

**Sir Thomas H. Middleton, K.B.E.**, read a paper on "The National Aspects of the Case for Increasing the Supplies of Basic Slag."

## THE NATIONAL ASPECTS OF THE CASE FOR INCREASING THE SUPPLIES OF BASIC SLAG.

By SIR T. H. MIDDLETON, K.B.E.

Several of the papers contributed to to-day's discussion deal with the uses and effects of basic slag as a fertiliser. I propose to approach the subject from a somewhat different standpoint, namely that of the increase of tillage land and of our supply of home-grown food. The supply of basic slag is one of three controlling factors—the others being the prices of cereals and wages—in the agricultural situation of to-day.

I propose in the first place to place before you a few figures bearing on the question of our present supplies of home-grown food, next to allude to the influence of basic slag in improving pastures, and then to show the connection between these subjects and the future course of tillage farming.

### *Food produced by Soils of the United Kingdom.*

From figures published in the annual volumes of statistics issued by the Board of Agriculture and Fisheries, and in the Report of the War (Food) Committee of the Royal Society, it may be shown that in the period before the War (1909-13) the soils of the United Kingdom were supplying products which measured in terms of energy would have sufficed for the support of about  $17\frac{1}{2}$  million persons. The whole population to be fed averaged about  $45\frac{1}{4}$  million persons; thus in each week the home supply would have sufficed from Friday night until Monday morning. As I have elsewhere said, we had become a nation of self-suppliers for the week-end!

It is interesting to compare the position before the outbreak of war with the condition of the food supply during the last great war in which the country was engaged. An examination of our imports in the early part of the nineteenth century shows that in 1801-10 the soils of the United Kingdom must have fed on an average some  $16\frac{1}{2}$  million persons. After Waterloo there was a rapid increase in our industrial population, and an enormous pressure on the means of subsistence. During the past 25 years writers on political and social subjects have had much to say of the iniquities of the period which led up to the "hungry forties." I shall not attempt to defend the action of the "greater villain" "who stole the common from the goose," but when we criticise agriculturists who are reported to have robbed the people, let us at least be fair, and let us admit that their energy enabled them in the period 1830-40 to feed a huge population. The "hunger" of the "forties" was not due to the incapacity of our farmers. The fare on which indus-

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trial England grew into a prosperous nation may have been meagre; it was ill-distributed, no doubt, and there was much hardship; but, viewed from the standpoint of to-day, the feat performed by our farmers in the period of reconstruction that followed Waterloo was astonishing, for by 1835 they maintained 24½ millions on the soils of the United Kingdom; in other words, nearly 50 per cent. more than at the outbreak of the Great War.

Taking the soils of the United Kingdom as a whole, it may be shown that before the war, they were providing for from 35 to 40 persons per 100 acres. In an estimate made in 1916 I found that, whereas 100 acres under the plough, *i.e.*, under other crops than grasses and clovers, maintained about 84 persons, a similar area under grass provided for from 17 to 20. I have not revised this particular estimate with the fuller figures now available; but an estimate recently made by another method leads me to think that my 1916 comparison was somewhat too favourable to grass, and that in the period 1909-13 rather fewer than 17 persons were actually supported by the average 100 acres of our cultivated grass land.

I do not propose at present to argue out the national aspects of grass and tillage farming. Speaking from a farmer's standpoint, I am prepared to agree that in many parts of the United Kingdom the advantages of grass farming are obvious, for it must be remembered that the food problem as the farmer sees it is not the feeding of our 46,000,000 people, for they have long ceased to be dependent on his efforts, but the feeding of his cattle, sheep, and other live stock. The two main human foods grown by the farmer—wheat and potatoes—occupied no more than 3,000,000 acres in the period before the war, while 36,000,000 acres were devoted to the crops required by his cattle and sheep. The value of the two tillage crops was about £27,000,000, while his live stock brought him in some £125,000,000.

