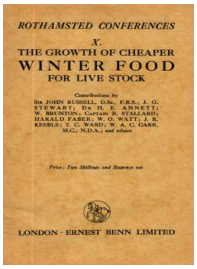
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The Growth of Cheaper Winter Food for Livestock

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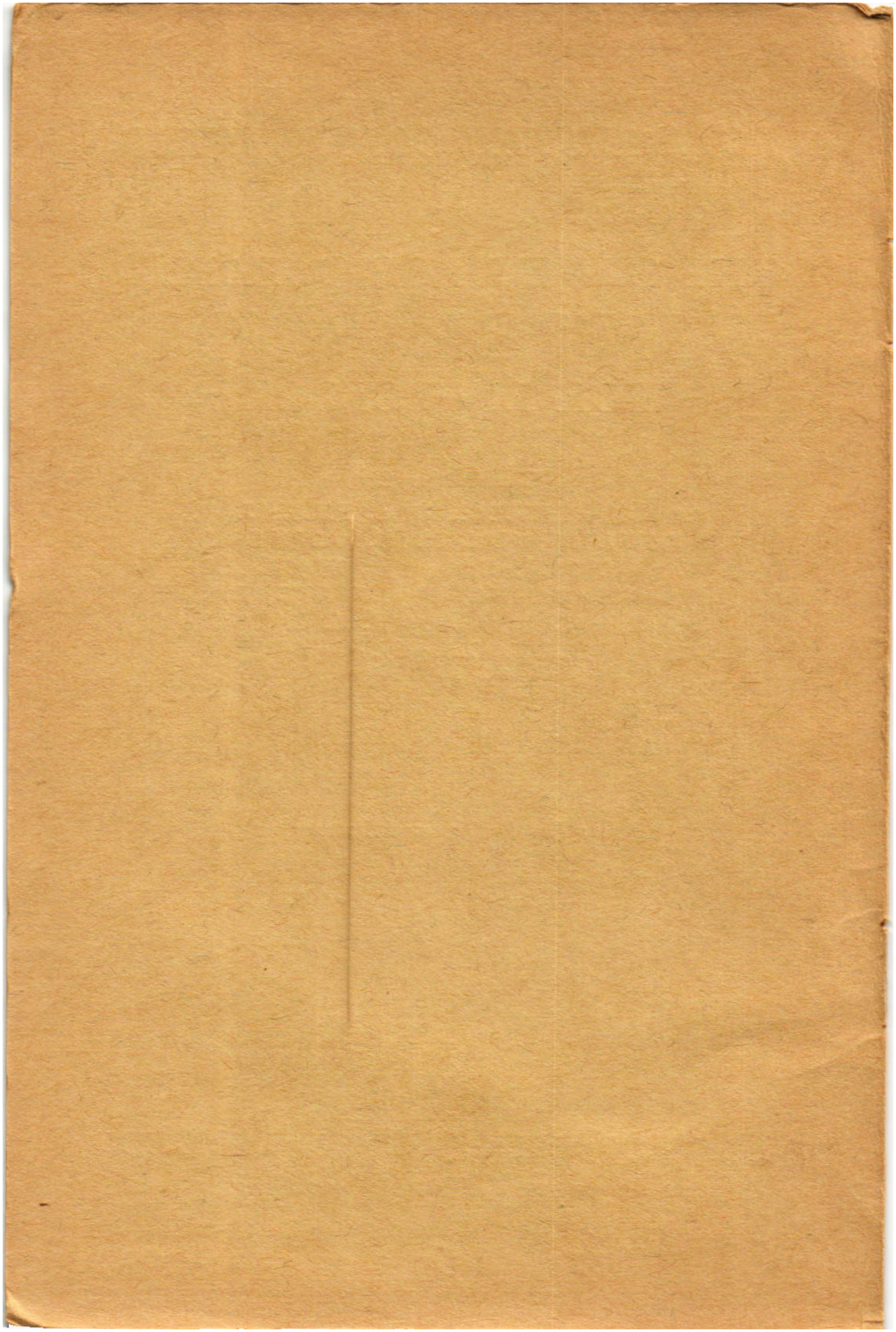
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THE GROWTH OF CHEAPER WINTER FOOD FOR LIVE STOCK

BEING THE REPORT OF A CONFERENCE HELD AT ROTHAMSTED ON NOVEMBER 15TH 1929 UNDER THE CHAIRMANSHIP OF

THE RT. HON. LORD CLINTON, D.L., J.P.

With Contributions by

SIR JOHN RUSSELL, D.Sc., F.R.S.; J. G. STEWART; DR H. E. ANNETT; W. BRUNTON; CAPTAIN R. STALLARD; HARALD FABER; W. O. WATT; J. R. KEEBLE; T. C. WARD; W. A. C. CARR, M.C., N.D.A.



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INTRODUCTION

THE problem of finding winter food for live stock is of increasing importance to farmers. Modern changes in British agriculture all tend to raise the position of live stock in the economy of the farm and to emphasize the need for effective management during the winter. There is the possibility of doing fairly well during the winter months, but on the other hand it is painfully easy to lose whatever may have been made in summer.

The problem is probably most important for the dairyman producing fresh milk for market. The highest prices are paid in winter, but the costs are also highest and the need for economy is very great.

For the meat producer the problem is rather different. The old method of winter production of beef was to feed cattle on roots, hay or straw, cake and corn, and this certainly gave meat of high quality. The costs are now too high and the method has been much altered, roots particularly being much less used. No satisfactory new method has yet been devised, and indeed it is not clear that the giving up of roots was the best change to make. In Denmark, as is shown later, farmers kept to roots, and even extended their use.

The provision of winter food is also of considerable interest to the grassland farmer producing meat on grass—*i.e.* during summer months only. This method, while cheap and usually profitable, has the disadvantage of making little provision for winter, so that new animals have to be bought from the hill farmers or from Ireland each spring, and any animals not finished in summer may have to be sold in autumn to other farmers possessing sufficient winter food. Hitherto the arable farmers alone have been in this position, and so there developed the transfer of live stock in autumn from the grass to the arable farms, a change advantageous to both groups of farmers so long as there was some sort of balance between the grass and arable land of the country. Where, however, there is much more grass than arable there tend to be many buyers of store cattle in spring and many sellers of unfinished animals in autumn; in consequence the grassland farmers may be driven into the awkward position of paying dearly for their stores in spring and of selling cheaply any animals left over in autumn. This difficulty could be largely overcome by the provision of cheap winter food.

The sheep farmer is equally interested. Given a sufficiently cheap supply of winter food he can hope to produce early lamb commanding a very attractive price per pound, otherwise he must wait till the grass is sufficiently advanced, and by this time others are on the market and prices have fallen.

These considerations always hold, and they give a permanent interest to the problem of producing cheap winter food. During

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the present winter, however, the problem is likely to be specially urgent, for the past summer (June to September) at Rothamsted has been the driest since the records began in February 1853, and it has been particularly unfavourable for the growth of winter food in the southern part of England.

The following papers show how the problem is being tackled by practical men in various parts of this country, and also in Denmark and in New Zealand. Some are depending on grass. This is less difficult now than it was, for under modern management and manuring the grass can be made to start earlier into growth in the spring, and to continue growing later in the autumn, so that the grazing season can be extended by several weeks. Dr Annett describes the method used in New Zealand; here the problem is reduced to its simplest because the cattle can be left out all winter, and they are given no concentrated foods there. Some grass is cut for hay, and some is made into stock silage, but neither cake nor corn is purchased. The milk supply is low in winter, but as the farmer is aiming only at butter production he arranges, like the English cheese-maker, for his cows to calve in time for the best growth of the grass. Usually this simple method does not answer in Great Britain, and the utmost that can be done is to extend the grazing season as described by Mr Brunton, so reducing the need for winter food.

It would of course be possible to get through the winter on hay alone, but this plan is not always economical.

Three other methods are therefore used: these are discussed in detail in the following papers:

(1) Fodder crops of good feeding value are grown.

Lucerne has proved of great value and deserves to be more used by farmers, especially now that inoculation is a practicable process. Marrow-stem kale, sugar-beet tops and fodder mixtures (*e.g.* oats, beans and tares) are cheap and good, while one ingenious and successful farmer uses the stalks of brussels sprouts with considerable success. Agricultural science is not yet at the end of its resources in this matter of fodder crops.

(2) Roots, either swedes or turnips, are grown.

This is the old method: it is going out in Great Britain, particularly in the Eastern and South-Eastern counties of England, where the area shrinks from year to year: it fell from 154,400 in 1920 to 104,500 in 1928,[1] and the fall continues. One might think that roots are doomed, but the experience of Danish farmers proves that they are not. In Denmark, as Mr Faber shows, the area under roots increases, and with it the numbers of live stock per hundred acres, the fertility of the land, and the total output of food from the farm. Several reasons have contributed to this result. The

[1] The counties are those enumerated under the headings "Eastern" and "South-Eastern" counties in the Ministry of Agriculture statistics.

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climate of Denmark is more suited to roots than that of the Eastern and South-Eastern counties of England. The Danes have concentrated their attention on the improvement of feeding value per acre rather than appearance or weight; they have made stringent regulations about seed being true to name, and they have improved their method of cultivation.

It is not easy to compare wages in Denmark with those in England because of differences in mode of payment, but there does not appear to be a sufficient difference in daily rates to explain the difference in attitude towards the root-crop. The trouble is that at present the English farmer, owing to climatic factors, often obtains only about twelve to fifteen tons of roots per acre, and until this can be increased roots must remain unprofitable. In the North the yields are higher, and roots remain a permanent factor in winter feeding.

(3) More use can be made of home-grown cereals; instead of selling them at low prices they can be ground for use on the farm. Before buying any concentrated feeding-stuff farmers should inquire about the prices that will be paid for their corn, and if this is not satisfactory then the purchases should be reduced accordingly.

No single one of those methods is likely to answer all round, and every farmer must solve for himself the question of the most likely for his conditions. Experiments are being made on mixture and other suitable crops and the best way of working these into the rotation. What is wanted is not more coarse fodder but more digestible material—protein, carbohydrate and fat—and the question is how to get this most economically and conveniently.

At this Conference there was no discussion of rations, but it was pointed out by Mr Stewart that the Scandinavian rations are more economical than ours, giving about one gallon per cow more milk than ours do: also that we appear to be giving too much protein, judging by American results.

E. J. RUSSELL.

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THE GROWTH OF WINTER FOOD FOR LIVE STOCK

By J. G. STEWART
Ministry of Agriculture

Some of you may have difficulty in believing that farmers in the part of the country I used to know best—beyond Aberdeen—could ever be lavish with anything. Nevertheless, for years they have used prodigious quantities of roots and straw in the feeding of their stock. When in the natural course of events I took the road southwards I found that in the Lothians the same extravagant habits obtained. By the time I reached Yorkshire—more than twenty years ago—the agricultural scientist was grappling with the problem, and was wavering between large quantities, moderate quantities and no roots at all. It did not seem to matter much, as the conclusion then reached was that all such rations were alike unprofitable; so that farmers down to the present day have presumably been living on their losses—in other words, on manurial residues. Nowadays, as regards bullock-feeding, the scientist seems to have caught up with the Aberdonian. We find, for instance, that a typical Norfolk ration based on scientific requirements for a 9-cwt. bullock is 17 lb. barley straw, 80 lb. mangolds, 2½ lb. cotton-cake.

As for milk, dairy herds may roughly be divided into two classes:

(1) Those with a 600–800 gallon average, typical of the majority of herds in the country, milked twice a day, and

(2) Those that reach up to 1000 gallons or more.

Those of the first class can make good use of the commoner products of the soil. And, after all, it is not so much a question of increasing the output of milk as of cheapening it. I do not deny that large quantities of milk can be produced on a handful of hay and a sackful of concentrates, but it hardly seems a policy for rural regeneration. On that principle one could farm the Crystal Palace or the dockyards! I maintain that yields of from 2–4 gallons a day can be produced at a lower cost for food per gallon on a ration composed mainly of home-grown corn, roots and "roughages" than similar yields on hay and purchased concentrates.

On top of 18 lb. of good hay, 56 lb. of kale or 70 lb. of mangolds constitute a 2-gallon ration. The normal recommendation for 2 gallons would be 7 lb. of concentrates. The kale or the mangolds may cost 4d., the 7 lb. of concentrates 8d. or 9d.

As Wyllie has pointed out, it is only when the basal ration is expensive that heavy yielders have the advantage. I know a college herd where two years ago an average of over 800 gallons resulted in

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a loss. Last year the same herd produced just over 500 gallons and paid its way. Concentrates were practically cut out.

Another point—recent work on protein requirements carried out on the Continent and in America seems to indicate that the English feeding standard is too high. If this should be confirmed, and the Cambridge findings in regard to young grass and young hay can be applied, the farmer will be more nearly independent of expensive purchased protein concentrates. In this connection it is interesting to examine the Scandinavian method of arriving at equivalent productive quantities of feeding-stuffs. The method was first brought to my notice by an article in the *Journal of the Irish Department of Agriculture*, written by Professor Wilson in 1916. If one takes typical Scandinavian rations as given in that paper for 2, 3, 4 and 6 gallons and compares them with rations based on the standard in use in this country—maintenance 6·6 S.E. and ·68 P.E., production, 2·5 S.E. and ·6 P.E.—one finds that for the same nutrients the Scandinavians rely on getting an extra gallon of milk—that is to say, a Scandinavian 3-gallon ration is reckoned as being worth only 2 gallons for English cows, a 4 for a 3 and a 5 for a 4. The work of Woodman and others on the nutritive value of young grass points the way to a cheap source of home-grown protein. If young leafy grass is a rich source of protein, well-made young leafy hay cannot be very far behind. Some interesting work bearing on this point has been done by Mercer, Carr, and Colonel Lyon in Cheshire. Leafy hay can normally be obtained in two ways—by cutting early or by grazing late and then shutting up for hay. It is easily made if got together quickly and cocked.

For winter feeding we must try for full crops of leafy hay, kale, mangolds, and pea-and-oat or bean-and-oat mixtures for grinding. In beet-growing districts the by-products are proving an economical source of winter food, and in many cases have largely displaced fodder roots.

