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✓  
*Farm  
management*

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# GRASS AND HAY FARMING

*AN ECONOMIC STUDY*

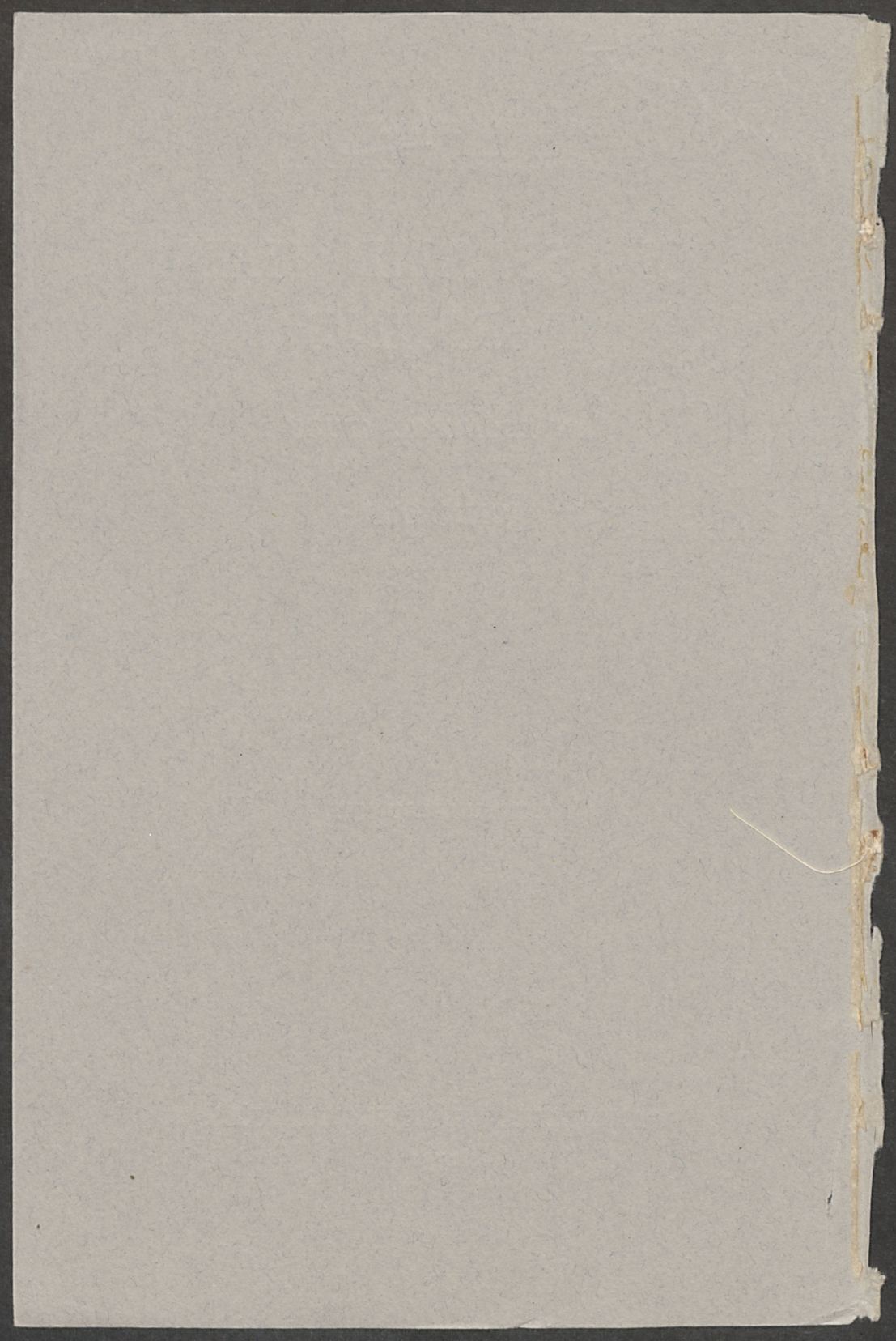
JOHN ORR

ONE SHILLING NET

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1931





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GRASS AND HAY FARMING

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## AN ECONOMIC STUDY

### 1. *Importance of Grass*

**G**RASS farming has generally borne a bad character beside its alternative, arable. Men who speak and write much about agriculture praise the plough, not when it is used to produce grass, but when it is busy in cultivating the soil for corn, roots or potatoes. When they want to tell a tale of woe, they speak of the increasing area of land being "laid away" to grass. The language used on this subject suggests that something is being put to sleep, turned from a state of activity to one of inactivity, that everything which happens when grass is taken as a crop instead of corn is undesirable. A farmer, probably when he is vexed with the world at large, threatens before that world that he will dismiss eight or nine men and boys, and twelve or fourteen horses, who have ploughed and sowed and reaped 600 acres, and that he will in their places employ only one shepherd and two dogs. He is going to take grass as a crop, and he invites the world to believe that all that grass on that area of good land needs for cultivation as proper as that which those other crops received is a man and two dogs. It is a poor compliment to pay to grass. Men's actions do not improve much on their words. There is the habit of letting land "tumble down" to grass, and of taking as little care of it when it is down. Some men pay more respect to this crop, but there are very few who have given it as high a place in their thoughts and programmes as has been given by thousands to wheat.

This attitude to grass is not profitable. There is not as much money lost in grass farming per acre as in corn farming, because far less is spent, but the money which is not made, but which might be made, from grass and hay is much more.

Between 1871 and 1929 the area under the plough in England and Wales decreased by 5,003,000 acres, while the area under permanent grass increased by 4,109,000 acres.<sup>1</sup> This change has gone on steadily, and has been as steadily deplored. Direct and serious efforts have been made to stop and reverse the movement, and are still being made. Their success, however, will probably only be moderate. The expanding area under wheat in Canada and other new countries makes it unlikely that wheat grown in the British climate will regain much of its old position. In 1925 the estimated value of the live stock, milk and dairy produce and wool sold off farms in the United Kingdom was £182,367,500, or 63·7 per cent. of the value of the total agricultural output,<sup>2</sup> and the foundations for development in this direction are sure and wide. Since grass and hay, therefore, play the most important part in the production of those things from which nearly two-thirds of the total agricultural income is derived, they deserve a proportionate amount of the attention of people concerned with agriculture. They deserve a little more than this in view of the long period of neglect from which they have suffered.

The rationing of cattle has been a subject of great interest for some years, but it has been largely rationing with cake and meal, mostly brought from overseas. Hope and interest were centred in the proper use of these, and ordinary farmers learned what they could about them. They use cake to finish fattening cattle, but grass or hay is the foundation of their ration from weaning until they are finished. Farmers also use cake and meal to regulate and maintain their supply of milk throughout the year. Here they have a test of feeding value, and they are unanimous in saying that the drop in the yield of milk caused by a change from good grass or hay to inferior grass or hay cannot be made up by the use of any concentrated food. Although the test in fattening and rearing is less sensitive and obvious than in milking, the difference tells in the one as much as in the other.

There is one part of British farming where this subject is of great importance. The spring starvation of sheep on the hills and of young cattle intermittently over the whole

<sup>1</sup> *Agricultural Statistics, 1929, Part I.*

<sup>2</sup> *The Agricultural Output and the Food Supplies of Great Britain, 1929.*



country is a feature of farming which ought to be eliminated. In other parts of the world drought inflicts loss on farmers by destroying the cattle and sheep, or by reducing their condition. Sometimes the havoc is overwhelming, but irrigation is used to deal with it when it remains within manageable limits. In Britain the starvation difficulty is annual. In the first two years of the lives of cattle, when they are not actually drawing money, or on the point of drawing money, during the months from December to April they are hungered, their growth is checked, and they never make as good beasts as they ought to make. This applies in the south of England as well as in Wales, Scotland or Ireland. This, the greatest difficulty of early farmers, has never been mastered as it should. Economic research might be used to ascertain how far the starvation which affects so many sheep and cattle in spring is inevitable because it is the more profitable of two alternatives. To eliminate this hungry period would be to increase the value as well as the output of live stock, and to reduce its cost of production, and there seems no better means of accomplishing this than the extended production of good grass and hay.

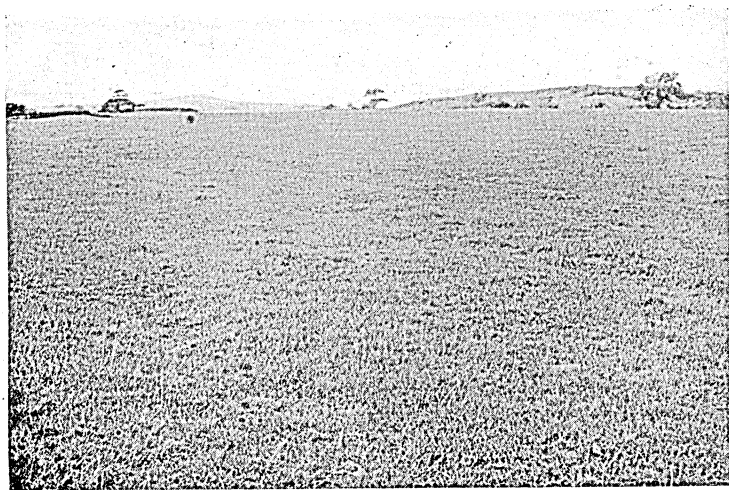
## 2. *Influence of Custom*

The research on which this study is principally based was carried on in Lancashire and Cheshire. Round the towns in which great industries have grown, a great dairying industry has arisen. Cows in milk are the main class of live stock. They are not starved. But there is a grass and hay problem all the same. It would be instructive to learn in how many ways grass is cultivated from the places where it is left entirely to itself to those where it receives as much attention as wheat. Every kind of management is represented in this area, but the most common is derived from the fact that a very heavy stock of cows is kept. The practice here illustrates what happens so often, how a comparatively easy style of management imposes itself on the farming of a countryside, inducing men to settle down and follow an established custom rather than search for opportunities to engage in profitable enterprise. With the large number of cows, and the great quantity of cake and meal used to feed them, an unusual amount of farmyard manure is produced.