Under these circumstances, the importance to the farmer of grass, the natural food of his live stock, needs no demonstration. Since grass is so important, its present quality and the scope for improvement are points to which I wish to direct your attention to-day. The methods of improvement will be discussed by others. I shall content myself with referring to certain general aspects of the subject.

*The Scope for Improvement in our Pastures.*

So far as I am aware, there are no trustworthy records from which the average production of meat by our finest permanent pastures can be estimated.

The best fattening pastures that I personally have met with are in the Market Harboro' district of Leicestershire, and I estimate that the richest field in this district, which I examined, would on an average of years produce from 180 to 200 lbs. of meat without the assistance of oilcakes. The field in question fattened a bullock per acre in the early part of the grazing season, made a "forward store" without oilcake, or a fat beast with oilcake in the autumn, and in addition would provide some keep for store cattle or sheep in the winter months.

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How many of our 33½ million acres of grass land come up to the level of the pasture described above? If one were to form an estimate from the newspaper controversies that centred round the ploughing up of grass land during the course of the war, one would probably be prepared to believe that about one-third, or possibly even one-half, of the grass land of England was of fine quality. In spite of the careful way in which the Agricultural Executive Committee in most cases selected land for ploughing, one heard constantly of their errors in destroying fine grazings to provide land for corn. Their task was to select no more than 1/8th of the grass land of England and Wales for ploughing, and although, notwithstanding their efforts, less than two million extra acres were in fact ploughed up, it was freely alleged that the live stock interests of the country were being jeopardised to provide wheat and oats. Clearly, if one believed all this war-time evidence, the pastures of England were a national heritage of great value. But let us test the position in another way. Is it possible that anything like one-third of our pastures can be up to the level of the "one-fat-bullock-per-acre" standard? What are the results of the grazing industry? The total number of grass-fattened cattle marketed in the United Kingdom does not exceed one million per annum, and it is common knowledge that a large percentage of this number is fattened with the help of oilcakes. Personally, therefore, I should be surprised to find that there are in fact 500,000 acres of grass land in this country which, without the help of concentrated feeding stuffs, fatten one bullock per acre on the average of a series of years.

Now, what about the other end of the scale? What yield may be expected from our poorest cultivated pastures—I do not refer to our 15 million acres of hill grazings, which probably produce less than 5 lbs. lean meat per acre per annum, but to our so-called cultivated land. I followed Dr. Somerville and preceded Professor Gilchrist in the management of some poor pastures in Northumberland. Professor Gilchrist will no doubt deal with its productivity in the paper which he will give us; but I may say that my own estimate is that land of this type—poor clay soil pasturage very common in the North of England—yields from 15 to 20 lbs. of lean meat per acre in the course of a year. Other experimental pastures in Northamptonshire and Cambridgeshire which I have had an opportunity of studying produced from 20 to 25 lbs. of lean meat in an average season, and from the opportunities I have had of inspecting poor pastures in other parts of the country, I have come to the conclusion that there are very many thousands of acres of grass land in the United Kingdom from which the nation obtains no more than 25 lbs. lean meat in the course of a season.

With the information at present available, it is not possible to make any close estimate of the average production of meat on the pastures of the United Kingdom. In the first place we do not know the total production. In the five years before the war it was estimated at 1,150,000 tons of beef and mutton, but with the more accurate information at the disposal of the Ministry of Food, it was found that in 1919 we produced some 875,000 tons only. There has been a considerable reduction in the number of sheep, especially

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of the larger sheep fed in the South of England, but the number of cattle is practically the same as in 1914. Feeding stuffs were scarce, and cattle were smaller than before the war. But when full allowance has been made for these circumstances, it is not possible to resist the conclusion that we over-estimated our meat production in the period before the war.