If only we would "steam up" our grass, our kale, mangolds, sugar-beet, and other responsive crops, as we are recommended to steam up our cows, agriculture might yet pull through.

High farming may be no remedy for low prices, but it is impossible indefinitely to farm arable land low. I have more respect for the old text: "There is that withholdeth more than is meet and it tendeth to poverty." We are too apt to think of farming in terms of artificial fertilizers and varieties, and overlook the fundamental importance of cultivation and continuous good farming. Much of our arable land is undoubtedly underfarmed—a fact which accounts for the low yields of beet and other crops. What is the good of worrying about such fine points as spacing, and neglecting the larger issues? A survey of 100 farms shows that in the case of 24-in. rows the average yield was 7·5 tons and in the case of 21-in. rows

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7·8 tons. What is wanted is at least 10 tons per acre, and for that we need higher farming—that is to say, thorough cultivation and accumulated fertility. It is no use trying to grow beet on extensive lines like turnips or swedes. This may mean limiting the annual ploughland by the introduction of temporary leys or lucerne—the latter as a regular rotational crop. Farmers are diffident about trying temporary leys in the Eastern Counties, although they were in common use there in the time of Coke of Norfolk and up to the middle of last century—giving way to one-year seeds when artificial fertilizers came in and the prices for corn were good. To-day, throughout East Anglia, it is possible to find numerous instances of successful laying away to grass with mixtures of the standard Cockle Park type suitable for three or four years. There may be difficulties in regard to water, in which case hay, annually, followed by sheep-grazing may be tried.

In a drought, arable-land hay is more reliable than permanent meadow. Because it contains young and vigorous plants it is more responsive to manurial treatment. The only really useful grasses on the Chiltern pastures that kept green throughout the drought were cocksfoot and timothy, and I am now engaged in ploughing out, with a view to re-seeding, a field which contained neither and was quite useless throughout the summer although normally containing an abundance of wild white clover.

I know of two instances where lucerne has been successfully introduced as a regular rotational crop.

The chief drawback to this kind of rotation would, in many cases, be wireworm, but wireworm is comparatively innocuous where mixed corn crops such as peas or beans and oats are taken. The great advantage of a mixed crop such as beans and oats is that it will stand up, and can therefore be liberally fertilized. This kind of intensification, which requires no more labour to speak of and admits of the use of fertilizers which are relatively cheap, may generally be reckoned as economically sound. I know a case where a farmer regularly grows after temporary ley no less than 30 cwt. —and often 2 tons—of grain per acre of a mixed crop of beans and oats ($3\frac{1}{2}$ bushels of beans and $2\frac{1}{2}$ bushels of oats). As a winter catch-crop there is probably nothing more economical than trifolium and Italian rye-grass. For about 15s. per acre you get a full seeding without ploughing, whereas a bushel of vetches alone costs about that sum.

I believe that one means of relieving the present stress is to concentrate on such an area of ploughland as we can do well, grow full crops and try to be more self-supporting in feeding-stuffs. The man who buys nothing he can produce for himself never goes "broke." We hear a lot about over-production of human food. Has anybody heard of over-production of cattle food?

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THE NEW ZEALAND SOLUTION OF THE PROBLEM

By Dr H. E. ANNETT
New Zealand

In New Zealand there are approximately 16,700,000 acres of good grassland, and 14,200,000 acres of land in rough grass. It will be of interest to note that Great Britain is similarly situated as regards grassland, in that she has 16,700,000 acres in good grassland and 14,800,000 acres in rough grassland.

Arable land is relatively of little importance in New Zealand. Rapid developments in production from grassland have taken place within recent years. The output of butter is six times greater than in 1900, and cheese fourteen times greater. The amount of dairy produce exported has doubled since the War, while the number of cows and heifers two years old and over in 1918 was 793,000, and 1,305,000 in 1927. The output of wool has increased by 80 per cent. and meat by 70 per cent. since 1900, but the meat increase has been mainly from lamb.

This great increase in production is due largely to the more extended use of fertilizers, chiefly phosphates, and better pasture management. In regard to the increase in production of dairy products, the part played by the herd-testing movement must not be overlooked.

The climate of the Auckland Province of North Island is, as a general rule, almost ideal for dairy farming. Cattle are never housed during the winter, and it would seem quite possible to get grass to grow the whole year round. The rainfall is ample and, on the whole, well distributed.

The New Zealand farmer is, moreover, an intelligent type of man. He has had his mind broadened by the co-operative movement, both as regards his dairy factories and the herd-testing movement, and that he is prepared to watch his own interests is indicated by the interest he is now taking in the marketing of his own products. I do not, however, claim any superiority for the farmer of New Zealand over the British farmer. The difference is one of circumstance.

Of recent years he has become accustomed to use large quantities of fertilizer, particularly in the Waikato. Since the war the percentage of grassland fertilized has increased from a negligible figure to about 20 per cent. This is a remarkable demonstration of how quickly the New Zealand farmer has taken to new methods. The fertilizer used is mainly superphosphate, and 215,000 tons of rock-phosphate, equivalent to 400,000 tons of superphosphate, were imported into New Zealand in 1928. This was mainly converted

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into superphosphate, though a small quantity of rock was used as such.

As an indication of the rate at which the practice of top-dressing with superphosphate is increasing, it may be mentioned that 174,587 tons of rock-phosphate were imported into New Zealand in 1927-1928, against 113,472 tons in 1926-1927, an increase of 54 per cent. It is estimated that approximately 3,000,000 acres of grassland were top-dressed in New Zealand last year, and certainly the bulk of this superphosphate was used on grassland.

The Waikato area of the Auckland Province is the most advanced in regard to the use of superphosphate, and the dairy farmer there commonly uses 3 cwt. of superphosphate per acre per annum, and cases are known where 4 cwt. or even 6 cwt. per acre per annum is being used over the whole farm. Quite a number of farmers are applying their superphosphate in two dressings at different times of the year, and the experiments being carried out by the Department of Agriculture at Marton appear to indicate that this is a very sound practice.

In these experiments it has been found that a flush of grass-growth occurs six to ten weeks after the application of superphosphate according to the time of year the manure was applied. It is possible that the phosphate content of grass recently manured with phosphate is higher than that not so recently manured, and this may react on the feeding value of the pasture. Therefore I think future work will show that the New Zealand practice of annual applications of phosphate is sounder than the usual English custom of applications of phosphates every few years.

It will be seen that although the New Zealand farmer is becoming a great user of fertilizer his manurial practice is one-sided, being almost entirely phosphatic. Liming is being practised to a small extent in certain areas, but the use of potassic and nitrogenous manures is rare.

Superphosphate has undoubtedly enabled the New Zealand farmer to carry more stock per acre. Many dairy farmers are now producing more than 200 lb. of butter-fat per acre, or say 550–600 gallons of milk. This increased production means an increase in the amount of plant food constituents removed from the soil in the increased grass consumption of the animal. The superphosphate supplies phosphate and some lime, but there is a danger that the animals may suffer on account of an insufficiency of potash, and, perhaps, of other rarer minerals which are not being replaced in the manurial scheme. We know nothing, moreover, regarding the rate at which lime is being lost from our New Zealand soil, and it is quite likely that even our heaviest dressings of superphosphate do not supply sufficient lime to make up for the loss from the soil in the drainage water and in the food consumed by the animal.

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The recent developments in grassland farming in Europe, embracing as they do a complete manurial scheme, seem therefore to have special interest for New Zealand.

Recently I have had the opportunity of visiting a large number of farms in Great Britain and Ireland, Holland and Germany, which are run on the intensive system. As a result of these visits I have been able to obtain much valuable information. Undoubtedly great results are being obtained from the system in many places, but it is quite obvious to me that we have still a great deal to learn regarding the way in which intensively grazed farms should be managed.

In New Zealand my own farm is run very intensively, and I am associated with numerous farmers who are working on similar lines. There is one very marked difference between the way we are putting the system into practice and the way it is being practised in England. In the latter country six or seven grazing paddocks are considered to be sufficient, and cows are left on each paddock a week, or even more. In a few cases, however, I was interested to see that the best milkers are allowed to go ahead of the rest of the herd into the paddock next to be grazed, for an hour or two per day. But perhaps the best system is that adopted by Mr Shaw at the Seale Hayne College, where, when a field is ready for grazing, the cows are allowed into it only for one and a half hours a day morning and evening for the first few days—the rest of the time being put back into the previous grazing field to clean it up. In this way the good grass is not fouled by the droppings, and very even grazing is obtained.

We in New Zealand are using many more paddocks in the grazing rotation, and we consider twelve to fifteen are necessary. It is unusual on the farms with which I am associated to allow milking cows to graze a paddock for more than two days. During the actual grazing time we usually run fourteen to sixteen cows to the acre, so that on a farm with, say, forty-five cows our paddocks would be about three acres in area. The grazing stock are followed by young and dry stock and, in my own case, with sheep after the young and dry stock.

Harrowing we consider to be an essential part of the system, and in general, I should say, we attach far greater importance to this than is done in England. A good deal of work is being carried out in New Zealand regarding the designing and testing of suitable harrows.

Quite a number of farms are now being run under the system in New Zealand, but before giving details of these I would like to make a few general remarks.

The use of milking machines is universal throughout New Zealand.

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Certainly as regards the North Island the use of the plough is becoming rare on dairy farms.

The growing of root-crops is being given up in favour of ensilage made from grass. The ensilage is made mostly in trenches and stacks, the tower silo requiring much more labour. One point which cannot, however, be sufficiently emphasized is that grass must be cut for ensilage much younger than is usually the case. We have all heard recently of the very great feeding value of young grass, and if we want silage capable of the best milk production it is only reasonable to suppose that grass for ensilage should be cut at the stage at which it is most nutritious. I have heard it said that it is not possible to handle such short grass, but I have recently visited a farmer in Germany who has made silage from short grass for some years, and finds no difficulty whatsoever in handling it. Moreover, when feeding the silage out from his tower silo he finds the further advantage in short grass that it can be easily forked out of the silo without previous cutting into sections with the hay knife. This farmer feeds this ensilage in the winter and gets 2d. per lb. more than his neighbours at this time of the year for his butter, because it is recognized as having the same quality as butter made from May grass. We in New Zealand have followed with interest the excellent work on silage which has been carried out at Cambridge. We are hoping to get more information regarding ensilage made from young grass, and Professor Drew's work in Ireland should prove of great value. I am also pleased to find that an important feature of the work at the Imperial Chemical Industries Research Station at Jealots Hill is a study of ensilage, and an investigation of what may eventually be an alternative process—namely, the preservation of young grass in the form of grass-cake, by means of artificial drying and pressing.

The fact that the farms are entirely, or almost entirely, grass farms in the North Island of New Zealand means a great economy of labour: on a hundred-acre farm it is common to milk 55–60 cows. The whole labour of the farm, including milking, would be done by two men.

It is probably realized by all of you that our seasons are opposite to yours, our winter coming at the time when your summer comes, and *vice versa*. Milking hitherto in New Zealand has not been practised all the year round. The New Zealand farmer has aimed at getting his cows to calve down at the middle to the end of August, and has usually had them dry in June and July. During this period of the year, and into August, hay is carted out for the stock into the fields, and the farmer usually likes to have from a half to one ton of hay per cow for winter feed.

Our first year's experience in the use of sulphate of ammonia showed us that we should have no difficulty in getting excellent

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feed in July. In consequence of this it seems certain that cows will be brought in several weeks earlier, and, moreover, better feed would be obtained in August and September, in which months early calvers have in the past been frequently pinched for feed. In October and November we usually have a great flush of grass.

We are also finding that applications of nitrogen in autumn—say, in early May—keep grass growing well into the winter, and it seems quite likely that nitrogenous manures will in parts of the North Island enable us to keep grass growing throughout the winter and thereby solve the problem of winter-feeding in a simple manner.

I will conclude by giving a few details regarding the stocking and the management of certain farms of which I have personal knowledge.

On my own farm I have 40 acres laid off for intensive grazing, but, deducting the areas taken up by buildings, trees, etc., there remain available for the stock approximately 34 acres. New milking sheds were erected in the centre of the farm, and the farm has been subdivided into fourteen paddocks of 2–2¼ acres each, one of 3 acres and a bull paddock of 1 acre. Water has been laid on to each paddock, no crops are grown, and the whole area is under grass.

In the first season 5 acres were cut for hay and another 5 acres for ensilage. The farm had been carrying 20 cows and 2 horses under the old system, but no young stock and no sheep. Under the new system 33 cows were milked on the area until the last three months of the season, when only 31 were milked; 12 calves were reared and, in addition, there were also 1 bull, 2 horses and 1 pony.

After the first three months 43 ewes, with 13 lambs at foot, were purchased; the ewes were shorn on the farm and were all sold off, together with 31 fat lambs, after five months on the farm. The farm produced 165 lb. of butter-fat per acre, reckoned on the gross area, and the sheep gave a fair profit. In addition, there were returns from calves sold, including some pedigree short-horn calves, and one has also to take into consideration the value of the twelve calves reared.

The manurial scheme was experimental and will not be detailed here, but consisted of an all-round manuring with phosphates, potash and nitrogen.

The many visitors to the farm remarked that the stock all looked in excellent condition.

The effect of the heavy stocking has resulted in great improvement of the pasture; the rye-grass has been especially stimulated.

The system of grazing was as follows: the milking cows were usually two days on a paddock, and were followed by the young and dry stock, and these in turn by the sheep, and after each grazing the paddocks were harrowed.

Farm A. This farm is on rolling downs country near Hamilton,

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Waikato. The present owner has had it for nine years and has never used a plough on it in that time. The farm is 150 acres in area and was carrying in this present season 917 breeding ewes, 450 hoggets, 22 yearling heifers, 20 steers, 8 dairy cows and 5 horses, and even with this stocking the feed was difficult to keep down.

Last year 1300 sheep were grazed during the winter, and in that season the ewes and lambs netted their owner £1287.

The system of management involved rotational grazing of small paddocks, together with heavy top-dressing—namely, with superphosphate and limestone. I ought to add that the owner is a business man and developed his own system independently of the newer idea of grass-land farming.