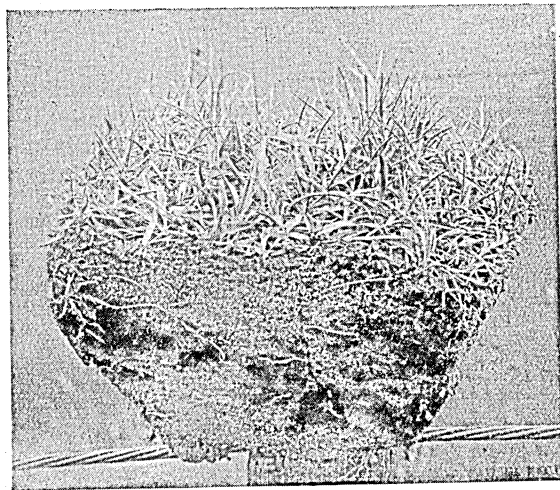
Out of this situation comes the habit which has hardened into a custom, the habit of applying the whole of the manure to the same fields year after year. This practice has constituted over the area occupied by the majority the whole system of cultivating grass. If there is a cow to two acres, or to one acre, and if there is a cake bill of £12 to £27 per head, the whole of the manure goes every year on the meadows first, and then on the pastures. There are farmers who in addition cart manure from towns. They never do anything equivalent to asking the soil whether it likes this monotonous treatment. It is the custom.

This subservience to a besetting influence leads invariably to a misdirection of capital and labour. It shows itself in different forms in different parts of the country. The counterpart of the form described here is found in districts where it is difficult to obtain farmyard manure, and where, although nothing can be found which will please the soil so thoroughly, farmers settle the matter without experiment and adopt less efficient substitutes. In every department of farming these crusted habits impair management.

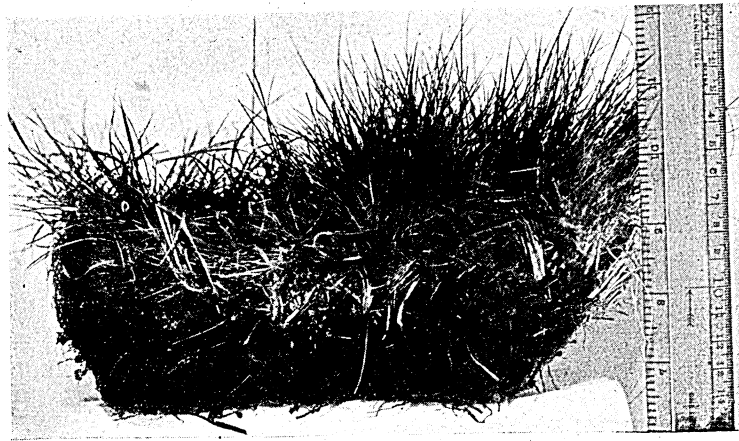
A minority of farmers in Lancashire and Cheshire have modified the one-sided system. They have used lime or phosphates at intervals. The habit of liming may have been inherited from their fathers, or it is maintained, less frequently than before, by landlords who give a certain quantity every year. Once in fifteen or twenty years fields receive a dressing of lime which counteracts the effects of the regular and excessive use of dung. Where this happens there are breaks in the unattractive appearance of the country, and an improvement in the quality of the grass. If farmers were shut up to the use of one form of manure, they would find none which would serve them better than dung. There is hardly a crop which it will not suit. But however varied its virtues are, they do not provide for an indefinite time all the elements of plant food which a crop of grass requires, and therefore do not make enough money for farmers with a worthy ambition in this direction. With a full supply of dung and nothing else for years desirable plants starve for want of something which they need. This has been demonstrated on a scale so wide in Lancashire and Cheshire that it is beyond question; it is an established scientific fact. In



MATTED FIELD, JUNE 1930, STOCKED BUT UNGRAZED



LUZULA MAT FROM SAME FIELD



MIXED MAT  
FROM SAME  
FIELD—  
SEPTEMBER

case there should be any mistake, it should be stated that the apparent alternative to this of giving neither dung nor anything else is less profitable. Desirable plants will starve more quickly and completely under this treatment, and farmers will lose an indefinite amount of money in employing it. This also has been demonstrated with scientific thoroughness in Lancashire and Cheshire. Starvation slow or quick which makes any beast young or old one of the ugliest sights in the world does the same for fields. A dry-haired, tight-skinned heifer or bullock, and a dry matted field are two things in the same class. They are both produced by the same methods, and they are unprofitable, and there are few farms in England which cannot show a field of this kind.

In pastures the ugly coat is made up of different kinds of grasses and weeds in different parts of the country. Some of them here are sorrel or sourdock (*Rumex acetosa*), bent (*Agrostis vulgaris*), mat grass (*Nardus stricta*), field wood rush (*Luzula campestris*), one or two of the potentillas—a bad lot—and other inferior grasses or weeds. The use which the cows make of all of them is to leave them alone. They range round for sweet plants, or an odd patch of them, which may survive in fields not wholly given up to inedible vegetation. It is all a disjointed business from the economic point of view. The bent grows, the wood rush grows and the mat grass grows. The cows do not graze them, they die down, form a mat, check next year's growth, and put the soil out of action. The cows, put out to feed on grass which should be there but is not, come back to the gate early in the day and wait for the cake and meal to take its place. This process in varying degrees, is in operation wherever the old attitude to grass is found. The spring of 1929 was dry and favourable for burning grass which was not wanted. One beautiful day in April, on the east side of a valley lying between two populous Lancashire towns in the south and two in the north, a farmer looked at the almost complete circle of fires and ascending smoke which were carrying off the uneaten grass of years. "There's surely something far wrong," he remarked, "when what the land that is nearest the best markets in the world produces goes up to heaven in smoke." It seemed bad economy.

In meadows sorrel, soft grass (*Holcus mollis*), and other

vegetation as poor, too often make up the crop. They look ugly in fifty different ways. Most frequently with the excess of dung they look like an old ewe carrying two fleeces of kempy wool, the one growing through the other, and both spoiled. The hay is thick in the bottom, goes down, loses colour before it is half grown, is difficult to mow and make, and bad food when it is made.

### 3. *Economic Research*

What, it may be asked, can economic science do to make the elements which constitute this problem clearer than they appear to the first glance of intelligent men with experience of agriculture? What can it do to make a solution easier or more certain? The remainder of this study must be taken as an answer to both questions. The method of research adopted was to observe in what ways farmers reacted to a programme in which a clear economic principle was embodied, the principle contained in the assumption that the investment of capital on lines dictated by the needs of the soil in getting crops of grass approaching, equalling, or surpassing those obtained in the best managed rotations is profitable, the assumption that this capital returns a high rate of interest. The reasonableness, or ultimately the inevitableness of the soil's right to demand what it does demand was accepted. There is nothing arbitrary and nothing susceptible to alteration here. The soil is an inexorable and uncompromising partner in all such situations. But at the same time, on the testimony of farmers in this part of the country, it is an honest partner. The recognition of both aspects, the hard and the honest, is essential for research as much as for money making. Research further included careful observation and as exact measurement as possible of the results produced by the management of different farmers, and an attempt to correlate the elements in their management with the results for which they were responsible.

Use was made of what has been discovered by enterprising farmers and by good men engaged in relevant lines of research about the soil's demands, and a programme of the following kind was presented to farmers in a variety of ways too numerous to record. The principal demands of the soil as

a condition on which it would do its best were embraced under the four headings :

- I. Cultivation.
- II. Plant Food.
- III. Seed of good grasses.
- IV. Grazing and mowing at the proper time and in the proper manner.

For cultivation implements as with other crops are the most useful, if not always necessary. These may be the plough and harrows as used for corn, or it may be a heavy ripping implement, or a disk, tine or spike harrow, or treading with sufficient stock in grazing. In addition to implements lime should be regarded as a cultivating agent. It alters the character of the soil very definitely, helping it to drain, and helping it to conduct moisture from subsoils in a drought. Besides all these wild white clover should be used to assist cultivation. By its active and pushful habit it will break up a matted turf, and change the character of the soil for good.

For plant food phosphates, potash and nitrogen should be used in generous quantities and with the proportion of each balancing those of the others. Chemists would probably not class lime as a plant food, but on soils of an acid nature it is needed to enable these mineral foods to perform their functions.

The seeds of good grasses and clovers are necessary to displace weeds and unprofitable grasses.

Grazing and mowing should be thoroughly done to clear the way constantly for the growth of new grass.

A programme anything like this, no matter how it was turned about, was a contrast to that of farmers who followed the established custom. Some details of how the custom works and of its cost may be given. There are variations within it. A considerable group of farmers not only apply all the manure they make in their yards to the same fields year after year: they purchase and cart manure from the neighbouring towns and from poultry farms. The theory underlying the practice is that land cannot have too much manure in this form, and that although something more than this is necessary, the loss in leaving it out is negligible.

An analysis of the cost of producing grass under this system, even if it is not complete, reveals the nature of the problem.