Even if we knew the total output of meat, it would be necessary before estimating the production of our grass land to ascertain (1) the production on hill grazings, (2) the yield from the products of arable land, and (3) the amount due to imported feeding stuffs. Though it is possible to make more or less satisfactory guesses at the yield from each of these sources, it will be evident that no great accuracy can be claimed for the final result of an estimate that has in view so many uncertain factors. On the basis of the estimated pre-war production of meat, my former view was that our pastures produce on the average 100 to 110 lbs. of lean meat per acre per annum, but at present I am disposed to think that 90 to 100 lbs. would be nearer the mark.

Moreover, the meat of the "average" pasture is very different in quality from that produced on the finest pasture. The food value of the lean meat from our "average" grazings is probably not more than two-thirds that of the fat meat of feeding pastures. Hence my opinion is that our best pastures have about three times the value of our "average" pastures as sources of human food, while they are 10 or 12 times more productive than the poor pastures that replace the former corn lands of many parts of the country. In any case, anyone who has investigated the subject will be prepared to admit that our pastures offer great scope for improvement. Let me illustrate this point. In 1902 I laid out four ten-acre fields on the unimproved pastures at Cockle Park, Northumberland; basic slag and other manures were applied. This land in its unimproved state produces about 20 lbs. lean meat per acre per annum. Records have been kept ever since, and Professor Gilchrist will no doubt allude to some of the lessons to be learned from a study of these records; but I propose to refer to one point only. It is that on the average of two of the plots, and during the 11 years 1904-14, the live increase made by cattle and sheep on these 20 acres was equal to about 105 lbs. of meat per acre, or more than five times the yield of the untreated land. The special interest of this experiment for us to-day is that the improvement was due to basic slag. The results of many other experiments might be cited to prove that on thousands of acres of this country the yield might be equally increased by the proper use of basic slag.

The effect of the application of slag to some types of pastures is so striking that the results have been described as magical; but there is no "magic" in its action. It depends on the habit and manner of growth of white-clover on land that has been depleted of phosphates by corn growing, and has then been left to "tumble down" to grass.

I am not, however, at present concerned with the mode of action of basis slag, but with the results; and most agriculturists will agree that, in conjunction with white clover, it is the most potent agent known for restoring fertility to worn out corn land. If the

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old corn growing lands of England are again to take their place in producing wheat, it seems probable that one feature in the scheme of management to be adopted will be the alternation of corn growing with a period during which clay soils will rest and regain fertility by growing clover manured with basic slag.

*Effect of Pasture Improvement on Tillage Farming.*

Apart from the uncertainty as to the future cost of labour, the chief obstacle to the expansion of tillage in this country is the difficulty that farmers would experience in devising means for supplying their live stock, were they to be deprived of any considerable proportion of the existing grass land. It is well known that, given the necessary skill and the command of capital and labour, food for live stock may be raised in greater quantity from land under the plough than from grass; but it is certain that in many instances stock could not be kept so cheaply as they now are were grass land to be broken up, and it is further certain that the life of the stock farmer would be less easy if tillage crops replaced his pastures. Any policy which aims at extending the corn-fields of England must therefore reckon with strong opposition, if the increase of corn means the decrease of grass and hay. But it seems to me that the area under corn could be largely extended without reducing the natural foods of our live stock; for, given enough basic slag, it would be an easy matter to restore all the land well adapted for corn growing to tillage, and to grow as much grass and hay as we do at present. Let us examine this statement.

In the early seventies of last century England and Wales had about 15 million acres under the plough. Before the war the area had fallen to 11½ million acres. In 1918 it had increased to 12½ million. Although labour is less plentiful and much more expensive than in the "seventies," there should be no difficulty, given remunerative prices, in again reaching the 15 million level. For in the interval the farmer's command of machinery and of manures have both greatly increased. In the immediate future the lack of buildings would prevent any considerable extension of tillage, but a time will come again, it may be anticipated, when builders will be glad to secure work, and when materials will be forthcoming. It is, I think, beyond dispute that 15 million acres of land suited for tillage could be found; what the farmer argues is that in view of the increase in his herds he could not carry on his business with 12 million acres of grass in England and Wales; he wants to have the 16 million he had available in 1914. As I have already indicated, I admit the difficulty. I do not say to him: "The extra 4 million acres under tillage would feed as many animals as the 4 million acres grass ploughed up." In theory it could do so; in practice the farmer might not succeed in the attempt. What I should prefer to say is: "Given manure and reasonable management, there will be no difficulty in growing as much grass and hay on 12 million acres in future as you produced on 16 millions before the war."