Farm B. is 50 acres in area and carried 40 cows. Two seasons ago it produced approximately 14,000 lb. of butter-fat, or about 280 lb. per acre: this was under a system of rotational grazing in small paddocks, together with a fairly good system of manuring.

Farm C. is 78 acres and carried 50 milking cows. The gross returns in each of the past two seasons has been approximately £1200.

The owner is a skilled English farmer, and grows a certain quantity of root-crops.

Farm D. is approximately 150 acres and is carrying 85 milking cows. The farm is laid out in 5-acre paddocks for rotational grazing. A good all-round manurial scheme is practised, including a fairly liberal use of nitrogenous manures.

No crops are grown, and the cattle are dependent entirely on grass, hay, and grass ensilage. A large number of yearling heifers—approximately 50—are carried, and recently 200 breeding ewes were purchased. Last year the herd of 85 cows averaged 364 lb. of butter-fat per cow, which is equivalent to approximately 200 lb. of butter-fat per acre.

The full benefit of the subdivision of fields has not yet been reached on this farm, and it is anticipated that far greater returns will eventually be realized.

The owner is so satisfied with the system that he is applying it to another farm of 180 acres which he has in the vicinity.

These instances are given, not as typical of dairy-farming conditions in New Zealand, but in order to show the results which certain farmers are at present obtaining. However, there are quite a number of dairy farmers in New Zealand who are producing over 200 lb. of butter-fat per acre.

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THE GROWTH OF WINTER FOOD FOR LIVE STOCK

By W. BRUNTON
Marton-in-Cleveland, Yorkshire

Before commencing on the production of winter foods for stock I should like to describe one of my own farms, and make the management of the crops practically the basis of my paper.

The farm is situated in the vicinity of a large town. A large part of the output of the farm is in the form of Grade A milk. I have not given all my attention to this particular product, but have put considerable trust in the ordinary wholesale farm products. Large outputs have been obtained of pork, mutton, corn crops, potatoes, poultry, without prejudice to the milk.

The gross output in 1928 was £7297, 15s. 3d., comprised chiefly of:

Sheep	£529	Roots and potatoes	£825
Pigs	813	Corn	1025
Poultry	354	Dairy products	3614

—the dairy products thus being about equal to all the other products combined.

In order to see how this has been obtained a study of the cropping is instructive: 88 acres have been devoted to corn crops and potatoes, and have yielded £1850. The remainder of the land has been at the disposal of the stock, and has been composed of 161 acres pasture (78 of which are used as a golf-course); 10 acres fodder, roots and kale; 21 acres seed hay. This land has given a gross output of £4195, in the form of milk and mutton.

To produce this output it is easily seen that a large amount of food is required, for besides consuming the produce of the farm I have purchased £2000 worth of concentrates, corn and hay, and nearly £1500 has been spent in labour on the farm.

The stock was composed of:

13 horses	150 breeding ewes
80 milk cows	71 pigs
2 bulls	500 head of poultry
27 young cattle	

Referring to the summary of costs, I find my cows have cost £16, 16s. per head:

	£	s.	d.
For grazing	3	7	6
Hay and straw	3	9	2
Roots	0	10	5
Concentrates	9	8	11

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The cost of the food for the production of milk is 64·2 per cent.

It is worth noting that, although 40 acres of my grassland is under the intensive system, the cost of grazing is only £3, 7s. 6d., or 12·9 per cent. of the 64·2 per cent. of the food, and the concentrates, 36·1 per cent.

I will now turn to the cost of the production of corn and hay on my farm. Knowing the quantity of stock I have to feed in the winter, I will try to find out how best to provide for them. I have grown about 2 tons of hay and 1 ton of corn per acre.

To produce 1 ton of hay has cost about £3; 1 cwt. of wheat and barley, 8s.; 1 cwt. of oats, 7s. My cows require about 1 ton of hay and 14 cwt. of corn. This means that 1 acre for hay will suffice 2 cows, and 3 acres for corn will suffice 5 cows.

It appears I will require 44 acres for hay and about 48 for corn for my cows. Assuming that it will take about the same quantity for my other stock I would require 96 acres to produce about 100 tons. To balance the 100 tons of corn I want about 50 tons of decorticated earth-nut or soya meal or dec. cotton cake, giving me a balanced ration of 150 tons. To buy a balanced ration as good as the one from dec. earth-nut and corn it will cost about £1650. Taking oats at 7s. per cwt. and dec. earth-nut at £11, 10s. per ton, the cost would be £1250, a saving of exactly £400.

This clearly points out to me the importance of not buying any winter food for my stock before I know what I am going to get for my corn. Ever since June the merchants have been interviewing me to buy cakes and compounds. When I ask them if they will give me 50s. for wheat, 40s. for barley, and 30s. for oats, they at once say they cannot do so, and consequently they have done very little business. It is necessary to purchase a third of the quantity required of a protein food, so if I can buy at a reasonable price I do so.

I now go on to prepare the cropping of my farm for the growth of winter food for my stock next winter. It is worth while to sum up the position as it presents itself. As far as I can see it means disaster if I go on farming my arable land in the old rotation. I have always had a good market for barley. My grandfather, father, and myself, as long as I have been farming, have made barley the chief crop, and sold it always directly it was harvested to the same firm. Fancy my disappointment this year when, a week before the harvest, I received a letter to say no more of my barley would be required. I naturally had prepared as usual, and have to-day four days' threshing of barley on this farm. Several merchants have had samples on the market and up to the present I have never had an offer. I attended one market and had plenty of German oats offered me. This flooding of German subsidized corn has come at a critical time for the English farmer. If the farmer works for twelve months without

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receiving anything in hard cash he naturally is disappointed at the position he finds himself in when he tries, as I have done, to sell his corn.

For this reason I am paying particular attention to the growing of crops that can be consumed by stock during winter, as well as marketed. If the price of corn is below the price of concentrates I consume the corn, and *vice versa*.

I now turn to the cropping of my farm, and arrange the following rotation:

70	acres	corn	16	acres	one-year ley
8	,,	potatoes	5	,,	sugar-beet
4	,,	winter barley	8	,,	roots, turnips and kale
18	,,	temporary seeds	4	,,	forage crop

The corn can be utilized to feed the stock and poultry—wheat to poultry, barley to pigs, oats to horses and cows. It is estimated that one sow, if she produces 16 pigs—and they are made into bacon—would consume round about 70 sacks of barley, which is a home market for 7 acres of barley at 5 qrs. per acre. The roots, with straw, are for cattle and light-milkers. Sugar-beet is included owing to the value of tops and the fact that I have an assured market for the beets. The next point is to produce as cheaply as possible. If I look at the production costs I find 41 per cent. are for foodstuffs, 32 per cent. for labour, and only 4·5 for fertilizers. Knowing full well that labour and purchased foodstuffs are more than 100 per cent. higher, and fertilizers probably lower than pre-War, I will certainly pay particular attention to give my crops all they require in the form of manures. Cut down the purchase of concentrates and I am compelled to view my labour costs.

The weakness of the old rotation of farming arable land is to be found in large proportion under roots. These cannot be produced profitably to be fed in abundance to stock, owing to the high cost of labour. Nearly all the farms I visited in Denmark and Germany (especially Denmark) grew a very large area under roots, owing to cheap labour. Many of the cattle were receiving 100 lb. of roots per day. After roots good crops of corn are produced, and this may be the reason why so much is available for export.

Again, comparing the labour costs per acre to grow a crop of roots with the labour per acre on the permanent pasture, I find it is 7s. 5d. for the pasture and £10 for roots, so naturally I pay attention to my grassland. Forty acres are under the new system of grassland management, and after four years of intensive treatment of grassland with such excellent results I must take into consideration this system.

There is no need to go into details of the management. One of the greatest advantages is the fact that the grazing period is materially

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lengthened, and grass can be obtained to take the place of late winter food. Grass can be obtained in February, which is invaluable for ewes and early lambs. Instead of turning the cows out in the second week in May they can be turned out the first week in April, and, in addition, better grazing is obtained in October.

I estimate that I can save about 8 tons of concentrates and 5 tons of hay on my farm, the majority being in the month of April and late autumn. Less land is required for grazing, and by a complete dressing of fertilizers on all land intended for mowing, more winter food for stock is obtained. The neglect of grassland is a great mistake. There are three reasons on my farm why this is so:

(1) The results obtained from a small area under intensive treatment.
(2) The amount of milk obtained during the grazing period with the cost of my grazing at £3, 7s. 6d. per cow.
(3) The labour only 7s. 2d. per acre.

As regards the arable crops, the growing of corn needs little comment. The main point to aim at is to grow as much as will stand. The chief factor to attain this is sunshine, over which we have no control. I have included four acres of winter barley in my rotation (ordinary Plumage Archer I have grown successfully) because of the early harvest. If 20 lb. per acre of Italian rye-grass is sown in early April, and top-dressed with sulphate of ammonia as soon as the barley is harvested, excellent grazing is obtained in late autumn and early spring.

A similar crop can be obtained on land where early potatoes have been lifted, as well as rape sown in rows.

The crop that has given me the most winter green food is marrow-stemmed kale. This crop I have grown exactly similar to turnips, and it has given me excellent food from November onwards, especially for milking cows. If kept well into winter many of the leaves fall off during heavy frosts, although last February we found it useful for ewes and lambs. I have included sugar-beet because of the fact that I have an assured market, as well as the tops for winter food. I saw excellent use made of them in Denmark and Germany, many were made into silo, and I see no reason why the same use cannot be made of them in this country.

I should like to say a word or two about the turnip crop. If I have a fairly strong loam I get the land manured and ploughed as early as I can after harvest. I take care I do not lose the benefits of the winter frost. I work the land in the spring and keep my fine tilth on the surface; then sow my fertilizers. Harrow only once. The secret of a crop of turnips is in the fine tilth and the conserving of the moisture.

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Since decreasing my root area I have introduced mixed forage crops. I have sown 2 acres of a mixture composed of:

1¼	bushel winter oats	1¼	bushel winter beans
¼	,, wheat	¼	,, winter tares
½	,, winter barley		

The land is strong and in good heart, and the only manure that I have used is 5 cwt. high-grade slag, guaranteed 80 per cent. solubility. I am trying this mixture more as an experiment in order to see if it is possible to harvest the crop with the binder. It will take considerably longer to cure in the stack, but it takes little harm in bad weather. I intend to harvest as soon as the cereals ripen, thrash the crop for the grain, and use the straw and grain in the place of hay, together with a little oil-containing concentrate.

The spring forage crop used is a mixture of:

Oats . . .	2 bushels
Tares . . .	1 ,,
Peas . . .	1 ,,

The crop replaces an ordinary root-crop. Plough in, about 6 inches deep, 10 tons of dung in the autumn, and apply 3 cwt. of supers at the time of sowing. Roll down with Cambridge roller as soon as possible. Top-dress with 1 cwt. sulphate of ammonia in the spring. The crop is cut with the grass-cutter when the bulk of the crop is in flower, about a third of the crop at a time. Allow two days to elapse between each cutting.

The crop is stored in a pit, which for a four-acre crop is 12 yards long, 3 yards wide, and 1 yard deep.

Each load of green material is tipped into the pit, and is evenly spread, and cart passes over material in pit.

When the hole is full the greenstuff is stacked over it to a height of 1 yard, the horses and carts still pass over.

Leave the stuff about two days to settle, then repeat operations until the crop is fed.

The material above ground is stacked with sides sloping inwards, so as to make a triangular heap about 2 yards high. Leave for a day to settle, then cover top of heap with soil.

Thick poles are suspended about half-way up the sides of the heap, and a six-inch covering of soil is built on the poles to cover heap. Air and rain should be excluded, and although there is a little waste it should yield 6 tons to the acre.

I hope you will not think that I expect the problem of how to make farming pay will be solved under this system of management. I do not for one moment think so myself. I have just outlined what I consider, in my opinion, is the most economical way to farm my farm at the present time and under the present conditions.

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The productions of my farm will chiefly be milk and milk products, beef, pork and mutton. Those will have to be turned into hard cash. At the present values it is impossible to get back what they have already cost.

THE GROWTH OF CHEAPER WINTER FOOD FOR DAIRY COWS

By Captain R. STALLARD
Pershore, Worcestershire

I do not propose to touch on the dairy farm run entirely for the sake of the dairy (by that I mean the farm which looks for its income entirely from the sale of dairy products and draft dairy cattle, where the cattle are managed with a view to getting very high milk records), for two reasons: (1) that I know nothing of such farming; (2) I am very strongly of the opinion that a farm should be of sufficient size to enable general farming to be carried out, for the reason that the by-products of one branch, such as vegetable and fruit growing, dairy and poultry, corn or live stock, may be the very life-blood of another branch.

Looking at the subject from the point of view of the general farmer—after good pasture, what is the next crop the farmer with a dairy will be most anxious to have? The answer indubitably is lucerne. Not only will he have two good crops of hay and a good aftermath for the dairy cattle to graze in late September, when milk yields are going down with a bump, but in the case of a dry summer he can fall back upon his lucerne to help out the bare pasture. In a wet summer he can make ensilage with alternate loads of lucerne and seeds.

The ground for lucerne must be selected with great care, for the following are absolutely essential:

(1) It must be well drained.
(2) It must be perfectly clean.
(3) It should be reasonably accessible to the buildings.

Taking my farm as having 200 acres of arable, I will select 60 acres as probably the maximum which will answer to these requirements.

I will now take you over a twelve-year rotation by which 30 acres of this 60 acres will be constantly under lucerne. I put down a fresh 10 acres of lucerne every other year in preference to 5 acres every year, because there is one thing quite certain, that, with present costs, it is uneconomical to work a ground of less than 10 acres. I would prefer 20 acres.