In the following table figures are given for the production of grass on a farm where both purchased and home-made manure is used. The gross rent of the farm is 50s. per acre. For the purpose of ascertaining the net cost of the grass the rent of the fields apart from the buildings is taken at 60 per cent. of the gross rent, that is, at 30s. per acre.

(1)

|                                      | £     | s. | d. |
|--------------------------------------|-------|----|----|
| Rent . . . . .                       | 1     | 10 | 0  |
| Formal harrowing. . . . .            | 0     | 1  | 6  |
| Upkeep of drains and fences. . . . . | 0     | 2  | 0  |
| Manure . . . . .                     | 3     | 17 | 1  |
|                                      | <hr/> |    |    |
| Cost per acre. . . . .               | 5     | 10 | 7  |
|                                      | <hr/> |    |    |

The purchased manure here cost £2 14s. 10d., or 71 per cent. of the total. The cost of making hay per acre varies with the weather. In 1930 before the weather broke in the middle of July, it cost £2 6s. 6d. per acre to make hay on a Lancashire farm. With a yield of 35 cwt. this makes the cost £4 10s. per ton for hay of no high feeding value.

The majority of the farmers do not purchase manure, but use all that is made in their yards every year. This practice may be considered less enterprising than that described, but since the direction of the enterprise is wrong, that which goes less far is safer and more profitable. Figures from this the largest group might be multiplied, but one has been selected as typical and as a basis of comparison, because the management has been changed, and another set of figures represents the present position. Following the methods adopted in (1) the following is the cost of growing grass.

(2)

|                        | £     | s. | d. |
|------------------------|-------|----|----|
| Rent . . . . .         | 1     | 13 | 9  |
| Harrowing . . . . .    | 0     | 1  | 6  |
| Drains, etc. . . . .   | 0     | 2  | 0  |
| Manure . . . . .       | 1     | 16 | 4  |
|                        | <hr/> |    |    |
| Cost per acre. . . . . | 3     | 13 | 7  |
|                        | <hr/> |    |    |

The flaw in this type of management will be more definitely located and its nature more clearly revealed by an example where the standard of management is very low, as it is on

a smaller group of farms. In this part of the country the object which most farmers have in view in using land is the production of milk. Their first step towards this object is to take land in order to obtain grass and hay. This step commits them to others. They pay rent, spend something on manure, keep their fences in tight or legal repair, their drains in more or less working condition, put their cows out to grass, and bring them in to milk. This is the direction which their enterprise takes at first and so far. The reason for spending this capital is to get some positive return on it. Instead of this, however, the farmers in this group lose an incredibly large percentage of the capital itself, and thus make a minus return.

In this, as in (1) and (2), 60 per cent. of the gross rent is taken as the rent of the fields.

| (3)                          |  | £     | s. | d. |
|------------------------------|--|-------|----|----|
| Rent . . . . .               |  | 1     | 2  | 0  |
| Fences, drains, etc. . . . . |  | 0     | 2  | 0  |
| Manure . . . . .             |  | 0     | 18 | 6  |
| Droving . . . . .            |  | 0     | 4  | 6  |
|                              |  | 2 7 0 |    |    |
| Cost per acre. . . . .       |  | 2 7 0 |    |    |

This is money actually spent in getting grass and feeding the cows with it. But if the grass which they actually get on this pasture is valued at 7s. per acre, the valuation is excessive. It may be argued that something should be added to this for an intangible advantage which the cows receive in the form of recreation, exercise or fresh air. This is too vague. There is a firmer basis for assuming that the value is less, that it is reduced by the restless ranging of the cows over the field in search of food which is not there. A stand of two hours at the gate waiting for the provender in the cowshed makes no money. Professor Wood had a formula for measuring the loss due to ranging for food, but it is unnecessary here to attempt anything so problematical. The measurable loss is 40s. per acre, or 85.1 per cent. of the capital invested.

The feature of this transaction which determines its character, which explains the economic position of the farmer, is that he does nothing which his soil requires him to do before

it will work for him. The object of spending 47s. per acre is that the soil should give at least 60s. worth of grass. To make a reasonable profit on his whole business a farmer requires a much higher rate of interest on the capital engaged in this part of it. The expenditure of 47s. here only brings this man to the threshold of his enterprise. Since there is nothing in it calculated to make the soil work the whole undertaking falls. Instead of backing up the 47s. with an amount sufficient to move the soil to the state of activity of which it is capable for producing grass he betrays his own capital, breaks off the process which he had started long before it is brought to its economic end, and sets off on an entirely new course of producing milk by means of purchased cake and meal. In doing so he ceases to be a farmer, and becomes a cowfeeder.

#### 4. *Routine and Enterprise*

In considering the structure of farm management as it operates here and on all farms, it is necessary for scientific purposes to divide the capital employed into two parts to correspond with differences which distinguish the one from the other. What is described here as routine capital are the charges like rent which are fixed by agreements and by obligatory circumstances outside the farmer himself. In table (3) the whole charge of £2 7s. per acre is practically routine capital which the farmer must spend before he will be admitted to a farm or earn in the least the title of farmer. He must pay rent; he must keep his fences tight to prevent his cattle from straying; he must put them out and take them in; and they must leave manure. The other part of the capital which is hardly represented on this farm, bears a direct and unvarying relationship to the farmer's own character as a manager; it measures in its amount and direction his capacity to bring into activity the forces in the soil and grass which eventually make money for him. This part is described as enterprise capital.

Should men engaged in other styles of farming in other parts of the country think their practice is free from the economic failing shown here, the criticisms may be extended to their management. There are few men in any line of farming who give perfectly adequate support to the instal-

ment of capital which they bind themselves to spend in the beginning of an enterprise by the application of the subsequent instalments necessary to make the first bear its full fruit. In arable farming the flaw shows itself after the routine expenditure on rent and inevitable charges is incurred. Not enough is put into one or several of the enterprise lines, cultivation, fertilisers, seeds and harvesting. The deficiency on the second half makes the expenditure on the first go astray and miss its point. Exhaustive accounts are not necessary to tell a man in what direction he is going. A careful valuation of what he gets, and its comparison with the expenditure incurred in getting it, is a sufficient guide. This valuation, or a more accurate substitute if obtainable, is indispensable, and is the most serviceable instrument in economic research. If it is used on crops of wheat, oats, potatoes and roots as well as on grass, it will make farming an active and tightly organised business.

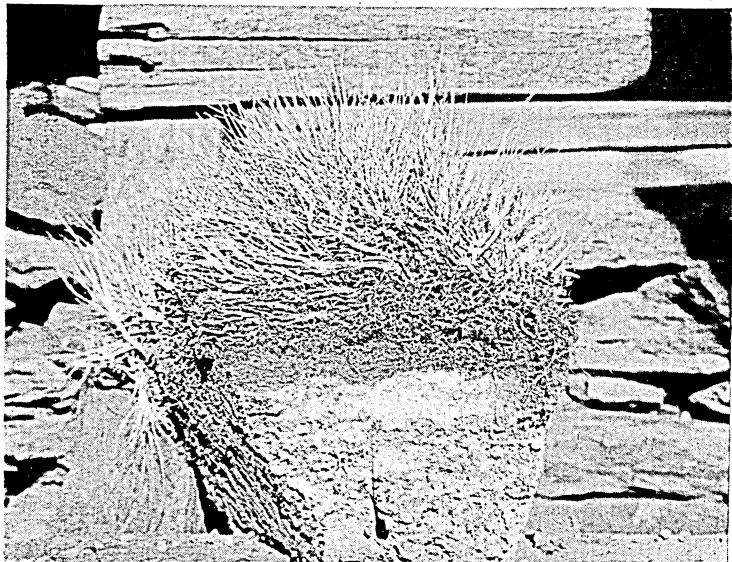
In example (3) the loss every year on the pasture is 40s. per acre. It does not stop there. The management of the meadows is similar. A valuation of their yield was not obtained. But with grass and hay produced in this manner the health of the cows suffers. No attempt worthy of trust can be made to assess the cost of this, but the mischief is there, and it is substantial, being assigned as the cause of serious if not fatal economic embarrassment. The situation is remarkable. Ordinary men in the position of farmers carry a burden comparable with that borne by wealthy landowners. Their pastures are as much an unprofitable attachment, many of them are in as poor condition, as the deer parks adjoining landowners' residences, or even as the parks where the ancient wild white cattle are or used to be kept. Where farmers have a retail milk round, or some corresponding advantage, they can afford this extravagance, but where the hard-beaten wholesale price obtains, or stock rearing and sheep, the margin is too narrow. This style of management by itself depletes their capital so seriously as to compel their abandonment of farms.

The element in pastures and meadows which is associated with the heaviest losses to farmers is the matted turf. There are several kinds of mat, different on different farms and in different parts of the country. Some of them are (1) the

long, hard and shaggy kind, (2) the long, rank and tangled, (3) the short and bristly, (4) the short, soft and woolly. They are brought into existence by prolonged bad management. They are composed of inferior grasses and weeds, alive and dead, with a close woven network of roots, also alive and dead. There are wide differences in the grasses and weeds, but what matters about them all from the economic point of view is that animals dislike them and leave them ungrazed, or if they are constrained to eat them in the form of grass and hay, their milk yield goes down and they fail to thrive. These plants are allowed to come in by the absence from the soil of the conditions necessary to support the growth of others more palatable and nutritive. Whether it is on the hillsides and in the dales of the North, or in the valleys and rolling lands of the South and Midlands, if for any reason grass is ungrazed or uncut year after year, it works against the new growth each season. In the majority of old pastures the mat can be seen "shining" through the grass which is trying to grow green on top of it, very late in spring and very early in autumn, and if the season is slightly cold or dry all through summer.

