of meals, 35 gallons of whole and 105 gallons of separated milk.

References.

[1] *The Dairy Industry in New Zealand*, p. 65, Bulletin 89, Department of Scientific and Industrial Research.

[2] *New Zealand Dairy Survey.* Report to the Australian Dairy Board.

[3] *The Dairy Industry in New Zealand*, p. 65.

[4] *New Zealand Journal of Agriculture*, July, 1944.

[5] *New Zealand Journal of Agriculture*, May, 1945.

[6] *New Zealand Dairy Survey.*

[7] *The Improvement of Cattle*, by John Hammond, M.A., D.Sc., F.R.S.

[8] *Farming in New Zealand*, New Zealand Dept. of Agriculture, p. 75.

[9] *Farming in New Zealand*, p. 73.

[10] *Farming in New Zealand*, p. 143.