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TWELVE-YEAR ROTATION

Year	A 10 *acres*	B 10 *acres*	C 10 *acres*	D 10 *acres*	E 10 *acres*	F 10 *acres*
1st . .	Lucerne	Lucerne	Lucerne	Winter beans	Winter oats	Peas and kale
2nd . .	Winter beans	Lucerne	Lucerne	Winter oats	Peas and kale	Lucerne
3rd . .	Winter oats	Lucerne	Lucerne	Peas and kale	Spring oats and seeds	Lucerne
4th . .	Peas and kale	Winter beans	Lucerne	Lucerne	Seeds	Lucerne
5th . .	Oats and seeds	Winter oats	Lucerne	Lucerne	Beans	Lucerne
6th . .	Seeds	Peas and kale	Winter beans	Lucerne	Lucerne	Lucerne
7th . .	Winter beans	Oats and seeds	Winter oats	Lucerne	Lucerne	Lucerne
8th . .	Lucerne	Seeds	Peas and kale	Lucerne	Lucerne	Beans
9th . .	Lucerne	Winter beans or winter oats	Oats and seeds	Lucerne	Lucerne	Oats
10th .	Lucerne	Lucerne	Seeds	Winter beans	Lucerne	Peas and kale
11th .	Lucerne	Lucerne	Winter beans	Oats	Lucerne	Oats and seeds
12th .	Lucerne	Lucerne	Lucerne	Peas and kale	Beans	Seeds

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Going through the rotation in detail: when the lucerne is due to be burst up I like to get it ploughed before starting harvest, and this ploughing should be at least 8 in. deep. I put the ground into beans in preference to wheat, because it will be too hollow, and after the lucerne there will be pests, which are more likely to take wheat than beans, though wherever possible poultry should be kept on this ploughing, in Worcestershire Arks, so that they can clean up the pests. I follow the beans with winter oats, these again with early peas. The peas will be drilled early in February, and after horse- and hand-hoeing, just before the peas fall over, drill kale in between. When the peas have been picked the haulm is harvested as winter fodder for the cows, the kale horse-hoed several times, and given 2 cwt. of mixed nitrates to the acre, to be followed by another 2 cwt. in August. These peas should pay for the haulm and the crop of kale. Spring oats follow, with seeds broadcast among them, unless the ground is due to come into lucerne, in which case the ground is worked as often as possible in order to get it perfectly clean. Lucerne can be drilled any time between the middle of May and the end of July. If the land, however, is perfectly clean, the lucerne can be broadcast in the spring oats, but in this case horse-hoeing the lucerne in its first year is out of the question. Should wet weather prevent cleaning, broadcast grass seeds and alsike clover with rape rather than plant dirty land.

As you, no doubt, are all aware, one of the secrets of successful lucerne-growing is keeping the lucerne absolutely clean in its first year, after that, with heavy harrowing several times in the spring and after cutting, the lucerne will look after itself.

I will now leave the lucerne for a time and tell you how to deal with the remainder of the farm.

SEVEN-YEAR ROTATION

20 acres of each Crop

First year	.	Winter beans
Second year	.	Winter wheat
Third year	.	Sprouts
Fourth year	.	Potatoes
Fifth year	.	Wheat, Yeoman II.
Sixth year	.	Winter oats, with seeds broadcast
Seventh year	.	Seeds or ensilage mixture

The 140 acres are worked on a seven-year rotation. Starting with seeds broken up deep, winter beans are drilled. The next year the bean stubble should be skimmed with a two-horse skim about four times. This is much cheaper than ploughing and working down the ploughing for a seed-bed, and also gives you an ideal seed-bed for wheat, for I am certain that wheat likes a little mould to cover the seed, with the undersoil quite firm.

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A piece of wheat similarly planted last winter showed up to great advantage compared with wheat following ploughing and duckfooting. This wheat, before the frost came, was anchored into a firm bottom and did not rise, whereas that on land which had been ploughed got very hollow indeed.

Wheat is followed by the most important crop by far on the farm —namely, sprouts. As soon as autumn drilling has been finished, if the ground is firm, muck should be applied up to a maximum of 40 loads to the acre, and then ploughed 10 in. deep, if possible. Early in the spring the ground is ploughed back again, but not so deep. As soon as the soil is sufficiently dry for the horses not to pad the ground a heavy six-horse scuffle is worked across it both ways, followed by the duckfeet. This scuffling is most important, as it helps to conserve the moisture throughout the summer.

The sprouts are planted on the square, a yard each way (when the weather is favourable), from early May until the end of June. Should it be impossible to plant 20 acres by the end of June, any land over should go into savoys. As soon as the plants have caught hold they should be hand-hoed, and the horse-hoe should practically live in the field. This last summer I must have horse-hoed and skimmed my sprouts over six times each way, and, in addition to cleaning the ground better than any fallow could do, all the moisture has been conserved. Picking goes on from September, but by early in January the picking of the first sprouts will be finished. Then comes the cows' turn. The stems which are left bare of all sprouts and leaves will put up the milk-yield of the cows, whatever they have been receiving. Why, I cannot tell you. But the fact remains that there is something in a sprout stem which you cannot get in roots, and which you cannot buy in bags. These stems follow on the kale, which has been growing on the other part of the farm, and any stems not fed to the cows by the first week in March start growing from the top and all down the stem, and if a few acres are left for this period of the year a large bulk of ideal food is available for the cows. In fact, you must be very careful not to leave too much to start growing or there will be more bulk available than you will care to draw off.

As the stems are drawn off to the cows, the empty ground is kept ploughed up deep. This goes into potatoes. Whereas it may be difficult to get it down in time fine enough for a spring corn crop, the potatoes can be planted in very rough ground, and the alternative wet and dry will bring the necessary mould. If there is not sufficient female labour about for picking up the potatoes in the autumn, the first 10 acres can be put into spring barley, although this must sound impossible to the barley-grower. My answer is that I have done so successfully for four years.

The potatoes are dug with Ransome's heavy plough (or digger),

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the ground then being duckfooted crossways, with women leasing behind, and then drilled with Yeoman II. wheat, harrowed, and again leased. Sufficient potatoes will be picked up to pay for the duck-footing and harrowing, so that you have your wheat planted for the cost of seed and drilling. This is the most important operation on the farm, and the weather must be watched very carefully, because it will go only when quite dry. Should the autumn be wet, and the seed-bed be impossible to obtain, it will have to be ploughed and drilled with Little Joss wheat in late January. I insist on Yeoman II. wheat, as this is the only wheat which will stand up after the previous crops. I have not threshed, but the last two years from Yeoman II. wheat I have had 60 bushels to the acre. In addition, on this ideal seed-bed it stools out so well that no weeds can grow.

These three crops—sprouts, potatoes and Yeoman II. wheat—will clean the dirtiest land imaginable; and, gentlemen, when I started on my present farm I should think it was the dirtiest in the county, but with this rotation I am gradually cleaning it without bare fallow.

Yeoman II. wheat is followed by winter oats, in which seeds are broadcast in April. The reason for having two white-straw crops following is that the Yeoman II. wheat will be so dense that no seeds can grow in it. Should the seeds fail, the land must be ploughed after harvest for an ensilage mixture; but, although ensilage mixture brings in more bulk than seeds, I would always rather have the seeds, because 20 acres of ensilage mixture will mean one team of horses occupied for over a month in September–October—which is the rush time on a heavy clay farm.

For white-straw crops to do any good, they must be drilled by the end of October, and the beans by Guy Fawkes' Day.

You will notice I have, as far as possible, eliminated all spring corn crops, for whereas winter corn drilled early is almost certain to do well, spring corn is always a gamble.

Most years there will be 30 acres of beans on the farm. It would be a very profitable proposition to select the 10 acres which had come through the winter worst, and, after hoeing, drill one to two bushels per acre of Grey Jack peas between the rows. This will give a very bulky crop, leaving some good pea and bean straw for the store cattle.

I expect you are all wondering why I have the audacity to read a paper on this subject without mentioning roots, but I think the word "cheaper" in the heading of the paper cuts them right out.

My first three years I grew roots, but have now cut them out, for the following reasons: (1) I never succeeded in growing the type of crop one sees illustrated in the seedsmen's catalogues; (2) they require considerable hand-work in May and early June, when every man available is required for sprout-planting in wet weather, and for hand-hoeing soft fruit when dry.

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Then, at the other end, roots are a nuisance on our heavy clay. They are not ready to lift until the middle of October, when there is a risk of frost on that part of the root exposed above the ground. Then, should the weather be wet, untold damage would be done to your ground in drawing them off. Three horses on a cart, pulling their guts out, with wheels cutting right in, is not only very expensive, but the ill effects on the ground would be seen in the succeeding crops for at least two or three years. In addition, if the roots are in burrows, wet and smothered with clay, the expense of cleaning them is out of proportion to their value. Whereas there is something essential in greenstuff, or even its stem, grown above the ground, which I cannot explain, not being a scientist, there is nothing in a root which cannot be obtained from some other source, and I think that one of the reasons why roots at times appear so successful is the fact that the cow, tied up for a long time without access to water, benefits from the water in the mangold rather than the solids, and it is the water which puts up a cow's record on the weighing-sheet.

You will see that to a certain extent I have provided a substitute for the mangolds at an infinitesimal cost.

Peas in an average year should pay for the cultivation of the kale, and the sprout stems and seconds and old leaves of savoys—which to the market-gardener are a liability in that he has to get rid of them before he can work his land—could be food to the dairy cows at the cost of cutting and carting.

One word of warning: I hope you will not go home thinking you are going to make your fortunes sprout-growing. There is such an under-consumption of green vegetables in the country at the moment that sufficient are grown at present. They are a costly crop to grow, and cost in an ordinary year £20 an acre, and in a year like this, when money has had to be spent on spraying, £25. So, before you start, you must organize an "Eat More Sprouts" campaign.

To summarize the total product for one year off the arable you have roughly:

Lucerne hay (cut twice)	30	acres
Seeds ,, (cut once or twice)	20–30	,,
Bean and pea straw	20–30	,,
Oat straw	20–30	,,
Pea haulm	10	,,
Wheat straw	20	,,
Kale	10	,,
Sprout stems and savoys	20	,,
Beans	off 20–30	,,
Oats	,, 20–30	,,
Wheat	,, 40	,,

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The wheat not required for poultry can usually be exchanged for bran, to advantage, with the local miller, and if I could dispose of the oats profitably to the local hunt I should not hesitate to do so, buying maize germ meal or dried grains with the money.

GROWING OF FODDER ROOTS IN DENMARK

By HARALD FABER
Agricultural Commissioner to the Danish Government

Danish farmers were late in learning to grow roots. They saw root-growing in England and Scotland, where several progressive Danish farmers in the sixties and seventies of last century went to study practical agriculture. The growing of sugar-beets was introduced into Denmark from Germany in the late seventies. By the year 1881, roots for feeding occupied only 45,000 acres, being two-thirds of 1 per cent. of the arable land, while Great Britain devoted 13 per cent. of her arable land to all root-crops. Danish farmers at that time had no faith in the feeding value of roots, such as mangolds and turnips, as they considered them worth little more than water. A series of very practical feeding experiments by the late N. J. Fjord, carried out on large farms in various parts of the country, showed that 1 lb. of dry matter in roots has the same feeding value as 1 lb. of corn when fed to pigs or to cows in milk. With the usual yields of roots and barley this meant that on 1 acre of land you can produce two and a half times as much foodstuffs by growing swedes or mangels as by growing barley. That opened the eyes of the farmers to the value of roots, and before the War the acreage of roots for feeding had increased to 630,000 acres. In thirty years the acreage had been multiplied by 14.

The roots were grown from seeds sold by merchants under a variety of names, either imported or grown in Denmark, and with little or no guarantee as to yield or purity, until a society was formed for improving cultivated plants. This society aimed at growing roots from selected stock seed, and tried to do away with the many trade names for really identical kinds of roots, thereby helping farmers in their selection when buying seed. At the same time, the analysis of seed for purity and germination at the (at first private) seed-testing station, which was opened in 1871, was becoming more general.

From about 1890 a most important series of field trials was begun for the purpose of improving the growing of roots so as to obtain the largest possible yield of foodstuffs per acre. The different kinds

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of roots have different contents of dry matter—roughly 12 per cent. in mangolds and swedes and 9 per cent. in turnips. The feeding experiments had shown that 1 lb. of dry matter in roots has the same feeding value as 1 lb. of corn. But it was soon found that within each kind of root there are many different strains with distinct characters, such as contents of dry matter, tendency to run to seed, and so on. And it was found that these characters are hereditary. The object of the trials was therefore *to find such strains as gave the greatest yield of foodstuff per acre.* Some strains would give a large yield of roots per acre, but if the roots contained a low percentage of dry matter, and consequently a large percentage of water, the total amount of foodstuff per acre might be low, which means that there would be cartloads of water to be carried from the fields, which water could be had just as well and cheaper from the well on the farm. As the roots are grown to feed cattle it is evidently to the advantage of the farmer to grow such strains as yield the greatest amount of foodstuff per acre. It was, therefore, the aim of the field trials to find such strains, and this work is being carried on to the present day.

At the same time it is important, by better cultivation, more manure, and so on, to increase the yield of roots, always provided that the yield of foodstuffs is increased in at least the same proportion. It can be proved from agricultural statistics that Denmark was considerably behind England and Scotland forty years ago with regard to the yield of roots, but that now she is a good deal ahead.

Taking all kinds of roots together, including potatoes, we find the following yields:

TABLE I

YIELDS PER ACRE OF ROOTS IN (METRIC)[1] TONS AND OF DRY MATTER IN CWT.

	Roots in (Metric) Tons per Acre			*Dry Matter in Cwt. per Acre*		
	England and Wales	*Scotland*	*Denmark*	*England and Wales*	*Scotland*	*Denmark*
1889-1893 . .	12·9	13·4	10·1	30·4	32·5	27·3
1899-1903 . .	12·5	12·9	12·6	29·7	30·5	32·9
1909-1913 . .	13·4	14·7	15·9	32·2	35·4	41·3
1923-1927 . .	12·2	14·1	17·4	31·9	34·7	40·0

[1] A metric ton is 1½ per cent. smaller than an English ton.

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A detailed description of the trials carried out at the Government Experimental Stations would take too much time here. It will be enough to mention that growers of seed were invited to submit samples of their stock, to be grown for some years in succession in competition. The final report would show which strains had yielded the greatest amount of foodstuff per acre, and the growers of such strains were rewarded for their efforts in improving them by the higher prices they would obtain for their seed.