The principal work which the mat performs is to shut out the air from the roots of the plants, from the soil about the roots and from the bacteria which need air on which to live as much as men need it. The story is one for the chemist to tell. The point of it is that these very minute creatures prepare and make available its food to grass exactly as cattlemen prepare and carry their food to cattle. For this service they demand certain conditions, and one of them is a reasonable amount of air. There is no compromise about their terms, nothing to be gained by haggling. The best thing for the farmer is to learn from the chemist what these terms are and concede them.

What the mat does in economics is to waste the farmer's money. Between the capital which he invests in his soil and grass, and the capital which he invests in his cattle and sheep there should be the closest and most active co-operation. The first portion of the capital cannot bear its fruit except through the second, but they never meet; the first is lost on the way to its object. Farmers over and over again point to fields where they have applied basic



FROM FIELD WHICH WAS SLAGGED TWENTY YEARS AGO,  
WITH NO RESULT



slag and other fertilisers. They say, sometimes rather triumphantly, that they have never seen where it has gone. There was never the slightest chance that they would. Phosphates, potash, nitrogen and even lime are intercepted on the way to their work, it may be for years, but generally it is for ever. A survey to determine how much of the permanent grass and hay in this country is grown on top of a wasteful mat would reveal a serious position. On a mat the crop is precarious, always in need of frequent feeding, sure to fail in a dry season, and always inferior in quality. Research has proved that no farmer can afford to congratulate himself on having improved the stock-carrying capacity of his farm, if he has a mat in his fields. A difficult season invariably discovers the weakness of superficial improvement, and forces him to go outside and purchase food.

Other conditions of the soil as well as the matted turf carry on the business of breaking the co-operation between one part of the farmer's capital and another. Acidity, or sourness, and waterlogging do it. They interfere with the services of the bacteria. The absence of phosphates, potash and nitrogen does it. Acidity and the mat often go together, but the first can do the work thoroughly well without the second. Arable land furnishes good examples of this, where a farmer will spend £7 10s. an acre in growing a crop of swedes, and in the end gets one or two loads of spindly roots, worth a few shillings, because they are smothered with spurrey (yaar) and infested with finger and toe. Lime is absent, and £1 an acre spread over a period would put it there, and give a crop worth £12. In the same rotation the same kind of management for seed hay loses the clover and gets a crop more of sorrel than of rye grass. Here there is no mat as partner to the acidity.

When the problem assumes this form, the remedy is for farmers to put a stop to the waste of their capital. This may be done by spending more, or by changing the direction of expenditure. Either method calls for consideration. While lime has been honoured in word more than in use, sewerage has been applied for a generation or more partly as a renovating agent, and partly as a manure. Various features have commended it to farmers—among them its lime content and its apparent cheapness. The latter aspect is

the economist's concern. Its use improves the quality of the grass, although the increase in quantity is not in proportion. The conclusion from this may be that the lime content of the sewerage is the element of chief value. The following example gives the cost of 310 tons of sewerage applied to 11 acres on one farm.

(4)

|   | £     | s. | d. |
|---|-------|----|----|
| Price at works . . . . .                | 7     | 15 | 0  |
| Charge for motor waggon . . . . .       | 93    | 0  | 0  |
| Cost of carting and spreading . . . . . | 64    | 3  | 4  |
|   | <hr/> |    |    |
|   | 164   | 18 | 4  |
| Cost per acre . . . . .                 | 14    | 19 | 10 |
|   | <hr/> |    |    |

As there was reason to expect this thundering heavy dressing produced an effect. The weight of the material together with the lime broke down the mat consistently and brought clover as well as better grass. There is no question of the farmer's enterprise. The question is of its direction. Better results can be obtained at less cost. The application of 28 tons to the acre was excessive. Research shows that for renovation a dressing of 23 tons with a reasonably high lime content is necessary and yet sufficient. With this reduced quantity and a reduced charge of 3s. 6d. per ton for motor transport the cost per acre is still £9 16s. 7d. per acre. But this expenditure is not justified on economic grounds. There may be no chemical or agricultural reason for abandoning the use of sewerage as a renovator and manure, but its value measured by the returns is less than that of an alternative, and farmers would be justified in asking municipalities to give it for nothing, and share the cost of transport. The expenditure on sewerage is periodical not annual. Taking the life at six years, the same as that taken for lime, and combining the cost of a moderate but effective dressing with that of the farmyard manure, the total cost of growing an acre of grass under this system is £5 6s. 4d. per acre.

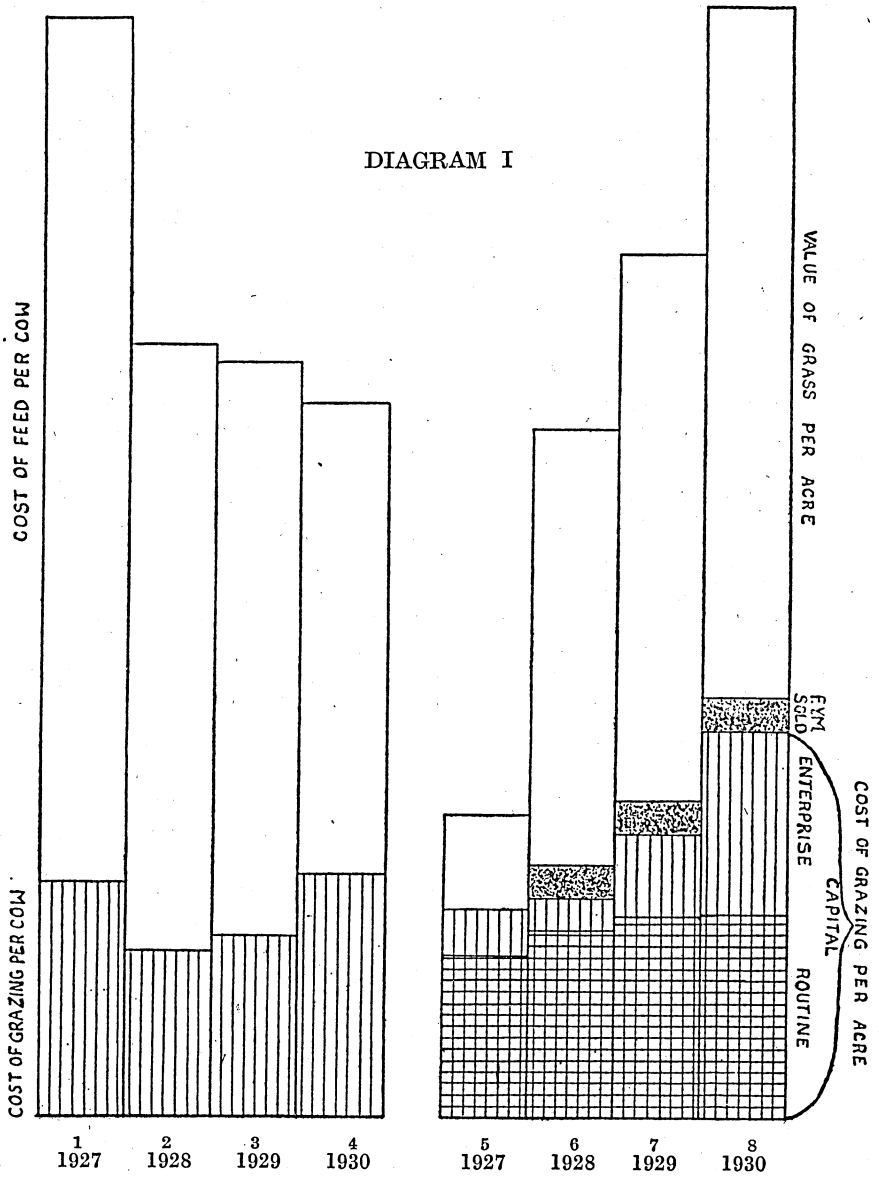
The problem of management generally and of their own types of management have been discussed with a large number of farmers in a manner somewhat like that adopted here. The substance was the same. Experiments as alternatives to their own types have been worked out in these

discussions, and over an area not very wide a large number of farmers have made themselves responsible, each putting into his own experiment his own individuality. The programme in so far as it is given definite shape is based on the conclusions and recommendations of chemistry and botany. Economic influences play about these and modify them. A number of men move so slowly and unsteadily that they might almost as well not move at all. The majority follow closely the recognised lines. A small number again move quickly and go very definitely beyond lines and limits. These provide the most interesting economic material.