Is this statement of the case reasonably probable? Let me give the grounds for my belief that it is.

Of the 16 million acres under grass at the outbreak of war there may have been one million so good that no marked response

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to manuring could be expected, and 3 millions on soils so dry and arid that no scheme of manuring would prove profitable. This would leave a balance of 12 million acres susceptible of profitable improvement. In view of the wide extent of our clay soils and chalk pastures, and the extraordinary response which most pastures and meadows of this type make to the application of basic slag, it seems to me to be reasonable to assume that if 4 million acres were ploughed, the remaining 8 million acres could grow as much grass as is now being produced on the whole 12 million acres.

*Value of Extra Tillage Land to the Nation.*

The value to the community of these 4 million extra acres under the plough would be much greater than at first might be supposed. The full effect is not apparent from the simple proportion 11:15.

Opponents of a plough policy usually start off with the assumption that the corn-growing capacity of Britain in proportion to her needs is so small that any effort which might be made to increase home supplies would be negligible. This assumption is far from being correct.

I estimate that if the necessity arose, and all the products of the soil were carefully rationed and efficiently distributed, the present population of the United Kingdom could be supplied with breadstuffs from the produce of about 14 million acres. Towards this total England and Wales would be required to contribute 10 million acres. Now, with 11 million acres under the plough, as in the pre-war period, and with the system of farming then current, we would normally grow  $5\frac{3}{4}$  million acres of grain. Should high prices continue to rule, it is probable that  $6\frac{1}{4}$  million acres would be forthcoming. With 15 million acres under the plough, we would grow from  $7\frac{1}{2}$  million acres when corn prices were low to  $8\frac{1}{2}$  millions, or even 9 millions, when prices ruled high (the average for the period 1871-75 was 8,100,000 acres). Should danger arise it would be impossible to secure 10 million acres of corn if we started, as in 1914, with 11 million acres of tillage land. In spite of the great effort made, we only got  $7\frac{1}{2}$  million acres in 1918. But if we began with 15 million acres of tillage in hand, our task, though formidable, would be by no means impossible. An extensive grass-ploughing campaign would be called for, but we should start on our effort to secure two or three million extra acres of corn, with the buildings, the men, the horses, and the machinery which 15 million acres of tillage would support in time of peace, instead of with the men and equipment of 11 million acres.

In a war crisis, therefore, these extra four million acres of tillage land would mean the difference between the provision of a sufficient, if meagre, supply of breadstuffs for the whole population, and a curtailment of the supplies that would lead in the first place to a breakdown of the machinery for rationing and later to famine and to the popular ferment that would inevitably seize a people deprived of a sufficiency of bread. It would mean the difference that there was between our own comfortable, if somewhat unattractive, diet in the last two years of the war, and the make-shifts on which our enemies attempted to fill, but failed to feed, themselves.



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But, it will be argued, "why prepare for another great war when we have made an end of great wars, and why suppose that if there is a war, imports will not reach us with as great certainty as they did between 1914 and 1918? We have shown how to defeat the submarine, and we can safely rely on our Navy and merchant vessels in any circumstances that can arise." Let us admit this argument, and examine the case for the extra 4 million acres as a peace proposition.