The first series of trials aimed at comparing samples of trade seed. From these trials it resulted that a few good strains of each kind of root held the field and all others were neglected. That has the great advantage that the efforts to improve the strains are thereby concentrated on these few strains. Of mangolds some strains are descended from a sort which was introduced by the firm of Vilmorin, Andrieux & Co., Paris, in 1853, and brought to Denmark a few years later. It was known as Yellow Egg-shaped des Barres, and was extensively grown in Denmark under the name of Barres. In 1880 samples of Oval-shaped Yellow or Yellow Intermediate were bought from the firm of Peter Lawson & Son, Edinburgh. It is very similar to the Barres of Vilmorin. Strains of these two kinds, both known in Denmark as Barres, have competed severely for years, but lately the strains of Barres descended from the samples from Peter Lawson are ousting all other kinds of mangolds from the Danish fields. In 1884, 21 per cent. of all mangolds grown were of these two kinds; by the year 1915 over 88 per cent. of all mangolds grown in Denmark were of various strains of Barres, and now the preponderance of Barres is probably still greater. Many of these strains have been developed by selection from roots grown by the leading seed merchants on their own fields.

From 1920 a new series (the sixth) began, for the purpose of serving more particularly the interests of seed merchants by comparing samples of stock seed, in order to show seed merchants where they can buy the best stock seed for cultivation through their seed-growers or on their own farms. This series was carried out by cultivations for four years. Twenty strains of Barres and twenty strains of swedes were compared. Each competing owner of stock seed must have a stock of at least 110 lb. of a Barres strain or 65 lb. of a strain of swedes. A sample of 33 lb. of Barres seed or 12 lb. of swedes seed had to be given free to be tested. While all the mangels were of Barres strains, six of the best strains of swedes were of Bangholm strains. The Bangholm strains are descended from seed which in the seventies was bought under that name from the firm of Peter Lawson & Son, Edinburgh. During the first two years all forty samples were grown on five experimental stations. At the end of the second year a report was drawn up classifying the samples according to yield of foodstuff per acre. Those samples

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which came in the lower half were then discarded. For each sample in the upper half—that is, nine samples of Barres and ten samples of swedes—two new samples were called for from the owners of the strains—viz. one sample of trade seed cultivated from the stock seed already examined, and one sample of the new generation of stock seed—and these samples were then grown for two more years and classified. In this way it was possible to point out the best stock seed of the latest generation—that is, of those samples which came in Class I.—and trade seed from former generations of the same strains were considered superannuated and no longer reliable.

It is, of course, a necessary condition for this work that the Government Committee which carries out the trials is able to control the trade in seed, and that each generation of stock seed and the trade seed grown therefrom are described in a way to give buyers a guarantee that they get what they want. For that purpose the generations of seed of Class I. are distinguished by a Roman figure. Stock seed of Class I. from the trial begun in 1920 was available in 1924, while trade seed of Class I. grown from that stock seed was available in 1926. Both are distinguished by the Roman figure VI., indicating that they have been found of Class I. in the sixth series of field trials.

The control so far as concerned stock seed was carried out in the following way in the previous (the fifth) series, when stock seed was examined for the first time. The samples of stock seed to be grown in the trial were drawn during the winter by the leader of the trials from the whole stock on hand, and then all the bags containing the whole stock were sealed with the seal of the committee. When the report was published showing which samples came in Class I. there was a rush from seed merchants to buy. The leader of the trials then opened the sealed bags of stock seed, saw the parcels to be sold packed in bags, and sealed these, so that the buyers received their purchases under official seal and thereby had a guarantee that they got what they wanted. For stock seed sold under this arrangement as much as £2 and £3 was paid per lb. of seed for respectively mangels and swedes.

But the chief control, both of stock seed and trade seed, has been gradually developed by co-operation between wholesale seed merchants, Farmers' Co-operative Seed Supply, and the Government Root Seed Commissioner. It began by the Commissioner growing samples of seed which were sold as of a special strain, in order to see if the resulting roots corresponded to roots grown from seed known to be of that strain. To invoice seed under the name of a special strain if it is not of that strain is an offence under the Law on Trade Description. As a result of this control several irregularities were discovered. One merchant had, for instance, to pay a compensation of £350 for having sent out inferior seed of turnips.

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In most countries seed merchants print on their invoice that: "We give no warranty as to description, quality or productiveness of any seed we send out, and we will not be in any way responsible for the crop." Differently in Denmark, where the Society of Danish Seed Merchants in 1912 adopted the "Guarantee of Genuineness" in the trade in root seed, guaranteeing that it was of the strain indicated and offering full compensation to the buyer for smaller yield resulting if it should be found that seed of another and inferior strain had been sold. This applies to mangolds, swedes, turnips and carrots. Samples of consignments sold were sown in control fields by the Commissioner, so that he in the autumn could decide whether the seed was what it professed to be, while a comparison was also possible with crops grown by other buyers (farmers) from the same stock seed. Inferiority in a crop due to faulty cultivation or to disease could thereby be proved, and no compensation would be due in such cases, but if seed of an inferior strain had been sold full compensation was paid to the farmer. In 1913 the Commissioner Helweg could write: "We have come to this state, that no seed merchant dares sell bad root seed in Denmark." This guarantee has also been extended to seed sold for export to other countries.

With such a development of the growing of roots it is evident that farmers profit by having a full guarantee of the quality of the seed they sow and by reaping the greatest possible yield of foodstuff per acre. The result thereof has been a rapidly increasing acreage of roots and yields of roots. The yield in metric tons per acre in Denmark was:

TABLE II

	Mangolds	*Turnips*	*Swedes*
1889-1893	1,003,266	901,032	169,074
1899-1903	2,092,360	2,038,410	1,271,490
1909-1913	4,414,600	2,738,500	4,554,600
1923-1927	5,698,658	2,467,357	10,425,874

It will be noticed that turnips have been grown lately to a somewhat smaller extent, because of the lower yield of foodstuff, and that the higher yielding swedes are grown to such an extent that the total crops of swedes in little Denmark in 1923-1927 was heavier than the total crop of turnips and swedes together in England and Wales. The total area devoted to fodder roots in Denmark is now about 900,000 acres, or 13½ per cent. of the arable land.

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WINTER FEEDING OF A DAIRY HERD ON A LIGHT-LAND ESSEX FARM

By W. O. WATT
Orsett, Essex

The farm is situated in the south of the county, on light land with gravel subsoil, and the annual rainfall is 22 inches, of which but a small proportion falls during the growing season. There is a good local market, and London is twenty miles distant by an excellent road.

The farm extends to 288 acres, of which 138 are under grass and 150 under the plough. Of the latter, 30 are in lucerne and the remaining portion of 120 acres is cropped according to the rotation to be described.

One hundred cattle are kept, consisting of forty milk cows with followers. Labour consists of three cowmen, two horsemen, and one tractor driver. Four horses are kept.

Rotation and Cropping

1. *Early Potatoes.*—Variety, "Epicure." Seed is planted at the rate of about 15 cwt. per acre by machine. All potatoes are sprouted in boxes previous to planting. From 3 to 4 tons of Scotch seed are purchased each year and the bulk of the crop is planted from once-grown seed.

Cultivation.—The land is ploughed after harvest, and later cross-ploughed and subsoiled.

Manuring.—10 to 12 tons of farmyard manure is applied in the autumn and 10 cwt. per acre of artificial manure, made up by Messrs Cole & Lequire, of Grays, Essex, to our prescription, which is as follows:—

4½	parts	sulphate of ammonia
10	,,	35 per cent. superphosphate
2½	,,	steamed bone flour
3	,,	sulphate of potash

The cost of this manure, delivered in the autumn of 1928 or the spring of 1929, was £6, 18s. per ton on the farm.

2. *Wheat.*—After the potatoes have been lifted, mustard is sown, and is ploughed in as a green manure in the autumn, the cost of the seed being 10s. per acre. Victor wheat is sown at the rate of 2½ bushels per acre, and the only manure applied is 1 cwt. sulphate of ammonia in February or early March.

3. *Winter Oats.*—Either Grey Winter or Marvellous White Winter is sown in the autumn, at the rate of 2½ bushels per acre

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in the case of Grey Winter, and 4 bushels per acre in the case of White Winter.

Manuring.—4 to 5 cwt. per acre of corn manure, made up to our prescription, is applied in the autumn. This manure consists of:

12 parts 30 per cent. superphosphate
4 ,, steamed bone flour
2 ,, muriate of potash
2 ,, sulphate of ammonia

The cost of this manure, delivered on the farm in the autumn of 1928, was £5, 5s. 6d. per ton. In addition, 1 cwt. per acre of sulphate of ammonia is applied in February or early March.

4. *Barley*.—Plumage Archer 1924 is sown in the autumn, at the rate of 3 bushels per acre; manuring same as in the case of winter oats.

5. *Seeds*.—A seeds mixture, consisting of 16 lb. perennial rye-grass and 8 lb. late-flowering red clover, is sown in the spring, with barley as the nurse crop.

Manuring.—6 cwt. of North African mineral phosphate and 1 cwt. of muriate of potash per acre are applied as soon as possible after the nurse crop has been harvested. The seeds are cut for hay in early June, and a second cut is sometimes taken.

6. *Barley*.—Plumage Archer 1924, autumn-sown. Manure *nil*.

7. *Oat and Tare Mixture*.—Consisting of Grey Winter oats (2 bushels), winter vetches (1 bushel), wheat (½ bushel). Manure *nil*. This is a cleaning crop, and one cut of hay is taken and then a bastard fallow by tractor during July.

The rotation may be varied to suit certain fields, judged by the quality of the land.

It will be observed that five out of the seven crops are selling crops, except for such portions as may be retained for horse and poultry food and for seed. The average yield of cereals has been: wheat, 6 qrs., oats, 7, barley, 6; and even with low prices these have shown a profit.

It is found to be sound economy to *sell* the cereals and buy concentrates, and it is therefore attempted to produce only the maintenance ration. This is adequately supplied by the lucerne hay, the clover mixture, and the vetch mixture. No meadows are cut for hay. Considering the nature of the soil, relatively high production is maintained and artificials are liberally used.

Under this scheme, which has been in operation for eight years, the land appears to improve in fertility, weeds are kept in subjection, and labour is reduced to a minimum. No roots are grown, as I do not consider them a sound proposition.

Lucerne.—Lucerne leys are occasionally laid down, and there is at present 30 acres under lucerne on the farm. Three cuts are

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taken in the year. Lucerne is sown with barley as a nurse crop and 2 tons per acre of carbonate of lime applied previous to sowing. A dressing of potassic superphosphate is applied after the nurse crop is harvested.

Grassland

Manuring.—6 to 8 cwt. per acre potassic North African mineral phosphate, containing 45 per cent. total phosphates and 6 per cent. potash, is applied in the autumn every three years, part of the grassland being done each year. This manure cost £3, 15s. 9d. per ton delivered on the farm. All the grassland is harrowed with Parmiter harrows in early spring. An experiment is being tried in treating a portion of one of the fields with sulphate of ammonia this year.

Milk Cows

Winter-ration cows receive maintenance ration of approximately 20 lb. hay, consisting of lucerne, clover mixture, or oat and tare mixture.

A production ratio consists of—

1 part	by weight	soya-bean cake
2 parts	,,	maize germ meal
1 part	,,	maize gluten food
1 part	,,	coconut cake

—mixed together and fed 3¼ lb. per gallon of milk. This ration is being delivered this year at £10 per ton spot cash.

Dry cows got 20 lb. hay and an average of 6 lb. daily of the above ration. The average yield in 1925–1926 was 800 gallons. The cows are recorded, and culled if not up to a fair average and sold to the butcher.

Calves

These receive whole milk for six to eight weeks, and afterwards receive hay *ad. lib.* and water, and 2 lb. daily of one part linseed cake and two parts crushed oats, increasing the ration as the calves get older.

Poultry

An up-to-date hen-house is provided, housing 200 hens. This is divided into four compartments, each 11 × 12 ft., the total length of the house being 48 ft. The house cost £100 to erect.

Water

Water is laid on to the farm in the cowsheds and poultry-houses. The cost of the water is 1s. 3d. per 1000 gallons, or 3½d. per ton.

Points worth noting are:

(1) The high mineral and protein content of the home-produced ration.

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(2) The simplicity of feeding, permitting of reduction and organization of labour.

(3) The good effect of these crops on the rotation as a whole in maintaining soil fertility, while obtaining maximum use of atmospheric nitrogen.

Under these conditions the herd has been maintained in a sound and healthy condition, and breeding has been successfully carried on with little trouble from abortion and Johne's diseases.

The herd average in 1927–1928 was 8098 lb. for all cows.

To summarize:

(1) The question of production of cheap food can be adequately considered only in relation to the economy of the farm *as a whole*.

(2) It is possible, and in my case profitable, to maintain a herd in good health and production without roots.

(3) Crops for maintenance should be *high in minerals and protein*, should cost little to produce and handle, and should benefit the cropping rotation. I place lucerne hay first, clover mixture second, and oat and tare hay third in respect of feeding quality.

(4) It is false economy to feed home produce when such may be sold and equivalent food value bought with a profit on the deal.

(5) The organization of the details of labour and machinery, with a view to obtaining efficiency and reducing labour costs, is an important aspect of the production of cheap foods.

THE GROWTH OF CHEAPER WINTER FOOD FOR LIVE STOCK

By J. R. KEEBLE
Manningtree, Essex

Before commencing it may be as well to give you a few facts about the holding upon which the matter for my paper has been based. We farm 1000 acres of mixed and light land, two-thirds of which are under the plough. The farm is situated by a tidal river—the Stour. There is a railway siding on the farm and a dock on the river.

We grow 150 acres of sugar-beet as our pivotal crop, about 100 acres of barley, and 30 to 40 acres wheat.

We breed and fat out about 500 hogs a year, mostly baconers, from Large Black sows by a Large White boar. There is a pedigree

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herd of Friesian cattle (tuberculin-tested) from which all the heifer calves are reared ; the bull calves mostly go to the butcher as early as possible.

There is also a ram-breeding flock of Suffolk sheep, and all the produce that is not sold for breeding goes to the butcher.

A considerable acreage of fruit is planted, mostly apples, plums and black currants. Shire horses used to be a considerable feature, but as the price is less than pre-War this branch has been given up.