### 5. *Experiments*

One such experiment is selected for description in some detail to illustrate one or two principles before they are discussed in general terms. Diagram I applies to the farm A, the management of which is referred to in example (2). It illustrates the manner in which the farmer departed from that management and the financial results of the change. Columns 1 and 5 represent his management in 1927 when he followed the old custom, applying all his farmyard manure to his meadows and spending heavily on purchased food. The costs given here are for the six summer months from May to October. In 1927 the cost of purchased food per cow during this period was £15 0s. 10d., and of grazing £4 1s 9d. The value of the grass (col. 5) was by valuation £1 13s. For the 1928 crop he applied an amount of lime, exceeding by 50 per cent. what was approved by the chemist. The result was to reduce the cost of his purchased food per cow by £4 9s. 3d. (col. 2), and to increase the value of his grass per acre by £5 18s. 9d. (col. 6). The changes in the value of the grass are measured by the reduction in the cost of purchased food used, the price of which has been kept constant throughout at the 1927 figure. For the 1929 crop the farmer applied phosphates and potash, about 100 per cent. more than the standard recommendation. There was a further slight decrease of 12s. 8d. (col. 3) in the cost of feeding stuffs per cow, and an increase in the value of his grass per acre of £1 19s. 3d. (col. 7). For the 1930 crop he used 3 cwt. of nitro-chalk to the acre, applied at one time, reducing the cost of purchased food per cow further by £1 15s. 2d. (col. 4),

DIAGRAM I



Scale 1 mm. = 2/-

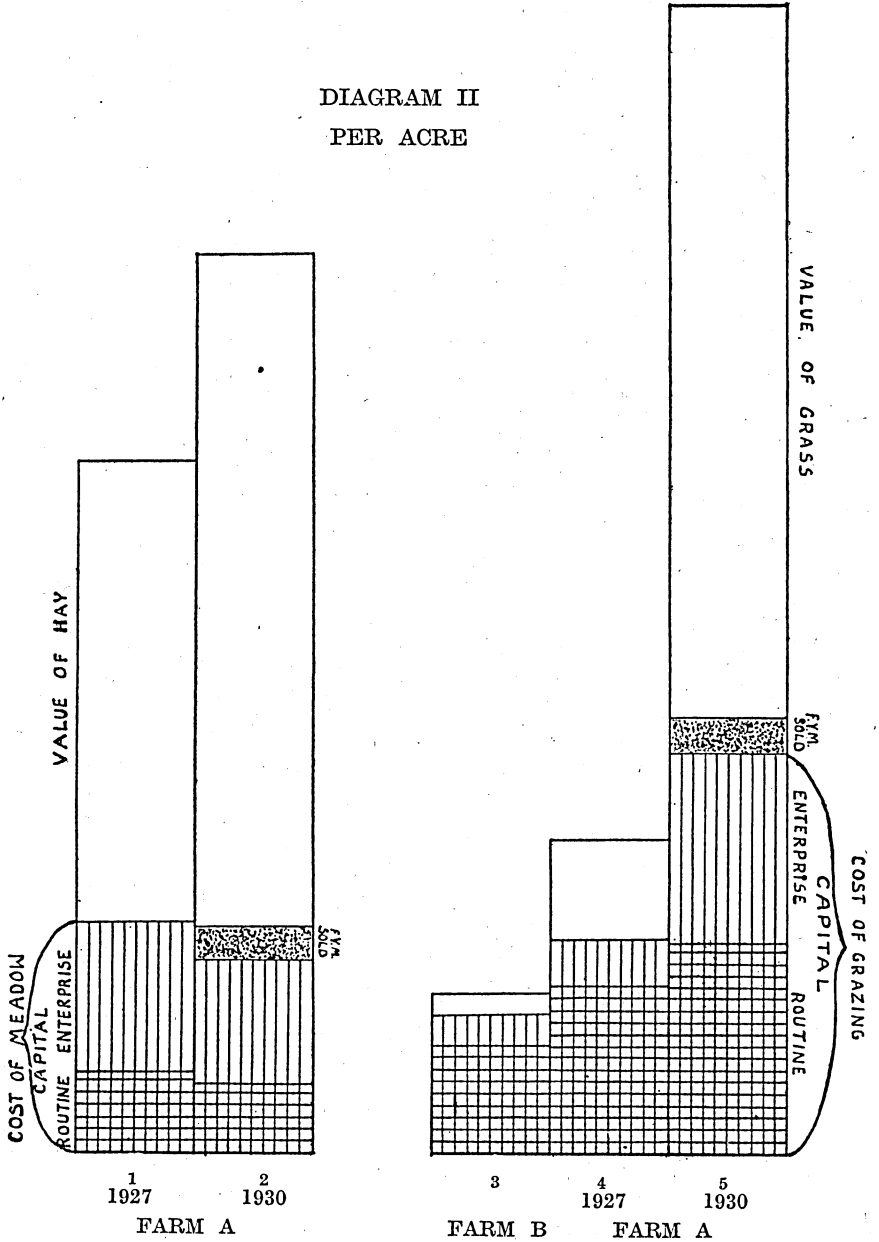
FARM A

and further increasing the value of the grass per acre by £2 10s. 7d. (col. 8). In the course of three years he reduced the cost of his purchased food for the six summer months by £6 17s. 1d. per cow, or by 45.5 per cent. In the same period he increased the value of his grass by £10 8s. 7d. per acre, or by 632 per cent. In 1927 he lost 53.9 per cent. of the capital employed in getting grass, while in 1930 he made 78.6 per cent. on this capital, or if 11s. per acre obtained from the sale of farmyard manure is included he made 86.75 per cent.

The treatment described here was applied to the whole area of the farm, to the meadows as well as to the pastures. This made it possible to obtain complete and accurate figures and to compare costs. As an experiment it was the most prompt, bold and comprehensive in area of any under observation, but only on the basis of manuring, as there was no attempt to change the botanical composition of the pasture by seed, or timely attempt at mechanical cultivation. The generous or lavish nature of the treatment is a feature of the management of other departments of the farm, for example, the use of cake and meal.

Diagram II illustrates the experience with the meadows and pastures side by side on the same farm, compares this experience with that for the pasture on farm B, the management of which is referred to in example (3), and shows the distinction drawn in the text between two kinds of capital employed in farming. The meadows were in better condition than the pastures, because they had received lime which was still producing an effect on the crop. Column 1 shows the expenditure, mostly on farmyard manure, in 1927 to be £4 12s. 4d. per acre, with the value of the crop £7 15s. Column 2 shows the expenditure in 1930 to be £3 5s. 4d., with the value of the crop £11 7s. 6d. The figure for 1927, £7 15s., is for a crop of 1 ton 11 cwt. per acre at £5 per ton, and the difference of £3 12s. 6d. between that and £11 7s. 6d. was measured definitely by the weight of hay which had to be stacked for the first time in the history of the farm. The increase in weight was at least 14½ cwt. per acre. The barns were packed more fully than any time before resort was had to the stack. The return on the capital under the old system was 67.8 per cent., and in 1930 under the new system 248.2 per cent., excluding 11s. per acre for manure sold.

DIAGRAM II  
PER ACRE



Scale 1 mm. = 2/-



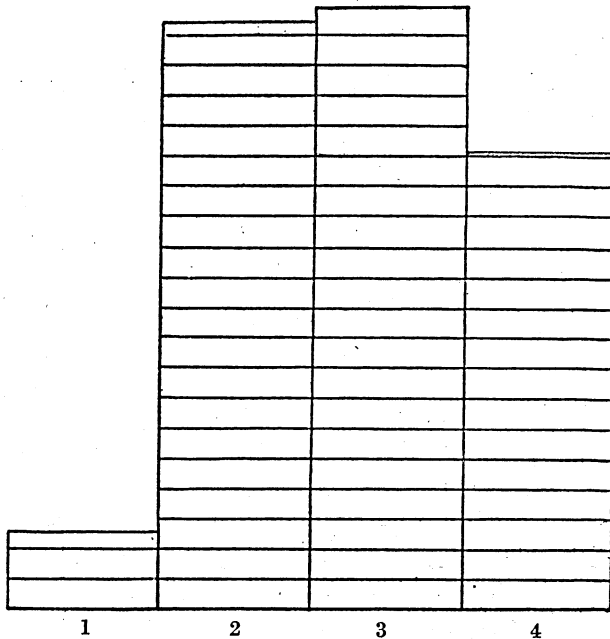
Column 3 represents the management of grass on farm B and its results, while columns 4 and 5 represent the old and new systems on farm A. The significance of direction can be seen in a comparison of the enterprise capital represented by vertical lines in columns 1, 3 and 4, and the returns from it with the enterprise capital and the corresponding returns shown by the similar lines in columns 2 and 5. The first represents the old custom, the use of farmyard manure and nothing else; the second represents the use of lime and mineral fertilisers. The question of providing sufficient support for the first instalments of capital by later instalments is illustrated in the proportions which routine capital and enterprise capital bear to each other. The latter should always be a large percentage of the former, or should exceed it in amount.

#### 6. *Strength and Direction*

Associated with the idea of capital is the idea of power. The South of England farmer has an expressive way of referring to a man's capital in this sense as his "strength." "He has too little strength," or "he has plenty of strength," are common remarks. The strength corresponds to what is here called enterprise capital. To get the idea of power rather than of money, and to provide a means of measuring the power, a certain unit different from an ordinary money unit may be taken. If the shilling were used it would sometimes make it necessary to handle unduly large figures, while the use of the pound would mean that the expenditure would often be expressed only in fractions. Taking the unit of enterprise capital or direct productive power as 4s., Diagram III illustrates the character of the management on four farms to which reference has been made. On the farm with the least enterprising management represented in column 1, there are 2.5 units of power, an altogether insufficient amount which is responsible for a heavy loss. The returns provide the test of the soundness or otherwise of the direction of the capital, but returns are not given here, as neither accurate records nor valuation are available for the farms represented in columns 2 and 3. In column 2 where dung is purchased there are 19.5 units; in column 3 where sewerage and dung are used there are 19.9 units, and in column 4 where lime

and minerals are used there are 15.1 units. In column 1 there is neither strength, direction nor returns; in columns 2 and 3 there is abundance of strength but the direction is wrong as indicated by the returns which are insufficient, less than those from column 4, although not accurately measured; in column 4 strength has been reasonably full and direction

DIAGRAM III  
UNITS OF ENTERPRISE CAPITAL  
PER ACRE



Scale 1 mm. = 1/-

has harmonised with it as proved by the return of £12 1s. 7d. per acre. A difference between columns 2 and 3 on the one hand and column 4 on the other is that the units of power could not be increased in the former without reducing the profit or increasing the loss unless the direction was changed at the same time, while in the latter it could be increased in the same direction with an increased profit.