On the lavish scale on which this rich nation fed itself and its livestock in the period 1909-13 I estimate that some 21 million acres growing "average" (*i.e.*, average British) crops would be wanted to supply the cereals consumed in the United Kingdom. The area under these crops in the United Kingdom in 1909-13 was between  $7\frac{1}{2}$  and 8 million acres. About 2 million acres were contributed by Scotland and Ireland. As I am discussing the subject from the standpoint of England and Wales only, we may assume that their share in the 21 million acres that would be called for if all our cereals were home grown, would be between 17 and 18 million acres. The actual contribution made by England and Wales in the period 1909-13 was 5,800,000 acres. Under the influence of high prices this area might be increased to  $6\frac{1}{4}$  million acres, *i.e.*, to 36 per cent. of the area required for a full supply.

Having regard to the large proportion of our area under permanent grass, and the demands which livestock fed on poor grass land make on the products of arable land, it is unlikely that even if corn prices remained at the present high level and the shilling loaf were a permanency, that we would have more than  $6\frac{1}{2}$  million acres under grain.

Under the conditions which I have postulated for an arable area of 15 million acres, the limits of corn growing would be wider. I have assumed the improvement of some 8 million acres of pasture by 50 per cent. What I meant to convey was that 8 million acres of grass could be made capable of carrying 50 per cent. more stock during the summer season, and of producing 50 per cent. more hay. But there would be a second important result of such a change. An improved pasture has a much longer grazing season than an unimproved; the grass comes earlier and lasts later; thus, assuming the same numbers of cattle and sheep to be kept through the summer on similar areas of improved pasture that had previously been kept on 12 million acres of unimproved land, there would be a smaller demand for winter keep in the one case than in the other.

A second circumstance favouring wider variations is the area under grain crops with 15 million acres arable than with 11 millions should be pointed out. The additional 4 million acres would, for the most part, consist of the heavier soils; these are more expensive to till, and when supplies of grain were abundant and prices low, a system of rotation pastures would, and should, be adopted. I say "should," because it is just these soils that, with the assistance of basic slag and white clover, might very profitably be laid down to short leas. When supplies were scarce and prices rose, this same land would stand a good deal of intensive corn growing. Thus I estimate that while with 15 million acres of arable land the probable area under grain would vary from  $7\frac{1}{2}$  to  $8\frac{1}{2}$  million acres,

the upper limit, if favoured by a wise national policy, might well reach 9 million acres. If, however, we adopt the more conservative figure of  $8\frac{1}{2}$  million acres under grain, we should still increase our home supplies by 12 to 14 per cent. An increase of this amount would not only substantially diminish our foreign purchases, but would tend to reduce fluctuations in price, for, in spite of the abuse which we bestow on our British climate, it seems to me that our own harvests may well fluctuate less in amount than the average of the exportable surplus of the harvests from which we must draw our future supplies. This is not the time to discuss the prospects of our future wheat supply, and I cannot pretend to an expert knowledge of the wheat trade, but when I look to the sources from which our supplies were drawn in the past, to the effect which war has had upon the soils and the labour that produced our wheat, and to the great fluctuations in yield due to climate, it does not seem to me that a nation which depends so largely as we have done in the past on "exportable surpluses," can escape great fluctuations in the price of bread.

Occasional high prices, even frequent high prices, will not in themselves secure the ploughing out of grass. Other measures are called for, and among the most important is an effort to increase the output of basic slag, so that the quality of our grass land may be improved.

To the steel maker the slag which he produces is no doubt a secondary consideration, but I hope that his concentration on improvements in the manufacture of steel will leave him with time and inclination to bestow attention on processes by which the quality and output of basic slag may be increased. I have endeavoured to direct attention to the national importance of basic slag, and I hope I have succeeded in indicating that its manufacture is not merely of interest to the farmer as a means of providing a profitable manure for his pastures, but that it has a direct bearing on the future of the bread supply of those engaged in the steel industry and of their fellows in our other industries. The conditions affecting the food supply of the industrial classes are very different from what they were in 1820, but they are also very different from what they were in 1914. The extent to which our urban population may be driven to rely for their supplies of food on the soils of this country cannot be foreseen. We must not too confidently assume that all that we ask for will be supplied by other countries. There may still be "hungry forties" ahead of us.