Hunter-breeding as a side-line is not very profitable, but gives a good deal of pleasure.

First of all I might say do not farm sour land, as it is labour in vain to try to grow crops on land that is markedly deficient in lime. On our holdings we have chalked all the arable land, with from 10 to 20 tons an acre. This is well-spent money, even if the land does not belong to the occupier, as should he have to leave for any reason there is compensation for eight years ; and in our experience most of the money comes back in two years.

We have seen very little result from a ton per acre of lime on light or mixed soil, but a good dressing of chalk will not be worn out in thirty years.

Sugar-beet has been a great help, and of this we grow about 150 acres annually. During the drought this summer we went over the fields and collected the " bolters " and threw them about on the grass for the cattle, who duly appreciated them. As soon as the beets are cleared, the tops become a valuable food for stock.

Some fields are folded off with sheep, who do well on them ; others are carted off for cattle and used green until after Christmas, and the rest are carted into silage heaps, or pits, to be used when the fresh tops are finished.

Care must be taken when starting to use the tops to let them get well wilted, and go on to them gradually, or mischief will be done.

As a considerable slice of the crown of the beet is cut off with the leaves, and the crowns contain a good percentage of sugar, they are a valuable feed for cattle and sheep, and even horses and pigs.

Where sugar-beet tops are most valued for feeding stock it is advisable on light or mixed soils to select a strong-growing variety, such as " Dippe " or " Schreiber."

Though the sugar percentage may be sacrificed to some extent it is probably compensated for by the extra weight of roots, and the weight of tops is very much heavier.

With some of the high-sugar-percentage beet, such as Kuhn, the tops amount to very little in a dry season, on light land.

This winter, being short of hay, the working horses are on a

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restricted allowance, this being supplemented with sugar-beet tops, and up to the present the results are satisfactory.

We winter a good many cattle out on the grass, with the addition of sugar-beet tops and, later on, silage.

To make sugar-beet silage we cart the tops into a heap, driving the carts over them just like a manure heap. When the heap is sufficiently large the ends are made up, and the whole is earthed-up like a beet-clamp.

Wet Pulp can sometimes be obtained from the factory at a very reasonable price, and when it can be had quite fresh it is valuable to mix in the silage, but when it has to come by train and gets hot in the truck, as it does after a day or two, we find it of very little use.

Concrete Silage Pits.—We have been warned against using concrete silage pits, but as there seems no particular reason against them, as long as the drainage is well catered for, we have ventured to make a large one, as an experiment. The floor is not concreted, but consists of gravel and sand, which will be covered with brushwood and poles, well sloped to a drainage outlet.

When silage was previously made, in a pit, we did not find so much waste on the outsides as in a heap on the level.

Freedom from Dirt.—We are particular to keep the beet tops as free from dirt as possible, and have them heaped up before the roots are carted, in order not to drive over them.

The dried pulp can be had from the factories by growers at a reasonable price, and if soaked is a good stock food.

Some authorities recommend this pulp for pigs, but we have not had much success in feeding it to them.

Lucerne.—I do not think we make half enough use of lucerne. The Danes grow it in large quantities, and it is to a great extent the basis of their success. In America the dried lucerne is ground up in mills made for the purpose. Mixed with molasses it is fed to stock, who thrive rapidly on it.

We are getting more and more to depend on lucerne for our hay crop, which cuts a big bulk and is carted with hay sweeps at a comparatively small cost. This year our lucerne yielded four cuts, which is a great help in dry weather. Ten acres that were sown down this spring had the seed dressed with cultures supplied by Rothamsted, and we never had a more promising-looking piece, though it was sown in the barley crop with 1 lb. per acre of wild white clover for cleaning purposes.

Green Peas.—We pick several acres of green peas each year, and the rice or green straw is collected and dried, and this, with the few thin pods that are left on it, makes valuable food for the cattle and sheep, for the winter.

As soon as the pea straw is collected the land is cleaned, and manured, and planted with some green crop for the winter.

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Early Potatoes.—About 20 acres of early potatoes are grown, and though the price is usually too low to yield much profit another green crop is planted for winter or spring use.

In Scotland I believe rye-grass follows early potatoes and yields a good crop.

Rye.—We always plant a certain amount of rye for the sheep to come on to after lambing, and this year we have sown an extra field; drilling the rows about twenty inches apart, we then ran the seed-barrow over it with a mixture of rape, trefolium and rye-grass, and it looks quite promising. We should have liked to put some nitrate of soda on, but were afraid the shepherd would say it made the lambs scour.

Rape.—The last few years, after taking a hay crop off the mixed seeds or trefolium, we have at once broken up the stubble, and sown it down with rape for the sheep in the spring; this seems to answer very well, as we get a crop of sugar-beet after the rape is fed off.

Later on in the season the sheep come on to tares, and then rape and thousand-head kale.

Any crop that does not require hoeing is grown for forage, as we work all the sugar-beet with our own staff, and we cannot spare men to hoe other crops.

We think that it cannot pay to spend £10 per acre on root-crops to be fed off by sheep to grow low-priced corn the next season.

Ensilage.—Well, we have had a shot at most things, and of course had a stave silo, in pre-War days, when they came into fashion. It did very well with a mixed crop of tares and oats, though the last crop we put in was sunflowers, which also did very well; but since sugar-beet came in we have not used it, and last winter it blew down in a heavy gale, and will never be re-erected if the beet crop has come to stay.

Mr Boutflour.—Since Mr Boutflour came round lecturing we have not used a chaff-cutter, except a hand one in the riding stable to cut a little hay for the hunters. Previously we had mixed green lucerne and straw in alternate layers and cut the mixture into chaff after it got cool, but have not done so lately.

Dutchmen and Potato Silage.—This spring there was a big surplus of potatoes, and though many Englishmen let theirs rot, our more thrifty Dutch neighbours made theirs into ensilage, by first putting a layer of green grass and then a layer of potatoes. I have not heard how the mixture turned out, but it was cheap food, and I should think all right.

Spartina-grass.—We are now harvesting (end of October) a very heavy crop of Spartina-grass. In this case it is mainly the seed we are after, as there seems to be a world-wide demand for it. Spartina, as we know, grows on the mud-flats of estuaries, and soon raises their level several inches. We planted some of this in 1919, and it has

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now spread over several acres. Our idea was to protect the sea-walls. However, from experiments carried on at Chelmsford, it has proved to be a valuable forage crop. We first heard of it from Professor Oliver, and he has been very kind in advising us ever since.

There is quite a percentage of iodine in it, and over 60 per cent. is digestible.

All stock eat it readily, and dry weather does not affect it, as it is submerged every twelve hours. We are hoping in future dry seasons to find it very useful.

Subterranean Clover.—I believe experiments have been made in England with this variety, with no very great results. However, a friend who has lately been to Australia brought over a bushel of seed, and though too late to sow in the fields he had a very promising crop in his garden.

Artificial Manuring.—We usually put on half-a-ton of artificial manure, including top-dressing, for sugar-beet, as well as a coat of farmyard. Most of the lucernes and grasses get an occasional dose of potash and phosphates in the autumn, and the corn gets sulphate of ammonia in the spring, and nothing pays better.

The only crop we do not dose is 10 acres of white turnips grown for the ewes at lambing time: here we always give way to the prejudices of the shepherd and let Nature have her own way, but I am bound to say she generally treats us well.

Damage by Kainit.—I fancy we have done harm sometimes to the sugar-beet crop by putting on kainit too late in the spring, so now we put muriate of potash instead.

Conclusion

To grow cheap forage the latest type of labour-saving machinery must be employed, including a powerful tractor capable of ploughing an acre an hour. We have not worked out the cost accurately, but believe it to be very much less than ploughing by horses, besides getting the work done quickly when time is important. The men employed must be capable of and willing to do piece-work, and an employer must not be afraid to let them earn money if they do the work.

Our men are on piece-work most of the year.

It is no use doing a thing because it always has been done, and full advantage must be taken of the latest scientific discoveries, though it is always well to be cautious in accepting new ideas.

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THE GROWTH OF WINTER FOOD FOR CATTLE

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In presenting this paper I want it to be understood that I can lay no claim to scientific knowledge, and can only try to describe processes that are in fairly general practical operation in a particular county—namely, Shropshire. All the methods I describe will not be applicable to the different climatic conditions that may prevail in other parts of the country, or be suitable to soils of a different character from those with which I am familiar. They achieve, however, their aim in our district, so far as the point of the marketing of our products, and there I confess we are generally beaten by conditions over which we have no control.

Great changes have taken place in our live-stock feeding, and these alterations have entailed consequent modifications in the production of the bulky feeds required for consumption on the farm.

Ten years ago, for instance, I could not have taken anyone to a single feeding farm in the county that had a complete water supply laid on to its feeding cattle. We relied upon the moisture the cattle obtained from the roots to keep them going. This entailed the liberal use, and consequently growth, of great quantities of roots, if a reasonable number of fat cattle were to be marketed from the holding.

Now most of the more up-to-date feeding farms are equipped with an adequate water supply to every animal. As a consequence, more hay and other dry feeds are consumed, also fewer roots; resulting in a substantial reduction in the amount of labour required during the winter months for carting and handling those roots.

An even greater change is now only in process of evolution, due to the establishment three years ago of a sugar-beet factory in the centre of our county. We are, in fact, only now accustoming ourselves to these changes, but the use of pulp from the factory has already become so general that no paper upon "The Growth of Winter Food for Cattle" would be complete without including more than a passing reference to the cultivation of the sugar-beet crop.

Owing to the passing of town horse-traction there is practically no market for hay sold off the farm these days. Having adequate water supplies laid on directly to the cattle, much more hay can be, and is, economically consumed in our farm-buildings in the production of beef.

Therefore, ample supplies of well-harvested hay are a necessity of our present winter-feeding methods.

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In the production of any of our root-crops I should place in the forefront the need for clean fallow land to work upon.

To obtain this, vigorous and effective autumn cultivation, carried out at the right time, is essential. Spring cultivation will rarely rid a field of squitch, unless the weather conditions be exceptional.

My own invariable practice is, as soon as each cornfield that is not sown with new seeds is cleared, to send a tractor with a well-weighted, rigid-tined cultivator into the field to thoroughly break it up. This, in my opinion, is the tractor's best and most effective job on the farm. After harvest my tractors are at work practically all the hours of daylight—at other times they are rarely on the land.

Autumn cultivation properly carried out will not only clean a field but keep it clean.

Having clean fallow land to operate upon, we proceed to apply such reserves of farmyard manure as we may have on hand in our fold yards from the previous winter's feeding season, ploughing it in to a depth of 5 or 6 in. only. During the last few years we have found it desirable to apply this well-rotted farmyard manure to the land intended for beet, for all authorities appear to agree that newly made strawy farmyard manure, particularly if it is not applied early, is likely to produce fangy beet, of unsatisfactory weight and with a low sugar-content.

The land that has had the autumn application of farmyard manure is ploughed a second time, at our convenience, during the winter, to such a depth as the character of the land will stand without disturbing undesirable subsoil—9 in. is about the limit that any of my own land can be safely ploughed; much of it will not stand this depth; but 10 in. is ploughed with advantage in some parts of the county. It will be noted that by the above methods the farmyard manure is left, by the two ploughings, sandwich fashion, some 3 in. or so below the surface.

To the remaining fallow land new season's farmyard is applied —with us this becomes available from the beginning of December onwards. When applied with only one ploughing we do not in any event exceed an 8 in. ploughing, believing that for any roots except beet, carrots or parsnips there is a definite limit to the depth from which the other root-crops draw their food. Also, there always seems a tendency for farmyard manure, or humus of any kind, to go downwards into the land, not come up, and the same tendency applies to an even greater degree in the case of lime.

If the cultivation of the beet crop has taught us anything it is that the majority of our soils have for many years been deficient in lime. Whatever else the beet-plant can be stinted of, it must not be kept short of lime, or failure is certain to follow. Therefore, between the completion of our deep ploughing and the final preparation of the seed-bed prior to sowing, we, as opportunity offers,

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and with suitable weather conditions prevailing, make our applications of lime, generally of ground lime or ground limestone. I have myself mainly switched on to the latter, for ground quicklime is, as everyone knows, most villainous stuff to handle, and can be applied only on calm days.

Having by the before-mentioned methods obtained clean fallow land, farmyard-manured, well ploughed and limed, it is, given a normal season, a fairly easy and expeditious process to put in the root-crop. I grow a fair acreage of potatoes, but as potatoes are not ordinarily recognized as a cattle food, except in seasons such as this and the past one, I propose passing on to the planting of the mangold crop.

For the necessary breaking up of the furrows for the planting of the root-crop I make as little use as possible of the tractor. Frankly, I do not like the tractor in the spring on loose land at all, believing that unless the land be exceptionally dry underneath one can easily get a solidification or compression below the surface that is decidedly injurious to plant life. I have had convincing proof of this only this last season. Therefore unless we are hard pushed, or the land is in exceptional condition, we rely upon our horses for this work.

The mangold crop we sow on a 22-in. drill, though, owing to the uncertain germination of the plant in recent years, I contemplate trying part of my acreage on the flat. Before seeding for the mangold crop we usually apply $1\frac{1}{4}$ cwt. of sulphate of ammonia, 3 or 4 cwt. of kainit (or $1\frac{1}{4}$ cwt. of muriate of potash), 4 cwt. of 30 per cent. superphosphate and 2 cwt. of 60 per cent. bone meal, following this with a top-dressing of 1 cwt. of nitrate of soda with a little kainit (to help distribution) after singling. If the mangold plant be exceptionally regular, or the field in less than average condition, we apply a second top-dressing of a similar kind just before finally leaving the crop for nature to do the rest of the work.

The beet crop has much the same spring treatment as our mangolds, beyond that we do not exceed 20-in. drills and also put the greater portion of the crop in on the flat, as it undoubtedly has a quicker germination than mangolds, and consequently gets out of the way of annual weeds better.

My artificial-manure application for beet is the same as for mangolds, beyond that we apply only 1 cwt. nitrate of soda as a top-dressing in any event, having become satisfied through the experience of previous seasons that any greater application of nitrogenous manure is calculated to force excessive top and lower the sugar-content of the root itself.