Consideration of the costs of particular experiments which did not embrace the whole area of farms may be postponed until some reasons for distinguishing between those two forms of capital are given and examined. Without pressing it too far the distinction drawn in the census tables under the double heading "farmers and graziers" corresponds with the distinction drawn here. Farmers, it seems to have been assumed, are a class engaged actively in the cultivation of the land which they occupied, producing crops of various kinds, while graziers do so little in the way of cultivation as not to deserve the title which suggests cultivation. Their title is derived from their business of removing a crop and not of producing it. The placing of stock in the fields is a less enterprising and more one-sided operation than the task of the farmer. The land in the grazier's occupation was expected to do more for itself, and his expenditure had less to do with stimulating and maintaining activity in the soil than that of the farmer. A high percentage of calcium, or a combination of virtues which chemists may be able to discover and define, in the soils of certain fields makes them capable of producing reasonably good crops of grass. They offer, or seem to offer what many men seek—a large return for little enterprise. But it is doubtful if there are any of those fields which would not give a larger net profit, if they were given the opportunity of responding to enterprising treatment. The result of research in what are reputed to be among the most productive grasslands of England suggests that so far as the grazier is not a fully developed farmer, an active and enterprising cultivator, he should be eliminated not in person but in function, being required by economic influence to transform himself into a farmer.

The same economic problem arises in connection with the constant search for some plant which will retain its hold and grow strong and healthy for ten years, or for longer, a thing which can be stabilised like lucerne, partly on the assumption that farmers in other countries where this is said to be possible are more fortunate and prosperous than those in England. The desire to save labour is laudable. But whether it is a botanist, or a practical farmer, who is engaged in the quest for the ever-standing plant, it is the economist's business to attempt to upset the condition of stability by trying any

mixture or plant which, with unresting enterprise behind it, will make 50 per cent. more on the farmer's capital than the stabilised mixture or plant makes. The ambition to make more money by employing labour and capital is more laudable.

There is the rotation grass in East Lothian and in other well cultivated parts of the country which fattens sheep in the last days of December or early days of January, until they are almost literally pushed off by the plough as it prepares the soil for the following crop. There are the fields in the South of England which were let for £11 per acre in that year of inflation and prosperity, 1920. Both crops are good, but their production depends on two systems of management widely different. The production of the rotation grass is based on the enterprise of the farmer which brings about an active co-operation of forces in the soil and grass. Everything about the rotation fields breathes enterprise and activity. They are the basis of every crop including grass. On the other hand the production of the more stabilised grass in the South depends chiefly on a combination of qualities in the soil which are rarely met. Farmers, however, very frequently, in the majority of cases indeed, rely on the latter foundation where it does not exist. The method, therefore, of assuring uniform improvement of grass, and the equally uniform maintenance of its quality and yield, is to extend and make universal enterprise of a character as sound as the grass which is its object. On this basis the grass in the valleys and rolling lands of the South, and in the dales and for some way up the hillsides of the North can be brought into the same category as the East Lothian grass, their values coming close to each other.

#### *7. Value of Grass per Acre*

What is the value of grass per acre which farmers should be expected to produce? This question is constantly raised in research. In 1920 the land let at £11 per acre might produce grass worth £17 to £20. In these times of deflation and depression the land which keeps its grass growing actively for nine, ten or eleven months of the year may produce grass worth almost as much. On farm A where the farmer used only the chemical means in a generous manner to put into operation the forces available for growing grass, the value

of the grass per acre as shown in the last columns of the Diagrams I and II is £12 1s. 7d. In the Report of the Rothamsted Experimental Station for 1929 the following statement is made: "Barley stands out as one of the most efficient transformers of cheap fertilisers into food; meadow hay runs it closely when 9 cwt. additional crop can be obtained without loss of quality by the use of 1 cwt. sulphate of ammonia or nitrate of soda: this does not always happen on permanent grass land: the other figures however are usually reached. The average result is that for an expenditure on fertilisers of between 10s. and 20s. it is reasonable to expect a return of 26 lb. protein equivalent worth about 3s. 2d., 312 lb. starch equivalent worth about 26s. 6d.; in all, food substance worth about 29s. 8d." Although it is detached from its full economic setting, this result supports those of the more complete economic experiments.

The experience with hay and with the grazing of the aftermath on farm A shows a high value per acre. The hay mown about the middle of June weighed 45½ cwt. At £5 per ton the value of this is £11 7s. 6d. Under the old system the value of a second crop of hay is low, and so is the value of the late grazing. But a feature of the experiments here has been that a generous dressing of fertilisers in spring alters this; keeps the growth active, and plays a profitable part in maintaining the milk yield as late as the middle of November. Measuring the value of the aftermath again by the actual reduction in the cost of feeding stuffs due to improved grazing it amounted to £4 0s. 6d. per acre. This gives a total value of £15 8s. per acre. On this farm, as probably in every case where the meadows have been limed periodically in contrast with the pastures, the feeding value of the hay was higher than that of the pasture grass. In the six summer months of 1927 the cost of feeding stuffs per cow was £4 7s. 9d. more than in the six winter months following. The grass per acre on the meadows is still more valuable by £3 6s. 5d., but there seems to be less prospect of increase except in weight. On the other hand the improvement in the pasture grass has been so marked, probably in quality as much as in weight, and there is so much still to do, that it is clear the limit has not been reached. The amount of cake and meal consumed per cow has remained constant at 22 cwt. for the six winter

months since 1927, while it has fallen from 30.8 cwt. in the six summer months of that year to 16.8 cwt. in 1930. On this farm 400 feet above sea level, with only commonplace qualities of soil, an atmosphere full of unfriendly chemicals, and with no advantage except an excessive rainfall, a crop of grass worth £16 an acre seems the standard to be aimed at and attained.

#### 8. *Minerals and Health*

The change in management which has enabled them to approach this standard has enabled farmers to reduce the cost of producing milk, beef and mutton. It has also given them an interest of a new kind in this side of their business. Beyond the more direct and measurable advantage a number of farmers who have used lime and other minerals for the first time insist that the change has benefited them substantially by the improvement in the health of their cows. A few go very far in saying how greatly their losses have been reduced. Without a veterinary survey, however, there is no basis for a scientific investigation of this question, and therefore none for a trustworthy conclusion. More convincing, perhaps, than the farmers' assertion about the improved health of their stock, is the demonstration given by the animals themselves of their preference for fields freshly and heavily treated with lime and mineral fertilisers.

While research is in progress producing exact information on this problem, farmers may guide themselves in managing their fields from this point of view by careful observation of the characters of the different grasses in their pastures and meadows. A healthy crop of grass can be told from its appearance, healthy not only in itself but for the stock to which it is to be fed. But have farmers ever studied and judged grass as they have studied and judged almost every other farm crop and every class of live stock? They will judge a stack or mow of hay by the scent of a handful, but this is an insufficient test. The appearance of grass overdone with nitrogen, of grass grown from the soaking of liquid manure, is different from that of grass in a well managed rotation. The first kind is a dark, dull green in colour, soft in the straw, bends and goes flat before it is far grown. It is without bone or body to keep it erect. Its rank, slushy nature makes it look not merely unhealthy but positively poisonous. The

second kind also carries its character in its face. It is neither dull nor pale, but a healthy green and stands tall and straight. There are as fine points to decide about the characters of single grasses, handfuls of grass and fields of grass as there are about the characters of horses, cattle and sheep. To discover these, to tell from the appearance of grass what it wants is exciting and profitable. Grass and soil should be studied together, as their characters vary together. There is a broad distinction between the soil which carries a mat and that which carries a quick growing crop of rye grass and clover. But the subtler differences should be studied and grasped until farmers are able to tell whether soil and grass together have enough mineral goodness and other kinds of goodness.

Besides what has been done by the chemist to make the farmer more completely master of his soil, the work of the botanist is giving him a firmer foundation on which to base his management of plant life. Capital in the soil may be made more fruitful by collaboration with capital in good seed. Fertilising may be used to eliminate in time inferior plants, and even to bring in more active and profitable plants, but from the economic point of view this transformation should not be left either to time or chance. With the seed of the most active and nutritive grasses put into co-operation with thoroughly fertilised soil an immediately profitable return can be made certain. The same surefooted work that has been done in the chemistry of soils at Rothamsted and elsewhere is now being done on the botany of agricultural plants at the Plant Breeding Station, Aberystwyth. The work is in its early stages. But there are already grasses of merit sufficient to enable the farmer to yoke his well directed capital in the soil with his well directed capital in the seed. If it required demonstration, it has been demonstrated very often in the too partial experiments here, that inferior grasses and even weeds are fond of a full and balanced ration of manure. They grow fat and lusty on it for a time. But for money making good pushing agents like the best fertilisers need good things to push like the best grasses.

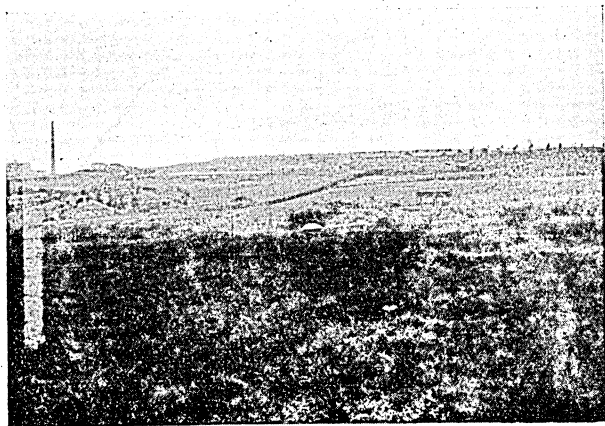
#### *9. Breaking and Making Pastures*

Problems of narrower but more definite scope were met in the course of research. Subjected to experimental treatment

they yielded information of importance. In Lancashire and Cheshire, as in all parts of the country, the experience which followed the attempt to lay down pastures and meadows ploughed up during the war raised again the problem contained in the ancient, respected saying with no necessary truth in it—the saying that “to break a pasture makes a man, but to make a pasture breaks a man.” Hundreds of fields on nearly as many farms were found where the attempt to get a good mixture of grass for pasture or mowing had miscarried. Investigation of what had happened showed that invariably there had been a lack of balance in the combination of the elements necessary for the success of those experiments in laying down grass. Farmers showed the composition and costs of the seed mixtures which they had purchased from reputable firms, but in no case were they able to give any assurance, still less any convincing proof, that the soil in which those guaranteed seeds had been sown held in sufficient quantity, or uniformly enough distributed, the constituents absolutely indispensable if the seed was to play its part. Six or seven inches of soil had been turned up, knocked about, and had given heavy crops of oats and potatoes, but lime and phosphates had never been worked through that depth of soil in the quantities sufficient to guarantee that the seed of good grasses and clover would meet the conditions in which alone they could live and thrive for three full years. A one season crop could thrive while a perennial was sure to fail. There again, with the order reversed from the former case, well directed capital in seed should have been matched with well directed capital in fertilisers thoroughly worked through the soil which was to form the seed-bed.

For economic reasons where the character of the soil is not known, where it has not been fully fertilised in a rotation several times round, the usual practice of ploughing and cultivating should be abandoned. It is in Lancashire meadows that to a depth of six inches the lime requirement has been found to be 13 and 14 tons to the acre. While it would take much money and time to change the character of six or seven inches of soil in this state, a reasonable measure of both spent in mixing lime and phosphates to the depth of half an inch, or one inch, or at most two inches, would make it certain that grasses and clover would catch and hold. These take

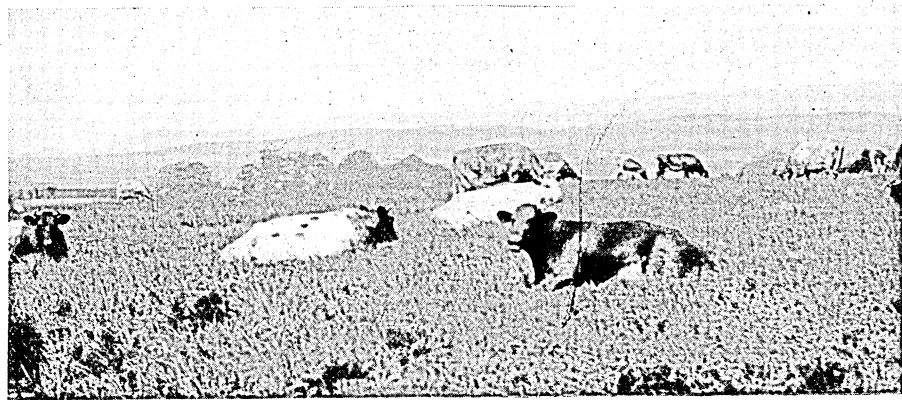




SEED MIXTURE AND HOLCUS—APRIL



SEED MIXTURE AND HOLCUS—JUNE



RENOVATED FIELD, FORMERLY "RUBBISH"

down with their roots the nourishment they need from the surface, and they will keep doing this as the food is supplied to them in economic instalments. There are few shorter and surer roads to large profits than the remaking of pastures and meadows by methods which are in harmony with the soil's capacity to respond.

The following example is that of a field of six acres which had been laid down with a good seed mixture, but which had gone astray for five years, and grew only what the farmer described as "rubbish." During its short arable life it had been given lime, phosphates, potash and sulphate of ammonia, all in standard quantities. After seeding down it had received farmyard manure, lime and all the mineral fertilisers as a meadow, but rapidly deteriorated. For the year 1928 it was given lime and phosphates, then chewed up ruthlessly, but not very deep, with a disk harrow. In April or May a moderately cheap mixture of perennial rye grass, rough stalked meadow grass and wild white clover was sown. These are the costs for six acres.

(5)

|                          | £  | s. | d. |
|--------------------------|----|----|----|
| Lime . . . . .           | 11 | 18 | 2  |
| Fertilisers . . . . .    | 9  | 18 | 1  |
| Seed . . . . .           | 8  | 11 | 0  |
| Labour (manual). . . . . | 2  | 18 | 5  |
| „ (horse) . . . . .      | 2  | 7  | 6  |
|                          |    |    |    |
| Total . . . . .          | 35 | 12 | 2  |
|                          |    |    |    |
| Cost per acre . . . . .  | 5  | 18 | 8  |

The result was immediately profitable. The seeds grew perfectly, and the few better grasses which survived in the old mixture put up new growths, making a thicker bottom, and altogether making a pasture which seemed better than the best temporary ley. For three years with the help of nitrogen the field has worked almost as long and as actively as fields in well managed rotations. Means of measuring accurately the value of the increased yield were not available. Placing a value of £1 5s. on the "rubbish" which was there, the loss under the old system was 84·9 per cent. In 1929 heifers which had the second run of this and other improved

fields were as fat in late summer as any grazed in famous pastures.

A word may be said here to encourage farmers to cultivate. Frequently, almost always, they are sensitive about the hard treatment of their grass. They feel alarm on seeing their soil naked and their grass cruelly battered about in March or April. There is no ground for fear even where the grass is worthy of respect. Both soil and grass enjoy this treatment. This field looked in March like a slaughtered creature that would never come alive again, but in July the grass was as good a crop in its own manner as any crop of oats or barley sown at the same time.

Bad meadows are generally more difficult to renovate than bad pastures. From long continued one-sided treatment the acidity of the soil is excessive. Long, tangled grass and matted roots on a sour soil make a formidable combination. Farmers may decide whether they will attack them with the plough and finish the fight once for all, or begin on the surface and work downwards. If a race of ploughmen were available everywhere, this could be made the subject of experiment on a general scale, and the economic advantage would almost certainly be in favour of the plough. The following table gives the cost per acre of renovating meadow land, where soft grass (*Holcus mollis*) covered the field like a thick carpet.

(6)

|                               | £     | s. | d. |
|-------------------------------|-------|----|----|
| Ploughing . . . . .           | 0     | 16 | 8  |
| Harrowing . . . . .           | 0     | 12 | 6  |
| Lime (3 tons ashes) . . . . . | 1     | 19 | 0  |
| Phosphates . . . . .          | 1     | 0  | 0  |
| Seed . . . . .                | 1     | 15 | 6  |
| Carting, etc. . . . .         | 0     | 19 | 0  |
|                               | <hr/> |    |    |
| Cost per acre. . . . .        | 7     | 2  | 8  |
|                               | <hr/> |    |    |

The furrow was deep enough to get two or three inches below the mat of creeping, knotted roots and was laid over flat to smother them. The lime and phosphates were applied on the top. The harrowing, which should only be in line with the furrows, was no more than sufficient to get a shallow tilth, the enterprise being limited to the thorough improvement of about one inch of surface soil. The catch was almost

perfect, and there is now a fully established crop of perennial rye grass, rough stalked meadow grass and wild white clover. With nitrogen the value of the grass taken as hay and pasture is equal to that in a first-rate rotation. The discriminating appreciation of the cows for the new sward has been too great a trial for the old fences.

While the object is to have complete schemes of renovation and management in which all the agents are yoked together in co-operation, the single and casual steps by which farmers advance towards this combination are interesting. One man who about 1922 entered a farm the whole of which had gone far out of condition began renovation work in 1924. That year he limed a field of 15 acres which had once been ploughed and laid down in tidy, clearly marked ridges, a good field which had become a shaggy, matted pasture. The next year he treated it generously with basic slag. In 1928 there was no break in the mat, and no change to make the grass attractive to cattle or sheep. In 1928 as an experiment he sowed 1 lb. of wild, white clover seed on two of the ridges in the last week of June, harrowing the ridges before and after sowing. The harrow failed to penetrate the mat so far as to show any soil, but the lime and phosphates must have been among the surface roots and débris to give the seed the reception it required; for in October there was a catch of clover as full and regular as if it had been sown in a perfectly prepared tilth. By September, 1930, the shaggy grass had largely melted down into the clover, and as far as the field can be seen the two ridges mark themselves off from the rest. The clover has covered the ground too completely in some places, making a better pasture for sheep than for cattle.