Mangolds—seasonal conditions permitting—we like to get in during the second and third weeks in April, though it is often later.

Beet we aim at getting in during the third or fourth week in April. When first we set out to grow beet we were informed that

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full and satisfactory crops might be anticipated if sown well on into June. Our experience entirely contradicts this, and each season so far the beet sown in April or very early in May has been a heavier crop, with a higher sugar-content, than later sowings.

Swedes I never sow before the 20th of May, on account of mildew. Even this date has been too early this dry season. Finger-and-toe we are not troubled with. About twenty-five years ago I took over a farm upon which a sound swede or turnip crop could not be grown because of the disease. By the simple method of adjusting the rotation so that the crop did not fall to be grown on the same land oftener than once in eight years we got rid of the trouble entirely. Now that I have altered all my arable land to a six-year course, instead of four, the swede and turnip crops do not fall to be grown on the same land oftener than once in twelve years, and finger-and-toe is never seen.

For swedes and turnips we, of course, apply a lighter dressing of artificial manures than for any of the other root-crops, my experience being that there is a definite limit to the amount of purchased plant-food that the swede crop will profitably utilize. We therefore apply only ¾ cwt. of sulphate of ammonia, 2 cwt. of kainit (or ¾ cwt. muriate of potash), with 4 cwt. of 30 per cent. superphosphate and 1 cwt. of steamed bone meal to prevent caking in the bags, top-dressing with 1 cwt. nitrate of soda after singling.

The mangold crop we single with a 7-in. hoe, beet with a 6-in. and swedes with an 8-in., all singling, as with every other possible job, being done by piece-work. Horse-hoeing of course is continuously carried on, weather and harvest operations permitting, from the time the various roots are big enough to stand it until the little white roots begin to appear across the drills, when it seems time to desist.

Our final operation to the beet crop is to draw enough soil up to the plants to cover the crown. This seems to be well worth doing, as, in my opinion, it undoubtedly reduces the proportion of beet to be cut away in topping to satisfy the requirements of the factory.

The harvesting of our root-crops of course commences with the potatoes, followed about the 1st of October with the beet-lifting, which, owing to the steadily increasing acreage which we are annually planting, goes on all through October and November—all pulling being done by piece-work, a good proportion of it by women from industrial districts.

The harvesting of the mangold crop commences with us about 15th October, and takes until about 7th November, the pulling, covering of what is necessary, filling into carts, and soiling up, all being done by male-labour piece-work. I may remark in passing that we never at any time leave any mangolds uncovered even for a night, believing that if a crop is worth growing at all it is worth

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taking care of when grown, and should not be left at risk of frost doing damage unnecessarily.

Swedes we cut and drop on the ground when required for immediate use for the cattle, but slung into heaps and soiled-up if intended for sheep food or later seasonal use for the cattle. We aim at having all root-crops secure from weather risks not later than the end of November or the first week in December.

As indicated previously, our normal rotation is a six-year course —two root-crops and one of clover alternated with three straw crops. The price of home-grown grain being what it is, and to enable us to grow the acreage of beet we desire, we started two years ago to follow our potato crop with beet instead of spring corn. This now throws us with about half our arable acreage under roots of one kind or another, entailing a very heavy labour bill, but at the present level of prices I propose keeping my acreage under grain within the narrowest possible limits.

Growing cattle foods, vegetables or beet *may* pay some years; producing grain under present conditions cannot.

THE GROWTH OF CROPS FOR DAIRY CATTLE

By W. A. C. CARR
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Crops for Dairy Cows

About two-thirds of the cost of keeping a dairy cow arises from feeding, and on the majority of farms this portion is divided almost equally between home-grown and purchased foods. In theory concentrated foods are needed chiefly for cows giving 3 to 6 gallons. These do not, as a rule, make up a big proportion of our herds at any time. Most farmers have perforce to content themselves with sales equivalent to an *average* daily output of under 2 gallons. If one wishes to visualize a dairy herd, therefore, as an economic unit, it is a picture of a number of animals giving rather under 2 gallons apiece, and needing somewhere about 11 or 12 lb. starch equivalent per head per day, that one must call up.

It is possible to make up from home-grown foods alone a ration closely approaching this standard. One of the main points in herd management is, therefore, can rations so constituted be grown more cheaply than their equivalent could be bought?

The whole question of costs on a dairy farm is surrounded by difficulties. To instance but two, crops are grown by labour

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employed primarily for another purpose—in a sense surplus labour; it is charged for at full rates, though not skilful in arable work.

With our small arable acreage depreciation on implements reaches a staggering figure per acre, and the standard of fertility on the land is determined in great measure by the dung, which a paternal government requires one to remove from the precincts of the cowhouse—again a surplus product.

For reasons such as these, costs per acre, if calculated in the normal manner, are apt to prove very high—though it must be admitted that one of these items ought to be cancelled out by correspondingly high yields. There is, however, no escape from costing methods if one wishes to evaluate crops grown.

Our arable land in South Cheshire is generally worked on a four-course rotation, with oats replacing the barley of the original Norfolk rotation.

The root-crop is a convenient starting-point in the shift, as this gets the farmyard manure. Valued by the modified Hall & Voelcker method, which we adopt, the cost of muck at Reaseheath runs from 9s. 6d. to 11s. per ton; so that, as 14 to 16 tons per acre is applied for roots, we start with an initial charge of £7 or £8 for dung and about £2 for carting and spreading—roughly £10 in all, which has got to be spread over the rotation somehow. We charge half—*i.e.* roughly £5—to the roots and the remainder equally between the next two crops.

Mangolds

In common with our neighbours, we invariably plough in during winter, after autumn cultivation, if the land is at all weedy. We find it difficult in the spring to conserve surface moisture and at the same time to keep down annual weeds, which are a sore trouble:

"We sow with all the art we know, but 'fore a plant appears,
A single seed from any weed a thousand children rears."

So serious is this trouble with a "slow starter" like mangolds that we are doubtful of the wisdom of growing in narrow drills, though we can generally grow much heavier crops. Successional sowings in patches of about an acre, at intervals of about a week, are highly desirable, and early singling essential. Despite the ravages of mangold-fly—an increasingly serious pest—it is a safe crop. We have never seen a real failure, and have frequently grown over 40 tons.

At Reaseheath our average costs (excluding managerial charges) during the past three years have been £35, 10s. We put the average crop at 35 tons, which, at our costs, is equal to £1 per ton, or 16s. 8d. per cwt. S.E.

Swedes are so variable, owing to "misses" in germination, mildew and *phoma*, that it is difficult to state an average. In good years 30 tons

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per acre is easily grown, so we doubt if the average can be less than 22 tons; and as costs are fairly constant at about £24 per acre this gives a cost of 22s. per ton, or 13s. 9d. per cwt. S.E.

Marrow-stem kale is easy to grow, cheap and safe. Our average cost is £30 per acre and the crop 25 tons—that is, £1, 4s. per ton, or 13s. 4d. per cwt. S.E.

Corn Crops

In judging the economics of corn crops in this area it is necessary to bear two facts in mind—the one, harvest difficulties, the other, the value of the straw for litter. It takes half-a-ton of straw per cow to litter a herd. The clean-milk movement has increased the demand greatly. Few farms grow enough. Of late years it has rarely been worth less than £3 on the farm. This year wheat straw is worth £4 and oat £5. A corn crop is therefore worth £4 to £6 per acre for straw alone. Spring oats constitute the standard corn crop of the area. We have known but one failure—due to frit-fly—in ten years, though we have both seen and experienced heavy losses due to lodging and other troubles associated with wet harvest weather. Taken after roots, the crop costs at Reaseheath, approximately, £13 per acre, or if £4 be deducted for straw, £9 per acre: yields vary greatly, 30 cwt. per acre is often grown, and sometimes harvested. We are confident the average for the area is at least 20 cwt. This corresponds to 15s. per cwt. S.E.

Taken as the fourth crop in the rotation it escapes any charge for farmyard manure, and the cost is reduced to about £10 per acre, or £6 if straw is deducted. We have, unfortunately, little direct evidence from our own farm, but the average crop harvested is not less than after roots. This makes the cost about 10s. per cwt. S.E.

Hay

Rye-grass is invariably mixed with clover for one-year leys, and grows so fast in the early summer that large crops of grassy hay result. It is rare to lose a crop through bad harvest weather, though we have once had this experience.

The second crop contains much more clover, and is generally harvested successfully in September's waning sunshine.

The two cuts may conveniently be taken together in arriving at costs. Average-yield costs of growing amount to £7 per acre, and the double crop 42 cwt. per acre out of stack.

If allowance is made for loss of one crop in ten years this amounts to an average per ton out of stack of 38 cwt. Judging by a few analyses Featherstone has done for us, S.E. is not more than 35, with dig. protein probably 4·5 per cent. This gives a cost of 10s. 7d. per cwt. S.E.

The costs for second-year seeds hay, when grown, depend

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mainly on whether a dressing of farmyard manure or of artificials is given. In the latter event a very cheap crop is produced, in the former the cost approaches that of meadow hay.

By way of comparison one may refer to meadow hay. Owing to the universal custom of putting on about 12 tons of dung at least once in two years, this is a very expensive crop to grow, and if the crop is cut reasonably early the yield is small compared with seeds hay. We do not usually get more than 20 to 22 cwt. per acre out of the stack. With an average cost of £6 per acre this is equivalent to £5, 14s. per ton, or (again utilizing our own analyses) of 14s. 3d. per cwt. S.E. The S.E. is, probably, at least 40. Again, however, costs are greatly reduced on meadows which will carry a respectable crop for several years without dung.

In dealing with hay crops we would draw attention to the misleading habit experimentalists have of stating yields in terms of tonnage carted. This is 30 per cent. above the weight of usable hay obtained from the stack.

In order to judge the cheapness, or otherwise, of home-grown fodders one cannot take any crop singly. A fairer picture is obtained if one takes a hypothetical area and calculates costs over a rotation thus:

	Yield (tons)	*Starch Equivalent (cwt.)*	*Cost*
Roots (3 acres)—1 acre mangolds	35	42	£35 10 0
1 ,, swedes .	22	35·2	24 0 0
1 ,, kale .	25	45	30 0 0
Oats 3 acres . .	3	36	27 0 0
Seeds 3 ,, . .	5·7	39·9	21 0 0
Oats 3 ,, . .	3	36	18 0 0
		234·1	£155 10 0

Average cost per unit of starch equivalent—13s. 3d.

The average cost per unit of starch equivalent in purchased foods is 14s. to 15s. Thus, despite high costs and the conservative estimates of yields we have taken, home-grown fodders appear to work out cheaper than purchased. In any event, they are the only means open to us of cashing the costly dung and surplus labour.

We can, and do generally, feed a ration of home-grown foodstuffs capable of supplying maintenance and the first gallon of milk; on

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occasion we have successfully fed on home-grown foods up to 2 gallons, by using large quantities of hay or of kale.

With cows above 3 gallons, however, difficulties of bulk come in if more than the first gallon is made up of bulky foods; indeed we think that it is generally advisable to restrict such foods to maintenance quantities with cows over 3 gallons.

Although a good case can be made out for home-grown fodders on the score of cheapness, two factors militate with us against full utilization of our own findings—viz.

(1) The limited quantities which the higher-yielding cows can economically deal with—especially hay aud roots;

(2) The limited quantities per cow available, owing to the heavy stock we carry. This is by far the greater difficulty.

The current view of concentrates as production foods, though useful, obscures the fact that they have also a maintenance value —that is to say, when used they reduce the consumption of home-grown fodders. Modern dairying has reached such a pitch of intensity that we could not keep our cows alive at all on the resources of our own farms. Many a Cheshire farmer uses concentrates in the first place as a means of keeping more cows on his holding. Unconsciously we all adopt this practice to some extent. As to whether this practice is wise or not, that is beyond the scope of this paper to discuss. Obviously it is a question depending on that other portion of the costs which is made up of depreciation, overhead charges and so forth.

Feeding Cattle

To turn to farms in N.E. Scotland, the position here is very different. They are distinctly dual-purpose farms. The lay-out is designed for ease of working under the plough; but feeding is carried out as part and parcel of the profit-making, not as a means of making dung, wherewith to grow saleable crops.

Successful feeding demands a supply of cheap food, and the rotation is planned to this end. Being in touch with the methods adopted on certain farms in Kincardineshire, where cattle are successfully fed almost entirely on home-grown food, some account of the system may be of interest.

The soil on the farms is not naturally rich, but owing to the use of wild white clover in the temporary leys big crops are grown. If this land is worked under a four-course rotation, and is ploughed up after one year's ley, crops tend to be poor, so a six-course rotation is followed, the leys remaining down for three years. A heavy crop of clover hay may be cut the first year, but there is now a tendency to graze feeding cattle on part of the first year's seeds. The demand for hay is not so good as formerly, and it is not required to a large extent for feeding purposes—good oat straw giving almost as good

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results when fed with roots. The cost of growing hay is probably less than in Cheshire, but even so £5 per ton is not considered an attractive price.

Feeding cattle graze the whole of the second- and third-year leys, and the herbage is such that they fatten without corn or cake. On occasion a few potatoes and locust beans are fed in order to finish cattle early in the grazing season.

Oats normally follow the leys in the rotation, though potatoes are grown on part of the area—the most fertile part. Oats are the favourite cereal, as the crop can be depended on to yield, without manure, 22 to 30 cwt. of good grain, which may be sold or utilized for feeding; moreover the straw, when cut "sharp" and well harvested, provides excellent fodder at a low cost. According to Collins, oat straw grown after a good turf has a higher feeding value than straw grown on land containing little organic matter.

By using tractors and modern machinery the cost of growing oats is reduced to a minimum.

Oats are followed by turnips, swedes and potatoes—turnips for use in early autumn and swedes to provide a daily ration of about 70 lb. per head of cattle during winter. Like other crops in the rotation, roots derive much benefit from the residue of the ley.

Large-scale methods again reduce the cost of root-growing, and crops of 25 to 30 tons per acre can be relied on. Attempts have been made to substitute silage or hay for roots, but a moderate ration of swedes is regarded almost as essential to successful feeding.

Barley and oats are grown after roots and form the nurse crops for the seeds. Barley is grown for sale to distillers, but a good deal can be fed to cattle, and the straw comes in useful for bedding.

Home-grown oats, barley, oat straw and swedes are therefore available at a low cost for winter feeding, and practice proves that purchased foods are almost unnecessary.

Cattle of about 10 cwt. receive and eat 12 to 14 lb. of good straw and 70 lb. swedes or thereby. On this ration there is no tendency for animals to scour. Straw is not fed *ad lib.*, as is often recommended, and this is considered a point of importance. No animal receives more straw than it will clean up within an hour or so after feeding, and the butt-ends are eaten as well as the finer parts.

Oats and barley have meantime a very low selling value, current quotations at Aberdeen being 6s. and 8s. 6d. per cwt. respectively for high-quality grain. At these prices farmers should feed corn in preference to cake.

Considerable care is necessary in feeding grain to cattle in fat condition. At one time digestive troubles invariably followed attempts to substitute for the greater portion of the cake, normally fed, corn, especially barley. It may be that this result was to some extent due to the custom of drying in a kiln all grain sent to the

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mill for grinding. It was, however, discovered that if a little crushed linseed was added to a cereal mixture there was no trouble with cattle going off their feed, and this has led to a considerable economy in feeding. At the present time the ration in use is as follows: 6 parts oats; 1½ parts barley; ¼ to ⅓ part crushed linseed.

The ration has S.E. of 62, and costs about £7 per ton, whereas cakes with a S.E. of 70 to 73 cost from £12 to £14 per ton. Only first-class dry grain is used, and it is considered that it must not be kiln-dried. It is found that 4 to 5 lb. of this corn mixture, together with roots and straw, make an efficient fattening ration.

Rough tests on the farms tend to show that cattle can be finished rather earlier with a liberal use of cakes, but the type of ration mentioned has been used for at least three winters, and the results have been highly satisfactory.

On occasion a little linseed cake is added, and if cattle are on a heavy feed it has been found advisable to increase the quantity of linseed. The cattle purchased for feeding are not by any means outstanding, but the finished animals kill well, and hold a high reputation at Aberdeen auction, where the standard of fat cattle is high.

Now it is notoriously difficult to apply the findings obtained from consideration of farming methods of one area to another area. But there are certain general features which apply in both the areas under consideration. It is in the first place clear that there are limits to the dissection of farming costs and processes. The value of a crop can be judged only in the light of its position in the farming system as a whole. And secondly, cheap fodder, though doubtless less efficient than concentrated foods, is justified, or indeed necessitated, when the end-product commands a low price in the country's markets, or in other words—but we will refrain from quoting in this place the famous dictum of your illustrious founder.

THE DISCUSSION

Mr Harold Drewitt, Colworth, Chichester, said: Nearly all the speakers have dealt with the provision of winter food for live stock from the intensive-production point of view, but it must not be forgotten that there is another aspect of the question as regards milk production—viz. the cheaper production of milk without so much regard being paid to the quantity produced. This system simplifies and cheapens milk production in several ways. No elaborate buildings are wanted to house the cows in, as they lie out day and night whatever the weather, and are only brought into a temporary yard with a movable milking-shed at milking time; no

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roots are grown, and straw is wanted only to thatch the hayricks which are built in the meadows the grass is grown in, the hay being scattered in winter on the ground for the cows to consume. It would be difficult to devise a cheaper system, particularly when the cost of buildings is taken into account. The essentials for success would seem to be a subsoil which is quite dry in winter, a hardy lot of cows, and a still hardier race of cowmen!

To a sheep breeder this Conference would seem to have paid but little attention to the provision of food for sheep in the winter time. Formerly in this district (South-West Sussex) the breeding ewes were kept on turnips until Christmas time, then a change would be made to swedes, while at lambing time swedes or turnips would be fed as the individual preference of the flockmaster might dictate; in all cases about 1 lb. of clover hay would be given all the winter. For the fattening tegs, swedes trimmed and cut in the field with cake and hay would be the usual practice. Nowadays high labour-costs have made this system of fattening tegs an impossibility; marrow-stem kale is largely grown in place of the swedes for feeding during the late autumn and early winter, after which those sheep which are not ready for the butcher have to gnaw the swedes for themselves. The cake and hay ration has been but little changed, although this season crushed oats, barley or maize are being largely used.

On those farms where sugar-beet is grown, reliance is placed on the tops for feeding up to the beginning of the new year. At first many tops were ploughed in for manure, but all growers who are accustomed to feed sheep seem to agree that feeding on the ground is the best and cheapest way of utilizing the beet tops. Care is taken not to feed the tops until about ten days after they have been trimmed off, and it is very desirable that 1 lb. of good hay or $\frac{2}{3}$ lb. of dried beet-pulp should be given. Experience would seem to show that if these precautions are taken no troubles, digestive or otherwise, need be anticipated.

The amount of feed provided by the best tops varies with each season, the time of year it is consumed and the variety of beet; but an average crop would provide keep on each acre for 100 South-down ewes for twelve days with the daily addition of 1 lb. of hay per head.

Professor WIBBERLEY said: The preponderance of grass to arable results in an annual slump in prices for store stock in autumn and dear prices in springtime, when farmers wish to stock the land. The autumn slump is also accentuated because of the eleven-month grazing system in Ireland, by means of which large tracts of grazing land have to be cleared in early November.

Twenty years ago I promulgated a system of arable farming, designed chiefly for stock-feeding purposes. The system was making

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considerable headway until the War demand for cereals side-tracked the farmers' interest in the system. To-day, in my opinion, the outlook for live-stock farming is decidedly brighter than it is for cereals. At present prices no man can produce milk, meat or mutton so long as he is almost entirely dependent on purchased foodstuffs for his supply of albuminoids.

On the average farm the ratio of albuminoids to non-albuminoids produced is about 1 to 13. I am convinced—more from practical observation than direct experiments—that by using a complete mixture of artificials on forage crops, and consuming or cutting earlier than is usual, the albuminoids of the crops can be very much increased. In December of 1919 I submitted a sample of vetch and cereal hay for analysis to the Department of Agriculture, Dublin. The crop was manured in early spring with a dressing of:

3 cwt. superphosphate
3 ,, kainit
1½ ,, nitrate of soda
} per acre.

It was cut just as the vetch was coming into flower and, though the crop wilted considerably, the yield of hay was 3½ tons per acre. The Department's analysis was:

Moisture	14·62
Oil	2·72
Albuminoids	15·12
Carbohydrates	41·12
Fibre	20·87
Ash (including sand and silica)	5·55
	100·00

Due to the introduction of efficient tractors and cheap fertilizers especially, forage cropping was a much simpler matter, and capable of being carried out on a larger scale than it was twenty years ago. One feature of the system was to under-sow a crop of trefoil and rye-grass or trifolium and rye-grass in corn. Other sowings of rye and vetch mixture were sown on the stubble after harvest. By using complete fertilizers containing nitrate these crops could be made available for folding and cutting from two to three weeks earlier than would be the case if the crops were not fertilized.

Apart from the great advantage of early-spring feed, the speeding up of the crops meant that the succeeding crops of marrow-stem kale, rape, and other crops of a like nature, could be sown much earlier, to be ready for autumn, winter and early-spring consumption.

As regards tractors and tractor implements, these speed up the cultivation of the land and, through the quick cultivation, the soil moisture is conserved, and results in the immediate germination of the seeds of the following-on crops of kale, etc.

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Another important feature in connection with the use of complete fertilizers on such crops as mixed vetch and cereal, lucerne and sainfoin, is, given a sufficient rainfall, at least an extra cut per season, and sometimes two, could be obtained.

The intensive grass-land treatment, in my opinion, is only going to make our farming still more lop-sided, and cause a greater disparity between the autumn and spring store prices. Probably this fact has been recognized by those responsible for the promulgation of the system, and now greater attention is being given to increasing the yield of arable crops by the more lavish use of fertilizers.

As you are all aware, the subject of obtaining a winter supply of digestible albuminoids, by drying grass and compressing the dried material into cakes, is being investigated at present. I personally do not think such a system will ever be a success. In saying so I hope sincerely that events will prove me to be in the wrong. Setting aside for the moment the high cost of a drying plant, and the painful slowness of drying and making young grass into cake, a farmer would have to go over his land so often, to cut and carry sufficient young grass for his winter requirements, that he would never have time for anything else. Also, in a dry season like the past, there would be no grass for either cutting or grazing. Dry weather does not affect forage crops in the same way as young grass. The former keep the land covered in and conserve the moisture. On a farm a few miles from Rothamsted we have been experimenting with complete fertilizers on lucerne, and in the past dry season have increased the yield of lucerne from about 25 cwt. to over 50 cwt. per acre. The part unmanured has been cut in the ordinary matured stage, that manured has been cut several times in what would be considered the unmatured state. Samples have been forwarded to the I.C.I., who have very kindly undertaken to analyse same, with a view to determining not the yields in produce per acre but the quantity of nutriment per acre.

It was considered unorthodox to apply nitrogenous manure to leguminous crops, but in my experience I feel convinced that by so doing, and cutting in a young state, the solution of the problem of cheap albuminoids would be found.

As compared with dried-grass experiments, such crops as vetch cereal mixtures, lucerne, sainfoin, could be dried and saved as hay with the ordinary implements on the farm, and could, by being allowed to wilt a little, be saved as silage.

Given cheap home-grown albuminoids, farmers, even at present prices, could produce all animal products at a profit. Through the introduction of synthetic nitrogen they have solved the problem of greater and cheaper crop production. By using nitrogen with other fertilizers on such crops as I have referred to, we should be able to produce synthetic albuminoids through the medium of the plants,

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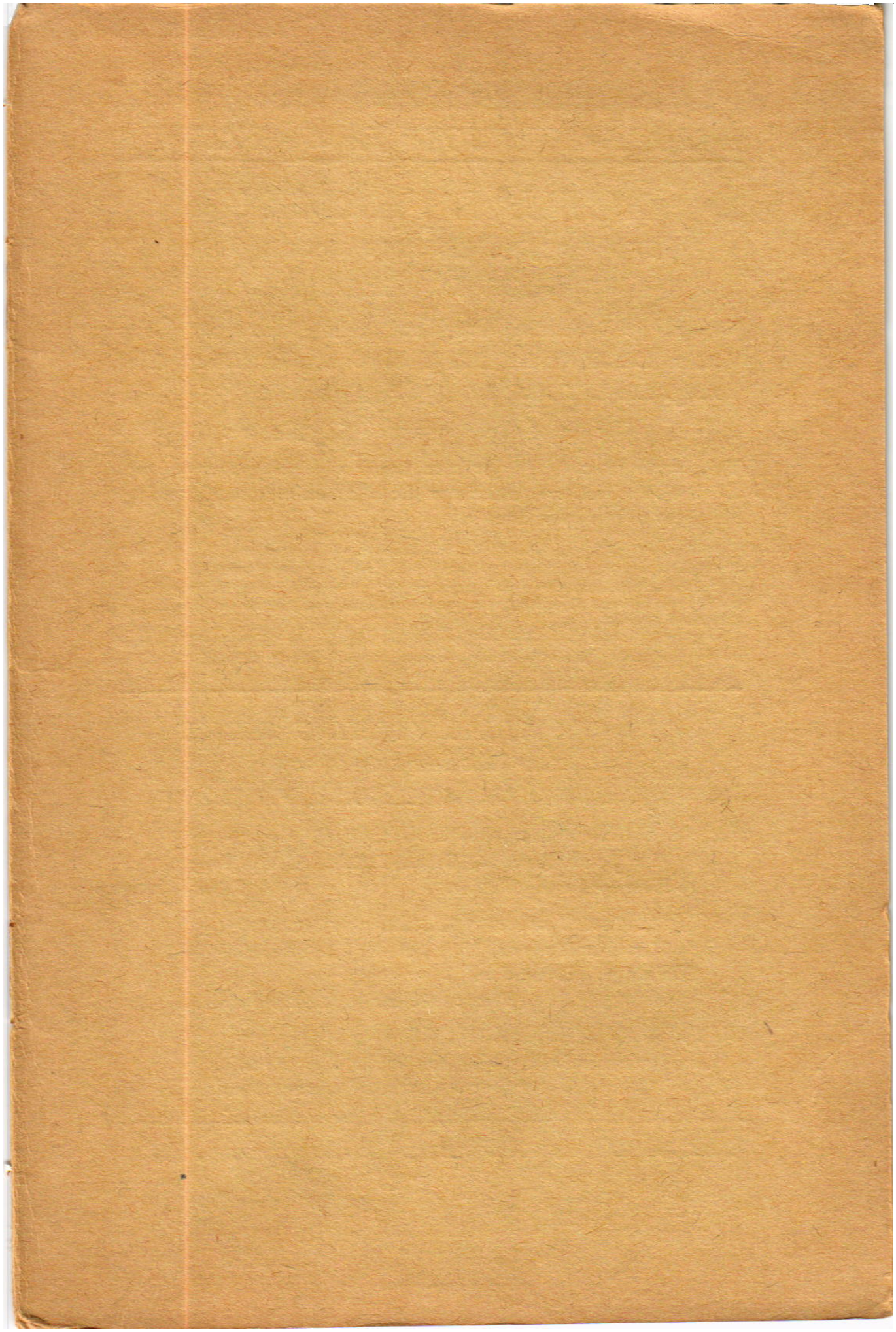
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and when that is accomplished we shall see that the classic statement relative to high farming and low prices is but a fetish.

Mr WATT drew attention to the fact that economics were one of the most important factors in farming, and that a close study of farming economics was the only way to keep down labour-costs. By labour-costs he did not mean lower wages. Every effort should be made, by using all the machinery possible, to produce a large output per man. On Ford's farm in Essex he was required to pay Ford's wages—*i.e.* 2s. 6d. to 3s. per hour, and all work had to be done by tractor. It enabled him to keep as few men as possible and obtain the best work from them. They had at this farm just completed the threshing of 80 acres of wheat. The yield was over 8 qrs. per acre. Straw sold in the stack made £4, 6s. per acre. Hay sold in the stack, £7 per ton.

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