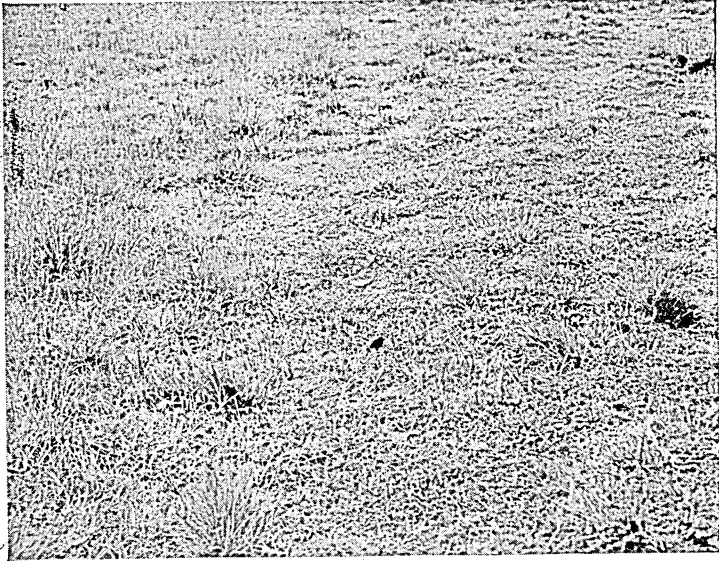
In 1929 two other ridges were given the same treatment with the same result. A similar area was taken in another field as badly matted but more recently limed and slagged. The same amount of seed was sown, but part of the area was left unharrowed. In October the catch on this portion was almost as good as that on the harrowed. Acting on this experience in the spring of 1930 the farmer bought 25 lb. of clover seed (New Zealand) at 3s. 6d. per lb., and sowed it on the remaining area of the 15 acres in the first field, now six years away from the lime and five from the slag, and without any harrowing. The result, however surprising among the

nardus, bent and potentillas, was less satisfactory. The catch was more partial than in the two previous years, probably because the phosphates were more nearly exhausted, or because the seed was less uniformly put in contact with it and the lime. What was demonstrated here and on other farms was that where lime and phosphates were held on the surface of a close mat of hard grasses, clover seed will catch successfully, the clover will grow and spread quickly, and will break down the mat gradually. Where it is desired the next step of mixing the clover with good grasses is a separate and profitable experiment.

This experiment of the farmer inside the larger experiment of which he is part was useful. His cutting down of co-operation with the soil to the minimum activity of sowing clover seed illustrates the readiness of men to back out of an enterprise instead of being eager to enter more deeply into it. Nothing of an economic nature is gained, nothing that will leave its mark on a man's career as a manager, or last his lifetime, if he has not acquired the habit of looking for openings to make new bargains with his soil and other partners in his business for the profitable investment of capital. Fortunately the farmer here has intelligence enough to learn from his experience, and enterprise enough to reverse his policy of withdrawal.

It should not be assumed from this example that wild white clover will catch as uniformly and grow as strong on every kind of mat. Careful research on this point is being carried on from Aberystwyth Plant Breeding Station, and reports, descriptive and statistical, which should be of great assistance, will no doubt be published. There has, however, been so large a measure of success in getting good catches not only of clover but of seed mixtures on bad meadows and pastures that, wherever sufficient lime and phosphate have been applied, it will not break a farmer to experiment on 2 acres with 4 lb. of wild white clover seed, or on 1 acre with a mixture.

Another illustration of the single and narrow tests by which men approach the full combination of activities may be given. A farmer who had followed the general custom of using farm-yard manure every year, of using sewerage at intervals; and of producing his milk chiefly from purchased food, decided to try what harrowing would do for a dull, matted field. It



CLOVER DISPLACING MAT OF NARDUS AND BENT

had received sewerage four years before, but still cows and horses broke the fences to escape from it when they were put in to graze. An old tine harrow was used to scourge it. Nothing more was done, but this wakened sleeping elements so thoroughly that in the following summer cows and horses were as eager to break into it as they had formerly been to get out of it. The cost of the harrowing was 8s. 4d. per acre. From this opening the farmer immediately moved on to other lines of a renovating scheme, and is on the way to a complete new system of management.

There is a temptation to eliminate the distinctive elements of economic experiments, the varying individualities of the men who are at once responsible for the experiments and parts of them, to assume the prerogative of the chemist, to control and slow down the experiments without regard to the farmer, so that the units of productive power applied may be carefully ascertained, and all that happens in the progress from a loss of 53.9 per cent. to a gain of 78.6 per cent. may be recorded. But farmers will not be as passive as soil or grass. For them the best thing is to make the passage from one point to the other as short as possible. After that is accomplished they may settle down to measure exactly the returns from the employment of additional capital, when they will have more money with which to do it, or they may make themselves perfectly neutral agents of the chemist and botanist.

#### 10. *Haymaking*

A slight digression may be allowed to the subject of hay-making. When the farmer has succeeded in growing a heavy crop of good grass, he is still faced with the difficulty of making it into good hay. The weather is the puzzling element in this problem, and where weather enters rules can have only a limited application. On this subject, however, less than anywhere has progress been made since the earliest times. The date of making meadow hay is probably as late as it was a thousand years ago, and there may have been as big a proportion of English hay spoiled by bad weather in 1930 as there was in a wet summer about 930. This is one cause of loss. The other is lateness of mowing which results in loss of feeding value. The one rule which may be advanced on this subject is that farmers should aim at getting their hay fully enough

grown to enable them to make it during the longest days of the year. The longest day should come in the very middle of haytime. The early part of June may be wet and unfavourable, but rain and a lengthening day are better for haymaking than rain and a shortening day. In the years 1920, 1924, 1927, and 1930 heavy and avoidable losses were incurred when the weather broke hopelessly in the last days of June or early part of July.

#### 11. *Enterprise and Honesty*

The management applied to farm A may be commended in respect of its strength for application to all farms. Economic instinct, or a spirit of adventure steadied by thoroughness of execution, which operated profitably with regard to other departments of the farm, carried the farmer beyond limits based on considerations of chemistry. The scheme of renovation would have been more successful if it had embraced cultivation and re-seeding. The results, however, are similar to those obtained on a large group of farms where the enterprise was only a little less strong but more diversified or balanced. Leaving the valleys and hillsides altogether, and coming to well managed arable farms with 15 per cent. of their area under grass, and to predominantly grass farms in some of the best grazing districts of England, the research to which farmers are moved discovers how far the production from their grass land is out of harmony with its capacity to produce. The proportion of their pastures and meadows which are seriously inferior both in yield and quality is a surprise to farmers. Fields which have been watched closely for the first time, which gave a disastrously unprofitable crop of hay in 1929 because the season was dry and the unsuspected mat hindered moisture movement, and which were left entirely ungrazed by young cattle after being mown in 1930, when the gates were left open to alternative and improved meadows—these fields are a problem to the farmers who have paid high prices, or who are paying high rents, with other standing charges for them. On the other hand, the quick fattening of cattle on boldly renovated fields, and the consequent quick and handsome returns on money invested in them, have been as great a surprise to men who had never imagined that their fields could do so much.



How do farmers respond to the appeal made to them by such situations? They have their own saying that "there's nowt as honest as land," a saying in which there is perhaps a strain of cynicism, a slight reflection on farmers themselves. There is ground for the reflection. But if a man goes into a farm where the soil has been left too much to itself for thirty years, he has some hard and costly work to perform before he comes at the honesty of the land. Often for similar reasons the virtues in men take time and work to discover. Honesty in them with reference to land is the initiating activity which wakens and wisely directs the soil's activities, the stirring and harmonious tune to which the soil dances. They deserve and require stimulus and help of a kind different from the soil. There is nothing so downright admirable and inspiring as a man who, thinking and speaking of his fields whose character has been obscured and perverted by two generations of bad treatment, and who, after wincing for a moment as he comes face to face with the high cost which the restoration of their character demands, trusts the land and says "I will do it," and says no more by way of farewell, but turns to his business. There is no better "stuff" of its kind in the world, and there is enough of it. In these despondent years a farmer added to his 200-acre holding one of 500 acres. The land had been deprived of its honest character. The farm with its five departments, two of them new to him, gaped with as many wide mouths for capital. Neighbours shook their heads. But not a day was lost from the date of entry. He experimented quickly and confidently with capital which came from his own character as a manager, and in two years the five-fold organisation ran as actively and profitably as the most penetrating critic or eager shareholder could desire.

Estate agents in their capacity as estate managers and not as farm managers have played a fruitful part, initiating and maintaining movement through their financial relationships with tenants. Their exercise of concession and pressure has shown a delicate piece of economic machinery at work which may be much more frequently used in future.

#### *12. To Lower Cost of Production*

With material of this kind there is indefinite scope and encouragement for improving management. Although the

weight of a bad habit lies heavily on the cultivation of grass, and although this keeps so much English land near the state of wilderness, it is only a problem of steady and methodical work. The standard has been raised, and can be raised so that the established custom is nearer the highest individual achievement. A financial motive more and more clearly presented is a powerful influence. When a farmer alters his attitude to the soil and treats it well, the soil treats the grass well, the grass treats the cattle well, and the cattle treat the farmer well. In this chain of things, therefore, a man is doing himself good quite unmistakably when he does his soil good. The estimated value of milk and dairy produce, of meat and wool, sold off farms in Great Britain alone in the year 1927-28 was £165,600,000. As these things are now produced to a very large extent on the basis of enterprises which are only half ripened or less, their cost of production is too high. To mature every section of the process of production is to reduce the cost, and at the same time to strengthen the position of the farmers. It enables them to extend and confirm their hold on the market against competing alternatives, and to serve their industry and country as well as themselves. Farmers get and give glimpses of the connection between things, and put their ideas quaintly in their own figurative language. One Cheshire farmer who had grown good grass for forty years spoke one day as if he were thinking aloud. "Dairy cows," he said, "and pigs have been honest to me."

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